

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1	56348	4	0	0	0	0	Overall the Chapter is very well researched and written. I was surprised however by the complete lack of discussion of lichens and just passing mention of mosses. These genera play critical roles in some ecosystems and contain an amazing array of species diversity. I would recommend adding a brief discussion about how climate change may impact these groups. (Kyle Joly, US National Park Service)	Thank you. Due to space limitations we decided not to add the brief discussion you have proposed, although we would have liked to.
2	57723	4	0	0	0	0	In general, forest ecosystems, especially boreal and tropical forests are among the largest BVOC sources globally. Is there any knowledge of what happens to BVOC emissions due to warming (and in interaction with N deposition, CO2 and O3) and what are the potential consequences for the climate? (Anne Kasurinen, University of Eastern Finland)	We touch on the issue of BVOC in the section on tropospheric ozone changes.
3	58261	4	0	0	0	0	In order to reflect contributions made by developing countries in the aspect of climate change adaption, it is suggested to increase the adaptive policymaking and measures of land and water ecosystems incorporated in "The Second National Assessment of Climate Change which was adopted as the formal reference literature. (Juqi Duan, National Climate Center, Chinese Meteorological Administration)	It is unclear what the author of this comment actually suggests, but we have summarized the general phenomena on a global scale based on a vast amount of refereed literature which we think, captures the range of knowledge and results.
4	58651	4	0	0	0	0	I think it is not clear whether vulnerability and impacts of terrestrial and inland water system can be attributable to climate change, therefore, I suggest IPCC should further strengthen the attribution analysis and call for strengthening scientific studies on climate change attribution in global scientific arena. (chunfeng wang, State Forestry Administration, China)	The chapter has put a large amount of effort into the detection and attribution issue. See especially Section 4.3.2, Figure 4-4 and explicit detection and attribution statements in all sections that provide traceable accounts for Figure 4-4.
5	58652	4	0	0	0	0	Since some paragraphs are lengthy, such as the statements in page 25 (L5-L8, L 53-L55), page26 (L20-L25) , page35(L7-L10), which are common knowledge, I suggest dropping the general statements that are not very relevant to the climate change responses or effects. (chunfeng wang, State Forestry Administration, China)	These are all introductory sentences to issues relating to NPP and forests. They define terms and concepts which are well known to experts, but are not necessarily common knowledge. In general, our opinion is that they are useful and should stay, but we he tried to be more brief.
6	59267	4	0	0	0	0	It is very welcome the choice made for being precise about forecasts, i.e. level of confidence overall, and level of specific components (evidence, robustness, agreement) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thank you.
7	59863	4	0	0	0	0	Because of the criticality, coastal stressors can be discussed in a separate sub section. Many nekton and invertebrate species use nearshore ecosystems as nursery and feeding grounds. These communities may be particularly sensitive to changes in land use and developmental pressures due to climate change. (AUSTRALIA)	The coastal issues are addressed in chapter 5.
8	59864	4	0	0	0	0	The section lacks information on the effect of climate change on plant-pollinator interaction. Although it is important to provide precise information on the potential impacts of different climate change scenarios on crop pollination, it is plausible that increase in temperature is the most important factor that affects plant-pollinator interaction. This sub-section could include the changes in global surface temperature, temperature sensitivity of crop pollinators and entomophilous crops. (e.g. see Kjøhl et al. 2012. Potential effects of climate change on crop pollination. FAO, Rome) (AUSTRALIA)	There is a section on pollination (4.3.4.4), where this additional reference was now included.
9	59865	4	0	0	0	0	General comment: The chapter would benefit from a section which discusses how freshwater ecosystems are part of the wider landscape such as how they are connected either physically or via a range of ecosystem processes. The reason is that climate changes that directly impact freshwater ecosystems are very likely to affect parts of the wider landscape. For example, warmer water temperatures can cause death of aquatic plants and animals which could then impact on water birds that prey on aquatic organisms etc. Also, any adaptations made in both freshwater ecosystems can have implications for the wider landscape and vice versa. (AUSTRALIA)	Inserted a small section and several references on ecosystem boundaries in 4.2, highlighting in particular the linkages and subsidies across terrestrial/aquatic boundaries.
10	61008	4	0	0	0	0	This chapter does not provide an unbiased, neutral assessment of the literature. Whilst it covers a wide range of recent literature, the interpretation of that literature is not balanced. For example, there is much too much emphasis on publications relating to modelling caveats and nuances in the paleo-record, and not enough emphasis on the rest of the literature supporting the statements made in AR4. There appears to be a complete disjoint between the messages coming from this chapter and that of the corresponding chapter in AR4. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have invested further work to remove potential bias in our treatment. We have rewritten key sections, especially the section on extinctions which is the focus of the example given. This section now focuses on lessons learned since AR4 and on risk as opposed to a critique of AR4. We have also harmonized treatment with Chapter 19 in consultation with their CLAs.

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11	61009	4	0	0	0	0	BIAS: the entire chapter needs to reflect more the perspective of Barnosky, A. D., Matzke, N., Tomiya, S., Wogan, G. O. U., Swartz, B., Quental, T. B., Marshall, C., McGuire, J. L., Lindsey, E. L., Maguire, K. C., Mersey, B., & Ferrer, E. A., 2011. Has the Earth's sixth mass extinction already arrived? Nature, 471(7336): 51-57. This paper suggests that it is not likely that extinction rates could have been as high in many past 500-year intervals as they have been in the most recent 500 years, where adequate data exist. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Barnosky et al. (2011) is cited, and we make precisely the same point; i.e. that we are currently at the very upper limit of past extinction rates. We have, however, reworded some of Section 4.3.2.5 for greater clarity.
12	61010	4	0	0	0	0	In general, much of this chapter reads like a text book and is not focused on the key questions relevant to IPCC, such as how has recent knowledge advanced what we knew in IPCC AR4, and what is the evidence supporting the statements made in the executive summary. It needs to be completely rewritten (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have reduced this drastically, but tried to keep a brief introductory line or sentence which helps to position the issue for a non-ecologist.
13	62884	4	0	0	0	0	This chapter seemed mainly talking about the relationship between climate change and environmental factors as well as the relationship between climate change and ecosystems. The title "Terrestrial and Inland Water Systems" might be not appropriate. (Xiaochun Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences)	The title is given to the chapter by the IPCC plenary, and can only be changed under exceptional circumstances. We note that several reviewers do not like it, but the alternatives also have problems, and the reasons for the dislike do not, in our opinion, amount to preferences rather than issues of scientific incorrectness and therefore do not justify returning this issue to plenary, even if that were possible.
14	62885	4	0	0	0	0	If Chapter 4 talks about ecosystems, it was better to discuss with different ecosystem types. (Xiaochun Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences)	The meaning of this comment is unclear. We write about major systems, which surely deals with different ecosystem "types".
15	63393	4	0	0	0	0	in places too many calls to references. Try to limit them to the mains ones. (Suzanne leroy, brunel university)	Concern is noted. Even more than before we tried to be sufficient but not exhaustive in referencing. There are many requests from reviewers to add references.
16	63497	4	0	0	0	0	There is a notable lack of information on freshwater systems, which is not representative of the literature. Please substantiate the assessment of impacts (observed and future) for freshwater ecosystems. In particular, given the fact some freshwater ecosystems are amongst the ecosystems most sensitive to temperature changes, a clear discussion of observed changes, and anticipated near term risk should be included. please also give cross-references to the respective regional chapter information, where applicable. (GERMANY)	Most of the coverage of freshwater systems is in section 4.3.3.3 (and CC-RF2, and Chapter 3), though some new material has been brought forward into 4.2 and 4.3.2. The vulnerability of freshwater systems to temperature changes is well covered in these sections.
17	68199	4	0	0	0	0	I was confused throughout the chapter by the mixture of modelling results and observed facts. Both are considered equally that I have found personally misleading. Assessment based upon observations with traceable data and published after peer reviews lead to stronger statements and conclusions than simulations and projections. Statement based upon scientific observations should therefore be clearly separated from modelling studies. and scenarios analysis (Denis Loustau, INRA)	We have attempted throughout to indicate the origin of statements, whether models or direct observations. The distinction is often not as sharp as that. The thread of the logic is often as important in where things are mentioned as organising them into 'observations' and 'models'.
18	68213	4	0	0	0	0	Cropping agroecosystems such as annual dry or irrigated crops, orchards, vineyards, greenhouses, are not treated in this chapter even if they cover a very large area of continents and are considered as widely impacted by climate. Why ? This is not acceptable to me unless this is covered somewhere. (Denis Loustau, INRA)	The agricultural ecosystems are covered extensively in chapter 7.
19	70314	4	0	0	0	0	I would find it useful to find an overview of types of models that are used to simulated ecological processes and patterns and recent developments with each of these. These could include dynamic vegetation models, Earth System Models, but also envelope models that are still widely being used. Other chapters have introduced a sub-chapter on methods that includes such information. This could be a box somewhere in Ch. 4.3 or a new sub-chapter before the current 4.3.3.1. (Stefan Fronzek, Finnish Environment Institute)	We have included a brief section (4.2.2) pointing out where the main methods reviews in the literature can be found. In addition, specific sections often note the types of models being used.
20	70706	4	0	0	0	0	This chapter is internally consistent and represents a comprehensive coverage of the issues. (Cate Macinnis-Ng, University of Auckland)	Thank you

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21	71840	4	0	0	0	0	Chapter 4 presents a vast volume of scientific evidence and analysis, focusing in large part since the publication of AR4 in 2007. Clearly a huge amount of good work has gone into the draft thus far, and my main comments are geared towards next steps for shaping into a compelling chapter in a work that will be widely read and cited. As a general matter, the chapter is most enlightening in its first half (up through 4.3.3), whereas latter sections (4.3.4 on Impacts on Key Services, 4.4 (Adaptation and its Limits), and 4.5 Emerging Issues and Key Uncertainties) need further elaboration and editing. In these latter sections there is a bit of a sense that the authors started with an outline, and were determined to put some text under each outline sub-heading, whether or not there was anything new or compelling to say on the topic. The FAQs are an excellent tool, and should go right up front after the executive summary. The executive summary (pp 3-6) is quite good, but could use some more structuring with sub-headings, and further text editing, to make it really compelling. If history is any guide, the Executive Summary and the FAQs are what 90% or more of the readership, and certainly the policymaker readership will read. The main body, stylistically, has three problems: o First, there need to be more topic sentences set apart, that tells the reader what the bottom line is of the sub-section they are about to read. (Many World Bank reports do this very well.) o Second, many very technical terms are used without definition or clarification of how the concept in question operates in the real world (brief examples would help.) o Third, a considerable amount of the text could be perhaps put into an annex section of supporting material as is practice in many scientific journals. It is important that it all be on the record, but not necessarily in the same narrative, on the same page. (UNITED STATES OF AMERICA)	Unfortunately subheadings in the ES were no available option. The notion of brief summary sentences in the main body is a good one and we tried to make use of this idea, e.g. when highlighting the detection and attribution topic in the respective sections. In general we relied on the glossary for technical terms, but checked where more call-outs to the glossary are needed. Supplementary text material was a possibility, but would have meant that these parts are no longer elements of the assessments, that's why we refrained from doing so.
22	71841	4	0	0	0	0	Overall this is a good review. It is thorough and pulls together a huge literature in a succinct manner. However there is an emphasis of ecosystems (the species that make up ecosystems) tracking their climates and not enough of a review/emphases on the fact that they may undergo micro-evolution or phenotypic plasticity. It is not known which evolutionary response species are going to undertake, and by simply falling into the trap of writing more about species dispersal (as there are more papers on it) misses something. The authors may wish to consider including a section about what is missing around understanding these other adaptive strategies and vulnerabilities (ie 4.3.3). The other major comment is that the literature cited has a North American and European feel to it. There are many papers from other reasons that i think should be cited. For example, a couple of good papers on the basis for conservation strategies based on species responses to climate change in the past are: Mackey, B. G., Watson, J.E.M., Hope, G. and S. Gilmore (2008). Climate change, biodiversity conservation, and the role of protected areas: An Australian perspective. Biodiversity, 9:11-18. Watson, J.E.M., Rao, M., Kang, A., and X. Yan (2012). Climate change adaptation planning for biodiversity conservation: a review. Advances in Climate Change Research, 3: 1-11. Watson, J.E.M., Cross, M., Rowland, E., Joseph, L.N., Rao, M. and A. Seimon (2011). Planning for species conservation in a time of climate change. Climate Change Volume 3: Research and technology for climate change adaptation and mitigation (editors Juan Blanco and Houshang Kheradmand), InTech Publishers. ISBN 979-953-307-278-3, Pp 379-402. some papers that talk about specific challenges of climate change on the biodiversity of Oceania are: Kingsford, R.T and J.E.M. Watson (2011). Impacts of and adaptations to climate change in Oceania: a synthesis. Pacific Conservation Biology, 17: 270-284. Kingsford, R.T. and J.E.M. Watson (2011). What hope for biodiversity in the face of anthropogenic climate change in Oceania? Pacific Conservation Biology, 17: 166-167. and papers that consider ecosystem based responses are: Grantham, H.S., McLeod, E., Brooks, A., Jupiter, S.D., Hardcastle, J., Richardson, A.J., Poloczanska, E.S., Hills, T., Mieszkowska, N., Klein, C.J. and J.E.M. Watson (2011). Ecosystem-based adaptation in marine ecosystems of tropical Oceania in response to climate change. Pacific Conservation Biology, 17: 241-258. Please spend some time reviewing papers in the other regions to provide more balance. More non European and North American examples would be nice. The above literature has these in it. (UNITED STATES OF AMERICA)	Thank you for the references, which due to space constraints we could not use, but the issue of evolutionary adaptation is quite extensively covered.
23	71842	4	0	0	0	0	The Executive Summary focuses largely on impacts on species and biodiversity (as well as feedbacks to climate), but it doesn't address ecosystem services. More material from 4.3.4 beginning on p. 53 should be included in the Exec Summary. (UNITED STATES OF AMERICA)	We have raised some ecosystem service issues to ES level, focussing on those which are a) robust enough to put in the ES, and b) are not services covered elsewhere, such as water in ch 3 and food in ch 7.

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24	71843	4	0	0	0	0	The chapter is very strong on both biodiversity and ecosystem impacts but extremely weak on impacts and vulnerability associated with ecosystem services. In section 4.3.4 it indicates that many of the impacts on ecosystem services are addressed in other chapters. It will be important to ensure that this is the case and also important to ensure that in the SPM there is a synthetic treatment of these issues since they are scattered across many chapters. Moreover, section 4.4.3 on the consequences and costs of inaction and benefits of action is weak. This is probably the most policy relevant portion of the entire chapter but has little information. The costs of inaction and the benefits of action relate largely to the impacts on ecosystem services. It is important that these issues be thoroughly addressed somewhere in the WGII report through a careful review of the literature. (UNITED STATES OF AMERICA)	We have put in pointers to Chapter 3 and 7, where many of the provisioning services are covered. We have also rebalanced some existing text between the 'systems' section of our chapter and the 'services' section so that this apparent imbalance is better addressed.
25	71844	4	0	0	0	0	The concept of "Cascading impacts" is mentioned in a couple of places in the chapter, but is an important issue that deserves higher profile discussion. It would be suitable as a complete section as part of 4.2 (e.g. 4.2.5) with an overview discussion of what cascading impacts are, why they are important, and how they can lead to major impacts (including to people), as well as examples of where they have been observed to date (e.g. bark beetle in the US/Canada, fires leading to flooding, erosion and water quality decreases in New Mexico, etc.) (UNITED STATES OF AMERICA)	Given the space pressure we are under, and the comment from several reviewers that we should refrain from writing a textbook, we are unable to justify a full new section on this topic, but have added a line to the 'multiple stressors' chapaeau to highlight the possibility of cascading effects.
26	71845	4	0	0	0	0	The effect of climate change driven erosion, soil loss, and sediment delivery on ecosystems is an important impact that is not addressed in this chapter. It is important both for the terrestrial ecosystems where the soil comes from, as well as for the freshwater ecosystems where the soil ends up. It could be another sub-section added to section 4.2 (e.g. 4.2.5). For example: Climatic Change March 2011, Volume 105, Issue 1-2, pp 223-242 Zhi Li, Wen-Zhao Liu, Xun-Chang Zhang, Fen-Li Zheng Assessing the site-specific impacts of climate change on hydrology, soil erosion and crop yields in the Loess Plateau of China (UNITED STATES OF AMERICA)	The water quality impacts are mainly covered in Chapter 3, and the food system consequences in Chapter 7. But also within Chapter 4 soils are treated to some extent, e.g. in Sections 4.2.1, 4.2.4, 4.3.2.3-5, 4.3.3.1-4, and 4.4.3. Although we wished to elaborate this more, we were particularly restricted by space.
27	71846	4	0	0	0	0	The Executive Summary and FAQs will likely be used the most. Suggest moving the FAQ section to the front, following the exec summary section. (UNITED STATES OF AMERICA)	The position of the FAQs is an editorial decision by the TSU
28	71847	4	0	0	0	0	There has been an emerging body of literature in the past decade pointing to greater resilience and adaptability of both species and ecosystems to climate impacts than previously thought. This doesn't have significant implications for the overall conclusions of this chapter, but it deserves greater mention in the Executive Summary. These studies are addressed in section 4.4 beginning on p. 56, but the Executive Summary does not give sufficient attention and space to the material in section 4.4. (UNITED STATES OF AMERICA)	A sentence about this was included in the executive summary.
29	71848	4	0	0	0	0	Triage is only mentioned once in the entire chapter as part of section 4.4.2.3. This is a major issue that deserves more discussion and its own sub-section, possibly as section 4.4.2.6. (UNITED STATES OF AMERICA)	Triage (e.g. in the context of ecosystems) is a system for evaluating what resources are available and allocating them in a direction that has the highest probability of a successful outcome. While we agree that this indeed is a relevant topic, we did not discuss the issue of priority setting approaches to a larger extent in our chapter (due to space limitations), and thus we did not feel that it would be justified to turn this into a section of its own.

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30	71849	4	0	0	0	0	Two issues apply to a number of sections and sentences throughout the chapter: 1) While many sections explain the state of the scientific literature in the standard IPCC terminology of "confidence", sometimes supplemented with explanation in terms of the combination of "evidence" and "agreement", some do not. Furthermore, some of the sections that do not, are written in a style that suggests that they were written by a single author. This further weakens their arguments. The whole chapter should be written in the standard terminology, in the style of a consensus document. 2) Furthermore, some sentences that do use the standard terminology, undercut it by using verb forms that indicate more uncertainty than the confidence term implies. These sentences mostly use the subjunctive, e.g. "There is very high confidence that Real Madrid might be the best team in the world." So, it might, but it might not. (Other such expressions use verb forms such as "may" or "could" or adverbs such as "possibly".) What is the reader to think that the authors are trying to say, when reading such a sentence. That the scientific community strongly believes Real Madrid to be the world's best, or that it can't make up its mind whether it's the best of not? Such sentences should be rewritten in the indicative: either "There is very high confidence that Real Madrid IS the best..", or "There is medium confidence that Real Madrid is the best...", depending on what they are trying to express. These issues are generally pointed out in the comments on the sections or sentence to which they apply. (UNITED STATES OF AMERICA)	Standard confidence terminology is obligatory in the ES, and may be used elsewhere. We have checked that it is used where appropriate, and when used, does not involve double-qualification.
31	76512	4	0	0	0	0	Climate change is going to make burned area in US to increase between 50 and 100 percent by 2050 and the fires themselves will promote this trend (Liu et al in press). Yongqiang Liu, Scott Goodrick, Warren Heilman (in press) Wildland fire emissions, carbon, and climate: Wildfire–climate interactions, Forest Ecology and Management. doi: 10.1016/j.foreco.2013.02.020 (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	Thank you for for the reference, on a topic we do discuss quite extensively. We did not cite it because at the time of revision it was not yet published.
32	76513	4	0	0	0	0	Species richness declines and biotic homogenisation have slowed down for NW-European pollinators and plants (Carvalho et al. in press). Carvalho, L. G., Kunin, W. E., Keil, P., Aguirre-Gutiérrez, J., Ellis, W. N., Fox, R., Groom, Q., Hennekens, S., Van Landuyt, W., Maes, D., Van de Meutter, F., Michez, D., Rasmont, P., Ode, B., Potts, S. G., Reemer, M., Roberts, S. P. M., Schaminée, J., WallisDeVries, M. F. and Biesmeijer, J. C. (in press). Species richness declines and biotic homogenisation have slowed down for NW-European pollinators and plants. - Ecology Letters. doi: 10.1111/ele.12121 (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We are aware of the paper which originated from projects where some of us were involved. As we have strict space limitations we finally decided not to cite it, as it is not a core topic in our assessment in relation to climate change
33	76514	4	0	0	0	0	Evidence of potential for evolutionary responses to climate change (Alberto et al. in press). Alberto, F. J., Aitken, S. N., Alía, R., González-Martínez, S. C., Hänninen, H., Kremer, A., Lefèvre, F., Lenormand, T., Yeaman, S., Whetten, R. and Savolainen, O. in press. Potential for evolutionary responses to climate change – evidence from tree populations. - Global Change Biology 19: 1645-1661. (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	Thank you. Due to space restrictions we decided not to include this citation in addition to the ones cited already.
34	76515	4	0	0	0	0	With respect to trends in burned area, Giglio et al. (2013) found a “gradual decrease of 1.7Mhayr <sup>-1</sup> (–1.4%yr <sup>-1</sup> ) in Northern Hemisphere Africa since 2000, a gradual increase of 2.3Mhayr <sup>-1</sup> (+1.8%yr <sup>-1</sup> ) in Southern Hemisphere Africa also since 2000, a slight increase of 0.2Mhayr <sup>-1</sup> (+2.5%yr <sup>-1</sup> ) in Southeast Asia since 1997, and a rapid decrease of approximately 5.5Mhayr <sup>-1</sup> (–10.7%yr <sup>-1</sup> ) from 2001 through 2011 in Australia, followed by a major upsurge in 2011 that exceeded the annual area burned in at least the previous 14 years. The net trend in global burned area from 2000 to 2012 was a modest decrease of 4.3Mhayr <sup>-1</sup> (–1.2%yr <sup>-1</sup> )”. Giglio, L., J. T. Randerson, and G. R. van der Werf, (2013), Analysis of daily, monthly, and annual burned area using the fourth-generation global fire emissions database (GFED4) J. Geophys. Res. Biogeosci. 118, 317–328, doi:10.1002/jgrg.20042. (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	Thank you for this reference. The MODIS-based record is too short (10 years) to draw much in the way of trend conclusions from a phenomenon which is intrinsically highly stochastic, but we cite the work in 4.3.1
35	78256	4	0	0	0	0	It is rarely clear what types of ecosystem change are being referred to. There is a lot of discussion and mention of climate change having “an effect on ecosystems” or causing “ecosystem changes,” but this is only occasionally clarified as being about changes in species distributions and abundances, changes in the rate of reactions within ecosystems, change in biome or ecosystem characterization (how we describe the ecosystem) or changes in ecosystem function. Consistent language about “impacts on ecosystems” is needed in the executive summary and throughout the chapter. Similarly what a “negative impact on a species” is should also be clarified. Does this mean change in abundance, dominance, distribution, fecundity? (Aaron Strong, Stanford University)	We have endeavoured to eliminate such vagueness
36	78296	4	0	0	0	0	UNFCCC recognises peatlands and their potential for emission mitigation action under the Kyoto protocol, including REDD+, CDM, Joint Implementation and emission trading and voluntary markets. (Arina Schrier, Wetlands International)	The topic of peatlands is addressed and some material (previously in 4.3.3.3) has been introduced in 4.2.4



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37	78297	4	0	0	0	0	Measures: no development in high carbon areas, including forest and peat. (Arina Schrier, Wetlands International)	This comment is addressed below (#38)
38	78298	4	0	0	0	0	Degraded forests and degraded peatland shall be targeted for rehabilitation and restoration given their potential and given the high impact on global warming (reducing global warming). For peatland (not any mitigation measures are mentioned yet, although it is one of the most impacted and impacting ecosystems on global warming given the huge carbon store and thus potential warming impact if it is degrading) mitigation measures could be: • Conservation of the forest or peatland in the case it's not yet developed for agriculture (conservation of species is being mentioned, and also very briefly the conservation of forest; conservation of peat is not mentioned). • In the case of a peatland that is already developed for agriculture: replacing crops that need drainage by paludicultures. Paludiculture is the productive use of wet (or rewetted) peatlands in such a way that peat carbon store is being preserved. It will provide sustainable livelihoods options for local people dependent on peat soils for their living • Rewetting and afforestation, reforestation, revegetation, rehabilitation activities (Arina Schrier, Wetlands International)	We have added a sentence to the section on peatlands to highlight these potential mitigation strategies (now in 4.2.4)
39	78299	4	0	0	0	0	A more detailed description on the fire-impacts as a result of climate change is missing. More information on: 1) increased fire frequency, intensity and area affected because of climate change (and the reversed impacts on climate change) 2) impacts on people's health, such as increased respiratory illnesses (e.g. in Indonesia as a result of the el-nino related fires in 1997 etc) 3) impacts of the haze conditions such as decreased photosynthesis, economic damage, impacts on air-traffic etc. (Arina Schrier, Wetlands International)	The already fairly extensive coverage on fire was revisited and expanded e.g. Figure 4.6., 4.8
40	78300	4	0	0	0	0	Climate change implies climatic changes such as changes in temperature, changes in rainfall and changes in the frequency and/or intensity. Currently the chapter 4 discusses mainly the impacts of 'warming', discusses warming models, adaptation to warming etc. , at least in the executive summary. It would be good, given the impacts of 'extreme's' (fire's because of droughts, floods, hurricanes/strong winds, droughts), to discuss this as well proportionally in the text and to summarize this in the summary. Its not all about 'warming' only. (Arina Schrier, Wetlands International)	The available literature on climate extremes, and the ecosystem consequences and disturbances they trigger has been referenced.
41	78301	4	0	0	0	0	For clarity reasons the structure of paragraph 4.3.3 on 'impacts on major systems' could be changed. 1) it would be good to give in the beginning of this paragraph a 'ranking' of which ecosystems are more or less impacted by climate change, and perhaps also 'impacting' climate change. Is forest affected more by climate change than peatland? And what about permafrost versus savannah? Etc. Perhaps this shall be expressed as 'area lost' and/or 'species lost' because of climate change; what are the ecosystems that are most affected? 2) forests and woodlands have been given a lot more attention than all other major ecosystems (in terms of the number of pages). 3) in the sub paragraph on forest, temperate- , boreal- and tropical forest are being discussed separately related to climate impacts. It would be good to keep this structure also for the other sub-paragraphs. (Arina Schrier, Wetlands International)	Nothing is implied by the order of presentation, nor do we wish to do so. There is no defensible metric on which to rank the impacts to ecosystems.
42	78302	4	0	0	0	0	Throughout the document the focus seems to be on climate impacts on 1) forest and 2) the Amazon basin. We would advice to broaden this focus to other 'hotspot' regions and 'hotspot' ecosystems, the current focus is too narrow. An example could be to add boxes on SE Asia's deforestation and peat degradation (LU and LUC), Australian forest fires because of droughts and other ecosystems that are affected by climate change (now there are boxes for the Amazone and for Borial/tundra biome shifts). (Arina Schrier, Wetlands International)	This comment is a somewhat exaggerated. Forests-including the Amazon- occupy just over 6% of the text. Not only has there been a great deal of work on them, but they also have global importance due to their carbon store, climate effects and location as a biodiversity habitat.
43	78308	4	0	0	0	0	Find additional information on deforestation rates in the attachement to wg2-ar5-supportingmaterial@ipcc-wg2.gov (Arina Schrier, Wetlands International)	We attempted to find additional literature on deforestation, as indicated. We feel that the citations we provide are sufficient.
44	78637	4	0	0	0	0	The chapter gives a very broad overview of climate impacts on ecosystems- with much emphasis on terrestrial systems. I tried to add some more detailed information with respect to freshwater and some marine studies, which were somewhat under represented- given the vast amount of information we indeed have. I included a paragraph on phenology, the effects of climate induced changes in water color by CDOC input from the catchment, evolution, surpassed critical threshold. I tried to include the full reference information for all cited publication. If I have missed one or the other I will be happy to sent them to you. If you like more detail- I could contribute further. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This is the introductory comment from Rita Adrian - these specific comments are addressed below (#408, 855, 1259, 1264, 1272)

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
45	79774	4	0	0	0	0	in general chapter 4 could be better matched with evidence from chapter 18, specifically 18.3.2 (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	Chapter 18 does not generate evidence, it reports it from chapters such as this one. They must be consistent, and as far as we are aware, they are, since we have put considerable effort into ensuring that they do.
46	81034	4	0	0	0	0	There are some missing/ incorrect citations in the chapter. These discrepancies have been highlighted in the ref check document for chapter 4 and is available in the supporting material web page. Chapter team may wish to rectify these errors before starting to work on SOD revisions and FGD preparation. (Monalisa Chatterjee, IPCC WGII TSU)	Thank you for pointing them out; we have tried to eliminate all of them
47	81730	4	0	0	0	0	1) Overall -- The chapter team has developed a strong 2nd-order draft. In the final draft, the chapter team is encouraged to continue prioritizing compact and rigorous assessment, effective figures, clear writing, and high specificity. (Katharine Mach, IPCC WGII TSU)	Thank you
48	81731	4	0	0	0	0	2) Coordination across Working Group II -- In developing the final draft of the chapter, the chapter team should continue to ensure coordinated assessment, both in the chapter text and at the level of key findings. As appropriate, cross-references to the sections of other chapters and/or their assessment findings should be used, continuing to ensure that overlaps are reduced and assessment harmonized. (Katharine Mach, IPCC WGII TSU)	A strenuous effort has been made to ensure consistency and cross-referencing
49	81732	4	0	0	0	0	3) Harmonization with the Working Group I contribution to the AR5 -- In developing the final draft, the chapter team should also ensure all cross-references to the Working Group I contribution are updated, with discussion of climate, climate change, and climate extremes referencing the assessment findings in that volume. Where cross-references are made, wherever possible and appropriate they should specify the specific relevant sections of Working Group I chapters, instead of generic references to whole chapters. (Katharine Mach, IPCC WGII TSU)	Chapter authors have been allocated then task of ensuring that this happens.
50	81733	4	0	0	0	0	4) Presentation of uncertainty language within parentheses -- As much as possible, the chapter team should present calibrated uncertainty language within parentheses at the end of sentences. Such placement maximizes the directness and clarity of statements. Wherever possible, formulations such as "there is high confidence that" should be nixed and replaced by "(high confidence)" at the end of the sentence. (Katharine Mach, IPCC WGII TSU)	We have now tried to apply this guidance as much as possible throughout the text
51	81734	4	0	0	0	0	5) Report release -- The chapter team should be aware that the final drafts of the chapters will be posted publicly at the time of the SPM approval, before final copyediting has occurred. Thus, the chapter team is encouraged to continue its careful attention to refined syntax and perfected referencing. (Katharine Mach, IPCC WGII TSU)	We have now tried to apply this guidance as much as possible throughout the text
52	81735	4	0	0	0	0	6) Tightening the assessment and supporting a maximally rigorous executive summary -- In developing the final draft, the chapter team is encouraged to revise each section so that the core nuanced key findings emerge clearly from each section with full and traceable support. Continuing with such focus, the chapter team should aim to shorten and tighten the assessment as much as possible. A goal of shortening the chapter text by 50% or more would be appropriate. One way to shorten the text would be to further use tables to present examples. (Katharine Mach, IPCC WGII TSU)	One major section has been converted to a table, several other sections have been targeted for radical shortening, and all sections have been trimmed as much as possible.
53	81736	4	0	0	0	0	7) Characterization of future risks -- In characterizing future risks for terrestrial ecosystems, to the degree appropriate the chapter team should indicate the extent to which risks (or key risks) can be reduced through mitigation, adaptation, and other responses. In discussing evolutionary adaptation or ecological shifts versus human responses and adaptation affecting ecosystems, clarity should be ensured. If possible, the chapter team should communicate how risks may increase as the level of climate change increases or, potentially, the relative importance of changes in mean conditions, as compared to changes in extreme events, as compared to potential non-linear changes associated with biome shifts or tipping points. Building from this, how much can risks be reduced through adaptation or other management approaches, in the near-term and the long-term? How are factors or stressors that multiply risks relevant in this context? As supported by its assessment of the literature, the author team should consider communicating risks for the era of climate responsibility (the next few decades, for which projected temperatures do not vary substantially across socioeconomic/climate scenarios) and for the era of climate options (the 2nd half of the 21st century and beyond). As would be helpful to the chapter, the framing of table SPM.4 could be considered in characterization of future risks, along with the key and emergent risk typology of chapter 19. It seems there is very nice potential for presentation, within a table, of the key risks for ecosystems, the relevant drivers (climate and non-climate) and their importance respectively, and the potential for risk reduction through different types of adaptation. (Katharine Mach, IPCC WGII TSU)	The chapter ran a specific exercise to do this.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
54	81737	4	0	0	0	0	8) Informing the summary products -- To further support robust and insightful summary products for the report, the chapter team is encouraged to maximize nuance as well as traceability in its key findings, continuing to use calibrated uncertainty language effectively. In addition to nuanced characterization of future risks (see the previous comment), the chapter team is encouraged to consider themes emerging across chapters, indicating for example how extreme events pose risks for ecosystems, how limits to adaptation may be relevant in the context of this chapter, and how interactions among mitigation and adaptation may occur. (Katharine Mach, IPCC WGII TSU)	Noted and implemented as far as possible.
55	81738	4	0	0	0	0	9) Subtleties of terminology -- Discussion of adaptation within Chapter 4 requires a sophisticated touch. The chapter team is grappling with different types of "natural" adaptation occurring through evolutionary and ecological processes and with human adaptation and management responses. The chapter team is encouraged to recognize and summarize the subtleties of terminology in the literature, then adopting--with thorough checking across the chapter--a clear and consistent terminology that is explained to the reader. Such clarity is especially important within section 4.4, since much of the rest the report adopts much more strictly human oriented usages of adaptation terminology. As another consideration of terminology, the chapter team should exercise care with phrases such as "the past few decades" or "the last several decades." Across cultures, words such as few and several can assume different meanings, and even as a native English speaker, I am not always sure what the chapter means. Where appropriate, it would be preferable to indicate more specifically how many decades are meant. (Katharine Mach, IPCC WGII TSU)	The prior and extensive use of the phrase 'adaptation' within the biological literature, in relation to evolution, is a reality we need to live with. We attempt to qualify it with the construct 'evolutionary adaptation' where this is intended and the context does not make it clear.
56	85035	4	0	0	0	0	GENERAL COMMENTS: I congratulate the author team for all their work on an interesting and informative SOD. When considering the suite of review comments, please look for opportunities to continue to hone and focus the text in revision even further, reducing length wherever possible. Please see my detailed comments for suggestions related to specificity of ES findings, traceable accounts, and specific clarifications. I have one other general comment. The definition of vulnerability used in the chapter (expressed at the beginning of section 4.3 on page 19, lines 19-24) is not consistent with the definition in the context of AR5 (see AR5 WGII Glossary), which defines vulnerability as the propensity or predisposition to be adversely affected. The definition of vulnerability used by the chapter includes the degree to which the climatic environment of a terrestrial ecosystem changes relative to conditions under which the ecosystem evolved, which is a measure of changes in physical conditions (in exposed systems) rather than vulnerability in the AR5 context. As characterized in Chapter 19 and the draft SPM and TS, both physical changes and vulnerability interact with exposure to determine risks. At minimum, the definitional difference needs to be addressed explicitly in the introduction to 4.3, but it would be preferable to consider adapting the definition of vulnerability used in the chapter and to consider physical changes, vulnerability, and exposure separately in the chapter discussions. (Michael Mastrandrea, IPCC WGII TSU)	Comment accepted. We have brought our definitions into line with the glossary, and unpack its underlying elements for ecosystems at a lower level.
57	85036	4	0	0	0	0	SUMMARY PRODUCTS: In preparing the final draft of your chapter and particularly your executive summary, please consider the ways in which your chapter material has been incorporated into the draft SPM and TS. For Chapter 4, this includes presentation of observed impacts and vulnerabilities in section A.i, sectoral and regional risks in section C.i, and interactions between adaptation and mitigation in section D.ii, as well as related figures and tables. Are there opportunities for presenting chapter findings and material in a way that further supports broad themes highlighted in the summary products and that facilitates additional cross-chapter synthesis in specific findings or figures/tables? Do the existing summary product drafts suggest additional coordination that should occur between Chapter 4 and other chapters at LAM4? (Michael Mastrandrea, IPCC WGII TSU)	Noted and implemented as far as possible.
58	58322	4	1	1	1	1	Title "water system" is confusing with chapter 3. Rally better to say "Terrestrial and freshwater ecosystems". (Martin Pecheux, Institut des Foraminifères Symbiotiques)	The chapter title is not decided by the authors, it is given by the plenary.
59	70367	4	1	13	1	13	Correct the spelling of the last name of Contributing Author Patrick Gonzalez (it ends with a "z") (Patrick Gonzalez, National Park Service)	Apologies
60	79038	4	1	15	1	22	Marten Winter is listed as both, CA and VCS. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Yes, Marten Winter has worked as both; in the earlier stage of the writing as a CA as well as a VCS, while later only as a CA while the VCS role has been taken over by Martin Musche (thus we have two VCSs)



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
61	68801	4	2	1	6	1	The use of bioenergy as renewable of energy to mitigate the shortage and climatic impacts fuels might be thought beneficial. In the report (chapter 4), it is dicussed that there are unintended challenges with the use of bioenery as they are going to cause large land use changes and may also interfere with food security especially in developing countries. With such a big significance, even mentioned it is mentioned in the SPM report (page 17, line 35-42), It is not summarized in the TS or Executive Summary of chapter 4! (NETHERLANDS)	Thanks for this hint. We have now included this in the ES and also treid to bring it up to the TS and SPM. In the ES it now reads as follows: "Widespread transformation of terrestrial ecosystems in order to mitigate climate change, such as carbon sequestration through planting fast-growing tree species into ecosystems where they did not previously occur, or the conversion of previously uncultivated or non-degraded land to bioenergy plantations, will lead to negative impacts on ecosystems and biodiversity (high confidence). For example, the land use scenario accompanying the mitigation scenario RCP2.6 features a large expansion of biofuel production, displacing natural forest cover. [4.2.4.1, 4.4.4]"
62	81739	4	2	44	0	0	Characterizing Future Risks in the Executive Summary -- As much as possible, the chapter team should continue to specify the degree to which future risks change or increase with increasing levels of climate change. Which risks emerge in the near-term (the next several decades, through the 2040s), and which emerge in the long-term (the 2nd half of the 21st century and beyond)? What is the potential for reducing risks through adaptation and mitigation? What are the limits to adaptation (autonomous versus human assisted)? The chapter team should also continue providing quantitative information on the ranges of possible outcomes. (Katharine Mach, IPCC WGII TSU)	In principle this comment is dealt with in our new sentence "Climate change is projected to be a powerful stressor on terrestrial and freshwater ecosystems in the second half of the 21st century, especially under high-warming scenarios such as RCP6.0 and RCP8.5 (high confidence)." As the fast majority of effects is expected to show up in the second half of the century. For the potential for reducing risk through adaptation and mitigation we now wrote: "Management actions can reduce, but not eliminate, the risk of impacts to terrestrial and freshwater ecosystems due to climate change, as well as increase the inherent capacity of ecosystems and their species to adapt to a changing climate (high confidence). The capacity for natural adaptation by ecosystems and their constituent organisms is substantial, but for many ecosystems and species it will be insufficient to cope with projected rates and magnitudes of climate change in the 21st century without substantial loss of species and ecosystem services, under medium-range warming (e.g., RCP6.0) or high-range warming scenarios (e.g., RCP8.5) (medium confidence). The capacity for ecosystems to adapt to climate change can be increased by reducing the other stresses operating on them; reducing the rate and magnitude of climate change; reducing habitat fragmentation and increasing connectivity; maintaining a large pool of genetic diversity and functional evolutionary processes; assisted translocation of slow moving organisms or those whose migration is impeded, along with the species on which they depend; and manipulation of disturbance regimes to keep them within the ranges necessary for species persistence and sustained ecosystem functioning. [4.4, 4.4.1, 4.4.2]" Limits to adaptation: We e.g. wrote: "Adaptation measures will be unable to prevent substantial change in the boreal-arctic system (high confidence)." Ranges of possible outcomes: WE have tried to incorporate these, especially by referring to different RCPs e.g in the context of mitigation through bioenergy plantations or in the first bullet point on the planet's biota.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
63	81740	4	2	44	0	0	Length of the Executive Summary -- The chapter team should aim to limit the length of the executive summary to 2.5 pages maximum. Reducing the executive summary to focus on the core conclusions of the chapter will also provide a guide to shortening and tightening the rest of the chapter. (Katharine Mach, IPCC WGII TSU)	We have tried to reduce the ES text, but have only reached 19000 characters (while one page has ca. 5000 characters); this means that we only succeeded in reducing it to roughly 3.5 instead of 2.5 pages
64	81741	4	2	44	0	0	Parenthetical Presentation of the Uncertainty Language Within the Executive Summary-- As much as possible, the chapter team should present calibrated uncertainty language within parentheses at the end of sentences. Such placement maximizes the directness and clarity of statements. Wherever possible, formulations such as "there is high confidence that" should be nixed and replaced by "(high confidence)" at the end of the sentence. The chapter team should also be aware of the convention used throughout the report: the calibrated terms applied to the 1st statement apply to subsequent statements unless otherwise specified. (Katharine Mach, IPCC WGII TSU)	We have adjusted this throughout the entire ES (and kept only very few exceptions where the transformation in the standard style caused major difficulties in bringing across the main message).
65	81742	4	2	44	0	0	Extinction and Biodiversity Risks -- Is it possible for the chapter team to say more, with more specificity, about risks to biodiversity than currently done? For example, one option is to provide differing levels of confidence for more qualitative versus quantitative statements; chapter 6 takes this approach for instance in describing projected changes for fisheries. Overall, throughout the executive summary, the chapter team should aim to further shed light for the reader on the question of how much climate change matters for ecosystems, as compared to other drivers. (Katharine Mach, IPCC WGII TSU)	After having made some major adjustments of the main chapter text in relation to extinction and biodiversity risks, we also have modified the ES accordingly; generally, stating how much climate change matters for ecosystems as compared to other drivers, was one of our core objectives already in the SOD and now we have further elaborated on this, hoping that the messages come across more clearly
66	85037	4	2	44	0	0	Executive Summary: Please continue to refine the focus and clarity of the executive summary as you revise the chapter--I have made various specific suggestions along these lines below. For example, to the extent possible as supported by the literature, please also emphasize what risks are projected to emerge over different time horizons (e.g., mid-century vs. end-of-century), as well as the potential or lack of potential for mitigation and adaptation to reduce them. Please also check and ensure clear line of sight to underlying chapter sections--in general this is done well at present, but I have noted places where further clarity is needed in my specific comments. (Michael Mastrandrea, IPCC WGII TSU)	Thanks Michael, we have been dealing with this as much as possible and tried to incorporate your specific comments
67	70870	4	2	46	0	0	should read '...anthropogenic climate change will approach...' (Andrew Friend, University of Cambridge)	This sentence is not in the ES any longer, but in principle we did not (as we could not) differentiate between the effects of anthropogenic climate change versus "natural" climate change
68	59268	4	2	46	0	48	Please rephrase the starting sentence of chapter 4. If you wait long enough in the future, there will certainly be such a change.(Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The starting sentence was rephrased and now includes the statement "during the 21st century"
69	58323	4	2	46	2	46	Suppress "of many". If you say "could approach", no use of "of many". Better "will approach the largest". Approach is very weak. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	"Approach" is no longer used throughout the ES.
70	57895	4	2	46	2	47	Change "(high confidence)" into "(low confidence)". It is because there is high uncertainty about the future climate. It is not accurate to state that future climate change could approach the largest amplitude. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	"Approach" is no longer used throughout the ES, while we maintain high confidence in the modified statement: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence)."
71	63498	4	2	46	2	47	This statement is not understandable because it is not precise enough in terms of region and time period addressed. Earth history has exhibited much larger climate change than what may occur based on projections of the 21st century. Please clarify! (GERMANY)	We agree, and therefore now have written: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence)."
72	76495	4	2	46	2	47	Consider replacing "magnitude" by "rate". If you do refer to magnitude perhaps clarify the timescale associated with "future" and "Earth history" (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We agree, and therefore now have written: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence)."

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
73	85149	4	2	46	2	47	The sentence must be phrased more carefully.. During the Earth history (billions years ago) <sup>2</sup> , very large variations occurred from ocean temperatures of some 50 °C to total glaciation. (Michel Petit, CGIET rue de Bercy)	We agree, and therefore now have written: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence)."
74	71850	4	2	46	2	49	This finding is confusing to interpret for several reasons: 1) in the first sentence, it is not clear if the use of the term "largest climatic changes" relates to the magnitude or rate of change, or both. 2) It is not clear what the word "this" is referring to in the phrase "associated feedbacks and services responded to this climate change". 3) it is unclear what is meant by the phrase "even when the rates of past global climate change were slower than implied by higher warming scenarios" (how can past changes be implied by future climate scenarios?). (UNITED STATES OF AMERICA)	We agree and have re-written the entire statement into: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence). Most ecosystems are vulnerable to climate change even at rates of climate change projected under low- to medium-range warming scenarios (e.g., RCP2.6 to RCP6.0). "
75	71851	4	2	46	2	54	These summary statements should be very clear and very precise. Three comments: 1) The "magnitude of future climate change" on line 46 should give bounds on how far in the future; 2) "this climate change" on line 48 should unambiguously reference "this past climate change"; 3) the "However" on line 50 sets up an implicit comparison of the magnitude of impacts of climate change and non-climate influences - with the following sentence giving the impression that the magnitude of the latter is greater - but this isn't stated clearly in this first summary paragraph, even though it is stated unambiguously on page 3 lines 12-27. (UNITED STATES OF AMERICA)	We have now re-written the majority of our ES statements, trying to be more precise and trying to more explicitly differentiate between climate change and non-climatic influences.
76	76496	4	2	46	2	54	This paragraph is not very clear (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We agree and thus have re-written it
77	70876	4	2	46	4	8	Everything so far is very (too) general with no specific useful content. (Andrew Friend, University of Cambridge)	We have re-written large parts of the ES in order to become more specific
78	70882	4	2	46	4	49	Everyhting has a strong negative biase. For balance a number of positive outcomes need to be mentioned, such as increased ranges of some species, higher productivity, migration into unproductive tundra, biomass increease, higher water use efficiency... (Andrew Friend, University of Cambridge)	We have tried to write many parts in a more neutral way and have also incorporated more positive examples; e.g.: "There is high confidence that the factors causing the current increase in land carbon include the positive effects of rising CO2 on plant productivity, a warming climate, nitrogen deposition and recovery from past disturbances." or: "Experiments and modelling studies provide medium confidence that increases in CO2 up to about 600 ppm will continue to enhance photosynthesis and plant water-use efficiency, but at a diminishing rate; and high confidence that low availability of nutrients, particularly nitrogen, will limit the response of many natural ecosystems to rising CO2."
79	71083	4	2	46	4	49	Some past changes in climate during the human era may be comparable to what we are anticipating in the near future, but these were localised, and probably slower, and affected relatively small numbers of people who could migrate away with few restrictions. Also the wording of the second sentence is a bit confusing. Based on content of [4.2.2], suggest changing this to: "There is high confidence that the magnitude of global climate change occurring within the next 50 to 100 years could exceed that of any of the largest climatic changes observed in human recorded history, and could be more rapid than comparable changes known to have caused massive ecological change since the last glaciation. There is also high confidence that the planet's biota, carbon cycle and associated feedbacks and services, have been affected by past global climatic changes, even when the rates of change were slower than implied by projections of severe warming (e.g. RCP 8.5). " (CANADA)	Thanks for this proposal. We have also used your proposed statements while re-writing these parts of the ES.
80	59269	4	2	47	0	49	The second phrase of chapter 4 needs also rephrasing. In general, the whole first paragraph of the summary needs more attention. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have re-phrased the entire first paragraph

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81	85038	4	2	47	2	49	Can more be said than just "respond" here, given the fundamental changes described in the text? What does this imply for current/future climate change? Please also clarify that "climate change" in line 48 refers to climate change in the more distant past. (Michael Mastrandrea, IPCC WGII TSU)	We hope to have covered the essence of this comment by writing: "The planet's biota and ecosystem processes were strongly affected by past climate changes at rates of climate change lower than those projected during the 21st century under high warming scenarios (e.g., RCP8.5) (high confidence)."
82	58324	4	2	48	2	48	Suppress service as you speak of past climatic events (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Sentence was completely changed and we write about ecosystem processes
83	85150	4	2	48	2	48	"this change" should gramatically be future climate change, which makes the sentence meaningless (Michel Petit, CGIET rue de Bercy)	We have re-written this part.
84	78251	4	2	48	2	49	It is not clear what "this climate change" refers to. Is it the largest climatic changes observed in Earth history? If this is true, the next sub-clause is very difficult to understand: the rates of past change were slower than implied by higher warming scenarios. What do higher warming scenarios have to do with past changes? And does the concept of ecosystem services in pre-human time make sense? (Aaron Strong, Stanford University)	We have re-written the entire paragraph in order to make it much clearer
85	58325	4	2	49	2	49	apart (the meteoritic impact at) the Cretaceous/tertiary boundary (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Yes, that's true (depending on the scale we look at it). But for the general statement we regard this a too specific case to be highlighted in our ES.
86	85151	4	2	49	2	54	The key role of the climate change rate should be more clearly expressed in this introductory paragraph (Michel Petit, CGIET rue de Bercy)	We entirely agree and have modified our text accordingly
87	64801	4	2	52	0	0	..most ecosystems will change.. (Dave Spittlehouse, BC Ministry Forests, Lands and Natural Resource Operations)	Text was modified, and where appropriate we have used "will" in the new version
88	71852	4	3	2	3	6	Estimates of past and present forest cover are not statistically valid. It is incorrect to say these estimates have "high confidence." See the following papers: Botkin, D. B. and L. Simpson, 1990, Biomass of the North American Boreal Forest: A step toward accurate Global Measures: Biogeochemistry 9:161-174. Botkin, D. B. and L. G. Simpson, 1990, Distribution of Biomass in the North American Boreal Forest, pp. 1036-1045 in G. Lund (ed.) Proceedings of the International Conference on Global Natural Resource Monitoring and Assessments: Preparing for the 21st Century, American Society for Photogrammetry and Remote Sensing. Botkin, D. B., R. A. Nisbet and L. G. Simpson, 1992, Forests and Global Climate Change, Chapter 19, pp. 274- 290 in S. K. Majumdar, L. S. Kalkstein, B. M. Yarnal, E. W. Miller, and L. M. Rosenfeld (eds.) Global Climate Change: Implications, Challenges and Mitigation Measures, Pennsylvania Academy of Sciences, Philadelphia. Botkin, D. B., Simpson, L. G., and H. J. Schenk, 1992, Estimating Biomass, Science Letters. Hall, F.G., D. B. Botkin, D. E. Strelbel, K. D. Woods, and S. J. Goetz, 1991, Large Scale Patterns in Forest Succession As Determined by Remote Sensing, Ecology 72: 628 - 640. The points made in these documents are still valid. Except for some recent satellite remote sensing, previous estimates were based on rather informal and variable definitions of the boundaries of forests. And much less is known about past forest cover. The statement should be deleted. It is untrue. (UNITED STATES OF AMERICA)	The past and present forest cover is no longer an issue in the ES, as we regard this as a less relevant detail on the level of the ES
89	68197	4	3	5	0	6	I disagree strongly with the sentence in bold. I suggest instead: "There is high (not medium) evidence that interactions (not only feedbacks) exist between terrestrial biosphere -or continental surfaces- (not only "ecosystems" see above) and the climate at scales ranging from local to global. Hayden B.P. (1998) Ecosystem feedbacks on climate at the landscape scale. Phil. Trans. R. Soc. Lond. B 353: 5-18., Betts, R. A., P. M. Cox, M. Collins, P. P. Harris, C. Huntingford and C. D. Jones (2004). The role of ecosystem-atmosphere interactions in simulated Amazonian precipitation decrease and forest dieback under global climate warming. Theoretical and Applied Climatology 78(1-3): 157-175. among others (Bonan, 2008, Betts et al. Submitted, in the references list), could be cited. Note also that this statement as written is fully contradicting the entire section 4.3.4.3. (Denis Loustau, INRA)	Thanks for spotting the inconsistency; we now have a paragraph which refers to 4.3.4.3 and which reads as follows: "When terrestrial ecosystems are substantially altered (in terms of plant cover, biomass, phenology or plant group dominance), either through the effects of climate change or through other mechanisms such as conversion to agriculture or human settlement, the local, regional and global climates are also affected (high confidence)."
90	64741	4	3	5	3	5	Please be sure that the definition for 'primary forest' is included in the glossary of terms for the report. (Robert Webb, NOAA OAR ESRL)	We do not mention "primary forest" any longer in the ES

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
91	70368	4	3	5	3	10	It was somewhat surprising to see that feedbacks between terrestrial ecosystems and climate only received a rating of 'medium' confidence. It would seem that the substantial body of published evidence of the dependence of the global carbon and water cycles on forests (cited by the chapter itself [4.3.2.4, 4.3.3.1] and reviewed by, for example, Bonan 2008 Science) would support a rating of 'high' confidence. (Patrick Gonzalez, National Park Service)	Thanks, yes you are right; we now have an adjusted paragraph which reads as follows: "When terrestrial ecosystems are substantially altered (in terms of plant cover, biomass, phenology or plant group dominance), either through the effects of climate change or through other mechanisms such as conversion to agriculture or human settlement, the local, regional and global climates are also affected (high confidence)."
92	71853	4	3	5	3	10	This should be stronger than 'medium' confidence. Clearly the role of ecosystems in sequestering carbon (and dramatically releasing carbon in the case of say, peat forests in Indonesia) is clear evidence of feedback. (UNITED STATES OF AMERICA)	Thanks, yes you are right; we now have an adjusted paragraph which reads as follows: "When terrestrial ecosystems are substantially altered (in terms of plant cover, biomass, phenology or plant group dominance), either through the effects of climate change or through other mechanisms such as conversion to agriculture or human settlement, the local, regional and global climates are also affected (high confidence)."
93	71084	4	3	8	3	9	Suggest also noting that changes in surface roughness are important, since they affect turbulent exchange and hence exchanges of momentum energy (wind) and sensible heat as well as evapotranspiration. (CANADA)	Thank you; as we can not make a too loong and detailed listing we just wrote: "The feedbacks between terrestrial ecosystems and climate include, among other mechanisms, changes in surface albedo..."
94	64742	4	3	9	3	9	replace 'be different from' with 'extend beyond' since in many if not most cases a local or regional ecosystem feedback on the climate will also have a local affect on climate that then propagates through the system. (Robert Webb, NOAA OAR ESRL)	We agree and have modified this accordingly.
95	85043	4	3	10	3	10	Please include all relevant line of sight for this finding. For example, 4.2.4.1 also contains relevant information. (Michael Mastrandrea, IPCC WGII TSU)	We have included the link to 4.2.4.1
96	71854	4	3	12	3	15	The summary statement doesn't give any indication of spatial variability, which the paragraph makes clear. To acheive this authors could insert "globally" on line 14 to read "threats to ecosystems globally" and modify to recognize that climate change is or will be the dominant stressor in more remote ecosystems, for example to read "with climate change a dominant stressor in areas not subject to intensive human disturbance, and becoming an increasing additional stress globally ..." (UNITED STATES OF AMERICA)	We have inserted "globally" in a re-written version of this paragraph and think to have captured the essence of the statement on the remote ecosystems in it as well.
97	78303	4	3	12	3	15	' there is high confidence that.....through the century'. Note that in the case of peat, Land Use Emissions from peatland drainage are not restricted to land use change, but also associated with the ongoing land use itself. In this respect peatland ecosystems differ from other ecosystems, where the main cause of ecosystem destruction is from land use change. This shall be made clear in the text. This is also true for page 11 lines 34-35 where is stated that LUCC (Land Use and Cover Change) is a main cause of changes in GHG sources and sinks. It shall be clear that also LU is impacting climate. (Arina Schrier, Wetlands International)	We have also included both land use and its change in the ES and in the chapter of page 11 of the SOD
98	71085	4	3	12	3	27	Suggest separating paragraph into two - one for terrestrial ecosystems and one for freshwater ecosystems. There is some overlap with Ch4, P3, L34 to L39. (CANADA)	We now have separated the paragraph into two; with the first one containing statments which are valid for both "systems"; a second one deals with freshwater systems with one on terrestrial ecosystems in between the two (terrestrial systems are dealt with in other paragraphs, like the ones on a) the carbon sinks, b) disturbances, c) forest dieback etc..). Furthermore, we hope that through the re-writing of many parts we achieved clearer statements.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
99	85039	4	3	12	3	27	The support in the chapter text for the aspects of this paragraph pertaining to terrestrial ecosystems could be clearer, as currently, this is spread across various subsections, without a clear framing in the context as presented in the executive summary in all cases. It may be useful to add a general concluding statement that ties all the individual lines of evidence together more clearly in the chapter, commenting on the impacts of climate change in the context of other stressors. (Michael Mastrandrea, IPCC WGII TSU)	We now have separated the paragraph into two; with the first one containing statements which are valid for both "systems"; a second one deals with freshwater systems with one on terrestrial ecosystems in between the two (terrestrial systems are dealt with in other paragraphs, like the ones on a) the carbon sinks, b) disturbances, c) forest dieback etc..).
100	85040	4	3	12	3	27	In addition, it would be useful to be clearer about the projected role of climate change over time. For example, does climate change pose a threat in the next few decades vs. the end of the century? It is important to clarify the impacts of climate change and how they evolve over time, even if other factors are projected to more significantly impact ecosystems. (Michael Mastrandrea, IPCC WGII TSU)	We have addressed this by mentioning that the climate change effects will become particularly important "in the second half of the 21st century", while "Direct human impacts such as land-use and land use change, pollution and water resource development will continue to dominate the threats to most freshwater (high confidence) and terrestrial (medium confidence) ecosystems globally over the next three decades." A more detailed account is hard to make based on the state of knowledge we have.
101	81743	4	3	14	3	14	Is it possible to be more specific with wording such as "dominate the threats to ecosystems" and "an increasing additional stress"? How much does climate change matter for ecosystems--can this question be answered more directly? (Katharine Mach, IPCC WGII TSU)	We now have tried to implement this by writing: "Model-based projections imply that under low to moderate warming scenarios (e.g., RCP2.6 to RCP6.0), direct land cover change will continue to dominate over (and conceal) climate-induced change as a driver of ecosystem change at the global scale; for higher climate change scenarios, some model projections imply climate-driven ecosystem changes sufficiently extensive to equal or exceed direct human impacts at the global scale (medium confidence). In high altitude and high latitude freshwater and terrestrial ecosystems, climate changes exceeding those projected under RCP2.6 will lead to major changes in species distributions and ecosystem function, especially in the second half of the 21st century (high confidence)."
102	68201	4	3	19	0	0	What is meant by " large-scale ecosystem character" ? This sentence is absolutely unclear. (Denis Loustau, INRA)	Thank you - you are completely right; we now have re-written this part.
103	78611	4	3	23	0	0	There is high confidence that rising water temperatures will lead to shifts in freshwater species distributions, relative species composition and compound..... (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The text was now modified into: "Rising water temperatures, due to global warming, will lead to shifts in freshwater species distributions and worsen water quality problems, especially in those systems experiencing high anthropogenic loading of nutrients (high confidence). Climate change-induced changes in precipitation will substantially alter ecologically important attributes of flow regimes in many rivers and wetlands and exacerbate impacts from human water use in developed river basins (medium confidence)."

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
104	71855	4	3	26	3	39	Suggest authors balance language that a changing climate can also ameliorate other threats to biodiversity. Changes in temp or precip could enable range expansions of some vulnerable species for example. (UNITED STATES OF AMERICA)	We have tried to write many parts in a more neutral way and have also incorporated more positive examples; e.g.: "There is high confidence that the factors causing the current increase in land carbon include the positive effects of rising CO2 on plant productivity, a warming climate, nitrogen deposition and recovery from past disturbances." or: "Experiments and modelling studies provide medium confidence that increases in CO2 up to about 600 ppm will continue to enhance photosynthesis and plant water-use efficiency, but at a diminishing rate; and high confidence that low availability of nutrients, particularly nitrogen, will limit the response of many natural ecosystems to rising CO2."
105	85152	4	3	31	3	31	Add soil degradation (Michel Petit, CGIET rue de Bercy)	As we did not focus on soil degradation in our text we also did not include this in the ES; we hope that the phrase: "... including but not limited to the simultaneous presence of land-use changes,..." is sufficient to tell that we could not cover all aspects.
106	70871	4	3	32	0	0	increasing CO2 will not constrain the capacity of many species to respond - it will likely increase their capacity... (Andrew Friend, University of Cambridge)	Text changed accordingly
107	71086	4	3	32	0	0	What do authors mean by 'novel pests'? Insects or any plant or animal whose populations increase due to climate change and have deleterious effects on human values? If the authors mean insects, when they use it together with diseases, perhaps this should say that. Also, authors could consider replacing 'diseases' (the outcome of a pathogen) with 'pathogens'. Alien species could be considered a novel pest or pathogen. Suggest checking that the terminology used is appropriately defined and consistently used and defined in IPCC documents (CANADA)	From the point of view of an ecosystems or a part thereof it indeed would have to be named differently, while avoiding "novel" (which now is simply "new") we kept "pests" as this is a commonly used term and more easily understood than e.g. plant feeders; so we now have used "exposure to new pests and pathogens".
108	57896	4	3	34	3	34	Need to modify the sentence "There is high confidence that a changing climate exacerbates other threat to biodiversity". There are examples of high temperature linked to high biodiversity in both recent and geological periods. Increase of temperature and linked increase of precipitation may increase biodiversity by increasing food resources. Jiang et al (2013) reported that biodiversity of small rodents showed positive relation with temperature during past about 3 decades in Inner Mongolia grassland. Buckeridge (2010) found the fossil barnacle diversity became lower during periods when oceans became cooler in Australia. Buckeridge JS (2010). Some biological consequences of environmental change: a study using barnacles (Cirripedia: Balanomorpha) and gum trees (Angiospermae: Myrtaceae). Integrative Zoology 5, 122–31. Jiang G., Liu J., Xu L., Yu G., He H. and Zhang Z. Climate warming increases biodiversity of small rodents by favoring rare or less abundant species in grassland ecosystem. Integrative Zoology, 2012, 9 (DOI: 10.1111/1749-4877.12027 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	You are right that threats are only negative, but certain species might profit; therefore reworded this and used "impacts" instead of "threats"
109	81744	4	3	34	3	36	Is it possible to specify the approximate time frame for these changes within the 21st-century? (Katharine Mach, IPCC WGII TSU)	As this is a continuous process, it is very difficult to give time frames, unless we say "especially in the second half of the 21st century" (that's what we now wrote)
110	85042	4	3	34	3	37	There is some overlap between this finding and the finding on page 4 lines 32-39. (Michael Mastrandrea, IPCC WGII TSU)	We have slightly re-written parts of the text and hope that it becomes clear that in the present paragraph it is mainly about impacts others than those of climate change, but in interaction with CC, while other parts are now dealt with at the paragraph you mentioned

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
111	71856	4	3	37	3	39	Impacts to species distributions and ecosystem functions do not only depend on the nature of projected changes in climate (as is currently stated in the text), but also on the sensitivities of those species and ecosystems to those changes in climate. Not only is there uncertainty in projected future climate changes, but there is also uncertainty in knowing how species and ecosystems will respond. We recommend that the authors acknowledge those sources of uncertainty in influencing confidence ratings for "specific future ecosystem changes" (in addition to the confidence assigned to regional climate change projections in WGI). (UNITED STATES OF AMERICA)	This part of the ES was completely modified and this part removed from here and is dealt with in the ES part equivalent to the previous part on page 4, lines 32-39
112	85041	4	3	37	3	39	The support in the chapter text is not clear for this nonbold text. Regarding its content, another approach is to evaluate confidence in future ecosystem changes conditional on specific regional climate change projections--confidence in the changes that would occur if a certain regional change took place can be higher than confidence in that regional change. Both pieces of information are important for understanding the conclusion, and it is worth mentioning this approach as well. (Michael Mastrandrea, IPCC WGII TSU)	This part of the ES was completely modified and this part removed from here and is dealt with in the ES part equivalent to the previous part on page 4, lines 32-39
113	70872	4	3	39	0	0	and by the ability of the impact models and the understanding therein (Andrew Friend, University of Cambridge)	This part of the ES was completely modified and this part removed from here and is dealt with in the ES part equivalent to the previous part on page 4, lines 32-39
114	71087	4	3	39	3	39	Suggest changing "projections by WGI" to "projections reviewed by WGI" (CANADA)	Text was removed.
115	70873	4	3	41	0	0	there is no uncertainty about this, so should read 'There is certainty that...' (Andrew Friend, University of Cambridge)	This was now modified into a high confidence statement.
116	81745	4	3	41	3	42	What is the intended timeframe for this statement? Since preindustrial or since much deeper time in Earth's history? It may be most effective to open with a statement clearly about recent decades, providing information on deeper time subsequently within the paragraph. (Katharine Mach, IPCC WGII TSU)	We have now opened the statement with reference to recent decades.
117	85044	4	3	41	3	42	Please specify what past timeframe is intended here. In addition, attribution of abundance changes is assigned medium confidence on pages 21 and 28, so it is unclear how this intersects with its presentation with high confidence here. Please clarify. (Michael Mastrandrea, IPCC WGII TSU)	We have now opened the statement with reference to recent decades; The assignment of medium confidence on page 21 in the SOD refers to "all species", while the high confidence here (as on page 21) refers to "many species"; no confidence statements have been made in page 28, but the state of knowledge is presented in a similar way in relation to "many" vs. "all"
118	71857	4	3	41	3	48	While this section correctly indicates that there are broad patterns of species and biomes shifting towards the poles and up in altitude, a later section (4.3.2, page 21 lines 22-25) highlights that there is growing recognition that "changes in climate over the last several decades have led to range shifts that are frequently not towards the poles or up in altitude". We suggest that the key finding in the executive summary acknowledge this fact (which is assigned a certainty of "high confidence") so as not to continue to perpetuate the assumption that all species will move poleward and upward. (UNITED STATES OF AMERICA)	This was now included in the new version, so as not to continue to perpetuate the assumption that all species will move poleward and upward. The text now reads as follows: "Interactions between changing temperature, precipitation and land use can sometimes result in range shifts that are downhill or away from the poles."
119	85045	4	3	41	4	8	This paragraph includes statements about both observations and projections, and switching back and forth as currently done could lead to confusion. Please consider ways to present observations and projections distinctly. (Michael Mastrandrea, IPCC WGII TSU)	We have now re-written the paragraph, but as we wanted to show the effects as a continuum from the past over the present to the future, we kept the joint presentation of observations and projections (with the latter being often based on the former)
120	81746	4	3	45	3	46	The terms "distant" and "recent past" are relative terms that are quite ambiguous to the reader. It would be much preferable to indicate more specifically what is meant. (Katharine Mach, IPCC WGII TSU)	We now wrote "recent decades"
121	85049	4	3	45	3	46	Please clarify what is meant by distant and recent past. (Michael Mastrandrea, IPCC WGII TSU)	We now wrote "recent decades"
122	85046	4	3	48	3	48	The relevance of section 4.3.2.1 to the previous statement about species and biome movement is not clear, as that section focuses on phenology. (Michael Mastrandrea, IPCC WGII TSU)	You are right, we removed the pointer to 4.3.2.1
123	81747	4	3	49	3	49	What is the approximate timeframe for this statement? Within the 21st-century? (Katharine Mach, IPCC WGII TSU)	This is for the second half of the 21st century (added to the text).
124	85047	4	3	50	3	52	Support is needed for this statement, as it is currently not clear where in the chapter text it occurs. (Michael Mastrandrea, IPCC WGII TSU)	We have now made more specific pointers to the respective parts of the main text.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
125	85048	4	3	53	3	53	The relevance of section 4.4.1.1 to the previous statement is not completely clear. (Michael Mastrandrea, IPCC WGII TSU)	This relates to ecosystem function and we have now altered the text to have more specific pointers
126	70874	4	3	54	0	0	disrupt' is too judgemental; better to use 'affects' (Andrew Friend, University of Cambridge)	We have modified this accordingly
127	61012	4	4	1	4	0	Currently the ES does not appear to comment on the differences and divergent reasons for species vulnerability across latitudes (i.e. tropical versus high latitude, physiological limitations versus higher projected degree of warming). The addition of a brief synopsis of the section (p33 line52-p34 line26) might be made to recognise the different ways in which c.c. impacts species across latitudes globally. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We considered to have this in the ES as well, but as we already had to reduce the length of the ES, we decided not take in this additional aspect.
128	70875	4	4	4	0	0	unclear (Andrew Friend, University of Cambridge)	This part was removed
129	61011	4	4	6	4	6	...high confidence that no past climate changes is a precise...' perhaps should be amended to 'no past climate change episode is a precise...' (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have re-written the entire paragraph in order to make this clearer
130	66390	4	4	6	4	6	Mismatch of singular and plural tenses: change 'is' to 'are'. (Peter Burt, University of Greenwich)	Text modified and corrected accordingly
131	81748	4	4	6	4	6	The intended timeframe of the "past climate changes" meant here should be indicated more specifically. (Katharine Mach, IPCC WGII TSU)	It refers to any climate change, historic and pre-historic
132	57897	4	4	10	4	10	There is also high confidence that occurrences of alien or invasive species are caused by rang shift to high altitude- or latitude-regions with increase of temperature. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	We agree and believe the text already adequately covers this
133	64743	4	4	10	4	10	replace 'is increasing' with 'will increase since most of the material cited suggests climate change will increase the likelihood in the future of the establishment, growth, .... (Robert Webb, NOAA OAR ESRL)	We have re-written the text and think to have included the intention of your comment
134	78252	4	4	11	0	0	Terms used are invasive alien species, alien invasive species and alien species. The lack of consistency means that it is difficult to know if these terms are being used interchangeably or to refer to invasivity as a particular attribute of some alien species. The time-frame over which "alien" is defined is not made clear. (Aaron Strong, Stanford University)	The terms 'invasive alien species' or 'invasive species' are now used and defined in the glossary.
135	62847	4	4	11	4	12	Given that some alien species will be hurt by climate change and some native species will be aided, the idea that alien species will be more likely than native species to have traits that facilitate their survival and reproduction under changing climate changes may be overstated. (Mark Urban, University of Connecticut)	This is a result of incorrect use of terminology - not alien species, but invasive alien species.
136	71088	4	4	11	4	12	If true that "alien invasive spp. are more likely than native spp. to have traits that favour survival and reproduction under CC", this statement does not appear to be substantiated here and it is not widely known. It is sufficiently important that the supporting information at [4.2.4.6] should be explicitly referenced here. Suggest inserting "[4.2.4.6]" at the end of this sentence as well as at the end of the next. (CANADA)	This is a summarised version of the more detailed referenced version in 4.2.4.6. This has been changed to "Some invasive alien species ..." in summary version
137	76497	4	4	11	4	12	This is not clear. Is there a reference to support this statement? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	See comment 136. This is a summarised version and references are in 4.2.4.6
138	71858	4	4	12	4	14	The authors should consider adding in at the end of line 14: "and by increased disturbances from natural and anthropogenic events to create favorable establishment sites" (UNITED STATES OF AMERICA)	Species movement will be driven both by climate change and by increased dispersal opportunities associated with human activities. [4.2.4.6] while establishment and spread of IAS might be favored by disturbed habitat but not species movement .
139	70877	4	4	14	0	0	and by increased susceptibility of stressed ecosystems to invasion (Andrew Friend, University of Cambridge)	Similar comment to #138; it is true that IAS establishment will be favoured in disturbed habitat but not species movement.
140	78257	4	4	16	4	17	The term "even for" in the confidence statement makes it ambiguous. Is the confidence higher or lower than expected for not mediu-range rates? Do we know anything about other ranges with confidence? (Aaron Strong, Stanford University)	Text was re-written to clarify this.
141	81749	4	4	16	4	17	What is the approximate timeframe for this statement within/beyond the 21st century? (Katharine Mach, IPCC WGII TSU)	This is within the 21st century, which is implicit in the RCPs
142	85050	4	4	16	4	17	Please specify the timeframe for this finding--over the 21st century, for example? (Michael Mastrandrea, IPCC WGII TSU)	This is within the 21st century, which is implicit in the RCPs
143	71859	4	4	16	4	30	There is no mention of fragmentation in this paragraph as it relates to the ability of species to track climate change. Authors could include this in the introductory sentence and clearly state the scope of the paragraph as being relevant to areas without human disturbance; alternatively authors could include additional sentences that reference the interactions between ability to migrate and fragmentation. (UNITED STATES OF AMERICA)	Fragmentation is now explicitly mentioned in the paragraph

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
144	71860	4	4	16	4	30	This paragraph confuses populations of species and the range of a species. The fact that a population of a species can't move fast enough to track climate change, doesn't mean that the species as a whole can't track it. Consider a species with a large range that covers a wide temperature range. It may well be that at the 'margin' of that species range, it can't move fast enough to track the climate change, but the species itself could be fine, since plenty of its range will still exist in suitable climates. (UNITED STATES OF AMERICA)	We agree that populations and the entire range of a species are two different things, but the point we make is not about the survival of a species with a large climatic niche, it is about how the species might be affected and this is particularly obvious if we consider individual populations of this species. The more populations are concerned, the more this affects the species a whole of course.
145	71861	4	4	16	4	30	This whole paragraph implies terrestrial, especially line 21 "large, flat areas". This should be clarified. Are inland wetland systems excluded? (UNITED STATES OF AMERICA)	The paragraph implies mainly terrestrial species, but also amphibians (as the examples are mentioned).
146	64744	4	4	18	4	18	insert 'millennia, centuries and' before 'decades' (Robert Webb, NOAA OAR ESRL)	This paragraph was rewritten and this sentence deleted
147	85051	4	4	18	4	19	What has been the result of inability to track recent climatic changes? (Michael Mastrandrea, IPCC WGII TSU)	We now wrote: "Populations of species that cannot keep up with their climate niche will find themselves in unfavourable climates, unable to reach areas of potentially suitable climate"
148	70878	4	4	20	0	0	this should read 'may find themselves in unfavorable climates and unable' (Andrew Friend, University of Cambridge)	Text was re-written.
149	64745	4	4	20	4	20	replace 'are' with 'will be' since sentence is about tracking future climate change (Robert Webb, NOAA OAR ESRL)	Text was re-written.
150	63499	4	4	21	4	22	After "species in large flat areas are particularly vulnerable because they must migrate over longer distances to keep up with climate change than species in mountainous regions" please add: "An important exception is for species that are already at the tops of mountains (or near other boundaries) - they are among the most threatened by climate change because they cannot move upwards" (citation from chapter 4, page 30, lines 4 -5). (GERMANY)	This is dealt with in the next paragraph as a point on its own
151	66391	4	4	21	4	22	Suggest moving 'than species in mountainous regions' to after 'distances' to improve clarity and English (Peter Burt, University of Greenwich)	We re-arranged the text accordingly
152	79039	4	4	21	4	22	Species in flat areas may be slow, but species in mountainous regions may be faced with a situation where there is no more room to migrate upwards due to lack of soil, water, or any other habitat element or requisite. Therefore, I suggest to either delete this sentence or to back it substantially. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We have written in the next paragraph as one which stands on its own, that an important exception is for species that are already at the tops of mountains (or near other boundaries) - they are among the most threatened by climate change because they cannot move further.
153	59270	4	4	22	0	23	There is the phrase 'examples include most trees, many plants and some small mammals'. Plants include trees. Please rephrase. In addition, these are not the only groups of species with low migration capacity. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Text modified accordingly: "plants (especially trees)". But as these are only examples, we did only include amphibians as a further group.
154	64746	4	4	22	2	22	delete 'than species in mountainous regions' since as indicated in the next finding (lines 32 to 39) suggests that species living at or near mountain tops may have to migrate significant distances to a different mountain top if their habitat is not locally available. (Robert Webb, NOAA OAR ESRL)	We kept this in in order to point at the contrasts. Other reviewers even wanted to have more text on the mountain tops already here.
155	70879	4	4	23	0	0	trees are plants! (Andrew Friend, University of Cambridge)	Yes - and we have modified the text accordingly.
156	71862	4	4	23	4	23	Amphibians -- e.g. salamanders -- are another example of a taxon with generally low migration capacity. (UNITED STATES OF AMERICA)	We have now included amphibians here as well
157	70880	4	4	27	0	0	There is certainty that barriers...' (Andrew Friend, University of Cambridge)	Text has been re-written
158	70881	4	4	29	0	0	ditto (Andrew Friend, University of Cambridge)	Text has been re-written
159	71863	4	4	29	4	27	The authors should consider adding 'large lakes, large urbanized areas' (UNITED STATES OF AMERICA)	We now wrote "dams on rivers and urbanized areas on land".



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
160	85052	4	4	29	4	30	Support is needed for this statement on outlier populations, as it is currently not clear in the chapter text. (Michael Mastrandrea, IPCC WGII TSU)	We have now rephrased an entire paragraph as follows: "Large magnitudes of climate change will reduce the populations, vigour and viability of species with spatially-restricted populations, such as those confined to small and isolated habitats, mountaintops or mountain streams, even if the species has the biological capacity to move fast enough to track suitable climates (high confidence). The adverse effects on restricted populations are modest for low magnitudes of climate change (e.g., RCP 2.6) but very severe for the highest magnitudes of projected climate change (e.g., RCP 8.5). [4.3.2.5, 4.3.3.4, 4.3.4.1]"
161	71864	4	4	30	4	30	The word "migration" applies to whole populations, but the examples are better characterized by the term "dispersal", meaning the transport of fewer individuals. (UNITED STATES OF AMERICA)	Thanks you; we have modified this into "dispersal"
162	71089	4	4	32	4	39	This text is confusing (e.g., migrating away from mountaintops then towards them). Perhaps "upward and poleward" terminology would be useful here. (CANADA)	We have re-written this paragraph taking this into account.
163	85053	4	4	32	4	39	As mentioned in an earlier comment, there is some overlap between this finding and the one on page 3 lines 34-39. (Michael Mastrandrea, IPCC WGII TSU)	We have tried to harmonize this.
164	71090	4	4	38	4	38	While this may be true, it is probably not a widespread phenomenon. Suggest qualifying this to something like: "...that there are demonstrable examples of some species beginning to migrate away from protected areas and towards mountaintops ...." Do these examples include plants, or are they restricted to more mobile animal spp? (CANADA)	As we wrote that "These general patterns of range shifts have also been observed over the last few decades in some well-studied species groups such as insects and birds and can be attributed to observed climatic changes (high confidence)." we think it indicates that these are not yet widespread phenomena. Examples seem to mostly be those of groups more mobile than plants.
165	85054	4	4	41	4	41	Please clarify what is meant by increased here. (Michael Mastrandrea, IPCC WGII TSU)	Now we write: "The extinction risk is increased under all RCP scenarios, and the risk increases with both the magnitude and rate of climate change. " We hope this helps to clarify. Generally the increase is higher as compared to present or historical conditions per time unit.
166	62848	4	4	41	4	43	I think this confidence level (very high) is too high. We have strong uncertainty in the predicted fraction of species that will go extinct with climate change - I would say that we have high confidence for increased extinction risk for some species, certainly not a 'substantial' fraction of species at this point. (Mark Urban, University of Connecticut)	We have changed this into the risk language and also do not write about a substantial fraction any longer
167	78258	4	4	41	4	43	Confidence that something implies something is not the same as confidence in its occurrence. I recognize this is about projection and models, but implication can be highly confident simply because one is confident that that is what a model output says regardless of confidence in the parameterization, etc. Clearing this language up would be useful. (Aaron Strong, Stanford University)	The text was re-written along the standard recommendations for confidence language. So we hope that this led to a cleared language.
168	81750	4	4	41	4	43	Following from my overall comment on the executive summary, can more be said here? Can more be said about the implied increased extinction risk? Most fundamentally, the reader does not gain from this statement a clear understanding of how much climate change matters as compared to other pressures. (Katharine Mach, IPCC WGII TSU)	We have re-written quite a bit of this paragraph and also added in relation to other pressures the following sentence: A large fraction of terrestrial and freshwater species face increased extinction risk under projected climate change during and beyond the 21st century, especially as climate change interacts with other pressures, such as habitat modification, over-exploitation, pollution and invasive species (high confidence). The extinction risk is increased under all RCP scenarios, and the risk increases with both the magnitude and rate of climate change.
169	66392	4	4	42	4	42	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We kept a non capital 'c' for century throughout our chapter, but this may be corrected by the TSU at a later stage of text processing.
170	81751	4	4	45	4	45	Is it possible to specify what is meant by "an extremely broad range"? (Katharine Mach, IPCC WGII TSU)	Paragraph was re-written to make this clearer.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
171	81752	4	4	48	4	49	Is it at least possible to specify a range for extinction risks with full characterization of relevant uncertainties? (Katharine Mach, IPCC WGII TSU)	We have tried to cover the range e.g. with the following statement: "Modelling studies and syntheses since the AR4 report broadly confirm that a large proportion of species are projected to be at increased risk of extinction at all but the lowest levels of climate warming (RCP2.6). Some aspects leading to uncertainty in the quantitative projections of extinction risks were not taken into account in previous models; as more realistic details are included, it has been shown that the extinction risks may be either under- or overestimated when based on simpler models. [4.3.2.5]"
172	70883	4	4	49	0	0	meaning of 'accurately'? (Andrew Friend, University of Cambridge)	"accurately" is not used any longer after we have largely re-written the paragraph
173	70884	4	4	51	0	0	meaning of 'many'? Everything is very vague... (Andrew Friend, University of Cambridge)	It is hard to be very specific in a summary document, but we have already mentioned South-American amphibians as an example.
174	70885	4	4	52	0	0	why the suggest restriction of 'climate change' to 'warming'? Inconsistent... (Andrew Friend, University of Cambridge)	Of course we did not want to restrict this to climate warming, thus it was changed into climate change in general
175	64857	4	5	4	5	5	"virtually certain" is ambiguous. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	Text of paragraph was completely re-written and the term avoided.
176	57680	4	5	4	5	26	add "water DIC and POC" in front of line 5. And add "there is high confidence that karst processes can enhance the water DIC and POC concentration with rising of the atmospheric CO2 "in the section. (Zhongcheng Jiang, Institute of Karst Geology,CAGS)	The comment is not accompanied by a substantiating reference, so we are unable to verify its validity. The topic is not dealt with in the underlying text.
177	71865	4	5	4	5	26	If there is high confidence that the sink is largely offset by carbon released through forest conversion and degradation, then how can there be virtual certainty that carbon stored in biomass and soils has increased? The 'largely offset' language suggests that there is a chance that there is no net sequestration, yet the text conveys there is virtual certainty that there is net sequestration. These need to be harmonized. (Also, why leave agricultural lands out of this paragraph?) (Note also that on p. 20, line 48 you refer to the net sink as "high confidence", not "virtually certain".) (UNITED STATES OF AMERICA)	We have re-written the text, do not write about virtual certainty any longer and we also write: "The natural carbon sink provided by terrestrial ecosystems is partially offset at the decadal timescale by carbon released through the conversion of natural ecosystems (principally forests) to farm and grazing land and through ecosystem degradation (high confidence)."
178	70886	4	5	5	0	0	This is not correct. The land use flux is about equal to the natural sink, and so the net sink is not at all 'virtually certain'. I suspect the sentence is referring to the natural sink only. (Andrew Friend, University of Cambridge)	The exact magnitude of the cumulative sink at decadal scale is quite uncertain, but there is hardly any doubt that it is a net sink, even once the land use source has been factored in; see WG1 ch 6. However, the sentence has been altered to remove other confusions: it now reads "Terrestrial and freshwater ecosystems have sequestered about a quarter of the carbon dioxide emitted to the atmosphere by human activities in the past three decades (high confidence). The net fluxes out of the atmosphere and into plant biomass and soils show large year-to-year variability; as a result there is low confidence in the ability to determine whether the net rate at which carbon has been taken up by terrestrial ecosystems at the global scale has changed between the decades 1991-2000 and 2001-2010. There is high confidence that the factors causing the current increase in land carbon include the positive effects of rising CO2 on plant productivity, a warming climate, nitrogen deposition and recovery from past disturbances, but low confidence regarding the relative contribution by each of these and other factors. [4.2.4.1, 4.2.4.2, 4.2.4.4, 4.3.2.2, 4.3.2.3, WGI AR5 Sections 6.3.1 and 6.3.2.6]"

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
179	76782	4	5	6	0	0	I struggle with interpreting "low confidence" statements - they have to be very clear what this means. Does "low confidence in X" mean that we think "X" will happen but there is only limited evidence, or are we saying that "X" is unlikely to happen. I think it is the former, but these sentences often sound like the latter. This sentence "low confidence land will continue to take up carbon" sounds like you are saying you think it is unlikely to happen. Calibrated language can be very powerful - but sometimes not intuitive to understand exactly what it intends to say (Chris Jones, Met Office)	We have now modified the usage of calibrated language and have put the confidence statements at the end of the sentences. By doing so we noticed the difficulty you talk about and hope that the message is clearer now.
180	61013	4	5	6	5	7	I found this sentence confusing- is there low confidence in the scientific evidence that suggests that the transfer of carbon dioxide from the atmosphere to the land will continue at a similar rate...' or is there low confidence that the current rate of carbon dioxide transfer will remain the same into the future? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have re-written this part which now reads: "Carbon stored in the terrestrial biosphere is vulnerable to loss back to the atmosphere as a result of the direct and indirect effects of climate change, deforestation and degradation (high confidence). The net transfer of carbon dioxide from the atmosphere to the land is projected to weaken during the 21st century (medium confidence)."
181	68802	4	5	6	5	7	The reason why this is expected is not explained in the statement ("There is low ... remainder of the century"). (NETHERLANDS)	The remainder of the paragraph explains that there are a number of factors acting with different strengths and signs, and along with the inherent high variability, gives us low confidence overall that the sink will persist
182	81753	4	5	6	5	7	The formulation of this sentence is ambiguous. Is it possible to indicate any understanding of whether increases or decreases in rate are expected, or is the author team indicating that maintenance of a "similar rate" is expected but with only low confidence? (Katharine Mach, IPCC WGII TSU)	We have re-written this part which now reads: "Carbon stored in the terrestrial biosphere is vulnerable to loss back to the atmosphere as a result of the direct and indirect effects of climate change, deforestation and degradation (high confidence). The net transfer of carbon dioxide from the atmosphere to the land is projected to weaken during the 21st century (medium confidence)."
183	85055	4	5	6	5	7	Does this mean that there is high confidence that the rate will change? In what direction, if so? Or is another meaning intended? Please clarify. (Michael Mastrandrea, IPCC WGII TSU)	We have re-written this part which now reads: "Carbon stored in the terrestrial biosphere is vulnerable to loss back to the atmosphere as a result of the direct and indirect effects of climate change, deforestation and degradation (high confidence). The net transfer of carbon dioxide from the atmosphere to the land is projected to weaken during the 21st century (medium confidence)."
184	70887	4	5	7	0	0	'similar rate' is ambiguous (Andrew Friend, University of Cambridge)	We have changed this, it now reads: "The net transfer of carbon dioxide from the atmosphere to the land is projected to weaken during the 21st century (medium confidence)."
185	59866	4	5	7	5	9	It is unclear whether the 'high confidence' statement on the offset of the terrestrial carbon sink refers to current/historic or projected emissions - the previous sentences refer to both. (AUSTRALIA)	We have now restructured the ES according to the guidelines provided by the TSU and have put as many confidence statements as possible at the end of the sentences. We hope that this resolves the issue.
186	85056	4	5	7	5	9	Please specify what is meant by large degree in line 8, if possible. Is this projected to evolve over time? (Michael Mastrandrea, IPCC WGII TSU)	We do not wish to give an impression of false accuracy here. The text now reads 'partly offset'. The sink term has a large uncertainty, and the land use change term as well. So calculating a fraction is possible, but has such wide uncertainty as to be misleading.
187	78304	4	5	7	5	10	'There is high confidence that the terrestrial carbon sink....through forest degradation'. (Arina Schrier, Wetlands International)	It is unclear what the reviewer wishes us to do
188	81754	4	5	8	5	8	With chapter team says "is offset" what is the relevant time frame--over the past 2 decades? (Katharine Mach, IPCC WGII TSU)	We now say at the decadal timescale.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
189	71866	4	5	8	5	9	Phrasing the sink-source relation in terms of "offset" seems strange, since that term is also used in policy language to describe carbon market offsets. The relation is simply one of the net of a positive and a negative component. Suggest rephrasing. (UNITED STATES OF AMERICA)	We used the term in its normal english sense. We prefer it to the alternatives, which would be 'balanced' or 'negated'
190	85058	4	5	9	5	9	This line of sight is relevant to the entire bold text, so it should be moved to the end (or all line of sight should be collected at the end of the paragraph, as in other chapters). (Michael Mastrandrea, IPCC WGII TSU)	We try to make the line of sight as specific as possible to each statement
191	71091	4	5	9	5	12	Land-use change also includes afforestation, which typically does not result in a loss of stored C to the atmosphere. IPCC AR4: Climate Change 2007, 7.3.3.1.5. "Afforestation: Recent (since 1970) afforestation and reforestation as direct human-induced activities have not yet had much impact on the global terrestrial carbon sink. However, regional sinks have been created in areas such as China, where afforestation since the 1970s has sequestered 0.45 GtC (Fang et al., 2001). The largest effect of afforestation is not immediate but through its legacy." (CANADA)	We have changed to deforestation instead of land-use.
192	78253	4	5	9	5	12	Use of "carbon stored thus far" does not make it clear whether this is all carbon, or carbon that was once anthropogenic emissions. (Aaron Strong, Stanford University)	This text no longer uses this phrase
193	85057	4	5	9	5	12	Please clarify the direct effects, in addition to the information on indirect effects already provided. (Michael Mastrandrea, IPCC WGII TSU)	This is a headline statement, in which a lot of detail is inappropriate. The details of direct and indirect effects are in the paragraph that follows.
194	81755	4	5	10	5	10	For this carbon storage "thus far" is the chapter team referring to carbon stored due to climate change? (Katharine Mach, IPCC WGII TSU)	This text no longer occurs.
195	71092	4	5	11	5	11	Suggest inserting "forest" before "fires" here. Not to say that fires in grasslands and agricultural regions don't also release carbon, but presumably the major concern is that carbon accumulated in relatively long-lived vegetation (i.e., forests) is becoming increasingly vulnerable to fire occurrence. (CANADA)	This point is accepted and was changed.
196	71093	4	5	14	5	16	This seems to contradict what is said at P5, L. 4-6, which states it is virtually certain that C stored in terrestrial ecosystems "...has increased over the past two decades...". I.e., if this is "virtually certain", it is unclear how there is "...low confidence in the ability to determine whether the net fluxes ... have increased or decreased over the past two decades."? Presumably, net fluxes into these ecosystems have increased on average, in spite of large interannual variability. Conversely, if changes in flux (directions) are still uncertain, then the initial statement at L. 4-6, may require revision. (CANADA)	We have re-written the previous part of lines 4-6, which now reads: "Carbon stored in the terrestrial biosphere is vulnerable to loss back to the atmosphere as a result of the direct and indirect effects of climate change, deforestation and degradation (high confidence). The net transfer of carbon dioxide from the atmosphere to the land is projected to weaken during the 21st century (medium confidence)."
197	70888	4	5	17	0	0	N deposition should also be mentioned (Andrew Friend, University of Cambridge)	This was accepted and added.
198	76783	4	5	17	0	0	Also mention N-deposition here (as covered well during the chapter) (Chris Jones, Met Office)	This was accepted and added.
199	85059	4	5	19	5	23	Please clarify if the effects in lines 19-20 would act to increase carbon storage, while the effects mentioned in lines 21-23 would act to decrease carbon storage. (Michael Mastrandrea, IPCC WGII TSU)	This is made clear by the use of the words 'decrease' and 'limit'
200	70889	4	5	20	0	0	Where does '600 ppm' come from? Seems rather precise... (Andrew Friend, University of Cambridge)	It is not precise, just the upper limit of most experiments. We say 'up to about'.
201	70890	4	5	22	0	0	Also mention disease/pests (Andrew Friend, University of Cambridge)	It is now mentioned.
202	71867	4	5	23	5	23	Do the authors intend to say that models -- alone, without empirical evidence -- can provide high confidence in this statement (or in any scientific statement)? Most of the scientific community would disagree. (UNITED STATES OF AMERICA)	We now write: "Experiments and modelling studies ..."
203	85060	4	5	24	5	26	Section 4.2.2.3 does not exist, and needs updating. It appears that section 4.2.4.4 has relevant information. (Michael Mastrandrea, IPCC WGII TSU)	This was corrected and fixed.
204	71868	4	5	28	0	0	The text utilizes 'medium confidence' despite the fact that increases have been well documented in many cases. Authors may want to review this statement. (UNITED STATES OF AMERICA)	The detection is clear, but attribution (in the strict sense applied in IPCC) is not in most cases
205	85061	4	5	28	5	31	Please clarify the logic here, as the first sentence is about observed changes, while the second seems to be about projected future changes. (Michael Mastrandrea, IPCC WGII TSU)	The first sentence is about detection and attribution. The second is a strong inference from ecological experiments and theory. We added inference to the third sentence to help explain
206	70891	4	5	29	0	0	Either they have or have not been detected ('medium confidence' makes no sense in this context) (Andrew Friend, University of Cambridge)	The detection is clear (and not qualified), it is the attribution that is qualified

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
207	64747	4	5	30	5	30	replace that such changes, which are by definition beyond the range of historical natural variability, will' with 'that future changes, which are beyond the range of historical natural variability, will' since the (Robert Webb, NOAA OAR ESRL)	it now reads: "Changes in the ecosystem disturbance regime beyond the range of natural variability will alter the structure, composition and functioning of ecosystems (high confidence)."
208	81756	4	5	30	5	30	The phrase "by definition" should be explained further for the reader, as the intended meaning is not fully clear. Also, is the chapter team saying that continuing increases in frequency and intensity will cause these alterations? Over what broad timeframe? (Katharine Mach, IPCC WGII TSU)	it now reads: "Changes in the ecosystem disturbance regime beyond the range of natural variability will alter the structure, composition and functioning of ecosystems (high confidence)."
209	85062	4	5	31	5	31	Please clarify that the "changes" mentioned at the end of this line are not the "changes" mentioned in the previous sentence, but the "alterations" mentioned previously. (Michael Mastrandrea, IPCC WGII TSU)	The new wording hopefully makes this clear. "Ecological theory and experimentation predicts that ecological change resulting from altered disturbance regimes will be manifested as relatively abrupt and spatially-patchy transitions in ecosystem structure, composition and function, rather than gradual and spatially-uniform shifts in location or abundance of species (medium confidence). [4.2.4.6, 4.3.3, 4.3.2.5, Box 4.3, Box 4.4, Figure 4.10]"
210	59867	4	5	31	5	32	Make it clear that the statement 'changes that will often be manifested....' is referring to the ecosystem changes (e.g. structure, function) rather than the changes to the ecosystem disturbances (e.g. fire, pests etc) (AUSTRALIA)	The new wording hopefully makes this clear. "Ecological theory and experimentation predicts that ecological change resulting from altered disturbance regimes will be manifested as relatively abrupt and spatially-patchy transitions in ecosystem structure, composition and function, rather than gradual and spatially-uniform shifts in location or abundance of species (medium confidence). [4.2.4.6, 4.3.3, 4.3.2.5, Box 4.3, Box 4.4, Figure 4.10]"
211	57898	4	5	35	5	42	Delete "global trend" or change it into "regional trend" (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	No, we mean a global trend here. The regional trends have been detected.
212	70892	4	5	36	0	0	does not make sense logically (Andrew Friend, University of Cambridge)	It seems logical and clear - regional increase in tree deaths has been detected, but cannot be extrapolated globally.
213	85063	4	5	37	5	37	Can the regions relevant to this statement be specified? (Michael Mastrandrea, IPCC WGII TSU)	The regions are specified in the body of the paragraph.
214	70893	4	5	38	0	0	threat' rather than 'risk' (Andrew Friend, University of Cambridge)	We deliberately used the risk language to be consistent with WG2 overall.
215	78602	4	5	40	5	42	agree (richard arthur fleming, canadian forest service)	Thank you!
216	70894	4	5	41	0	0	observed is detectable' does not make sense (Andrew Friend, University of Cambridge)	We agree and have fixed it.
217	81757	4	5	41	5	41	What is the timeframe for observed mortality being detectable--over the last decade? (Katharine Mach, IPCC WGII TSU)	We added: 'over the past few decades'.
218	81758	4	5	44	5	45	The formulation of this finding requires the reader to understand what the finding was in the 4th assessment report. It would be much preferable to make this statement fully stand alone, with the comparison with the 4th assessment report more secondary in nature. Otherwise, it is hard for the reader to understand what is meant by "more sensitive" or "much sooner." (Katharine Mach, IPCC WGII TSU)	Reference to the AR4 has been removed, and the sentence is now categorical.
219	58806	4	5	44	5	46	The sentences in this paragraph seem to be exaggerated in terms of the impact of climate change on tree sensitivity. You have referred the section 4.3.3.1 to show how trees are more sensitive to future climate change than reported in IPCC AR4; however, the section 4.3.3.1 does not necessarily compare with the information in the AR4. Also most of the tree mortality are caused by drought, not temperature rise. (Tetsuya Matsui, Forestry and Forest Products Research Institute)	The paragraph does not mention temperature, and has been shortened and balanced to reflect the possibility of positive effects.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
220	61014	4	5	44	5	46	The effect of climate change on forests has been revised downwards in the latest studies. See Cox et al Nature 2013. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The statement is based on a range of literature and lines of evidence, not on a single paper. The Cox paper is about forest bioclimatic range, particularly in the Amazon, and is not a general statement about world forests.
221	71869	4	5	44	5	46	This is an example of a statement that mixes a confidence statement ("medium confidence") with two subjunctive verbs ("may be" and "could become") that express doubt. Suggest rephrasing it to simply say either medium or low confidence. Also, this statement appears somewhat contradictory to the later discussion of Amazon dieback, where the more recent literature appears to show that this is less probable than previously thought. See Box 4-3 on pp. 41-42. Authors should revise this sentence to be consistent with later section on same topic. (UNITED STATES OF AMERICA)	The reviewer is correct, and this has been fixed.
222	67850	4	5	44	5	49	The first sentence, "Recent experimental, observational ... much sooner than previously anticipated. [4.3.3.1]", does not seem to have sufficient explanation in the indicated section 4.3.3.1, particularly for the comparison made with the assessment by IPCC AR4, therefore it is strongly suggested to delete the sentence. Also, for the second sentence, "There is high confidence that future climate change impacts on tree mortality and tree ranges could be large, ...", the stated level of "high" confidence here is suggested to be lowered since the section 4.3.3 points out that tree mortality and tree ranges are driven by various factors; i.e. direct attribution of tree mortality and tree ranges to climate change is not necessarily clear. (JAPAN)	We have deleted the reference to AR4. We are satisfied that 4.3.3.1 contains enough material to support this statement.
223	70895	4	5	45	0	0	Does Cox et al. (doi:10.1038/nature11882 ) not contradict this? (Andrew Friend, University of Cambridge)	The statement is based on a range of literature and lines of evidence, not on a single paper. The Cox paper is about forest bioclimatic range, and especially the Amazon, not the world
224	64858	4	5	47	5	47	tree ranges could be large (ambiguous statement) (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	This sentence no longer is in the text.
225	58807	4	5	47	5	49	You've said high confidence that future climate change impacts on tree mortality and tree ranges could be large; however, there are not many papers directly showed tree mortality is caused by climate change: most papers discussed tree mortality is caused by combinations of various factors such as drought and insect attack, etc. Therefore it may be better to lower the degree of your confidence from "high" to "medium". (Tetsuya Matsui, Forestry and Forest Products Research Institute)	The sentence has been changed and the confidence is now medium.
226	81759	4	5	49	5	49	What is meant by "details"--magnitude, geographic distribution, etc.? (Katharine Mach, IPCC WGII TSU)	The word does not appear in the new text.
227	70896	4	5	51	0	0	illogical (Andrew Friend, University of Cambridge)	It is unclear which element the reviewer finds illogical, the text is now quite different, and we hope very clear.
228	81760	4	5	51	5	51	It would be helpful to indicate more specifically what is meant by "increasingly greater caution." (Katharine Mach, IPCC WGII TSU)	It now reads: "Earlier projections of increased tree growth and enhanced forest C sequestration due to increased growing season duration, rising CO2 concentration and atmospheric N deposition, must be balanced by observations and projections of increasing tree mortality and forest loss due to fires and pest attacks."
229	71094	4	5	51	5	52	Suggest revising this to something like: "the counter-balancing effects of mortality, dieback and losses due to natural disturbances such as forest fires and pest attacks" (CANADA)	It now reads: "Earlier projections of increased tree growth and enhanced forest C sequestration due to increased growing season duration, rising CO2 concentration and atmospheric N deposition, must be balanced by observations and projections of increasing tree mortality and forest loss due to fires and pest attacks."
230	85064	4	5	54	5	54	The relevance of section 4.3.4 here is not clear, given that it does not discuss provision of timber and wood products. (Michael Mastrandrea, IPCC WGII TSU)	4.3.4.2 does now.
231	71871	4	6	2	0	0	Provide more specifics for "forest loss" since this is a very broad concept. (UNITED STATES OF AMERICA)	We now write: 'widespread loss of forest cover'.
232	71870	4	6	2	6	29	There seems to be some overlap between these two key findings about the Amazon. Perhaps the two statements are separate enough, but care should be taken to ensure that they are not redundant (or to combine them into one single finding). (UNITED STATES OF AMERICA)	They are quite distinct now and nothing to gain from merging them

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
233	71095	4	6	3	6	4	Should "land use" be "land-use change" instead? (CANADA)	We accepted this proposal and added land-use change.
234	81761	4	6	5	6	6	Does this result pertain to studies across scenarios of climate change within the century? It could be helpful to clarify this. (Katharine Mach, IPCC WGII TSU)	We have now thoroughly re-written the entire paragraph on the Amazon and hope that now our results are much clearer.
235	76616	4	6	5	6	22	at lines 5-6 it is written that few future climates cannot support rainforest in the Amazon; at lines 19 it is said that it is plausible (even with low confidence) that much of the Amazon forest will transform abruptly in something different. I find these two sentences are in partial contrast with each other. Could you revise, please? (Claudio Cassardo, University of Torino)	This phrase no longer occurs in the summary.
236	71872	4	6	8	6	8	"May still affect" is not directional regarding climate and should be. A stronger statement such as "may reduce forest cover and forest density in the Amazon, with attendant emissions feedbacks." could be used here. (UNITED STATES OF AMERICA)	The sentence has been removed.
237	85065	4	6	8	6	8	Please specify what is meant by "affect" here--do you mean an increase in fire risk? (Michael Mastrandrea, IPCC WGII TSU)	The sentence has been removed.
238	70897	4	6	10	0	0	can' becomes 'will' in next sentence (Andrew Friend, University of Cambridge)	They are two separate sentences, addressing two separate points.
239	64859	4	6	10	6	11	"pushed by climate change". The word "push" seems a bit awkward. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development)	It has been rephrased
240	76617	4	6	10	6	11	"There is ... and function": is this valid at global, regional or local scale? (Claudio Cassardo, University of Torino)	This sentence no longer occurs.
241	71873	4	6	10	6	13	Bold summary statements do not reflect content of the paragraph. Insert statement recognizing that there is no strong evidence than any specific tipping points can yet be identified or predicted with confidence. (UNITED STATES OF AMERICA)	The bold has been phrased as a risk statement, consistent with WG2, and the confidence has been downgraded.
242	85066	4	6	10	6	13	Please clarify line of sight for the bold statement here. (Michael Mastrandrea, IPCC WGII TSU)	This has been clarified.
243	57899	4	6	10	6	29	Change "high confidence" into "low or medium confidence". It is because most description in this paragraph are highlighted in low confidence or medium confidence. It is not acceptable to draw conclusion with high confidence based on descriptions with low- or medium confidence evidences. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	We have changed this to medium confidence.
244	71096	4	6	10	6	29	This paragraph is difficult to follow. Consider revising. (CANADA)	It has been entirely rewritten.
245	70898	4	6	11	0	0	is there real evidence that these tipping points exist? (Andrew Friend, University of Cambridge)	We explain that plausible mechanisms exist, supported by models and experiments
246	71874	4	6	11	0	0	Suggest changing "and function" to "or function". It may not affect all three at once but likely will affect at least one of these (UNITED STATES OF AMERICA)	This sentence no longer occurs.
247	59868	4	6	13	6	13	"This has happened many times in Earth history". It is unclear whether this refers to the crossing of tipping points, or the significant increase in emissions that may occur as a result. Please clarify (AUSTRALIA)	This sentence no longer occurs.
248	71875	4	6	15	6	18	This statement does not seem to be well supported with evidence on p. 49 and in Box 4-4. If anything, the material on p. 49 which states that there will soon be "a potentially strong positive feedback" suggests that the potential for a boreal tipping point is stronger than suggested here. (UNITED STATES OF AMERICA)	The confidence limits and material has been made consistent.
249	71097	4	6	16	6	17	This sentence appears to separate "thawing permafrost and burning forests" from the notion that climatic change could "push the boreal-arctic system across a tipping point". These processes would (or could) likely contribute to the tipping point being crossed. [They are "tipping elements" - see Lenton et al (2008).] Suggest splitting this sentence into two parts and revise as follows: "... transformation of the ecology and albedo of this region. Thawing permafrost and increased forest fires would be major drivers of these transformations, as well as causes of accelerated releases of GHGs." (CANADA)	We no longer explicitly use the tipping point language.
250	64748	4	6	17	6	17	to inform policy makers, provide more specificity to "this century" --- do you mean the end of the century or very soon - like next year? (Robert Webb, NOAA OAR ESRL)	We are not in a position to be more specific.
251	70899	4	6	18	0	0	adaptation'? (Andrew Friend, University of Cambridge)	This has been changed to 'adaptation'.
252	66393	4	6	18	6	18	The word 'adaption' seems strange here, I think it should be 'adaptation'. (Peter Burt, University of Greenwich)	This has been changed to 'adaptation'.
253	64860	4	6	20	6	22	LONG SENTENCE. Consider re-wording (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development)	The whole paragraph has been reworded.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
254	71876	4	6	24	6	24	Is the intent of the text to say that there are predicted to be effects elsewhere on the planet (but that we have low confidence in that prediction)? or that we have medium or high confidence that there will not be effects elsewhere? (UNITED STATES OF AMERICA)	The sentence has been deleted.
255	71877	4	6	27	6	27	The phrase "policy and market-driven" is quite vague --could use more specifics to describe some of the steps taken.. E.g. strong enforcement actions by public prosecutors, the soy moratorium, the incentive created by Norway's results-dependent REDD+ funding, etc. (UNITED STATES OF AMERICA)	This sentence has been deleted
256	71878	4	6	27	6	30	Statement of policy success in the Amazon is out of place in paragraph about tipping points, even though one of the tipping points discussed is about the Amazon. (UNITED STATES OF AMERICA)	The sentence has been removed.
257	76618	4	6	28	6	28	"decreased": worldwide? (Claudio Cassardo, University of Torino)	This sentence has been deleted.
258	59869	4	6	28	6	29	This sentence needs to refer to the "decreased GLOBAL anthropogenic carbon emissions" as per the statement in Box 4-1 on page 12. (AUSTRALIA)	This sentence has been deleted.
259	70900	4	6	29	0	0	It is hard to believe in this level of confidence for this exact magnitude (Andrew Friend, University of Cambridge)	This sentence has been deleted.
260	71879	4	6	29	0	0	"1.5%" 1.5 percent in what time interval? (UNITED STATES OF AMERICA)	This sentence has been deleted.
261	71098	4	6	31	6	41	Overlap with text in Ch 4, P 4, L 32 to L39. Could be removed. (CANADA)	The overlap has been removed.
262	85067	4	6	31	6	41	Please consider ways to integrate information on adaptation such as that summarized here into the other findings on impacts. (Michael Mastrandrea, IPCC WGII TSU)	We wish to have a stand alone paragraph on adaptation.
263	62849	4	6	33	6	34	I think there is a higher confidence that species will adapt to climate change. Some species will not have sufficient additive genetic variation, but where it exists it could prove sufficient. Skelly, D. K., L. N. Joseph, H. Possingham, L. K. Freidenburg, T. J. Farrugia, M. T. Kinnison, and A. P. Hendry. 2007. Evolutionary responses to climate change. Conservation Biology 21:1353-1355. (Mark Urban, University of Connecticut)	This is a relatively new field, which is why we remain a little cautious.
264	76619	4	6	34	6	34	change "that this is" with "that it will be", as it refers to the future (Claudio Cassardo, University of Torino)	We now use 'will be'.
265	70901	4	6	35	0	0	over what timescale are the RCPs considered? (Andrew Friend, University of Cambridge)	We have added: '...in the 21st century'.
266	59870	4	6	35	6	36	Check that statements like 'medium-range warming (e.g. RCP6.0)' and 'high-range warming (RCP8.5)' are used consistently across the whole report e.g. Chapter 7 users similar terminology in terms of warming ranges, but relates them to temperature increases rather than RCPs. (AUSTRALIA)	Good point, we have tried to check for this consistency after drafts were shared and hope we achieved this in the end (although the process is quite complex).
267	78612	4	6	36	0	0	Include : reductions of external nutrient loads to freshwaters (because climate warming- basically acts like a nutrient input in e.g. productive lakes) (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This very specific point is covered by our more general statement about reducing other stresses.
268	64861	4	6	37	6	37	... " other stresses operating on them; for e.g. reducing the rate and magnitude... " (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	No, those are separate issues (reducing the rate of climate change is not an example of another non-climate stress)
269	68803	4	6	37	6	37	Not clear what is meant with "change" in the following phrase "reducing the rate and magnitude of change" (NETHERLANDS)	We mean climate change, we have added this clarification.
270	85068	4	6	41	6	41	It appears that 4.4.2 is also relevant to this paragraph. (Michael Mastrandrea, IPCC WGII TSU)	We changed the line of sight references to include 4.4.2.
271	79404	4	6	43	6	0	"There is medium confidence that management adaptation responses to climate change in some sectors will lead to unintended and unwanted outcomes for terrestrial and freshwater ecosystems. For example, adaptation responses to counter increased variability of water supply for urban and agricultural use, such as building more and larger impoundments and increased water abstraction, will compound the direct effects of climate change in freshwater ecosystems." I would query whether it's correct to say building more and larger impoundments will compound the effects of climate change. I would imagine it depends on where and how they're built and operated? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have changed the wording of this paragraph and also wrote "in many cases" in order to avoid the impression that this has to be a general pattern. The paragraph now reads as follows: "Adaptation responses to climate change in the urban and agricultural sectors can have unintended negative outcomes for terrestrial and freshwater ecosystems (medium confidence). For example, adaptation responses to counter increased variability of water supply, such as building more and larger impoundments and increased water extraction, will in many cases worsen the direct effects of climate change in freshwater ecosystems. [4.3.3.3, 4.3.4.6]"
272	59871	4	6	43	6	43	The term 'management adaptation' is used only once elsewhere in the chapter, and is not defined in the glossary. Generally, there is mixed use of adaptation terms throughout the chapter - for example, should 'human-assisted adaptation' (as per page 60, s4.4.2) be used here, and defined in the glossary? (AUSTRALIA)	We took out the word 'management' here and have tried to be consistent in using human-assisted where we want to be specific.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
273	71880	4	6	46	6	46	The word "abstraction" is strange here -- "extraction" or some other term would be better. (UNITED STATES OF AMERICA)	Abstraction is the word used by hydrologists, but we have changed it to extraction to the more general reader.
274	85069	4	6	47	6	47	Section 4.3.4.5 does not exist, please update this line of sight. (Michael Mastrandrea, IPCC WGII TSU)	The line of sight is now 4.4.4.6.
275	71881	4	6	47	6	49	It seems odd to say there can be "very high confidence" that the use of the terrestrial biosphere for mitigation "may" lead to negative impacts on ecosystems. The finding seems stronger: there is "very high confidence" that use of the terrestrial biosphere for mitigation "will" lead to negative impacts on ecosystems. Note the change of "may" to "will". (UNITED STATES OF AMERICA)	We made it 'will', and made the sentence clearer.
276	58653	4	6	47	6	50	I think the views expressed in this sentence in boldface are too general and not very correct, which cannot be supported by the corresponding assessment in para 4.2.4.1. To increase carbon sink, the introduction of fast-growing tree species and creation of biofuel plantation are not necessarily causing negative impacts on ecosystem and biodiversity. For example, if the plantation is created on cropland, or turning monoculture forest plantation into the plantation with multiple tree species, it may have positive impacts on ecosystem and biodiversity. However, if turning natural forest into monoculture forest plantation, it can cause negative impacts on ecosystem and biodiversity. Therefore, the revision is suggested as follows: There is very high confidence that the use of the terrestrial biosphere in climate mitigation actions, such as introduction of fast-growing tree species for carbon sequestration or creation of biofuel plantation through conversion of natural forests, may lead to negative impacts on ecosystems and biodiversity. (chunfeng wang, State Forestry Administration, China)	We have been more specific in the paragraph along the lines you have suggested, and section 4.4.4 now contains the supporting evidence.
277	68804	4	6	47	6	50	Conclusion is not based on section 4.2.4.1 (NETHERLANDS)	Section 4.4.4 now adds further evidence.
278	67851	4	6	47	6	51	A concern presented in Chapter 4 and should be stated here is about large-scale forest conversion or land use change leading to habitat loss and fragmentation (e.g. paragraph 4.2.4.1 P11L12,P12L19), and not about "use of terrestrial biosphere in climate mitigation actions" as a whole, (e.g. mitigation actions by conservation of forests). Introduction of fast-growing tree species, which is an effective means for the rehabilitation of degraded or bare lands, should not be denied in general as mentioned here. Further, this sentence seems to oppose the use of the terrestrial biosphere in climate mitigation actions and thus contradicts UNFCCC Article 4 paragraph 1(d), "Promote sustainable management, and promote and ... including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;" Regarding fast-growing tree species, the relevant text raise concern about increasing water consumption in some country (semi-arid areas) in paragraph 3.7.2., but this sentence would be mistaken as if these lead to negative impacts on ecosystem and biodiversity as a whole. This sentence should be deleted or revised so as to avoid unnecessary misunderstanding (JAPAN)	We have qualified this paragraph, we are talking about plantations in formerly uncultivated lands.
279	68193	4	6	47	6	51	I don't think that §4.2.4.1 provides enough evidence for withstanding this statement as it is phrased. When fast growing trees replace crops or abandoned lands their net effects on the global climate may be neutral or positive when accounting for fossil fuel substitution. Their production and use may help to avoid primary forest deforestation and to protect and conserve virgin ecosystems (forests in Siberia, Indonesia and Africa which are being harvested illegally). Only the case of primary or secondary forest replacement by fast growing plantations might be deleterious for the climate and biodiversity. This matter is complex and depends on the timeline considered so that I would avoid stating that "high confidence" that LU and fast growing trees introduction may lead to negative impacts. This is not clearly supported by §4.2.4.1. LUC will continue to happen anyway and should be oriented for climate and biodiversity protection rather than banned vainly and ideologically. (Denis Loustau, INRA)	We have qualified this paragraph, we are talking about plantations in formerly uncultivated lands.
280	71882	4	6	47	6	51	This is too negative. There is an important opportunity to reforest areas where forests have been lost or degraded that would be both beneficial for the local ecosystems and beneficial for climate. Thus, while it is true that use of the terrestrial biosphere for climate mitigation may lead to negative impacts, it also may lead to positive ones. Both sides should be mentioned. (UNITED STATES OF AMERICA)	We have added qualifications to make this point.
281	70902	4	6	49	0	0	change 'may' to 'will' (Andrew Friend, University of Cambridge)	We have done so.
282	71884	4	6	49	0	0	Suggest changing the term 'forest' to 'natural forest' (UNITED STATES OF AMERICA)	We now generalise to uncultivated or undegraded; it is not only forests at risk.
283	71883	4	6	49	6	51	The single statement noting biofuel expansion in one of the mitigation scenarios is not enough to fully support the bolded "very high confidence" statement on lines 47-50. A better statement would read something like "mitigation scenarios that include substantial biofuel expansion sacrifice natural forests and other ecosystems." (UNITED STATES OF AMERICA)	The bold statement is the general one, with biofuels as an example. There could be other mitigation approaches - such as changing the land surface albedo - which would impact biodiversity and ecosystem services.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
284	70903	4	6	50	0	0	This sentence about a specific scenario does not fit well with the very general statements made so far. (Andrew Friend, University of Cambridge)	A fair point, but we believe that the underlying assumptions in that particular scenario are important enough to warrant highlighting.
285	76620	4	6	50	6	51	The last sentence of the page seems not linked with the previous ones (Claudio Cassardo, University of Torino)	We link it now with 'for example'.
286	70904	4	7	9	0	0	any confidence'? perhaps 'high confidence'? (Andrew Friend, University of Cambridge)	The quoted phrase is from the SPM of WGII of AR4. It does not itself do an attribution statement, but later in the SPM is the phrase 'A global assessment of data since 1970 has shown it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems' is used. The text has been changed to reflect their exact words.
287	70905	4	7	10	0	0	What does 'increased risk of extinction' mean? Surely a small change in the environment would have a small effect on the risk of extinction? But why does this need stating? It has to be absolute magnitude of the risk any any change in that that matters. (Andrew Friend, University of Cambridge)	We agree that is imprecise, but we are simply quoting what was said.
288	81762	4	7	17	0	0	Section 4.2. This section provides a nice introduction to the chapter, but its length should be reduced by over 50%. (Katharine Mach, IPCC WGII TSU)	The chapeau could be dropped without fundamentally affecting the findings of the chapter, but it makes 3 foundational points which we feel are important and not necessarily shared understanding: that ecosystems are not necessarily equilibrial; that variation and disturbance are necessary to their function; and that we view ecosystems as containing rather than excluding people. We will shorten as much as possible without being cryptic.
289	68200	4	7	17	7	29	This paragraph gives one theoretical point of view with few selected references (mainly books and purely theoretical studies). It is self-contradictory, ignoring that external drivers and disturbances are actually part of the ecosystem according to Tans's definition. It does not bring much to the understanding of biosphere-climate interaction. Human activity must be understood globally as far as climate is concerned so that the way the term "ecosystem" is used here, implicitly a spatial entity, may be misleading. Analysis of the interaction between continental biosphere and climate should cover a range of spatial and temporal scales consistent with the physics of climate and atmosphere, from plot to global and second to century. I would prefer to refer to a "multiple scale, nested view of terrestrial ecosystems" rather than "dynamic and inclusive". Humans are animals and as such were always part of ecosystems where they live. This is not new at all, even if excluding human from ecosystems was and is still a common but strange mistake in ecology. (Denis Loustau, INRA)	The points made by this reviewer are valid, and well known to ecologists for some time. However, we are not writing for ecologists. Our concern is that these points are not common currency among policymakers or the public. Since they are so fundamental, in our opinion they need to be stated, we have done so a briefly as possible.
290	70906	4	7	17	7	29	This section is very brief and sits oddly. It would be helpful to have more detail and to explain what the aims of the present assessment are in the light of the previous one. (Andrew Friend, University of Cambridge)	We cannot make it more detailed, given many calls that it should be briefer.
291	85136	4	7	17	19	12	section 4.2 reads as a textbook or as a review. Suggest simplifying it to save space for other parts. (Wu Shaohong, Chinese Academy of Agricultural Sciences)	It is introductory material and will be shortened to a bare minimum. See comment 290.
292	71885	4	7	19	0	0	Suggesting rephrasing sentence and delete "no longer" since ecologists don't generally view ecosystems as unchanging historically or currently. True, there was 'climax'; but using 'unchanging' is perhaps going to far. The scientific community acknowledges there are a myriad of ways ecosystems can change. (UNITED STATES OF AMERICA)	Accepted, the sentence no longer contains those words.
293	70907	4	7	22	0	0	What does 'relatively constant environment' reall mean? (Andrew Friend, University of Cambridge)	This section has been rephased.
294	81763	4	7	22	7	22	It would be helpful to clarify what is meant by "attempts to restrict this intrinsic variation." (Katharine Mach, IPCC WGII TSU)	The words are fairly explicit. An example is the attempts to protect forests from fires, which ultimately reduces their resilience in the face of fire.
295	70908	4	7	23	0	0	Why is this relevant? Surely the chapter should focus on facts? (Andrew Friend, University of Cambridge)	It is not viewed as relevant by ecologists, since they know it already, but is not necessarily common currency outside of the field, among our target audience of policymakers.
296	78259	4	7	26	4	26	The word "relatively" is not linked to any other clause and thus the reader cannot understand to what the tightness of the coupling is relative. (Aaron Strong, Stanford University)	relatively tightly' has been deleted.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
297	64862	4	7	26	7	26	Gunderson and Holling, 2001 reference now 13 years old. Consider updating. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	The reference was not cited in AR4, nor was this topic addressed, which is why we introduce it. This is an appropriate and not wildly outdated reference; if there is a better recent one we are happy to use it, but the scientific norm is to cite the original paper on first use.
298	71099	4	7	32	0	0	Section 4.2.1 Is the term 'adaptive entities' for ecosystems commonly used in the literature? Some prefer to think of species, populations, and individuals adapting to environmental variability and this adaptation, or maladaptation, leading to 'ecosystem change' and/or regime shift in states. The notion of ecosystems as 'adaptive systems' may have become something of a short hand for describing the above. Most scientists would agree though that ecosystem behave as complex systems, which is largely what this section is describing (thresholds, feedbacks, unpredictability, etc). Authors could consider a new title for this section. (CANADA)	The phrase usually used is 'adaptive systems', which introduced a bit of redundancy; entities is clear in the context.
299	81764	4	7	32	0	0	Section 4.2.1. The chapter team should consider ending this section, rather than starting it, with tipping points, flipping the order of paragraphs 1-2 and 3-4. (Katharine Mach, IPCC WGII TSU)	The section has been revised, with the objective of minimising it.
300	80065	4	7	34	0	0	Tipping points may be redox changes rendering aquatic systems from sinks (oxic) to sources (anoxic) of CO <sub>2</sub> , e.g. after increased terrestrial DOC input... (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This is a nice example, but does not introduce a new type of threshold beyond the three discussed.
301	80066	4	7	34	0	0	Add that also organisms evolve in time and hence food webs will change as a result of changes in habitat and organisms over time. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	I think this comment is mis-referenced in terms of location. The issue of evolution is dealt with in 4.4.1.2.
302	66394	4	7	36	7	36	'et al' should be in italics, with a full stop after the 'l' and a comma before the date. (Peter Burt, University of Greenwich)	We have adjusted this to the general standards of WGII.
303	70909	4	7	37	0	0	Not clear what this means. (Andrew Friend, University of Cambridge)	I presume this refers to the sentence ' Some thresholds reflect human preferences'. That seems fairly plain. An example is the 2degC target. There is no system or biophysical limit there, it is a negotiated construct.
304	78613	4	7	39	0	0	include: or changes in intraguild competition (Scharfenber et al. 2013) Scharfenberger U., A. Mahdy, R. Adrian. 2013. Threshold-driven shifts in two copepod species: testing ecological theory with observational data. Limnology and Oceanography., 58(2) 741–752. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This is an example of a system-dynamical threshold, it is not appropriate to quote just this one example of many.
305	71100	4	7	39	7	42	There are likely to be many occasions when "the net effect of all the positive and negative feedback loops regulating the ecosystem is positive". Suggest a slight revision, something like: "the point at which the net effect of all the positive and negative feedback loops regulating the ecosystem is positive may become sufficiently large and frequent (or persistent) that it leads to a change in ecosystem state...." Amplification may also be part of the process, but what would cause that amplification is not addressed here. (CANADA)	The suggested formulation is acceptable, and has been adapted for use in the revised section.
306	71101	4	7	42	7	44	Suggest mentioning here that the new ecosystem state is often initially degraded (e.g. in terms of carbon storage, structural complexity, biodiversity, resilience) when compared to the previous state, although in the longer term the degradation may be reversed (e.g., permafrost thermokarsting may lead to a drier, more productive, ecosystem several decades later). (CANADA)	This may be true in many cases, but I know of no literature which shows that it is necessarily so.
307	71102	4	7	43	0	0	Can 'environmental drivers' be replaced with 'environmental variability' here? As mentioned elsewhere, 'driver' is a vague and overused term in the ecological literature. It is not defined in the IPCC glossary of terms; this might be a solution. (CANADA)	We are specifically trying to tease out the perturbations from outside the system, for which 'drivers' is commonly used. Variability could include both internally and externally originating changes.
308	81765	4	7	44	7	44	The chapter team could consider specifying synonyms for tipping points (regime shifts, etc.) and then indicating terminology used in this chapter. (Katharine Mach, IPCC WGII TSU)	It is better to point to the glossary, where these terms are unpacked.
309	71886	4	7	49	7	49	The use of the word "avoid" implies that crossing the threshold always has negative impacts. This will not be true if the current state of the system is degraded. In fact restoration ecology can often be seen as an attempt to push the system back across a threshold to a more desirable, self-maintaining state. (UNITED STATES OF AMERICA)	Good point. We will say the more neutral 'until they are crossed'.
310	71887	4	8	4	8	4	The phrase "on genetic variability" is in the wrong place -- text is trying to relay that natural selection operates against those individuals less able to survive, etc., not that there is genetic variability against such individuals. Suggest rephrasing, perhaps as two separate sentences. (UNITED STATES OF AMERICA)	We have replaced this text with a pointer to section 4.4.1.2, where the topic is dealt with more comprehensively.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
311	62850	4	8	6	8	6	Natural selection does not just cause a shift in tolerance range, but also the mean, and the variance depending on if selection is directional, stabilizing or disruptive. (Mark Urban, University of Connecticut)	We have replaced this text with a pointer to section 4.4.1.2, where the topic is dealt with more comprehensively.
312	71888	4	8	6	8	10	A good reference for this section is: Mackey, B. G., Watson, J.E.M., Hope, G. and S. Gilmore (2008). Climate change, biodiversity conservation, and the role of protected areas: An Australian perspective. Biodiversity, 9:11-18. (UNITED STATES OF AMERICA)	Thank you for the reference; we did not end up using it.
313	76498	4	8	7	8	8	A particular case of what? Plasticity? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	No, a particular case of adaptation. We have clarified what we mean, which is to clearly separate the idea of human-driven adaptation from natural adaptation.
314	81766	4	8	7	8	8	This statement could be clarified. (Katharine Mach, IPCC WGII TSU)	Agreed and done.
315	62851	4	8	8	8	10	I find this an odd and mangled use of the term adaptation. Ecosystems cannot adapt. A change in ecosystem state need not be adaptive. There is no fitness of an ecosystem so the term makes no sense. Just call it a change or a regime shift. Also using a webpage as a citation is something I don't allow my students to do. The IPCC should not do it either. (Mark Urban, University of Connecticut)	The 'adaptive systems' phrase is widely used in the context of ecosystems. We agree that it risks introduces misunderstanding by conflation with evolutionary adaptation, and double confusion in the context of climate change, where adaptation means something else again. This is the messy reality of language, which we can't change, but we strive to be clear about what we mean in each context. We have dropped the web reference.
316	81767	4	8	9	8	18	Should it be explicitly mentioned that range shifts and changes in distribution are forms of adaptation through ecological change? (Katharine Mach, IPCC WGII TSU)	This section has been reformulated to make the intent of the background theory more policy-explicit.
317	71889	4	8	10	8	10	Is the website regimeshifts.org a peer-reviewed publication? If so, convert it into a standard citation. (UNITED STATES OF AMERICA)	We have done so.
318	78614	4	8	11	0	0	....by other species with similar functional attributes (Scharfenberger et al. 2013). (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	It is not clear what the reviewer requires, but the sentence has changed anyway.
319	76499	4	8	11	8	11	And why not by species with different functional attributes? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	True. Sentence has been modified accordingly.
320	57702	4	8	15	0	0	Add Penuelas et al 2013 to the reference. Evidence of current impact of climate change on life: a walk from genes to the biosphere Global Change Biology Josep Peñuelas, Jordi Sardans, Marc Estiarte, Romà Ogaya, Jofre Carnicer, Marta Coll, Adria Barbeta, Albert Rivas-Ubach, Joan Llusà, Martin Garbulsky, Iolanda Filella and Alistair S. Jump 2013, DOI: 10.1111/gcb.12143 (Josep Penuelas, CREAM-CSIC)	Thank you for the reference, which is more appropriate higher up where we discuss the multiscale nature of ecosystems, but after reviewing it feel that it adds little to the discussion there.
321	71890	4	8	16	8	16	The distinction between formal and informal attribution is unclear. (UNITED STATES OF AMERICA)	We dropped the phrase.
322	64749	4	8	16	8	17	The biome shifts are from 1700 to present and thus include the post LIA warming as well as anthropogenic climate change. Suggest replacing 'climate change' with 'changes in climate' since 'climate change' may be misinterpreted to be exclusively anthropogenic global warming climate change (Robert Webb, NOAA OAR ESRL)	Good point, accepted
323	78240	4	8	17	8	50	This seems to be relatively brief coverage of the many future projected veg/biome shifts that have been published. Granted, more will be said later about what we know in individual "Major Systems"... but it might be informative here to at least summarize some of the conclusions of the Pereira et al. (2010) review; Scholze et al. (2006) and Reu et al. (2010) ( <a href="http://biogeosciences-discuss.net/7/7449/2010/bgd-7-7449-2010.pdf">http://biogeosciences-discuss.net/7/7449/2010/bgd-7-7449-2010.pdf</a> ) are additional global sets of projections that could be compared here. (Max Moritz, University of California, Berkeley)	The text is brief, but the substantive material is in the Table 4.1
324	71891	4	8	18	0	0	See questions on Fig. 2. Can you use a 'submitted' ref as documentation? Lots of questions, partially but not fully answered in legend. (UNITED STATES OF AMERICA)	Figure 4.2 was completely redone, as the paper was not accepted in time. All papers not accepted at the end of August 2013 have been removed as references of our findings throughout the text.
325	71103	4	8	18	10	28	Rehfeldt, et al. 2012, Ecol. Appl. 22:119-141 could be cited re. North American biome shifts and novel climates projected using niche(equilibrium) models; as well as a few other similar papers on projections about biome shifts. (CANADA)	Thank you for the reference.
326	64863	4	8	21	8	21	"Biomes shifts from 1700AD" (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	Accepted.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
327	64750	4	8	21	8	23	Need to clean up this sentence since the Gonzalez et al paper only examined 20th century change. "Biome shifts from 1700 to the present from published field research that examined trends over periods 30 y for biomes in areas where climate (rather than land-use change or other factors) predominantly influenced vegetation as well as 20th century changes derived from a systematic analysis of published studies (Gonzalez et al. (2010). (Robert Webb, NOAA OAR ESRL)	The text has been changed and now only says 20th century.
328	71892	4	8	27	8	27	Does "tropical woodland (RW)" include tropical forest? If so, suggest saying it explicitly and if not, explain why tropical forest is left out. (UNITED STATES OF AMERICA)	It has been added (note all abbreviations are now in fig 4-1)
329	76621	4	8	33	8	36	as well as Fig. 4-1 page 135: in my opinion, this figure does not add information with respect to the Table 4-1. On the contrary, it may considered as misleading, as the data are few and visually one has the impression of missing correlations where the temperature rates are largest. I suggest to eliminate this figure. (Claudio Cassardo, University of Torino)	We have decided to keep the figure, since it serves several purposes - showing that the evidence is geographically widespread, and reminding readers where the biomes are.
330	81365	4	8	33	8	36	Figure 4-1: The figure caption is inadequate even if some explanation appears in the text. Please clarify what is meant by "arrows indicate general direction of shifts." For instance, what does the arrow pointing in lower left corner (i.e. arrow for 21, Sierra Nevada) indicate? And why are there multiple arrows at some locations (i.e., 18, 19)? (Yuka Estrada, IPCC WGII TSU)	The figure caption has been changed to clarify it, and the arrows have been removed.
331	64751	4	8	34	8	34	This lead sentence in Figure Caption 4-1 is not really accurate since the Gonzalez et al paper examined "observed changes of 20th century climate" (1901-2000) rather than from 1700 to present. (Robert Webb, NOAA OAR ESRL)	The text has been changed and now only says 20th century.
332	79042	4	8	36	0	0	Please elaborate better what the arrows indicate: does an arrow on the map pointing to the bottem of the page indicate a downward movement of species distribution, a decrease in abundance or a southward shift? Or all three possibilies (and, perhaps, others)? (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	The figure caption and symbols have been changed to clarify it.
333	64752	4	8	36	8	36	If the "Arrows indicate general direction of shifts" then make the arrows bigger in the figure. (Robert Webb, NOAA OAR ESRL)	The figure caption and symbols have been changed to clarify it.
334	68195	4	8	38	0	50	Only if this modelling study is accepted should this figure be maintained. What is meant by "severe ecosystem change"? Moreover, throughout the chapter, the term "ecosystem" is used without a clear definition: land use form, plant functional type, other meanings referring to the biocenotics, biophysics, biogeochemistry of the system? The ecosystem definition given in the glossary is extremely vague and therefore useless. (Denis Loustau, INRA)	The introductory section (4.2.1) makes it quite clear what we consider to be an ecosystem. Fig 4.2 has been revised, and the study cited in the previous version has been removed since the paper was not accepted by the deadline. The new figure is a synthesis of two model studies.
335	71893	4	8	39	8	39	The phrase "severe ecoystem change" has not been defined in the text. It needs to be defined, either in the text or here in the caption for Figure 4-2. (UNITED STATES OF AMERICA)	Changed in text to reflect biome shifts, which have been defined. Figure 4-2 has been changed to present different studies, after the paper cited in the SOD version was not accepted by the deadline.
336	81768	4	8	39	8	39	How is "severe ecosystem change" defined--biome shifts? (Katharine Mach, IPCC WGII TSU)	Changed in text to reflect biome shifts, which have been defined.
337	71104	4	8	39	8	50	Fig 4-2 is hard to understand. Some averaging is reported over 30-year windows (centered on a particular year) but there is no indication of when these 30-year periods occur. Later the caption indicates that the model results agree for "different levels of warming": does this mean that the 30-year periods are different for the different GCMs and GHG forcing scenarios? If so, that should be made clear, but may be difficult to explain. Perhaps it could be split into two or even three different sets of graphs? (CANADA)	Figure 4-2 has been extensively changed. This comment is no longer relevant
338	76622	4	8	40	8	40	all? What means "all"? Figure shows seven lines. Are they only seven ecosystem models in the world? (Claudio Cassardo, University of Torino)	Figure 4-2 has been extensively changed. This comment is no longer relevant
339	81366	4	8	40	8	41	"The colors represent the different ecosystems models, which are also horizontally separated for clarity." Not clear what the authors mean here. (Yuka Estrada, IPCC WGII TSU)	Figure 4-2 has been extensively changed. This comment is no longer relevant
340	68194	4	8	42	0	0	centered (Denis Loustau, INRA)	Figure 4-2 has been extensively changed. This comment is no longer relevant
341	66395	4	8	42	8	42	Correct typo in middle of line ('cente4red'). (Peter Burt, University of Greenwich)	Figure 4-2 has been extensively changed. This comment is no longer relevant
342	76623	4	8	42	8	42	correct the typo in "cente4red" (Claudio Cassardo, University of Torino)	Figure 4-2 has been extensively changed. This comment is no longer relevant
343	81769	4	8	44	8	44	It would be clearest to remove the parentheses around "annual." (Katharine Mach, IPCC WGII TSU)	Figure 4-2 has been extensively changed. This comment is no longer relevant

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
344	79044	4	8	49	8	50	It is neither clear what this sentence really refers to (with 5 panels to chose from), nor - if it relates to the left-hand panel only - would I call the deviations between models "good agreement" (with appr. 0.04, 0.12, 0.18 and 0.18 as 50%-spans at 1, 2, 3, 4 degrees GMT). Please either delete it or enhance it so the content becomes clearer. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Figure 4-2 has been extensively changed. This comment is no longer relevant
345	81770	4	8	49	8	50	Is there good agreement? It would be helpful to clarify this. (Katharine Mach, IPCC WGII TSU)	Figure 4-2 has been extensively changed. This comment is no longer relevant
346	70910	4	9	1	0	0	The chapter is rather haphazard. What is the overall aim? No plan seems evident. (Andrew Friend, University of Cambridge)	The aim is stated clearly in the title of the section. No change made.
347	61015	4	9	1	10	28	The publications by Kathy Willis are used to backup the statement made that there has been a lowering of confidence in the statements made in AR4 about extinction risks. Kathy Willis' work relates to climatic change in the past at three time periods, one 55 million years ago, one 125000 years ago (the Emian, last interglacial maximum), and the more recent end of last ice age 10,000 years ago. She claims that the rate of climate change in three periods is comparable to that projected to be caused by climate change over the next century. However, for the two more distant time periods, the rate of climate change is extremely uncertain, so these cannot be used as analogs of the present situation. Furthermore, even though temperature change following the last ice age was similar to that projected to result from anthropogenic climate change, one cannot use a past warming from a much colder temperature to the present day temperature, and assume a linear relationship between what happened then and what will happen the future because (i) the global temperatures are different, so whatever the plot between global T, rate of global T change and extinction risk actually is, we are in a different place on that three dimensional plot than we were then. Secondly, the present day situation, in which species migration is massively impeded by barriers and yet humans are capable of assisting species migration to some extent, is quite different. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	No changes made. This comment is focused on section 4.2.2., a section that makes no asertions about exitinction risks other than the point (page 9, lines 19-12) that in the past, large climate change drove large ecological change associated with large extinction events. We go on to say that the paleo record provides evidence that future climate change could potentiall cause species extinctions (p 9, line 20). We then talk about the deglacial extinctions, and that humans may have exacerbated these (p 9, lines 22-48). That is all we say about extinctions, so this comment doesn't inicate any change is needed. With respect to Willis papers, we reference these papers for issues other than extinction, so again, this comment doesn't seem to suggest any change, other than we could write more about the no analog nature of past climate change relative to the future, but we already cover that, and space limits prevent adding more "text-book" like detail. More specifically with respect to Willis - on line page 9, line 9, we cite Willis work only in reference to the past magnitudes of change, and not rates; we do not mention extinction. On lines 28-9, we cite Willis work in relation to the Younger Dryas only - a period for which much is known about the magnitudes and rates of climate change, as well as extinctions evident in the fossil record. We go on to highlight how the Younger Dryas is not an analog for the future, in agreement with this reviewer comment. On page 10, line 3, we cite Willis and MacDonald, 2011 only to make the point that large climate change causes species mixtures to change, novel plant communities to appear, and carbon cycle changes to take place; nothing more. Finally, we looked for references to 4.2.2 later in the text, and could find no situation where 4.2.2 was cited in support of the assertions make in this comment.
348	68805	4	9	3	9	20	The conclusion at the end of the paragraph seems insufficient. It is true that the history of past climate change effects can help forecast future changes as well but it must be supported by an evidence that future changes will also behave similar to the past or present because in the future ecosystems may repond differently as compared to the past or present. Or else it need to be assumed that future changes will be similar to the past or present and hence the indicated confidence level should be lowerd atleast to medium confidence level. (NETHERLANDS)	We insert the world "global' to be more precise;"The paleoecological record thus provides high confidence (robust evidence, high agreement) that large global climate change,..." . The assertion made in this conclusion (lines 17-20) is associated with high confidence (both in therms of evidence and agreement). We know of no paper that refutes it. The key point, articulated with more precision in the revised lines 17-20, is that global climatic changes as large as that projected to occur in the future always causes large scale biome shifts, reshuffling of communities and, potentiall, species extinctions.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
349	70911	4	9	6	0	0	It read inconsistently to now include simple definitions along with the likelihood statements. (Andrew Friend, University of Cambridge)	definitions of what? Comment too vague to interpret. Guessing it refers to the evidence and agreement statement, which has been eliminated since "high confidence" implies strong evidence and agreement"
350	58326	4	9	12	9	12	precise "...ca 65 Ma; for comparison with actual state, see Barnovsky et al., 2011". (Martin Pecheux, Institut des Foraminifères Symbiotiques)	checked Barnosky et al 2011 - they use ca. 65 Ma. Thus, no change made.
351	58327	4	9	12	9	12	Add: "Recovery took several million years (Wood, 1999, Kirchner and weil, 2000);" Kirchner JW, Weil A, 2000, Delayed biological recovery from extinctions throughout the fossil record. Nature, 404, 177180. Wood R, 1999, Reef evolution. Oxford Univ. Press, 324 pp. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	text edited to highlight this point, referring to the Barnosky et al., 2011 citation - both to save space and to avoid text book review of literature. This point has been made my many workers.
352	70705	4	9	15	0	0	What about woody thickening in Australia and other semi-arid regions of the world? I wonder if it is appropriate to mention woody thickening here? For instance, see Witt, Harrington and Page (2010) Is 'vegetation thickening' occurring in Queensland's mulga lands - a 50-year aerial photographic analysis. Aust. J. Bot. 57(7) 572-582 (Cate Macinnis-Ng, University of Auckland)	Woody encroachment and recent (e.g., based on photographic analysis) observations are not the topic of this paleologic section are are covered elsewhere in the chapter.
353	66396	4	9	19	9	19	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	done
354	70912	4	9	20	0	0	speciation also! (Andrew Friend, University of Cambridge)	is there a paper that draws on the paleoecological record to state that change in the next 100 years will drive speciation? We do not know of any.
355	58328	4	9	20	9	20	"potentially" ???! Suppress (Martin Pecheux, Institut des Foraminifères Symbiotiques)	deleted (noting also that we already say "can")
356	59872	4	9	22	9	23	For the statement "provides a relatively recent analogy for climate change at a rate of a speed that approaches that projected for the 21st century" - please specify which RCP, as the rate of change is very different. (AUSTRALIA)	text edited to highlight that the Younger Dryas involved rates of change comparable to that associated with all RCPs depending on region.
357	70913	4	9	23	0	0	remove 'of a speed' (Andrew Friend, University of Cambridge)	done
358	58771	4	9	23	4	23	"at a rate of a speed that approcahes" should read "at a rate that approaches.." OR "at a speed that approaches" (Jonathan Silvertown, The Open University)	done
359	61016	4	9	23	9	23	Should the statement '...provides a [...] recent analogy for climate change at a rate of speed that approaches that projected for the 21st century' be qualified numerically i.e. what was the climate change velocity during the Younger Dryas cooling event? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	there isn't enough room to go into specific rates, but we are now specific about how the paleo rates compare with those associated with the RCPs - see response to comment #356.
360	66397	4	9	23	9	23	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	done
361	71105	4	9	23	9	23	Suggest deletion "of a speed" (CANADA)	done
362	71106	4	9	23	9	24	If the Younger Dryas cooling provides a comparable rate of change, are all projections for future change more rapid or only those at the high end of the range? I.e., how does YD cooling compare to warming under RCP2.6, for example? (CANADA)	see comment #356 - text edited to be more specific.
363	66398	4	9	26	9	26	Change 'humans' to 'human'. (Peter Burt, University of Greenwich)	done
364	77324	4	9	26	9	27	Again the authors discuss extinctions using imprecise terminology. If a species becomes extinct locally or regional (not globally) then it has become exterpedated, not extinct. (Maria Caffrey, National Park Service and University of Colorado, Boulder)	edited to be more precise
365	66399	4	9	28	9	28	small number' is imprecise (and poor scientific expression): please quantify. (Peter Burt, University of Greenwich)	edited to remove this text, shorten text, and make sentence less awkward
366	71894	4	9	29	9	29	The phrase "climate excursions" is unclear, suggest clarifying or using another term. (UNITED STATES OF AMERICA)	done; used another term ("climate changes" to clarify
367	80370	4	9	31	9	34	This critical statement should be cross-referenced to WGI: "The mid-Holocene around ca. 6 ka provides a very recent example of the effects of modest climate change, because regional warming during this period (ca. 0.5-1.5°C above pre-industrial temperatures in some regions) was the same order of magnitude as the warming the Earth has experienced over the last century." (Gian-Kasper Plattner, IPCC WGI TSU)	The text has been synched with chapter 5 of the AR5 WG1 report, and the relevant section of this chapter is now cited.
368	70914	4	9	42	0	0	and atmospheric CO2 change (Andrew Friend, University of Cambridge)	text modified to add this point
369	71895	4	9	50	0	0	The word "ecosystem" seems to be missing after "terrestrial" (UNITED STATES OF AMERICA)	inserted the word "vegetation" to fix this typo
370	64864	4	9	50	9	50	... state of the art vegetation models... (such as ??) (Dan F. Orcherton, PACE-Pacific Centre for Enivonment and Sustainable Development )	edited slightly, but sentence and references make this clear - no space for text-book review



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
371	70915	4	9	51	0	0	I assume 'terrestrial vegetation' (Andrew Friend, University of Cambridge)	have inserted "vegetation" to make this clear
372	71107	4	9	51	9	51	Insert "ecosystems" after "terrestrial". (CANADA)	see comment 371 "vegetation" makes more sense here, and thus we have edited that way instead
373	71896	4	9	52	10	2	Authors may wish to include mentioning that the land-use changes add complexity for today's landscapes as compared to the paleo record which had more limited human interactions (UNITED STATES OF AMERICA)	edited to make this point clear
374	70916	4	9	53	0	0	Could also cite Friend et al. (PNAS submitted) (Andrew Friend, University of Cambridge)	full citation and/or paper not provided; don't know this work, nor if it is now accepted. Thus, can't cite.
375	76784	4	9	53	0	0	could also cross-reference to WG1 Ch.6, sec 6.4 (Chris Jones, Met Office)	done
376	66400	4	9	53	9	53	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	done
377	71108	4	9	53	9	53	Suggest "forced by projected 21st century climate change" in place of "applied to 21st century climate change". (CANADA)	done
378	71109	4	9	54	10	1	"...biomes will move" may be more clearly stated as: "...the climatic zones linked to recognizable biomes will be increasingly shifted away from their present positions, imposing increasing climatic stress on those biomes and triggering changes in their functioning, composition and distribution." (CANADA)	text edited to reflect this point, but also to still connect clearly to the papers cited.
379	70917	4	10	2	0	0	Better to say 'if future climate is different from the recent past...' (Andrew Friend, University of Cambridge)	this would change the meaning of the sentence, so we left as is.
380	76624	4	10	4	10	4	remove bracket ")" (Claudio Cassardo, University of Torino)	done
381	61017	4	10	4	10	8	Policy relevant: Evidence from the paleoecological record questions the long-term viability of policies which seek to maintain ecosystems in their current form, such as current protects areas trying to maintain the present-day species mixture. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	True, this is exactly why we made this point.
382	78254	4	10	7	10	7	It is not clear whether "aquatic" refers only to inland waters. (Aaron Strong, Stanford University)	Edited to make more clear
383	66401	4	10	19	10	19	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	done
384	62852	4	10	21	10	21	it wasn't clear what orbitally-driven change was. I think I know, but a short definition would be useful. (Mark Urban, University of Connecticut)	edited to make more clear
385	64865	4	10	24	10	25	"State of the art climate and Earth systems models " (provide examples) (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	an example is given (see citation)
386	70918	4	10	26	0	0	I would have thought that if there were aspects of past change that cannot be captured by the models then the confidence that some changes in the future will not be captured is almost certain. (Andrew Friend, University of Cambridge)	text edited to reflect this logical point - now says high confidence.
387	71110	4	10	26	10	26	Is confidence in earth system models to capture "the full range of abrupt change" low rather than medium? (CANADA)	see comment #386 - edited to be clear on this point
388	71897	4	10	26	10	27	The confidence statement (medium) is combined with a subjunctive (may), and confused by a negative and partial expression (not capture some). The current wording in this sentence makes it difficult to understand what is the assertion in which the scientific community has medium confidence. Suggest rewriting. (UNITED STATES OF AMERICA)	done
389	76500	4	10	26	10	28	What are the implications of this? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	see precious three comments - text edited to be more clear
390	81771	4	10	31	0	0	Section 4.2.3. This paragraph could be shortened and merged into 4.2.1. (Katharine Mach, IPCC WGII TSU)	Accepted.
391	71898	4	10	31	10	38	Authors could consider touching on the the topics of landscapes and socio-ecological systems. The whole debate on whether we are in the "anthropocene", the view that humans are in fact "invasive alien species" in many ecological contexts, the question of whether and under what conditions indigenous worldviews and natural resources management systems are a basis for a better interface, etc (UNITED STATES OF AMERICA)	These are good points, but we cannot possible do them justice without exceeding our length limits. We have moved the SES section into 4.2.1
392	59271	4	10	37	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes). (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have done a final pass over the whole document for this purpose, and hope we did not miss too many errors.
393	66402	4	10	37	10	37	Delete ' at start of line. (Peter Burt, University of Greenwich)	Balancing ' added.
394	78255	4	10	38	10	38	There are many other references to the idea of social-ecological systems besides Fikret Berkes' et al 2003's book here, uncluding multiple works by Elinor Ostrom in the 1990s inter alia. (Aaron Strong, Stanford University)	Yes there are, but since we do not have space to review the concept in detail, we chose to only point to a primary source.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
395	64866	4	10	38	10	39	Berkes et al., 2003 is somewhat outdated. This is good, but are there others ? (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	Yes there are, but since we do not have space to review the concept in detail, we chose to only point to a primary source.
396	79935	4	10	41	11	6	Please consider including "fragmentation" as an important cause. (NORWAY)	Added 'habitat loss and fragmentation'
397	79934	4	10	41	16	14	Section 4.2.4.: Consider discussing over-exploitation and pollution since these drivers also may affect the ecosystems'/biosphere's resilience and adaptability to climate change. (NORWAY)	We do discuss two aspects of pollution - N loading and tropospheric ozone.
398	70919	4	10	43	0	0	CO2 as well (Andrew Friend, University of Cambridge)	It is covered in the text - the list is not intended to be exhaustive
399	59272	4	10	43	0	45	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The sentence has been rephrased.
400	79933	4	10	43	10	44	Consider adding "over-exploitation" to the list of main drivers of global change. It has a very big importance, especially in marine and coastal environments (and intensive/industrialised agriculture). (NORWAY)	Included and the list has been rephrased to show that it is not exhaustive
401	64867	4	10	44	10	44	"biological invasions" ?? (this could be changed to "biological invasive species" (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	Accepted and text changed accordingly
402	59273	4	10	45	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been rewritten.
403	78615	4	10	47	0	0	findings and interventions based on single-factor analysis (Huber et al. 2008). Huber V., R. Adrian, D. Gerten. 2008. Phytoplankton response to climate warming modified by trophic state. Limnology and Oceanography, 53 (1): 1-13. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	Thank you, it has been cited.
404	57086	4	10	47	10	47	experiment Larsen -> experiment (Larsen (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Fixed.
405	59873	4	10	47	10	52	In references to the statements on 'smaller effects than predicted from single factor effects', and 'effect size appears to be reduced when more factors are involved', could you please clarify whether this reduction is from the effect size of any single effect, or reduced from the cumulative effect of all the climate factors? (AUSTRALIA)	It is a reduction of the cumulative effect.
406	71899	4	10	47	10	52	The concluding sentence -- that models show the opposite trend (to the data?) -- would seem to undermine any confidence we have in the models. Is this the intent of the text? If yes, suggest being more explicit and if not, explain the apparent contradiction. (UNITED STATES OF AMERICA)	Since this is just one study, we cannot draw a general conclusion from it, and we note it as a caution, with the term 'suggest'.
407	71111	4	10	51	10	52	Suggest clarifying whether some models tend to show the opposite trend. If it is true of all models (to date) then this should be indicated. (CANADA)	Since this is just one study, we cannot draw a general conclusion from it, and we note it as a caution, with the term 'suggest'.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
408	78636	4	10	53	0	0	include some information on alterations in carbon input into rivers and lakes from the catchment(multiple stressors of temperatur and changes in color: The input of organic carbon through run-off from the catchment area, and consequently water color, has increased in many north temperate freshwater ecosystems (Hongve, Riise & Kristiansen, 2004; Evans, Monteith & Cooper, 2005; Erlandsson et al., 2008) and has been attributed to climate warming. Increased light attenuation might lead to lower algal concentrations and loss of submersed vegetation (Ask et al., 2009; Karlsson et al., 2009), cascading up the food web by reducing zooplankton abundances due to lower resource availability. Ekvall and Hansson (2012) studied how combined effects of warming and increased colour of lakes may affect spring plankton phenology and trophic interactions. Overall they found higher effect of temperature than of humic substances on phytoplankton and zooplankton abundance - but also high synergistic effects between the two stressors. While increased temperature led to an earlier peak in phytoplankton and zooplankton and a change in the relative timing of different zooplankton groups, increased water color reduced chlorophyll-a concentrations. References: Hongve, Dag; Riise, Gunnhild; Kristiansen, Jan F. 2004. Increased colour and organic acid concentrations in Norwegian forest lakes and drinking water – a result of increased precipitation? Aquatic Sciences vol. 66 issue 2 June, 2004. p. 231 – 238. C.D. Evans, D.T. Monteith, D.M. Cooper. 2005. Long-term increases in surface water dissolved organic carbon: Observations, possible causes and environmental impacts. Environmental Pollution 137 (2005) 55e71 Martin Erlandsson, N. Cory, J. Fölster, S. Köhler, H. Laudon, G. A. Weyhenmeyer, and K. Bishop. 2011. Increasing Dissolved Organic Carbon Redefines the Extent of Surface Water Acidification and Helps Resolve a Classic Controversy. BioScience • August 2011 / Vol. 61 No. 8 www.biosciencemag Ask, J., J. Karlsson, L. Persson, P. Ask, P. Bystrom, and M. Jansson. 2009a. Terrestrial organic matter and light penetration: Effects on bacterial and primary production in lakes. Limnology and Oceanography 54:2034–2040. Karlsson, J., P. Bystrom, J. Ask, P. Ask, L. Persson, and M. Jansson. 2009. Light limitation of nutrient-poor lake ecosystems. Nature 460:506–509. Ekvall MK, Hansson L-A (2012) Differences in Recruitment and Life-History Strategy Alter Zooplankton Spring Dynamics Under Climate-Change Conditions. PLoS ONE 7(9): e44614. doi:10.1371/journal.pone.0044614 (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This issue has been incorporated into section 4.3.3.3
409	59274	4	11	3	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This has been done.
410	71112	4	11	3	0	0	Perhaps a definition of both drivers and stressors should appear in the glossary; it would help to understand what is meant by authors and the distinction among these two. (CANADA)	The phrases have been deleted.
411	78616	4	11	3	0	0	...future changes predicted (Huber et al. 2008) (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	It is cited elsewhere, and the main citation here is to chapter 18.
412	71900	4	11	3	11	3	What is meant by "predicted" here? (at broad spatial scales?). Detection/attribution might not be applicable at local scales, as mentioned in lines 24-32. (UNITED STATES OF AMERICA)	The study did not examine scale-rated effects, so we cannot infer them.
413	79936	4	11	5	11	6	We question whether the threat from invasive alien species has low degree of relatedness to climate change since climate change may promote the spread of invasive alien species e.g. a warmer ocean. Similarly land use change is related (to a rather high de (NORWAY)	We have deleted this text, simply saying that they are correlated to varying degrees.
414	79937	4	11	9	12	21	Section 4.2.4.1.: Please state that today land use change (resulting in habitat loss and fragmentation) is the most important threat to ecosystems, biodiversity and species' survival. (NORWAY)	A respective statement was included in the beginning of the section and a reference was provided.
415	79938	4	11	9	12	21	Section 4.2.4.1.: Please consider including a discussion about the effects of LUCC on climate change and the effects of LUCC on ecosystems/species in itself or in combination with climate change. (NORWAY)	There is an extensive discussion of the effects of LUCC on climate in this section, and also in WG1 chapter 6
416	80371	4	11	9	12	21	Section 4.2.4.1: Corresponding WGI TSU FOD comment is repeated: "No reference to WGI AR5. Coordination with WGI will be needed given the lack of information provided for this particular topic in the WGI AR5 FOD. Certainly this link needs to be established where the climate feedbacks (e.g., on temperature, clouds, precipitation) from changes in land use are discussed in this Chapter." (Gian-Kasper Plattner, IPCC WGI TSU)	We have inserted such a reference.
417	57094	4	11	11	0	0	This Section lacks an important result about rainfall enhancement due to increase of crop productivity with time. The latter was found for Missisipi river basin by Groisman et al. (2012). The full reference is Groisman, Pavel Ya., Richard W. Knight, Thomas R. Karl, 2012: Changes in intense precipitation over the central united states. J. Hydrometeor, 13, 47–66. doi: http://dx.doi.org/10.1175/JHM-D-11-039.1 (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	The reference was included as an example for direct climate effects of land use and land cover change.
418	80068	4	11	11	0	0	Missing: changes in water usage, e.g. increase in aquaculture and river daming which greatly alter ecosystem function... (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	The issues of changing water use are covered under freshwater systems later in the chapter.
419	71901	4	11	11	11	14	Suggest including a mention of industrial logging here, especially for the tropics. (UNITED STATES OF AMERICA)	We have now mentioned industrial logging and have provided references.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
420	71902	4	11	16	11	16	Is "common" here meant to imply that there are many examples (many expanding cities), rather than that the area involved is large? If the second, the statement appears to contradict Figure 4.3. (UNITED STATES OF AMERICA)	The statement was removed from the text during the revision process.
421	68806	4	11	16	11	17	LUCC is both a cause and a consequence of climate change' needs explanation. In what way is it a cause and in what way a consequence? (NETHERLANDS)	LUCC as a cause of climate change is extensively discussed in the following paragraphs. The 'consequence' is noted here by example of the biome shifts, but is also extensively covered in other sections of the chapter.
422	71903	4	11	17	11	22	Suggest including citations to deforestation drivers work. See Boucher et al 2011 for a synthesis of drivers including many recent citations. (UNITED STATES OF AMERICA)	The review on drivers of deforestation by Hosonuma et al. 2012 has been cited in the revised text.
423	59275	4	11	18	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The sentence has been rewritten.
424	56483	4	11	18	11	20	The sentence "In the future climate change is..." need to be rephrased. (Archis Ambulkar, Brinjac Engineering Inc.)	It has been rephrased.
425	58654	4	11	18	11	22	I suggest the conclusion in this part should be supported by references. Please provide references cited. (chunfeng wang, State Forestry Administration, China)	Specific references have been added to exemplify and the sentence has been partially rephrased.
426	59276	4	11	18	11	22	Mention should be made to the fact that the rate of ecosystem change in some countries may change in the following years due to the worldwide economic recession. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)	We are unable to speculate about that without some published literature reference.
427	68807	4	11	18	11	22	There is no information or referencing to the underlying statements. In addition, there is no reference in Figure 4-2, as to whom the findings belong to. (NETHERLANDS)	Specific references have been added to exemplify and the sentence has been partially rephrased.
428	71904	4	11	19	0	0	Figure 4-2: The estimate of "more than a quarter" is very conservative - suggest using a range or the median in the statement (UNITED STATES OF AMERICA)	Figure 4-2 has been extensively changed. This comment is no longer relevant
429	80067	4	11	34	0	0	In this chapter I miss the linkage between terrestrial and aquatic ecosystems which is greatly affected by human activities, e.g. increased DOC in inland waters and coastal areas changing absorption of solar energy. This can lead to anoxia due to reduced primary production and increased microbial respiration. This renders the function of the landscape to stronger emitters of CO2. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This is a good point. We have included a pointer to Section 4.3.3.3.
430	71113	4	11	34	11	35	Suggest this could be revised as follows, "LUCC contributes to radiative forcing, and hence climate change, through changes in the sources or sinks of GHGs, changes in surface and cloud albedos, and alterations in the surface energy balance (the partitioning of available solar radiation into evapotranspiration and sensible heat)." (CANADA)	We have used wording based on your suggestion
431	60392	4	11	34	11	46	I agree with these statements, but is it worth saying that these are average or typical responses? For example, Teuling et al (2010) found that forested areas are, on average, warmer than grasslands, but they tend to reduce the severity of heatwaves when compared to grasslands. (Edward Pope, Met Office)	We include the phrase 'on average'
432	71114	4	11	34	11	46	Paragraph is difficult to follow. Clearly state the effect of latitude on albedo and transpiration. (CANADA)	We have extensively rewritten the paragraph. Hopefully it is now clearer.
433	76785	4	11	34	11	46	de Noblet et al, and Brovkin et al studies are relevant here [give refs] (Chris Jones, Met Office)	Both references have been included and discussed
434	76787	4	11	34	11	46	de Noblet et al, and Brovkin et al studies are relevant here [de Noblet-Ducoudre, et al, 2012, Journal of Climate, 25, 3261-3281. Brovkin et al, 2013, J. Clim online: <a href="http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00623.1">http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00623.1</a> ] (Chris Jones, Met Office)	Both references have been included and discussed
435	70920	4	11	35	0	0	Absorption changes, but it is the partitioning of that energy that has a large effect as well (Andrew Friend, University of Cambridge)	The sentence has been changed to the more general 'surface energy balance'
436	58329	4	11	35	11	35	, as well as through evaporation (as stated line 38) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This is now covered by 'surface energy balance'
437	61018	4	11	36	11	39	I found this sentence confusing- does the equation balance or not? i.e. does conversion of forest to non-forest result in net warming or not- I suspect the answer to this is scale dependent? Would this statement be improved by teasing out the impacts of forest conversion on the basis of scale. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The paragraph has been extensively reworked. There is some evidence that it is scale dependent (Longobardi et al)
438	71115	4	11	39	11	40	Some new studies add to (and possibly contradict) this finding include Bathiany et al. (2010) Biogeosciences 7: 1383-1399; Arora and Montenegro (2011) Nature Geosci. 4: 514-2011; See also Longobardi et al. (2012) Biogeosciences Discussions 9: 14369-14687. (CANADA)	Bathiany et al. 2010 and Longobardi et al. 2012 are cited in the revised text.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
439	58655	4	11	40	11	42	"Equilibrium experiments with the GDFL climate model (Findell et al., 2007) concluded that the land-use change driven climatic impacts not mediated by greenhouse gases were generally minor, but significant in a few regions (Eastern Europe, Northern India, and Eastern China)", I think the meaning of this sentence is not clearly expressed, I suggest delete or revise it. (chunfeng wang, State Forestry Administration, China)	It was rephrased as: "...the non-GHG climate impacts were generally minor, but nevertheless significant in some regions..."
440	71905	4	11	45	0	0	Could more specific examples be provided for "changes" ? Are these Increases? (UNITED STATES OF AMERICA)	The paragraph was completely revised and rephrased. The criticized statement was removed. The effects of deforestation in high latitude forest on albedo are discussed.
441	71116	4	11	45	11	46	The sense of this statement is not clear. Firstly, "high latitudes" usually refers to regions above the tree-line. Second, this statement would seem to apply generally to any forest removal in areas with a seasonal snow cover. (CANADA)	It now refers to mid to high latitudes usually ie from 45 degrees, which includes large areas of forest, and the region that has seasonal snow cover.
442	66403	4	11	46	11	46	Place references in alphabetical order (Peter Burt, University of Greenwich)	The order was corrected.
443	79768	4	11	48	0	0	Is there any information about tropical or subtropical afforestation or monoculture afforestation of economically valuable crops, such as in southeastern China? Or how this afforestation may alter albedo, carbon loss, soil quality, or so on? Also, is this whole section referring to temperate afforestation only? That's not clear. Although given page 50 lines 38-45, perhaps this is only of minor or future concern. (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	The section has been rewritten to be much more specific. There are no studies for SE China. Generally, tropical areas of high cloud cover still retain net cooling when afforested.
444	71906	4	11	48	11	48	Suggest adding "and reforestation/restoration" after "Afforestation" (UNITED STATES OF AMERICA)	This topic is now discussed in section 4.3.4.5. We added reforestation. (restoration to forest would be covered by afforestation).
445	56484	4	11	48	11	50	Please add comma i.e. "over the long term, afforestation". (Archis Ambulkar, Brinjac Engineering Inc.)	This section has been re-written and no longer contains that phrase
446	71907	4	11	48	11	53	Suggest being cautious in taking a site specific finding and giving it global credence. The idea that afforestation would lead to a slight net global warming when albedo is factored in must be very ecosystem specific. In areas where there is winter snow cover, this can't be the case since reforestation there would reduce albedo. (UNITED STATES OF AMERICA)	The topic is now discussed in Section 4.3.4.5. We have rephrased the paragraph and have included a more differentiated discussion on the climate effects of afforestation programmes.
447	71909	4	11	49	0	0	Suggest being clear that the referenced Schwaiger and Bird paper models out 250 years -a very long term. Note that Schwaiger and Bird paper found a cooling from years 25 to 190. It is misleading to emphasize that afforestation may lead to a slight net global warming 'when' albedo increase neutralizes C uptake. Suggest changing wording to be more clear, using 'if and when' or could say "Afforestation programs are often recommended to promote carbon sequestration, but some of the sequestration is negated by albedo increases, and over the very long term (>200 years), there is some evidence that the increased albedo may lead to a slight net global warming (Schwaiger and Bird, 2010)." (UNITED STATES OF AMERICA)	The topic is now discussed in Section 4.3.4.5. We have rephrased the paragraph and have included a more differentiated discussion on the climate effects of afforestation programmes.
448	70369	4	11	49	11	49	This should read "...afforestation, particularly at high latitudes..." because the difference in albedo would be much greater in polar and boreal areas, because of the replacement of snow cover with tree cover, than in lower latitudes, where tree cover may replace other forms of vegetation. The previous paragraph itself makes this point with several citations. (Patrick Gonzalez, National Park Service)	We have now rewritten the section so that the differential effects are made explicit. See also discussion in Section 4.3.4.5.
449	71908	4	11	49	11	49	Change "when" for "if" or "where". This point applies to boreal and some temperate afforestation but not tropical afforestation, as discussed later. (UNITED STATES OF AMERICA)	We have clarified this.
450	58330	4	11	50	11	50	This statement is very important. Many project count afforestation as carbon sink, and massive tropical afforestation is the greatest hope for future generations. You cannot state that based on only one publication. Moreover, it is a small revue, only available in electronic form at 30 €. TSU provide it to me. It appears that this study is a very special case for albedo (which of course must be taken in account): it is in Spain with very dark coniferous forest, it is with snow in winter and moreover in a region where sky is clear in winter: hence an important albedo effect, but it is an extreme case. Schwaiger and Bird (a geophysist) are in a mbH, a society of limited responsibility. They have strong conflicting interest with the topic as there firm developp bioenergy crops in developping countries. So suppress your sentence. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	They are not the only source of this observation, there are now many studies showing this effect. See also discussion in Section 4.3.4.5.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
451	71117	4	11	51	0	0	This sentence talks about significant positive slopes in regressions as opposed to the effect. Should the authors report details about statistical analyses or, more simply, talk about the effect in a more general sense. Is there something about these particular regressions that is significant or might the author reword the sentence more directly report the effect? None of the other studies cited in this paragraph specifically mention the statistical technique. (CANADA)	The topic is now discussed in Section 4.3.4.5. The point of this sentence is that it is an observational study rather than a modelling study. We have rephrased as significant positive correlations, which means the same.
452	71118	4	11	52	12	2	This seems too vague - please specify "other biophysical effects". (CANADA)	The sentence was rephrased and "other biophysical effects" deleted.
453	56485	4	12	4	0	0	Sentence "The reported effects on precipitation due to conversion of forest..." might be easier to understand. (Archis Ambulkar, Brinjac Engineering Inc.)	This paragraph was removed from this section during the revision process
454	58656	4	12	6	12	7	Please provide references cited to support "in some cases forest clearing has been reported to enhance local rainfall". Otherwise, it should be deleted. (chunfeng wang, State Forestry Administration, China)	This paragraph was removed from this section during the revision process
455	60393	4	12	6	12	10	This statement could probably do with a reference, particularly since it identifies a different impact to those described in the following sentence, which has 2 references. Although the appropriate references may be those given on line 9. (Edward Pope, Met Office)	This paragraph was removed from this section during the revision process
456	68202	4	12	7	0	0	This is a particular case of clearings surrounded by forests but it does not contradict that deforestation decreases rainfall in most observations. (Denis Loustau, INRA)	This paragraph was removed from this section during the revision process
457	66404	4	12	12	12	12	Delete comma after 'al.'. (Peter Burt, University of Greenwich)	This paragraph was removed from this section during the revision process
458	71119	4	12	13	12	14	"They observed a greater decrease in PE at stations with significant agricultural influence." Suggest clarification. A greater decrease in PE compared to ...? Or, is the intended meaning that average PE was lower at stations surrounded by agriculture? (CANADA)	This paragraph was removed from this section during the revision process
459	71120	4	12	19	12	21	This sentence is standing alone as a paragraph. Is it possible to integrate it elsewhere? (CANADA)	The statement can now be found in the beginning of this section.
460	79939	4	12	19	12	21	This needs to be stated earlier in this section and more highlighted and discussed. As well as reflected in TS and SPM. (NORWAY)	The statement can now be found in the beginning of this section.
461	66405	4	12	21	12	21	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Following recommendations of several native speakers it was decided not to use capital letters in this case.
462	71910	4	12	21	12	21	Convert the URL for the CBD web page to a standard reference (author, date, etc.) if it is a peer-reviewed publication and it was submitted and accepted before the cut-off dates. (UNITED STATES OF AMERICA)	The citation was corrected. It is Leadley et al. (2010).
463	80372	4	12	25	13	37	Box 4.1: Coordination with WGI Ch6 and Ch12 is strongly suggested. (Gian-Kasper Plattner, IPCC WGI TSU)	Draft response: Thank you for this suggestion. Box 4.1 has been reviewed by a WG1 Ch6 author (see comment 478) and one of our lead authors reviewed the FOD of WG1 Ch6, but we have also invited a Contributing Author who was also a Contributing Author on WG1 Ch6 to assist with final revisions and ensure consistency.
464	71911	4	12	30	12	30	The phrase "outpacing the growth in supply" is correct only for the last decade (the 2000s); for the previous several decades, at least as far back as World War II, supply grew faster than demand, resulting in a long-term trend of falling agricultural prices. Clarify that the recent tendency is a turnaround from what had been happening for many years previously. (UNITED STATES OF AMERICA)	Have added "now" to show it is a more recent phenomenon.
465	66406	4	12	31	12	31	'per capita' should be in italics. (Peter Burt, University of Greenwich)	This has now been italicised
466	56486	4	12	32	0	0	Term OECD used for first time in this chapter is not defined here. (Archis Ambulkar, Brinjac Engineering Inc.)	We now use "developed countries" instead of "OECD"
467	71912	4	12	32	0	0	Suggest spelling out OECD (UNITED STATES OF AMERICA)	We now use "developed countries" instead of "OECD"
468	56487	4	12	33	12	39	The sentence is too long to comprehend, if possible, please split it into more than one sentence. (Archis Ambulkar, Brinjac Engineering Inc.)	The whole paragraph has been re-written to make it easier to comprehend.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
469	79770	4	12	35	0	0	a shortage of arable land in temperate systems could put pressure on marginal or sensitive lands/soils, potentially leading to carbon loss. An analysis of changes in federal funding of, or registration into, the CRP (conservation reserve program) ( <a href="https://www.fsa.usda.gov/FSA/webapp?area=home&amp;subject=copr&amp;topic=crp">https://www.fsa.usda.gov/FSA/webapp?area=home&amp;subject=copr&amp;topic=crp</a> ) might give evidence for that. (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	Thank you for this suggestion. However, as part of shortening the text and also bearing in mind comment 470, the sentence on shortage of arable land in temperate systems has been removed. Also, while it is a good point, it relates more to Working Group 3's subject area (Mitigation).
470	71913	4	12	35	12	35	The phrase "possibly a shortage of arable land that is not already under cultivation" is contradicted by the fact that the land area under cultivation in the temperate zone has been declining in the last few decades. (The trend is the opposite in the tropics). Suggest harmonizing wording. (UNITED STATES OF AMERICA)	We disagree that this is a contradiction, as conversion to non-agricultural land does not necessarily mean it could be made available for cultivation again, as it can be for other uses (eg. forestry, human settlements)
471	66407	4	12	41	12	41	'per capita' should be in italics. (Peter Burt, University of Greenwich)	This has now been italicised
472	71914	4	12	41	12	41	Replace "low" with "lower" -- for the major emerging economies (e.g. China, Brazil, Mexico, India) Levels of food consumption per capita in some cases are 60 or 80% that of developed countries, for example for meat. (UNITED STATES OF AMERICA)	Sentence removed during shortening of text.
473	71915	4	12	46	12	49	Clarify: This starts with "One of the uncertainties about future land use trends is climate policy." It then goes on to talk about declining deforestation rates in the Amazon. It is unclear what the link is, and what is intended here. (UNITED STATES OF AMERICA)	The link is that reduced deforestation is related in part to climate mitigation policy and mechanisms (eg: REDD). This is the subject of the cited paper (Soares-Filho et al, 2010). This link has been made more explicit.
474	71916	4	12	47	12	49	Clarification request: what was the 10-yr period for comparison? and the 1.5% reduction is compared to what? (UNITED STATES OF AMERICA)	Clarified in text that this is relative to 1996-2005.
475	79045	4	12	52	0	0	"RCP" = Representative Concentration Pathway, not "Regional". (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	The correction has been made.
476	64869	4	13	8	13	8	should read ..."a number of climate change related socioeconomic and policy driven pathways" (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	We disagree. Some of the socioeconomic drivers in the RCPs are not related to climate change. No change has been made.
477	71917	4	13	8	13	12	This report needs to reject strategies that replace natural forests with plantations, regardless of the climate change scenarios underlying them %00 biodiversity loss is an equally devastating global phenomenon, and it cannot be sacrificed for quick climate fixes that are more politically convenient for politicians than reducing industrial emissions. (UNITED STATES OF AMERICA)	The IPCC does not make policy-prescriptive statements and hence cannot reject or support any particular strategy. That is the role of policymakers. The implications of mitigation strategies that involve ecosystem transformations have been made clearer, so that policymakers can be fully informed in deciding whether to accept or reject such strategies.
478	76786	4	13	8	13	19	yes, it is important to note this point. Note also that RCPs are not intended to fully span "uncertainty" in anything other than global radiative forcing. So future land-use could easily lie outside the RCP range shown in fig 4.3. e.g. see papers by Wise et al (Science) or Thomson et al (PNAS) (Chris Jones, Met Office)	Thank for for confirming the importance of this point. We have added a sentence on the primary focus of the RCPs being overall radiative forcing.
479	64868	4	13	9	13	9	" title should be "Land Use Cover Change (LUCC)" (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	We are not sure what title is being referred to on this specific line. We have now used LUCC in this box.
480	79046	4	13	10	0	0	What is a "mature" ecosystem? The context suggests you think it is a natural system in a state where it stores large amounts of carbon, which is not necessarily true (for example, it may not be valid for disturbance-driven "succession" ecosystems). I suggest to delete "mature". What do you want to do if a "mature" system breaks down due to natural reasons? (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Deleted "natural, mature".
481	79047	4	13	10	0	0	Please make sure you really mean "sinks" here (sink: removes C from the atmosphere), not pools (store C) or stocks (the C stored). (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Carbon sinks no longer discussed in this Box - text shortened to focus on key points.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
482	71918	4	13	15	13	17	Is RCP2.6 compatible with the aforementioned possibility that increased forest cover means increased warming? Page 11, lines 48+. (UNITED STATES OF AMERICA)	RCP2.6 involves net deforestation, including in temperate regions where albedo effects are probably strongest. Therefore there seems to be no incompatibility between RCP2.6 as a global warming mitigation scenario and the overall cooling effects of deforestation through increased surface albedo.
483	76625	4	13	26	13	26	it is written "patterns of the future land cover change", but figure 4-4 reports the past, present and future patterns, and not their changes (Claudio Cassardo, University of Torino)	Figure 4-4 has been removed during shortening of the chapter.
484	71919	4	13	27	13	27	The phrase "by definition" is incorrect as used in the text -- at least some secondary forest must become primary again if it originated far in the past, irrespective of the timescale. Suggest could use phrase "by the definitions used for this figure". (UNITED STATES OF AMERICA)	The phrase in question has been removed during shortening of the text.
485	71920	4	13	30	13	31	What is RCP6.0 forest area constant mean? Constant since 2005? It is hard to see these data from Fig 2, but may be relevant to comment on the expansion of forest cover in RCP4.5. (UNITED STATES OF AMERICA)	Total forest cover no longer mentioned after shortening text, but the comment about constant forest cover in RCP6.0 no longer applies. However, we now mention regrowth of secondary forest in RCP4.5.
486	64753	4	13	34	13	35	Rewrite Figure caption 4-4 to read: "Fractional cover of primary vegetation at 1850 based on historical reconstructions (KleinGoldewijk, 2001), at 2005 based on satellite data, and at 2100 in scenarios associated with the RCPs (Hurtt et al., 2011). (Robert Webb, NOAA OAR ESRL)	Figure 4-4 has been removed during shortening of the chapter.
487	57714	4	13	40	0	0	Section 4.2.4.2. Nitrogen deposition. Comment: there are only small amount of studies, where plant, soil and soil organism responses to reduced N deposition (i.e. N deposition close 30 - 40 kg N/ha/y) are studied. Thus, the main part of the literature considers rather extreme N deposition effects (which can be true in the most polluted areas still), but more information about more modest N deposition and warming effects in combination are needed to get more realistic picture. This could be briefly discussed in the text too. (Anne Kasurinen, University of Eastern Finland)	We discussed ranges of deposition rates of 5-20 Tg/N/yr and above as being of interest, and the lower end of this range is considered low-level. We have additionally cited Clark and Tilman (2008) as a specific example of a study of low-level deposition.
488	57135	4	13	40	14	51	This section only discuss the Nitrogen deposition or surplus is a stressor to induce changes in terrestrial system and inland water system, but nitrogen limitation also constrains sustainability of ecosystem response to elevated CO2. See (1) Reich et al.2006. Nitrogen limitation constrains sustainability of ecosystem response to CO2. (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	This has been mentioned in the discussion on interactive effects, citing the recommended paper.
489	80069	4	13	42	0	0	Role of freshwaters and wetlands are particularly important for denitrification, this is completely missing here. Coupling between terrestrial and inland waters is extremely important for N cycling, e.g.role of wetlands as a source of N2O largely depends on cycles of flooding and droughts. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)	This relates more to the global N cycle and climate feedbacks, which is covered in chapter 6 of the WG1 report. The scope of this section specifically concerns the impacts of N deposition on ecosystems. No change made in response to this comment.
490	57131	4	13	42	13	43	Please add the following literatures: (1) Canfield DE, Glazer AN, Falkowski PG. 2010. The evolution and future of Earth's nitrogen cycle. Science 330:192-196.(2) Sutton M.A. et al. 2013. Our Nutrient World: The challenge to produce more food and energy with less pollution. Global overview of nutrient Managment. Center for Ecology and Hydrology. (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	We have cited Canfield et al (2010) in place of another reference, but do not have space to cite a further reference and consider it unnecessary here.
491	79049	4	13	42	13	46	Please explain why you consider 160 TgN to be close to 255 TgN. Are the 160 Tg additional to the 255 Tg, and are the 255 Tg pre-industrial still near or equal to the natural N flux? (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We have corrected 160 to 210, and quantified the current natural flux as 203, based on the latest review by Fowler et al (2013).
492	81772	4	13	45	13	45	Are the 2 fluxes being compared operating in the same direction? It would be helpful to clarify this, along with indicating the current "natural" flux. (Katharine Mach, IPCC WGII TSU)	We have re-worded to make this clear, and quantified the natural flux.
493	59277	4	13	48	0	49	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Long sentence split into two.
494	58331	4	13	52	13	52	in many terrestrial and oceanic ecosystems (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This sentence has been removed during shortening of the text.
495	85137	4	13	52	14	3	Can this N deposition be traced back its sources? (Wu Shaohong, Chinese Academy of Agricultural Sciences)	We have now mentioned fertilizer production and fossil fuel burning in an earlier sentence in this paragraph.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
496	57132	4	13	53	14	3	Please add the following literatures: (1)Duce RA, Laroche J, Altieri K, et al. 2008. Impact of atmospheric anthropogenic nitrogen on the open ocean. Science 320:893-897. (2)Cui SH, Shi YL, Groffman PM, et al. 2013. Centennial-scale analysis of the creation and fate of reactive nitrogen in China (1910–2010). PNAS 110(6):2052-2057.(3)Guo JH, Liu XJ, Zhang Y, et al. 2010. Significant acidification in major Chinese croplands. Science 327:1008-1011.(4)Liu X, Zhang Y, Han W, et al. 2013. Enhanced nitrogen deposition over China. Nature 494:459-462. (5)Chen M, Chen J, Sun F. 2010. Estimating nutrient releases from agriculture in China: An extended substance flow analysis framework and a modeling tool. Science of the Total Environment 408(21):5123-5136. (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	Thank you for the suggestions. However, for reasons of space it is not possible to cite all relevant literature, and these do not add substantially enough to the discussion to warrant additional space. Without a specific reason having been suggested, we have not added these references.
497	70921	4	13	54	0	0	Also cite doi: 10.1038/ngeo01207 (Andrew Friend, University of Cambridge)	This reference could not be found, and no reason for citing it was given by the reviewer anyway, so we have not cited it.
498	61019	4	14	1	14	3	What are the underlying reasons for a projected increase in nitrogen deposition in rapidly emerging economies? An increase in food production? I feel this statement needs to be further qualified. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	An explanatory statement and supporting reference have been added.
499	64870	4	14	1	14	3	are there any examples of Nitrogen deposition in the Pacific or Oceania regions? (not just Western Europe)? (Dan F. Orcherton, PACE-Pacific Centre for Envionment and Sustainable Development )	We have cited Zhu et al (2005) which discussed human impact on the N cycle in Asia.
500	57703	4	14	3	0	0	Add a new sentence here: Human-induced carbon and nitrogen fertilization are generating a strong imbalance with P. This imbalance confers an increasingly important role to P availability and N : P ratio in the Earth’s life system, affecting carbon sequestra- tion potential and the structure, function and evolution of the Earth’s ecosystems (Peñuelas et al. 2012, Sardans et al. 2012). PEÑUELAS J., SARDANS J., RIVAS-UBACH A., JANSSENS I.A. 2012. The human-induced imbalance between C, N and P in Earth's life system. Global Change Biology 189: 5-8. SARDANS J., RIVAS-UBACH A., PEÑUELAS J. 2012. The C:N:P stoichiometry of organisms and ecosystems in a changing world: A review and perspectives. Perspectives in Plant Ecology, Evolution and Systematics 14: 33-47. (Josep Penuelas, CREAM-CSIC)	Thank you for the suggestion. Unfortunately space constrains limit our ability to introduce new material, and while this point is interesting, we do not feel it is of sufficiently high priority to warrant inclusion.
501	66408	4	14	5	14	5	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Peter Burt, University of Greenwich)	We disagree that capitalisation is normal here. No change made.
502	57136	4	14	5	14	8	Studies in grasslands show that chronic low-level nitrogen deposition will result in loss of plant species. (1) Clark CM, Tilman D.2008. Loss of plant species after chronic low-level nitrogen deposition to prairie grasslands. Nature 451:712-616.(2) Power et al. 2006. Ecosystem recovery: heathland response to a reduction in nitrogen deposition. Glob Change Biol 12:1241-1252 (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	Clark & Tilman (2008) studied N deposition rates as low as 10 kgN/ha/yr, and Pwer et al (20006) looked at 15 kgN/ha/yr - both values are within the range (5-20) given in this sentence. We have cited these as further evidence on this topic.
503	71921	4	14	11	0	0	It seems peculiar to use a 2008 paper to state there are few studies since AR4 (UNITED STATES OF AMERICA)	This sentence has been removed as it was incorrect.
504	78617	4	14	24	0	0	The impact....in freshwater systems (reference: Weyhenmeyer et al. 2007), since they.....(Weyhenmeyer, G.A., E. Jeppesen, R.Adrian, T. Blenckner, T. Jankowski, E. Jennings, J.P. Jensen, P. Nöges, T. Nöges & D. Straile (2007). Nitrate-depleted conditions on the increase in shallow northern European lakes. Limnology and Oceanography 52(4), 1346-1353. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The suggested reference has been included later in the paragraph.
505	78618	4	14	24	0	0	Weyhenmeyer et al. 2007 explained the decreasing NO3-N concentrations in lakes by a reduction in external nitrogen loading including atmospheric deposition, and by changes in climate. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This study showing reduced N loading has been mentioned later in the paragraph.
506	57134	4	14	24	14	27	Please add the following literature to indicate that global N cycle will furthur alter ecological processes: Elser et al. 2009. Shifts in Lake N:P stoichiometry and nutrient limitation driven by atmospheric nitrogen deposition. Science 326:835-837. (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	This paper is already cited in this paragraph (see SOD page 24 line 30).
507	66409	4	14	25	14	25	Why is phosphorous spelt out in full here, when it is abbreviated in the following line and none of the other elements mentioned are defined in this way? (Peter Burt, University of Greenwich)	Nitrogen was spelt out at the start of the section.
508	71922	4	14	32	14	34	This statement shows similarity, but is somewhat contradictory, to statement in lines 9-11 on page 14 (UNITED STATES OF AMERICA)	The earlier sentence was incorrect and has been removed.
509	76788	4	14	32	14	51	You could discuss here the distinction between N deposition increasing NPP and increasing carbon storage. The two are not the same and will depend on different factors. The former may be more likely, but ultimately the latter may be more important (Chris Jones, Met Office)	Although this is a good point, it does not affect the overall conclusions of this section and we do not have space for additional discussion unless of high importance. No change made in response to this.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
510	71121	4	14	42	14	42	Please review whether N deposition is a key driver in the Canadian Boreal. N deposition is relatively low (Bobbink et al., 2011; Ch 4 14, L 7), and as noted on Ch 4 P 14 L 48, moss-dominated systems can attenuate the response of woody plants. (CANADA)	We do not have the space to discuss this point for individual regions. As noted by the reviewer, we have noted the differences regarding moss-dominated ecosystems.
511	76626	4	14	42	14	43	in line 42 change "hemisphere, however" with "hemisphere. However"; in line 43, remove "are" (Claudio Cassardo, University of Torino)	Change made as suggested.
512	56488	4	14	43	0	0	Please correct "changes in precipitation are may exceed..." (Archis Ambulkar, Brinjac Engineering Inc.)	Change made as suggested.
513	59278	4	14	43	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	"are" removed.
514	76501	4	14	43	14	43	"are" (typo?) (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	"are" removed.
515	76627	4	14	48	14	48	I understand the importance of each ecosyste,, but I am wondering how big are the effects of changes in such ecosystems on the global balance of nitrogen, phosphorous and carbon (Claudio Cassardo, University of Torino)	The focus of this chapter is specifically on the impacts on ecosystems. The global C and N cycles are discussed in chapter 6 of the WG1 report.
516	57133	4	14	49	14	51	Please add the following literature to manifest the combined effect on plant productivity of disturbed carbon-nitrogen cycles: Canfield DE, Glazer AN, Falkowski PG. 2010. The evolution and future of Earth's nitrogen cycle. Science 330:192-196. (Minpeng Chen, Insitution of Environment and Sustainable Development in Agriculture)	A citation of this paper has been inserted earlier in this section.
517	57715	4	15	1	0	0	Section 4.3.4.3 Tropospheric ozone. There are some field studies made where elevated temperature and ozone interactions have been studied, any information about them (i.e. can warming reduce the negative effects of ozone, or what is assumed to happen)? (Anne Kasurinen, University of Eastern Finland)	No reference is given, so these studies are hard to locate
518	80070	4	15	1	0	0	Lack of knowledge on effects on inland water systems (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This section deals with impacts of increased ozone in troposphere on terrestrial systems. While there is quite a lot in the literature on UV impacts on freshwaters from ozone depletion, to the best of our knowledge, the effects of tropospheric ozone increases on inland waters have not been considered.
519	58657	4	15	1	15	41	Ozone's effect on environmental protection should be also mentioned and considered. The negative effects known as "Ozone hole" have been widely focused on. It had better balanced on both negative and positive of ozone's role in the environment, to avoid misleading that ozone could be eliminated. I suggest add a sentence of "certain amount of ozone in the atmosphere is necessary for mankind and other living things, such as sterilization and preventing from rickets (citations)" before expressing negative effects of ozone. (chunfeng wang, State Forestry Administration, China)	The ozone hole is stratospheric ozone, not tropospheric ozone. Th positive industrial uses of ozone are not relevant to environmental ozone.
520	64871	4	15	1	15	41	no mention of how tropospheric ozone is affecting humans directly in different parts of the Earth (i.e Tropical vs. temperate lands,etc). (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	This chapter is on ecosystem effects of ozone, and specifically in the context of climate change. Health impacts are beyond our scope.
521	80373	4	15	1	15	41	Section 4.2.4.3: Corresponding WGI TSU FOD comment is repeated: "Analysis of changes in trop. O3 (1st para of section) should be closely compared to WGI Ch2 and Annex II. Currently no cross-reference is included." (Gian-Kasper Plattner, IPCC WGI TSU)	We have now pointed to WGI AR5 Figure 2.7.
522	85138	4	15	1	15	41	Ozone's effect environmental protection should be also mentioned and considered. The negative effects known as "Ozone hole" has been widely focused on. It had better balance on both negative and positive of ozone's role in the environment, to avoid misleading that ozone could be eliminated. I suggest that adding a sentence of "certain amount of ozone in the atmosphere is necessary for mankind and other living things, such as sterilization and preventing from rickets (citations)" before saying negative effects of ozone. (Wu Shaohong, Chinese Academy of Agricultural Sciences)	This is a repeat of comment 519. The ozone hole is stratospheric ozone, not tropospheric ozone. Th positive industrial uses of ozone are not relevant to environmental ozone.
523	58332	4	15	3	15	4	You must give significant quantitative data in ppb (Martin Pecheux, Institut des Foraminifères Symbiotiques)	values added.
524	58798	4	15	3	15	9	VOC is an important issue. (Tetsuya Matsui, Forestry and Forest Products Research Institute)	VOCs are mentioned in the section.
525	66410	4	15	7	15	7	Change 'VOC' to 'VOCs'. (Peter Burt, University of Greenwich)	Done



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
526	58805	4	15	7	15	8	Here is mentioned about VOC, but not about BVOC. So, would it be possible to mention BVOC here? BVOC is first mentioned in chapter 4.3.3.5.4 in "Urban ecosystems", but it could rather be mentioned here. BVOC including isoprene (C <sub>5</sub> H <sub>8</sub> ), monoterpene (C <sub>10</sub> H <sub>16</sub> ), alcohols, organic acids and aldehydes are released from many plant species. It is estimated that the global emission of BVOCs ranges from 500 to 1200 Tg carbon per year, while the global emission of anthropogenic VOCs such as benzene, toluene and xylene released from mobile and stationary sources, is estimated to be 100 Tg carbon per year. Therefore, the global emission of BVOCs is much greater than that of anthropogenic VOCs. Global emission of isoprene accounts for about 50 % of total BVOCs emission, and it is estimated that the mean global emission rate of isoprene is 449 Tg carbon per year in 1998 and 2005. Since isoprene has two chemical double bonds, it's highly reactive with the hydroxyl radical (OH). Therefore, isoprene is known as substantial precursors of tropospheric ozone and organic aerosol (Okumura et al. 2011). Reference: Okumura, M., Nakagawa, K., Kominami, Y., Miyama, T., Kinoshita, K., Hamotani, K., Tohno, S., Yoneda, M., Tani, A. (2011), Isoprene flux measurement using relaxed eddy accumulation method in warm-temperate mixed forest in Japan. Proc. 'Earth Observation for Land-Atmosphere Interaction Science', Frascati, Italy 3 –5 November 2010 (ESA SP-688, January 2011). (Tetsuya Matsui, Forestry and Forest Products Research Institute)	BVOC is a synonym for VOC, referring to those VOCs which are of biogenic origin. Therefore, what we say about VOC applies to BVOC too. We have added a sentence here to explain this
527	76628	4	15	12	15	12	change "focussed" in "focused" (Claudio Cassardo, University of Torino)	Done, but it seems either is correct
528	81773	4	15	14	15	14	For the percentage given here, is it possible to specify the relevant range/uncertainties? (Katharine Mach, IPCC WGII TSU)	We quote the value given in the paper, it does not associate a certainty level with it.
529	76629	4	15	15	15	16	this means that NPP for other ecosystems than temperate forests is predicted to increase up to 50%? (Claudio Cassardo, University of Torino)	No, that does not logically follow from the sentence.
530	56489	4	15	22	0	0	A correction might be needed "generally reduced and respiration increased..." (Archis Ambulkar, Brinjac Engineering Inc.)	This sentence has been restructured.
531	61020	4	15	23	15	24	Is it assumed that the terms angio and gymnosperm are widely understood? It's unlikely that non-experts will understand these terms And what is the reason that gymnosperms are less sensitive than angiosperms to ozone? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We now say 'conifers and broadleaved'
532	76630	4	15	25	15	27	the reference of Huntingford et al. (2011) is quoted for two conclusions in partial contrast with each other. At lines 24-25 it is said that, in the H11 modeling study, runoff increases with increasing ozone. Later, it is said that "studies that measured runoff are contradictory": is H11 also a study on measures? I confess my ignorance: I do not have read this study. (Claudio Cassardo, University of Torino)	As we note, the evidence is partly contradictory on this point.
533	58333	4	15	27	15	27	Add perhaps This emphasizes the very great complexity of climatic chane impact. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Thanks for the suggestion, but we thought it is not necessary to make this explicit as it seems obvious from the entire context.
534	81774	4	15	29	15	31	For this projection, what is the timeframe and range of projected values beyond the central estimate given? (Katharine Mach, IPCC WGII TSU)	The projection is for the 21st century, which we mention now: We also now give the range reported.
535	56490	4	15	34	15	50	The term FACE is defined in line 50, however this abbreviation is used earlier in line 34. So, FACE should be defined in line 34 instead (as is used there for first time). (Archis Ambulkar, Brinjac Engineering Inc.)	The first use is deleted.
536	57716	4	15	39	15	41	"Research into developing ozone resistant varieties.." In forest trees, ozone-resistant genotypes seem to be the ones which have the poorest growth in general (i.e. they produce less biomass) and are more effective in secondary compound production (chemical defence). How is it with crop plants; are O <sub>3</sub> resistant varieties smaller in size and produce less crop than ozone-sensitive varieties? So is it reasonable to believe that more ozone resistant varieties would really help in long-term? What are the costs for the farmers to obtain such a varieties is another question, and are they available in developing regions (i.e., in Africa and Asia, which are likely to most suffer from high tropospheric O <sub>3</sub> concentrations in the near future)? (Anne Kasurinen, University of Eastern Finland)	These are all good and valid points, a bit too detailed for treatment here, but in the absence of referenced literature, not possible for us to follow up on.
537	66411	4	15	40	15	41	References should be in chronological order. (Peter Burt, University of Greenwich)	Corrected.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
538	57681	4	15	44	17	41	4.2.4.4 Rising CO2 well express the impacts of rising CO2 on plant ecosystem, especially in FACE, but for inland water system the contents are not perfect. Recently there are a lot of researches on relation between water cycle and carbon cycle, especially the study on karst processes and carbon cycle in water systems have made a significant progress. The karst system sensitively respond to climate change, especially the karst processes have a closed relation with air CO2 content (Yuan Daoxian. 1997a, The carbon cycle in karst. Zeitschrift für Geomorphologie Neue Folge, 108 (Suppl-Bd):91-102. Yuan D. 1997b, Sensitivity of karst process to environmental change along the PEP-II transect. Quaternary International. 37:105-113. Larson C. 2011, An unsung carbon sink. Science. 334:886-887.) . The flux of inorganic carbon sink in karst system was assessed to be 12~17.7 Tg C/a in China karst area (Jiang Z, Yuan D. 1999. CO2 source-sink in karst processes in karst areas of China Episodes, 22 (1):33~35. Yan J., Wang Y.P., Zhou G., Li S., Yu G., Li K..2011. Carbon uptake by karsts in the Houzhai Basin, southwest China. J. Geophys. Res..116.G04012, doi:10.1029/2011JG001686.) and 0.3~0.6 Pg C/a in the global karst area (Gombert P.2002. Role of karstic dissolution in global carbon cycle. Global and Planetary Change. 32:177-184.), accounting to about 11.5%~23.1% of residual terrestrial sink (Quéré C. L., Andres R. J., Boden T., et al., 2012, The global carbon budget 1959–2011. Earth. Syst. Sci. Data Discuss., 5, 1107–1157. ). Further, combining the action of carbonate dissolution, the global water cycle and photosynthetic uptake of DIC by aquatic vegetation in karst system, the net carbon sink is estimated as 0.7052 Pg C/a (Liu Z., Dreybrodt W., Wang H..2010. A new direction in effective accounting for the atmospheric CO2 budget: Considering the combined action of carbonate dissolution, the global water cycle and photosynthetic uptake of DIC by aquatic organisms. Earth-Science Reviews. 99:162-172.). Some high-resolution monitoring results (at 15 min interval) demonstrate that the carbon sink in karst system is very sensitivity of its responsiveness to CO2 variation or rise in outside environment at all seasonal, diurnal and rain-event scale (Liu Zaihua, Li Qiang, Sun Hailong, Wang Jinliang, 2007. Seasonal, diurnal and storm-scale hydrochemical variations of typical epikarst springs in subtropical karst areas of SW China: soil CO2 and dilution effects. Journal of Hydrology, 337(1-2): 207-223. Yang R, Liu Z, Zeng C, Zhao M.2012. Response of epikarst hydrochemical changes to soil CO2 and weather conditions at Chenqi, Puding, SW China. Journal of Hydrology. 468–469:151–158). There was an increase in PCO2 (or HCO3-) in karst groundwater caused by the increase in soil CO2 in spring to summer growing season, while a decrease in PCO2 (or HCO3-) caused by the decrease in soil CO2 happened in autumn–winter dormant season. Similar variations were also found on diurnal scales but with a time lag of a few hours (1~3 hours) between hydrochemical changes and soil CO2 change during dry season, showing effect of the groundwater recharge mode as well as the complexity of the supply path (quick flow by conduit or slow flow by fracture). At very high rainfall intensity, the dilution effect dominates the decrease in PCO2 (or HCO3-) in karst system, while carbon sink flux is increase due to the discharge huge rise. In lower rainfall intensity, soil CO2 effect determines the increase in PCO2 (or HCO3-) and the carbon flux is rise correspondingly . Therefore, the role of karst processes in the global carbon cycle needs to be reappraised. (Zhongcheng Jiang, Institute of Karst Geology, CAGS)	Thank you for the suggestion. However, the recommended papers focus on the carbon cycle which is discussed in Chapter 6 of the WG1 report. For reasons of space and to avoid duplication, the discussion here focusses specifically on other issues.
539	80071	4	15	46	0	0	Lack of studies of pCO2 effects on inland waters which is contrary to terrestrial or oceanic systems... Particularly, on interactions between terrestrial and aquatic systems! (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	We have included a brief paragraph on pCO2 effects on inland waters. There is only limited literature on interactions between terrestrial and aquatic ecosystems via the effects of CO2, and this issue is discussed in Box CC-VW cited here.
540	76789	4	15	46	15	47	this is an ignorant question, but I wondered if there is any effect of acidification of freshwater systems. I know ocean acidification is out of remit for this chapter, but do freshwater systems also worry about increased CO2 for this reason? If so this should certainly be mentioned here. Even if not, maybe a line to explicitly say not, and maybe explain why oceans do but freshwater systems don't (Chris Jones, Met Office)	We have now included a brief paragraph on this. pH of freshwater systems is affected more by other factors than rising CO2.
541	58658	4	15	46	16	28	Is there any research on the comparison of the differences of impacts on ecosystems between elevated CO2 by 100 years and a growing season? FACE experiment is under the condition with increased CO2 concentration in short-term, the results from this experiment is very different with the scale of more than 100 years. The outcomes from FACE experiment are not equal to the reality in real world. (chunfeng wang, State Forestry Administration, China)	We point out that long-term effects are smaller in some studies, but also that palaeo evidence suggests effects of CO2 at the ecosystem scale.
542	85139	4	15	46	16	28	Is there any research on comparison of the differences of impacts on ecosystems between elevated CO2 by 100 years and a growing season? The experiment compacted 100 years' warming into one or several growing seasons. Could the results explain the impacts? (Wu Shaohong, Chinese Academy of Agricultural Sciences)	This section is not about effects of warming, as seems to be thought by the reviewer, but on direct effects of carbon dioxide on plant physiology.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
543	64872	4	15	46	16	54	No mention of tropical forests and FACE. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	At page 17 line 28 of the SOD of this chapter we said "there is currently no tropical FACE experiment". (NB line numbering will probably change in the final version).
544	59279	4	15	53	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence has been revised to make clearer.
545	62893	4	16	2	0	0	The word 'system' may be changed to 'systems'. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	The sentence in which this occurs has been removed in shortening the text.
546	62894	4	16	3	0	0	Please check if the word 'been' after 'assimilation' can be deleted. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	The sentence in which this occurs has been removed in shortening the text.
547	71122	4	16	8	16	11	This sentence is unclear. Suggest revising. (CANADA)	The sentence has been revised to improve clarity.
548	59280	4	16	11	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The sentence in which this occurs has been removed in shortening the text.
549	62895	4	16	11	0	0	The end bracket after '(2012)' may be added. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	The sentence in which this occurs has been removed in shortening the text.
550	57087	4	16	11	16	11	(2012 did -> (2012) did (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	The sentence in which this occurs has been removed in shortening the text.
551	68203	4	16	16	16	18	Some tree species show no response to atmospheric CO2 in terms of stomatal conductance and transpiration, e.g. Fagus silvatica, Pinus pinaster species. (Denis Loustau, INRA)	We have inserted "in many species" to clarify that it is not all species.
552	66412	4	16	17	16	18	Place references in chronological order (Peter Burt, University of Greenwich)	References re-ordered as suggested.
553	59281	4	16	19	0	21	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We assume this referred to the use of "includes" instead of "include". This has been corrected.
554	58334	4	16	19	16	19	it would be good to add the woks showing that amazonian trees are growing more very probably due to CO2 fertilization, as said p 20 line 49 without refs, and p 26 l 10-14 and 34-35 with references (repetition allowed) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We do not have the space to repeat points made elsewhere in the chapter.
555	66413	4	16	20	16	20	via' should be italics (Peter Burt, University of Greenwich)	Italicised as suggested.
556	71123	4	16	22	16	28	Do these statements apply to just C4 plants, as suggested by the context? Some references are for C3 plants. (CANADA)	These statements have either been moved or deleted during revision and shortening of the text.
557	66414	4	16	24	16	24	Place Carney and Drake references in chronological order. (Peter Burt, University of Greenwich)	These references and the associated sentence have been removed in shortening the text.
558	71124	4	16	30	0	0	Typically 'resilience' is a term used to describe ecosystems; in contemporary complex systems science literature it is considered an emergent property of ecosystems, in addition to other such as productivity, and species composition/physiognomy. It seems more appropriate to use 'adaptation' rather than resilience to describe Individual, populations, and species responses to environmental change. Perhaps describing ecosystems as 'adaptive entities' is a convenient 'shorthand' for describing adaptation of species, populations, and individuals. Perhaps the use of resilience (ecosystems) vs. adaptation (spp, & populations) could be distinguished, or at least the use of the terms for this document defined. (CANADA)	We have changed "can assist in maintaining resilience" to "can affect the response".
559	71125	4	16	32	16	33	How far back is "evolutionary time"? It must be difficult to tell if some biodiversity-sustaining events have changed relative to evolutionary time. (CANADA)	We assume this refers to page 19 lines 32-33 as it fits the context much more than page 16 lines 32-33. If so, the sentence in question has been re-phrased.
560	71923	4	16	32	16	33	allow woody plants to become tall enough to withstand ground fire..in rangelands'. This is a potentially questionable statement. First, woody plants in rangelands are typically shrubby and never out of zone of flames; Second, taller is not necessarily better to withstand ground fires, but rather thicker bark. (UNITED STATES OF AMERICA)	The cited papers provide the evidence for the statement. The reviewer has not provided references to support the objection. We retain the sentence but add "In savannas" to be more specific in relation to the evidence cited.
561	71126	4	16	32	16	34	Suggest omitting this sentence. This only applies to savanna systems with specific assumptions on co2-growth response. Could add to section 4.3.3.2.1 (CANADA)	We have added "In savannas". We consider it is a useful example of how Co2 effects interact with other processes so have retained it.
562	71924	4	16	35	16	36	Insert reference. Mohan, J.E., L.H. Ziska, W.H. Schlesinger, R.B. Thomas, R.C. Sicher, K. George, and J.S. Clark. 2006. Biomass and toxicity responses of poison ivy (Toxicodendron radicans) to elevated atmospheric CO2. PNAS 103(24): 9086-9089. (UNITED STATES OF AMERICA)	This is a very useful reference as it refers to additional experimental evidence concerning the statement, so has been inserted.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
563	57705	4	16	39	0	0	Add reference: PEÑUELAS J., CANADELL J., OGAYA R. 2011. Increased water-use efficiency during the 20th century did not translate into enhanced tree growth. <i>Global Ecology and Biogeography</i> 20: 597-608. (Josep Penuelas, CREAM-CSIC)	The suggested paper seems rather specific to be cited in relation to this general statement, and moreover the statement has been revised and shortened, so we have not inserted this citation. The paper is already cited elsewhere in the chapter.
564	78260	4	16	42	16	42	I believe that the Zavaleta et al. (2003a) reference to the Jasper Ridge Global Change Experiment was from the study after the experiment was moved to an annual grassland on a clay-loam soil at Jasper Ridge (rather than the original experiment on the serpentine soils). Thus, the words "grassland on serpentine soils" may not be correct here for this reference from the results of JRGCE. (Aaron Strong, Stanford University)	We have removed the reference to this study since it is from 2003 so does not reflect new science since AR4 and is merely one of three examples cited - the other two examples are post-AR4.
565	70922	4	16	52	0	0	spatial' scale? (Andrew Friend, University of Cambridge)	"spatial" has been inserted.
566	71127	4	17	1	17	9	Difficult to understand. Consider revising. (CANADA)	We have removed "inclusion of" from the start of the sentence to make it less cumbersome.
567	71925	4	17	1	17	9	Paragraph references generically "CO2 effects" in first sentence; second sentence talks about a climate model simulation; and third sentence references "However, when CO2 effects are included." Clarify that this paragraph is about CO2 effects not mediated through warming by saying directly something like "CO2 fertilization effects" or "CO2 effects on plant growth and physiology." Perhaps this comment applies to all of section 4.2.4.4; on page 15 line 47, could clarify that "The discussion here is focused on impacts on terrestrial ecosystems and inland water systems that are not mediated through the global carbon cycle and CO2's global mean temperature impacts." (UNITED STATES OF AMERICA)	We have clarified this in the opening section of this section.
568	71926	4	17	3	17	4	The phrase "this leads to widespread forest loss being simulated under most climate projections.." seems to contradict the previous assertion on p. 6, lines 2-3. Explain why. (UNITED STATES OF AMERICA)	This sentence has been removed during shortening of the text.
569	58335	4	17	4	17	5	Uncomprehensible (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This sentence has been removed during shortening of the text.
570	70924	4	17	5	0	0	Also cite Friend et al. (submitted, PNAS) (Andrew Friend, University of Cambridge)	We now cite Friend et al, Carbon residence time dominates uncertainty in terrestrial vegetation responses to future climate and atmospheric CO2 (accepted for publication in PNAS), since it presents results of ecosystem models driven by the new RCP scenarios so provides new additional evidence relating to the statement based on the current scenarios.
571	58336	4	17	6	17	6	Put as much as (than) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This comment does not appear to refer to this line, and unfortunately we cannot identify whether it relates to a different line. No action taken in response to this.
572	70923	4	17	7	0	0	I am not sure how formulations of photosynthesis would be influenced by FACE experiments as implied here (Andrew Friend, University of Cambridge)	This sentence has been removed during shortening of the text.
573	71927	4	17	7	0	0	What are implications of DGVMs not including FACE experiments? (UNITED STATES OF AMERICA)	This sentence has been removed during shortening of the text.
574	76790	4	17	11	17	24	Good et al. ( <i>J. Climate</i> , 2011) is a good example of how the CO2 direct effect on vegetation may ameliorate a risk from climate change (in that case Amazon dieback) (Chris Jones, Met Office)	This reference has been included.
575	71128	4	17	27	17	28	Suggest rewording this to: "Large-scale FACE experiments have only been carried out on temperate/boreal species and only at temperate locations (e.g. Hickler et al. 2008); there are currently no boreal or tropical FACE experiments." (CANADA)	The reviewer is correct - large-scale studies of boreal species have taken place in temperate regions. We have made the suggested change but specifically saying that there are currently no tropical or large-scale boreal FACE experiments" as small-scale FACE experiments on bog ecosystems exist in Finland and Sweden.
576	66415	4	17	28	17	28	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Peter Burt, University of Greenwich)	We disagree that capitalisation is normal here. No change made.
577	66416	4	17	29	17	29	Space required between number and unit (Peter Burt, University of Greenwich)	Space inserted
578	62896	4	17	32	0	0	The end bracket after 'ppmv)' may be removed. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	Bracket removed.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
579	57088	4	17	33	17	33	21st Century -> 21st century (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Phrase removed in shortening the text.
580	58337	4	17	34	17	34	Rather RCP 4.5 (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Reference to a specific RCP has been removed from this part of the text during revisions for shortening and clarity.
581	59282	4	17	35	0	37	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been removed during shortening of the text.
582	59283	4	17	36	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been removed during shortening of the text.
583	59284	4	17	41	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Full stop has been inserted.
584	70925	4	17	41	0	0	It would be helpful to have some numbers here, otherwise it sounds like a very negative outlook. CO2 increases may have very positive implications for ecosystem productivity and water resources (Andrew Friend, University of Cambridge)	We have given this comment very careful consideration, and are unable to see which numbers would be relevant or how adding additional detail can retain the clarity of this summary statement. "Negative" or "positive" slants are value judgements - we consider that this statement summarises the main conclusions of the section objectively. No change has been made.
585	78619	4	17	42	0	0	Include: Tranvik et al. 2009 explored the role of lakes in carbon cycling and global climate, examine the mechanisms influencing carbon pools and transformations in lakes, and discuss how the metabolism of carbon in the inland waters is likely to change in response to climate. They synthesize that (1) inland waters constitute a significant component of the global carbon cycle, (2) their contribution to this cycle has significantly changed as a result of human activities, and (3) they will continue to change in response to future climate change causing decreased as well as increased abundance of lakes as well as increases in the number of aquatic impoundments. (Reference: Tranvik L.J. AND OTHERS. 2009. Lakes and reservoirs as regulators of carbon cycling and climate. Limnology and Oceanography 54: 2283–2297. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The content of this paragraph concerns the global carbon cycle so is more relevant to WG1 chapter 6. No change has been made.
586	71928	4	17	44	0	0	The section on "Diffuse Versus Direct Radiation" should be further explained, including how the apparent near-total lack of understanding of the possible impacts of aerosol geoengineering means that no such actions could be taken. (UNITED STATES OF AMERICA)	This chapter deals specifically with impacts on terrestrial and freshwater systems, so discussion of the wider impacts beyond these systems is outside the scope of this chapter. Further discussion of Solar Radiation Management is in the Working Group 1 volume, chapter 7 section 7.7. The IPCC provides policy-relevant scientific information but is not policy-prescriptive, so we are unable to oppose or support any particular policy.
587	80072	4	17	46	0	0	Lack of knowledge on the effects of changes in radiation on inland waters. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	No references provided in support of this rather general comment, and due to limitations of space we are unable to add additional text unless there is a strong reason to do so. We consider that we have covered the main effect of direct / diffuse radiation on terrestrial and inland water systems and done as much as space will permit in this section.
588	62897	4	17	47	0	0	Please check if the word 'between' can be replaced with 'as'. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	We prefer "between" because the key point is the partitioning into these forms, and we feel that this word emphasis this.
589	70926	4	17	48	0	0	with more diffuse 'is reduced' meaning 'has been'? over what timescale? (Andrew Friend, University of Cambridge)	We have clarified that this is over the industrial era.
590	71929	4	17	48	17	48	Is the trend (over time) toward "dimming" throughout the world? Isn't it the case that pollution control measures in developed countries (e.g. the US Clean Air Act) have reduced aerosols over recent decades, leading to "brightening"? (UNITED STATES OF AMERICA)	We have mentioned air quality measures and their effect on aerosol concentrations in the future and recently.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
591	71930	4	17	49	0	0	Reduced by up to 30 W m-2 since when? Please clarify. (UNITED STATES OF AMERICA)	We have clarified that this is over the industrial era.
592	71931	4	17	51	17	52	It would be beneficial to include another sentence to explain how diffuse radiation increases net photosynthesis over direct radiation, especially with the modeled 25% increase in C sink due to this process. (UNITED STATES OF AMERICA)	We have included a short explanation.
593	76791	4	18	2	0	0	when you say "a scenario of climate change and decreased aerosol" you could note that most scenarios (certainly all RCPs) project a strong decrease in anthro aerosols, so this aspect is more than just a single scenario, but probably quite likely (Chris Jones, Met Office)	We have now done so.
594	57089	4	18	3	0	0	21st Century -> 21st century (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Correction made.
595	66417	4	18	3	18	3	Insert 'the' after 'of'. (Peter Burt, University of Greenwich)	Insertion made.
596	71932	4	18	5	18	6	Look up the Boucher et al. reference to see if a full, formal citation is available yet. (UNITED STATES OF AMERICA)	The Boucher et al citation was to a chapter in the Working Group 1 volume of AR5, which will be released ahead of the Working Group 2 volume. The citation has been changed to follow the standard format of cross-WG citation.
597	76502	4	18	9	0	0	Section 4.2.4.6. "Invasive and Alien Species". I think it would be important to explain the difference between invasive and alien species (in the glossary?) (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We agree - this has been defined in the glossary
598	57900	4	18	9	18	9	Suggest add an example showing climate-driven invasion of alien species negatively affect endanger species under climate warming. The is, extending its range northwards and upwards in response to winter warming. The invasion of the pine processionary moth (a highly damaging pine defoliator on Scots pine) in the Alps with temperature increase has imposed a big threat to the Spanish moon moth, a red listed species (Imbert et al. 2012). Imbert CE, Goussard F and Roques A, 2012. Is the expansion of the pine processionary moth, due to global warming, impacting the endangered Spanish moon moth through an induced change in food quality? Integrative Zoology 2012; 7: 147–157 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	Space constraints prevent a more detailed coverage of examples such as these.
599	77850	4	18	11	18	18	it should be add one comment that alien species occur in regions not only because of climate change but also because of human activity - for example inland water navigation, transport etc. (POLAND)	This point has been made
600	62853	4	18	13	18	15	I was wondering here how alien species were being defined. If a native species expands its range because of climate change is it considered alien in this context? I wouldn't call it alien, but the text isn't clear on this point. (Mark Urban, University of Connecticut)	We agree that definitions are important and this is now clarified in the glossary
601	57704	4	18	16	0	0	Add reference : SARDANS J., PEÑUELAS J. 2012. The role of plants in the effects of Global Change on nutrient availability and stoichiometry in the plant-soil system. Plant Physiology 160: 1741-1761. (Josep Penuelas, CREAL-CSIC)	We do not believe this is needed
602	80073	4	18	20	0	0	Climate change will severely change connectivity between different ecosystems, e.g. river catchment basins are increasingly connected and disturbed via dams, floods or droughts etc., facilitating invasion... (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This point has been made in the revised draft
603	80074	4	18	20	0	0	I miss a statement on microbial invasions, e.g. problem of pathogenic species due to increased and continuous human waste discharge.. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	Pathogens now mentioned-see edit above
604	76503	4	18	23	18	24	This is not clear. Is there a reference to support this statement? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	The supporting references were included at the end of this sentence in line 26 and 27.
605	61021	4	18	23	18	27	Is there any supporting evidence that could be included which shows that invasive animal species have similar traits to those identified in plants? i.e. faster growth rates? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes - this has been shown for springtails - a reference that we had included in an earlier draft but that is not included in the current one
606	76504	4	18	27	18	29	Is this universal or for instance, invasive plants tend to be more drought tolerant, when considering only species in a invaded habitat where drought is an important filter? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	The statement has been revised to acknowledge this point - that "Some invasive plants are more drought tolerant ...".
607	71933	4	18	31	0	0	Define the term resource pulses (UNITED STATES OF AMERICA)	We have changed the phrase to 'redistributing available resources'

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
608	78603	4	18	31	18	40	Hopefully you talk of ecologically invasive & not internationally invasive - the latter usage obscures the problem, its causes, & mitigation. Much of this paragraph applies equally well to native species (e.g., Candau, J-N & RA Fleming 2011 Forecasting the response of spruce budworm defoliation to climate change in Ontario. Can. J. For. Res. 41: 1948-1960). It would be more interesting if you took a more causal, mechanistic approach here. For instance, does climate change help invasives in their dispersal or establishment & then relate how disturbance & resource pulse affect these. (richard arthur fleming, canadian forest service)	We have adopted a mechanistic approach - the original draft was explicitly structured to examine evidence for the various phases of invasion, and I think this is still sufficiently covered in the final draft
609	66418	4	18	34	18	34	Insert commas either side of 'however'. (Peter Burt, University of Greenwich)	We have made the suggested change on edited draft
610	66419	4	18	38	18	38	'chapter' should be 'Section' (with a capital 'S' as a proper noun in this context). (Peter Burt, University of Greenwich)	We have made the suggested change on edited draft
611	71934	4	18	39	18	40	Statement may not be entirely accurate. Suggest that authors review additional information or rephrase. (UNITED STATES OF AMERICA)	We have revised this to "may be favoured"
612	71130	4	18	42	0	45	The proposed benefits to biodiversity and society of interactive effects of climate change and invasive species on threatened species, forest structural recovery, and available biomass is unclear. Can the authors be more specific about how this interaction affects these societal values? (CANADA)	There is not scope in this section to consider this in more detail - further information can be found in the cited references
613	71129	4	18	42	18	45	Difficult to follow. Examples of interactive effects are too disparate. (CANADA)	These are intended as a few examples of interactive effects and are not intended to be comprehensive
614	71131	4	18	52	0	0	Are negative 'cumulative effects' the same as 'Threat syndromes'? Is this a new term used commonly in the literature with regard to risk and risk assessment? Does 'threat syndrome' need to be defined in the glossary? (CANADA)	This has been rephrased to remove 'threat syndromes'
615	71935	4	18	52	0	0	Explain/define "threat syndromes" (UNITED STATES OF AMERICA)	This has been rephrased to remove 'threat syndromes'
616	59285	4	18	52	19	14	Here, confidence levels for expected changes are given, but without additional information regarding evidence and/or agreement and/or robustness (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	These statements are based on the assessed literature as referenced. There is not the scope to go into more detail here.
617	80075	4	19	0	0	0	This chapter is largely biased towards terrestrial systems and little is mentioned on inlandwaters and their interaction with terrestrial systems. This is particularly true for the subheadings: 4.3.1.1. to 4.3.2.4. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This general comment has been dealt with elsewhere; by moving sections from 4.3.3.3 to earlier sections and with new material. Freshwater invasions are mentioned here, but the evidence for climate change invasion interactions is dominated by publications on terrestrial systems.
618	70927	4	19	2	0	0	surprisingly little so far on freshwater ecosystems (Andrew Friend, University of Cambridge)	See comment 617. There is little empirical work on the interaction between climate change and invasion in freshwater that provides conclusions different from the general points made about invasion.
619	68204	4	19	9	0	0	Robinet and Roques refer to forest not crops. (Denis Loustau, INRA)	This refers to forests managed in part for timber harvest - we have changed crop systems to 'production systems'
620	71132	4	19	9	19	11	Suggest that "Warming has led to..." be changed to "Warming has contributed to". In the case of mountain pine bark beetle cited here, it is generally agreed that other factors contributed to the scale of forest loss, even though climate warming clearly played an important role. (CANADA)	We have made the suggested change on revised draft
621	78604	4	19	9	19	11	There are many better refs than Kurz for this point. Kurz focusses on the CO2 generated by the MPB outbreak. Check out Allan Carroll & Ken Raffa. (e.g., Raffa et al 2008 Cross-scale Drivers of Natural Disturbances Prone to Anthropogenic Amplification: The Dynamics of Bark Beetle Eruptions. BioScience 58(6)). Good to see 'invasive' used in the ecol sense here but might want to address that issue with a brief explanation (or did I miss it?). (richard arthur fleming, canadian forest service)	We have made the suggested change on edited draft.
622	70928	4	19	10	0	0	is this insect invasive? (Andrew Friend, University of Cambridge)	No it includes fungal pathogens, viruses, bacteria and phytoplasmas
623	68205	4	19	12	0	14	I suggest to replace this by: Management strategies should therefore account for the potential occurrence of alien pests into naive populations of plant or animal species of economic interest. (Denis Loustau, INRA)	We believe the original text is more appropriate in this context

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
624	71133	4	19	13	19	14	Perhaps say "effective mechanical control as biomass (and/or population size) of invasive species increases"? It is possible that some invasives are physically smaller than the species they replace... but better adapted, so numbers rather than biomass may be the critical factor. (CANADA)	This has been revised
625	70370	4	19	17	0	0	Section 4.3. This section unfortunately mixes detection and attribution of historical impacts with analysis of future vulnerabilities. It would be good to highlight the substantial historical impacts of climate change by providing it with its own separate section. So, I suggest moving the historical impacts parts of Section 4.3.2 and 4.3.3 to a separate section preceding the material on future vulnerability. (Patrick Gonzalez, National Park Service)	We have completely reorganised the detection and attribution statements. They are now embedded in the various sections, and are usually flagged as D&A statements.
626	81775	4	19	17	0	0	Section 4.3. In preparing the final draft, the chapter team should shorten this section by 50%. (Katharine Mach, IPCC WGII TSU)	Agreed. The major strategy used has been to tabulate much material, and then shorten some sections (phenology and species movement).
627	79940	4	19	17	35	2	Section 4.3. Other extinction drivers (mostly of antropogenic origin) have to be discussed in relation to climate change as a driver of species extinctions, not only as drivers of change of the physical/chemical environment. Today habitat loss and fragme (NORWAY)	The discussion of other drivers of change has been explicitly targetted to how they interact with climate change.
628	70371	4	19	19	4	19	This should be edited to be consistent with the IPCC AR4 definition of vulnerability, perhaps by saying "...is defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change. It is composed of three elements..." (Patrick Gonzalez, National Park Service)	The main point is that it needs to be consistent with the AR5 WGII vulnerability definition, which we used as baseline.
629	71134	4	19	19	19	24	Suggest changing "their" to "the" as in ".. the degree to which the climatic environment..." to match the reference to ecosystem (singular) that follows. (CANADA)	Done
630	85122	4	19	19	19	24	As mentioned in my general comments, the definition of vulnerability presented here is not consistent with the definition in the context of AR5 (see AR5 WGII Glossary), which defines vulnerability as the propensity or predisposition to be adversely affected. While the second two components expressed here are consistent, the degree to which the climatic environment of a terrestrial ecosystem changes relative to conditions under which the ecosystem evolved is a measure of changes in physical conditions (in exposed systems) rather than vulnerability in the AR5 context. As characterized in Chapter 19 and the draft SPM and TS, both physical changes and vulnerability interact with exposure to determine risks. At minimum, the definitional difference needs to be addressed explicitly here, but it would be preferable to consider adapting the definition of vulnerability used in the chapter and to consider physical changes, vulnerability, and exposure separately (and as determinants of risk) in the chapter discussions. (Michael Mastrandrea, IPCC WGII TSU)	Actually, it is not inconsistent - we should not have used the word 'defined' here, when we meant 'determined'. We have removed the apparent inconsistency.
631	62854	4	19	20	19	20	An ecosystem cannot evolve, only populations can (Mark Urban, University of Connecticut)	The reviewer is correct, strictly speaking. We now use the word 'developed'.
632	70929	4	19	21	0	0	I cannot see how the second two of these things which define vulnerability are fundamentally different from each other. Surely the sensitivity and the degree to which the ecosystem can maintain itself are the same thing? (Andrew Friend, University of Cambridge)	No, they are not the same. For instance, the sensitivity might be the steepness of the respiration rate to temperature curve, but the coping capacity is the plasticity of that curve.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
633	71135	4	19	28	19	50	One thing that could be stated here is also that species are adapted to quite a range of variation in disturbance characteristics. With regards to fire for instance, as a result of natural selection, the degree of resistance or tolerance to fire through specific reproductive mechanisms varies both within and among species. Jack pine and lodgepole pine are fire adapted, with early sexual maturity and serotinous, fire-resistant cones. In both species, the proportion of trees with serotinous cones is higher in populations occurring in regions where the fire regime is dominated by extensive lethal fires than in those where the fire regime is characterised by local non-lethal fires (Muir and Lotan 1985; Gauthier et al. 1996). In general, black spruce, trembling aspen and paper birch have an intermediate degree of vulnerability to repeated fires, and to drought conditions for establishment in the case of black spruce (Le Goff and Sirois 2004; Jasinski and Payette 2005; Moss and Hermanutz 2009). Genetic and phenotypic variability of resistance to pests also contributes to adaptive capacity. For example, populations of boreal tree species that cope with recurring insect outbreaks tend to have adaptive traits such as well-established seedling banks (Baskerville 1975; Duchesneau and Morin 1999), prolific propagule production (Greene et al. 1999), or physiological and phytochemical mechanisms of pest resistance and resilience (Keeling and Bohlmann 2006). References: Gauthier, S., Bergeron, Y., and Simon, J.-P. 1996. Effects of fire regime on the serotiny level of jack pine. <i>J. Ecol.</i> 84(4): 539–548. Muir, P.S., and Lotan, J.E. 1985. Disturbance history and serotiny of <i>Pinus contorta</i> in western Montana. <i>Ecology</i> , 66(5): 1658–1668. doi:10.2307/1938028. Le Goff, H., and Sirois, L. 2004. Black spruce and jack pine dynamics simulated under varying fire cycles in the northern boreal forest of Quebec, Canada. <i>Can. J. For. Res.</i> 34(12): 2399–2409. doi:10.1139/x04-121. Jasinski, J.P.P., and Payette, S. 2005. The creation of alternative stable states in the southern boreal forest, Québec, Canada. <i>Ecol. Monogr.</i> 75(4): 561–583. Moss, M., and Hermanutz, L. 2009. Postfire seedling recruitment at the southern limit of lichen woodland. <i>Can. J. For. Res.</i> 39(12): 2299–2306. doi:10.1139/X09-150. Baskerville, G.L. 1975. Spruce budworm: super silviculturist. <i>For. Chron.</i> 51(4): 138–140. Duchesneau, R., and Morin, H. 1999. Early seedling demography in balsam fir seedling banks. <i>Can. J. For. Res.</i> 29(10): 1502–1509. Greene, D. F., Zasada, J. C., Sirois, L., Kneeshaw, D., Morin, H., Charron, I., and Simard, M.-J. 1999. A review of the regeneration dynamics of North American boreal forest tree species. <i>Can. J. For. Res.</i> 29(6): 824–839. doi:10.1139/x98-112. Keeling, C.I., and Bohlmann, J. 2006. Genes, enzymes and chemicals of terpenoid diversity in the constitutive and induced defence of conifers against insects and pathogens. <i>New Phytol.</i> 170(4): 657–675. (CANADA)	This is detailed and useful information, but too specific to this example, and too long to replicate for several ecosystems
634	68206	4	19	29	0	0	components instead of "factors" (Denis Loustau, INRA)	We have used 'considerations'
635	64754	4	19	29	19	39	There is an opportunity in this paragraph to connect changes in extremes and disturbance regime shifts to thresholds and tipping points. Add sentence at the end of the paragraph "However, subtle changes in climate extremes and disturbance regimes may result in significant changes in ecosystem structure as environmental thresholds are crossed and irreversible tipping points exceeded." (Robert Webb, NOAA OAR ESRL)	Nice point, but the problem is making it a conclusion founded in literature, which unfortunately was not provided.
636	71936	4	19	29	19	39	This section makes a very important point and would benefit from a bulleted (like (a), (b), (c)) presentation and some illustrative examples. (UNITED STATES OF AMERICA)	Thank you. We have refrained from using bullets and numbered subclauses throughout, largely to save space
637	62855	4	19	32	19	20	The term, 'evolutionary time,' is not well defined. Evolution can occur over the course of a single generation. Therefore evolutionary time encompasses a wide range of times. I would stay away from this term altogether and just delete the end of this sentence. (Mark Urban, University of Connecticut)	we have rephrased to avoid this term.
638	62856	4	19	33	19	35	What is the support for this idea that extreme conditions determine species ranges rather than means. It is a nice concept, but I don't know of any empirical tests that would verify it, and no citation is given (Mark Urban, University of Connecticut)	The concept has been given a recent reference.
639	70930	4	19	36	0	0	predicted future change? (Andrew Friend, University of Cambridge)	projected' has been used
640	71136	4	19	36	19	37	Recommend this sentence be placed in the context of climate change: E.g. "In a changing climate, changes in the probabilities of such extremes are typically disproportionately larger than the change in the mean (see IPCC, 2012...)" Note that "changes in probabilities of extremes" can be both up and down, as in extreme maximum and minimum temperature events, so the plural is justified even when compared to a singular mean. (CANADA)	The sentence has been changed which should satisfy this comment.
641	71139	4	19	37	0	0	In addition to abiotic disturbances -drought, fire, wind, and floods biotic disturbances such as insect and disease epidemics are also important ecosystem disturbances controlling biodiversity, and directly affected by climate change (CANADA)	Good point, added.
642	71137	4	19	37	19	39	How far back is "evolutionary time"? It must be difficult to tell if some biodiversity-sustaining events have changed relative to evolutionary time. (CANADA)	We have change to ..to which the species are adapted.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
643	71138	4	19	37	19	39	This sentence appears to be incomplete. Suggest reviewing. (CANADA)	The sentence has been changed.
644	62857	4	19	39	0	0	Something seems to be missing in this second part after the colon (Mark Urban, University of Connecticut)	It has been fixed.
645	68207	4	19	39	0	0	I dont understand this sentence. Do you mean that disturbances are part of most ecosystem successional trajectory and are necessary for allowing to maintain a high species richness in a given location ? (Denis Loustau, INRA)	The sentence has been fixed, and should now be clear.
646	71937	4	19	39	0	0	Use of phrase 'outside this range they have adapted to' is unclear. (UNITED STATES OF AMERICA)	The sentence has been fixed, and should now be clear.
647	71938	4	19	44	19	44	The term for "probability intensity function" is not standard. Unclear if authors simply mean probability distribution function or something else.s (UNITED STATES OF AMERICA)	We have clarified.
648	59286	4	19	45	0	45	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have fixed the sentence
649	76505	4	19	45	19	45	improve sentence (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We have fixed the sentence
650	81776	4	19	45	19	45	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	we no longer use the word 'likely' here
651	59287	4	19	47	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have fixed the sentence
652	71140	4	19	47	19	49	The cited literature does not support this statement because 4 out of 5 references are for the western US states and the conclusions from these are unapplicable to other regions of the world. And the fifth reference, Moritz et al., deals with projections of future fire occurrences, not the detection of current trends. References cited here should report on post-fire ecosystem changes. For fire activity trends in Canada, the paper by Gillett et al. 2004Geophysical Research Letters Volume 31, Issue 18, could be relevant. For recent global trends in fire danger, see Girardin, M.P., Ali, A.A., Carcaillet, C., Mudelsee, M., Drobyshev, I., Hély, C., Bergeron, Y. 2009. Heterogeneous response of circumboreal wildfire risk to climate change since the early 1900s. Global Change Biology 15, 2751–2769, doi: 10.1111/j.1365-2486.2009.01869.x. Some of the work by Merritt Turetsky and also Jill Johnstone on post-fire ecological changes could aid supporting this statement. Turetsky, M., E.S. Kane, J.W. Harden, R.D. Ottmar, K.L. Manies, E. Hoy, E.S. Kasischke. 2011. Recent acceleration of biomass burning and carbon losses in Alaskan forests and peatlands. Nature Geoscience 4: 27-31 Brown, C. and Johnstone, J.F. (2012) Once burned, twice shy: Repeat fires reduce seed availability and alter substrate constraints on Picea mariana regeneration. Forest Ecology and Management 266: 34-41. Johnstone, J.F., Hollingsworth, T.K.N., Chapin, F.S., III, and Mack, M.C. (2010) Changes in fire regime break the legacy lock on successional trajectories in Alaskan boreal forest. Global Change Biology 16: 1281-1295 (CANADA)	Thanks for these references, which we have used.
653	76506	4	19	47	19	49	Develop more. Consider the interplay between climate change, fuel structure and fire (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We are constrained by space and cannot make an in depth analysis here - fire is used as a particular example.
654	71141	4	19	47	19	50	It could be pointed out that those changes are often reported over a relatively recent time period. It is difficult to be certain that fire regime has changed drastically when periods with high fire activity have a high year to year variation. One paper (Bergeron et al. 2010 IJWF) has looked at changes in fire frequency over the Holocene and compared that to the projected one with a number of scenarios. It indicates that at the end of the century, fire cycle is likely to be included in the Natural range of variability but at the high end... more studies like this are required. Bergeron, Y., Cyr, D. Girardin, M.P., and C. Carcaillet 2010. Will climate change drive 21st century burn rates in Canadian boreal forest outside of its natural variability: collating global climate model experiments with sedimentary charcoal data. (CANADA)	Also a good point
655	81777	4	20	1	0	0	Section 4.3.2. The title of this section could seem to imply that observations of change will be treated, but there is also a fair amount of consideration of projections. Should the section title be adjusted? (Katharine Mach, IPCC WGII TSU)	The title of this section has been changed to reflect that some sections treat both observations and future projections.
656	59288	4	20	1	0	24	Nevertheless, how confidence in detection of change is defined should have been explained earlier, in the beginning of chapter 4, as confidence in detection has been widely used up to this point.(Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We follow the strict rules, explained in chapter 18, and building on WG1



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
657	71939	4	20	1	27	23	This section on Evidence of Changes in Ecosystems is very strong. However there are inconsistencies between the sections. The sections on phenology, primary productivity, biomass and carbon stocks, and evapotranspiration do not have "observed changes" and "future changes" subsections, which are included in the Changes in Species Range, Abundance and Extinction sections. It would make sense for all of these sections to follow a similar structure for consistency, preferably with the subsections included. (UNITED STATES OF AMERICA)	We have striven for more consistency. Many sections now have a historical and projected subsection, and most a detection and attribution statement. However, some sections do not have a "future changes" section.
658	81778	4	20	5	20	14	The calibrated uncertainty language used on lines 5-6, 9-10 and 14 should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	Calibrated uncertainty language has been italicised.
659	71142	4	20	7	20	9	Suggest revising to: "Note that a slightly different definition of detection is used here than that presented in Chapter 18, because here it is based solely..." (CANADA)	Sentence reworded
660	64755	4	20	7	20	12	The authors should be commended for the approach to climate change impact detection and attribution. The approach used and described in AR5 WG2 Chapter 4 is highly defensible because it documents connections of impacts to changes in regional to local climate (both natural variability and anthropogenic climate change) and will only go further (given the challenges in making causal linkages between observed regional to local changes in climate conditions and anthropogenic climate change) when there is robust detection and attribution of the regional to local climate conditions. Using this approach, valuable information on the impacts of local to regional changes in climate can be communicated to decision makers without waiting for the robust detection and attribution of local to regional climate change that may be forthcoming as the science advances and/or time series of observations become sufficiently long to detect local to regional trends that can be demonstrated to be the result of anthropogenic global climate change. It is a shame that this approach has to be explained as "slightly different definition than Chapter 18 for detection". Instead all AR5 WG2 Chapters should adopt this approach to climate change impact detection and attribution. (Robert Webb, NOAA OAR ESRL)	Thank you.
661	78620	4	20	12	0	0	Include reference at the end of line (Adrian et al. 2009)- is already in the reference list. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This introduction does not have references as these are given later in the text
662	59289	4	20	17	0	18	This sentence should be better deleted. It makes part of section 4.3.2 to which it refers as if it was to follow. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been deleted
663	66420	4	20	18	20	18	Delete 'the' and use capital 'S' for 'Section'. (Peter Burt, University of Greenwich)	This sentence has been deleted
664	71940	4	20	18	20	18	Section 4.3.2 does not "follow this introduction" - this introduction is part of section 4.3.2. (UNITED STATES OF AMERICA)	Sentence deleted
665	68808	4	20	20	20	24	The conclusions made here do not look transparent . Either it has to be supported by additional knowledge with explicit referencing or any recent findings from the author. (NETHERLANDS)	Details are in the text of sections. This is only a summary.
666	61022	4	20	21	20	24	Reference needed for this statement. Suggest: C.D. Jones et al., "Committed terrestrial ecosystem changes due to climate change", Nature Geoscience, 2009, Vol.2, pp.484-487 (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Details are in the text of sections. This is only a summary.
667	66421	4	20	22	20	22	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Disagree. Century not in caps elsewhere in this chapter and most style manuals do not capitalise in this context.
668	81779	4	20	22	20	22	"high confidence" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	We changed the wording to remove reserved language
669	59290	4	20	28	0	29	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The sentence has been reworded.
670	76631	4	20	30	20	30	and also in Fig. 4-5 pag. 147: change "points" in "boxes" (Claudio Cassardo, University of Torino)	Done - the word "symbols" is used
671	62089	4	20	33	20	43	Excellent overview of the state of the literature. (Elizabeth Wolkovich, University of British Columbia)	Thank you, but all of this text has been moved to corresponding sections
672	58339	4	20	33	22	43	For all these paragraphs, GIVE REFERENCES (Martin Pecheux, Institut des Foraminifères Symbiotiques)	All of this text has been deleted and key points added to corresponding sections if necessary
673	58659	4	20	33	22	43	Such a big part of text is read as a summary of the following text, it is very strange to have this "summary". I suggest deleting this part. (chunfeng wang, State Forestry Administration, China)	All of this text has been deleted and key points added to corresponding sections if necessary
674	71143	4	20	33	22	43	These summaries seem out of place - perhaps include them in the relevant sections instead. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
675	81780	4	20	33	22	43	If I remember correctly, this material was presented within a box last time, which seemed to work better. One option for the author team to consider is shortening the subsections and integrating the paragraphs at the start of each subsection to follow (starting with 4.3.2.1 on page 22). Additionally, for all detected changes that are described within these paragraphs, the relevant time frame should be indicated more specifically. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
676	85140	4	20	33	22	43	Such big part of text reads as a summary of the following text, it is very odd to have this "summary". Suggest deleting. (Wu Shaohong, Chinese Academy of Agricultural Sciences)	All of this text has been deleted and key points added to corresponding sections if necessary
677	78621	4	20	36	0	0	nesting for birds, or freshwater and marine species (for review see Adrian et al. 2012), has shifted for.... (Reference: Adrian R., D. Gerten, V. Huber, C. Wagner, S. R. Schmidt (2012). Windows of change: Temporal scale of analysis is decisive to detect ecosystem responses to climate change. Marine Biology: 159:2533–2542. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	All of this text has been deleted and key points added to corresponding sections if necessary
678	81781	4	20	36	20	36	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
679	71941	4	20	37	20	37	The phrase "moderate agreement" is misused here; in standard IPCC-speak it refers to agreement among scientists, rather than "agreement" (that is, similar results) in studies of different species. Suggest using a different term. (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
680	81782	4	20	37	20	37	"medium agreement" should be used instead of "moderate agreement." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
681	68208	4	20	41	0	0	low instead of "high" (Denis Loustau, INRA)	All of this text has been deleted and key points added to corresponding sections if necessary
682	61023	4	20	41	20	41	Should text in italics read "low confidence" or "medium confidence"? The rest of the sentence implies it should do. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	All of this text has been deleted and key points added to corresponding sections if necessary
683	56491	4	20	45	0	0	Should it be "Primary Productivity, Biomass and C Stocks" - removing extra "and". (Archis Ambulkar, Brinjac Engineering Inc.)	All of this text has been deleted and key points added to corresponding sections if necessary
684	71942	4	20	46	0	0	Define/explain eddy flux towers (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
685	71144	4	20	46	20	46	Suggest including inventory-based models in this list (Pan et al., 2011), Ch 4, P 25, L 32. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
686	71943	4	20	47	20	47	"Once the effects of deforestation are accounted for" could be made more clear - suggest rephrasing to read "excluding the carbon emissions from deforestation" or "deforestation and other land use and cover change"; or else it should read "including" (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
687	81783	4	20	49	20	49	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
688	58338	4	20	49	20	53	References required (Martin Pecheux, Institut des Foraminifères Symbiotiques)	All of this text has been deleted and key points added to corresponding sections if necessary
689	71145	4	20	49	20	53	Suggest including a comment relating to reduced impacts of CO2 enhancement at cold locations. There is some overlap here with Section 4.2.4.4. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
690	71944	4	20	50	0	0	In North America, secondary regrowth after heavy harvests (e.g., eastern US practically clear cut by 1920) is a primary reason for the sink, and this sink is shrinking because forests are maturing again. (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
691	64873	4	20	51	20	51	" Most studies speculate that rising CO2 concentrations are contributing to this trend... " (ambiguous statement based on the word speculate). If there are some specific references regarding the speculation or ambiguous in this place them in. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	All of this text has been deleted and key points added to corresponding sections if necessary
692	71146	4	20	51	20	53	Should "most studies" be changed to "many studies"? E.g., some tree-ring studies have looked for CO2 fertilization effects but not been able to demonstrate a statistically significant trend. At P. 26, L. 11-L. 12, it is stated that about 20% of ITRDB sites indicate CO2 fertilization, which implies that the remaining 80% do not. Girardin et al. 2011. Testing for a CO2 fertilization effect on growth of Canadian boreal forests. Journal of Geophysical Research. Vol. 116, G01012, doi:10.1029/2010JG001287. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
693	78622	4	20	54	0	0	We can expect a higher phytoplankton biomass and particularly higher biomass of cyanobacteria under warm climates (Jöhnk et al. 2008, Wagner and Adrian 2009, Jeppesen et al., 2009). (references: K. D. JÖHNK, J.HUISMAN, J. SHARPLES, B.SOMMEIJER, P. M. VI S S E R and J . M . STROOM. 2008. Global Change Biology 14, 1–18; Wagner, C., Adrian R. 2009. Cyanobacteria blooms: Quantifying the effects of climate change. Limnology and Oceanography 54(6): 2460-2468; Jeppesen, E. , B. Kronvang, M. Meerhoff, M. Søndergaard, K. M. Hansen, H. E. Andersen, T. L. Lauridsen, and L. Liboriussen, M. Beklioglu and A. Özen, J. E. Olesen. 2009. Climate Change Effects on Runoff, Catchment Phosphorus Loading and Lake Ecological State, and Potential Adaptations. J. Environ. Qual. 38:1930–1941 (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	All of this text has been deleted and key points added to corresponding sections if necessary
694	81784	4	21	3	21	3	"low agreement" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
695	58660	4	21	4	21	7	I don't think para 4.3.2.4 can support "The trend of rising.....land management and irrigation." (chunfeng wang, State Forestry Administration, China)	All of this text has been deleted and key points added to corresponding sections if necessary
696	62898	4	21	5	0	0	The word 'in' after 'trend' is suggested to be deleted. (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	All of this text has been deleted and key points added to corresponding sections if necessary
697	57901	4	21	9	21	9	Suggest add examples showing range shift under global warming caused outbreaks of pests. Trăn et al. (2007) show that new beetle outbreaks in New Jersey and Ohio (2001), and then in Maryland (2005) are directly caused by latitudinal shift due to warming up in winter. Warm winter also caused the range shift of mountain pine beetle Dendroctonus ponderosae Hopkins and the unprecedented outbreak of this species damaing over 10.1 million hectares of lodgepole pine forests (Pinus contorta Dougl.) in British Columbia, Canada (Robinet and Roques 2010.) Robinet C and Roques A 2010. Direct impacts of recent climate warming on insect populations Integrative Zoology 5: 132-142 Trăn JK, Ylioja T, Billings R, Régnière J, Ayres MP (2007). Impact of minimum winter temperatures on the population dynamics of Dendroctonus frontalis. Ecological Applications 17, 882–99. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	All of this text has been deleted and key points added to corresponding sections if necessary
698	62858	4	21	9	21	25	The take-away message I get from this paragraph is that only arthropods have shifted ranges with climate change. There are good studies showing this is the case for birds (Tingley et al. 2012) and mammals (Mortiz et al. 2008). (Mark Urban, University of Connecticut)	All of this text has been deleted and key points added to corresponding sections if necessary
699	59291	4	21	12	0	15	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	All of this text has been deleted and key points added to corresponding sections if necessary
700	81785	4	21	14	21	15	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
701	81786	4	21	18	21	18	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
702	66422	4	21	22	21	22	Change 'importance' to 'important'. (Peter Burt, University of Greenwich)	All of this text has been deleted and key points added to corresponding sections if necessary
703	56492	4	21	22	21	25	The sentence needs to be revised - some suggestion "An important advance", "is the recognition of changes in climate over the last several decades that have led..." (Archis Ambulkar, Brinjac Engineering Inc.)	All of this text has been deleted and key points added to corresponding sections if necessary
704	68209	4	21	23	0	0	"that" after recognition is missing. (Denis Loustau, INRA)	All of this text has been deleted and key points added to corresponding sections if necessary
705	59874	4	21	27	21	28	The statement 'There is high confidence that global species extinctions are at or above the highest rates of species extinction in the fossil record', is not precisely consistent with p32, line32-33: 'Global species extinctions, many of them caused by human activities, are now close to the upper limits of observed natural rates of extinction in the fossil record' (Barnosky et al., 2011) (AUSTRALIA)	All of this text has been deleted and key points added to corresponding sections if necessary
706	76632	4	21	28	21	28	"highest rates of species extinction in the fossil record": how long is this record? "highest rate" even if compared with the 5 major mass extinctions or with what else? (Claudio Cassardo, University of Torino)	All of this text has been deleted and key points added to corresponding sections if necessary
707	81787	4	21	30	21	30	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
708	58340	4	21	37	21	37	Add provisions on future global extinctions (20% to 50%) (Thomas et al., 2004, Pereira et al., 2010, Hannah (ed), 2012 and refs. herein) Hannah L (Ed), 2012, Saving a million species. Extinction risk from climate change. Island Press, Washington, USA, 417 pp. Pereira HM et al., 2010, Scenarios for Global Biodiversity in the 21st Century. Science, 330, 1496-1501. Thomas CD et al., 2004, Extinction risk from climate change. Nature, 427, 145-148. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	All of this text has been deleted and key points added to corresponding sections if necessary
709	71945	4	21	37	21	37	Suggest using "invasive pathogens" rather than "invasive disease". (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
710	66423	4	21	39	21	40	Imprecise, and bad English. I suggest 'have increased' rather than 'are increasing' and 'since 19XX' rather than 'over ..decades'. (Peter Burt, University of Greenwich)	All of this text has been deleted and key points added to corresponding sections if necessary
711	81788	4	21	39	21	40	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
712	81790	4	21	45	21	48	It would be preferable to specify the approximate time frame for these changes. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
713	57717	4	21	45	21	51	Tree mortality. If warming increases the stem height growth more than stem diameter growth, trees are likely to be taller but also thinner from the base. Doesn't this also increase the risk of tree mortality, especially in areas where weather extremes (high wind storms) are increasing? Has this been estimated anywhere? Another regional/local risk might be winter-time flooding (if the main part of winter-time precipitation comes as water, not snow): any information about this risk? (Anne Kasurinen, University of Eastern Finland)	All of this text has been deleted and key points added to corresponding sections if necessary
714	71147	4	21	48	21	51	Lack of time series measurements is certainly a problem, but some studies have used tree rings, including rings found in dead trees, to infer changes in growth and mortality rates over periods of decades to centuries. (It is recognized that tree ring data tend to be biased in favor of the survivors). Perhaps note that such techniques show promise for unravelling climatic effects from other factors? (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
715	81789	4	21	49	21	49	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
716	71148	4	21	52	22	20	What is meant by Regimes shift in each of the subsection titles? What regimes are being referred to? (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
717	78605	4	21	53	21	54	disagree! MPB is NOT in the boreal forest. Spruce Beetle is making some in-roads in the N-W boreal. The current Spruce Budworm Outbreak is remarkably small compared to the mid-1970s. The Russians have v little data to go on. (richard arthur fleming, canadian forest service)	All of this text has been deleted and key points added to corresponding sections if necessary
718	71149	4	22	2	22	2	Suggest changing "morality" to "mortality" (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
719	76633	4	22	2	22	2	typo: "morality" --> "mortality" (Claudio Cassardo, University of Torino)	All of this text has been deleted and key points added to corresponding sections if necessary
720	71150	4	22	4	0	19	Section 4.3.2.1. on Phenology: This entire section does not seem to flow in an overtly logical way: satellite imagery; breeding phenology, patterns of autumn migration; behavioral changes and high temps (also some information on migration changes); snow cover and snow depth effects; experiments vs. models vs. observations; changes in phenology changing interspecific interactions; differential species responses. Perhaps some additional thought could be give to how this section is organized, so the impacts of CC on phenology are more effectively presented. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
721	78606	4	22	5	0	0	Common mis-conception. Changes in range are inconsequential since it takes thousands, if not millions, of insects to do real forest damage. What warming does is allow much greater survival (partic in winter) so populations can build up to damaging levels more often. Range extension can help but is not the primary reason. After all, range extent is typically determined by v low density populations which are barely hanging on. This is why studies of actual insect-caused damage are actually much more relevant than range shifts. (richard arthur fleming, canadian forest service)	All of this text has been deleted and key points added to corresponding sections if necessary
722	71151	4	22	6	22	7	Perhaps insert "recent" before "climate change" at end of L. 6? (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
723	81791	4	22	9	22	10	It would be preferable to indicate more specifically the approximate timeframe for these changes. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
724	81792	4	22	10	22	10	"medium confidence" should be used in place of "moderate confidence." (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
725	76634	4	22	14	22	14	"vines": I am a wine amateur and understand the economic importance of vines, however their distribution is almost null on a global basis, and I do not understand why this consideration on vines is inserted in the paragraph of "Amazon Forest regime shift"... (Claudio Cassardo, University of Torino)	All of this text has been deleted and key points added to corresponding sections if necessary
726	81793	4	22	20	22	20	It would be preferable to specify the approximate timeframe for these observed changes. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
727	76792	4	22	20	22	27	can you say anything here on wetland extent changes and changes in lake (number or extent) (Chris Jones, Met Office)	All of this text has been deleted and key points added to corresponding sections if necessary
728	64874	4	22	29	22	29	Cultural landscapes should have more diversified examples not just from Japan or Europe. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	All of this text has been deleted and key points added to corresponding sections if necessary
729	81794	4	22	29	22	31	It would be preferable to indicate the approximate timeframe for these changes. (Katharine Mach, IPCC WGII TSU)	All of this text has been deleted and key points added to corresponding sections if necessary
730	71946	4	22	30	22	30	Explain what "Satoyama landscapes" are. Is this a region of Japan, or a kind of habitat, or form of agroecosystem? (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
731	66424	4	22	32	22	32	Delete comma after 'al.'. (Peter Burt, University of Greenwich)	All of this text has been deleted and key points added to corresponding sections if necessary
732	66425	4	22	35	22	35	Change 'are' to 'is' to avoid mismatch of singular and plural. (Peter Burt, University of Greenwich)	All of this text has been deleted and key points added to corresponding sections if necessary
733	62859	4	22	35	22	36	Why is rapid evolutionary in quotes? This is a well-established concept - no need for quotes (Mark Urban, University of Connecticut)	All of this text has been deleted and key points added to corresponding sections if necessary
734	62860	4	22	35	22	43	I'm not convinced that there is such low confidence in this idea. A great deal of evidence shows that adaptation occurs in response to natural selection. There is very high confidence. We might lack a large number of studies that show it in response to climate change. But it is no different than any other selective factor. Also, an Evolutionary Applications issue is underway that will evaluate evolutionary responses across all taxa. The special issue won't be published until Jan. 2014, but once it is, I think it will be hard to argue for low confidence in this. Andrew Hendry and Juha Merila are leading this effort if you want to contact them for pre-prints. (Mark Urban, University of Connecticut)	All of this text has been deleted and key points added to corresponding sections if necessary. Note, however, that this assessment is based on the current literature and its ability to clearly demonstrate adaptation in response to climate change..
735	78623	4	22	36	0	0	.....is extremely limited- but see...Predicting the effect of climate warming is complicated by adaptation and microevolution. Heating experiments have demonstrated the occurrence of a rapid microevolutionary response of a cladoceran species in both survival and individual performance (age at reproduction and number of offspring). The study suggests that populations may persist locally under the predicted scenarios of global warming (Van Doorslaer et al., 2007). Van Doorslaer, W., R. Stoks, E. Jeppesen, and L. De Meester. 2007. Adaptive microevolutionary responses to simulated global warming in Simocephalus vetulus: a mesocosm study. Global Change Biology 13:878–886. See also: W. Van Doorslaer, R. Stoks, I. Swillen1, H. Feuchtmayr, D. Atkinson, B. Moss, L. De Meester. 2010. Experimental thermal microevolution in community-embedded Daphnia populations. Climate Research. (43): 81–89. ; Norberg, J., M. C. Urban, M. Vellend, C. A. Klausmeier, and N. Loeuille. 2012. Eco-evolutionary responses of biodiversity to climate change. Nature Climate Change. ; ....Urban, M. C., L. De Meester, M. Vellend, R. Stoks, and J. Vanoverbeke. 2012. A crucial step toward realism: responses to climate change from an evolving metacommunity perspective. Evolutionary Applications 5: 154–167. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	All of this text has been deleted and key points added to corresponding sections if necessary
736	71947	4	22	37	22	41	Need to define/explain phenotypic versus phonological (UNITED STATES OF AMERICA)	All of this text has been deleted and key points added to corresponding sections if necessary
737	56493	4	22	42	0	0	Suggestion "well-studied cases means that there..." (Archis Ambulkar, Brinjac Engineering Inc.)	All of this text has been deleted and key points added to corresponding sections if necessary
738	71152	4	22	42	22	42	Suggest insertion of "genetic" before "adaptation" -- to make it clear that this is the kind of adaptation being weakly attributed to climate change. (CANADA)	All of this text has been deleted and key points added to corresponding sections if necessary
739	57902	4	22	46	22	46	Suggest add an example of insect in breeding adaptation to global warming: early flight of insects as a phonological adaptation to global warming. With recent climate warming, over 70% of the butterfly species are found to have their first flights advanced in the UK, Spain and California (Robinet and Roques 2010.). Robinet C and Roques A 2010. Direct impacts of recent climate warming on insect populations Integrative Zoology 5: 132-142 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	This paper already cited.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
740	59292	4	22	46	24	54	There are many duplications in the text. The most prominent concern phenology. The same data with, in some cases, different sources appear in chapters 4.3.2.1 and 4.4.1.1. (GREECE)	This section has been substantially revised to eliminate redundancies with section 4.4.1.1, reduce length and make the key advances since AR4 more clear.
741	59875	4	22	48	22	51	Please clarify whether 'fewer in the southern hemisphere' - is potentially due to fewer observations/studies, or reflective of a lesser impact. (AUSTRALIA)	This paragraph has been revised, but now includes clarification that phenology studies are mainly in the Northern Hemisphere.
742	66426	4	22	50	22	50	Elsewhere in the Chapter/document there is Northern Hemisphere/Southern Hemisphere, and northern/southern Hemisphere. Please be consistent (I suggest capitals for both words, and please check the rest of the Chapter). (Peter Burt, University of Greenwich)	We have checked for consistency throughout the chapter. In case some errors remained, it will be checked again at copy-editing stage
743	56494	4	22	51	0	0	Suggestion to add comma - "Since the AR4, many..." (Archis Ambulkar, Brinjac Engineering Inc.)	Comma added.
744	62861	4	22	51	22	51	Do you mean the adaptive evolution here of phenology? If not just call them phenological changes (Mark Urban, University of Connecticut)	Changed to "phenological changes" to avoid confusion over use of "adaptations".
745	76857	4	22	52	22	52	Section 4.3.2.1 Phenology: Additional reference to phenological adaptations of amphibians to climate change, and also uniquely documenting local adaptation in phenology Phillipmore, A. B., Hadfield, J. D., Jones, O. R. & Smithers, R. J. (2010) Differences in spawning date between populations of common frog reveal local adaptation. PNAS, 107, 8292-8297. (Tom Oliver, Centre for Ecology and Hydrology)	Reference added
746	62090	4	22	52	23	2	Not sure if this citation meets the timeline for new work that can be cited but it is one of the largest compilations to date -- covering North America and Europe: Cook et al. 2013 (Cook et al. 2012. Ecosystems. Sensitivity of spring phenology to warming across temporal and spatial climate gradients in two independent databases). Also note this new meta-analysis from Europe: Dierenbach et al. 2013. The plant phenological online database (PPODB): an online database for long-term phenological data. International Journal of Biometeorology. (Note that these do not change findings, but provides further support.) (Elizabeth Wolkovich, University of British Columbia)	Thank you - Cook et al (2012) has been included in the assessment.
747	57706	4	22	54	0	0	Add reference after primack et al: Josep Peñuelas, Jordi Sardans, Marc Estiarte, Romà Ogaya, Jofre Carnicer, Marta Coll, Adria Barbeta, Albert Rivas-Ubach, Joan Llusià, Martin Garbulska, Iolanda Filella and Alistair S. Jump. 2013. Evidence of current impact of climate change on life: a walk from genes to the biosphere. Global Change Biology 2013, DOI: 10.1111/gcb.12143 (Josep Penuelas, CREAM-CSIC)	Reference added
748	78624	4	22	54	0	0	...Primack et al. 2009; marine and freshwater plankton: Adrian et al. 2009, Adrian et al. 2012) and meta analyses.... (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	We have now mentioned freshwater plankton (marine is not within the scope of this chapter) and cited Adrian et al 2009 in support of this.
749	64875	4	23	1	23	54	satellite (GIS image) examples should be more diversified and provide insight into tropical forest land cover change and climate change related impacts (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development)	This section focusses specifically on phenology, not land cover change, so no change has been made in response to this comment.
750	71153	4	23	4	0	19	When authors say the spring phenology is "advanced", do they mean they occurred earlier in the year rather than "advanced" in time, which would imply later. And, what is 'start of growing season length'? Do authors simply mean length of the growing season? (CANADA)	Changed to "earlier", and removed "length".
751	61024	4	23	6	23	6	The acronym NDVI needs expanding here. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	NDVI now defined here
752	71154	4	23	6	23	6	NDVI is mentioned later on P. 25, L. 35, where it is also defined. Suggest expanding the acronym and defining NDVI here first. (CANADA)	NDVI now defined here
753	71948	4	23	8	23	9	Are these numbers averages over all growing seasons globally, or a particular region (e.g. North temperate)? (UNITED STATES OF AMERICA)	Text added to clarify that this is between 30°N and 80°N
754	58341	4	23	14	23	14	References required (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Referenced White et al 2009 in support of this.
755	76635	4	23	15	23	19	in this sentence I cannot find the verb... (Claudio Cassardo, University of Torino)	The verb is "is".
756	59293	4	23	17	0	19	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	"to reveal" changed to "reveal"
757	71155	4	23	18	23	18	Suggest changing "to reveal" to "reveals" (CANADA)	"to reveal" changed to "reveal"

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
758	57903	4	23	21	23	21	Suggest add an example of insect in breeding adaptation to global warming: early flight of insects as a phenological adaptation to global warming. With recent climate warming, over 70% of the butterfly species are found to have their first flights advanced in the UK, Spain and California (Robinet and Roques 2010.). Robinet C and Roques A 2010. Direct impacts of recent climate warming on insect populations Integrative Zoology 5: 132-142 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	This paper already cited.
759	62862	4	23	21	23	29	Another example is the earlier migration and breeding of amphibians Beebee, T. J. C. Amphibian breeding and climate. Nature 374, 219-220 (1995) and Gibbs, J. P. & Briesch, A. R. Climate warming and calling phenology of frogs near Ithaca, New York, 1900-1999. Conserv. Biol. 15, 1175-1178 (2001). (Mark Urban, University of Connecticut)	Thank you for the suggestions, but these papers are before the main period of literature assessed in AR5 (which is mainly post-AR4).
760	78607	4	23	21	23	29	good to see causal links explained (richard arthur fleming, canadian forest service)	Thank you for the supportive comment.
761	66427	4	23	23	23	23	Change 'on' to 'in'. (Peter Burt, University of Greenwich)	Comment no longer relevant after restructuring of sentence.
762	76636	4	23	24	23	25	change "-3.70 days/decade +/-0.7" with "-3.7 +/- 0.7 days/decade" (Claudio Cassardo, University of Torino)	Change made as suggested.
763	71949	4	23	26	0	0	Please define/explain what is meant by: mean parturition (UNITED STATES OF AMERICA)	"Parturition date" replaced with "date of giving birth to young"
764	71156	4	23	27	23	29	This sentence is incomplete. Suggest reviewing. (CANADA)	Sentence revised to make complete.
765	76637	4	23	27	23	29	the "significant delay of the mean breeding date" is correlated to what? (Claudio Cassardo, University of Torino)	We have inserted "linked to decreased sea ice extent".
766	71950	4	23	33	23	34	This point could be elaborated. For example, to show that birds migrating from south america to Wisconsin do not adjust their migration/arrival times as compared to more regional migrants (Bradley N.L., Leopold A.C., Ross J. and Huffaker W. 1999. Phenological changes reflect climate change in Wisconsin. Proceedings of the National Academy of Sciences 96: 9701-9704.) (UNITED STATES OF AMERICA)	Thank you for the suggestion. However, the recommended paper is rather old (1999) and merely supports the point already made instead of adding new information, so does not justify the additional space that citing it would require.
767	56495	4	23	35	0	0	Suggested change "Insects also show..." (Archis Ambulkar, Brinjac Engineering Inc.)	Change made as suggested.
768	78608	4	23	35	23	39	yes (richard arthur fleming, canadian forest service)	Thank you for the supportive comment.
769	71157	4	23	36	0	39	Some insect species shift from semi-voltine to univoltine; and the outcome of this shift can cause insect outbreaks that cause much damage to forest resources. (CANADA)	Sentence removed during shortening of text. However, insect outbreaks are mentioned elsewhere in the chapter (eg: 4.2.4.6)
770	60344	4	23	36	23	39	The following reference is also relevant in this context: Goergen, K., J. Beersma, L. Hoffmann, and J. Junk (2013), ENSEMBLES-based assessment of regional climate effects in Luxembourg and their impact on vegetation, Climatic Change, 1-13. (Andrew Ferrone, Public Research Centre - Gabriel Lippmann)	We have not inserted this citation because this section deals with evidence for observed change, whereas the suggested paper is on projected future changes.
771	61025	4	23	36	23	39	line beginning 'Development rates speed up...' Reads as though it is referring to insects (because of the preceding sentence) not as is intended a number of different species types. Perhaps a separate paragraph is needed or clarification that this refers to multiple species types. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Sentence removed during shortening of text.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
772	78625	4	23	40	0	0	.....include a paragrapg on phenology shifts in lakes. One of the most prominent examples of climate induced changes in lakes of the northern hemisphere were changes in phenology. Coherent changes in ice phenology, and in spring and early summer plankton phenology in recent years have been attributed to climate change (Adrian et al. 1999, Weyhenmeyer et al. 1999, Gerten & Adrian 2000, Straile 2002) as synchronized by large scale climatic signals such as the North Atlantic Oscillation (for review see Blenkner et al. 2007, Gerten and Adrian 2002, Straile et al. 2003). While indirect temperature such as early ice-off which improves under water light conditions have caused an early start of the spring algal bloom development, direct temperature effects caused changes in the timing of rotifer and daphnid spring maxima (Gerten & Adrian 2000, Adrian et al. 2006, Straile et al. 2012) cascading into an earlier timing of the clear water phase (Straile 2002). For zooplankton, phenological shifts are usually restricted to fast-growing plankton, whereas longer-lived plankton may respond in more complex ways through changes in day length specific water temperature affecting the emergence of resting stages (Gerten and Adrian 2002, Winder and Schindler 2004; Adrian et al. 2006). Moreover, climate warming can accelerate ontogenetic development of long lived organisms exhibiting complex life cycles, which can cause a shift in life history such as the development of additional generations within a year as has been shown for fish and copepod species (Gerten and Adrian 2002, Schindler et al. 2005; Adrian et al. 2006; Winder et al. 2009). Enhanced oxygen depletion in the hypolimnion was strongly linked to a climate induced extensions of thermally stratified periods causing internal eutrophication in productive lakes (Søndergaard et al. 2003, Mooji et al. 2005, Wilhelm and Adrian 2008). References: ADRIAN, R., N. WALZ, T. HINTZE, S. HOEG, AND R. RUSCHE. 1999.Effects of ice duration on the plankton succession during spring in a shallow polymictic lake. <i>Freshwater Biol.</i> 41: 621–623. Weyhenmeyer G. A., T. BLECKNER, AND K. PETERSSON. 1999. Changes of the plankton spring outburst related to the North Atlantic Oscillation. <i>Limnol. Oceanogr.</i> 44: 1788–1792. Gerten, D. & R. Adrian (2000) Climate driven changes in spring plankton dynamics and the sensitivity of shallow polymictic lakes to the North Atlantic Oscillation. <i>Limnology and Oceanography</i> 45(5):1058-1066. Blenkner, T., R. Adrian, D. M. Livingstone, E. Jennings, C. N.Aonghusa, D. G. George, T. Jankowski, M. Järvinen, T. Nöges, D. Straile, K. Teubner, G. A. Weyhenmeyer (2007) Large-scale climatic signatures in lakes across Europe: A meta – analysis. <i>Global Change Biology</i> , 13, 1314-1326. doi: 10.1111/j.1365-2486.2007.01364.x STRAILE, D. 2002. The North Atlantic Oscillation synchronizes food-web interactions in central European lakes. <i>Proc. Royal Soc. B Bio.</i> 269: 391–395. Gerten, D. & R. Adrian (2002) Species specific response of freshwater copepods to recent summer warming. <i>Freshwater Biology</i> 47: 2163-2173. Winder M., AND D. E. SCHINDLER. 2004. Climate change uncouples trophic interactions in a lake ecosystem. <i>Ecology</i> 85: 2100–2106. Adrian R., S. WILHELM, AND D. GERTEN. 2006. Life history traits of lake plankton species may govern their phenological response to climate warming. <i>Global Change Biology</i> 12: 652–661. Winder M., D.E Schindler, T. E. ESSINGTON, AND A. H. LITT. 2009. Disrupted seasonal clockwork in the population dynamics of a freshwater copepod by climate warming. <i>Limnol. Oceanogr.</i> 54: 2493–2505. Schindler D.E., D. E. ROGERS, M.D. SCHEUERELL, AND C. A. ABREY. 2005. Effects of changing climate on zooplankton and juvenile sockeye salmon growth in southwestern Alaska. <i>Ecology</i> 86: 198–209. Søndergaard, M., Jensen, J.P. & Jeppesen, E. (2003) Role of sediment and internal loading of phosphorus in shallow lakes. <i>Hydrobiologia</i> , 506–509, 135–145. Mooij WM, Hulsman S, De Senerpont Domis LN, Nolet BA, Bodelier PLE, Boers PCM, Dionisio Pires LM, Gons HJ, Ibelings BW, Noordhuis R, Portielje R, Wolfstein K, Lammens EHRR (2005) The impact of climate change on lakes in the Netherlands: a review. <i>Aquat Ecol</i> 39:381–400. Wilhelm S. & R. Adrian. 2008. Impact of summer warming on the thermal characteristics of a polymictic lake: Consequences for oxygen, nutrients and phytoplankton. <i>Freshwater Biology</i> 53: 226-237. Straile D, Adrian R., Schindler D.E. (2012). Uniform temperature dependency of the phenology of keystone herbivore in lake of the Northern Hemisphere. <i>PloSONE</i> 7(10):345497. doi:10.1371/journal.pone.0045497; pages 1-9. Gerten, D. & R. Adrian (2002) Effects of climate warming, North Atlantic Oscillation and El Niño on thermal conditions and plankton dynamics in European and North American lakes. <i>TheScientificWorldJOURNAL</i> 2: 586-606. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	Thank you for suggesting this text. Due to space limitations and the fact that most of the cited references are in the pre-AR5 literature period, we have not been able to include the entire paragraph. However, we have cited Straile et al (2012) as an example of how models can be used to explain observed phenological changes.
773	71951	4	23	41	24	7	These paragraphs give the results of individual studies in separate sentences -- authors may wish to shorten this part by summarizing the overall trend (with "confidence" or "agreement" tags). (UNITED STATES OF AMERICA)	This section has been re-written to provide more of a summary, retaining a smaller number of specific examples where useful for illustration.
774	59294	4	23	45	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Space added between "and" and "2002"
775	57090	4	23	45	23	45	and2002 -> and 2002 (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Space added between "and" and "2002"
776	66428	4	23	45	23	45	Insert space after 'and'. (Peter Burt, University of Greenwich)	Space added between "and" and "2002"
777	76638	4	23	45	23	45	typo: "and2002" --> "and 2002" (Claudio Cassardo, University of Torino)	Space added between "and" and "2002"

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778	71158	4	23	46	23	47	This sentence is not clear. Which factors explained "portions of variation in migratory changes"? (CANADA)	Sentence revised to make this clearer.
779	56496	4	23	48	0	0	Instead of "attributed to changes in temperature changes..." should be revised to "attributed to temperature changes..." (Archis Ambulkar, Brinjac Engineering Inc.)	This part of the sentence has been removed in shortening of the text
780	66429	4	23	52	23	52	Insert 'and' after 'temperature'. (Peter Burt, University of Greenwich)	This part of the sentence has been removed in shortening of the text
781	71159	4	23	52	23	53	Suggest rewording as: "Interactions between temperature and precipitation determine snowmelt changes, which are reported to lead to...." (CANADA)	This part of the sentence has been removed in shortening of the text
782	59295	4	23	52	24	1	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Shortening of the sentence has removed the part causing difficulty here.
783	78609	4	24	1	24	3	yes - an adverse effect on insects. So be careful of broad generalizations. (richard arthur fleming, canadian forest service)	No specific change suggested by this comment. We consider that we have taken care over this point.
784	71160	4	24	2	24	3	Suggest rewording as: "...and hence have been found to affect survival of dependent insects in US mountain ranges in 1980, 1985, 1986 and 1989 (Boggs ...)" (CANADA)	Removed "can" which has the same effect as the change suggested here, with fewer words.
785	56497	4	24	3	0	0	Suggested change "Mammals also show..." (Archis Ambulkar, Brinjac Engineering Inc.)	Change made as suggested.
786	66430	4	24	3	24	2	Change 'show also' to 'also show' (better English) (Peter Burt, University of Greenwich)	Change made as suggested.
787	71161	4	24	3	24	6	This sentence is hard to follow. Consider revising. (CANADA)	Sentence has been revised to make clearer.
788	78626	4	24	10	0	0	climate (Gaedke et al 2010, Sommer and Lewnadowska 2011) References: GAEDKE U., M. RUHENSTROTH-BAUER, INA WIEGAND, KATRIN TIROK, N.ABERLEW , P ETRA BREITHAUPT, KATHRIN LENGFELLNER, J . WOHLERS and U. SOMMER. 2010. Biotic interactions may overrule direct climate effects on spring phytoplankton dynamics. Global Change Biology (2010) 16, 1122–1136 SOMMER U. and A. LEWANDOWSKA. 2011. Climate change and the phytoplankton spring bloom: warming and overwintering zooplankton have similar effects on phytoplankton. Global Change Biology (2011) 17, 154–162. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	It is not clear what the suggested change contributes to the discussion. No change made.
789	62092	4	24	13	24	14	Citation to add: Dunne et al. 2003 (Ecology: Subalpine meadow flowering phenology responses to climate change: Integrating experimental and gradient methods) also found agreement between methods. Both Dunne and Gunderson are focused on single site comparisons while Wolkovich et al. is a meta-analysis -- this may be a point worth mentioning. (Elizabeth Wolkovich, University of British Columbia)	Thank you for the suggestion, but Dunne et al 2003 is from the pre-AR5 literature assessment period and inclusion here as a secondary example does not warrant the additional space.
790	62091	4	24	15	24	16	I think this could be better phrased to better-represent the literature: flipper-tagging isn't really an 'experiment' and the paper is not suggesting work on wild species is an issue, it's about the *methods* affecting the findings. I suspect starting the sentence with some such as 'observational data however can also be affected by specific methods' would be more accurate. (Elizabeth Wolkovich, University of British Columbia)	Change made as suggested.
791	62093	4	24	18	24	42	Again, I realize there may be a time window on the citations but in case this can be included, new work showing loss of specialist pollinators is relevant here possibly Burkle et al. 2013. Plant-Pollinator Interactions over 120 Years: Loss of Species, Co-Occurrence, and Function. Science (link: <a href="http://www.sciencemag.org/content/339/6127/1611.abstract">http://www.sciencemag.org/content/339/6127/1611.abstract</a> ). (Note that this does not change findings, but provides further support.). Additional new possibly relevant work: Reed et al. 2013 Population Growth in a Wild Bird Is Buffered Against Phenological Mismatch. Science. (Elizabeth Wolkovich, University of British Columbia)	Discussion of interspecific interactions has been removed from this section due to redundancy with section 4.4.1.1. The information from the suggested papers has been included in 4.4.1.1 and these papers cited.
792	59296	4	24	31	0	33	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This paragraph has been removed due to redundancy with section 4.4.1.1

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
793	57904	4	24	31	24	31	Suggest add examples of asynchrony between plant and insects resulting disappearance of cycles. Differential response of animals and plants to climate warming may lead to their phenological asynchrony disruption of synchrony (Robinet and Roques 2010). Recently, mismatch between egg hatch date and bud burst date of plants have been observed in the moth ( <i>Opheroptera brumata</i> L.) and pedunculate oak (Visser & Both 2005), and between sycamore and its associated aphid, <i>Drepanosiphum platanoides</i> Koch. (Dixon 2003). The usual warm winter and spring during 1989–1991 might also have disrupted the strict synchrony previously existing between hatching of larch budmoth larvae, <i>Zeiraphera diniana</i> Guénée, and larch foliage availability (Esper et al. 2007), which may resulted in the unexpected collapse of expected cycles of this insect during the 1990s (Battisti 2008). Climate-driven mismatch is also observed in birds and mammals between resource availability and requirement (e.g. Visser et al. 2004; Visser & Both 2005; Jonzen et al. 2007; Post et al. 2008). Robinet C and Roques A 2010. Direct impacts of recent climate warming on insect populations <i>Integrative Zoology</i> 5: 132-142 Dixon AFG (2003). Climate change and phonological asynchrony. <i>Ecological Entomology</i> 28, 380–81. Visser ME, Both C (2005). Shifts in phenology due to global climate change: The need for a yardstick. <i>Proceedings of the Royal Society of London B</i> 272, 2561–9. Esper J, Büntgen U, Franck DC, Nievergelt D, Liebhold A (2007). 1200 years of regular outbreaks in alpine insects. <i>Proceedings of the Royal Society of London B</i> 274, 671-9. Visser ME, Both C (2005). Shifts in phenology due to global climate change: The need for a yardstick. <i>Proceedings of the Royal Society of London B</i> 272, 2561–9. Visser ME, Both C, Lambrechts MM (2004). Global climate change leads to mistimed avian reproduction. <i>Advances in Ecological Research</i> 35, 89–110. Post E, Pedersen C, Wilmers CC, Forchhammer MC (2008). Warming, plant phenology and the spatial dimension of trophic mismatch for large herbivores. <i>Proceedings of the Royal Society of London B</i> 275, 2005-13. Jonzen N, Hedenstrom A, Lundberg P (2007). Climate change and the optimal arrival of migratory birds. <i>Proceedings of the Royal Society of London B</i> 274, 269–74. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	This paragraph has been removed due to redundancy with section 4.4.1.1. Thank you for suggesting the papers - some are already cited, some are before the main period of literature reviewed by AR5, and while some are within that review period, we have considered the information that they provide and concluded that they do not provide a significant enough contribution to warrant the extra space required in citing them.
794	71162	4	24	32	24	32	Suggest changing "effect" to "affect" (CANADA)	This paragraph has been removed due to redundancy with section 4.4.1.1
795	66431	4	24	33	24	33	What does the 'P.' stand for? Taxonomic rules dictate spelling out generic name on first usage. (Peter Burt, University of Greenwich)	This paragraph has been removed due to redundancy with section 4.4.1.1
796	71163	4	24	33	24	36	This sentence is hard to follow. Consider revising. (CANADA)	This paragraph has been removed due to redundancy with section 4.4.1.1
797	58342	4	24	36	24	36	I don't understand this sentence (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This paragraph has been removed due to redundancy with section 4.4.1.1
798	66432	4	24	41	24	41	'per' should be in italics. (Peter Burt, University of Greenwich)	This paragraph has been removed due to redundancy with section 4.4.1.1
799	59297	4	24	49	0	51	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been removed in shortening the text.
800	78627	4	24	51	0	0	...(Cock et al 2008, Adrian et al. 2009) (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	This sentence has been removed in shortening the text. Adrian et al 2009 has now been cited elsewhere in the section.
801	76639	4	24	51	24	51	"some studies": how many? Just two are mentioned... (Claudio Cassardo, University of Torino)	This sentence has been removed in shortening the text.
802	62094	4	24	51	24	52	I would add 'e.g.' to both the Cook et al. and Naef-Daenzer et al. references for clarity. Certainly many studies other than these now include decades of data (Fitter in Chinnor, Inouye in Gothic for example) or over 100 years (many studies from Scandanavia and Central Europe, the Marsham record in England etc.) (Elizabeth Wolkovich, University of British Columbia)	This sentence has been removed in shortening the text, but length of records is now referred to when citing specific studies and meta-analyses.
803	59299	4	24	52	0	54	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been removed in shortening the text.
804	71164	4	24	52	24	53	Given the caveats expressed in previous sentences, suggest that "some" be inserted in front of "phenological shifts". (CANADA)	We have inserted "many" in our statement on the detection of phenological trends (which is now earlier in this section).
805	59298	4	24	52	24	54	Phenological shifts are occurring but we must be interested in which direction these shifts occur. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)	The directions of shifts is now clarified in our top-level statements in this section.
806	76640	4	24	52	24	54	the conclusion (high confidence" seems to me a bit too positive, especially considering the uncertainty; why do not use "medium to high"? (Claudio Cassardo, University of Torino)	Our assessment is that the evidence is robust and agreement is high, which justifies the high confidence.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
807	66433	4	24	53	24	53	'high agreement' should be in italics. (Peter Burt, University of Greenwich)	Text italicised as suggested.
808	71170	4	25	0	0	0	Suggest using gender neutral language. Replace 'man' with 'human' (CANADA)	Accepted, but I cant find the instance you point to.
809	57905	4	25	5	25	8	Suggest to delete the statement 'Primary production.....important indicators of ecosystem function' (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	This sentence has been shortened and thus changed in the direction desired.
810	66434	4	25	6	25	6	Insert 'the' after 'of'. (Peter Burt, University of Greenwich)	Sentence has been changed.
811	56498	4	25	8	25	10	Suggested change "With a well-established theory, experimentation and observation, all agree..." (Archis Ambulkar, Brinjac Engineering Inc.)	The suggested formulation adds no improvement.
812	66435	4	25	11	25	11	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Done.
813	58343	4	25	15	25	26	After "The first is", state where "The second is" (Martin Pecheux, Institut des Foraminifères Symbiotiques)	The opening sentence with 'first' has been deleted.
814	66436	4	25	16	25	16	carbon dioxide' should be 'CO2'. (Peter Burt, University of Greenwich)	Altered To CO2
815	71952	4	25	18	25	19	Please define/explain sink term and source term (UNITED STATES OF AMERICA)	The term source and sink are common parlance in both the policy and research arena, and occur in the glossary.
816	71953	4	25	21	25	22	Use "estimated" rather than "postulated". Also, cite more recent Global Carbon Budget publications than 2009. (UNITED STATES OF AMERICA)	Accepted. We cite the WGI ch 6 for consistency, and the period 2000 to 2009 is the most recent whole decade (they also give 2002 to 2011, but that then disagrees with many other studies based on the whole decade.
817	76793	4	25	22	0	0	when you quote these numbers you could (a) refer more precisely to WG1 Ch6, table 6.1, (b) define what you mean by "+ or " - in Ch.6 we revised our table to give 2-sigma limits, so table 6.1 now says 2.6 +- 1.2 PgC for 2000-2009. If you quote a different uncertainty (+- 1 sigma) you need to specify this, or it will look like an inconsistency (Chris Jones, Met Office)	Thanks for pointing this out, we have brought it in line.
818	79050	4	25	22	25	24	The uptake of C can respond to mechanisms or conditions, but not to models. In addition, volcanic eruptions and ENSO aren't models, either. Please rephrase sentence. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	That should have been mode, not model. The sentence has now been simplified to 'climate variations'.
819	56499	4	25	23	0	0	ENSO term is not defined or elaborated in this chapter prior to being used in this sentence (Archis Ambulkar, Brinjac Engineering Inc.)	The phrase has been dropped.
820	71165	4	25	23	25	23	"...in response to global climate models such as ENSO and major volcanic eruptions...". Presumably "models" is an error and should be replaced by something like "phenomena"? Should "ENSO" be pluralized? (CANADA)	It should have been mode. The sentence has been changed.
821	66329	4	25	24	25	26	In the chapter it is declared: "It is currently not possible to state with any degree of confidence that the net uptake of carbon on land has either increased or decreased over the past two decades (Raupach et al., 2008)". Meanwhile there are several Russ (Anna Kukhta, Institute of Global Climate and Ecology of Roshydromet and RAS)	It seems that this comment has been truncated, making it difficult to follow up on. Are there Russian papers showing a decadal change in the carbon uptake rate in terrestrial ecosystems?
822	71166	4	25	24	25	26	Given the date of the reference to Raupach (2008), this statement sounds like it could be out of date, and might contradict what was stated earlier at L. 20 to L 22. Which "past two decades" are being referred to? Are there more recent assessments which would be able to give a more definitive answer, say for the period 1991 to 2010? (CANADA)	It does not contradict the ES statement, which refers to the total C stock in terrestrial ecosystems, whereas this refers to a change in the rate of carbon uptake (ie, the second differential of C stock). Papers post Raupach would add nothing, since this is a decade-to-decade comparison, which Raupach does for the 90s and 2000s. We dont have another decade to work with yet
823	79051	4	25	28	25	32	Here you neglect the existence of various carbon and / or biomass inventories which are also usable for C uptake estimation. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We do use these, especially the Pan et al one, which still does not change the conclusion.
824	81795	4	25	29	25	29	In place of "broad agreement" the chapter team should consider presenting summary terms for evidence and agreement, following the guidance for authors. (Katharine Mach, IPCC WGII TSU)	Changed to high agreement and medium evidence.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
825	71954	4	25	30	0	0	largely untransformed' - Can it be claimed that there are many ecosystems that are largely untransformed - where are these? If the intent of the text is to relay that the class type stays as forest, that should be made clear. Also remember that a lot of temperate forests are still regrowing from past disturbance. (UNITED STATES OF AMERICA)	It is hard to find concise language to capture this for all audiences. We do mean that the forest stays forest, but it is not only forests. What we are trying to exclude is the areas which have not undergone transformation to croplands and human settlements. We have settled for natural and semi-natural.
826	71167	4	25	30	25	32	Changes in disturbance regimes may also be contributing to regional C sources, as previously mentioned, e.g., in western Canada due to mountain pine beetle outbreaks (Kurz et al. 2008). Suggest adding text to address the effects of natural disturbances on productivity here. (CANADA)	Have added a sentence in the first paragraph of the section
827	71168	4	25	34	25	40	This preamble about NDVI could be merged with the text on P. 23 and deleted from here. (CANADA)	Done.
828	66330	4	25	34	25	51	The chapter presents primary production climatogeni? changes. North American forest areas and Sahel are in the focus of the consideration. From our point of view this sample is not representative enough. The primary production changes of such huge regions (Anna Kukhta, Institute of Global Climate and Ecology of Roshydromet and RAS)	I think the reviewer is making a possibly important point, but it has been truncated so I cant follow up on it.
829	71955	4	25	35	25	35	NDVI is already used, define at first use. (UNITED STATES OF AMERICA)	Agreed. It is defined there.
830	81796	4	25	39	25	39	This statement could be clarified. (Katharine Mach, IPCC WGII TSU)	The 'but' has been changed to 'or' and the record length has been related to inherent variability.
831	71169	4	25	42	25	44	Please include a citation for the lack of a systematic change in growing season length. (CANADA)	It was Goetz et al 2007
832	61026	4	25	48	25	48	Explain what a forb is. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Replaced with 'herbs', which is not botanically exact, but close enough.
833	57906	4	25	53	26	1	Suggest to delete the statement 'Tree ring record.....to which the tree was exposed'. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	Since this is not written for dendrographic experts, a sentence to explain the relevance to tree rings to productivity is in order.
834	79052	4	26	1	26	15	Diameter growth of trees is not only dependant on physiological factors, it is also very sensitive to stand structure and competition and thus easily influenced by e.g. management activities which override CO2 fertilization or ozone damage. So the correlation you mention in line 11 should be checked against changes in management and in N deposition, especially for chronologies from Europe or N America. And: tree ring studies were mostly not oriented towards growth analysis of recent times, but towards dendro-archaeological work (dating of wood from e. g. man-made structures), so it is almost impossible to analyse these data in regard to site-specific factors like soil. Please make sure your text on this topic covers the difficulties and limitations of this approach, too. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Thank you for this insight. We are ourselves not in a position to do this analysis, and must rely on the many published papers and meta-analyses that they have accounted for confounding factors. We have made it clear that other factors may be involved.
835	66437	4	26	10	26	10	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	made consistent throughout, though our advice is small c.
836	71171	4	26	10	26	17	Suggest assessing here the work of Girardin et al.: Girardin, M.P., Guo, J.X., Bernier, P.Y., Raulier, F., Gauthier, S. 2012. Changes in growth of pristine boreal North American forests from 1950 to 2005 driven by landscape demographics and species traits. Biogeosciences, 9, 2523-2536. Girardin, M.P., Bernier, P.Y., and Gauthier, S. 2011. Increasing potential NEP of eastern boreal North American forests constrained by decreasing wildfire activity. Ecosphere - A journal of the Ecological Society of America, 2:art25 (CANADA)	We looked at these. The first is a regional study, and is consistent with our conclusion. For citation, we focussed on the global syntheses, such as Britta 2008, rather than the large number of local and regional studies we could have cited. The second is not directly related to the point being made in this paragraph
837	78628	4	26	16	0	0	include a sentence on changes in primary production in lakes: Climate-related responses of lake biota include changes in primary productivity (O'Reilly et al. 2003; Michelutti et al. 2005), and benthic net photosynthesis and dark respiration rates (Baulch et al. 2005). References: O'REILLY, C. M., S. R. ALIN, P.-D. PLISNIER, A. S. COHEN, AND B.A. MCKEE. 2003. Climate change decreases aquatic ecosystem productivity in Lake Tanganyika, Africa. Nature 424:766-768. MICHELUTTI, N., A. P. WOLFE, R. D. VINEBROOKE, B. RIVARD, AND J. P. BRINER. 2005. Recent primary production increases in arctic lakes. Geophys. Res. Lett. 32: L19715, doi:10.1029/2005GL023693 BAULCH, H. M., D. W. SCHINDLER, M. A. TURNER, D. L. FINDLAY, M. J. PATERSON, AND R. D. VINEBROOKE. 2005. Effects of warming on benthic communities in a boreal lake: Implications of climate change. Limnol. Oceanogr. 50: 1377-1392. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	We have introduced a short paragraph on lakes
838	57907	4	26	20	26	25	Suggest to delete the statement 'Forest are routinely monitored for .....but have a lesser effect on trend detection' (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	The sentence has been shortened and restructured to still explain how forest monitoring can be used in the context of climate change.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
839	71172	4	26	21	26	21	Please provide a citation for "hundreds of small plots" for typical forest monitoring. (CANADA)	The phrase is no longer used
840	78307	4	26	26	26	29	there is stated that from tropical regions not much carbon stock, stock change data is available. Please consider the following data and references to this data for adding text or for rewriting some parts in paragraph 4.2.3.3. given below is the latest (RS) data on SE Asian tropical forests and deforestation rates. (Arina Schrier, Wetlands International)	The comment contains no reference.
841	71956	4	26	27	26	38	Clarify whether the terrestrial sink is partially offset, wholly offset, or offset and exceeded by emissions from deforestation and land use (UNITED STATES OF AMERICA)	The gross terrestrial sink is partly offset by a land use source, but still leaves a large net sink. This has been clarified across the three places in the chapter that are relevant.
842	56500	4	26	29	0	0	REDD term is not defined or elaborated in this chapter prior to being used in this sentence (Archis Ambulkar, Brinjac Engineering Inc.)	Reduced Emissions from Deforestation and Degradation. It has been spelled out.
843	61027	4	26	29	26	29	What is REDD+? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Reduced Emissions from Deforestation and Degradation. It has been spelled out.
844	71957	4	26	29	26	29	"The REDD+ initiative" is an odd reference - REDD+ won't increase data except through additional remote sensing or through increased forest management in a range of countries. Perhaps rephrase "and increased investment in forest monitoring and management through initiatives such as REDD+." (UNITED STATES OF AMERICA)	Reduced Emissions from Deforestation and Degradation has been spelled out, and the suggested formulation has been used.
845	71958	4	26	29	26	29	REDD+ should be defined and briefly described. (UNITED STATES OF AMERICA)	Reduced Emissions from Deforestation and Degradation. It has been spelled out.
846	64876	4	26	31	26	31	For some increase in biomass and carbon stocks over the past century in Europe. More specific examples be provided on biomass and carbon stocks in tropical regions (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	The IPCC treatment of such topics cannot be exhaustive, citing every paper that has been published related to a topic. We favour publications which have already synthesised large numbers of studies, and this has been done for the tropical section (see also additional 4.3.3.1.3). It remains true that inventory data, on a widespread basis, is less available in the tropics than the temperate areas.
847	71173	4	26	32	26	33	Suggest rewording as follows: "Canadian managed forests increased in biomass only slightly during 1998-2008 because growth was offset by significant losses due to fires and beetle outbreaks..." (CANADA)	Reworded as suggested.
848	71959	4	26	35	26	35	Clarify whether "dropping after a drought in 2005" implies continuously through the end of the time period, or just temporarily for a year or two (UNITED STATES OF AMERICA)	the word 'temporarily' was added.
849	58344	4	26	35	26	37	Error, mature forests cannot withdraw CO2, unless extention or making coal. Correct. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	The problem here is to distinguish them from regrowth forests, following clearing. We have used the phrase recently-undisturbed instead.
850	58345	4	26	37	26	38	Give the quantity (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We have given quantities.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
851	79773	4	26	40	0	0	This section is very oversimplified and to give one paragraph to a C pool 10 times that of forests is inadequate. To say the least, the size of this stock is not only a balance between primary productivity and soil respiration, but is mediated by decomposition rates. For this reason, it would be justified for the authors to give attention to the soil C pools in Alaska and northern peatlands, which are large and could be especially in danger given warming scenarios. Some references could help: Luo Y. (2007) Terrestrial carbon-cycle feedback to climate warming. Annual Review of Ecology, Evolution, and Systematics 38:683-712; Allison S., and KK Treseder. (2008) Warming and drying suppress microbial activity and carbon cycling in boreal forest soils. Global Change Biology 14:2898-2909. DOI: 10.1111/j.1365-2486.2008.01716.x; Allison S.D., Wallenstein M.D., Bradford M.A. (2010) Soil-carbon response to warming dependent on microbial physiology. Nature Geosci 3:336-340; Trumbore S. (2006) Carbon respired by terrestrial ecosystems - recent progress and challenges. Global Change Biology 12:141-153. DOI: 10.1111/j.1365-2486.2005.01067.x; Treseder K., Balsler T., Bradford M., Brodie E., Dubinsky E., Eviner V., Hofmockel K., Lennon J., Levine U., MacGregor B., Pett-Ridge J., Waldrop M. (2012) Integrating microbial ecology into ecosystem models: challenges and priorities. Biogeochemistry 109:7-18. DOI: 10.1007/s10533-011-9636-5. Within the IPCC report, the authors could refer somewhat to 18.3.1.3, 4; 18.3.2.4 line 46, regarding thawing of permafrost soils (that it is occurring) and changes in arctic productivity, although there might be less information or evidence of how this thawing will change soil carbon stocks (other than the indirect evidence from erosion, landslides, so on). The authors could also refer to chapter 28 and chapter 26 (26.5 and agricultural sections) for potential evidence, the section on soil quality in chapter 26 is very good. (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	Decomposition is part of soil respiration. Peatlands are addressed in 4.3.3.3, and the specific issue of arctic peatlands is dealt with in detail in 4.3.3.4 and Box 4-4, as well as in Chapter 28 and 18. Pointers have been added.
852	61028	4	26	40	26	47	Add a comment on what impact an increase in soil respiration is likely to have with regard to climate change, specifically its impact on carbon stocks. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have now spelled out the consequences.
853	76794	4	26	40	26	47	important here to stress the uncertainty in soil carbon stocks as different datasets measure different things, extrapolate differently, use different depth horizons etc. WG1-Ch.6. have a figure (6.1) showing 1500-2400 PgC in "soil" with a further 1700 in permafrost. So your 3300 is consistent, but could do with an uncertainty estimate too I think (Chris Jones, Met Office)	We have updated this paragraph and used numbers consistent with WG1
854	71174	4	26	42	26	42	Suggest clarifying here that global soil C stock is the balance of inputs and losses accumulated over many years, and that in some colder regions particularly high soil C densities have accumulated over centuries to millennia. These regions are characteristically at high latitudes (sometimes higher altitudes) where cold conditions contribute to the preservation of the C stock, and raise concerns about the effects of climate warming in these regions. (CANADA)	we have added...over many years.
855	78629	4	26	48	0	0	Phytoplankton and especially bloom forming cyanobacteria will profit from rising temperature through direct (Huisman et al. 2004, Jönck et al. 2008 ) and indirect temperature effects. Warming induced extensions of e.g. thermally stratified periods enhances the risk of internal nutrient loading. Once productive lakes stratify, oxygen concentration will deplete in the hypolimnion causing anaerobic conditions in the sediment near water layers and subsequent release of phosphorus (Mooij et al. 2005, Wagner and Adrian 2009). Reference: Wagner C, Adrian R (2009) Cyanobacteria dominance: quantifying the effects of climate change. Limnol Oceanogr 54:2460-2468 (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	A sentence has been added on this. Further, this point has been incorporated into Section 4.3.3.3.
856	71175	4	26	50	27	23	Section 4.3.2.4: This section is difficult to understand. A connection between the iWUE and the transpiration component of ET would help. (CANADA)	We have now mentioned at the start of the section that stomatal conductance affects transpiration, so along with the definition of iWUE as the ratio of photosynthesis to stomatal conductance, this should help clarify.
857	71960	4	26	50	27	23	The following new reference should be included in the discussion of change in evapotranspiration : Anthropogenic influence on multidecadal changes in reconstructed global evapotranspiration H. Douville, A. Ribes, B. Decharme, R. Alkama, & J. Sheffield Nature Climate Change 3, 59-62 (2013) doi:10.1038/nclimate1632 Published online 29 July 2012 (UNITED STATES OF AMERICA)	This reference provides highly relevant information and has now been cited.
858	76642	4	26	53	27	10	in the mentioned studies, that I do not have read in detail, the distribution of the used stations over land is uniform? I think the different distribution could cause some differences in evaluating the results... (Claudio Cassardo, University of Torino)	We have clarified that the distribution is non-uniform, but do not have the space to discuss the implications.
859	76641	4	26	54	26	54	change "are" with "have" (Claudio Cassardo, University of Torino)	Word replaced as suggested.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
860	66438	4	27	1	27	1	Change 'are' to 'is' to avoid mismatch of singular and plural. (Peter Burt, University of Greenwich)	There is no "are" on this line. Presumably this comment really means the other way round since we have used "is" with "data", which is plural. We have replaced "is" with "are".
861	71176	4	27	2	27	2	The Penman-Monteith equation is one of many equations available to estimate ET using meteorological data. Suggest clarifying. (CANADA)	We have removed reference to Penman Monteith during shortening of the text.
862	62899	4	27	4	0	0	The reason for increase in evapotranspiration between 1982 and 2002 has not been mentioned. Was it due to increase in temperature? (Muhammad Mohsin Iqbal, Global Change Impact Studies Centre)	The suggested reasons behind the increased ET have now been mentioned.
863	68210	4	27	5	0	0	I suggest to replace x mm.y-2 by "(mean) annual change of x mm.yr-1" (Denis Loustau, INRA)	ET would be in mm/yr, but these lines refer to rates to change in ET which is mm/yr/yr hence mm yr-2. No change has been made here.
864	76643	4	27	22	27	23	despite the interesting results, these works (K2010 and G2011) refer to a single site, and thus cannot be considered too meaningful (Claudio Cassardo, University of Torino)	The references are cited along with others, and we consider them useful examples which do not unduly weight the assessment. No change has been made.
865	76508	4	27	26	0	0	Section 4.3.2.5. "Changes in Species Range, Abundance and Extinction". I think that a discussion on the implications of the fact that "Rates of displacement vary greatly within and among species groups" is missing, particularly regarding the denoted differences between plants and animals. For example, implications for the plant-animal interactions such as pollination, dispersion, herbivory, etc (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We agree that this is of considerable importance and the importance of species interactions is referred to repeatedly in this section with appropriate citations. However, we do not go into the details of this issue due to very tight space constraints.
866	62863	4	27	28	27	28	Do you mean phenotypic plasticity when you write 'phenotypic adaptation.' I think this is very confusing because of course the phenotype evolves through changes in the genotype so genotypic and phenotypic adaptation could mean the same thing. (Mark Urban, University of Connecticut)	Changed to "phenotypic plasticity"
867	71961	4	27	28	27	29	Please define/explain difference between genotypic and phenotypic adaptation (UNITED STATES OF AMERICA)	Reworded - see 866
868	71962	4	27	28	27	31	Suggest authors expand literature cited, some examples are: Mackey, B. G., Watson, J.E.M., Hope, G. and S. Gilmore (2008). Climate change, biodiversity conservation, and the role of protected areas: An Australian perspective. <i>Biodiversity</i> , 9:11-18. Watson, J.E.M., Rao, M., Kang, A., and X. Yan (2012). Climate change adaptation planning for biodiversity conservation: a review. <i>Advances in Climate Change Research</i> , 3: 1-11. Watson, J.E.M., Cross, M., Rowland, E., Joseph, L.N., Rao, M. and A. Seimon (2011). Planning for species conservation in a time of climate change. <i>Climate Change Volume 3: Research and technology for climate change adaptation and mitigation</i> (editors Juan Blanco and Houshang Kheradmand), InTech Publishers. ISBN 979-953-307-278-3, Pp 379-402. Kingsford, R.T and J.E.M. Watson (2011). Impacts of and adaptations to climate change in Oceania: a synthesis. <i>Pacific Conservation Biology</i> , 17: 270-284. Kingsford, R.T. and J.E.M. Watson (2011). What hope for biodiversity in the face of anthropogenic climate change in Oceania? <i>Pacific Conservation Biology</i> , 17: 166-167. (UNITED STATES OF AMERICA)	We have e.g. added Penuelas et al. 2013 in this section, but did not include more papers as we had to save space and just wanted to cite a view representative papers. Furthermore this section is about vulnerabilities but not about adaptive management or planning.
869	57707	4	27	29	0	0	Add reference after Bellard et al: Josep Peñuelas, Jordi Sardans, Marc Estiarte, Romà Ogaya, Jofre Carnicer, Marta Coll, Adria Barbeta, Albert Rivas-Ubach, Joan Llusià, Martin Garbulsky, Iolanda Filella and Alistair S. Jump. 2013. Evidence of current impact of climate change on life: a walk from genes to the biosphere. <i>Global Change Biology</i> 2013, DOI: 10.1111/gcb.12143 (Josep Penuelas, CREAM-CSIC)	Reference added
870	66439	4	27	29	27	29	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Ok
871	62871	4	27	34	27	34	Relevant to this point is the Zarnetske et al. 2012 manuscript in Science, where the idea of the biotic multiplier is advanced. The idea is that certain species multiply the effects of climate change on communities as a joint function of their strong sensitivity to climate change and their strong effects on communities. These species tend to be top consumers. Empirical studies bear out these findings and are reviewed in this manuscript: Zarnetske, P. L., Skelly, D. K. & Urban, M. C. Biotic multipliers of climate change. <i>Science</i> 336, 1516-1518 (2012). (Mark Urban, University of Connecticut)	Reference added
872	79941	4	27	34	27	35	Global extinction results in permanent loss of species, local extinction results in loss of unique combinations of genes (though the same combinations may hypothetically appear again if the genes persist in the gene pool and are brought together by outbre (NORWAY)	Wording was changed to "unique forms of life"
873	62864	4	27	35	27	35	And genes themselves will be lost, not just specific combinations of them (Mark Urban, University of Connecticut)	Wording was changed to "unique forms of life"



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
874	66440	4	27	37	27	37	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Ok
875	71177	4	27	37	27	38	Suggest insertion of a qualifier (e.g. "some" or "many" ) in front of "terrestrial plant and animal species' ranges have moved" (CANADA)	Ok, used "many"
876	66441	4	27	41	27	41	'vice versa' should be in italics (Peter Burt, University of Greenwich)	Not changed, commonly used foreign words are not in italics
877	62486	4	27	45	28	26	Consider adding the following reference for India: Telwala Y, Brook BW, Manish K, Pandit MK (2013) Climate-Induced Elevational Range Shifts and Increase in Plant Species Richness in a Himalayan Biodiversity Epicentre. PLoS ONE 8(2): e57103. doi:10.1371/journal.pone.0057103. Key finding of this paper is as follows: In India, a study by Telwala et al (2013) based on extensive field sampling and historical data estimated the vegetation shift patterns for 124 endemic species in the Eastern Himalayan state of Sikkim, over the period 1849-1850 to 2007-2010. They estimated that 87% of the 124 endemic species showed geographical range shifts in response to observed warming experiencing a mean upward displacement rate of 27.53±22.04 meters per decade. It concludes that the "present-day plant assemblages and community structure in the Himalaya is substantially different from the last century and is, therefore, in a state of flux under the impact of warming". They further caution that the continued warming is likely to result in ongoing elevational range contractions, and eventually species extinctions, particularly at mountaintops. (INDIA)	Included Telwala et al. (2013)
878	71178	4	27	45	28	26	Repetition of the "upward and poleward" and "complex responses" ideas occurs in this section. (CANADA)	We have removed "complex" in two sentences
879	66442	4	27	46	27	46	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
880	59300	4	27	49	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
881	71179	4	28	1	28	2	What is meant by "species groups" here? It could mean "genera" or "communities" for example, and one of these terms would be more explicit. Fig. 4-7 shows that it is probably intended to mean "broad phylogenetic groupings", such as "trees", "ungulates", "rodents", "birds". If the latter is the intended use here, it should be stated up front. Searching backwards shows the first occurrence of this term is at P. 21, L. 9. It is not defined there either, but it is easy to comprehend from context. Suggest a formal "definition" there so that subsequent usage is clear. (CANADA)	This is now clarified: species groups = broad taxonomic groups
882	58346	4	28	3	28	4	Close ) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Done
883	76644	4	28	4	28	4	typo: change "et al. (2011" with "et al., 2011" (Claudio Cassardo, University of Torino)	Done
884	71180	4	28	5	0	0	Do the authors mean mountain areas or timberline? (CANADA)	We mean "mountain areas" - this is clear from wording
885	66443	4	28	9	28	0	'vs' should be in italics. (Peter Burt, University of Greenwich)	Not changed, commonly used foreign words are not in italics
886	78630	4	28	11	0	0	include species range shifts for freshwater algae: The invasive cyanobacterium <i>Cylindrospermopsis raciborskii</i> is increasingly spreading in temperate freshwater habitats worldwide (Vidal and Kruk 2008, Haande et al. 2008). This is of concern due to its ability to produce potent toxins. References: LETICIA VIDAL1* & CARLA KRUK .2008. <i>Cylindrospermopsis raciborskii</i> (Cyanobacteria) extends its distribution to Latitude 34°53'S: taxonomical and ecological features in Uruguayan eutrophic lakes. Pan-American Journal of Aquatic Sciences (2008) 3(2): 142-151. Haande, S., Rohrlack, T., Ballot, A., Røberg, K. Skulberg, R Beck, Martin, Wiedner, C.2008. Genetic characterisation of <i>Cylindrospermopsis raciborskii</i> (Nostocales, Cyanobacteria) isolates from Africa and Europe. Harmful Algae: 7: 692-701. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	These references do not provide strong evidence for climate attribution.
887	71181	4	28	12	28	12	Could perhaps make the point here that these global spatial variations in the rates of climate change are broadly consistent with GCM projections? E.g. "Consistent with global climate model projections, rates of recent climate change have varied greatly around the globe....." (CANADA)	Not changed. This is not the main point of this sentence.
888	65131	4	28	12	28	26	There are examples of greater rates of change and movement for Japan ( and cited in the Asia chapter). See Ogawa-Onishi, Y. and Berry, P.M. (2013) Ecological impacts of climate change in Japan: the importance of integrating local and international publications. Biological Conservation, 157: 361-371. (Pam Berry, Oxford)	This is a very interesting article, but in this section we have primarily cited i) global syntheses or ii) studies of mechanisms underlying range shifts, so we have not included this citation.
889	81797	4	28	14	28	18	Over what time frame were these rates of change observed? (Katharine Mach, IPCC WGII TSU)	This varies a lot between studies in the synthesis of Chen et al. (2011), so it is difficult to give a representative time frame.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
890	71963	4	28	14	28	19	It is important to realize that the Chen paper does not include any trees, and few plants. So it is unjustified to generalize the 17km and 11m numbers to all terrestrial species. Nor is it justified to compare "2 to 3 times greater" to the Parmesan and Yohe paper. Parmesan and Yohe included more plants. It matters what species are being considered. (UNITED STATES OF AMERICA)	We have clarified that this varies greatly among species groups. The Parmesan and Yohe paper also had few references to plants for range shifts.
891	58347	4	28	16	28	17	I don't understand this sentence (Martin Pecheux, Institut des Foraminifères Symbiotiques)	The sentence has been reworded
892	66444	4	28	18	28	18	'per' should be in italics. (Peter Burt, University of Greenwich)	Not changed, commonly used foreign words are not in italics
893	71182	4	28	20	0	0	Do the authors mean temperature and precipitation shift at different rates across space by the following statement: 'temperature and precipitation have frequently shifted in divergent geographical directions'. Perhaps some clarification of the text is called for here. Also, is this inconsistent with the statement that follows? To what climate signals is it referring to exactly? (CANADA)	Rates and direction may differ. E.g., warming can be driving species uphill while changes in precipitation are driving them downhill. We have not found a better way to express this idea in few words. It is consistent with the statement that follows.
894	66445	4	28	22	28	22	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
895	64756	4	28	25	28	25	replace 'recent changes' with 'recent detected changes' (Robert Webb, NOAA OAR ESRL)	We felt this is clear from the wording of the sentence and have not changed the wording.
896	66446	4	28	28	28	28	Delete 'report' (Peter Burt, University of Greenwich)	Done
897	71964	4	28	28	28	31	A very critical distinction should be included here. The text implies that ecological niche models do not include anything but climate. This may be true for some, but cannot be stated as a blanket statement. Nor can it be said that SDMs or bioclimatic models only use climate variables. This is absolutely not true. Consider citing background on this point with the following reference: Franklin, J. 2009. Mapping species distributions: spatial inference and prediction. Cambridge University Press, Cambridge, UK. (UNITED STATES OF AMERICA)	We have changed the wording to reflect this and it now reads "ecological niche models (ENMs) that estimate future ranges based on current relationships between environment and species distribution"
898	71965	4	28	28	28	52	The greatest limitation is that it is not known if species will track their climates or undergo either phenotypic plasticity or micro-evolution, or do a combination of these. This should be made clear for the readership. It is not simply about species moving and in many cases, they simply won't be able to (do to current landuse changes) (UNITED STATES OF AMERICA)	There are a number of limitations in models: we have added a partial list including genetic adaptation and phenotypic plasticity. We also not clearly spell out what the various consequences that not moving could have, including adaptation.
899	71966	4	28	28	31	22	It seems out of place that a discussion of Future Range Shift is in the 4.3.2 section on Evidence of Changes in Ecosystems over the recent past. (UNITED STATES OF AMERICA)	The title of the main section has been changed to reflect that some sections treat both observations and future projections.
900	71967	4	28	30	28	31	Species distribution models do not always depend solely on climatic factors. They can include soils and other factors too. It is not true to state that "SDM or bioclimatic models 'depend entirely on climate factors'". (UNITED STATES OF AMERICA)	We have changed the wording to reflect this (see 897)
901	71968	4	28	32	28	35	This sentence could be reworked for clarity. There is a variation in outcomes from both types of models which can go both ways, depending on species. (UNITED STATES OF AMERICA)	Not changed. We agree that comparisons can go both ways, but this is precisely what is stated.
902	62865	4	28	40	28	41	realistic displacement rates and species interactions as well (Mark Urban, University of Connecticut)	Done
903	68211	4	28	44	0	0	AR4 (Denis Loustau, INRA)	Done
904	81367	4	28	44	0	0	A4 --> AR4 (Yuka Estrada, IPCC WGII TSU)	Done
905	59301	4	28	44	0	45	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
906	66447	4	28	44	28	44	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'), and change 'A4' to 'AR4'. (Peter Burt, University of Greenwich)	Done
907	76507	4	28	45	28	46	explain better climate velocity (e.g., include units). Include definition in the glossary? (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We have provided a precise definition in the paragraph on climate velocity below. It has also been added to the Glossary.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
908	61029	4	29	3	29	4	For consistency is dispersal capacity a clearer term than 'displacement capacity' are these terms one and the same? Because I would argue that dispersal capacity refers to the inherent ability of a species to move (disperse) through the landscape in tracking climate change (i.e. the rate) and 'displacement' would refer to the degree to which a species niche is shifted under climate change, requiring the species to disperse. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	There is a difficult problem with vocabulary. Literature on plant displacement in response to climate change typically refers to migration rates, which include both dispersal and establishment. Use of dispersal would be incorrect when referring to plant migration. Literature on animals typically refers to dispersal in response to climate change, and migration is a very different process than defined for plants. To avoid conflicting use of words that do not have common definitions we have used "displacement rates".
909	66448	4	29	6	29	6	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Disagree.
910	59876	4	29	6	29	24	The term 'climate velocity' should appear in the glossary. (AUSTRALIA)	We have provided a precise definition in the paragraph on climate velocity below. It has been added to the Glossary.
911	71969	4	29	19	0	0	It would be useful to define/explain "climate velocity" - or drop the term altogether. (UNITED STATES OF AMERICA)	We have provided a precise definition in the paragraph on climate velocity below. It has been added to the Glossary.
912	62866	4	29	26	29	41	I think an important point to make is the degree to which species within groups vary in dispersal. In Urban et al. 2012 (Proceedings Royal Society B), we show strong log-normally distributed dispersal within taxonomic groups (see appendix of this paper for data and analysis). For instance, amphibians vary in dispersal distance from a few meters to several kilometers. This variation within groups can easily be just as great as between groups. Urban, M. C., Tewksbury, J. J. & Sheldon, K. S. On a collision course: competition and dispersal differences create no-analogue communities and cause extinctions during climate change. Proceedings of the Royal Society B-Biological Sciences 279, 2072-2080 (2012). (Mark Urban, University of Connecticut)	We agree. This is clearly shown in Fig 4.6 and stated in the text. We have added an additional mention of this in the text. Urban et al. (2012) is cited elsewhere in text.
913	59302	4	29	33	0	35	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been reworded
914	58348	4	29	33	29	33	References wellcome (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Multiple references are given in the Figure legend
915	62867	4	29	39	29	41	One criticism of this approach is that it does not account for real dispersal kernels but relies on mean or median distances. Range expansion will depend on mean dispersal and also the degree to which dispersal kernels are fat-tailed and also population growth rates. Thus these types of analyses are imperfect at best. (Mark Urban, University of Connecticut)	The studies used in this analysis have used a variety of methods. Plant studies have typically used dispersal kernel methods, but animal studies have focused on dispersal distance, but do account for long distance dispersal (see Schloss et al. for example). We agree that some models do not account for population growth rates or a variety of other important factors, and we discuss associated caveats.
916	58349	4	29	48	29	48	"arrow on right pointing downward" what it is ? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Arrow has been removed
917	60345	4	30	1	30	4	The following reference is also relevant in this context: Matzarakis, A., Rammelberg, J., and Junk, J.: Assessment of thermal bioclimate and tourism climate potential for central Europe—the example of Luxembourg, Theor Appl Climatol, 1-10, 10.1007/s00704-013-0835-y, 2013. (Andrew Ferrone, Public Research Centre - Gabriel Lippmann)	This reference is interesting, but not particularly relevant.
918	66449	4	30	7	30	7	Insert commas either side of 'reviewed below'. (Peter Burt, University of Greenwich)	Sentence reworded
919	58350	4	30	29	3	33	here or elsewhere, it would be good to give references of the migration of trees at the glacial/interglacial transition, particularly United states, as it provide the best estimate of possible velocities. Refs p 31 line 8, Legend Fig 4;8 (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We have given several references to this.
920	78610	4	30	34	30	35	optimistic? Not for insect pests? (richard arthur fleming, canadian forest service)	Optimistic is used in the sense that dispersal capacity "may be overestimated". It has no bearing on whether ranges shifts would have positive or negative effects.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
921	71970	4	30	42	30	42	The arrows in the figure are gray with red arrowheads, not "thin red". Suggest revising the figure for clarity. (UNITED STATES OF AMERICA)	Figure revised
922	81798	4	30	47	30	48	For the described 17% of model projections outside this bound, is the chapter team referring to ensemble means or individual runs? I may be misunderstanding the sentence on lines 49-50. (Katharine Mach, IPCC WGII TSU)	This refers to the ensemble, not individual runs
923	66450	4	30	50	30	50	'per' should be in italics. (Peter Burt, University of Greenwich)	Not done
924	68198	4	31	0	38	0	This 4.2.3 part is vague, poorly referenced and useless. (Denis Loustau, INRA)	It is not clear what section this refers to since it spans parts of section 4.3.2.5 all the way through to parts of section 4.3.3 and does not include any parts of 4.2.3; As such, we are unable to respond to this.
925	59303	4	31	1	0	3	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
926	81799	4	31	17	31	17	"very low confidence" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	Done
927	58351	4	31	20	31	20	100m/yr, not 100km/yr (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Removed
928	57908	4	31	24	31	24	Suggest add the notion that climate warming does not cause outbreaks of a lethal amphibian pathogen It has been highly debated if global warming is causing outbreaks of a lethal amphibian pathogen, the chytrid fungus <i>Batrachochytrium dendrobatidis</i> (Longcore, Pessier & D.K. Nichols 1999). A recent study does not support the links between high temperatures and mortality of amphibians infected with this pathogen. They found the pathogen was equally lethal at 17 as at 23 °C, and no significant differences in mortality of frogs was detected (Bustamante et al 2010). Bustamante HM, Livo LJ and Carey C. 2010. Effects of temperature and hydric environment on survival of the Panamanian Golden Frog infected with a pathogenic chytrid fungus. <i>Integrative Zoology</i> 5: 143-153 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	We believe the text reflected this, but have added the Bustamante reference and a confidence statement reflecting low agreement concerning climate as a major driver to bolster this message.
929	57909	4	31	24	31	24	Need to modify the sentences. Effect of temperature increase on abundance of species is often nonlinear (Zhang 2012), but may be frequency-dependent (Stige et al. 2007; Zhang et al. 2009; Tian et al. 2011), region-specific (Xu et al. 2011) or species-specific (Cadby et al. 2010, Jiang et al. 2012). The impact of temperature change is often complex; it affects species abundance directly through affecting reproduction, growth, survival or dispersal, or indirectly thorough affect other climatic factors, vegetation, food, competitor, parasites or predators. Examples of frequency-dependent response: By using nearly over thousands yrs' historical data, it was found locust outbreaks are more linked to high frequency of droughts in cold periods in China (Stige et al. 2007; Zhang et al. 2009; Tian et al. 2011). This finding is different with the observation on the positive relation between locust and temperature with decadal scale (Ma 1958; Ma et al., 1965). Example of region-specific response: Xu et al. (2011) found that the intensity of the third plague pandemic was positively associated with precipitation of previous years in dry northern China, but negatively associated previous years in damp southern China. Examples of species-specific response: Jiang et al. (2011) report that many rodent species in Inner Mongolia grassland of China, e.g. hibernating species, showed positive response in abundance to temperature increase; but a few showed negative response, probably due to they do not like high vegetation or rainfall induced by increased temperature. Seabirds breeding the Northern Hemisphere are likely affected by more intense and frequent heat stress (Christensen et al. 2007; Oswald and Arnold, 2012,). There is an example of climate warming showing positive effect on a reptile species ( <i>Niveoscincus ocellatus</i> Gray, 1845) in Tasmania, Australia (Cadby et al. 2010; Wapstra et al. 2010). Warming temperatures have resulted in offspring of the common lizard ( <i>Lacerta vivipara</i> Von Jacquin, 1787) being born larger (Chamaille-Jammes et al. 2006). (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	This work on locust outbreaks is very interesting and clearly shows that climate is a clear driver of abundance. However, thees references do not directly address the issue of recent climate warming. On the other hand, Jiang et al. 2013 (more relevant than 2011) is particularly pertinent and we have added this reference. We are limited in the number of references that we can add, so this was chosen as the most pertinent of the several suggested in this and the following two comments.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
930	57910	4	31	24	31	24	Reference : Zhang ZB, 2012. Biological consequences of global change: opportunities and challenges. Integrative Zoology, 7: 111–112 Xu L, Liu Q, Stige LC et al. (2011). Nonlinear effect of climate on plague during the third pandemic in China. PNAS 108, 10214–9. Tian H., Stige L. C., Cazelles B., Kausrud K. L., Svarverud R., Stenseth N. C.* and Zhang,Z.B.*. 2011. Reconstruction of a 1,910-y-long locust series reveals consistent associations with climate fluctuations in China. PNAS, 108: 14521–14526. Ma (1958) The population dynamics of the oriental migratory locust ( <i>Locusta migratoria manilensis</i> ) in China. Acta Entomol Sin 8:1–40. Ma S, Ding Y, Li D (1965) Study on long-term prediction of locust population fluctuations. Acta Entomol Sin 14:319–338. Stige LC, Chan KS, Zhang Z, Frank D, Stenseth NC (2007) Thousand-year-long Chinese time series reveals climatic forcing of decadal locust dynamics. Proc Natl Acad Sci USA 104:16188–16193. Zhang Z, et al. (2009) Periodic temperature-associated drought/flood drives locust plagues in China. Proc R Soc Lond Ser B Biol Sci 276:823–831. Jiang G, Zhao T, Liu J, Xu L, Yu G, He H, Krebs CJ, Zhang Z (2011). Effects of ENSO-linked climate and vegetation on population dynamics of sympatric rodent species in semi-arid grasslands of Inner Mongolia, China. Canadian Journal of Zoology 89, 678–691. Christensen JH, Hewitson B, Busuioac A et al. (2007). Regional climate projections. In: Solomon S, Qin D, Manning M et al., eds. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, pp. 847–940. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	see 929
931	57911	4	31	24	31	24	References (continued): Oswald SA and Arnold, JM. 2012. Direct impacts of climatic warming on heat stress in endothermic species: seabirds as bioindicators of changing thermoregulatory constraints. Integrative Zoology, 7: 121–136 Cadby CD, While GM, Hobday AJ, Uller T and Wapstra E. 2010. Multi-scale approach to understanding climate effects on offspring size at birth and date of birth in a reptile. Integrative Zoology 2010; 5: 164-175 Wapstra E, Uller T, Sinn DL et al. (2009). Climate effects on offspring sex ratio in a viviparous lizard. Journal of Animal Ecology 78, 84–90. Wapstra E, Uller T, While GM, Olsson M, Shine R (2010). Giving offspring a head start in life: Field and experimental evidence for selection on maternal basking behaviour in lizards. Journal of Evolutionary Biology 23, 651–7. Chamaille-Jammes S, Massot M, Arago P, Clobert J (2006). Global warming and positive fitness response in mountain populations of common lizards <i>Lacerta vivipara</i> . Global Change Biology 12, 392–402. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	see 929
932	76645	4	31	26	31	26	"is reviewed above": please mention explicitly the paragraph (Claudio Cassardo, University of Torino)	Done
933	66451	4	31	27	31	27	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
934	64757	4	31	28	31	28	replace 'regional climate change' with 'regional changes in climate' (Robert Webb, NOAA OAR ESRL)	Done
935	78631	4	31	30	0	0	include reference for freshwater. Adrian et al. 2009 (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	We agree that freshwater references were lacking, but found that Vodadi-Fulap et al. 2012 was more pertinent.
936	78632	4	31	36	0	0	include reference for freshwater. Scharfenberger et al. 2013 (reference is given somewhere above) (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	see 935
937	62868	4	31	36	31	36	Add citation: Gilman, S. E., Urban, M. C., Tewksbury, J., Gilchrist, G. W. & Holt, R. D. A framework for community interactions under climate change. Trends in Ecology & Evolution 25, 325-331 (2010). (Mark Urban, University of Connecticut)	Thank you for the suggestion, but we already have several citations on this issue.
938	57912	4	31	38	31	38	Suggest to add an example that global warming may cause population decline. Kausrud et al.(2008) found that ice-melting caused by global warming contributed to the disappearance of lemming cycles in Scadinavia regions. Kausrud, K. L., A. Mysterud, H. Steen, J. O. Vik, E. Ostbye, B. Cazelles, E. Framstad, A. M. Eikeset, I. Mysterud, T. Solhoy, and N. C. Stenseth. 2008. Linking climate change to lemming cycles. Nature 456:93-U93. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	Thank you for this recommendation, but we can include only a very limited number of examples due to space constraints.
939	62869	4	31	46	31	46	I like to use 'extirpation' for populations and extinction for species. I wonder if a similar convention would work in this document. (Mark Urban, University of Connecticut)	It was felt that extirpation was less comprehensible to most readers than local extinction.
940	58352	4	31	47	31	49	In which species ? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Species name added
941	71183	4	31	47	31	49	Looking at the list of references indicates that this sentence refers to the Antarctic penguin population changes mentioned in the previous sentence, but it reads as if it is a general conclusion to the paragraph. Suggest rewording for clarity, e.g. "The attribution of these penguin population declines to regional climate change is well supported...." (CANADA)	Sentence reworded



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
942	76646	4	31	53	32	2	it depends also on which side of the mountain is considered! (Claudio Cassardo, University of Torino)	We agree, but do not see how this modifies what is written. No change was made to wording.
943	66452	4	31	54	31	54	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Peter Burt, University of Greenwich)	Not changed. Boreal is spelled with a "b" throughout.
944	76858	4	32	4	32	5	Section 4.3.2.5: Additional reference highlighting the difficulties of attribution of changes in abundance to climate versus land use change Clavero, M., Villero, D. & Brotons, L. (2011) Climate change or land use dynamics: do we know what climate change indicators indicate? PLoS ONE, 6, e18581. (Tom Oliver, Centre for Ecology and Hydrology)	Reference added
945	71971	4	32	9	32	30	It seems out of place that a discussion of Projected Changes to Abundance and Local Extinction is in the 4.3.2 section on Evidence of Changes in Ecosystems over the recent past. (UNITED STATES OF AMERICA)	The title of the main section has been changed to reflect that some sections treat both observations and future projections.
946	71972	4	32	9	32	30	no confidence statements about homogenization or loss of genetic diversity (UNITED STATES OF AMERICA)	Confidence statements concerning genetic diversity are in 4.4.1.2
947	71184	4	32	11	32	12	This is hard to follow. Suggest revising as follows: "Projected areas of local extinction range from near 0% to 95% of the present-day species' distribution ..." (CANADA)	We have reworded the sentence
948	81800	4	32	11	32	12	What are the broad time frames and scenarios of climate change for these projections? (Katharine Mach, IPCC WGII TSU)	Added time frame
949	59304	4	32	18	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
950	59305	4	32	21	0	22	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
951	76509	4	32	21	32	22	Even when population size increases? Or only when population size decreases? If this is only for when population size decreases, clarify it and perhaps explain what it is expected to happen to genetic diversity in the cases for which population size increases (if it is possible). (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We have clarified that this refers to situations when population size decreases
952	59306	4	32	21	32	30	Changes in abundances will also be accompanied by severe losses in genetic diversity. However, climate change may induce increase in genetic diversity. As the habitat becomes unsuitable, populations may disperse, may cut themselves off the parent populations and establish new populations with different diversity patterns. That is always the case with genetic drift. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)	We discuss this in more detail in section 4.4.1.2 and give examples of when the climate change can increase genetic diversity
953	59307	4	32	26	0	29	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence removed
954	79942	4	32	26	32	29	This sentence is not understandable, please consider rephrasing. (NORWAY)	Sentence removed
955	71185	4	32	27	0	28	For some readers, it might be valuable to describe and cite, in plain language, the implications of 'phylogenetic homogenization' (CANADA)	Sentence removed
956	56501	4	32	29	0	0	Suggested change "losses of genetic diversity that are already occurring due to other global changes..." (Archis Ambulkar, Brinjac Engineering Inc.)	Done
957	59308	4	32	29	0	30	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
958	58353	4	32	33	32	33	!! In the fossil record during the Big Five mass extinction (their p; 55) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This comment is not phrased in a way that we understand what is meant.
959	79943	4	32	34	32	35	Please clearly state that these are the main threats to biodiversity, ecosystems and species survival today, and include pollution in the list of threats (cf. I. 38-39). (NORWAY)	We have added the threats including pollution.
960	76859	4	32	38	32	38	Section 4.3.2.5: 'Mollusk' should be 'Mollusc' and in Figure 4-6 (Tom Oliver, Centre for Ecology and Hydrology)	Done
961	71186	4	32	39	0	43	Can 'environmental drivers be replaced with 'cause' in this phrase in order to use the word 'driver(s)' can be used more sparingly throughout the document. In many cases, it could be replaced with more direct and plain language. (CANADA)	In this case we prefer drivers.
962	66453	4	32	39	32	39	I suggest replacing the hyphen with a comma, I misread this as 'pollution-changes' and the sentence initially did not make sense. (Peter Burt, University of Greenwich)	This was intended to be a dash and not a hyphen, this has been corrected.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
963	85070	4	32	43	33	4	It would be useful to clearly explain the assignment of medium confidence that appears in the executive summary here. (Michael Mastrandrea, IPCC WGII TSU)	Sentence added to substantiate confidence statement in ES
964	66454	4	32	45	32	45	Insert '(Bufo periglenes)' in italics after 'toad'. (Peter Burt, University of Greenwich)	Done
965	71973	4	32	47	32	47	Add "previously" before "ascribed", since you're explaining why we no longer have the same confidence as before. (UNITED STATES OF AMERICA)	Done
966	66455	4	32	48	32	48	Insert comma after 'since'. (Peter Burt, University of Greenwich)	Not changed, question of style
967	66456	4	32	50	32	50	Insert commas either side of 'and'. (Peter Burt, University of Greenwich)	Not changed, question of style
968	79944	4	32	53	33	1	Very informative observation that should be more highlighted and discussed, as well as reflected in TS (NORWAY)	A phrase has been added to the ES to reflect this.
969	80076	4	33	0	0	0	I suggest to better take all landscape components together and discuss terrestrial and aquatic systems for a given landscape together. Both terrestrial and aquatic systems will be characterized by specific environmental features and in coupling with each other. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	While we don't know to which section this exactly refers, we tried to deal with the different aspects along an internal logic, which sometimes also led to a treatment along specific environmental features like e.g. in section 4.3.2.
970	64877	4	33	0	36	0	Forests and woodlands 4.3.3.1 should include tropical forests (in ACP countries, as well as Asia Pacific, China, India and the Middle East) which include a lot more than just the Amazon basin. There are tropical wet forests, tropical dry forests, savannas and grassland areas that are included in this as well (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development)	Reference is made to tropical forest regions outside of the Amazon. We have given greater emphasis to the Amazon because of the greater amount of published evidence and because of the evidence of a potential large-scale forest dieback (which is not predicted for other tropical forest regions).
971	62870	4	33	1	33	4	very low confidence is given here that observed species extinctions can be attributed to climate change. The logic offered is that only a small fraction of species have gone extinct. I think you want to argue instead that the low confidence stems from the inability to attribute extinction in these few species to climate change rather than that not a lot of species have gone extinct. This statement deals with the probability that species have gone extinct rather than the total fraction - at least that's how I read it. (Mark Urban, University of Connecticut)	This has been reworded as suggested.
972	61030	4	33	6	33	43	The assessment of the effect of recent literature upon ability to project extinction risk is exceedingly biased. Whilst many caveats exist in relation to niche modelling approaches, that has always been recognised. These models indeed project that some families are much more sensitive than others to extinction risk: that range doesn't make their projections more or less reliable. The same issues relating to the discussion of paleoclimate (See comment 5) are used to back up the statements made here, that there can only be low confidence in projections of extinction risk, and that quantification is not possible. In fact, in AR4 it was also recognised that quantification, as in absolute quantification, of extinction was not possible, and hence the phrasing is that of 'increased risk' of extinction. To say that large reductions in species climatic ranges does not increase extinction risk is clearly nonsensical. I therefore believe this section is totally misleading and extremely damaging for messages coming out to policy makers, who are thus led to believe that perhaps they no longer need to be concerned that climate change might cause large waves of extinction. Whilst an appropriate range of literature is cited in the text, the problem is with the balance of argument that emerges from the authors' assessment of that literature. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We do not feel that this text was biased, but we have reworked this entire section to i) recast it in the context of risk and ii) provide a more positive view of what has been learned since AR4. This was done with the participation of two CA's with strong expertise in climate change and extinctions and in coordination with Chapter 19. We have added a sentence concerning caveats in using the paleo record to project future extinctions. We clearly identify species extinction as a high risk.
973	71974	4	33	10	33	11	The phrase "increasing risk" is not very strong or specific without indication of what the scale of the risk was previously. A change from 20 to 21% in probability of extinction by 2100 is not very consequential. Nor is an increase from 1% to 2%, even though the probability is doubled. Yet both are "increasing risk". Can you say anything to give an idea of the magnitude of the increases involved, even in ballpark terms? (UNITED STATES OF AMERICA)	We have clearly indicated the range of species that are projected to be at increased risk. However, it is very difficult to summarize the degree to which risk increases across studies due to large differences in methodology. We have now qualified this as a "substantial" increase in extinction risk, i.e., well above the range of a increase of 1% point in extinction risk.
974	58354	4	33	12	33	39	Hannah (ed) 2012 and in reference p 94 line 52 (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This reference is used elsewhere and is not required here.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
975	71187	4	33	17	33	23	Suggest reorganizing as follows: "Modeling studies use a wide range of methods to estimate future extinction risk, generally inferring it indirectly from changes in availability of habitat, and rarely accounting for demographic factors such as dispersal ability and generation time (Akçakaya et al. 2006). Several recent studies project increased extinction risks by 2100 due to climate change, but estimates range from below 1% to more than 50% of species in the groups that have been studied (Pereira et al., 2010; Bellard et al., 2012; Cameron, 2012). However, since the AR4, the ability of such models to accurately quantify future extinction risk has been questioned. For example, these models rarely...." (CANADA)	We have entirely reworded this section to clarify the messages and provide a clearer view of what has been learned since AR4.
976	71975	4	33	21	33	21	It's not clear what the 1% and above 50% numbers refer to -- the CHANGES in risk of extinction? the percent of species expected to go extinct? Clarify. (UNITED STATES OF AMERICA)	This is now phrased as at "substantially increased risk of extinction". The percent of species expected to go extinct is not known because there is no clear connection between rising extinction risk and observed extinction rates.
977	71188	4	33	22	0	25	Are all the cited models actually inferring extinction risk from changes in habitat availability, or are they simply projecting suitable habitat. Many constructors of these models are more explicit about what exactly the models do (project climatically suitable habitat). Can the authors describe how models recently incorporating adaptive capacity, dispersal, and species interactions have improved projections? (CANADA)	We have entirely reworded this section to clarify the messages and provide a clearer view of what has been learned since AR4 especially with respect to adaptive capacity, dispersal and species interactions.
978	76860	4	33	22	33	22	Section 4.3.2.5: An recent study might also be considered here: Warren, R., VanDerWal, J., Price, J., Welbergen, J. A., Atkinson, I., Ramirez-Villegas, J., Osborn, T. J., Jarvis, A., Shoo, L. P., Williams, S. E. & Lowe, J. (2013) Quantifying the benefit of early climate change mitigation in avoiding biodiversity loss. Nature Clim. Change, advance online publication. (Tom Oliver, Centre for Ecology and Hydrology)	Reference added
979	71189	4	33	30	33	35	Does the apparent low rate of extinctions over the last several 100,000 years account for small invertebrates, many of which would not leave traces in the fossil record and which likely don't attract as much interest from paleontologists as large mammals, birds and fishes? (CANADA)	The fossil record is poor for some invertebrates, but is good for others including gastropods, bivalves, decapods and corals.
980	58355	4	33	32	33	32	...Holocene, probably due to human hunting - (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This is hotly debated and we do not wish to open this issue here as it is not essential for statements made in the text.
981	66457	4	33	32	33	32	Replace hyphens with commas for clarity. (Peter Burt, University of Greenwich)	These were supposed to be dashes not hyphens, this has been corrected
982	59309	4	33	35	0	39	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Section has been entirely rewritten
983	66458	4	33	35	33	35	Insert 'as' after 'such'. (Peter Burt, University of Greenwich)	Section has been entirely rewritten
984	62764	4	33	40	33	43	Let me introduce you a good paper (Shimazaki et al. 2012) to be referred on this sentence, which suggested the importance of fine resolution modelling to incorporate the effects of topographic (microclimate) factors. In this paper, they suggested that coarse resolution models overestimate the persistence of the species of potential habitat, while they partly underestimate the persistence of local refugia. Shimazaki, M., Tsuyama, I., Nakazono, E., Nakao, K., Konoshima, M., Tanaka, N. and Nakashizuka, T. (2012) Fine-resolution assessment of potential refugia for a dominant fir species ( <i>Abies mariesii</i> ) of subalpine coniferous forests after climate change. Plant Ecology, 213, 603-612. doi: 10.1007/s11258-012-0025-5 (Ikutaro Tsuyama, Forestry and Forest Products Research Institute)	Reference added
985	58356	4	33	43	33	43	Add: "However, there is little doubt that we are facing the 6th mass extinction for direct human perturbation and future climate change (Barnosvky et al., 2011). According to geological record and theoretical consideration on evolution, recovery will take several million years (high confidence, low evidence)(Wood, 1999, Kirchner and Weil, 2000) unless cryogenic saving of Earth biodiversity (Clarke, 2009, Lermen et al., 2009, Rawson et al., 2011)." Kirchner JW, Weil A, 2000, Delayed biological recovery from extinctions throughout the fossil record. Nature, 404, 177180. Wood R, 1999, Reef evolution. Oxford Univ. Press, 324 pp. Clarke AG, 2009, The Frozen Ark Project: the role of zoos and aquariums in preserving the genetic material of threatened animals. Int Zoo Yearbook, 43, 222-230. Lermen D et al., 2009, Cryobanking of viable biomaterials: implementation of new strategies for conservation purposes. Mol Ecol, 18, 1030-1033. Rawson DM, Reid GM, Llyod RE, 2011, Conservation rationale, research applications and techniques in the cryopreservation of lower vertebrate biodiversity from marine and freshwater environments. Int Zoo Yearbook, 45, 108-123. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This is not what Barnosky et al. 2011 state. Also, rates of recovery from mass extinction are hotly debated.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
986	70372	4	33	46	0	0	Section 4.3.3. The use of the term "impacts" in the section title and sub-titles could be misleading because this section mixes material on historical impacts and future vulnerabilities. It would be good for the chapter to be consistent in discussing past effects as "impacts" and projected future effects as "vulnerabilities." To make this distinction clear, I suggest moving the historical impacts parts of Section 4.3.2 and 4.3.3 to a separate section preceding the material on future vulnerability. (Patrick Gonzalez, National Park Service)	While this organization would have a certain logic, this would require reshuffling the entire Chapter 4. There are also good reasons not to make a clear distinction between status, trends and projections. See also response to comment 17.
987	78241	4	33	46	0	0	Section 4.3.3 and subsections on each major system mention fire repeatedly, but the global multi-model ensemble projections in Moritz et al. (2012) are not used in any of them (e.g., to help assess confidence in whether fire activity may increase or decrease for a given area or veg type). Although statistical/correlative fire models (e.g., Westerling et al. 2011, Moritz et al. 2012) do not necessarily reflect feedbacks that may occur between fire-veg-climate, they do provide empirically based forecasts for how fire activity may be expected to change. Furthermore, the Moritz et al. (2012) projections include model agreement maps, which are directly applicable to the IPCC confidence levels for change. Note, however, that the primary caveat in using Moritz et al. (2012) to assess confidence is that the models do not include measures of interannual variation in climate variables (i.e., more stable/robust climate norms from the GCMs are used); certain biomes where fire can be strongly sensitive to interannual variation, particularly the tropical rainforests of the world, may or may not be modeled well in this study. (Max Moritz, University of California, Berkeley)	The figure showing fire maps (Figure 4-8 in the SOD, Figure 4-6 in the FGD) has been revised to include several further studies, including Moritz et al (2012).
988	81801	4	33	46	0	0	Section 4.3.3. In preparing the final draft, the chapter team should shorten this section by 50%. (Katharine Mach, IPCC WGII TSU)	Although we have tried our best to shorten Section 4.3.3 by 50%, we only succeeded in reducing it by one quarter.
989	71976	4	33	46	36	19	This section of text lacks statements on "confidence" (low, medium, high, very high, etc.). These should be added. (UNITED STATES OF AMERICA)	This text has been substantially modified and no longer requires confidence statements
990	85121	4	33	48	33	50	Exposure and vulnerability are now considered separately in the context of AR5 (see AR5 WGII Glossary). As characterized in Chapter 19 and the draft SPM and TS, both interact with physical changes to determine risks. Please consider the terminology here and its consistency with the glossary. Risk may be more appropriate than vulnerability in this context. (Michael Mastrandrea, IPCC WGII TSU)	Done. We have reframed this in the context of risk
991	59310	4	33	48	34	26	Many spelling and grammatical mistakes. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)	Fixed
992	61031	4	33	48	53	28	Within the section on impacts on major systems some sub-sections comment on the predicted impacts of climate change on species with regards to the specific ecosystem (i.e. 4.3.3.3 Rivers, Lakes etc. p46, line 35-47). However, there is inconsistency, in particular on the impacts of c.c. on animal species, with some sub-sections in which no comment is made. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	In general, this section focuses on ecosystem level effects. In many systems this means primarily focusing on dominant vegetation types. In aquatic systems this logically shifts to include a stronger focus on animals as they play a larger role in mediating ecosystem structure and function. Climate change impacts on species are dealt with in Section 4.3.2.5.
993	59311	4	33	49	0	50	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
994	71977	4	33	50	33	50	This sentence, and the rest of this section, seems to be using "thresholds" and "tipping points" as synonyms. This was not the case in the earlier section that used the terms (p. 7, lines 34-44), in which tipping points were only one kind of possible threshold. Use one or the other here, in a manner that is consistent with the earlier section. (UNITED STATES OF AMERICA)	We now use "tipping points" which are defined in the Glossary
995	58110	4	33	52	34	26	This paragraph could be introduced better to help the reader take both viewpoints on board. Perhaps start with something like: "Ecosystems may be vulnerable either where projected change is large compared to current variability, or where changes are large in absolute magnitude. Fig 4-7 illustrates these two perspectives, helping to explain why there is especially strong focus on tropical and high latitude regions." (Peter Good, UK Metoffice)	We agree and have reorganized as suggested.
996	81802	4	34	2	34	2	Casual usage of "likely" should be avoided. If being used as a likelihood term, it should be italicized. (Katharine Mach, IPCC WGII TSU)	Removed
997	58360	4	34	3	34	23	There is a "there" too much (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Fixed
998	68809	4	34	4	34	5	The focus on ecosystems around the equator overlooks the effect of climate change on the arctic systems. These are also very vulnerable to climate change. (NETHERLANDS)	This was the point we were trying to make, that both systems are at high risk. The text has been reworded to make this clearer.
999	56502	4	34	11	0	0	Suggested change "there are a number of..." (Archis Ambulkar, Brinjac Engineering Inc.)	Done; but "There is a number"

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1000	66459	4	34	11	34	11	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Peter Burt, University of Greenwich)	No change made; our convention is to use lower case boreal
1001	76647	4	34	11	34	11	please add "is" after "there" (Claudio Cassardo, University of Torino)	Done
1002	76648	4	34	12	34	12	change "that" with "for which" (Claudio Cassardo, University of Torino)	Not changed
1003	76649	4	34	15	34	15	add "in winter" after "climates" (Claudio Cassardo, University of Torino)	Sentence removed
1004	66460	4	34	17	34	22	Different styles for writing 'high northern latitudes'! (Peter Burt, University of Greenwich)	Capitalization harmonized
1005	58359	4	34	22	34	22	...warming (and change in precipitation in sub-tropical belt) vs... (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Sentence removed
1006	66461	4	34	22	34	22	'vs' should be in italics. (Peter Burt, University of Greenwich)	Not changed
1007	56503	4	34	23	0	0	Suggested change "However, there are good indications..." (Archis Ambulkar, Brinjac Engineering Inc.)	This sentence was reworded.
1008	59312	4	34	23	0	24	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence reworded
1009	76650	4	34	23	34	23	typo: remove the second "there are" (Claudio Cassardo, University of Torino)	This entire section has been substantially reworded and this sentence no longer appears in the tex.
1010	60832	4	34	26	0	0	An additional paragraph or few sentences are needed either in the end of this paragraph or in the one which follows to state that future vegetation changes themselves (in response to climate change) can alter the local, and potentially regional climate with reference to the following papers: Jiang, D., Zhang, Y., and Lang, X.: Vegetation feedback under future global warming, <i>Theor. Appl. Climatol.</i> , 106, 211–227,2011; Falloon, P. D., Dankers, R., Betts, R. A., Jones, C. D., Booth, B. B. B., and Lambert, F. H.: Role of vegetation change in future climate under the A1B scenario and a climate stabilisation scenario, using the HadCM3C earth system model, <i>Biogeosciences</i> 9, 4739-4756,doi:10.5194/bg-9-4739-2012; Strengers, B. J., M"uller, C., Schaeffer, M., Haarsma, R. J., Severijns, C., Gerten, D., Schaphoff, S., van den Houdt, R., and Oostenrijk, R.: Assessing 20th century climate–vegetation feedbacks of land-use change and natural vegetation dynamics in a fully coupled vegetation–climate model, <i>Int. J. Climatol.</i> , 30, 2055–2065.doi:10.1002/joc.2132, 2010; Swann, A. L., Fung, I. Y., Levis, S., Bonan, G., and Doney, S.: Changes in Arctic vegetation induce high-latitude warming through the greenhouse effect. <i>P. Natl. Acad. Sci. USA</i> , 107, 1295–1300, doi:10.1073/pnas.0913846107, 2010. Swann, A. L. S., Fung, I. Y., and Chiang, J. C. H.: Mid-latitude afforestation shifts general circulation and tropical precipitation, <i>PNAS</i> , 109, 712–716, doi:10.1073/pnas.1116706108, 2011; Wramneby, A., Smith, B., and Samuelsson, P.: Hot spots of vegetation-climate feedbacks under future greenhouse forcing in Europe, <i>J. Geophys. Res.</i> , 115, D21119, doi:10.1029/2010JD014307, 2010. (Peter Falloon, Met Office Hadley Centre)	This issue is dealt with extensively in Section 4.2.4.1
1011	76795	4	34	28	0	0	Figure 4-7. This figure bothered me. Why have you selected a single season here which didn't seem to me to be crucial to the discussion. JJA means summer in one hemisphere and winter in the other, which will have different implications presumably for its impact on vegetation. In the tropics does JJA have any particular significance? I think you should at very least show two seasons. Then you complicate further by panel (C) being a different quantity and switching to DJF. Perhaps show both seasons for both quantities and make this a 4-panel plot? (Chris Jones, Met Office)	Figure removed
1012	59877	4	34	28	34	37	Figure 4-7 is labelled 'Vulnerability of terrestrial biomes to future change' but it is actually showing exposure (or climate indexes related to vulnerability, as described) - it doesn't take into account other factors considered in vulnerability. Consider re-labelling the figure. (AUSTRALIA)	Figure removed
1013	76651	4	34	31	34	31	and also in Fig. 4-7 pag. 139: actually it is not an "evolution" because it is expressed in percentage. Just to be sure to have understood well, when I read 70%, it means the probability that the 20-years mean temperature in 2046-65 or 2080-99 is of 70% higher than in 1980-2005? could please specify better this point? (Claudio Cassardo, University of Torino)	Figure and related text removed
1014	81803	4	34	31	34	31	Are the temperatures described on this line average temperatures over the window? (Katharine Mach, IPCC WGII TSU)	Figure and related text removed
1015	71978	4	34	36	34	36	This phrase implies that the figure shows much greater increases in high northern latitudes, but this is not clear from the figure itself. Authors could consider remaking it with a wider range of colors so that the high vs. medium vs. low latitude differences are clearer. (UNITED STATES OF AMERICA)	Figure removed



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1016	81804	4	34	40	34	45	These statements are redundant with 4.2.1 and overlap should be reduced. (Katharine Mach, IPCC WGII TSU)	We have substantially shorted this section. However, the overlap is not strong as it focuses on current and future risks and not the paleo record (section 4.2.1)
1017	58111	4	34	42	0	0	may be difficult to slow or reverse' (Peter Good, UK Metoffice)	Sentence removed
1018	58361	4	34	53	34	53	...recent past (but coral reefs with mass bleaching, Chapter 5, Box CC-CR) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	It is clear that we are near a coral reef tipping point, but most studies have set the ultimate tipping point somewhere in the future.
1019	59313	4	35	7	0	8	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence is now corrected.
1020	71979	4	35	7	35	7	Most biofuel comes from maize, sugar cane and palm oil, not from forests. The text appears to be using biofuel and bioenergy as synonyms here (and in the following paragraphs), but "biofuel" should be reserved for reference to vehicle fuels. (UNITED STATES OF AMERICA)	Agreed. We have eliminated the use of biofuel to refer to biomass energy.
1021	76652	4	35	7	35	8	generally I do not report comma mistakes, but here commas are misleading; remove commas after "woodlands" and "food and" (Claudio Cassardo, University of Torino)	This sentence is now corrected.
1022	57914	4	35	7	35	10	Suggest to delete the statement 'Forests and woodlands, regions(Gibson et al, 2011). Climate change and forests interact strongly.' (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	The statement in question was reworded in the FGD.
1023	71980	4	35	7	35	10	The first few sentences cover a very select view of forest services. Note also pollination services; non-timber forest products; sources of protein and other subsistence collections for forest-dwelling populations. Cite number of people globally who rely on forests at various levels of intensity. See, e.g., World Bank. 2002. Sustaining Forests: A Development Strategy. The World Bank Group, Washington, DC. <a href="http://siteresources.worldbank.org/intforests/Resources/SustainingForest...">http://siteresources.worldbank.org/intforests/Resources/SustainingForest...</a> (UNITED STATES OF AMERICA)	This sentence has been rewritten.
1024	71190	4	35	7	35	34	This text seems to overlap with Ch 4 P 11 L 34 to L 53. Suggest editing or removing. (CANADA)	We have reduced the redundancy between these sections.
1025	56504	4	35	8	0	0	Suggestion to remove comma - "including food and cultural services..." (Archis Ambulkar, Brinjac Engineering Inc.)	We have reworked this sentence
1026	68810	4	35	8	35	8	What is meant with "good quality water"? Quality that suffices for drinking water? (NETHERLANDS)	This part of the text has been reworded
1027	56837	4	35	11	0	0	are among major drivers of forest productivities and forest dynamics in most places. (Mostafa Jafari, TPS for LFCCs - RIFR - IRIMO)	This wording was kept the same, since it is accurate. The phrase "are major drivers" does not exclude the possibility of other major drivers.
1028	79053	4	35	11	35	15	Here, you miss that the uptake of C by forests is equally (or even more ) important than the storage of C. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We decided that no change was necessary here. Uptake of C by forests is only relevant to the radiative forcing of the atmosphere if it is larger or smaller than release of C by forests, which is captured in the "storage" term.
1029	57913	4	35	12	35	12	Suggest to change the word 'controlling' into 'affecting'. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	We have changed the wording to "help control" in response to the comment.
1030	71981	4	35	17	35	22	While forests get a lot of attention in the chapter, the fact that natural tropical forests and tropical peatlands are disproportionately important is not given high enough profile in the report, both in terms of the mitigation aspect but also the impacts of climate change on biodiversity, which on the terrestrial side, is 50-80% of the remaining natural tropical forests. (UNITED STATES OF AMERICA)	The chapter makes explicit mention of the particular importance of climate change impacts on biodiversity in the case of the Amazon in the Executive Summary and mentions the high diversity of tropical forests in the main text.
1031	70373	4	35	19	35	19	Use appropriate precision with the carbon amount - two significant figures reflect the accuracy of carbon estimates (860 ± 70 Pg C). (Patrick Gonzalez, National Park Service)	This is now corrected.
1032	70374	4	35	20	35	20	It would be good to replace Le Quéré et al. 2009 with the updated Le Quéré et al. 2013 (Le Quéré, C., R.J. Andres, T. Boden, T. Conway, R.A. Houghton, J.I. House, G. Marland, G.P. Peters, G.R. van der Werf, A. Ahlström, R.M. Andrew, L. Bopp, J.G. Canadell, P. Ciais, S.C. Doney, C. Enright, P. Friedlingstein, C. Huntingford, A.K. Jain, C. Jourdain, E. Kato, R.F. Keeling, K. Klein Goldewijk, S. Levis, P. Levy, M. Lomas, B. Poulter, M.R. Raupach, J. Schwinger, S. Sitch, B.D. Stocker, N. Viovy, S. Zaehle, and N. Zeng. 2013. The global carbon budget 1959–2011. Earth System Science Data 5: 165-185.) (Patrick Gonzalez, National Park Service)	We have made the suggested change.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1033	78306	4	35	20	35	22	' The carbon stored in intact.....for global forests of of 1.2 +- 0.8 Pg C yr-1'. Forest are not only lost by deforestation, also fires are (specifically in dry years, with extreme droughts because of climate change) a major thread for forests. Perhaps El Nino shall be introduced somewhere? (Arina Schrier, Wetlands International)	We discuss fire and El Nino in the sections on individual forest ecosystems.
1034	85127	4	35	20	35	23	Further studies need to be done in Tropical region as deforestation is not the main driver of carbon release (neither the timber harvesting activities nor any forest activities) ; there are other factors contributing to the cause: i.e transportation, energy, agriculture etc. (MALAYSIA)	We decided to focus on the proximate drivers of carbon release, which are deforestation and forest degradation (by logging and fire). Transportation, energy, and agriculture are secondary drivers that shape the pattern and pace of deforestation and forest degradation.
1035	71983	4	35	21	0	0	The text states a release of 2.8 Pg C/yr from tropical deforestation, resulting in the net storage of 1.2. This implies all of the release from land-use change to be due to tropical deforestation, which cannot be accurate. (UNITED STATES OF AMERICA)	Pan et al. conclude gross emissions of 2.9 Pg from tropical deforestation and forest degradation, counterbalanced by a tropical forest sink. We have now corrected this statement say that most of the release from land-use change is from tropical deforestation.
1036	71982	4	35	21	35	21	The 2.8 PgC figure in Pan et al. (and others) is not all or even mostly "tropical deforestation"; that amounts to only about 1 PgC of it. The other, non-deforestation components are however subject to much more uncertainty. It would be better to give only the tropical deforestation number. (UNITED STATES OF AMERICA)	Our revised statement accurately reflects the Pan et al. findings. (Note that there is 2.9 Pg of gross emissions from tropical land use, counterbalanced by a tropical forest sink.)
1037	76653	4	35	21	35	21	"due to land-use change": includes also forest fires? (Claudio Cassardo, University of Torino)	Forest fires in the tropics are poorly quantified, but are included in the estimates that we cite.
1038	76654	4	35	21	35	22	"due to tropical deforestation": only tropical? Why extratropical deforestation is not considered? Too small? (Claudio Cassardo, University of Torino)	We have now added "mostly due to tropical deforestation". Extra-tropical sources are quite small.
1039	76796	4	35	24	35	34	this paragraph felt a bit out of place here. I wondered why it is included. Biophysical feedbacks may play a part in creating feedbacks that create tipping points for example - in which case you should more explicitly make that link. Otherwise it feels a bit of a disjointed addition. (Chris Jones, Met Office)	We have now removed this paragraph, since biophysical effects are addressed earlier in the chapter.
1040	61032	4	35	26	35	28	Qualify that the fact that 'tropical forests pump more water and aerosols into the atmosphere than non-forest systems..' effectively increases their albedo, hence why they have a cooling effect. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This statement has been removed
1041	79945	4	35	27	35	29	"Boreal forests have low albedo" compared to what? Non-forested land or clear-cuts covered with snow? Please specify. (NORWAY)	This statement has been moved to 4.2.4.1 and is now qualified (relative to snowpack)
1042	76655	4	35	28	35	28	"than non-forest systems": with the expression "non-forest", authors mean only other types of vegetation different from forests, or also other soil coverage type, like bare soil? I suggest to add this explanation... (Claudio Cassardo, University of Torino)	This section was moved to 4.2.4.1. We feel that "conversion of forest to non-forest" implies non-forest ecosystems, and doesn't require further qualification.
1043	61033	4	35	29	35	31	Another study by Spracklen et al. (2008) Boreal forests, aerosols and the impacts on clouds and climate. Phil. Trans. Roy. Soc. A, 366, 4613–4626 suggests that the cooling effect of aerosols formed from terpenes emitted by boreal forests might be larger than the warming caused by their low albedo. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have now included the Spracklen et al. study
1044	79946	4	35	29	35	31	Please consider discussing in WG III, ch. 11 the following statement: " the biophysical effect of boreal forest is to warm the atmosphere". (NORWAY)	This statement is directed towards WGIII.
1045	71984	4	35	31	35	34	Authors may wish to consider providing more information on how, or at least in what direction, the precipitation pattern is altered with deforestation in tropics and temperate forests. (UNITED STATES OF AMERICA)	We can't make this change, since the precipitation pattern can be altered in different ways.
1046	76656	4	35	33	35	33	"temperate" means at mid-latitudes? Thus forests are divided in: tropical, temperate and boreal? Just to understand, because it has never been said (Claudio Cassardo, University of Torino)	Yes. We use this three-part division throughout the chapter.
1047	79947	4	35	36	35	37	The text about stabilization of forest carbon stocks is not consistent with WG III Ch. figure 6.3. Please be consistent. (NORWAY)	We examined Fig 6.3 (WGIII) and could not understand this comment.
1048	71985	4	35	36	35	40	Clarify that forest loss is excluded. (UNITED STATES OF AMERICA)	We do not feel that this clarification is necessary. C uptake and C loss from land-use are two independent processes.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1049	71986	4	35	36	36	2	The discussion of fire is based mostly on one modeling study using one global model. This section should consider at a minimum this reference based on an ensemble of 16 GCMs, and consider use figures from it in the place of Figure 4-8: Max A. Moritz, Marc-Andri© Parisien, Enric Batllori, Meg A. Krawchuk, Jeff Van Dorn, David J. Ganz, and Katharine Hayhoe 2012. Climate change and disruptions to global fire activity. Ecosphere 3:art49. <a href="http://dx.doi.org/10.1890/ES11-00345.1">http://dx.doi.org/10.1890/ES11-00345.1</a> (UNITED STATES OF AMERICA)	We have added additional model results to Figure 4-8, but decided not to use Moritz et al.
1050	79054	4	35	36	36	15	You neglect the contribution of forest management to the timing and magnitude of C uptake or release in forests. Also, age-class distribution and / or forest structure in managed forests has a great influence on forest growth (=C uptake or release). Please rework the text. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We mention the role of forest management in the section on Temperate Forests.
1051	66462	4	35	37	35	37	These dates are not possessive, delete the apostrophes. (Peter Burt, University of Greenwich)	This is now corrected.
1052	71191	4	35	38	35	40	Suggest "stimulation", in place of "simulation". (CANADA)	This is now corrected.
1053	79948	4	35	40	35	41	What about increased deployment of renewable energy to displace fossil emissions as stated in SRREN (IPCC 2011). This effort can contribute to long term stabilization of the GHG concentration in the atmosphere. As the system stabilizes, the land sink nece (NORWAY)	We do not feel that this is the appropriate place to discuss mitigation options.
1054	58112	4	35	42	0	0	susceptibility to fire' is imprecise. Perhaps 'meteorological conditions favouring fire' (Peter Good, UK Metoffice)	We now refer to "forest susceptibility to fire", but felt that it was not necessary to qualify this as being related to meteorological conditions.
1055	76510	4	35	42	35	42	what do you mean by "susceptibility to fire"? Higher fire risk? Higher fire recurrence and intensity? Or the effects of fire over the ecosystems will be higher? Please clarify (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	We now refer to "forest susceptibility to fire", which is described further down in this section.
1056	71192	4	35	43	0	47	Greatest risk for large, 'positive' feedbacks from forests to climate (negative feedbacks would contribute to stabilization). Is deforestation via land use not a major factor, or are the author just referring to changes in natural disturbance regimes here? While LULUC is addressed in paragraphs above, is there a need for a link here? Perhaps this paragraph should be combined with or directly below this one. (CANADA)	We have now reworded this statement to refer to positive feedbacks and refer now to changes in disturbance regimes. The links to LULUC are made below in this section.
1057	58113	4	35	44	0	45	could precipitate this transition' - what transition? Transition to weaker sink or net source? The sentence on fire in between breaks your 'this' (Peter Good, UK Metoffice)	We have reworded this for greater clarity
1058	76657	4	35	46	35	47	"as well as ... tundra": but this will extend forested area, so it is not a risk!!! (Claudio Cassardo, University of Torino)	The "risk" refers to large-scale changes in forests that are driven or reinforced by positive feedbacks between forests and climate.
1059	76658	4	35	53	35	53	I know is a fussiness, but 1980-2010 and 2070-2100 are 31-years periods, not 30-years (Claudio Cassardo, University of Torino)	The captions are being revised to clarify that 30-year periods were used
1060	79949	4	36	4	36	5	Please check for consistency with figure 6.3 in CH 6 WG III. (NORWAY)	We have done this.
1061	66463	4	36	7	36	7	via' should be in italics. (Peter Burt, University of Greenwich)	This is now corrected.
1062	71193	4	36	12	36	19	This text seems to overlap with Section 4.2.4.1. Suggest editing or removing. (CANADA)	This text has been reworded to reduce overlap.
1063	71987	4	36	12	36	19	The assertion that net deforestation has slowed over the last decade should be paired with the point that loss and degradation of natural tropical forests has, on the other hand, continued unabated, with progress in the Amazon offset by disastrous rates of clearing in SE Asia and growing clearance in the Congo Basin. (UNITED STATES OF AMERICA)	This statement has now been revised to reflect the high uncertainty over future trends.
1064	71988	4	36	12	36	19	This paragraph paints a rather-too-rosy scenario for forests overall, with the first and last sentence highlighting slowed deforestation in the last decade and ending with a sentence that "tropical deforestation could slow substantially over the next few decades..." To clarify the text suggest authors could rearrange the sentences: put last sentence third, and currently third sentence last, so paragraph ends on the cautionary note that pressures on forests from food, feed, fiber, and fuel could increase substantially in the future. (UNITED STATES OF AMERICA)	This paragraph has been revised to reflect our uncertainty over future trends in tropical forests.
1065	71989	4	36	14	36	19	The first sentences of this paragraph are strongly based on data, and important; however this third and the fourth sentence are speculative as well as being unsatisfactory "on the one hand.. on the other hand" kinds of arguments. Authors may want to delete these sentences, simply give the actual data. (UNITED STATES OF AMERICA)	This paragraph has been revised to reflect our uncertainty over future trends in tropical forests.
1066	66464	4	36	16	36	16	Change 'are' to 'is' to avoid mismatch of singular and plural. (Peter Burt, University of Greenwich)	This is now corrected.
1067	76659	4	36	16	36	16	"a number of signs": please be more precise: which signes? (Claudio Cassardo, University of Torino)	We replaced this statement with more precise wording.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1068	57718	4	36	23	37	21	See above comment. (NOTE: Comment above reads as: Tree mortality. If warming increases the stem height growth more than stem diameter growth, trees are likely to be taller but also thinner from the base. Doesn't this also increase the risk of tree mortality, especially in areas where weather extremes (high wind storms) are increasing? Has this been estimated anywhere? Another regional/local risk might be winter-time flooding (if the main part of winter-time precipitation comes as water, not snow): any information about this risk?) (Anne Kasurinen, University of Eastern Finland)	We are unaware of studies that have documented this aspect of potential future tree mortality trends, nor winter-time flooding.
1069	76797	4	36	25	0	0	can you harmonise your use of the phrase "die-off" and "die back" - choose one throughout (I assume they mean the same thing in the context of this chapter) (Chris Jones, Met Office)	We now use dieback throughout the text.
1070	58114	4	36	25	0	39	Unclear on the balance here. So there are lots of places showing extensive mortality. How does this compare to the observed plots without extensive mortality? The first two sentences seem to jar a bit. Perhaps sufficient to start sentence 2 with 'However, plot level...' (Peter Good, UK Metoffice)	We have now reworded this paragraph for greater clarity.
1071	71990	4	36	25	37	3	The meaning of the word "widespread" in the phrase "widespread forest loss" needs to be clarified. If it means "observed in many places" it is correct, and Figure 4-9 shows it. But if it means "covering a large proportion of the forest", it is misleading. Clarify that you are using it with the first meaning and that this does not imply the second. (UNITED STATES OF AMERICA)	We now define "widespread" in the text.
1072	71194	4	36	35	0	36	Raffa. et al is not the most appropriate reference for vegetation mortality due to climate change but is appropriate in the next sentence. Recent Hogg et al. publications re: aspen dieback in Canada would be more appropriate. Consider replacing 'pest' with insect, when referring to native insects with eruptive population dynamics. (CANADA)	We incorporated this suggestion
1073	71195	4	36	52	37	1	This sentence is confusing: the general theme is that multiple droughts will have a bad effect on trees and forests but the phrase "evidence from several systems indicates recovery times may be shorter than recent drought return intervals..." suggests the opposite. Consider revising. (CANADA)	This has been reworded for greater clarity
1074	58115	4	36	54	0	0	don't you mean '_longer_' than recent drought return intervals'? (Peter Good, UK Metoffice)	This is now corrected.
1075	68212	4	36	54	0	0	longer instead of "shorter"? Why "recent" ? (Denis Loustau, INRA)	Yes. This is now corrected.
1076	66465	4	37	2	37	2	Delete 'up' to avoid tautology (expansion in altitude can only be upwards). (Peter Burt, University of Greenwich)	This is now corrected.
1077	76660	4	37	2	37	3	"may also ... mortality": but some insects, as for instance pollinators, can be useful (Claudio Cassardo, University of Torino)	We have now added the word "pest" to make the point more clear.
1078	59314	4	37	8	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This is now corrected.
1079	71991	4	37	16	0	0	There are two papers here listed prior to 2009, which shouldn't be here : 1998 and 2007 (UNITED STATES OF AMERICA)	This is now corrected and the listed papers have now been removed.
1080	71992	4	37	26	37	52	Starting here in section 4.3.3.1.1., there is an abrupt shift to the writing style in earlier sections with many sentences including italicized statements of confidence. The reason for the shift is unclear. (UNITED STATES OF AMERICA)	Confidence statements have been italicized - it is now standardized.
1081	58116	4	37	26	38	45	My impression from this sentence is that paragraphs appear to change tack mid-way through. The paragraphs need to be introduced better so we have a picture of the uncertainty straight off. For example, paragraph 1 starts 'most projections suggest a poleward expansion', suggesting that the key message is of expansion. However, at the end we have, 'high confidence...widespread forest dieback'. Paragraph 1 (starting line 38) starts off as 'forest productivity is widely expected to increase', then goes on to attribute tentatively observed decreases in productivity to warming-induced drought. If warming causes productivity declines, then why would we expect future increases in productivity? And, why is this effect not reproduced in historical simulations (or is it?) (Peter Good, UK Metoffice)	Editing has been done to make the section flow better, and to highlight that although there is the common belief that there will be a poleward expansion of forests, there are also many uncertainties and complications to the story.
1082	76798	4	37	34	0	0	"high confidence" of widespread boreal dieback?? Really? At the very least you need much more evidence than citing Sitch et al. They found 4/5 models increased vegetation carbon and 3/4 models with dynamic vegetation had constant or increased tree cover. Only LPJ had loss of trees. This doesn't lead to high confidence... (Chris Jones, Met Office)	Text changed to make it clear that we feel there is medium confidence (down from high) that regions of the boreal forest could witness widespread forest dieback, not that there will be widespread boreal forest dieback. There is not yet enough information to make a strong assessment of this latter possibility.
1083	58117	4	37	38	0	0	widely expected, with medium confidence'. Perhaps drop 'widely', as the confidence statement should say it all. (Peter Good, UK Metoffice)	agreed, 'widely' dropped

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1084	76661	4	37	38	37	38	"to increase as ...": yes, but only if they do not die (see lines 33-36)!!! (Claudio Cassardo, University of Torino)	text edited to be more clear about how the science has evolved to include more complexity
1085	79055	4	37	42	37	44	This statement needs further explanation. If fire is correlated with temperature the signal should not be random, but in line with temperature developments, i.e. increasing over time. Depending on the size of the burns and the time it takes a burned area to reach a state to sustain a new burn, the area under the "burned area curve" could also follow an inverted "U" if, with rising fire-danger, the potentially burnable area decreases. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	shortened text to avoid controversy over fire and instead focus on most likely mechanism behind the productivity declines. Indeed, increased fire could result in more younger aged stands and higher productivity. Space limitations prevent complete text-book coverage of all possible factors.
1086	71196	4	37	44	37	50	Trends in forest productivity as documented by tree-ring studies may be more complex than reported in these statements. Tree-ring evidence from black spruce and jack pine forests of Quebec, Canada, suggest an age/size related effect on forest growth relationships to drought. Girardin et al. (2012) found that mature forests, with ages between 70 and 140 years or so, have responded positively to climate warming since the 1950s. However, this response reversed with subsequent forest ageing. Although climate warming since the 1950s has set the stage for improving growth conditions, in old black spruce forests (age > 140 years) the benefits were cancelled by decreases of available soil moisture necessary for plant growth and by the increasing metabolism that support plant maintenance processes under high temperature. Girardin, M.P., Guo, J.X., Bernier, P.Y., Raulier, F., Gauthier, S. 2012. Changes in growth of pristine boreal North American forests from 1950 to 2005 driven by landscape demographics and species traits. Biogeosciences, 9, 2523-2536. (CANADA)	Added a sentence to make this point and cited this paper.
1087	71197	4	37	44	37	50	The following papers also provide support to the increase of forest productivity in some boreal regions where precipitation is not limiting. Nevertheless, the paper by Girardin et al. (2011 in Ecosphere) suggest that this increase may have been offset by forest ageing. /// Girardin, M.P., Bernier, P.Y., and Gauthier, S. 2011. Increasing potential NEP of eastern boreal North American forests constrained by decreasing wildfire activity. Ecosphere - A journal of the Ecological Society of America, 2:art25. /// Girardin, M.P., Bernier, P.Y., Raulier, F., Tardif, J.C., Conciatori, F., Guo, X.J. 2011. Testing for a CO2 fertilization effect on growth of Canadian boreal forests. Journal of Geophysical Research , 116, G01012, doi:10.1029/2010JG001287 (CANADA)	Same issue as comment 1086, so also cited Girardin et al., 2011, but did not expand the section into the topic of CO2 fertilization - the section focuses on "The impacts of climate change on boareal forests"
1088	71198	4	37	45	37	45	Suggest connecting vapor- pressure deficit argument to section 4.3.2.4 (CANADA)	Section 4.3.2.4 has a different focus - specifically, the changes in evapotranspiration and role in the water cycle. Bringing potential evapotranspiration and vapor pressure deficit (VPD) into that section would mean expanding it, and that would dilute the focus plus lead to a more textbook like treatment for which we have no allocate space. However, to support the introduction of VPD better, we have added a citation.
1089	71199	4	37	47	37	49	This text seems to overlap with Section 4.3.2.2. Suggest editing or removing. (CANADA)	Section 4.3.2.2 is global in scope, and more general, whereas this para (and sentence at issue in this comment) are focused specifically on the boreal forest. Our goal is to provide more in depth focus here that complements what was in the earlier 4.3.2.2. Also note that other reviewers asked for additional information. We have thus attempted to strike the right balance.
1090	58118	4	37	50	0	51	If we are not certain why there are productivity declines in the less mesic regions, how can we be confident that the observed increases in the boreal-tundra ectone are due to the more mesic conditions? (Peter Good, UK Metoffice)	Good point. We edited text to sound less certain, and also added a sentence that highlights some of the added complexity.
1091	76662	4	37	50	37	50	"mesic": it is first time in my life I find this unusual word; maybe could be useful to add a note explaining its meaning? (Claudio Cassardo, University of Torino)	Added "(moist)" to be clear
1092	58119	4	38	1	0	2	Do you mean that _if_ there is drying and productivity declines etc. etc. then there will be greater fire disturbance. This sounds like we are highly confident that there will be future drying, productivity declines, etc. etc. This is obviously contradicted by the observed productivity increases in some regions. A high confidence statement needs to be clearly presented. (Peter Good, UK Metoffice)	Altered text to be more clear that we were not saying that we are highly confident that there will be future drying, etc.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1093	81805	4	38	1	38	1	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the sentence. (Katharine Mach, IPCC WGII TSU)	Done.
1094	71200	4	38	1	38	6	In relation to the statement "the boreal biome fire regime intensified in recent decades" : it is extremely important that the period referred to be specified, because an increasing number of studies from North America now point to a decrease of fire activity during the 20th century. Indeed, In Canada fire activity increased in the 1970s up until the early 21st century and this relative to the 1940-1960s. But before the 1940s, fire activity in Canada was quite important. So depending on the period of analysis, different trends may be obtained. See Girardin, M.P. 2007. Interannual to decadal changes in area burned in Canada from 1781 to 1982 and the relationship to Northern Hemisphere land temperatures. Global Ecology and Biogeography 16(5): 557-566, doi: 10.1111/j.1466-8238.2007.00321.x. As indicated in the cited paper by Girardin and Mudelsee, the sign of the trend analysis depends a lot on the period under analysis (this is also demonstrated in the work of Girardin and Wotton 2009). For a spatial perspective of fire activity trends and associated climatologies across Canada, see Girardin, M.P., Ali, A.A., Carcaillet, C., Gauthier, S., Hély, C., Le Goff, H., Terrier, A., Bergeron, Y. . 2013. Fire in managed forests of eastern Canada: risks and options, Forest Ecology and Management, Special Issues on Mega Fires, Volume 294, 238–249.// Girardin, M.P. and Wotton, B.M. 2009. Summer moisture and wildfire risks across Canada. Journal of Applied Meteorology and Climatology 48: 517-533 (CANADA)	Noted. Text changed to reflect fire regimes have intensified regionally, and Girardin et al., 2013 is now cited.
1095	71201	4	38	1	38	16	There are other species that are well adapted or established on mineral soil, of which jack pine is an example. Perhaps the assumption should not be made that this deciduous tree invasion will occur throughout NA; as both studies come from Alaska. (CANADA)	Have modified text to be clear that the deciduous tree invasion will occur only in some regions; space limitations preclude going into greater detail
1096	66466	4	38	9	38	9	Insert 'in' after 'changes'. (Peter Burt, University of Greenwich)	Done.
1097	81806	4	38	17	38	17	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the sentence. (Katharine Mach, IPCC WGII TSU)	Done.
1098	60394	4	38	17	38	28	I know of an interesting case study of the effect of forest fire on the climate of Tuntsa in northern Finland. Vajda & Venalainen (2005) found that winds were 60-70% stronger in the, deforested region. This was accompanied by ice abrasion, and a general increase in the severity of the climate in the region which has inhibited the re-establishment of tree cover. There was also a study looking at the potential effect of BVOCs (Spracklen, 2008), which could change in the future. I guess this is more speculative though. (Edward Pope, Met Office)	No change made. It is not clear how this comment relates to the point of the paragraph, and in any case, we don't have the page space to go into the full complexity of possible local responses, however speculative.
1099	66467	4	38	20	38	20	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Peter Burt, University of Greenwich)	No change made; our convention is to use lower case boreal
1100	76800	4	38	30	38	45	could mention here that thawing permafrost may initially lead to carbon uptake due to rapid response of increase growth, whereas loss of thawed carbon may take longer, although will become the dominant term in the carbon balance on longer timescales. (Chris Jones, Met Office)	See response to 1101- this change helps here too. However, without one or more references to support the assertion that the net change would be greater carbon uptake, we emphasize the strong sense in the literature that the net change will be a release of carbon to the atmosphere. If we had more space, we could go into detail, but we don't. Note that
1101	58120	4	38	32	0	0	'_could_ exacerbate additional warming' (Peter Good, UK Metoffice)	Done.
1102	76799	4	38	33	0	0	could cross-reference here to WG1-Ch6-sec 6.4.3 (Chris Jones, Met Office)	Done, also added a 'high confidence' to mirror the IPCC WG1 Chapter 6 conclusion
1103	61034	4	38	36	38	36	Is 'thermokarsting' defined in the glossary of terms, or should it's meaning, i.e. 'the thawing of ice-rich soil' be clarified in this paragraph? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Meaning added.
1104	61035	4	38	36	38	36	What is "thermokarsting", what are the "different substrates" and why is topography important? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	See previous comment/response. We provide citations supporting/detailing the rest of the sentence. Space limits prohibits a more textbook treatment.
1105	71993	4	38	36	38	36	Thermokarsting is not defined and should be cross-referenced to other permafrost sections (UNITED STATES OF AMERICA)	We have added the meaning of thermokarsting, and already refer to section 4.3.3.4 (the other section that has a focus on permafrost). We have added cross-refs to WG1 as well.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1106	61036	4	38	43	38	45	Discusses the likely negative upshot of carbon management in maintaining permafrost, particularly due to the large spatial scale and broadscale ecological and societal impacts. It might be useful to mention what these are? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We provide one example, but space limitations prohibit adding more.
1107	56505	4	38	44	0	0	Suggestion to add comma - "to winter temperatures (xxx), are impractical..." (Archis Ambulkar, Brinjac Engineering Inc.)	Done
1108	71203	4	38	48	0	0	Do the authors mean 'temperate deciduous/mixed forests'. If so, indicate in the section title. Note, some western North America's conifer forests are also often considered temperate forests. (e.g., coastal temperate rainforests) (CANADA)	This is a level of detail we felt inappropriate.
1109	71202	4	38	48	40	4	Overlap with Section 4.3.2.2. Suggest reviewing. (CANADA)	We have edited to reduce overlap.
1110	76663	4	39	2	39	2	"With the exception of Europe": and what about Europe? It is not said... (Claudio Cassardo, University of Torino)	We have now removed reference to Europe.
1111	58122	4	39	6	0	0	perhaps '(high confidence due to robust evidence and high agreement)' (Peter Good, UK Metoffice)	Accepted this recommendation.
1112	58121	4	39	6	42	39	Like the explanations of the confidence level used here and in tropical forest section. Could be used more widely (Peter Good, UK Metoffice)	These have now also been used more widely in the temperate forest section.
1113	76664	4	39	7	39	7	please use same number of digits in mean and uncertainty: 0.70 +/- 0.08 or 0.7 +/- 0.1; same for 0.80 +/- 0.09 or 0.8 +/- 0.1 (Claudio Cassardo, University of Torino)	Corrected
1114	58123	4	39	18	0	19	I would have though that a peak is hard to detect: it is hard enough to detect a linear trend usually, let alone a peak (Peter Good, UK Metoffice)	Net uptake was increasing thru end of 20th century, and is now showing an opposite trend. This implies a peak was passed.
1115	66468	4	39	19	39	19	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	corrected
1116	58124	4	39	29	0	32	Rather long sentence (Peter Good, UK Metoffice)	Revised to shorten the sentence.
1117	71994	4	39	34	39	34	Suggest inserting "rates" after "carbon storage" for accuracy and clarity. (UNITED STATES OF AMERICA)	We have left this as is, since storage is defined elsewhere as uptake.
1118	71995	4	39	39	39	40	The statement that there is 'low agreement' with the long-term, climate-driven changes in geographical range on temperate geographical range shifts can be challenged. Maybe the authors have to say that because of the variability among DVGMS, but there is high agreement with paleo data and process models and SDM models that the spruce-fir zone, for example, is changing. (UNITED STATES OF AMERICA)	We agree that there is medium evidence of change in temperate forests, but a lack of agreement (low agreement) in the overall trend.
1119	66469	4	39	42	39	42	Delete 'up' to avoid tautology (expansion in altitude can only be upwards). (Peter Burt, University of Greenwich)	Corrected
1120	58125	4	39	44	0	45	most probably cannot achieve' unclear. Do you mean 'cannot be achieved'? (Peter Good, UK Metoffice)	This statement now changed to be clearer.
1121	59315	4	39	44	0	45	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This statement now changed to be clearer.
1122	61037	4	39	45	39	47	In recognition of the fact that the velocity of climate change is likely to outstrip the dispersal rates achievable by some species the report recognises assisted migration as an option. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have reworded this sentence to link with previous sentence.
1123	58799	4	39	47	39	50	Higa et al. (2013) compared performance of three high performance species distribution models (MARS, GAM, GBM) for 19 edible plants in Japan for selecting indicator plant species for climate change impact monitoring. This paper would be added as a reference in this context. Reference: Higa M., Nakao K., Tsuyama I., Nakazono E., Yasuda M., Matsui T. and Tanaka N. 2013. Indicator plant species selection for monitoring the impact of climate change based on prediction uncertainty. Ecological Indicators 29: 307-315. (Tetsuya Matsui, Forestry and Forest Products Research Institute)	We felt that this paper did not add sufficient new information to be cited. (We were tasked with reducing the size of our chapter)
1124	66470	4	39	51	39	51	In this line, 'modelling' is used in its (correct) spelling, but most other usages in the Chapter are 'modeling'. (Peter Burt, University of Greenwich)	We have now corrected this throughout

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1125	62765	4	39	53	40	1	Let me recommend a paper (Tsuyama et al. in press) to be referred here which demonstrated the ability of niche-based models to project changes in plant species ranges by comparing the distributions of paleoecological data (pollen fossil data) and projected potential habitat for a subalpine coniferous species ( <i>Tsuga diversifolia</i> ) in Japan at the last glacial maximum period. Tsuyama, I., Nakao, K., Higa, M., Matsui, T., Shichi, K. and Tanaka, N. (in press) What controls the distribution of the Japanese endemic hemlock, <i>Tsuga diversifolia</i> ? Footprint of climate in the glacial period on current habitat occupancy. Journal of Forest Research. doi: 10.1007/s10310-013-0399-9 (Ikutaro Tsuyama, Forestry and Forest Products Research Institute)	This is a noteworthy paper, but we decided not to add it in, largely because it is for a single species.
1126	66471	4	40	3	40	3	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We disagree. Lower case is correct here.
1127	71204	4	40	3	40	4	Is it necessary or relevant to mention animal species here? As has been discussed earlier in the chapter, one might expect animal species that depend on particular tree species or forest communities to be able to keep up with the trees. (CANADA)	We decided to not include animal species in the "Major systems" section for terrestrial ecosystems, since they are treated earlier in the chapter and our focus here is on major structural and functional changes in ecosystems.
1128	62487	4	40	7	41	29	Consider including the following two studies from India (in context of project impact of climate change on wet and dry tropical forests): Ravindranath et al (2006) projected the impact of climate change on Indian forests and conclude that about 77% and 68% of the forest grids in India are likely to experience vegetation shift under the A2 and B2 scenarios of climate change respectively by 2080s. Chaturvedi et al (2011) using a dynamic global vegetation modeling (DGVM) approach projected that about 39% to 45% of forest grids in India may not remain optimally suitable for the current vegetation by 2080s under A2 and B2 scenarios respectively. Ravindranath et al 2006: Ravindranath NH, Joshi NV, Sukumar R, Saxena A (2006) Impact of climate change on forest in India. Current Science, 90(3):354–361 Chaturvedi, R. K., Gopalakrishnan, R., Jayaram, M., Bala, G., Joshi, N. V., Sukumar, R. and Ravindranath, N. H (2011) Impact of climate on Indian forests: a dynamic vegetation modeling approach. Mitigat. Adapt. Strat. Global Change, 16, 119–142. (INDIA)	We have now included Chaturvedi et al. 2011 in the paragraph on dry tropical forests.
1129	58126	4	40	9	0	10	I prefer 'and atmospheric CO2 concentration combine in complex ways with the direct influences. I don't like 'superimposed', as this implies linear combination to me. (Peter Good, UK Metoffice)	We have changed the statement as suggested
1130	81807	4	40	9	40	16	The chapter team should consider presenting citations or calibrated uncertainty language for these statements. (Katharine Mach, IPCC WGII TSU)	We added new citations
1131	58127	4	40	13	0	0	to fire ignition sources' (Peter Good, UK Metoffice)	"fire" added in
1132	58128	4	40	14	0	15	influences of humans and current understanding is largely through' (Peter Good, UK Metoffice)	This opening paragraph is now shorter and reworded.
1133	58129	4	40	18	0	28	How about mentioning CO2 fertilization of vines in this paragraph: it's part of the uncertainty of the direct CO2 effect on vegetation. (Peter Good, UK Metoffice)	Vines are mentioned further down in the text.
1134	66472	4	40	19	40	19	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Corrected
1135	71205	4	40	27	40	27	Can you provide some examples of "the larger ecosystem-scale studies" that may throw doubt on the physiological formulations "generally used" in DGVM and ESMs? (CANADA)	We feel this detail is not necessary.
1136	76801	4	40	28	0	0	If this statement on optimised models refers to HadGEM2-ES then I think it overstates things. That model had parameters calibrated to better match observations, but we didn't change the underlying formulation of the response to CO2 (Chris Jones, Met Office)	We have decided to keep this statement, but substituting "optimized" for "calibrated"
1137	71206	4	40	30	40	41	Overlap with Section 4.3.2.4 . Suggest reviewing. (CANADA)	We have reworded to reduce overlap.
1138	80374	4	40	33	40	33	There is no WGI Annex A, but WGI Annex I. (Gian-Kasper Plattner, IPCC WGI TSU)	Corrected. We have also added name of document.
1139	56506	4	40	37	40	38	Full stop missing after "used". Also there are two (xxx) (xxx) for references after "used". Should they be together. (Archis Ambulkar, Brinjac Engineering Inc.)	Corrected
1140	58130	4	40	38	0	40	Should also cite Malhi paper alongside Cox and Huntingford, as in Box. Maybe also say why it's less likely: extreme drying of HadCM3 not reproduced, and lower sensitivity to temperature, possibly. (Peter Good, UK Metoffice)	Malhi et al. 2009 has been added
1141	76665	4	40	38	40	38	what is exactly the meaning of "medley studies"? (Claudio Cassardo, University of Torino)	We removed "medley"
1142	58131	4	40	39	0	40	climatological envelope is less likely to undergo...' We need to be precise here. Less likely than what? Less likely than AR4 assessment? There is a corresponding statement in Box 4-3. (Peter Good, UK Metoffice)	We now refer to AR4 and have reworded this statement.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1143	81808	4	40	39	40	39	"less likely" is not a likelihood term in the guidance for authors. Either a likelihood term should be used, or the term should not be italicized. (Katharine Mach, IPCC WGII TSU)	This correction was not made (because of oversight)
1144	66473	4	40	40	40	40	In this line, 'modelled' is used in its (correct) spelling, but most other usages in the Chapter are 'modeled'. (Peter Burt, University of Greenwich)	Changed throughout.
1145	71207	4	40	44	40	44	Suggest deleting "in moist tropical forests" (CANADA)	Revised as recommended.
1146	71208	4	40	47	40	47	Presumably faster tree growth would be driven by an increase in the ratio of diffuse to direct radiation? Could that be stated here? (CANADA)	We've decided to not add this, given our mandate to shrink the chapter.
1147	58132	4	40	48	0	49	I wonder if we need to be more precise about the sentence starting 'There is low confidence...'. Surely the forest is changing in some way due to rising atmospheric CO2, but we have low confidence that this is detectable, whether it is monotonic, and what the signs of changes are. Perhaps just 'low confidence in a detectable change...'? (Peter Good, UK Metoffice)	We've decided to leave this sentence as is to be consistent with our other sections and their treatment of uncertainty.
1148	58133	4	40	51	0	52	Last part of this sentence is odd ('but is not yet observed as changes in forest biomass (except Clark et al., 2003)'). Need to explain why Clark et al. is insufficient (elsewhere in AR5 a single reference is considered sufficient). Presumably because it focusses on one location(?) (Peter Good, UK Metoffice)	WE state this in this way since most tropical forest studies have not found evidence of temperature-induced suppression of tree growth.
1149	59316	4	41	1	0	3	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	reworded
1150	71209	4	41	1	41	3	Replace second "in moist tropical forests" with "in these ecosystems" (CANADA)	done
1151	58134	4	41	2	0	0	What indirect role of climate change do you mean? It's effect on fire frequency/intensity? (Peter Good, UK Metoffice)	Yes. This is made clear further down in the paragraph and in the Amazon box.
1152	76671	4	41	12	42	12	"in sum" --> "in summary" (Claudio Cassardo, University of Torino)	Done
1153	59317	4	41	15	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Done
1154	66474	4	41	15	41	15	Cochrane, 2003' should be in brackets (Peter Burt, University of Greenwich)	done
1155	66475	4	41	15	41	15	Insert comma after 'itself'. (Peter Burt, University of Greenwich)	done
1156	76666	4	41	15	41	15	typo: put "Cochrane, 2003" between round brackets (Claudio Cassardo, University of Torino)	done
1157	59318	4	41	16	0	17	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	done
1158	66476	4	41	16	41	16	Replace semi colon with '(' and put following references in chronological order (Peter Burt, University of Greenwich)	done
1159	76667	4	41	16	41	16	typo: insert "(" before "Uhl" (Claudio Cassardo, University of Torino)	done
1160	56507	4	41	16	41	17	Missing "(" before Uhl and Kauffman... (Archis Ambulkar, Brinjac Engineering Inc.)	done
1161	58135	4	41	17	0	0	Land use _also_ often increases' (Peter Good, UK Metoffice)	corrected
1162	71996	4	41	20	41	20	Is there high confidence that severe droughts are increasing? Discussion in other paragraphs seems to imply that this is not at all clear. (UNITED STATES OF AMERICA)	WE have reworked this paragraph to more clearly state, separately, certainty of severe drought increasing with climate change, and the effects of severe drought on fire and tree mortality
1163	71997	4	41	22	41	29	Authors may wish to review this paragraph and revise for clarity. There should be a better distinction made between 'severe risk' and 'risk'. (UNITED STATES OF AMERICA)	We revised this paragraph to be more clear.
1164	71210	4	41	24	41	25	"More than half of the remaining tropical dry forests (54%) are located in South America. Approximately one third of the remaining tropical forests in the Americas are predicted to experience 'severe climate change'...." This is confusing. Is the implication meant to be that one third of all tropical forests are predicted to experience climate change? If this is the case, what is the relationship between the 54% of all remaining dry tropical forest being in SA and the one third that will be affected by climate change? (CANADA)	Revised for greater clarity
1165	81809	4	41	24	41	27	The scenario of climate change for this projected outcome should be specified. (Katharine Mach, IPCC WGII TSU)	Added citation for climate models used, although scenarios are not stated.
1166	66477	4	41	26	41	26	Use degree symbol instead of 'deg.' (Peter Burt, University of Greenwich)	done
1167	71211	4	41	26	41	26	Suggest changing "temperate" to "temperature". Presumably this is mean annual temperature? (CANADA)	done
1168	76668	4	41	26	41	26	typo: change "temperate" in "temperature" (Claudio Cassardo, University of Torino)	done

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1169	76669	4	41	26	41	26	change "deg .C" in ""C" (Claudio Cassardo, University of Torino)	done
1170	76670	4	41	26	41	27	"at least 2.5 deg. C and/or ... 50 mm a-1": since also temperature is a rate, I suggest to change as "at least 2.5 °C/year and/or ... 50 mm/year" (it seems to me the unit "a" does not exist) (Claudio Cassardo, University of Torino)	done
1171	81810	4	41	29	41	29	It would be helpful to specify--at risk of what? (Katharine Mach, IPCC WGII TSU)	now: ". . At risk of replacement or degradation."
1172	80375	4	41	31	42	31	Box 4.3: This box should include cross-references to WGI/SREX wherever possible, currently there are none. (Gian-Kasper Plattner, IPCC WGI TSU)	We didn't do this as the result of oversight.
1173	76805	4	41	33	0	0	the strength, or otherwise, of CO2 fertilisation in the tropics is a key uncertainty here too. Clark et al., 2013 find some observational evidence for climate stress effect on NPP, but not a CO2 fertilisation effect (in a decade-long dataset). [Clark et al., 2013, JGR Biogeosciences: <a href="http://onlinelibrary.wiley.com/doi/10.1002/jgrg.20067/abstract">http://onlinelibrary.wiley.com/doi/10.1002/jgrg.20067/abstract</a> ] (Chris Jones, Met Office)	We refer to this uncertainty.
1174	76804	4	41	35	41	45	this discussion on Amazon dieback is clearly important and a confidence statement will be widely cited I think. You could discuss here that there is still some disagreement on the drivers of simulated Amazon dieback with some (e.g. Good et al., 2011) diagnosing it to be driven more by drying than warming while others (e.g. Galbraith or Huntingford) have claimed it is more driven by warming than drying. Given one (warming) is a much more robust signal of change than the other (drying) how does this affect the confidence statement? (Chris Jones, Met Office)	We have reworked this paragraph to more clearly summarize state of knowledge.
1175	58136	4	41	37	0	0	purely climate-driven dieback'. Do you mean just the effect of climate change excluding fire (and other?) changes? Have to be careful as climate changes drive fire changes and hence dieback risk. One might talk about 'direct effect of climate changes', but I don't like that, as you could talk about an 'indirect' effect via modification of soil moisture. (Peter Good, UK Metoffice)	We clarify our meaning later in the revised paragraph.
1176	58137	4	41	37	0	0	lower than previously thought'. See my comment on page 40, line 39. We need to be precise here. Lower than previously though by who? Kriegler et al. (2009) demonstrated the wide range of expert opinion on such issues. Or do we think all experts would now revise their opinions downward. Less likely than AR4 assessment? (Peter Good, UK Metoffice)	Addressed in revised paragraph.
1177	58152	4	41	37	0	38	I suggest caution in citing Cox et al. (2013) as evidence for reduced likelihood of Amazon dieback (which is not the main point of this paper). First, the evidence for a constraint on dieback in the model comes from the statement that $\gamma_{lc} < -100\text{GtC/K}$ is 'typically associated with models projecting dieback'. However, the only models in this ensemble with dynamic vegetation were the four HadCM3 variants - insufficient for a statistical link. Second, it is unclear that their observable quantity (temperature sensitivity of CO2 growth rate) has any relevance to dieback biophysics. The paper states that model differences in this observable quantity are mostly associated with differences in the sensitivity of soil respiration to temperature, and not NPP sensitivity (in their ensemble). The model differences in soil respiration sensitivity could be relevant to dieback biophysics only if they were driven by greater litter during warm years in the more sensitive models, but this is not investigated in the paper. (continued in next line of spreadsheet) (Peter Good, UK Metoffice)	We have edited the paragraph to respond to this comment.
1178	58153	4	41	37	0	38	(continuation of comment on caution in citing Cox et al. (2013) as evidence for reduced likelihood of amazon dieback). In HadCM3C at least, litter scales with vegetation carbon (except for sub-zero temperatures). This would tend to buffer short-timescale litter variability and reduce the correlation with annual temperature anomalies. Any litter variability would be driven by NPP variability - and, as stated above, the correlation between NPP and NEP sensitivities is weak. The constraint on $\gamma_{lc}$ may indirectly constraint dieback likelihood by constraining global warming, but given the uncertainties in regional response, this constraint is weak. (Peter Good, UK Metoffice)	We have edited the paragraph to respond to this and related comments.
1179	76802	4	41	38	0	0	Do you really believe the Cox et al constraint on future carbon loss is a constraint on dieback of the ecosystem? (Chris Jones, Met Office)	We have reduced the prominence of the Cox et al. citation.
1180	58139	4	41	38	0	39	robust evidence, medium agreement' What is the robust evidence here? These are mostly model studies with fairly simple vegetation treatments. (Peter Good, UK Metoffice)	We reviewed the evidence and decided to change it to "medium evidence, medium agreement"
1181	58138	4	41	39	0	0	what do you mean by 'widespread forest loss'? If you say that you have medium confidence that something is not going to happen, have to be clear on what the something is. Malhi 2009 suggested that changes over the E. amazon are still plausible. (Peter Good, UK Metoffice)	Sentence is reworded
1182	76803	4	41	39	0	0	can you make it clear if this confidence statement on "forest loss during this century" is conditional on a particular scenario, the RCP set of scenarios, any future scenario?? (Chris Jones, Met Office)	This modeling studies examined several future scenarios. This paragraph has now been reworked.
1183	76672	4	41	39	41	39	"principle" --> "main"? (Claudio Cassardo, University of Torino)	We couldn't find the word "principle" that is referred to.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1184	58140	4	41	49	0	0	what is the role of greater sunlight penetration here? Are you thinking of letting the grasses grow (fire fuel), which is also mentioned below (line 54), in the context of climate-driven tree mortality. (Peter Good, UK Metoffice)	Greater sunlight penetration to the forest floor of forests damaged by fire permits grass invasion, increasing risk of recurrent burning. We consider this an indirect effect of climate change.
1185	71998	4	42	13	42	16	The prediction of 55% loss in Nepstad et al 2008 is no longer based on the "current pattern", given the large decrease in deforestation rates since the early 2000s. The authors may wish to either explain that it is based on deforestation going back to the rates for that earlier period, which no longer apply, or else consider dropping this sentence. (UNITED STATES OF AMERICA)	We have adjusted the text to reflect this suggestion.
1186	81811	4	42	14	42	14	For the percentage giving here, is it possible to specify the range/uncertainties associated with the projection? (Katharine Mach, IPCC WGII TSU)	The article does not estimate the range of uncertainty. We have removed the percentage and replaced it with "more than half"
1187	66478	4	42	17	42	17	Delete comma after '2005'. (Peter Burt, University of Greenwich)	done
1188	61038	4	42	19	42	21	It is recognised that fire could play a role in the transition of Amazon forest to a dry stable state. To reduce fire risk and so guard against a fire-mediated tipping point the maintaining of mature forest is recommended. Deforestation increases the risk of fire because it inhibits rainfall in the region and provides an ignition sources to flammable forest. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This comment is captured in the revised text and the Amazon diagram.
1189	76806	4	42	23	0	0	figure 4-10. schematics like this can be very useful, but will always be picked on for things they omit. A few comments here: (a) how do you define "drought"? Is this meteorological (reduced precip) or hydrological (reduced soil moisture). (b) how does increased air temp affect drought? if it is a soil moisture definition, OK, but a precip one maybe not? (c) how does CO2 affect drought? stomatal closure might reduce evapotranspiration and hence INCREASE soil moisture? (d) how does air temp increase tree growth? in hot tropics higher T might reduce growth? (e) you lack a negative arrow from CO2 to tree death given CO2 fertilisation and improved WUE, (f) wouldn't more tree growth give you MORE fire, and more fire give you LESS tree ? in which case are these two arrows the wrong way round? (Chris Jones, Met Office)	The goal of this diagram is to capture some of the most robust relationships that underly a possible near-term tipping point in the Amazon and that have empirical evidence backing them up and is not intended to be comprehensive. Drought is severe reduction in rainfall that affects both soil moisture and fuel flammability. High air T certainly accelerates drought and increases fuel flammability. Effect of CO2 on tree death lacking empirical evidence. Faster tree growth actually reduces flammability of forests by accelerating rate of canopy closure (and low light, high moisture) conditions in the forest floor.
1190	71999	4	42	23	42	29	Below are several suggested changes for the authors' consideration which could improve the legend for Figure 4-10: -- Place the figure earlier in Box 4-3, rather than here at the end of it -- Explain that it shows the processes by which a tipping point could be reached -- Clarify if the confidence is in the existence of the processes shown, or in there being large enough to move the system past the tipping point (the first is implied by the discussion in the text). -- Also explain that "positive" and "negative" refer to + and - feedback loops, since many readers interpret them (incorrectly) as meaning effects that have positive or negative consequences for humans and/or for ecosystems -- the reverse of what's the case here. (UNITED STATES OF AMERICA)	Good suggestions. We have redone the figure, removed the uncertainty statements, and edited the legend/caption.
1191	59319	4	42	34	0	39	It is not clear why distinct biomes like savannas and deserts should make part of an umbrella-type category (Rangelands and Drylands including Mediterranean-type systems). Also, the four-line introduction does not offer much. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We were under space pressure to combine many subcategories. The logic we used use to separate forests (largely used for timber) from the continuum of ecosystems, on an aridity gradient, largely used for grazing (savannas, grasslands, shrublande, deserts). The introduction tries to explain this
1192	57682	4	42	34	42	34	delete "including Miditerranean-type Systems", because the system is not a type of land. (Zhongcheng Jiang, Institute of Karst Geology,CAGS)	Several reviewers asked us to include Mediterranean systems, so we have done so. These occur worldwide, including outside of the geographical Mediterranean, which is why we use the phrase Mediterranean -type. It is an ecosystem ecological category rather than a land type.
1193	59320	4	42	44	0	44	The definition of savannas is rather poor (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Taken out the word 'defined', leaving this as a lay definition without calling it that.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1194	60395	4	42	44	42	53	At least in West Africa, I know that the climate shows natural variability across a huge range of timescales (e.g. Shanahan et al 2009; Maloney & Shaman, 2008; Nicholson, 2000) which makes it difficult to attribute observed changes to anthropogenic effects. (Edward Pope, Met Office)	This is true, and climate variability is mentioned, but we can't really go into the details of why detection and attribution of tree cover change in savannas is difficult in the limited space we have.
1195	64321	4	42	48	0	53	Critical pressures, such as land use change, that logically hinder occurrences of fire in some savanna, such as those in East Africa, particularly Kenya, are unmentioned (Margaret Mwangi, Pennsylvania State University)	It is not quite as simple as this - see the Archibald et al 2009 paper cited - altered lands often have a higher burned area fraction.
1196	66479	4	43	7	43	7	'per' should be in italics. (Peter Burt, University of Greenwich)	I don't think this is the convention followed in IPCC
1197	66480	4	43	13	43	13	Insert comma after 'yet'. (Peter Burt, University of Greenwich)	Done
1198	68811	4	43	13	43	25	In section 4.3.3.2.1 (line 13-14) stated that majority of the causes for woodland and grass land are attributed to climate and atmospheric changes, while the detail discussion almost fully focused on effects of CO2 and little about climate. It is later stated that rainfall increase could be one of the factors. There is no evidence stated that shows if there is really an increase in rainfall amount and frequency in the the savana region. (NETHERLANDS)	Rainfall is projected to go up or down in savannas, there is quite a lot of discussion on climate, and of course CO2 underlies climate changes.
1199	76673	4	43	17	43	17	typo: "saplings" --> "samplings" (Claudio Cassardo, University of Torino)	No, we meant saplings.
1200	72000	4	43	20	43	23	Invasive species will likely play a large role as well. (UNITED STATES OF AMERICA)	Yes, but savanna trees increasing in range are by definition 'invasive species'
1201	60396	4	43	22	43	28	I don't know whether it is worth mentioning here the effect of forest loss (through climate change and deforestation) in somewhere like eastern Spain, which has been linked to a reduction in rainfall in that area (Millan et al 2005a; 2008) (Edward Pope, Met Office)	In this brief summary we had to restrict our statements mainly to large (continental) regions and phenomena.
1202	61039	4	43	23	43	24	Do projections of future precipitation patterns suggest that rainfall will increase in the Savannah system? Perhaps this statement needs supporting evidence or a link/ reference to WGI discussions on precipitation patterns. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	It can go either way, mostly up. We have added that.
1203	71212	4	43	27	43	28	"could lead to more savanna-like conditions". This is unclear, and could be read as either tropical forest undergoing a reduction in tree cover, or grasslands undergoing an increase in tree cover. (CANADA)	It is forests open up and being invaded by grasslands. Clarified.
1204	72001	4	43	27	43	28	The authors may want to put the sentence about the projection at the end of this paragraph, since it seems to be contradicted by the data from both central Africa and northern Australia. (UNITED STATES OF AMERICA)	No it isn't contradictory, since expanding of the forest boundary into savannas would be predicted in a higher CO2, wetter, world, but since the authors of those papers make no conclusion about causes, we can't. But the reorganisation of the section should make this clearer.
1205	72002	4	43	29	0	0	The phrase "forests will be moving into savannas and grasslands" is not clear. (UNITED STATES OF AMERICA)	The statement is that forests have been observed to be moving into adjacent grasslands and savannas seems clear.
1206	61040	4	43	30	43	31	Is there evidence/ nuanced reasoning for why forest has expanded into former savannah areas in Northern Australia - ? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This section has been completely re-written. In essence, the phenomenon under discussion here is now treated with the following sentence: "In many places around the world the savanna boundary is moving into former grasslands on elevation gradients, in other words into areas inferred to be formerly too cool for trees (Breshears, 2006)."
1207	72003	4	43	34	45	15	Section 4.3.3.2.2 (Grasslands and Shrublands) This section lacks statements on "confidence" (low, medium, high, very high, etc.), which should be included. Additionally this section is written in the style of an old-fashioned review paper: "A said that...", "B et al. found that...", "C and D were of the opinion that..." This seems slightly antiquated and unsuited to a consensus document such as AR5. Authors may wish to revise the section to more completely relay the consensus of the literature (and how confident the scientific community is in that consensus) rather than the findings of single studies. (UNITED STATES OF AMERICA)	The Section was fully revised and rewritten, following reviewer's comments. New references were added.
1208	59321	4	43	36	45	15	Following the above, although in the title of section 4.3.3.2, Mediterranean-type systems are clearly stated, there is no particular mention to them in the text. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	A section on Mediterranean-type systems was included.
1209	71213	4	43	36	45	15	This section could be condensed - summarize results rather than presenting case studies. (CANADA)	The section has been shortened.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1210	56508	4	43	39	0	0	Full stop missing after "Chen, 2013)". (Archis Ambulkar, Brinjac Engineering Inc.)	Thank you, it was inserted.
1211	59322	4	43	39	0	41	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Grammar was corrected.
1212	56509	4	43	40	0	0	There are two "are" in the sentence. Needs revision. (Archis Ambulkar, Brinjac Engineering Inc.)	Grammar was corrected.
1213	66481	4	43	43	43	43	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We have used capital letter.
1214	66482	4	43	45	43	45	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We have used capital letter.
1215	71214	4	43	51	43	52	Suggest insertion of "they" before "highlight". (CANADA)	The sentence was rephrased.
1216	66483	4	43	52	43	52	Change 'highlight' to 'highlighting'. (Peter Burt, University of Greenwich)	The sentence was rephrased.
1217	57708	4	44	4	0	0	Add after carbon assimilation: and plant and soil nutrient contents and stoichiometries (Sardans et al. 2008a,b; SARDANS J., PEÑUELAS J., ESTIARTE M., PRIETO P. 2008. Warming and drought alter C and N concentration, allocation and accumulation in a Mediterranean shrubland. Global Change Biology 14: 2304-2316. SARDANS J., PEÑUELAS J., PRIETO P., ESTIARTE M. 2008. Changes in Ca, Fe, Mg, Mo, Na, and S content in a Mediterranean shrubland under warming and drought. Journal of Geophysical Research 113. G03039, doi:10.1029/2008JG000795. (Josep Penuelas, CREAF-CSIC)	We rephrased the sentence to "Rainfall amount and timing have large effects on a wide range of biological processes in grasslands and shrublands, including seed germination, seedling establishment, plant growth, flowering time, root mass, community composition, population and community dynamics production, decomposition and respiration, microbial processes and carbon, plant and soil nutrient contents " and added the suggested references.
1218	56510	4	44	9	44	10	Delete extra "to" so that sentence becomes "led to decreases in plant productivity and delayed flowering." (Archis Ambulkar, Brinjac Engineering Inc.)	The sentence was removed during the revision process.
1219	56511	4	44	17	0	0	Change "accompanies" to "accompany" (Archis Ambulkar, Brinjac Engineering Inc.)	Corrected.
1220	61041	4	44	17	44	20	Changes in patterns and timing of precipitation will impact a wide range of biological processes in grasslands and shrublands, such as seed germination, community composition and carbon assimilation with an the added impact on human food security. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Some of these elements already existed in the Section, which just the same was re-written. Food security is the topic of Chapter 7.
1221	68812	4	44	17	44	20	In the statements indicated it seems that like higher food security and income may cause conflicts between nomadic and sedentary, but is rather the land-use change of rangeland to cropland by sedentary farmers that may potentially cause conflicts. Therefore, it is necessary to report or emphasize the landuse change as the potential source of conflict between nomadic and sedentary populations.(see Vohland and Barry, 2009) (NETHERLANDS)	The statement was removed during the revision process.
1222	59323	4	44	23	0	24	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The statement was rephrased.
1223	71215	4	44	26	44	28	The sites referenced here were mainly forested; there was one crop system and five grassland sites, whereas 20 sites were forests. Suggest reviewing sources. (CANADA)	The statement was rephrased and the incorrect number was eliminated.
1224	66484	4	44	37	44	37	Change 'nitrogen' to 'N' (as in lines 30 and 43). (Peter Burt, University of Greenwich)	Done.
1225	66485	4	44	46	44	46	Change 'fifty' to '50' for consistency. (Peter Burt, University of Greenwich)	The sentence was removed during the revision process.
1226	61042	4	44	53	45	1	Is the increase in species richness dependent on sufficient water availability? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	It is dependent on rising temperature, and to decreases in water availability in low latitude countries
1227	71216	4	44	53	45	2	The mechanism is not explained, nor is a hypothesis proposed. Does this sentence refer to the work of Sommer et al. (2010)? Is there other work that could be cited? Suggest clarifying that Sommer et al. (2010) provides the basis for this assertion--if that is the intention, and if possible, making a statement about why diversity increases with warming in cool systems, but decreases in warmer systems. It could be speculated it is about the number of species able to tolerate increasing aridity and temperature stress at the high end, and conversely for the cool end. However, grazing intensity (and the diversity of herbivores) should have a role too? (CANADA)	The text has now been rephrased: "In most temperate and arctic regions, the capacity to support richer (i.e. more diverse) communities is projected to increase with rising temperature, while decreases in water availability suggest a decline in capacity to support species-rich communities in most tropical and subtropical regions (Sommer et al., 2010)."

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1228	71218	4	45	0	0	0	Section 4.3.3.3 There is very little on fresh-water ecosystems in earlier sections of the document. Suggest the evidence of change be presented earlier, in Section 4.3.2 (CANADA)	Agreed. Some material from 4.3.3.3 and CC-RF2 (See also comment #1670) has been brought forward and incorporated into a new subheading in 4.3.2
1229	59324	4	45	4	0	11	There is some mention on the fire regimes for the different continents, but none for Europe, particularly for its fire-prone Mediterranean part. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The paragraph on fire was rewritten and additional references which also cover Europe were included.
1230	76511	4	45	7	45	8	Not only in Australian grasslands. See: "Lenihan J, Bachelet D, Neilson R, Drapek R (2008) Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California. Climatic Change 87:215-230" and "Giannakopoulos C, Le Sager P, Bindi M, Moriondo M, Kostopoulou E, Goodess CM (2009) Climatic changes and associated impacts in the Mediterranean resulting from a 2°C global warming. Global and Planetary Change 68:209-224" (Bruno Moreira, Centre for Functional Ecology - University of Coimbra)	Both references were included.
1231	60281	4	45	7	45	11	It is not only fire frequency that is projected to increase. Another aspect of the fire regime, peak fire season, is also projected to broaden (e.g. Cary 2002; Clarke et al. 2013). This could have impacts on recruitment success of species with seasonal emergence patterns post-fire or a seasonal component to their germination. (References: (1) Cary GJ (2002) Importance of a changing climate for fire regimes in Australia. In: Bradstock RA, Williams JE, Gill MA (eds) Flammable Australia - the fire regimes and biodiversity of a continent. Cambridge University Press; (2) Clarke H, Lucas C, Smith P (2013) Changes in Australian fire weather between 1973 and 2010. International Journal of Climatology 33, 931-944.) (Mark Ooi, University of Wollongong)	The statement was rephrased and Clarke et al. (2013) were cited.
1232	79771	4	45	13	0	0	A potential reference here could be: Follett R.F., Reed D.A. Soil Carbon Sequestration in Grazing Lands: Societal Benefits and Policy Implications. Rangeland Ecology & Management 63:4-15. DOI: 10.2111/08-225.1. (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	Thanks for this proposal. As the focus is on climate change impacts rather than mitigation etc. we decided not to include this reference.
1233	57683	4	45	18	45	45	In "4.3.3.2.3 Deserts", the rocky deserts should be included. Rocky deserts distribute widely in the world, and there are large rocky desert areas with many people in south China, Viet Nam and Spain where are really poor areas. However, the impacts of climate change on rocky deserts are different from deserts. Rocky deserts occurred in karst areas, so warm temperature and high precipitation increase the rate of rock solution and soil erosion and then lead to increase rocky desert area, but main causes of rocky deserts are human activities such as cropland use, fire and cut tree (Yuan Daoxian, Rock desertification in the subtropical karst of south China. Z. Geomorph. N. F., 1997, 108(2): 81-90). In the sparse population areas, the regional range of rocky deserts respond to the dry climate (Zhang Cheng, Yuan Daoxian, New development of IGCP 448 "World Correlation of Karst Ecosystem (2000-2004)", Episodes. 2001, 24(4): 279-280). In karst rocky deserts, the well developed ground aquifers lead to rapid leakage of the surface water (YUAN Daoxian. 2002b. Geology and geohydrology of karst and its relevance to society, Invited Speech at the 30th Session of IGCP Scientific Board, February, UNESCO /Paris: in Minutes 30th Session of IGCP Scientific Board, 13-15), so the drought in the regions is becoming increasingly severe in recent years (YANG Yunchuan XIAO Feipeng CHENG Genwei et al, Comprehensive risk management strategy for agricultural drought disaster in Dashishan region of Guangxi, Agricultural Research in the Arid Areas, 2012, (30)3:267-273). (Zhongcheng Jiang, Institute of Karst Geology, CAGS)	Thanks for this interesting and relevant hint. Due to space constraints we did not go into further detail here, but hope to we have covered some of the principle problems (i.e. the impacts of combined drivers, i.e. including those beyond climate change) within our chapter.
1234	59325	4	45	20	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have tried to improve the English language.
1235	72004	4	45	24	0	0	Define/explain the Hadley circulation (UNITED STATES OF AMERICA)	Now explained through: "...the Hadley circulation which determines the location of the broad band of hot deserts"
1236	59326	4	45	24	0	27	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have tried to improve the English language.
1237	64322	4	45	32	0	45	Citations are mixed up: lines 32 to 38 versus 40 to 45 are word-for-word the same; however, the citations are different. the citation are switched (swapped) (Margaret Mwangi, Pennsylvania State University)	This has now been corrected.
1238	68813	4	45	32	45	42	In the statements Page 45 (line 32 to 38) and Page 45 (line 40 to 45) are almost a copy of each other, while two different references are named (Lapola et al., 2009 in the first and Stahlschmidt et al, 2011). Those statements should be combined to make one idea instead of two by also combining the two references. (NETHERLANDS)	This has now been corrected.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1239	57719	4	45	32	45	45	Part of the text is repeated here. Check the references here: in the first sentence authors are referring to Lapola et al. 2009, but in the repeated text they are referring to Stahlschmidt et al. 2011. (Anne Kasurinen, University of Eastern Finland)	This has now been corrected.
1240	60282	4	45	32	45	45	The section on deserts provides no examples of the effects climate change may have on dynamics, whilst several examples are provided for most of the other ecosystems. This provides some foundation to report a few examples, in part, so as not to suggest that these ecosystems are any less vulnerable or important than any other system. For example, there is some evidence highlighting the impact of warming and its interaction with changes to rainfall season on ecological dynamics of annual plant species (Kimball et al. 2010). There is also some experimental work showing the potential for seed bank loss for ephemeral species under increased soil temperatures related to climate change (Ooi et al. 2009). Both of these papers suggest that species composition is likely to shift in response to climatic changes. These are just examples I am familiar with, however, numerous and potentially more suitable references exist. (References: (1) Kimball S, Angert AL, Huxman TE, Venable DL (2010) Contemporary climate change in the Sonoran Desert favors cold-adapted species. Global Change Biology 16, 1555-1565; (2) Ooi MKJ, Auld TD, Denham AD (2009) Climate change and bet-hedging: interactions between increased soil temperatures and seed bank persistence. Global Change Biology 15, 2375-2386.). Please note, Lines 32-38 are repeated in Lines 40-45 but with different references. (Mark Ooi, University of Wollongong)	The proposed new references were included.
1241	76674	4	45	32	45	45	the sentence in lines 40-45 is copied almost entirely from the one in lines 32-38, but the first reference is different: Lapola before, Stahlschmidt after. Please correct... (Claudio Cassardo, University of Torino)	This has now been corrected.
1242	79057	4	45	32	45	45	The content of the lower paragraph is already included in the last part of the other paragraph. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	This has now been corrected.
1243	58362	4	45	40	45	45	Repetition (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This has now been corrected.
1244	58661	4	45	40	45	45	This para seems repeating the line 32-38 of this page, please combining the two parts. (chunfeng wang, State Forestry Administration, China)	This has now been corrected.
1245	71217	4	45	40	45	45	Suggest deleting this paragraph. It is a repeat of L. 32-38. (CANADA)	This has now been corrected.
1246	72005	4	45	40	45	45	This text nearly duplicates that immediately above it (lines 32-38) although with a different citation. Authors may wish to consolidate the two parts. (UNITED STATES OF AMERICA)	This has now been corrected.
1247	80077	4	45	50	0	0	Missing: link between global change effects and ecosystem functions which can be better characterized when discussing the different landscapes. In particular, I miss the microbial processes. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	Effects of warming (in particular) and, in the case of lakes, thermal stratification, on nutrient loading, production and food webs are considered in 4.3.3.3.
1248	59327	4	46	1	0	7	What is the meaning of 4% pa? Also, it is written that '10,000 to 20,000 freshwater species are extinct or at risk'. What time scale does this refer to? When thousands of species are said to be extinct, the information should be double checked and secure. I had a quick look at the paper mentioned (Strayer and Dudgeon 2010), but it was not easy to find these numbers. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The FOD review requested that we include extinction rates. The extinction rate of 4% is in fact per decade (not pa) and has been corrected. This comes from Dudgeon et al. (2006) and this reference has been inserted. The estimate of 10-20,000 species are extinct or imperiled comes from Strayer and Dudgeon (2010) and is attributed to human activities. This too has been clarified in this section.
1249	72006	4	46	3	0	0	Suggest not using the abbreviation 'pa' here, especially for such a key statistic (UNITED STATES OF AMERICA)	Agreed. As noted on comment 1248, this should read 4% per decade and has been corrected.
1250	58363	4	46	3	43	3	What is 4% pa? Per decade ? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This was incorrect. As noted on comment 1248, this figure should be 4% per decade and has been corrected.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1251	71219	4	46	4	46	4	"at least 10,000 - 20,000 freshwater species are extinct or at risk". This seems like a contradiction to earlier info about extinctions at P. 32 which says that there are "...more than 800 global extinctions documented by the IUCN..." Perhaps the 10,000-20,000 reported here are "local extinctions"? Suggest clarifying. (CANADA)	Strayer and Dudgeon (2010) (see also Strayer 2006), estimated this from IUCN figures for described species of mollusks, decapods, and odonates. 8% of described species in these groups are listed and they assumed a similar level for other freshwater groups. They also noted that In intensively developed areas, such as Europe and North America, it is not unusual for > 1/3 of the freshwater species in a taxonomic group to be extinct or imperiled. It is noted in the text that this is an estimate.
1252	59328	4	46	5	0	5	Please replace significant with another word; keep it only for statistical significance. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	OK. The term significant has been removed and the sentence re-written as "This is a particular concern given that freshwater habitats ..."
1253	78305	4	46	9	19	0	The importance of the peat carbon sink function shall be mentioned and the 'large degree' by peat degradation world wide shall be mentioned: 1) peat is degrading at alarming rates (page 46 lines 9-19) 2) peat is a huge carbon store, stores 10+ times more carbon than all forest globally and is thus a huge potential carbon source if not managed properly (if drained) 3) impacts of climate change can accelerate the peat degradation in different ways and the reversed impacts in terms of global warming are high . (Arina Schrier, Wetlands International)	This Chapter considers the effects of climate change on peatland ecosystems. It is noted in this section that anthropogenic impacts to peatlands have turned them from a weak carbon sink to a source (note - this has been moved to section 4).
1254	76807	4	46	9	46	19	also mention the importance of pluvial carbon loss in disturbed peat regions (Moore et al., 2013, Nature) (Chris Jones, Met Office)	Reference to fluvial losses (Moore et al.) has been included in the section on peatlands, now in section 4.2.4.1
1255	71220	4	46	10	46	11	The comparisons of peatland C stock presented here are confusing. Suggest simply stating the best/latest estimate of global peatland C stock in Pg C. (CANADA)	Have included estimate of global peatland stock from Frockling et al 2011 (400–600 Pg carbon)
1256	66486	4	46	15	46	15	Delete comma after 'drainage' (all processes mentioned refer to the Indonesian peat swamp, not only burning). (Peter Burt, University of Greenwich)	Comma has been deleted
1257	72007	4	46	15	46	15	Is the 400 Mg figure what would be released if ALL peat swamp carbon were emitted, or a projection for some date based on some scenario? (UNITED STATES OF AMERICA)	This figure (1,400 Mg) was estimated over a 25yr period. I have clarified this and used the actual annual estimates and error from Murdiyarto et al., 2010
1258	64670	4	46	21	0	0	Another study which has shown that changes in hydrological regime are important for the future of wetlands and that these may depend as much on the future socio-economic situation as the projected changes in climate is Harrison, P.A, Berry, P.M., Henriques, C. and Holman, I.P. (2008). Impact of socio-economic and climate change scenarios on wetlands: linking water resource and biodiversity meta-models. Climatic Change, 90, 113-139. (Paula Harrison, University of Oxford)	Noted but we do not believe the reference is needed here.
1259	78633	4	46	24	0	0	include reference:..from altered thermal regimes (Livingstone 2003, Wilhelm and Adrian 2008), alterered....references: LIVINGSTONE, D. M. 2003. Impact of secular climate change on the thermal structure of a large temperate central European lake. Climate Change 57: 205–225. WILHELM, S., AND R. ADRIAN. 2008. Impact of summer warming on the thermal characteristics of a polymictic lake and consequences for oxygen, nutrients and phytoplankton. Freshwater Biol. 53: 226–237. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The issue of altered thermal regimes is explore in more detail later in this section and includes the more recent of these two references. Accordingly, no change has been made to this initial statement.
1260	66487	4	46	27	46	27	Capital 'A' for 'Arctic'. (Peter Burt, University of Greenwich)	Arctic has been capitalized
1261	77068	4	46	35	46	47	Note, however, that this rising temperature signal can evidently be difficult to robustly detect due to confounding factors and process complexity (Arismendi, I., S. Johnson, J. Dunham, R. Haggerty, and D. Hockman-Wert. 2012. The paradox of cooling streams in a warming world: regional climate trends do not parallel variable local trends in stream temperature in the Pacific continental United States. Geophys. Res. Lett., doi:10.1029/2012GL051448). A qualifying statement of this sort seems important to mention; failing to do so might compromise credibility. (Sean Fleming, Meteorological Service of Canada)	I have included a reference to this recent analysis in 4.3.3.3
1262	66488	4	46	44	46	44	Hyphen required after 'warm'. (Peter Burt, University of Greenwich)	Hyphen has been inserted
1263	61043	4	46	49	46	49	Perhaps define the meaning of 'epilmnctic' i.e. as 'the layer of water above the thermocline' to make it clearer to non-specialists. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	OK. Have re-worded this to "The well-mixed surface waters (epilimnion) in many lakes ..."

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1264	78634	4	46	51	0	0	resulting in reduced periods of ice formation (Magnusson et al 2000, Livingstone and Adrian 2009, Weyhenmeyer et al. 2011), in early onset.references: LIVINGSTONE, D. M. AND R. ADRIAN. 2009. Modeling the duration of intermittent ice cover on a lake for climate-change studies. Limnol. Oceanogr. 54: 1709–1722. MAGNUSON, J. J., AND oTHERS. 2000. Historical trends in lake and river ice cover in the Northern Hemisphere. Science 289: 1743–1746, and Errata 2001, Science 291: 254. Weyhenmeyer, G., Livingstone, D., Meili, M., Jensen, O., Benson, B. et al. (2011). Large geographical differences in the sensitivity of ice-covered lakes and rivers in the Northern Hemisphere to temperature changes. Global Change Biology, 17(1): 268-275.....Some more information on the effctcs of changes in thermal regime: Shifts from dimictic to monomictic regime are predicted by the existing climate scenarios to take place in the majority of European dimictic lakes already by the end of the 21st century (Kirillin 2010), i.e. winter stratification will completely disappear in these lakes. In summer, climate warming produces an opposite, stabilizing effect that may eventually lead to the mixing regime shift to dimictic in hitherto polymictic lakes. The ecological consequences of this regime shift are even more drastic than di-/monomictic transitions, because the abrupt detachment of the nutrient-rich hypolimnion from the euphotic layer is likely to trigger stronger competition between autotrophic species resulting in changes in phytoplankton species composition and ecosystem functionality (Wilhelm and Adrian, Wagner and Adrian 2009, 2011). In the long run climate change may reduce the resilience of a system and as such the transitions to the turbid state may occur at a lower nutrient threshold level, resulting in a higher proportion of turbid lakes in the future (Mooij et al. 2005). References: Kirillin2010. Modelling the impact of global warming on water temperature and seasonal mixing regimes in small temperate lakes. Boreal Environment research 15: 279-293. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The references to changes in ice cover have been included. Space limitations preclude a more detailed discussion of the implications of changing thermal regimes in lakes.
1265	81812	4	47	2	47	2	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Noted - and intended.
1266	71221	4	47	11	47	32	Strong focus on temperature in earlier sections, but not precipitation. Suggest that precipitation trends be introduced earlier, in Section 4.3.2. (CANADA)	Precipitation trends and implications for altered hydrology are dealt with in Chapter 3. The consequences of this to freshwater systems are considered in 4.3.3.3 and in CC-RF2.
1267	77851	4	47	13	47	13	proposition to add after bracket:Under circumstances of low flow storage reservoirs ensuring water not only for users but also for ecosystems located downstream of reservoirs and become particularly important (POLAND)	This refers to the potential for reservoirs to release water for environmental purposes - have added a short statement to this effect in 4.4.2.3.
1268	77069	4	47	19	47	19	After "changes in physical habitat and water quality (Bryant, 2009)" I very strongly suggest adding something like the following: "These effects may be either compounded or temporarily mitigated in glacier-fed rivers, depending on whether glacial runoff is locally in its final decreasing or initial increasing phase under climate change. Glacial headwaters, which lie at the source of many of the world's largest transboundary basins, also have unique and sensitive ecosystems which may be threatened by continued warming. These may serve as important indicator systems for climate change." Seven key references here include: (i) Milner AM and others (2009), Hydroecological response of river systems to shrinking glaciers. Hydrological Processes, 23: 62-77; (ii) Fleming SW (2005), Comparative analysis of glacial and nival streamflow regimes with implications for lotic habitat quantity and fish species richness. River Research and Applications, 21:363-379; (iii) Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality. Hydrological Processes, 23:42-61; (iv) Baraer M and others (2012), Glacier recession and water resources in Peru's Cordillera Blanca, Journal of Glaciology, 58:134-150; (v) Hood E and Berner L (2009), Effects of changing glacial coverage on the physical and biogeochemical properties of coastal streams in southeastern Alaska. Journal of Geophysical Research, 114, doi:10.1029/2009JG000971; (vi) Jansson P and others (2003), The concept of glacier storage: a review. Journal of Hydrology 282: 116-129; (vii) Jacobsen D and others (2012), Biodiversity under threat in glacier-fed river systems. Nature Climate Change, 2: 361-364. (Sean Fleming, Meteorological Service of Canada)	Some additional text and references have been added to 4.3.3.3 and these issues are also addressed in CC-RF2.
1269	76675	4	47	28	47	28	typo: "Mire" --> "More" (Claudio Cassardo, University of Torino)	Mire' is correct - a collective term for bogs, transition bogs and fens
1270	72008	4	47	29	47	30	Do the GCMs generally agree in predicting less precipitation and longer dry seasons in southeast Asia? Authors may want to make clear whether this assertion is based on just one model, or many. (UNITED STATES OF AMERICA)	This has been clarified to be decreased dry season precipitation.
1271	64671	4	47	34	0	0	See also Richards, J.A., Mokrech, M. and Berry, P.M. (2008) Regional assessment of climate change impacts on coastal and fluvial ecosystems and the scope for adaptation. Climatic Change, 90(1-2): 141-167. (Paula Harrison, University of Oxford)	This reference has been considered but is not essential for this section

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1272	78635	4	47	41	0	0	add something on critical thresholds such as Surpassed critical threshold are known for a number of system levels – often related to changes in phenology (ice, water temperature, plankton phenology, emergence, spawning events). Peeters et al. (2007) e.g. quantified surpassed critical thresholds in spring for a number of meteorological variables to determine an early or late onset of phytoplankton growth in Lake Constance. In a recently developed model Straile et al. (2012) used water temperature phenology as a predictor for Daphnia seasonal dynamics in North Temperate lakes. The timing of the year when surface water temperatures reached 13°C explained 49% of the variability of the timing of the spring Daphnia maximum in two German lakes (Lake Constance, Müggelsee) and in Lake Washington (USA). The Daphnia phenology model also performed well for predicting the timing of the Daphnia maxima in 49 lakes within the northern Hemisphere (Straile et al. 2012). Early spawning of Dreissena polymorpha was related to an early reach of a critical water temperature threshold of 13°C, known to initiate the first spawning event in a year (Wilhelm and Adrian 2007). The excess of direct and indirect temperature thresholds (length of thermal stratification) have been shown to trigger processes, such as the onset and magnitude of cyanobacteria blooms (Wagner and Adrian 2009a, Huber et al. 2011). Stratification lengths of greater than 3 weeks caused a switch from non-nitrogen fixing cyanobacteria dominance to a dominance of N-fixing cyanobacteria species and as such affecting not only relative species composition but also ecosystem functioning (Wagner and Adrian 2009). Reference: Straile D. , Adrian R. and D.E. Schindler. 2012. Iniform temperature dependency in the phenology of a keystone herbivore in lakes of the Northern Hemisphere. PlosOne 7(10): e45497. Peeters F., Straile D., Lorke A., Ollinger D. 2007. Turbulent mixing and phytoplankton spring bloom development in a deep lake. Limnology and oceanography 52: 286-298. (Rita Adrian, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	These issues are covered in brief in 4.3.3.3 but space constraints prevent a more detailed discussion
1273	56512	4	47	43	0	0	Please include "and" as "Tundra, Alpine and Permafrost Systems" (Archis Ambulkar, Brinjac Engineering Inc.)	Done.
1274	80078	4	47	45	0	0	Missing: Linkage to aquatic systems, e.g. thawing of permafrost soil leads to increased run off of terrestrial DOC greatly affecting aquatic respiration potentially leading to anoxia! (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	The issue of increased DOC is now addressed in section 4.3.3.3 (Rivers, Lakes, Wetlands and Peatlands) with several key references.
1275	56513	4	47	46	0	0	Include ")" after Hartmann et.al. in press. (Archis Ambulkar, Brinjac Engineering Inc.)	Done
1276	57091	4	47	46	47	46	in press -> in press) (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Done
1277	66385	4	47	46	47	46	closing brackets needed after "in press." (Carla Andreia Silva Mora, University of Lisbon)	Done
1278	76676	4	47	46	47	46	typo: add ")" after "press" (Claudio Cassardo, University of Torino)	Done
1279	59329	4	47	49	0	51	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Edited sentence to be more clear.
1280	70686	4	47	51	47	51	No mention is made to changing permafrost in Antarctica, especially in the Antarctic Peninsula. I suggest adding the following in the end of the paragraph: "Changes in terrestrial environments in Antarctica have also been reported. Vieira et al (2010) show that in in the Maritime Antarctic permafrost temperatures are close to thaw, making the terrestrial environment very sensitive to climate change. The first effects of warming permafrost have been reported by Bockheim et al (2013) for the Palmer archipelago, while Guglielmin and Cannone (2012) report permafrost warming in continental Antarctica since 1997." References: Bockheim J, Vieira G, Ramos M, Lopez-Martinez J, Serrano E, Guglielmin M, Wilhelm K, Nieuwendam A. 2013. Climate Warming and Permafrost Dynamics in the Antarctic Peninsula Region . Global and Planetary Change, 100: 215-223; Guglielmin M, Cannone N 2012. A permafrost warming in a cooling Antarctica? Climatic Change 111: 177–195.; Vieira, G., Bockheim, J., Guglielmin, M., Balks, M., Abramov, A.A., Boelhouwers, J., Cannone, N., Ganzert, L., Gilichinsky, D.A., Goryachkin, S., López-Martínez, J., Meiklejohn, I., Raffi, R., Ramos, M., Schaefer, C., Serrano, E., Simas, F., Sletten, R., Wagner, D. 2010 - Thermal State of permafrost and active-layer monitoring in the Antarctic: advances during the International Polar Year 2007-09. Permafrost and Periglacial Processes, 21(2): 182-197. (Goncalo Vieira, University of Lisbon)	Added sentence as suggested.
1281	59330	4	47	53	48	3	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Edited sentence to be more clear.
1282	57092	4	48	1	48	1	21st Century -> 21st century (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Done

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1283	70313	4	48	3	0	0	I suggest to add a reference to another recent paper reporting projections of vegetation shifts for sub-arctic wet lands is: Bosiö J, Johansson M, Callaghan TV, Johansen B, Christensen TR (2012) Future vegetation changes in thawing subarctic mires and implications for greenhouse gas exchange—a regional assessment. Climatic Change 115:379–398 (Stefan Fronzek, Finnish Environment Institute)	Done
1284	76808	4	48	5	48	6	Jones et al (2009, Nature Geoscience) were the first to explicitly raise the issue of committed vegetation changes due to long response times. (Chris Jones, Met Office)	Reference added
1285	66489	4	48	11	48	11	Capital 'A' for 'Arctic'. (Peter Burt, University of Greenwich)	Done
1286	66490	4	48	17	48	17	For consistency elsewhere, please give taxonomic details of species mentioned. (Peter Burt, University of Greenwich)	Deleted reference to example species - not consistent w/ rest of section
1287	66491	4	48	32	48	32	Capital 'A' for 'Arctic'. (Peter Burt, University of Greenwich)	Done
1288	72009	4	48	34	48	34	"leap frogging" term use is inconsistent with pg 50, line 9 (UNITED STATES OF AMERICA)	substituted another term to avoid jargon
1289	59331	4	48	40	0	43	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Text edited to make more streamlined and clear.
1290	61044	4	48	42	48	42	Perhaps define the meaning of 'cryoturbation' for a non-specialist audience to aid understanding of why the processes is involved in altering vegetation succession. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Text edited to make more streamlined and clear; 'cryoturbation' no longer mentioned
1291	61045	4	48	42	48	42	What does the term "cryoturbation" mean? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Text edited to make more streamlined and clear; 'cryoturbation' no longer mentioned
1292	76809	4	48	45	0	0	consistency check required with WG1. Ch12 state "virtually certain" future thawing of permafrost (Chris Jones, Met Office)	text corrected to state this and be consistent with WG1 Chap 12
1293	80376	4	48	45	48	46	Please ensure consistency with Ch12 WGI AR5 and add cross-reference (already WGI TSU FOD comment). The current confidence statement is not from WGI AR5 assessment: "high confidence that permafrost is projected to decline further over first half of 21st century" does not match current WGI AR5 Ch12 statement "A retreat of permafrost extent with rising global temperatures is virtually certain". Please revise accordingly (Gian-Kasper Plattner, IPCC WGI TSU)	text corrected to state this and be consistent with WG1 Chap 12
1294	71222	4	48	45	48	51	This statement and Figure 4-11 require a source. (CANADA)	Source added, and also in Fig caption.
1295	76810	4	49	1	0	0	Figure 4-11. I'd advise a multi-model plot here given this exists. See e.g. WG1-Ch12-fig 12.33 (That's the figure number in their SOD) (Chris Jones, Met Office)	In contrast to WG1-Ch12-Fig 12.33, Fig 4-11 goes out beyond 2100 in order to show the full response of permafrost. In this context, we have included as many model results as are available.
1296	66492	4	49	3	49	3	Insert space between number and unit. (Peter Burt, University of Greenwich)	Done
1297	76677	4	49	3	49	3	remove "deep" (Claudio Cassardo, University of Torino)	Done
1298	71223	4	49	6	49	7	Suggest providing an up-to-date estimate of C content of frozen soils and permafrost (Same issue as at P. 46, L10-11). Perhaps a table of global C stocks could be provided? (CANADA)	Number added. Global C stocks covered in depth in WG1 Chapter 6
1299	71224	4	49	7	49	11	Suggest specifying the positive feedback sources and their relative contribution. (CANADA)	Added reference to WG1 Chapter 6 where this is done.
1300	76811	4	49	8	0	0	can you quantify (and justify!) "soon" (Chris Jones, Met Office)	Deleted this vague word and added referenbce to WG1 Chap 6 for those needing quantification (space too limited in this section for thorough discussion)
1301	70687	4	49	15	49	15	Mention could be made to changes in the terrestrial environments of the Antarctic Peninsula region and Maritime Antarctic, since warming is leading to vegetation development and the area can potentially function as a net carbon sink in soils, although seemingly negligible at the global scale, contrarily to the Arctic. (Goncalo Vieira, University of Lisbon)	Have added reference to Antarctic earlier in section, and space limitations preclude discussion of how smaller regional potential permafrost sinks and sources may change in future. Arctic is emphasized here because of its likely change from a large carbon sink to source given continued climate change.
1302	56349	4	49	22	0	0	One of the reasons scientists are predicting dramatic impacts to caribou is declining lichen abundance (see above) (Kyle Joly, US National Park Service)	Edited the sentence to provide more detail (in form of citations) about caribou dynamics and climate, past and future. Space limitation preclude going into more textbook detail.

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1303	56350	4	49	22	0	0	I do not think stating that "populations of other Arctic animals will be affected dramatically" tells the reader very much. Will the affect be positive or negative? Positive for some, negative for others? Will some changes be positive and other negative for a single species? What might these affects be? Demographic, behavioral, distribution, etc? It is just a very open-ended statement that raises more questions than it answers. (Kyle Joly, US National Park Service)	Edit the text to make it clear (via citations especially) that this important statement is backed up, and detailed, by the literature. Space limitations preclude going into more detail.
1304	59332	4	49	26	0	40	There is no information about alpine areas in the Mediterranean region. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have added a section on Mediterranean systems, and note that there is also a chapter focused on Europe. Unfortunately we don't have the room to detail change in all mountain systems of the globe.
1305	71225	4	49	26	0	40	Can anything be said about movement of the tree line in this paragraph on alpine systems? (CANADA)	Edited to include information on tree line movement in alpine systems
1306	56514	4	49	32	0	0	Term "already" is used twice, please delete one. (Archis Ambulkar, Brinjac Engineering Inc.)	done
1307	58800	4	49	32	49	35	Let me introduce additional research paper, Yasuda et al (2007), which detected shrinkage of alpine moor vegetation in Japanese high mountain by using aerial photographs. Moor vegetation, which is sensitive to snow depth, has reduced 10 % in the areas in the past 33 years. I believe this is an additional good example of climate change impact in high mountain ecosystems in East Asia. Reference: Yasuda M., Daimaru H. and Okitsu S. 2007. Detection of Alpine Moor Vegetation Change by Comparison of Orthonized Aerophotographs at Different Times. Geographical Review of Japan 80: 842-856 (in Japanese with English abstract) (Tetsuya Matsui, Forestry and Forest Products Research Institute)	reference added
1308	58801	4	49	32	49	35	This sentence mentions Africa, Tibet, the Alps, the tropics and elsewhere; however, it would be better to state Asia instead of Tibet, because there is a research paper conducted in other Asian high mountain regions in the reference (eg., Kudo et al 2011). (Tetsuya Matsui, Forestry and Forest Products Research Institute)	done
1309	71226	4	49	32	49	40	Consider moving this to Section 4.3.2.5 (CANADA)	No justification given, and are decision is to stick to the organization we have had through multiple drafts
1310	81813	4	49	36	49	36	It would be helpful to clarify the terminology used to describe vascular plant species here. (Katharine Mach, IPCC WGII TSU)	Agreed "vascular" is too technical and is out of place in this text. It is not needed and has been deleted
1311	76812	4	49	44	0	0	this box is a good place to discuss the response of different aspects on different timescales - e.g. GPP might respond very quickly to environmental changes, but vegetation composition continues to respond over decades or more. Jones et al (2009, Nature Geoscience) discuss results showing "committed ecosystem changes" analogous to commitments of ice-sheet loss or sea-level rise. (Chris Jones, Met Office)	We added this point in the main text of the section, so don't need to do it also in the box.
1312	76678	4	49	48	49	48	remove "far" (Claudio Cassardo, University of Torino)	Wording changed to be more clear. "far" has been deleted.
1313	66493	4	49	53	49	53	Capital 'E' for 'Earth' (you mean the planet, not soil). (Peter Burt, University of Greenwich)	Done
1314	66494	4	50	2	50	2	Capital 'E' for 'Earth' (you mean the planet, not soil). (Peter Burt, University of Greenwich)	Done
1315	56351	4	50	4	50	23	An important came out in 2013 by Roland et al. It revealed enormously important findings. First, with warming soils, white spruce may be able to expand into black spruce habitats, and also into the alpine. Second was that not all fire lead to changes in community composition Roland et al. 2013 Landscape-scale patterns in tree occupancy and abundance in subarctic Alaska. Ecological Monographs 83:19-48. <a href="http://dx.doi.org/10.1890/11-2136.1">http://dx.doi.org/10.1890/11-2136.1</a> . These new findings should be integrated into the discussion here. This is one of the few studies documenting impacts to alpine areas in northern climates. A recommendation to further study these areas should be made. Edaphic conditions may be inhibitng change northern alpine areas. (Kyle Joly, US National Park Service)	text has been altered to reflect points in this paper, and reference to this work has been added
1316	81814	4	50	22	50	23	How should the reader interpret height versus width of the arrows? Also, do they pertain to the present or the future, and do they indicate magnitude or change in magnitude? (Katharine Mach, IPCC WGII TSU)	All the details have now been dealt with in collaboration with the TSU in order to achieve optimum solutions for this former Figure 4-12 (now 4-10) as with all other figures.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1317	59333	4	50	28	0	33	The introduction here is rather inadequate. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The introduction (which actually is just an explanatory sentence) just gives the rationale for why we included the elements we did include. For this purpose we do not want to miss it.
1318	67852	4	50	36	0	0	The title for 4.3.3.5.1 should read "Planted forests" instead of "Plantation forestry" to avoid confusion about the words. The word "plantation" generally refers to those forests managed for commercial commodity production such as coffee, gum, etc., whereas section 4.3.3.5.1 seemingly uses "plantation forestry" for a broader meaning to include not only plantations but other types of planted forests. Any similar usage of the word "plantation" should be changed to "planted forests" throughout the draft. (JAPAN)	We intentionally restricted our text here to plantations. We think that planted forests include too many systems which are already dealt with in the forest sections in chapter 4.3.3.1.
1319	72010	4	50	36	52	18	Both plantation forestry and bioenergy (esp. production on abandoned lands) have obvious mitigation implications that are not referenced or addressed in the context of future landscapes (e.g. carbon capture). (UNITED STATES OF AMERICA)	We agree and have include the following sentence at the end of the first paragraph (at former page 50, line 45): "Afforestation usually results in net CO2 uptake from the atmosphere (Canadell and Raupach, 2008; Van Minnen et al., 2008) but does not necessarily result in a reduction in global warming (Bala et al., 2007; see Section 4.3.4.5)."
1320	66495	4	50	38	50	38	Bad English: replace 'on' with 'regarding'. (Peter Burt, University of Greenwich)	Thanks, we have tried to adjust our entire text to better English
1321	66496	4	50	38	50	38	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Thanks, we have changed this throughout the text.
1322	76679	4	50	41	50	41	the percentage "7%" is global or refers to forested areas only? Please specify... (Claudio Cassardo, University of Torino)	Yes, it is global. We have re-written the sentence to make this clearer.
1323	81815	4	50	41	50	41	It would be helpful to clarify the phrase "with 7%" at the start of this sentence. (Katharine Mach, IPCC WGII TSU)	We have re-written the sentence to make this clearer
1324	71227	4	50	41	50	42	Suggest rewording as follows: "Plantations cover only about 7% of global forest area, with the largest areas in..." (CANADA)	Thanks, done in a way quite close to the suggested one
1325	66497	4	50	45	50	45	Change 'area' to 'areas'. (Peter Burt, University of Greenwich)	thanks, we have changed it accordingly
1326	66498	4	50	47	50	47	Cumbersome: replace hyphen with comma. (Peter Burt, University of Greenwich)	thanks, we have changed it accordingly
1327	71228	4	51	1	51	5	Suggest splitting this sentence into two parts. Second to start at end of L 3 "The effects of disturbances...." (CANADA)	thanks, we have changed it accordingly
1328	68214	4	51	5	0	0	Loustau, D. (2010). Forests, carbon cycle and climate change. Versailles, QUAE: 350p. This reference could be cited here. This book includes several chapters dealing with climate impacts on forests and interactions with pests and range shifts at regional scale. (Denis Loustau, INRA)	Thanks for the hint; we have included this
1329	68215	4	51	6	0	0	Kurz results do not concern plantation forest. (Denis Loustau, INRA)	We have deleted the sentence with Kurz et al. 2008 and added to the reference at the end of the previous sentence "see also section 4.3.3.1 and Box 4.2", where Kurz et al. are mentioned.
1330	72011	4	51	6	51	7	The Kurz et al. result is important but it applies to the whole Canadian forest sector, most of which is not plantations. Suggest including it in the boreal forest section, not here under plantation forestry. (UNITED STATES OF AMERICA)	We have deleted the sentence with Kurz et al. 2008 and added to the reference at the end of the previous sentence "see also section 4.3.3.1 and Box 4.2", where Kurz et al. are mentioned.
1331	68216	4	51	12	0	0	To be added after Sitch et al. : Loustau, D., A. Bosc, A. Colin, J. Ogee, H. Davi, C. Francois, E. Dufrene, M. Deque, E. Cloppet, D. Arrouays, C. I. Bas, N. Saby, G. Pignard, N. Hamza, A. Granier, N. Breda, P. Ciais, N. Viovy and F. Delage (2005). Modeling climate change effects on the potential production of French plains forests at the sub-regional level. Tree Physiology 25(7): 813-823. (Denis Loustau, INRA)	Due to space constraints we decided not to include the reference, also because it dates back to 2005
1332	71229	4	51	16	51	16	Suggest deleting "even" here. (CANADA)	Thanks, we have changed it accordingly.
1333	66499	4	51	19	51	19	For consistency, give common names as well as taxonomic details. (Peter Burt, University of Greenwich)	We have now only used the common names as here this is rather straight forward.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1334	71230	4	51	21	0	0	No single provenance need be chosen, a diversity of provenances can be deployed along climate gradients. This can be described as a risk-management approach to deploying provenances in a changing climate. This is in addition to a multi-species/ mixed stand approach. (CANADA)	We now wrote "For example, risk spreading by promoting mixed stands, containing multiple species or provenances, combined with natural regeneration " instead of "multi-species mixed stands".
1335	61046	4	51	24	51	29	Discusses the role of adaptive management in sustaining forest plantations under climate change, by using a mixed-species approach, or by including native species within the stands. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We mentioned these approaches, but can't afford a more exhaustive discussion due to space constraints.
1336	56515	4	51	25	0	0	Include ")" after Dale et.al. 2010. (Archis Ambulkar, Brinjac Engineering Inc.)	Thanks, we have changed it accordingly.
1337	57093	4	51	25	51	25	2010. -> 2010). (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Thanks, we have changed it accordingly.
1338	72012	4	51	36	0	0	(Section on bioenergy sytems): The intent of this sub-section is not clear. Suggest clearly stating that the replacement of natural forest ecosystems for the production of bioenergy is a self-defeating strategy in terms of both climate change and biodiversity, and should be rejected. (UNITED STATES OF AMERICA)	We have now divided this section into two - one deals with bioenergy systems as impacted by climate change (still remains here), while another part is moved to section 4.4.4 under the "unintended consequences", where the issue raised here is dealt with.
1339	79950	4	51	36	52	18	COMMENT: This paragraph about bioenergy is discussed under the headline "4.3.3 Impacts of major systems". The discussion is about "tipping points" and thresholds within the climate system. Production of modern bioenergy is growing rapidly throughout the world (NORWAY)	We have now divided this section into two - one deals with bioenergy systems as impacted by climate change (still remains here), while another part is moved to section 4.4.4 under the "unintended consequences".
1340	61047	4	51	38	52	18	The section 4.3.3.5.2 Bioenergy systems is particularly policy relevant, especially in respect to the additional pressure on terrestrial and freshwater systems caused by changes in land use but also pressure on food security caused by a switch from food crops to fuel crops, so would the authors please note and comment on those links? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have now divided this section into two - one deals with bioenergy systems as impacted by climate change (still remains here), while another part is moved to section 4.4.4 under the "unintended consequences", where the issue raised here is dealt with.
1341	56516	4	51	40	0	0	Change to "in general on decline" (Archis Ambulkar, Brinjac Engineering Inc.)	We have re-written several portions of text which includes this part
1342	71231	4	51	45	51	46	Text in parentheses is unclear. Suggest rewording to: "(given that many forest plantations are grown for bioenergy purposes)" (CANADA)	We have re-written several portions of text which includes this part
1343	66500	4	51	46	51	46	Capital 'C' required for 'chapter' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Thanks, we have changed it accordingly.
1344	76856	4	51	46	51	49	Section 4.3.3.5.2 Bioenergy Systems: The reference referring to conclusions from a review of climate change on biofuel yields in temperate environments in this sentence (Luckman and Kavanagh, 2000) is incorrect. Luckman and Kavanagh, 2000 is a paper considering 'Impact of Climate Fluctuations on Mountain Environments in the Canadian Rockies'! The correct reference for the conclusion that elevated CO2 may increase drought tolerance was in the first order draft: Oliver, R.J., Finch, J.W., and Taylor, G., 2009: Second generation bioenergy crops and climate change: a review of the effects of elevated atmospheric CO2 and drought on water use and the implications for yield. Global Change Biology Bioenergy, 1(2), 97-114. Also, the word 'increase' in this sentence should be 'increased'. (Tom Oliver, Centre for Ecology and Hydrology)	Thanks for spotting this error; we have corrected it and also written "increased".
1345	76813	4	51	50	0	0	Hughes et al., 2010, GCB Bioenergy, show some modelling results of how bioenergy production changes regionally and in time under climate change (Chris Jones, Met Office)	Thanks, we decided not to include this reference here - due to space constraints (and as it did not add further information of key relevance).
1346	56517	4	52	3	0	0	Change to "in a 20 years perspective there is..." (Archis Ambulkar, Brinjac Engineering Inc.)	We have re-written several portions of text which includes this part.
1347	66501	4	52	3	52	3	Change 'it' to 'there'. (Peter Burt, University of Greenwich)	We have re-written several portions of text which includes this part.
1348	76680	4	52	3	52	3	typo: change "it is" with "there is" (Claudio Cassardo, University of Torino)	We have re-written several portions of text which includes this part.
1349	56518	4	52	4	0	0	Term "EU RES" referred here does not seem to be defined in this chapter. (Archis Ambulkar, Brinjac Engineering Inc.)	We have made this to Section 4.4.4 and now made it explicit: Renewable Energy Sources.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1350	61048	4	52	4	52	4	EU RES policy needs explaining. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have made this to Section 4.4.4 and now made it explicit: Renewable Energy Sources.
1351	56519	4	52	8	0	0	Change to "with a global reduction of forest stocks by 2%..." (Archis Ambulkar, Brinjac Engineering Inc.)	Thanks, we have changed it along your recommendation and moved this to Section 4.4.4.
1352	66502	4	52	12	52	13	References should be in chronological order. (Peter Burt, University of Greenwich)	We now have arranged all reference in chronological order.
1353	76681	4	52	15	52	16	change "many species rich grasslands" in "many rich grassland species" (Claudio Cassardo, University of Torino)	indeed we write about grasslands which are rich in species, thus no change would have been required. However we deleted some aspects and thus this term is not present any longer in our chapter.
1354	72013	4	52	21	0	0	The intent of the section on cultural landscapes is unclear. (UNITED STATES OF AMERICA)	Issues of cultural landscapes are of particular importance in the context of climate change in the general perception and discussion in many parts of the world (very high on the agenda e.g. in Europe).
1355	68814	4	52	25	52	25	Inconsistent referencing in the body of the text. There is no need to mention page number in the reference as indicated "p.334". Please remove. (NETHERLANDS)	We removed this sentence
1356	66503	4	52	33	52	33	Cumbersome: replace hyphens with commas. (Peter Burt, University of Greenwich)	We removed this sentence
1357	61049	4	52	33	52	39	Discusses the management of cultural landscapes in maintaining species mix, particularly endangered species. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, and this is obviously important as the relevance otherwise seems not obvious to people with different background (see comment 1354)
1358	71232	4	52	44	52	44	Suggest inserting "and" before "while" (CANADA)	We think the original version should be ok
1359	76861	4	52	44	52	45	Section 4.3.3.5.3 Cultural landscapes: Note that there is also a paper suggesting that the trends in community temperature index found in Devictor et al. could also be partly attributable to land use change: Clavero, M., Villero, D. & Brotons, L. (2011) Climate change or land use dynamics: do we know what climate change indicators indicate? PLoS ONE, 6, e18581. (Tom Oliver, Centre for Ecology and Hydrology)	Reference was included, thanks for highlighting.
1360	66504	4	52	45	52	46	Split infinitive: move 'better' to after 'picture'. (Peter Burt, University of Greenwich)	Text was re-written, thus this comment was no longer relevant.
1361	61050	4	52	47	52	49	Discussing the adaptation of protected area networks to take into account shifts in climate with relevance to species migration and dispersal. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, we agree, but here we focus on land-use generally, which has a lot to do with dispersal (we did not make this point explicit here, but it is part of Settele & Kühn 2009, which is cited).
1362	80080	4	53	0	0	0	Chapter on "Impacts on key species" is largely restricted to terrestrial systems, whereas aquatic systems and their interactions with terrestrial systems is missing.... SOMMER U. and A. LEWANDOWSKA. 2011. Climate change and the phytoplankton spring bloom: warming and overwintering zooplankton have similar effects on phytoplankton. Global Change Biology (2011) 17, 154–162. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This section address impacts on key 'services' (not species). The latter, including effects of warming on lake phenology are dealt with in 4.3.3.3 and also now in 4.3.2. The main ecosystem service from freshwaters (provision of clean drinking water) is dealt with in Chapter 3 and has been removed from Chapter 4.
1363	81816	4	53	1	53	1	Section 4.3.3.5.4. This section should be shortened to focus on ecosystem impacts. (Katharine Mach, IPCC WGII TSU)	We have shortened the Section and tried to have a better focus on urban ecosystem impacts purely.
1364	72014	4	53	1	53	28	Authors may wish to consider including a mention of disease outbreaks (potential for increase under warming) for urban systems. (UNITED STATES OF AMERICA)	Due to the request to focus on ecosystem impacts (comment 1363), we unfortunately could not include this aspect.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1365	72015	4	53	1	53	28	This section on urban ecosystems touches many other chapters of the report without referencing them: Human Health, Urban Areas, and possibly Human Security and Livelihoods. It provides a cursory discussion and review of some very large issues (e.g. heat stress, flooding, etc.) At a minimum the other chapters should be referenced for more depth on these matters. In addition, the urban natural ecosystems themselves do not get much discussion. Below are a few suggested examples of impacts in urban ecosystems that could receive more discussion: Impacts to urban forests and parks Landslides due to increased precipitation as mediated by natural vegetation Tree phenology effects on human health (e.g. allergies/asthma, etc.) Increased rainfall in urban areas as habitat for disease vectors Impacts to residential landscaping (UNITED STATES OF AMERICA)	Thank you for the comments. We have rewritten the section quite a bit, trying to accommodate some of these comments. We also have included a number of pointers to other sections and chapters. As we had to reduce our overall text length, we unfortunately could not go too much into further detail here.
1366	80377	4	53	1	53	28	Section 4.3.3.5.4: More specific reference than IPCC 2012 is needed when referring to the SREX Ch3. Please ensure consistency with WGI AR5 as assessment might have been updated from SREX. (Gian-Kasper Plattner, IPCC WGI TSU)	We make reference to IPCC, 2012: Summary for Policymakers. And hope that the complete reference we provided (where you are one of the authors) is as clear as a source for these more general statements: IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor & P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 3-21.
1367	71233	4	53	1	55	11	This section is hard to follow. Suggest reworking. (CANADA)	Thanks, we have re-written and also shortened the section, hoping that it is better to follow now.
1368	80079	4	53	3	0	0	Urban systems are often characterized by disconnecting land and water thereby affecting their role for ecosystem functioning and hence element and nutrient cycles. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	Thanks, we focus on climate change effects on urban ecosystems and not of urbanisation in general but we included a sentence on changes in water availability.
1369	66505	4	53	3	53	3	cumbersome: change text in brackets to 'see Chapter 8 for definition'. (Peter Burt, University of Greenwich)	Thanks, we changed the text and point at Section 8.1.2 for the definition.
1370	57464	4	53	3	53	28	Urbanization and global warming affects water environments. Especially stable water from groundwater will be severe in high temperature affecting ecosystem in lowland lakes and ponds (Gunawardhana et al., Tidal effects on aquifer thermal regime: An analytical solution for coastal ecosystem management, Journal of Hydrology, Vol.377, No.3-4, pp.377-390, 2009.). (So Kazama, Tohoku University)	Thanks for mentioning. We included a general statement that water availability in urban ecosystems will be affected also by climate change but used a more specific reference (Hunt & Watkiss 2011) since the mentioned reference was not helpful enough.
1371	76682	4	53	4	53	4	"0.5% of Earth's terrestrial surface": since land is 1/3 of Earth's surface, then this means roughly 1.5% of land? Not so small! (Claudio Cassardo, University of Torino)	Thanks. We changed this into "land surface".
1372	59334	4	53	10	0	13	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thanks, we generally improved the language.
1373	66506	4	53	10	53	10	Insert 'by' after 'or'. (Peter Burt, University of Greenwich)	Thanks, we generally improved the language.
1374	66507	4	53	10	53	10	Insert comma after 'however'. (Peter Burt, University of Greenwich)	Thanks, we generally improved the language.
1375	66508	4	53	11	53	11	Insert comma after ')' (Peter Burt, University of Greenwich)	Thanks, we generally improved the language.
1376	56520	4	53	12	53	13	Should the sentence be "sea level will continue to rise..." or "sea level rise in future will contribute to affecting coastal urban areas." (Archis Ambulkar, Brinjac Engineering Inc.)	We changed the phrase in the direction of the 2nd suggestion.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1377	77852	4	53	13	53	13	May be one sentence should be add. Urban areas are exposed on local convectional rains and in consequence urban floods (POLAND)	Thanks, we included a statement: "Heavy rainfall events are also projected to increase (IPCC, 2012), and although the hydrological conditions in urban areas make them prone to flooding (medium confidence), there is limited evidence that they will be over-proportionally affected. It is very likely that sea level rise in future will contribute to flooding, erosion and salinisation of coastal urban ecosystems (IPCC, 2012)."
1378	66509	4	53	15	53	15	Insert comma after 'however'. (Peter Burt, University of Greenwich)	Thanks, we generally improved the language.
1379	56521	4	53	16	0	0	Should it be "significantly higher" (Archis Ambulkar, Brinjac Engineering Inc.)	Thanks, we generally improved the language.
1380	71234	4	53	18	53	19	This sentence is unclear. Suggest revising. (CANADA)	Thanks, we generally improved the language.
1381	66510	4	53	21	53	21	I don't know what 'traits compositions' means. (Peter Burt, University of Greenwich)	Thanks, we hope to have made it clearer.
1382	56522	4	53	23	0	0	Change to "this effect might also continue in the future..." (Archis Ambulkar, Brinjac Engineering Inc.)	Thanks, we changed wording.
1383	57720	4	53	27	53	28	"With increasing numbers of alien species, also the BVOC... will increase. Are total VOC emissions really increasing due to alien species alone, or is it more of a change in the emission profiles (i.e. emission of sesquiterpenes are increasing, but then there are less monoterpene emissions or vice versa)? This would need more explanation. (Anne Kasurinen, University of Eastern Finland)	After more in depth review we decided to delete this statement, since the direct BVOC and climate change relationship is not clear enough.
1384	61051	4	53	27	53	28	BVOC emissions may also affect air quality in and downwind of urban centres (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	After more in depth review we decided to delete this statement, since the direct BVOC and climate change relationship is not clear enough.
1385	79772	4	53	31	0	0	This section doesn't seem to do well with how different types of ecosystem services interact with one another. For instance, a degraded habitat for biodiversity could lead to less potable water (or water with lower quality), through the supporting service of degraded soil and erosion/sediment runoff. For example the discussion of freshwater systems including soil and rock (18.3.1.1, 18.3.1.3-4) and shallow landslides ( ch 18.3.1.3-4, ch 3.2.6), Figure 18-3. Along this line, where in the report are supporting services discussed? These indirect services, part of my point here, could be important for addressing how climate change alters ecosystem services. (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	It is not clear that the example given (degraded biomass habitat and less potable water) does constitute an interaction in the normal scientific sense of that word. They simply may occur together- the one is not worse or better in the presence of the other, and vice versa. Potable water is dealt with in chap 3, and there is some text on sedimentation in 4.2. If landslides are covered in ch 18, it is better for us to point there. Supporting services are mostly covered in 4.2. under primary production and N deposition, where their links to climate are made clear.
1386	81817	4	53	31	0	0	Section 4.3.4. This section should be shortened in length as much as possible and ideally by 50%. Cross-references to earlier sections of the chapter should be used as much as possible to reduce and tighten the section. (Katharine Mach, IPCC WGII TSU)	We have tried to shorten all our sections. For this one, there were several calls to lengthen it (eg 1388). We are moving some material around to balance sections, and strive for conciseness throughout.
1387	81818	4	53	31	0	0	Section 4.3.4. The chapter team should consider presenting a table of risks related to ecosystem services, potentially using icons to indicate the relevant drivers of change for each example and their relative importance. (Katharine Mach, IPCC WGII TSU)	We have now provided a risk table(table 4.3) which does implicitly or explicitly address some ecosystem service risks - in particular risks to the climate regulation service. It uses the generally agreed icons of WGII.
1388	72016	4	53	31	56	55	Section 4.3.4: The section on "Impacts to Key Services" is very weak and would benefit from more in depth treatment. It is reasonable that provisioning services are discussed in other chapters, but there are at least a couple of major services missing: 1. Sediment retention / soil loss / erosion 2. Nutrient regulation 3. Pollution detoxification 4. Recreation/Tourism (UNITED STATES OF AMERICA)	It is not possible to exhaustively treat the services. Our logic was to treat those where there is some evidence of climate sensitivity, and which were not treated in other chapters better. Sediment retention and pollution are in ch 3 (with a bit in ch 4), Recreation/tourism is in ch 10.
1389	72017	4	53	31	61	24	Section 4.3.4: Most of the subsections in this part of the text lack "confidence" expressions, which should be added. (UNITED STATES OF AMERICA)	Confidence statements have now been added.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1390	64672	4	53	33	0	0	It might be useful to include a very brief overview of current trends in ecosystem services here as there is much information available from the Millennium Ecosystem Assessment, many national assessments, such as the UK NEA (see <a href="http://uknea.unep-wcmc.org/">http://uknea.unep-wcmc.org/</a> for the reports) and for Europe see Harrison, P.A., Vandewalle, M., Sykes M.T., Berry, P.M., Bugter, R., de Bello, F., Feld, C.K., Grandin, U., Harrington, R., Haslett, J.R., Jongman, R.H.G., Luck, G.W., da Silva, P.M., Moora, M., Settele, J., Sousa, J.P. & Zobel, M. (2010). Identifying and prioritising services in European terrestrial and freshwater ecosystems. <i>Biodiversity and Conservation</i> , 19: 2791-2821. (Paula Harrison, University of Oxford)	It is not possible to exhaustively treat the services. Our logic was to treat those where there is some evidence of climate sensitivity, and which were not treated in other chapters better - while we would have liked to cite the paper which was co-authored by one of our CLAs.
1391	81819	4	53	33	53	33	The glossary could be cross-referenced here to reduce this paragraph. (Katharine Mach, IPCC WGII TSU)	The paragraph cannot be materially shortened, since we need it to point to where the various services are covered, and to explain which ones are covered here.
1392	58364	4	53	37	53	37	What is TEEB ? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	The Economics of Ecosystems and Biodiversity. Now deleted.
1393	61052	4	53	37	53	37	What is TEEB and why is it important here? The reference needs completing. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The reference to TEEB is deleted as unnecessary.
1394	72018	4	53	37	53	37	Suggest referencing and spelling out TEEB. (UNITED STATES OF AMERICA)	TEEB has been deleted
1395	71235	4	53	40	0	42	Potable water is a provisioning service addressed in this section so the last sentence of this paragraph is a bit contradictory. Should the section on potable water be in the chapter addressing provisioning services? Is there another way to title and present ecosystem changes in hydrology in this section? What about implications for fish habitat? (CANADA)	We have left the entirety of potable water to chapter 3.
1396	66511	4	53	41	53	41	Capital 'C' required for 'chapter' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We follow the IPCC style on this
1397	81820	4	53	41	53	41	The reference to chapter 13 here does not seem most appropriate. Presumably chapter 10 is meant? (Katharine Mach, IPCC WGII TSU)	Yes, we mean chapter 10
1398	65132	4	53	45	54	29	This section needs to make a much more explicit link between the biodiversity and ecosystem services (ES), as it is a contested issue about the exact role of different components of biodiversity in the delivery of different ES (Pam Berry, Oxford)	Our intention here is to briefly highlight the habitat provision for biodiversity as an ecosystem service, but not into the role of biodiversity in service delivery - that's to a small extent dealt with in 4.3.4.2-5. Generally, this is a vast and contended issue, the subject of entire assessments such as the MA. The best we can do here is point to them.
1399	72019	4	53	45	54	29	Much of the content of these paragraphs has already appeared in previous sections. Authors may wish to consolidate some information for space considerations. (UNITED STATES OF AMERICA)	We have now consolidated the information and reduced the amount of text and pointed to other sections of our and other WG's chapters.
1400	80081	4	53	47	0	0	Freshwater systems are important habitats since they harbour high area-specific numbers of species and since freshwater habitat are strongest affected by humans. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This point is captured in 4.3.3.3. Additional information on range shifts (for terrestrial and freshwater species) in response to warming are dealt with in more detail in 4.3.2.
1401	66512	4	53	47	53	48	Insert colon after 'inducing' and commas either side of 'and'. (Peter Burt, University of Greenwich)	Thanks, we have tried to adjust our entire text to better English
1402	81821	4	53	51	53	51	The specific relevant section(s) in chapter 28 should be specified, and further citations should be provided here. (Katharine Mach, IPCC WGII TSU)	The pointer to the section of chapter 28 (28.2.2.1.3) was added, where there are numerous references.
1403	80082	4	54	0	0	0	Freshwater change in their function as pathways for pest, diseases etc. (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	This point seems to relate to the potential spread of water-borne disease (this is dealt with in Chapter 11).
1404	57465	4	54	1	54	12	Water is also important factor in habitat, which is influenced by climate change. Higher fluctuation of water stream changes habitat dynamically and provides more severe ecosystem (Nukazawa et al., Evaluation of seasonal habitat variations of freshwater fishes, fireflies, and frogs using a habitat suitability index model that includes river water temperature, Ecological Modelling, Vol.222, No.20-22, pp.3718-3726, 2011.). (So Kazama, Tohoku University)	Many of these issues are dealt with in section 4.3.3.3. Additionally, as the example presented here is more of an indirect link to climate change we decided not to integrate this.
1405	66513	4	54	2	54	2	Imprecise: please quantify 'large distances'. (Peter Burt, University of Greenwich)	We have added a quantification: "up to several hundred kilometres".

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1406	81822	4	54	2	54	7	For the projected outcomes described on these lines, the relevant scenarios of climate change, ranges of projections, and time frames should be specified for each. (Katharine Mach, IPCC WGII TSU)	We have provided the relevant information given in the papers (up to several hundred kilometers).
1407	56523	4	54	9	0	0	Might want to use different term instead of using word "change" twice in the sentence presently - "in some changes climate change..." (Archis Ambulkar, Brinjac Engineering Inc.)	it should read "in some cases"... - we have corrected this
1408	61053	4	54	11	54	12	Highlights the need for adaptation of current protected area networks, and also the importance of the habitat matrix outside of protected areas in creating environments suitable for species in the future. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have inserted pointers at the relevant chapters 4.4.2.2 and 4.4.2.3.
1409	81823	4	54	11	54	12	Is it possible to provide citations for this statement? (Katharine Mach, IPCC WGII TSU)	As indicated in the text, the statement refers to the papers cited in the preceding sentences; we also added a pointer towards chapters 4.4.2.2 and 4.4.2.3.
1410	71236	4	54	14	0	0	There is more literature that could be cited re: biome shifts and no-analog climate habitats (e.g., Rehfeldt et al. 2012 Ecol. Monogr). Combined with a risk management approach to adaptation, both niche and mechanistic models can play a role in guiding adaptation. (CANADA)	We have now cross-referenced to Section 4.3.3 and Fig. 4.1, where there is relevant literature cited.
1411	81824	4	54	15	54	15	It would be helpful to indicate more precisely what is meant by "non-analog climates." (Katharine Mach, IPCC WGII TSU)	We now reworded the sentence and avoided the technical term "non-analog climates".
1412	66514	4	54	16	54	16	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	We have corrected this.
1413	65133	4	54	32	55	11	Need to make explicit what this will mean for the delivery of pollination as an ES (Pam Berry, Oxford)	As we have written towards the end of the first paragraph, "This may result in temporarily reduced effectiveness of the "regulating services", which generally depend on species interactions (Montoya and Raffaelli, 2010). ", but the exact direction and the quantification of these changes is still difficult.
1414	62872	4	54	34	54	34	Add citation: Gilman, S. E., Urban, M. C., Tewksbury, J., Gilchrist, G. W. & Holt, R. D. A framework for community interactions under climate change. Trends in Ecology & Evolution 25, 325-331 (2010). (Mark Urban, University of Connecticut)	We have included this citation.
1415	76683	4	54	34	54	38	this paragraph enhances importance of pollinators for services. But in my opinion the most important contribution of pollinators is for vegetation reproduction: they are essential for this!!! (Claudio Cassardo, University of Torino)	We generally regard pollination as a service - and of course it is a core contribution to vegetation reproduction. We regard our text to be inclusive of this.
1416	66515	4	54	35	54	35	Insert comma after 'interactions' and replace 'like' with 'such as'. (Peter Burt, University of Greenwich)	Thanks, we have tried to adjust our entire text to better English, including the advise given here.
1417	71237	4	54	41	0	0	Are there any documented instances where climate change might directly, or indirectly, change eruptive insect population dynamics to reduce impacts? If not perhaps this could be indicated. (CANADA)	We have now inserted: "..but assessments of changes in impacts are hard to make (Payette, 2007)." We hope that this is a sufficient indication of the aspect you wanted us to highlight
1418	66516	4	54	43	54	43	'via' should be in italics. (Peter Burt, University of Greenwich)	We have now put this in italics.
1419	66517	4	54	44	54	44	'via' should be in italics. (Peter Burt, University of Greenwich)	The text has been modified and is now without "via" here.
1420	71238	4	54	47	54	29	This section writes more about shifts in 'habitat for individual species' than changes in 'habitat for biodiversity'. Can anything be said about projected shifts in diversity 'hotspots'? (CANADA)	Not that we could present anything about hotspots, but in relation to habitat for biodiversity we have included information on biomes, which also is a higher aggregation level compared to individual species.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1421	72020	4	54	49	54	51	Suprising that no likelihood statements can be made for the impacts of climate change on pollination, even if evidence is weak (important service to articulate). (UNITED STATES OF AMERICA)	Potts et al (2010) write "Recent climate change has already affected butterfly distributions, and future changes, which are predicted to be greater in extent than recent historical changes, are likely to have even more severe impacts. These patterns are consistent with the few studies on bees." Under the assumption that the decline of pollinators affects pollination we have at least medium confidence on negative impacts of climate change on pollination. Thus we have included such a statement.
1422	62095	4	54	52	55	3	Good discussion, but should probably add Burkle et al. 2013. Plant-Pollinator Interactions over 120 Years: Loss of Species, Co-Occurrence, and Function. Science (link: <a href="http://www.sciencemag.org/content/339/6127/1611.abstract">http://www.sciencemag.org/content/339/6127/1611.abstract</a> ) and Bartomeus et al. 2011. Climate-associated phenological advances in bee pollinators and bee-pollinated plants. PNAS. (Elizabeth Wolkovich, University of British Columbia)	Thanks for the positive take on our discussion; we have added both references to our text.
1423	66518	4	54	53	54	53	Clarity: replace hyphen with comma. (Peter Burt, University of Greenwich)	text has been modified and is now without a hyphen.
1424	81825	4	54	53	54	54	It would be preferable to be more precise as compared to "less than feared." (Katharine Mach, IPCC WGII TSU)	We have modified the text and do not use this term any more.
1425	59335	4	54	53	55	2	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thank you; now the sentence is a complete one.
1426	59336	4	55	1	0	1	should be phenological (not phonological) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We have corrected this - Thank you.
1427	63394	4	55	1	55	1	phenological (Suzanne leroy, brunel university)	We have corrected this - Thank you.
1428	76684	4	55	1	55	1	typo: phonological --> phenological (Claudio Cassardo, University of Torino)	We have corrected this - Thank you.
1429	76862	4	55	1	55	1	phonological' should be 'phenological'. Also two lines down 'proof' should be 'prove' (Tom Oliver, Centre for Ecology and Hydrology)	We have corrected this - Thank you.
1430	81826	4	55	1	55	2	It would be preferable to be more precise than "grossly underestimate." (Katharine Mach, IPCC WGII TSU)	To explain this in more detail would require quite some space, thus we decided to leave it as is - the reference is there if people want to go in further detail.
1431	59337	4	55	2	0	3	It cannot be understood what Willmer's view is about even when comparing with phenology chapter. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thanks for this important hint; we have complete re-checked this paragraph and found that there was a major error during the end note preparation; actually it is Willmer 2012 in both instances (instead of Willmer 2003 and Penuelas and Boada 2003); and this reference is now also put back to the reference list.
1432	71239	4	55	5	0	0	Suggest adding a sentence re: some context about the importance of honey bees being a important pollinator (CANADA)	We now explicitly mention honeybees as pollinators.
1433	76863	4	55	7	55	11	Paragraph needs attention- abbreviation 'incl.' should be 'including' also 'that's why' should be spelt out in full. The sentence is also very long and should probably be two sentences. (Tom Oliver, Centre for Ecology and Hydrology)	We have made the corrections and also made two sentences out of it.
1434	56524	4	55	9	0	0	Remove space between change and comma i.e. "change ," (Archis Ambulkar, Brinjac Engineering Inc.)	We removed all unnecessary spaces.
1435	62096	4	55	9	55	9	May need to add Bartomeus (Bartomeus et al. 2011. Climate-associated phenological advances in bee pollinators and bee-pollinated plants. PNAS) citation before comma (in clause about coping with climate change). (Elizabeth Wolkovich, University of British Columbia)	We added the reference.
1436	66519	4	55	9	55	9	Insert comma after 'environments' (Peter Burt, University of Greenwich)	We have no inserted a colon.
1437	66520	4	55	9	55	9	delete space after 'change' (Peter Burt, University of Greenwich)	We removed all unnecessary spaces.
1438	63395	4	55	10	55	10	that is (Suzanne leroy, brunel university)	Sentence has been changed.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1439	64758	4	55	14	55	14	Climate Regulation Services' may be a recently adopted concept in the scientific community but it is highly likely to be misunderstood to be an agency with the regulatory responsibility for greenhouse gas emissions. Suggest changing section title to "Ecosystem Services" (Robert Webb, NOAA OAR ESRL)	This is the phrase used by the science community - it would be a pity to introduce another one- but 'Moderation of the climate by ecosystems' will work.
1440	71240	4	55	16	55	19	Note that not all ecosystems behave this way. These benefits/services are generally recognized for treed landscapes.... The opposite effects would be features of a viable desert ecosystem, for example. (CANADA)	Actually, these local benefits are widely practiced in non-treed landscapes such as deserts. But the whole preamble has been radically shortened anyway.
1441	81827	4	55	16	55	22	Citations should be provided for these statements. (Katharine Mach, IPCC WGII TSU)	They have been so reduced that a citation is not needed.
1442	64878	4	55	26	55	26	"One study (authors...) suggests that the overall effect of tropical before station on global temperature is up to 75% greater than it would be expected...this assumption is based on one study. Consider removing or adding other references to substantiate this claim (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	It is only one study, and is balanced by the sentences immediately following.
1443	66521	4	55	30	55	30	Change 'indicates' to 'indicate' (Peter Burt, University of Greenwich)	Done
1444	61054	4	55	35	55	39	In relation to climate regulation services, it has been suggested that planting crops with high-albedo leaves could help regional cooling. In modelling this process this practice was found to be marginally beneficial at high latitudes but potentially damaging impacts at low latitudes. The range of leaf albedo in current crops is insufficient to make a meaningful difference. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The section has been reworded, hopefully to make it clear and easy to read.
1445	76685	4	55	37	55	37	change "have" with "has" (Claudio Cassardo, University of Torino)	Have' is gramatically correct in this case
1446	80378	4	55	42	56	8	Section 4.3.4.4: For statements such as "caused by increased variability in precipitation and decreased snow/ice storage" reference is currently made to WGII Ch3, but reference to the relevant WGI AR5 chapter should be added as well (and consistency should be checked). Similarly, the statement "caused by increased variability in precipitation and decreased snow/ice storage" needs to be backed up by reference to WGI AR5. (Gian-Kasper Plattner, IPCC WGI TSU)	This section on potable water supply has been removed as the issue is adequately addressed in Chapter 3.
1447	81828	4	55	44	55	44	A level of confidence may be more appropriate here as compared to a likelihood term. (Katharine Mach, IPCC WGII TSU)	This section on potable water supply has been removed as the issue is adequately addressed in Chapter 3.
1448	81829	4	55	49	55	50	A more specific cross-reference should be provided to the relevant section in chapter 3. Additionally, uncertainty language used here should reflect the terminology of chapter 3's key finding. (Katharine Mach, IPCC WGII TSU)	This section on potable water supply has been removed as the issue is adequately addressed in Chapter 3.
1449	61055	4	56	18	56	19	In the section on adaptation and its limits it is suggested that where species or ecosystems are unable to adapt autonomously there may be a role for human-assisted adaption as a supplementary approach. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, I think we make this clear - what point does the reviewer wish us to make?
1450	66522	4	56	18	56	24	Reference to glossary entry should appear on line 18, not line 24. (Peter Burt, University of Greenwich)	Corrected
1451	71241	4	56	24	0	44	Autonomous adaptation is not defined in the glossary; and it is not clear from this text how it is different from ecosystem resilience (or a component of resilience) defined in the context of complex system science (as opposed to traditional use of the word resilience to time to ecosystem recovery from disturbance). Would a box defining autonomous adaptation, human adaptation and socio-ecological resilience in the context of complex system science help to clear up use of the terminology? (CANADA)	It is defined in the glossary, under adaptation, as is resilience. But we don't want to be drawn into that definitional argument.
1452	59878	4	56	24	56	24	The term 'autonomous adaptation' doesn't currently appear in the glossary. There is a mix of adaptation terms used throughout the chapter e.g. 'management adaptation' and 'human-assisted adaptation'. It would be good to be consistent with these terms throughout the chapter. (AUSTRALIA)	We will strive to be consistent internally and with the glossary, which does contain autonomous adaptation under adaptation.
1453	81830	4	56	24	56	24	The phrase "autonomous adaptation" is not in the glossary and thus the glossary should not be referenced here. (Katharine Mach, IPCC WGII TSU)	It is in the FD version, and should remain there
1454	68217	4	56	27	0	0	replace "necessary for" by " part of" (Denis Loustau, INRA)	accepted

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1455	71242	4	56	33	56	35	Earlier in the chapter, some discussion referred to the tendency of tropical ecosystems to be relatively sensitive to small changes in climate because the interannual variability of present-day tropical climate (e.g., temperature range) is typically much lower than the variability of climates at higher latitudes. The statement here should perhaps be modified to recognize this, because tropical ecosystems have presumably also persisted for longer (even much longer) than, say, boreal ecosystems, which is why tropical systems tend to have greater biodiversity and more "stability". (CANADA)	This example is a big and long-unresolved topic, and is not central to our arguments, so we would prefer to sidestep it.
1456	62873	4	56	33	56	44	In Norberg et al. Nature Climate Science, the joint effects of evolution and dispersal are evaluated for responses to climate change in communities assembled along a climate gradient. The manuscript finds that evolution is necessary to prevent extinctions and that dispersal alone is incapable of preventing extinctions. This is relevant to the idea in this paragraph in terms of how population evolution can increase resilience of communities. cite: Norberg, J., Urban, M. C., Vellend, M., Klausmeier, C. A. & Loeuille, N. Eco-evolutionary responses of biodiversity to climate change. Nature Climate Change 2, 747-751 (2012). (Mark Urban, University of Connecticut)	The reference is relevant to 4.4.1.2
1457	72021	4	56	36	56	36	It is not clear how, if at all, autonomous adaptation differs from the more commonly used concept of adaptive capacity (AC). AC is used at least 5 times elsewhere in the section but the specific components are not defined in the context of autonomous adaptation. (UNITED STATES OF AMERICA)	The idea is similar, but not quite the same. We will strive to be consistent.
1458	59338	4	56	47	57	46	There are many duplications in the text. The most prominent concern phenology. The same data with, in some cases, different sources appear in chapters 4.3.2.1 and 4.4.1.1. (Anastasio Legakis, Department of Biology, University of Athens, Greece) (GREECE)	This section and 4.3.2.1 have been re-written to remove duplications.
1459	71243	4	57	2	57	2	Suggest replacing "it" with "that species" (CANADA)	We disagree, we think "it" is less clumsy and still clear.
1460	72022	4	57	2	57	31	These paragraphs mostly duplicate previous sections; combine their content with those, and drop them here. (UNITED STATES OF AMERICA)	This section and 4.3.2.1 have been re-written to remove duplications.
1461	66523	4	57	7	57	7	'Daylength' should be one word, remove hyphen. (Peter Burt, University of Greenwich)	Hyphen removed.
1462	62097	4	57	9	57	9	I would add 'many' to 'late succession trees' -- we do not know the cues for all late-succession trees. (Elizabeth Wolkovich, University of British Columbia)	many' added.
1463	61056	4	57	10	57	11	Models may not simulate temperature variations very well at some locations, so that their ability to project changes in these cues is limited or non-existent. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree, but this is not really the point here. Even if temperature trends can be projected forwards, their implications for phenology are complex. No change made.
1464	66524	4	57	13	57	13	Capital 'M' for 'Mountains'. (Peter Burt, University of Greenwich)	M' capitalized.
1465	59339	4	57	18	0	20	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	"that" changed to "those that".
1466	81831	4	57	18	57	20	The timeframe for this observation should be specified. (Katharine Mach, IPCC WGII TSU)	Timeframe included.
1467	71244	4	57	19	57	19	Suggest replacing "while that" with "while those that" (CANADA)	"that" changed to "those that".
1468	81832	4	57	21	57	21	It could be even clearer to specify which 2 decades are relevant here. (Katharine Mach, IPCC WGII TSU)	Specific dates included.
1469	56525	4	57	23	0	0	Change to "shown to be stronger..." (Archis Ambulkar, Brinjac Engineering Inc.)	Sentence removed to save space and because information was from before the AR4 report.
1470	59340	4	57	23	0	24	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence removed to save space and because information was from before the AR4 report.
1471	63396	4	57	23	57	23	to be stronger (Suzanne leroy, brunel university)	Sentence removed to save space and because information was from before the AR4 report.
1472	76686	4	57	23	57	23	typo: "to stronger" --> "to be stronger" (Claudio Cassardo, University of Torino)	Sentence removed to save space and because information was from before the AR4 report.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1473	71245	4	57	28	57	29	Also P. 58 L, 7-8. This seems to be axiomatic thinking for forest insect pests which are assumed to be able to adapt far faster than tree hosts (for example). One strategy is to produce large numbers of eggs/young with wide genetic variation, so that all climatic outcomes are covered and a rapid response to systematic change can be achieved. E.g., Volney, W.J.A., and Fleming, R.A. 2007. Spruce budworm ( <i>Choristoneura</i> spp.) biotype reactions to forest and climate characteristics. <i>Global Change Biol.</i> 13(8): 1630–1643. Schwartz, M.D., Ahas, R., and Aasa, A. 2006. Onset of spring starting earlier across the Northern Hemisphere. <i>Global Change Biol.</i> 12(2): 343–351. doi: 10.1111/j.1365-2486.2005.01097.x. (CANADA)	We have added a sentence on the strategy of laying eggs with a wide range of emergence dates, citing Volney et al as suggested.
1474	62874	4	57	33	57	33	Plasticity can also evolve. (Mark Urban, University of Connecticut)	This paragraph has been removed in shortening the text.
1475	66525	4	57	42	57	42	Meaning unclear: if you mean a particular class of substrate, please amplify the meaning of 'C'. If you mean 'carbon' please give this in full. (Peter Burt, University of Greenwich)	This paragraph has been removed in shortening the text.
1476	80083	4	57	51	0	0	Microbes are important ecosystem components for gene pools and ecosystem functioning, but are not mentioned at all? (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	Much of the work on evolutionary rescue has been done with micro-organisms. Field observations of rapid evolutionary response have focused on larger organisms.
1477	66526	4	57	51	57	51	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
1478	61057	4	58	1	58	1	Perhaps define, 'Epigenetics' in line for non-specialists. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Added to Glossary
1479	66527	4	58	11	58	11	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
1480	66528	4	58	15	58	15	Insert '(Strix aluco)' in italics after 'owl'. (Peter Burt, University of Greenwich)	Done
1481	62875	4	58	16	58	18	I would caution against using this study to show adaptation of breeding times. The methods used are statistical and indirect. The study never evaluated genetic variation in a trait, only that plasticity changed across latitude. Since other environmental factors could play a role in generating plasticity, the pattern is indicative but far from conclusive about a genetic origin. (Mark Urban, University of Connecticut)	The key to this study is that the very large data set allows the sorting out of the overall plastic response and a large effect of local adaptation. This strong local adaptation effect argues in favor of a strong genetic component to adaptation. Caveats for using observational data of this type are highlighted in the text.
1482	66529	4	58	17	58	17	Insert '(Rana temporaria)' in italics after 'frog'. (Peter Burt, University of Greenwich)	Done
1483	66530	4	58	20	58	20	Change 'a' to 'an'. (Peter Burt, University of Greenwich)	Done
1484	66531	4	58	25	58	25	Change 'weakness' to 'weaknesses'. (Peter Burt, University of Greenwich)	Done
1485	66532	4	58	25	58	25	Split infinitive: move 'clearly' to after demonstrate'. (Peter Burt, University of Greenwich)	Not done, "to significantly attenuate" is acceptable especially since it is not a compound split infinitive.
1486	62876	4	58	25	58	27	What is the methodological weakness of these studies? This seems strangely dismissive of rapid adaptation. Certainly many studies do not actually evaluate genetic determinants of traits, but then they cannot claim rapid adaptation. The work on rapid adaptation using experimental evolution or common garden experiments are not methodologically weak. (Mark Urban, University of Connecticut)	Several papers argue that very few studies meet strong criteria for demonstrating genetic adaptation to climate change. The specific requirements for a robust demonstration are discussed in the cited papers as well as critiques of the literature. There is insufficient space to discuss these in this chapter.
1487	64879	4	58	33	58	33	"...there is good evidence that environmental niches are conserved..." Good evidence is rather ambiguous. (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development)	"Good" removed
1488	59341	4	58	48	58	48	Extant instead of extent. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)	Not changed, it is "extent"
1489	62877	4	59	1	59	2	also there are really important interactions with community dynamics - Norberg, J., Urban, M. C., Vellend, M., Klausmeier, C. A. & Loeuille, N. Eco-evolutionary responses of biodiversity to climate change. <i>Nature Climate Change</i> , DOI: 10.1038/NCLIMATE1588 (2012) & Urban, M. C., De Meester, L., Vellend, M., Stoks, R. & Vanoverbeke, J. A crucial step toward realism: responses to climate change from an evolving metacommunity perspective. <i>Evolutionary Applications</i> 5, 154-167 (2012). (Mark Urban, University of Connecticut)	Norberg reference added

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1490	66533	4	59	4	59	4	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Peter Burt, University of Greenwich)	Done
1491	72023	4	59	4	59	35	This is written in old-fashioned paper-by-paper review article style -- shorten and express it in IPCC summary form. (UNITED STATES OF AMERICA)	Many people are not familiar with these issues so some background is needed. We have shorted this section and strived to improve readability, but there has been a lot of activity in this field since AR4.
1492	66534	4	59	6	59	6	Split infinitive: move 'significantly' to after 'change'. (Peter Burt, University of Greenwich)	See 1485
1493	68218	4	59	7	0	0	This statement is an hypothesis sold by mainly colleagues in genetics and tree genetic improvement and neither an observation nor a modelling results: the relative speed of change of climate and range shift is not compatible with the reproduction regime of most long lived organisms. It denies the observed fact that generation time of trees and even-aged forests (a large majority of temperate and boreal forests) is two to three orders of magnitudes longer than the actual climate change rate. One study reported by Jump et al is not a tree species the other is controversial (not really an adaptation but a narrowing of actual genetic diversity) since Fagus stands suffer of drought stress throughout the southern halve of its natural range in Europe (see Marru et al. in reference) where it is predicted to disappear by most climate envelop models. (Denis Loustau, INRA)	We have tempered this statement. However, we clearly stated that the capacity for adaptation by trees is quite small. Depending on pollen dispersal and management regime there does appear to be some potential for adaptation.
1494	56526	4	59	9	0	0	Term "rates" is used twice in sentence "modest rates of projected rates...", please edit (Archis Ambulkar, Brinjac Engineering Inc.)	Done
1495	61058	4	59	11	59	11	Which particular species of insect was studied? Can it be regarded as representative species? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	There are extremely few robust studies of genetic adaptation, so it is too early to be discussing representative species. We don't yet know how many species can adapt to this extent, and this is clearly stated in our conclusion.
1496	56527	4	59	14	0	0	Term "future" is used twice in sentence "future rates of future climate change...", please edit (Archis Ambulkar, Brinjac Engineering Inc.)	Done
1497	59342	4	59	17	0	0	should be ectotherms (not ecotherms) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence reworded
1498	66535	4	59	17	59	17	I think 'ectotherms' should be 'ectotherms'. (Peter Burt, University of Greenwich)	Sentence reworded
1499	66536	4	59	18	59	18	'per' should be in italics. (Peter Burt, University of Greenwich)	Not done
1500	61059	4	59	31	59	35	Discussion of phenotype plasticity is very technical and meanings are not clear. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have tried to simplify this sentence. It is complex, but the point is important.
1501	71246	4	59	34	59	34	Presumably plasticity with high fitness cost would also affect an organism in its present-day environment. So, as a general trait for increased survival is it not almost bound to be disadvantageous in any situation? (CANADA)	High plasticity, even when it has high costs, can be advantageous in highly variable environments.
1502	81833	4	59	37	59	37	A specific reference to the relevant chapter needs to be provided here, following the recommended citation format. (Katharine Mach, IPCC WGII TSU)	Done
1503	66537	4	60	3	60	3	Capital 'S' required for 'section' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Done
1504	71247	4	60	3	60	9	This is a nice brief summary of the problem. Suggest mentioning that all three factors that are listed could be overcome in the specific case of upward migration of species (and communities/ecosystems) in some mountainous regions. (CANADA)	Thank you. Text has been added about mountain ecosystems.
1505	72024	4	60	3	62	24	While it is unclear where it should be cited, authors may wish to consider referencing the following article in this section on species migrations and and human-assisted adaptation -- it discusses a novel approach to identifying connectivity for climate change using climate gradients: TRISTAN A. NUÍÁNEZ, JOSHUA J. LAWLER, BRAD H. MCRAE, D. JOHN PIERCE, MEADE B. KROSBY, DARREN M. KAVANAGH, PETER H. SINGLETON, AND JOSHUA J. TEWKSBURY. 2013. Connectivity Planning to Address Climate Change. Conservation Biology 27(2):407-416. (UNITED STATES OF AMERICA)	Thank you for the reference.
1506	72025	4	60	7	60	7	This kind of migration (all parts of the ecosystem, simultaneously moving at the same part) is clearly impossible but also an unnecessarily strict condition -- ecosystem interactions clearly can be maintained as composition changes. (UNITED STATES OF AMERICA)	Good point; we phrase it as a constraint rather than a prohibition.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1507	59343	4	60	12	62	24	This chapter could benefit from considerable improvement. Moreover some passages seem to have been written for a North American audience rather than an international one. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	It was not our intent to reflect a regional bias. We review the literature as we find it. We have contacted the author of the comment and received the statement that the comment is about the impression she got reading the whole 4.4.2. chapter. On her consecutive 4 comments she then was more specific, as there she refers "to those parts of chapter 4.4.2. that I consider quite problematic (and upon which my overall judgement for the chapter was mainly based)." Consequently we deal with the specific comments (numbers 1518, 1521, 1531, 1554).
1508	80084	4	60	14	0	0	I miss a focus on interactions between various ecosystems in a landscape, e.g. the terrestrial-aquatic boundary as a hotspot for biogeochemical processes in a landscape..! (Hans-Peter Grossart, Leibniz Institute of Freshwater Ecology and Inland Fisheries Berlin)	It is not clear that that issue belongs specifically in this section.
1509	81834	4	60	14	60	16	The phrases "human-assisted adaptation" and "planned adaptation" do not appear in the glossary, and thus the cross-reference here should be removed. (Katharine Mach, IPCC WGII TSU)	Actually they do appear in the FD glossary (see under adaptation, the WG3 contribution), but since we define them right there, the reference to the glossary has been removed.
1510	60397	4	60	14	60	26	There are quite a few studies, which may be of interest, that look at the use of urban trees to provide shade, increase evaporative cooling, reduce gusts and the effects of small-scale flooding events (e.g. Lisbon: Oliveira et al 2011; Paris: Lion et al 2009; London: Boehnenstengel et al 2011; Freiburg: Streiling & Matzarakis 2003; Chania: Georgi & Dimitrou 2010). (Edward Pope, Met Office)	These would be better assessed in the chapter on urban environments
1511	56528	4	60	15	0	0	Change term to "socio-ecological" (Archis Ambulkar, Brinjac Engineering Inc.)	Socio-ecological is the phrase preferred by this research community
1512	56529	4	60	16	0	0	Add a full stop after sentence - "of climate change (see glossary)." (Archis Ambulkar, Brinjac Engineering Inc.)	Done.
1513	66538	4	60	17	60	17	Capital 'C' required for 'chapters' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Done.
1514	67853	4	60	21	0	24	This sentence "Ecosystem-based Adaptation" provides an option that integrates the use of biodiversity and ecosystem services into climate change adaptation strategies in ways that can optimize co-benefits for local communities and carbon management, as well as reduce the risks associated with possible maladaptation (see Box CC-EA)" is a very important message for policy-makers and we strongly recommend this be included in the SPM and TS as it is critical information for informed policy making decisions. (JAPAN)	Thanks for the support. Some ecosystem-based adaptation message have been carried up to the ES and SPM.
1515	61060	4	60	21	64	15	Policy relevance Sections, 4.4.2 on 'Human assisted adaptation', 4.4.3 'Consequences and costs of inactions and benefits of action' and 4.4.4 'Unintended consequences of adaptation and mitigation in this and other sectors.' (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We are unable to understand the comment. What is it we are intended to do?
1516	56530	4	60	25	0	0	Change to "all forms of human-assisted..." (Archis Ambulkar, Brinjac Engineering Inc.)	done
1517	72026	4	60	29	60	37	"Ecosystem-based Adaptation" is defined in a vague way that does not point to the focus on using ecosystems to help society adapt. As currently written, the text is focused on resilience for ecosystems rather than resilience for people through the use of ecosystems. Suggest referencing the chapter cross-cutting box on Ecosystem-based Adaptation, which more clearly makes the link to using ecosystems to build resilience for society. (UNITED STATES OF AMERICA)	We do cross reference it, and don't define it here - we just state what its outcome intends to be. There is a CC-EA box that defines and expands on the concept.
1518	59344	4	60	36	0	37	It would be better if we were told which are these protective and restorative actions aimed at increasing resilience that are included under 'ecosystem-based adaptation' instead of having only a term introduced. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	There is a cross-chapter box on Ecosystem-based adaptation (Box CC-EA) which includes details. We reference it.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1519	63500	4	60	36	60	37	The text states "Ecosystem-based-adaptation is the phrase increasingly used to cover a package of protective and restorative actions aimed at increasing resilience." The term "ecosystem-based-adaptation" is more commonly used to describe a strategy of using ecosystems and their services for societal adaptation (see chapter 8.3) than as a strategy for adaptation of natural systems since "ecosystem-based-adaptation" is defined as: "Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change." (CBD Technical series 41, page 41). Nevertheless, "Ecosystem-based adaptation, which integrates the sustainable use of biodiversity and ecosystem services into an overall adaptation strategy can be cost-effective and generate social, economic and cultural co-benefits and contribute to the conservation of biodiversity" (CBD Technical series 41, page 41). Therefore, in the context of this chapter it is suggested to rephrase the existing sentence so it would read: "Protective and restorative actions aimed at increasing resilience can also be cost-effective means as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change and may also lead to social, economic and cultural co-benefits. This is known as "ecosystem-based adaptation" (Ells et al. 2009, CBD 2009). (GERMANY)	We now oly wrote: "This is part of "ecosystem-based adaptation" (Colls et al., 2009; Box CC-EA )." But as you can see, there is a cross-chapter box on Ecosystem-based adaptation which includes details (Box CC-EA), to which we reference .
1520	65134	4	60	36	60	37	This sentence would be better in the previous section e.g. Line 24 (Pam Berry, Oxford)	We have changed it to be more relevant to this paragraph.
1521	59345	4	60	40	61	3	The issue of protected areas and how efficiently they are able to conserve biodiversity under climate change - thus serving the goal for which they were created - is very important meriting more attention. Also, recommendations could be given as of how to proceed so as to be able to face the current inadequacies in our understanding and limited forecasting ability. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thank you for the comment. We also think it important, but are under space constraints to be brief and only develop what is new since AR4
1522	72027	4	60	40	61	3	(Section on size, location and layout of protected areas): The broader point that needs to me made is that the definition of "critical habitat" in a non-climate change world is inadequate for a world facing climate change. The definition, as utilized by governments, multilateral development banks, and others, needs to be broadened to allow for shifts in range, connectivity, the need for increased habitat redundancy and other factors. Authors may wish to include this point up front, and in the executive summary of the report. (UNITED STATES OF AMERICA)	This is an important point, but for us to make it explicitly it would need to be based on assessed literature. It is implicit in the paragraph as written.
1523	59879	4	60	42	61	3	Suggest including reference to Dunlop, M., D.W. Hilbert, S. Ferrier, A. House, A. Liedloff, S.M. Prober, A. Smyth, T.G. Martin, T. Harwood, K.J. Williams, C. Fletcher, H. Murphy, 2012: Implications of climate change for Biodiversity Conservation and the National Reserve System: Final synthesis. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities, and the Department of Climate Change and Energy Efficiency. CSIRO Climate Adaptation Flagship, Canberra 80pp. Suggest adding the following text, referring to the above document, "In Australia the implications of climate change for biodiversity conservation and the National Reserve system were assessed (Dunlop et al., 2012) and the spatial variations in biodiversity in Australia's landscapes and in climate change were found to provide many opportunities to facilitate the natural adaptation of biodiversity through ecological and evolutionary processes. These include expanding the network of protected areas to accommodate significant ecological changes, and developing methods for large-scale habitat restoration, especially in heavily cleared landscapes (Dunlop et al., 2012). The Australian Government has funded and is implementing significant national initiatives including Caring for our Country, the Biodiversity Fund and the National Wildlife Corridors Plan which protect, extend and restore habitats and protected areas." (AUSTRALIA)	Thank you for the fererence, which we have used, along with text based on your suggestion.
1524	72028	4	60	42	61	3	This paragraph (and admittedly, most of the modelling that it summarizes) is based on the assumption that species survive only in the protected areas. This is clearly untrue and contradicts the recent conservation biology emphasis on agroecosystems, the "quality of the matrix", private-lands management, etc. Authors may want to include this concept in this section. (UNITED STATES OF AMERICA)	That certainly is not our intention or belief, but this section is specifically about protected areas. We have added toext to make that clear.
1525	76864	4	60	49	4	49	Section 4.4.2.2: reference for this statement that current protected areas will have utility to for previously absent species: Thomas, C. D., Gillingham, P. K., Bradbury, R. B., Roy, D. B., Anderson, B. J., Baxter, J. M., Bourn, N. A. D., Crick, H. Q. P., Findon, R. A., Fox, R., Hodgson, J. A., Holt, A. R., Morecroft, M. D., O'Hanlon, N. J., Oliver, T. H., Pearce-Higgins, J. W., Procter, D. A., Thomas, J. A., Walker, K. J., Walmsley, C. A., Wilson, R. J. & Hill, J. K. (2012) Protected areas facilitate species' range expansions. Proceedings of the National Academy of Sciences, 109, 14063-14068. (Tom Oliver, Centre for Ecology and Hydrology)	We have used it, thank you
1526	81835	4	60	49	60	51	For what scenarios of climate change does this projection hold? (Katharine Mach, IPCC WGII TSU)	Sorry, we have not been able to check this in time to put it into the text, we infer it is for A2-type scenarious.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1527	56531	4	60	50	0	0	Term "and concluded that" repeated twice in the sentence, please edit. (Archis Ambulkar, Brinjac Engineering Inc.)	Removed
1528	66539	4	60	50	60	50	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Done
1529	71248	4	60	50	60	50	Suggest deleting first "and concluded that" (CANADA)	done
1530	71249	4	61	1	61	1	Suggest deleting ";" (CANADA)	done
1531	59346	4	61	6	0	24	The section about 'Landscape and Watershed Management' deals only with US and Canada. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	We agree. New references were added to the section.
1532	57466	4	61	6	61	24	Rapid development in lowland deltas makes more vulnerability by flooding. Myat et al. (A comparison of historical land-use change patterns and recommendations for flood plain developments in three delta regions in Southeast Asia, Water International, Vol.37, No.3, pp.218-235, 2012) observed three deltas with different delta changing from forest to urban area. So that, landuse control is needed for safe development. Also some delta areas in Cambodia and Myammer use inundation water for planting of rice. Urbanazation of the delta makes the sustainable agricultural system disappear and the flood risk increase. (Kazama et al., Evaluation of flood control and inundation conservation in Cambodia using flood and economic growth models, Hydrological Processes, Vol.23, No.4, pp.623-632, 2009.) Kang et al.(An ecological assessment of a dammed pool formed by a slit dam, International Journal of River Basin Management, Vol.10, No.4, pp.331-340, 2012.) pays attention to frashed flood protection and ecosystem harmony using slit dams. This is one of adaptations for climate change. (So Kazama, Tohoku University)	This chapter focusses on human-assisted adaptation rather than vulnerabilities; and principles have been summarized. Due to limited space we could not mention too many case studies.
1533	76865	4	61	6	61	24	Section 4.4.2.3: This section seems to be missing key principles for landscape management to adapt to climate change. E.g. Increase habitat heterogeneity of sites and connectivity of habitats across landscapes : Key Reference: Heller, N. E. & Zavaleta, E. S. (2009) Biodiversity management in the face of climate change: a review of 22 years of recommendations. Biological Conservation, 142, 14-32. . Also it might be worthwhile considering how climate change adaptation can be integrated into previous landscape-scale biodeiversity conservation: Oliver, T. H., Smithers, R. J., Bailey, S., Walmsley, C. A. & Watts, K. (2012) A decision framework for considering climate change adaptation in biodiversity conservation. Journal of Applied Ecology, 49, 1247-1255. (Tom Oliver, Centre for Ecology and Hydrology)	These aspects and references have been included.
1534	71250	4	61	6	62	5	How about managing forests to decrease fire disturbance risks at wildland-urban interfaces? Notably, manipulation of vegetation composition and stand structure has been proposed as a strategy for offsetting climatic change impacts on wildfires in Canada. Considerable portions of boreal forests are currently being harvested and there may be opportunities for using planned manipulation of vegetation for management of future wildfire risks. The concept has a long history, and its potential effect has been demonstrated through model simulation experiments and recently found empirical support in the analysis of paleoecological data (Girardin et al. 2013). Interestingly, this management option could also provide an additional benefit to the use of assisted species migration as it would require introducing non-flammable broadleaves species into forests which are otherwise flammable needle leaves. See these two recent papers: Terrier, A., Girardin, M.P., Périé, C., Legendre, P., Bergeron, Y. 2013. Potential changes in forest composition could reduce impacts of climate change on boreal wildfires, Ecological Applications 23: 21-35. Girardin, M.P., Ali, A.A., Carcaillet, C., Blarquez, O., Hély, C., Terrier, A., Genries, G., Bergeron, Y. In press. Vegetation limits the impact of a warm climate on boreal wildfires. New Phytologist ( <a href="http://www.cef-cfr.ca/uploads/Membres/girardin-new-phytol.pdf">http://www.cef-cfr.ca/uploads/Membres/girardin-new-phytol.pdf</a> ) . The following paper in Forest Ecology and Management also provide options for adapting to high fire risks under climate change, mostly for timber harvesting and sustainable management: Girardin, M.P., Ali, A.A., Carcaillet, C., Gauthier, S., Hély, C., Le Goff, H., Terrier, A., Bergeron, Y. . 2013. Fire in managed forests of eastern Canada: Risks and options, Forest Ecology and Management, Special Issues on Mega Fires Vol 294: 238-249. (CANADA)	Fire risk management was included following the suggestions.
1535	61061	4	61	8	61	8	I think this section (4.4.2.3 Landscape and Watershed management) could do with an introductory sentence/paragraph into what landscape/watershed management is- and the identified underlying values of such an approach before introducing specific cases. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We tried to implement this suggestion and added some more general aspects.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1536	64880	4	61	8	61	24	Section 4.4.2.3 landscapes and watershed management is centering on North American habitats and management options in North American ecosystems. Is it possible to branch out or brought in this perspective on landscape and watershed management to other areas ? (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	The text was changed and includes other geographical areas.
1537	66540	4	61	9	61	9	Delete comma and put '2009' in brackets. (Peter Burt, University of Greenwich)	Citations were now treated consistently throughout the chapter.
1538	72029	4	61	19	61	24	Suggest deleting this paragraph as it refers only to a single model of a single region. (UNITED STATES OF AMERICA)	The text was re-written, implementing this comment.
1539	56532	4	61	20	0	0	There appears successive comma and full stop in the sentence - "LANDIS-II, (xxx)." Please edit (Archis Ambulkar, Brinjac Engineering Inc.)	We have tried our best to improve English style.
1540	71251	4	61	20	61	22	Something is missing in this explanation. Most likely this could be addressed by inserting the word "varying" or "altering" or "adjusting" before "three" on L. 20. (CANADA)	The text was changed accordingly.
1541	57915	4	61	27	61	27	Suggest add an example showing agricultural activities could reduce the positive effect of global warming on some pests. Human activities may mediate the effect of global warming on species. Yan et al. (2012) found increase of irrigation area in North China Plain offset the positive effect of global warming on winter reproduction and abundance of a hamster species in winter, causing continued decline of the population during past 2 decades. Yan C, L. Xu, T. Xu, X. Cao, F. Wang, S. Wang, S. Hao, H. Yang and Z. Zhang. 2012. Agricultural irrigation mediates climatic effects and density dependence in population dynamics of Chinese striped hamster in North China Plain. Journal of Animal Ecology 2:1365-2656. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	Thank you, we used the citation
1542	64802	4	61	27	62	5	Assisted migration is has been proposed and is being used for commercial conifer tree reforestation in western North America. Local provences have a much arrower climate ranges than the species as a whole. Aitken, S.N., S. Yeaman, J.A. Holliday, T. Wang, and S. Curtis-McLane. 2008. Adaptation, migration or extirpation: Climate change outcomes for tree populations. Evol. Appl. 1:95-111. BC has made adjustments to seed transfer policy to begin adapting to climate change <a href="http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/3cbst_project.htm">http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/3cbst_project.htm</a> Rehfeldt, G.E., and B.C. Jaquish. 2010. Ecological impacts and management strategies for western larch in the face of climate-change. Mitig. Adapt. Strateg. Glob. Change 15:283-306. (Dave Spittlehouse, BC Ministry Forests, Lands and Natural Resource Operations)	Thanks you, we have added these citations.
1543	56533	4	61	30	61	31	There appears successive comma and full stop in the sentence - "climate change, (xxx)." Please edit (Archis Ambulkar, Brinjac Engineering Inc.)	Fixed.
1544	72030	4	61	34	61	37	Suggest another formulation of the sentence for accuracy and clarity, such as "there is low agreement in the scientific community about when it is appropriate to increase the resilience of ecosystems to climate change" (UNITED STATES OF AMERICA)	I shortened and restructerd the sentence.
1545	70375	4	61	37	61	37	Citing Richardson et al. (2009) would provide published support for this point (Richardson, D.M., J.J. Hellmann, J.S. McLachlan, D.F. Sax, M.W. Schwartz, P. Gonzalez, E.J. Brennan, A. Camacho, T.L. Root, O.E. Sala, S.H. Schneider, D.M. Ashe, J.R. Clark, R. Early, J.R. Etterson, E.D. Fielder, J.L. Gill, B.A. Minter, S. Polasky, H.D. Safford, A.R. Thompson, and M. Vellend. 2009. Multidimensional evaluation of managed relocation. Proceedings of the National Academy of Sciences of the USA 106: 9721-9724.) (Patrick Gonzalez, National Park Service)	Thank you, I used it.
1546	64759	4	61	39	61	39	Why is 'maintaining or improving migration corridors or ecological networks' only considered a 'low-regrets strategy' rather than a 'no-regrets strategy'. Change to 'no-regrets' (Robert Webb, NOAA OAR ESRL)	The sentence which follows two sentences later provides a few circumstances where there might be regrets, so although 'no regrets' is the commonly used term, it would be a bit od if we then went on to describe regrets!
1547	56534	4	61	44	61	45	Change to "species, rather it may decrease..." (Archis Ambulkar, Brinjac Engineering Inc.)	No, those are not contrasts but separate points.
1548	71252	4	61	48	62	2	Some potentially useful sources of information that could be included here are: Ste-Marie, C; Nelson, EA; et al. 2011. Assisted migration: Introduction to a multifaceted concept. Forestry Chronicle 86(6): 724-730; Aubin, I; Garbe, CM; et al. 2011. Why we disagree about assisted migration: Ethical implications of a key debate regarding the future of Canada's forests. Forestry Chronicle 86(6): 755-765; Winder, R; Nelson, EA; Beardmore, T. 2011. Ecological implications for assisted migration in Canadian forests. Forestry Chronicle 86(6): 731-744; (CANADA)	Thanks! We used them.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1549	71253	4	61	48	66	35	Active management may also include translocation of genetically distinct populations within the current range of a species. There may be less disagreement among scientists about this, when used taking a risk management approach, than moving species to locations where they have no history. This may be particularly the case in movement of tree population in forestry. So the issue of translocation may be a matter of degrees. Please refer to Pedlar et al. 2012 Bioscience 62(9), 835-842 as well as Aitken et. al publications. (CANADA)	I adjusted the text to include this detail, and used the reference
1550	66541	4	61	50	61	50	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Done
1551	59347	4	62	2	0	3	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Fixed.
1552	71254	4	62	2	62	2	Delete second occurrence of "could" (CANADA)	Fixed.
1553	56535	4	62	2	62	3	Sentence appears incomplete - probably remove second "that" from the sentence. (Archis Ambulkar, Brinjac Engineering Inc.)	Fixed.
1554	59348	4	62	8	0	24	As for in situ conservation (protected areas), the issue of ex situ conservation could have been more adequately discussed; also, a greater variety of examples would be desirable. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Thank you for the advice; we are under severe length restrictions.
1555	58365	4	62	19	6	19	Cryogenic saving of a maximum of Earth biodiversity is gaining support (Clarke, 2009, Lermen et al., 2009, Rawson et al., 2011). There is the Frozen Ark ( <a href="http://www.frozenark.org">www.frozenark.org</a> ), a reunion of 23 institutions aims to cryopreserve threatened species, and the Global Genome Initiative ( <a href="http://ggi.si.edu">ggi.si.edu</a> ) and the Global Genome Biodiversity Network ( <a href="http://ggbn.org">ggbn.org</a> ) with 9.3 million samples. Clarke AG, 2009, The Frozen Ark Project: the role of zoos and aquariums in preserving the genetic material of threatened animals. Int Zoo Yearbook, 43, 222-230. Lermen D et al., 2009, Cryobanking of viable biomaterials: implementation of new strategies for conservation purposes. Mol Ecol, 18, 1030-1033. Rawson DM, Reid GM, Llyod RE, 2011, Conservation rationale, research applications and techniques in the cryopreservation of lower vertebrate biodiversity from marine and freshwater environments. Int Zoo Yearbook, 45, 108-123 (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We do note this approach, and will add some of the references you cite.
1556	61062	4	62	23	62	24	Is there an appropriate example of a species reintroduction to the wild from ex-situ breeding? Such as the reintroduction of beavers into Scotland? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	There are a few such examples (and quite a lot of failures), but it seems a bit of a digression in an assessment of climate change that is already very long.
1557	66542	4	62	23	62	24	'ex-situ' should be in italics. (Peter Burt, University of Greenwich)	Agreed, and done.
1558	81836	4	62	27	0	0	Section 4.4.3. The chapter team should shorten and focus this section as much as possible, maintaining clear focus on climate change and ecosystems. (Katharine Mach, IPCC WGII TSU)	The section has been substantially modified. Now it focusses on a) reviewing the results of previous exercises of cost assessment and b) discussing trade-offs in ES provision triggered by actions in response to climate-change.
1559	72031	4	62	27	63	9	This section is extremely weak. While it is difficult to address the costs of inaction and benefits of action, this section requires a more complete survey to accurately reflect these issues. (UNITED STATES OF AMERICA)	The section has been substantially modified. Now it focusses on a) reviewing the results of previous exercises of cost assessment and b) discussing trade-offs in ES provision triggered by actions in response to climate-change.
1560	72032	4	62	27	64	15	Sections 4.4.3 and 4.4.4 lack "confidence" statements, which should be added. This is particularly important for section 4.4.3, whose style makes it appear to be simply the opinion of a single author. For this section, reworking of the text so as to express the consensus of the scientific community (or lack of it) is necessary as well. (UNITED STATES OF AMERICA)	The section has been substantially modified. Now it focusses on a) reviewing the results of previous exercises of cost assessment and b) discussing trade-offs in ES provision triggered by actions in response to climate-change. Section 4.4.3. is (and always was) the outcome of work of several authors within the working team. Thus, within the constraints of a limited text length, it should (at least now) reflect the views of a (a large part of) the community. Many of the references are themselves reviews.
1561	56536	4	62	29	0	0	Change to "will plausibly lead to..." (Archis Ambulkar, Brinjac Engineering Inc.)	Agreed and text modified along this recommendation.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1562	59349	4	62	29	0	30	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Agreed. Several language mistakes have been corrected. The writing of some paragraphs has been substantially modified.
1563	76866	4	62	29	62	31	Under this definition all the above actions in Section 4.4.2 would be 'mitigation'- reducing damages from climate change. Is the terminology of adaptation and mitigation costs necessary here? It is problematic as both these costs (and actions in 4.4.2) would normally fall under the more recognised IPCC term of 'climate change adaptation', with 'climate change mitigation' being reserved for actions to reduce CO2 emissions. (Tom Oliver, Centre for Ecology and Hydrology)	Agreed. The paragraph including the definitions has been substantially modified, clarifying the link between the terms 'damage', 'mitigation' and 'adaptation' and ecosystem change / management.
1564	72033	4	62	32	62	33	The sentence beginning "The timing of the action" seems to be missing one or more words. (UNITED STATES OF AMERICA)	This sentence has been deleted.
1565	56537	4	62	33	0	0	A word appears to be missing in the sentence - "increasing costs that result from xxxx must be..." (Archis Ambulkar, Brinjac Engineering Inc.)	This sentence has been deleted.
1566	63501	4	62	33	0	0	Comment: a word is missing after "increasing costs that result from...".. Please check the original publication for supplement. (GERMANY)	This sentence has been deleted.
1567	71255	4	62	33	62	33	It appears that something is missing here. "increasing costs that result from XXXX must be weighed against the risks..." (CANADA)	This sentence has been deleted.
1568	59350	4	62	34	0	35	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Agreed. Several language mistakes have been corrected. The writing of some paragraphs has been substantially modified.
1569	58662	4	62	34	62	38	I think the expression of "afforestation for climate mitigation is costly in terms water provision" is not reflecting the key message in the reference cited. Through the studies in the specific cases in South Africa, the author of the reference cited thinks afforestation appears viable to the forestry industry under current water tariffs and current carbon accounting legislation, but would appear unviable if the forestry industry were to pay the true cost of water used by the plantations. I suggest revising the original expression. (chunfeng wang, State Forestry Administration, China)	The reviewers are right in their identification of the main result in the referenced paper. However, we understood that the key message of the reference is also compatible with the statement in the text as the title of the cited paper is: 'Trade-offs between ecosystem services: Water and carbon in a biodiversity hotspot'. Moreover, in the abstract, the author indicates: "economic incentives for carbon sequestration may encourage the expansion of Pinus radiata timber plantations in the Fynbos biome of South Africa, with negative consequences for water supply and biodiversity". Therefore we understand that this is also a key message of the paper.'
1570	56538	4	62	35	0	0	Should it be "in terms of water provision" (Archis Ambulkar, Brinjac Engineering Inc.)	Agreed and modified accordingly.
1571	72034	4	62	35	0	0	Suggest changing the word "is" to "may be" for accuracy. (UNITED STATES OF AMERICA)	We have adjusted this; the references demonstrate cost of measures in terms of water provision.
1572	76687	4	62	35	62	35	typo: "terms water" --> "terms of water" (Claudio Cassardo, University of Torino)	Agreed and modified accordingly.
1573	72035	4	62	37	0	0	Suggest changing "but due" to "but often due" for accuracy. (UNITED STATES OF AMERICA)	Agreed and modified into: "but due to the typically lower per hectare yields".
1574	66543	4	62	37	62	37	'per' should be in italics. (Peter Burt, University of Greenwich)	Sorry, me missed this twice in the last stage of writing, but hope it will still be corrected during the final editing.
1575	56539	4	62	40	0	0	Should word "ten" before Brink et.al. be deleted or replaced. (Archis Ambulkar, Brinjac Engineering Inc.)	As it is part of the surname, this word should stay there.
1576	59351	4	62	40	0	42	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Agreed. Several language mistakes have been corrected. The writing of some paragraphs has been substantially modified.
1577	76688	4	62	40	62	40	typo: remove "ten" at the bottom (Claudio Cassardo, University of Torino)	As it is part of the surname, this word should stay there.
1578	81837	4	62	41	62	41	It would be helpful to clarify what the "2010 biodiversity goals" are. (Katharine Mach, IPCC WGII TSU)	The 2010 biodiversity goals, related to a significant reduction of the current rates of biodiversity loss at the global, regional and national levels are relatively well known and have not been included due to constraints in the text length.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1579	71256	4	62	41	62	44	Is the study of ten Brink et al. (2008) global or is it focused on Europe? Would be good to have the "14 trillion Euro in 2050" amount made clear. Also, could it be placed in context with estimates of mitigation costs? (CANADA)	The study of ten Brink et al. (2008) has a global scope. Other references related to costs of action and inaction have been added. For the 'amount made clear' we are sorry to say that we failed to provide details.
1580	81838	4	62	43	62	43	Where €14 trillion are described here, it would be preferable to present the range/uncertainties for the estimate. (Katharine Mach, IPCC WGII TSU)	You are right, but unfortunately we failed to provide this.
1581	66544	4	62	48	62	48	'via' should be in italics (Peter Burt, University of Greenwich)	The sentence has been deleted.
1582	64881	4	62	51	62	51	The market price for carbon is volatile, link to speculation and political agreements on emissions reductions. The statement is ambiguous and the market price for carbon is "volatile" (with respect to what, or compared to what?) (Dan F. Orcherton, PACE-Pacific Centre for Environment and Sustainable Development )	The sentence has been deleted.
1583	72036	4	62	52	0	0	Suggest including clarification: range of 23 (1995) to 371 (2007) dollars per metric ton: how much of this difference is inflation vs. price rise? (UNITED STATES OF AMERICA)	The sentence has been deleted.
1584	71257	4	62	52	62	52	Convert costs to current dollars. Estimates of carbon costs from compliance markets could be included. (CANADA)	The sentence has been deleted.
1585	65139	4	63	0	0	0	There is the review of how mitigation and adaptation actions in other sectors impact on biodiversity. See either Paterson, J.S., Araújo, M.B., Berry, P.M., Piper, J.M., and Rounsevell, M.D.A.R. (2008) Mitigation, adaptation and the threat to biodiversity. Conservation Biology, 22, 1352-1355. or Berry, P.M. (ed.) (2009) Biodiversity in the Balance – Mitigation and Adaptation Conflicts and Synergies. Pensoft (Pam Berry, Oxford)	Thank you - Paterson et al (2008) provides important information on this topic, so we have cited it.
1586	58663	4	63	1	63	1	REDD+ is the unified expression used widely in UNFCCC process, please revise it throughout the chapter and relevant chapters in this assessment report. (chunfeng wang, State Forestry Administration, China)	The sentence has been deleted.
1587	72037	4	63	1	63	2	This sentence incorrectly describes existing REDD programs, which mostly are not based on carbon-offset trading but rather on fund-based, non-offset payments. This is the case with the two that are the largest by far, in terms of money paid out (Norway's with Brazil and with Guyana) and also with most of the others being developed in large tropical forest countries. It is false to say that REDD relies "on the premises on which market-based payments for ecosystem services (PES) are founded." (UNITED STATES OF AMERICA)	The sentence has been deleted.
1588	81839	4	63	12	0	0	Section 4.4.4. This section should be shortened, for example by tightening paragraphs 3 and 4 on lines 25-38. (Katharine Mach, IPCC WGII TSU)	The Section has been shortened.
1589	71563	4	63	12	64	15	Section 4.4.4 could benefit either from examples from, or simply reference to, Paterson et al (2008) Mitigation, adaptation and the threat to biodiversity. Conservation Biology, 22, 1352; and Turner et al (2010) Climate change: helping nature survive the human response. Conservation Letters, 3, 304. (David Hole, Conservation International)	Thank you - both Paterson et al (2008) and Turner et al (2010) provide important information on this topic, so we have cited them.
1590	72038	4	63	12	64	15	Authors may wish to consider adding the 'accounting error' issue associated with biofuels that Searchinger has been emphasizing here. Governments are treating biomass energy as carbon neutral, when in fact if natural systems are converted to produce that biomass then it cannot be considered carbon neutral. (UNITED STATES OF AMERICA)	That issue is out of scope of this chapter - the mitigation potential of bioenergy is discussed in Chapter 11 of the Working Group 3 volume, and we do not have the space to cover it here as well.
1591	72039	4	63	12	64	15	The following reference is relevant for this section on the unintended consequences of adaptation and mitigation actions: Climate change: helping nature survive the human response Will R. Turner <sup>1</sup> , Bethany A. Bradley <sup>2</sup> , Lyndon D. Estes <sup>3</sup> , David G. Hole <sup>1</sup> , Michael Oppenheimer <sup>4</sup> , & David S. Wilcove <sup>5</sup> Conservation Letters 3 (2010) 304 From the abstract: "Human history and recent studies suggest that our actions to cope with climate change (adaptation) or lessen its rate and magnitude (mitigation) could have impacts that match and even exceed the direct effects of climate change on ecosystems." (UNITED STATES OF AMERICA)	Thank you - Turner et al (2010) provides important information on this topic, so we have cited it.
1592	72041	4	63	16	0	0	Bioenergy can also occur at small scale without affecting ag or natural resources. Authors may consider changing 'Bio-energy' to 'Large-scale bioenergy' (UNITED STATES OF AMERICA)	"large-scale" added early in the section.
1593	72040	4	63	16	63	17	There are other sources of land for bioenergy. The most important are lands that were previously cleared and later abandoned, which are quite extensive. There is also the possibility of using agricultural lands which produce protein and calories very inefficiently -- e.g. much of the world's pasture land. (UNITED STATES OF AMERICA)	This has been mentioned, citing McAlpine et al (2009). Arguments against this have also been mentioned.

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1594	76689	4	63	16	64	15	I do not understand which are the conclusions of this section (4.4.4) an in general of whole section 4.4. (Claudio Cassardo, University of Torino)	The text has been revised to clarify this better. The final paragraph of Section 4.4.4 in the SOD has been removed as it is not really in the scope of the chapter - this may have been part of the source of confusion here. Section 4.4.4 is one sub-section and does not include conclusions from the rest of section 4.4
1595	76814	4	63	25	63	30	Yes - I think this is an important discussion. IAMs that created the RCPs such as 2.6 make assumptions around future changes (increases) in crop yields, but this is one particularly uncertain model parameter. If these future increases in yield don't happen then future demand for agricultural land for food production increases massively. See e.g. Thomson et al (2008, PNAS). (Chris Jones, Met Office)	Thank you for the supportive comment. The points made here do not seem to warrant any changes, so none have been made.
1596	66545	4	63	26	63	26	Text missing: I think you need 'are estimated' or 'will' after 'crops'. (Peter Burt, University of Greenwich)	We have inserted "are projected to".
1597	68177	4	63	35	63	38	These sentences do not represent contemporary science. The source of carbon in a reservoir is not exclusively from the vegetation (Tranvik et al, 2009). Much of the inundated carbon stock is not released to the atmosphere. Some dams may also serve as GHG sinks, e.g., in Lao PDR. These statement represent unbalanced reporting and outdated science. (International Hydropower Association (IHA))	This topic is covered in more detail in the Working Group III report, Chapter 7 Section 7.8.1, so we have shortened our discussion here and referred the reader to WGIII.
1598	72042	4	63	35	63	38	Flooding of vegetation: would this not be a short-term flush of CH4? If so, this should be mentioned. (UNITED STATES OF AMERICA)	This topic is covered in more detail in the Working Group III report, Chapter 7 Section 7.8.1, so we have shortened our discussion here and referred the reader to WGIII.
1599	59352	4	63	36	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence removed in shortening the text - this topic is covered by WGIII Chapter 7 Section 7.8.1
1600	66546	4	63	36	63	36	Subscript '4' required. (Peter Burt, University of Greenwich)	4' changed to subscript.
1601	68080	4	63	38	63	38	The conclusion that "so dams may act as sources of greenhouse gas emissions" is not accurate enough. It is suggested to make the following changes: 1. The following words be added after Line 37. "However, after some periods of damming of the river, a lot of aquatic vegetations growing in the reservoir will absorb DIC of water and deposit in POC(Forbes M. G., Doyle R.D., Scott J. T., et al. 2010. Carbon sink to source: longitudinal gradients of planktonic P: R ratios in subtropical reservoirs. Biogeochemistry. DOI 10.1007/s10533-010- 9533-3.), especially in agriculture areas (Downing J. A., Cole J. J., Middelburg J. J. etal. 2008. Sediment organic carbon burial in agriculturally eutrophic impoundments over the last century. Global Biogeochem. Cycl. 22. doi: 10.1029/2006GB002854.)". 2. "so dams may act as sources of greenhouse gas emissions" be changed to "So dams may lead to sink of greenhouse gas CO2 sequestering, while large dams may act as sources of greenhouse gas CH4 emissions". (CHINA)	This topic is covered in more detail in the Working Group III report, Chapter 7 Section 7.8.1, so we have shortened our discussion here and referred the reader to WGIII.
1602	59353	4	63	41	0	44	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Sentence revised.
1603	66548	4	63	42	63	43	per' should be in italics. (Peter Burt, University of Greenwich)	per' italicized.
1604	66547	4	63	43	63	43	Poor English: delete comma and 'although' . (Peter Burt, University of Greenwich)	Replaced ", although" with ". However,"
1605	71258	4	63	43	63	43	Suggest changing "and while" to "while" (CANADA)	removed "and" as suggested.
1606	78668	4	63	48	63	54	I would like to repeat my comment from the FOD, because I suspect an error in the reference paper : I did not find this effect in the SRREN, and have some doubts : the cited paper provides calculations based on albedo changes, but part of this change relates to energy which is actually converted to electricity, not directly to heat in the PV panel. This energy also exists when fossil or nuclear sources are used. I think that this was not taken into account. I suspect that if it was taken into account, the effect of solar radiation absorption changes when installing PV panels would be even smaller than found in the study, and may often be negligible even in the local scale - such as in town (where albedo changes in general may have local effects). The effect I am referring to has a link with the efficiency of panels, - the more efficient it is, the more the "decreased albedo" actually represents electricity production rather than direct heat production (as a dark roof would). (Philippe Marbaix, Université catholique de Louvain)	With efficiency of solar panels at about 20% and unlikely to become substantially higher, we think this does not alter our conclusion that the effect may be important for some PV installations but not at the global scale. However we have reworded to make it clear that the top-level conclusions is that the albedo effect is not a major concern, as the previous wording may not have made this clear.



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1607	56540	4	63	49	0	0	Change to "positive radiative force on..." (Archis Ambulkar, Brinjac Engineering Inc.)	"forcing" is the correct term, but we have changed "on" to "of".
1608	71259	4	63	50	63	52	It would seem likely that efficiency of PV (Watts Out/Watts In) will increase to some extent with newer PV technologies. Does this imply that albedo effects would become even less important in the future? (CANADA)	Possibly, but there does not appear to be any literature on this specific point, and we would expect this to be a second-order contribution compared to that already discussed, so further discussion does not justify the space that would be required. Thank you for paying attention to the issue though.
1609	66549	4	64	2	64	2	Adaption' should be 'Adaptation'. (Peter Burt, University of Greenwich)	Adaption' changed to 'adaptation'.
1610	72043	4	64	4	64	6	This mention of assisted migration should refer back to section 4.4.2.4. (UNITED STATES OF AMERICA)	Reference to 4.4.2.4 inserted.
1611	78242	4	64	18	0	0	Section 4.5 seems a bit sparse. I would add here that we know much less than we need to about the sensitivity of various processes (e.g., fire as mentioned in previous comment, but also spp persistence under different scenarios) to changes in interannual variability of key climate variables, relative to changes in the climate norms for those same variables. This is an important knowledge gap; exacerbating this problem is the fact that the GCMs do not (for the most part) produce meaningful temporal sequences of years (e.g., a wet winter one year followed by a warm and dry spring the next). Until the GCMs are better at producing realistic sequences, we need a handle on just how much of a given process (and where) can be modeled by climate norms (as they shift), versus that due to variation around those norms (as it shifts). (Max Moritz, University of California, Berkeley)	This point has been included
1612	72044	4	64	18	64	54	Authors should consider further development of this section. There should be a stronger link between the listed uncertainty topics and important certainty statements earlier in the chapter (e.g. spp. Interactions, novel climates, genetic mechanisms for adaptation). Ecosystem services are an important emerging issue, even in the subcontext of regulating services, that deserves more description as an emerging issue. (UNITED STATES OF AMERICA)	Good suggestion, and we have used it.
1613	71260	4	64	27	64	27	It is unclear what "plausible and immanent" means here. (CANADA)	Plausibel means that there is a scientifically justified storyline, immanent means sometime soon.
1614	68219	4	64	28	0	30	A very naive statement: entire sessions of scientific congress such as AGU and EGU are dedicated to this particular interaction for many years, not speaking of the literature in biogeosciences and remote sensing. (Denis Loustau, INRA)	It is true that parts of this issue have been well-studies; nevertheless they are not considered at all in policies. Perhaps the problem is in communication rather than research.
1615	68220	4	64	43	0	46	yes but this Ozone - CO2 interaction has been studied for long in fumigation chambers . (Denis Loustau, INRA)	True, but as our assessment states, there are still big uncetainties, partly because ecosystems don't fit well into chanbers.
1616	57721	4	64	43	64	46	I agree with authors, but what is the knowledge so far (there has been these interaction studies already, but how to proceed on the basis of the existing knowledge). Are there possibilities to study interaction in large scale (i.e., in larger systems than in open-air exposure facilities in the field)? (Anne Kasurinen, University of Eastern Finland)	Agreed, that is what we meant and we have clarified it.
1617	71261	4	64	44	64	44	Change "suture" to "future" (CANADA)	Thank you, done
1618	76690	4	64	44	64	44	typo: "suture" --> "future" (Claudio Cassardo, University of Torino)	Thank you, done
1619	56541	4	64	45	0	0	Change to "since they are of..." (Archis Ambulkar, Brinjac Engineering Inc.)	Thank you, done
1620	68221	4	64	48	0	51	I dont think the overoptimistic and out of time concept of "permissible change" or "tolerable change" is appropriate here in AR5. World and especially vulnerable costal areas in developing countries is now wellbeyond the point of "permissible change" . Conflicts and even wars are being caused by resource rarefaction throughout a world where industrialised countries imposed a global dramatic change to non developed ones. All international negotiation and commitments failed dramatically to slow down the GHG accumulation in the atmosphere. There is no more room for a permissible(for who, what ?) change nor to tolerate. Wrong message. (Denis Loustau, INRA)	The term tolerable was the one used here, and referes to the maximum adaptation and migration rate by populations of species, not the human concept of what might be permissible or acceptable (words we did NOT use). We have tried to clarify.
1621	56542	4	64	49	0	0	UNFCCC term is not defined or elaborated in this chapter prior to being used in this sentence (Archis Ambulkar, Brinjac Engineering Inc.)	UNFCCC is in the IPCC list of acronyms

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1622	65135	4	64	53	54	54	Added in to this is the uncertainty flagged up earlier in the chapter about the impacts of climate change on ES and my comment on the oft mentioned uncertainty in the exact nature of the relationship between ES and biodiversity, even before you get to costings with the inherent methodological problems (Pam Berry, Oxford)	Agreed
1623	71262	4	64	53	64	54	This sentence is unclear. Suggest revising. (CANADA)	Fixed.
1624	68222	4	64	54	0	0	? See N Stern Assessment. (Denis Loustau, INRA)	The Stern review was a start, but came to the same conclusion
1625	72045	4	65	1	66	35	The FAQs seem very useful and will be relevant to policymakers given the plain writing style. Following each FAQ with a set of chapter and section references would be helpful to make it clear where to look for more in-depth information on each, and the support for each statement. Also suggest including a FAQ on tipping points. (UNITED STATES OF AMERICA)	As we have been informed by the TSU: "FAQs are supposed to be a stand alone product and do not require cross-referencing with sections of your chapter", thus no reference is made, but the FAQs will be placed in proximity of the relevant chapter. In relation to tipping points we have been told by the TSU: "Given the large number of FAQs already found in Chapter 4 and given that tipping points are being covered in the summary products, I would suggest not adding another FAQ on this subject" (both quotes: Eric Kissel, email of 12. Sept 2013)
1626	81225	4	65	5	0	0	FAQ 4-1 The answer provides an interesting background on the issue of climate change impact on species but readers may wish to know more about conservation options. Moreover, the answer is a little repetitive and can be reduced in length. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-4; This FAQ has been substantially reworded for clarity
1627	57916	4	65	5	65	5	Need to add the notion that climate warming does not cause outbreaks of a lethal amphibian pathogen It has been highly debated if global warming is causing outbreaks of a lethal amphibian pathogen, the chytrid fungus Batrachochytrium dendrobatidis (Longcore, Pessier & D.K. Nichols 1999). A recent study does not support the links between high temperatures and mortality of amphibians infected with this pathogen. They found the pathogen was equally lethal at 17 as at 23 °C, and no significant differences in mortality of frogs was detected (Bustamante et al 2010). Bustamante HM, Livo LJ and Carey C. 2010. Effects of temperature and hydric environment on survival of the Panamanian Golden Frog infected with a pathogenic chytrid fungus. Integrative Zoology 5: 143-153 (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	NEW FAQ 4-4; We discuss this in detail in Section 4.3.2.5, but do not have space to go into details here
1628	71263	4	65	5	66	35	Suggest reworking this section for clarity and readability. (CANADA)	NEW FAQ 4-4; This FAQ has been substantially reworded for clarity
1629	71264	4	65	7	65	9	Presumably this sentence refers to a "recent past" within human recorded history, and that should be made clear. (CANADA)	NEW FAQ 4-4; This FAQ has been substantially reworded for clarity
1630	58366	4	65	17	65	17	...quantify the risk, but it is probable that we are facing the 6th mass extinction. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	NEW FAQ 4-4; There is high agreement that the risk of species extinctions is high, but there is low agreement on the probability of mass extinctions. This FAQ has been reworded to reflect this.
1631	81226	4	65	21	0	0	FAQ 4-2 To make the FAQ more accessible, authors may wish to use an example that is not about environment. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-5; The examples are about ecosystem services, which are the benefits that people get from nature. How is that not about people, and how could it not be about the environment?
1632	66550	4	65	23	65	23	Poor English: replace 'like' with 'such as'. (Peter Burt, University of Greenwich)	NEW FAQ 4-5; Now changed to "such as".
1633	71265	4	65	26	65	28	Suggest rewording as follows: "'Ecosystem change' includes changes in the numbers and proportions of the individual species that make up the ecosystem, the ecosystem's physical appearance (e.g., tall or short, open or dense) and how it works (e.g., whether it is highly productive or relatively unproductive)." (CANADA)	NEW FAQ 4-5; We have used wording based on your suggestion.
1634	71266	4	65	36	0	0	Should this FAQ say "non-climate change related effects" not "non-GHG effects"? The current wording is confusing. Suggest also specifying that the effects being discussed are environmental. (CANADA)	NEW FAQ 4-2; We would argue that these are still climate change effects - and suggest that using "non-GHG" is more appropriate.
1635	81227	4	65	36	0	0	FAQ 4-3 The language is too technical. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-2; The new version has addressed this.
1636	72046	4	65	42	0	0	The statement 'which cannot be grown under low pH' is vague. (UNITED STATES OF AMERICA)	NEW FAQ 4-2; The text has been revised to address this.

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1637	76691	4	65	42	65	42	change "cannot be grown" with "cannot grow" (Claudio Cassardo, University of Torino)	NEW FAQ 4-2; The text has been revised to address this.
1638	71267	4	65	44	0	0	Should this FAQ specifying that it is referring to "economic" costs? (CANADA)	NEW FAQ 4-7; Yes, it should, thus we have included "economic" in the headline.
1639	81228	4	65	44	0	0	FAQ 4-4 Same currency would be useful. Perhaps some mention why it is difficult to evaluate the costs. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-7; Currencies are now all in US-Dollars and difficulty is briefly explained.
1640	71268	4	65	45	65	46	Suggest rewording as follows: "Climate change will certainly alter the services provided by most ecosystems, and for high degrees of change, the overall impacts are most likely to be negative." (CANADA)	NEW FAQ 4-7; We have adopted the rewording; thanks!
1641	72047	4	65	48	0	0	Question on the text 'several 1000 \$/ha per hour': is this on a 24/7 basis? Or during storm events? This statement may need further explanation, as it raises many questions. (UNITED STATES OF AMERICA)	NEW FAQ 4-7; We now have modified the text and removed the coral reef example, as this is not within the scope of our chapter.
1642	66551	4	65	48	65	48	'per' should be in italics. (Peter Burt, University of Greenwich)	NEW FAQ 4-7; "per" is not used any longer.
1643	76692	4	65	48	65	50	"1000 \$/ha per hour" and "EUR 153 billion per year": why use two different units? If I can understand the different money, at least express both in "per year"!!! (Claudio Cassardo, University of Torino)	NEW FAQ 4-7; We here now only have the following statement: "Pollination is critical for the food supply as well as for overall environmental health. Its value has been estimated globally at \$350 billion for the year 2010 (The range of estimates is 200 – 500 \$ billion)."
1644	71269	4	65	48	65	51	Please clarify whether the estimate of the value of pollinators is for Europe only or global. (CANADA)	NEW FAQ 4-7; It is global; we have clarified this in the text now.
1645	66552	4	65	50	65	50	'per' should be in italics. (Peter Burt, University of Greenwich)	NEW FAQ 4-7; "per" is not used any longer.
1646	72048	4	65	50	65	51	Suggest deleting the parenthetical phrase and just give the value using PPP estimation, as well as the 153 billion euro/year value -- i.e. as a range. (UNITED STATES OF AMERICA)	NEW FAQ 4-7; We have rephrased the sentence and used newer data and included the range.
1647	81229	4	66	1	0	0	FAQ 4-5 The FAQ is too general and may be dropped. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-6; Thus we have now tried to make it more specific and rearranged and rewrote the text quite a bit.
1648	71270	4	66	1	0	7	This FAQ doesn't really seem to address "opportunities". Is there a way to recast it? Also, could "co-benefits" of managing ecosystems for climate change be addressed here? (CANADA)	NEW FAQ 4-6; We have re-written the FAQ and also changed the wording of the FAQ into: "Can ecosystems be managed to help them and people to adapt to climate change?" Also the co-benefit of forest restoration for biodiversity is made explicit.
1649	66553	4	66	2	66	2	Delete space after 'change'. (Peter Burt, University of Greenwich)	NEW FAQ 4-6; all unnecessary spaces were deleted.
1650	66554	4	66	2	66	2	Insert comma after 'exmple'. (Peter Burt, University of Greenwich)	NEW FAQ 4-6; This is not part of the updated text any longer.
1651	71271	4	66	3	66	5	Suggest also considering whether pest control should be included as a management option. (CANADA)	NEW FAQ 4-6; We have now written: "Adaptation is also helped through more proactive detection and management of wildfire and pest outbreaks"
1652	72049	4	66	4	0	0	Suggest changing the term 'excessive harvest' to 'nonsustainable silviculture' which is a broader term. (UNITED STATES OF AMERICA)	NEW FAQ 4-6; Text was re-written and "excessive harvest" is not used any longer.
1653	71272	4	66	5	66	5	This message about "Maintaining biological diversity and near-natural disturbance regimes" to reduce other (non-climatic) stresses on ecosystems did not appear in the main text of Chapter 4 (as far as this reviewer can recall). The need to maintain "near-natural disturbance regimes" sounds attractive, but it may not be so for all ecosystems. Is there scientific evidence to support this? (CANADA)	NEW FAQ 4-6; We have completely re-written the FAQ and avoided these elements, for which scientific evidence is too sparse.
1654	58367	4	66	6	66	6	...out of the wild in zoos, genebanks or cryogenic tanks until such time... (Martin Pecheux, Institut des Foraminifères Symbiotiques)	In the NEW FAQ 4-6 we now write "Adaptation is also helped through more proactive detection and management of wildfire and pest outbreaks, reduced drainage of peatlands, the creation of species migration corridors and assisted migration.", while the concept of taking species out of the wild until conditions are better again might remain an extremely rare case, that's why we did not include it.

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1655	81230	4	66	9	0	0	FAQ 4-6 The FAQ should be supported with some facts about observed land cover change and estimated impacts. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-1; The FAQ was now re-written, kinds of land cover change are mentioned and estimated impacts provided; but we stayed on a very general level in order to make the text easily understandable.
1656	72050	4	66	9	66	9	Author may wish to rephrase this question for proper intent. There is no doubt that land use and land cover change can cause changes in climate -- considerable evidence, reviewed in all three WG reports of AR5 as well as in AR4 and previously, show that it can. The question should be, how does LULCC cause changes in climate. (UNITED STATES OF AMERICA)	NEW FAQ 4-1; The FAQ was rephrased as suggested by reviewer and ways of how LUCC causes change in climate are mentioned. Additional comment: On page 11, line 24 through 26 of the Chapter 4 SOD, we sustain that: "The cause-and-effect entanglement of climate change and LUCC make attribution of consequences to one or the other very difficult. In 13 of the 24 regional land use studies reviewed for this chapter, local-to-regional climate change was at least partly attributed to LUCC, generally with limited evidence and low confidence". This limited evidence was confirmed after the revision made for the Chapter 4 FGD.
1657	79951	4	66	9	66	15	Please consider to mention that land use strategies can also substitute for fossil emissions. Furthermore the percentage given in line 14 is it about antropogenic emissions? (NORWAY)	NEW FAQ 4-1; We have considered to include fossil emission substitutions, but we thought that emission and absorption of greenhouse gases refers to any kind of sources of emission. The percentage is no longer in the FAQ.
1658	76693	4	66	10	66	11	it can also affect evapotranspiration and, more in general, the components of the hydrological balance (Claudio Cassardo, University of Torino)	NEW FAQ 4-1; We agree and included: "Vegetation and land use patterns also influence water use and evapotranspiration, which alter local climate conditions."
1659	72051	4	66	14	66	15	The estimate of "around a fifth", i.e. 20%, is out of date -- even the AR4 estimates were lower (17%) and the denominator (fossil fuel emissions) has increased quite substantially since then. The most recent estimates are closer to 10%, although not yet published in the peer-reviewed literature. In any case, this figure is not necessary here; and the authors should consider dropping the whole sentence. (UNITED STATES OF AMERICA)	NEW FAQ 4-1; This statement was dropped
1660	81231	4	66	17	0	0	FAQ 4-7 The answer provides a lot of background. Most effective approach would be to simply answer the question. (Monalisa Chatterjee, IPCC WGII TSU)	NEW FAQ 4-3; Agreed. We have edited this FAQ to remove the background and simplify the text.
1661	57917	4	66	17	66	17	Need to add the statement on the potential positive effect of alien species on biodiversity. Though there will be more alien species with increase of temperature, it may also increase biodiversity by adding non-native species to the invaded regions. If they are not invasive species damaging the ecosystem, they may positively contribute to the ecosystem services. (Zhibin Zhang, Institute of Zoology, Chinese Academy of Sciences)	NEW FAQ 4-3; An invasive alien species is defined in the glossary as an "agent of change, and threatens native biological diversity". By definition, it is difficult to envisage that alien species will have a positive effect on biodiversity - either at local or regional scales. Similarly, by definition invasive alien species are unlikely to positively impact ecosystem services.
1662	62878	4	66	18	66	19	Based on this definition, any species that expands its range based on climate change - a consequence of human activity - would constitute an alien species. I don't think we want to apply the term alien to species that are tracking their moving climate optimum. You could say well-outside its range or at a distance that would not normally be reachable through natural dispersal processes. (Mark Urban, University of Connecticut)	NEW FAQ 4-3; The term 'invasive alien species' has been defined in the glossary as "A species introduced outside its natural past or present distribution (i.e., an alien species) that becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity (IUCN, 2000; CBD, 2002)." The FAQ has been edited to remove this description and to simplify the text.
1663	71273	4	66	21	66	21	Suggest rewording as follows: "the number of new species" in this line should be changed to "the number of species that can be considered aliens...." (CANADA)	NEW FAQ 4-3; This has been re-worded and addressed in the new draft
1664	81840	4	66	24	66	24	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	NEW FAQ 4-3; We now write: "...increases the likelihood that alien species are accidentally transported..." which language-wise is appropriately used in this case

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1665	81841	4	66	28	66	28	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	NEW FAQ 4-3; We now write: "...increases the likelihood that alien species are accidentally transported..." which language-wise is appropriately used in this case
1666	81373	4	66	38	67	12	Africa chapter also discusses EBA in the section 22.4.5.6 (p. 43 L37-52) and has a figure on EBA which should be cross referenced. (Yuka Estrada, IPCC WGII TSU)	Ten other chapters (4,5,8,13,14,15,19,22,25,27) reference ecosystem-based adaptation. All are now referenced and there is a request for all of those chapters to reference this cross-chapter box.
1667	59354	4	66	40	67	33	All examples of ecosystem based approaches concern developing countries. Is the validity and use of these approaches confined in the developing world? If there is some relevance of these approaches in the developed world, it should be stated in a more clear way. (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	A more concise reference to the importance of ecosystem-based adaptation has been added on page 67, line 8. There are references to ecosystem-based adaptation in developed countries including Opperman and Jonkman.
1668	72052	4	66	40	67	33	It is worth noting in this section on EBA that ecosystem-based adaptation actions often have additional co-benefits through the multiple ecosystem service benefits they provide -- e.g. recreation, carbon sequestration, etc. (UNITED STATES OF AMERICA)	A sentence referring to co-benefits from ecosystem-based adaptation has been added.
1669	66555	4	67	10	67	10	Date missing in reference. (Peter Burt, University of Greenwich)	The year for the citation has been added.
1670	71274	4	68	23	68	34	Some of this information could be presented in Section 4.3.2. (CANADA)	Agreed. Some material from CC-RF2 and 4.3.3.3 (See also comment 1228) has been brought forward and incorporated into a new subheading in 4.3.2
1671	66556	4	68	32	68	32	Poor English: replace 'like' with 'such as'. (Peter Burt, University of Greenwich)	replaced 'like' with 'as occurs'
1672	59355	4	68	37	0	39	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Changed to: "Impact of climate change relative to the impact of water withdrawals and dams on natural flows for two ecologically relevant river flow characteristics (mean annual flow and monthly low flow Q90), computed by a global water model (Döll and Zhang, 2010)."
1673	66557	4	68	38	68	38	Define Q90 (Peter Burt, University of Greenwich)	Added to caption: "Monthly Q90 is defined as the flow that is exceeded in 9 out of 10 months."
1674	66558	4	69	6	69	6	Capital 'C' required for 'chapter' (in this context it is a proper noun and is also in keeping with other usage in the document). (Peter Burt, University of Greenwich)	Changed to "section 3.2.3 in Chapter 3"
1675	59356	4	69	48	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The correct surname is Muller Schmied
1676	76694	4	70	34	70	34	typo: insert a space before "Numerous" (Claudio Cassardo, University of Torino)	This paragraph has been revised and this comment is no longer relevant.
1677	71275	4	70	42	70	44	"i.e., increased biomass production, spatial encroachment and, thus, higher transpiration, as confirmed by FACE..." The "thus, higher transpiration" is not obvious from previous text. "spatial encroachment" might imply an increase in LAI and hence transpiration from the trees, which would offset the gains in iWUE mentioned previously, but it might also mean more shading of competing understory vegetation and hence a reduction in transpiration from the understory and in evaporation from soil. It is not clear why transpiration should increase overall. Suggest explaining in more detail. (CANADA)	This sentence has been revised to clarify what is meant by structural effect - we specifically focus on biomass production, and 'spatial encroachment' has been removed.
1678	59357	4	70	49	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Brackets around Labat et al 2004 have been removed.
1679	76695	4	71	2	71	2	typo: insert a space before "effects" (Claudio Cassardo, University of Torino)	This paragraph has been revised and this comment is no longer relevant.
1680	76696	4	71	4	71	4	typo: insert a space before "change" (Claudio Cassardo, University of Torino)	This paragraph has been revised and this comment is no longer relevant.
1681	59358	4	71	13	0	14	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The comma after Sterling et al has been removed.



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1682	79056	4	71	14	71	16	This seems to be due to the methodology of the study. Short-term, low number of watersheds, and this combined with natural variability make detection of land-use change impacts on run-off difficult. Please evaluate Alkama et al. with regard to this sort of pre-conditioning of the results. In addition, you may want to have a look at the following book and the literature cited therein (sorry, it's in German but at least 2 of the 3 authors of this box should have no problem with this): Bork, H.-R., H. Bork, C. Dalchow, B. Faust, H.-P. Piorr & Th. Schatz (1998): Landschaftsentwicklung in Mitteleuropa. Wirkungen des Menschen auf Landschaften. Klett-Perthes, Gotha, 328 S. ISBN 978-3-623-00849-3. It contains examples of how land-use change influenced run-off, erosion and landscape in the past and estimates of the magnitude of these changes. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We have shortened this part of the text, and just make the overall conclusion that the literature since AR4 suggests that climate change and variability have been the main drivers of runoff change - Alkama et al (2011) do not contradict that. The suggested reference is somewhat old - not only pre-AR4 but also pre-TAR, so is not a priority for citation in AR5. We are happy that our conclusion on this topic is appropriate, and that the post-AR4 literature gives the up-to-date picture.
1683	66559	4	71	15	71	16	Delete duplicated references outside brackets. (Peter Burt, University of Greenwich)	Duplicate references have been removed.
1684	76697	4	71	15	71	16	typo: remove ", 2011" (Claudio Cassardo, University of Torino)	The duplication of 2011 has been removed.
1685	59359	4	71	16	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The duplication of 2011 has been removed.
1686	59360	4	71	20	0	21	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This sentence has been removed so this comment is no longer relevant.
1687	76698	4	71	20	71	20	typo: insert a space before "(i.e." (Claudio Cassardo, University of Torino)	This sentence has been removed so this comment is no longer relevant.
1688	76699	4	71	21	71	21	typo: insert a space before "is still" (Claudio Cassardo, University of Torino)	This sentence has been removed so this comment is no longer relevant.
1689	59361	4	71	23	0	28	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	These sentences have been revised for clarity, and a space has been inserted where needed.
1690	66560	4	71	24	71	24	Capital 'C' required for 'century' (in this context it is a proper noun and is also in keeping with other usage in the document) and delete hyphen (Peter Burt, University of Greenwich)	Here we retain lower case c for consistency with elsewhere.
1691	76700	4	71	24	71	24	typo: insert a space before "21st" (Claudio Cassardo, University of Torino)	Space inserted.
1692	71276	4	71	30	71	33	This sentence is difficult to follow. Do you mean runoff changes are following precipitation changes? (CANADA)	Yes, this was the intended meaning. The sentence has been revised to make this clearer.
1693	59362	4	71	32	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	The sentence has been revised to improve clarity, and grammatical errors have been removed.
1694	66561	4	71	34	71	34	Delete comma after 'al.'. (Peter Burt, University of Greenwich)	Comma deleted.
1695	76701	4	72	2	72	2	typo: insert a space before "Removal" (Claudio Cassardo, University of Torino)	This paragraph has been removed in shortening the text, so this comment is no longer relevant.
1696	76702	4	72	3	72	3	typo: insert a space before "in" (Claudio Cassardo, University of Torino)	This paragraph has been removed in shortening the text, so this comment is no longer relevant.
1697	76703	4	72	4	72	4	typo: insert a space before "Changes" (Claudio Cassardo, University of Torino)	This paragraph has been removed in shortening the text, so this comment is no longer relevant.
1698	76704	4	72	9	72	9	remove "e.g." (Claudio Cassardo, University of Torino)	This paragraph has been removed in shortening the text, so this comment is no longer relevant.
1699	59363	4	74	17	0	54	Please check and correct (format 'et al.' everywhere) (GREECE)	This cross-chapter box is no longer part of chapter 4
1700	66562	4	74	21	74	21	Delete comma after 'energy'. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4. It is between ch 3 and 7
1701	66563	4	74	25	74	25	Replace 'Chapter' with 'Section' (these are section numbers not individual chapters). (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1702	66564	4	74	26	74	26	'per' should be in italics. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1703	66565	4	74	36	74	36	Replace 'Chapter' with 'Section' (these are section numbers not individual chapters). (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1704	66566	4	74	37	74	37	'et al' should be in italics, with a full stop after the 'l' and a comma before the date. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4

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1705	66567	4	74	38	74	38	'et al' should be in italics, with the date in brackets after. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1706	59364	4	74	42	0	45	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This cross-chapter box is no longer part of chapter 4
1707	76705	4	74	43	74	43	change "region and future" with "region. Future" (Claudio Cassardo, University of Torino)	This cross-chapter box is no longer part of chapter 4
1708	66568	4	74	45	74	45	'et al.' should be in italics. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1709	66569	4	74	49	74	49	'per' should be in italics. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1710	66570	4	74	51	74	52	'et al.' should be in italics. (Peter Burt, University of Greenwich)	This cross-chapter box is no longer part of chapter 4
1711	72053	4	74	53	0	0	The text '40% in some countries' requires a citation. (UNITED STATES OF AMERICA)	This cross-chapter box is no longer part of chapter 4
1712	71277	4	75	1	75	3	"A lack of water security can lead to increasing energy demand and vice versa, e.g., over-irrigation in response to electricity or water supply gaps." The latter part of this sentence is hard to follow... i.e., how does over-irrigation occur if electricity or water supplies are intermittent? (CANADA)	This cross-chapter box is no longer part of chapter 4
1713	66571	4	75	39	75	39	Reference out of alphabetical order (in Scottish surnames 'Mac' and 'Mc' are treated the same, therefore this should appear on line 34). (Peter Burt, University of Greenwich)	Thank you. This cross-chapter box is no longer part of chapter 4
1714	71278	4	87	36	87	37	This citation lacks page numbers. Could provide DOI: 10.1029/2007GL029678 (CANADA)	Thank you. This journal has no page numbers. However, I have added the electronic article number to this reference.
1715	71279	4	103	41	103	43	This citation is incomplete. Leadley, P., Pereira, H.M., Alkemade, R., Fernandez-Manjarrés, J.F., Proença, V., Scharlemann, J.P.W., Walpole, M.J. (2010) Biodiversity Scenarios: Projections of 21st century change in biodiversity and associated ecosystem services. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 50, 132 pages. (CANADA)	Thank you. We have added the missing information and corrected misspellings.
1716	66572	4	106	20	106	25	References should appear in line 12. (Peter Burt, University of Greenwich)	The order of references follows the styleguide which was specified by the TSU
1717	66573	4	108	7	109	2	Block of references out of alphabetical order. (Peter Burt, University of Greenwich)	The order of references follows the styleguide which was specified by the TSU
1718	70704	4	120	0	0	0	Fig. 4-2. What do the numbers in this figure represent? (Cate Macinnis-Ng, University of Auckland)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1719	81363	4	131	0	0	0	Table 4-1: I am not sure the "plots" column adds much information here. It needs to clarify what the numbers are indicating at the very least. (Yuka Estrada, IPCC WGII TSU)	The number of plots gives the sample size of the analysis, an indication of the potential significance or generalizability of the result.
1720	81842	4	131	0	0	0	Table 4-1. Within the caption for this table and the header, it could be helpful to clarify further the units used for precipitation change--are they equivalent to percentage change per century? Such wording might be clearer for a general reader of the chapter. (Katharine Mach, IPCC WGII TSU)	Table header and entries have been changed to % century-1.
1721	76706	4	131	0	132	0	in the second last column "Temp. Change (°C century-1)" the left digits are too close to the border and partially covered by it (Claudio Cassardo, University of Torino)	Table formatting has been corrected.
1722	79040	4	131	0	132	0	Table 4-1: Please adjust column width and set numbers right-bound (except time period). (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Table formatting has been corrected.
1723	59365	4	131	3	0	0	Please check and correct (misspellings and/or formatting-punctuation mistakes) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Spelling and punctuation checked again.
1724	79041	4	133	0	0	0	Table 4-2: Please either explain "MESSAGE", "AIM" etc. in the text to this table or delete the terms from the first column. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	MESSAGE, AIM etc have been explained as model names.
1725	68081	4	135	0	0	0	Figure 4-1 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	Borders no longer shown
1726	70315	4	135	0	0	0	Numbers need to be explained in the caption or a legend needs to be added. (Stefan Fronzek, Finnish Environment Institute)	The legend indicates that the numbers refer to the cases in Table 4-1.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1727	71280	4	135	0	0	0	Figure 4-1. How is an elevation shift indicated by the arrows? (CANADA)	Figure revised; arrows removed.
1728	71281	4	135	0	0	0	Figure 4-2. Right panels. Why are there two lines for each RCP? Font is too small to read. (CANADA)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1729	72054	4	135	0	0	0	Fig. 4-2: This figure does not have enough support. What are the models, their sources? What do you mean by 'severe ecosystem change'? What are caveats and characteristics to 'biome shifts'? (UNITED STATES OF AMERICA)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1730	72055	4	135	0	0	0	Figure 4-2: It is not clear why there are two sets of lines for each of the RCPs in the panel of four figures to the right. Also, the dark blue and dark red lines look solid rather than dotted as in the legend. (UNITED STATES OF AMERICA)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1731	79043	4	135	0	0	0	Figure 4-2: left panel: Please consider reworking this overly complicated figure. Organize models in two groups (with and w/o dynamic vegetation) and collate the diagrams into 2 boxplots / d_GMT . Differences between models are not the primary objective here and this agglomeration of coloured lines is very hard to interpret. With the right-hand panels, it is unclear why there are dotted and solid lines given in the same figure. The text to this figure does not explain this, too. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1732	81368	4	135	0	0	0	Figure 4-2: The figure requires more explanation in the caption. Please spell out in the caption that global mean temperature is GMT. What constitutes "severe ecosystem change" here? For the left pane, which is more important to show, the results collated for unit-degree bins, or models with(out) dynamic vegetation composition change? Since they are overlaid on top of each other with the same color schemes (and opacity), the two sets of data are disrupting each other rather than complementing each other. They would not show well on a black and white printer. (Yuka Estrada, IPCC WGII TSU)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1733	81843	4	135	0	0	0	Figure 4-1. Is it possible to make this figure add more value to the table presentation of the same information? (Katharine Mach, IPCC WGII TSU)	Figure has been completely revised to add more value by graphically showing the retracting and expanding biomes in the context of the biomes of surrounding areas.
1734	81844	4	135	0	0	0	Figure 4-2. For the y-axis of this graphic, it would be helpful to clarify further what is meant by "threatened by severe change." Would severe change mean a biome shift? (Katharine Mach, IPCC WGII TSU)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1735	76707	4	135	0	135	0	Fig. 4-1, as said before, in my opinion, this figure does not add information with respect to the Table 4-1. On the contrary, it may considered as misleading, as the data are few and visually one has the impression of missing correlations where the temperature rates are largest. I suggest to eliminate this figure. (Claudio Cassardo, University of Torino)	Figure has been completely revised. It now graphically shows the retracting and expanding biomes in the context of the biomes of surrounding areas.
1736	76708	4	135	0	135	0	Fig. 4-2: in the captions, what mens "all ecosystem models"? How many models are they? (Claudio Cassardo, University of Torino)	This figure has been removed as the paper it was from was not accepted for publication before the cutoff date for papers to be eligible for citation.
1737	81364	4	135	0	144	0	The figure caption needs be comprehensible to non-experts and explain all elements of the figure, so that it can stand alone. (Yuka Estrada, IPCC WGII TSU)	We have tried to achieve this by thoroughly rewriting all of them.
1738	77323	4	135	135	0	0	Figure 4-1: The figure caption needs more explanation (what are arrows, how accurate is this data, what time period is this based on?). Biome shifts over what period? I also think this figure is misleading because the accuracy of it highly depends on where research has been conducted. This either needs more information explaining what database and/or datasets it is based on or it should be removed to avoid misleading the reader. (Maria Caffrey, National Park Service and University of Colorado, Boulder)	The figure legend and Table 4-1 provide a complete explanation of the details of the figure.
1739	71282	4	136	0	0	0	Figure 4-3. What is considered non-forest? Grasslands, tundra, savannas? And how is secondary defined? (CANADA)	Non-forest and secondary vegetation have now been defined.
1740	79048	4	136	0	0	0	Figure 4-4: In the text, primary vegetation is referred to as vegetation "before 1500", here you use 1850. This is dangerous, because research indicates that the vegetation structure in e.g. N America was very well influenced by humans prior to this date. So I suggest to delete "primary" and find some other term. In addition, apparently you included model or project names in the figure (MESSAGE, AIM, ...). Please either explain or delete them. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	This figure has been removed, and although some of the panels have been included in a revised version of Figure 4-2, the 1850 panel is not among them because the focus is on future changes not historical. Model names (MESSAGE, AIM etc) have been removed. "Primary" and "Secondary" have been defined in the legend for Figure 4-3.

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1741	79769	4	136	0	0	0	Figure 4-3: This figure is a little unclear, it would be easier if all the RCP boxes were outlined (especially the first one, it looks like part of the figure) (Jessica Gutknecht, Helmholtz Centre for Environmental Research-UFZ)	We have asked several colleagues - and at the latest in combination with the caption it seems that the message is quite clear.
1742	81369	4	136	0	0	0	Figure 4-3: It may be good to change the opacity of the area representing "projections" to distinguish from the historical data. (Yuka Estrada, IPCC WGII TSU)	We considered this proposal, but in collaboration with the TSU decided to leave it as it is, as the text explains: "from satellite data and historical reconstructions up to 2005 ..., and from scenarios associated with the RCPs from 2005 to 2100".
1743	81370	4	136	0	0	0	Figure 4-4: Robinson projection is the recommended projection for global maps. Please ensure this projection is used wherever possible to have a consistent presentation across the volume. (Yuka Estrada, IPCC WGII TSU)	This figure has been removed, but some of the panels have been incorporated into a new figure 4-2 and have been presented in Robinson projection.
1744	81845	4	136	0	0	0	Figure 4-4. The chapter team could consider keeping this figure and dropping figure 4-3 and table 4-2 in shortening the box. (Katharine Mach, IPCC WGII TSU)	We have decided to keep Figure 4-3 and remove Figure 4-4, but have incorporated some panels from Figure 4-4 into a revised version of Figure 4-2 to allow a clearer comparison of projected climate-driven biome shifts with current and projected areas of primary vegetation undisturbed by direct human land use impacts. We have also decided to retain Table 4-2 as we consider that this presents important information - however, we have shortened the text of the box.
1745	76709	4	136	0	136	0	Fig. 4-4: what is the meaning of the titles of Figures? For instance, "2100. RCP8.5-MESSAGE": I can understand 2100, RCP8.5 but not MESSAGE. And so on... please explain in captions. (Claudio Cassardo, University of Torino)	This figure has been removed, and although some of the panels have been included in a revised version of Figure 4-2, the model names (MESSAGE etc) have been removed.
1746	71283	4	137	0	0	0	Figure 4-5. Why is tree mortality considered as both "evidence" and as "impact". (CANADA)	"Evidence" and "Impacts" are keywords in the titles of the sections where these phenomena are described
1747	81846	4	137	0	0	0	Figure 4-5. The chapter team is strongly encouraged to consider presenting a summary table with this figure. It could include examples and explanation, description of the physical drivers, etc. For the impacts on major systems, it would be helpful to clarify if early signs of regime shifts have been observed across each category--and what they are. (Katharine Mach, IPCC WGII TSU)	In order to make the drastic reductions in page length we have opted for referring readers to the appropriate sections where all is explained and justified
1748	71284	4	138	0	0	0	Fig 4-6 is interesting. The definition of "species groups" is now clearer. Why are some "species groups" not listed? E.g., "amphibians" as a group are notoriously limited in their capacity to migrate. (CANADA)	We focused on groups for which there was a very strong basis for estimating dispersal capacity for a wide range of species within each group (with the exception of FW molluscs). We did not feel that we had adequate coverage for amphibians.
1749	79058	4	138	0	0	0	Figure 4-6: Please consider altering figure A. It is overly complicated. If the bounds for temperature reconstruction were given as a broad, coloured or grey-shaded band, one would not have to distinguish "broad, black, solid" from "broad, black, dotted" and "black, solid, thin" simultaneously. Also, using "historical" to indicate reconstructions is not advisable. "History" implies "has been" and will most surely be interpreted by most readers as "observed", too. With regard to panel B, please consider to explain the concept of "climate velocity" in the legend, too. Climate itself has no apparent velocity, and the concept you use here is correlated to the speed of climate change. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	We have substantially reduced the complexity of panel A. Climate velocity is related to climate impacts and refers to the speed at which isoclimates move over landscapes with time. We now describe climate velocity more clearly in the text and have included it in the Glossary.
1750	81371	4	138	0	0	0	Figure 4-6: This figure has a lot of great information, but the figure caption is inadequate to explain anything to the reader. First, the connections between the three panels should be clearly explained and graphically presented. The red arrow (too faint to see) from A (to B?) to C makes it more confusing than helpful. Second, the three axes in the panel B are not very intuitive and hard to interpret. It is also not clear what exactly the arrows (habitat fragmentation vs human assistance) on the left of the panel C are showing. (Yuka Estrada, IPCC WGII TSU)	We have substantially modified and simplified the figure to make it clearer. It does, however, remain a complex figure.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1751	81847	4	138	0	0	0	Figure 4-6. For the color bar legend, the categories cannot be fully distinguished: "some species cannot track climate" cannot be distinguished, necessarily, from "most species able to track climate." For the mountainous areas component of the climate velocity part of the graphic, it would be helpful to clarify that there are different issues restricting tracking of climate within mountainous areas. (Katharine Mach, IPCC WGII TSU)	We have removed the color code. Issues dealing with species tracking climate in mountains are highlighted in the text.
1752	76710	4	138	0	138	0	Fig. 4-6c: what is the unit on y-axis? Is it same of third axis of Fig. 4-6b? (Claudio Cassardo, University of Torino)	We have clarified this in the legend
1753	68082	4	139	0	0	0	Figure 4-7 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	This figure has been removed
1754	71285	4	139	0	0	0	Figure 4-7 B probably isn't needed and could be omitted. (CANADA)	Agree. This figure has been removed
1755	76711	4	139	0	139	0	Fig. 4-7b: please explain better in the captions the meaning of the percentage in the scale: it is not clear (see also my comment in the text) (Claudio Cassardo, University of Torino)	This figure has been removed
1756	71286	4	140	0	0	0	Figure 4-8 Please alter colour-bar to correspond with FFDI categories listed in upper right. (CANADA)	This has been done for the left-hand column. For the right-hand column this is not possible.
1757	81372	4	140	0	0	0	Figure 4-8: Robinson projection is the recommended projection for global maps. Please ensure this projection is used wherever possible to have a consistent presentation across the volume. It is extremely confusing to have different ranges of scales even though both are using very similar color scheme. Which legend is used for each map? (Yuka Estrada, IPCC WGII TSU)	The panels have been re-done in Robinson projection, and colour bars added to individual panels to make it clear which one is used where.
1758	76712	4	140	0	140	0	Fig. 4-8. First: in my opinion, these figures are too small: it should be better to enlarge them like the size of Fig. 4-7. Second: the scale is misleading: in the color bar, half scale is used to differentiate several sub-grades of low risk, which is useless. My suggestion is to replot the scale and differentiate the color bar as follows. Green for low, yellow for moderate, orange for high, red for very high and dark red or black for extreme. Right scale instead is ok as it is. (Claudio Cassardo, University of Torino)	The size of the panels in the final report is yet to be determined, but readability is of course important. The colour scales have been changed as suggested.
1759	59366	4	142	0	0	0	Fig 4-10: DROUGHTS (all letters in one line) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	This figure has now been redone.
1760	79059	4	142	0	0	0	Figure 4 - 10: Please explain why you draw a "positive, low confidence" arrow from forest fires to tree growth. To my knowledge, trees in the Amazon are not fire-adapted like some N American Pinus species and thus the growth enhancement due to nutrient release or reduction in competition will - I assume - be more than balanced by direct mortality. Please have a look into this. And, sorry for the nit-picking, please explain why you differentiate between deforestation and tree death - a "deforested" tree usually is dead and, often, has been removed at least in part from the site. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	Many trees in the Amazon are fire-resistant (see Brando et al. 2012), and the survivors of a fire grow more rapidly. Deforestation affects all trees--through clear-cutting. Tree mortality by drought or fire affects only a fraction of a forests' mature trees.
1761	71287	4	143	0	0	0	Fig. 4-11 Recommend including a legend. (CANADA)	This figure has been replaced with one which presents the permafrost projections from the CMIP5 multi-model ensemble, with one panel each for RCPs 2.6, 4.5 and 8.5.
1762	72056	4	143	0	0	0	Fig. 4-11. Insufficient documentation (UNITED STATES OF AMERICA)	This figure has been replaced with one which presents the permafrost projections from the CMIP5 multi-model ensemble, with one panel each for RCPs 2.6, 4.5 and 8.5.
1763	79060	4	143	0	0	0	Figure 4 - 11: The legend does not explain what the differently coloured lines should show. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	This figure has been replaced with one which presents the permafrost projections from the CMIP5 multi-model ensemble, with one panel each for RCPs 2.6, 4.5 and 8.5.



#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1764	80379	4	143	0	0	0	Figure 4-11: Make sure to compare to any available information from Ch4 and Ch11/12 assessment in WGI AR5. There are no uncertainties included (WGI Ch12 Fig 12.33 has them), no information is provided on the scenarios shown. Please revise. (Gian-Kasper Plattner, IPCC WGI TSU)	We have compared with the relevant WG1 chapters as suggested. In order to present the uncertainties we have now replaced this figure with one showing permafrost extents simulated by the CMIP5 multi-model ensemble. This includes one panel each for RCPs 2.6, 4.5 and 8.5. This complements WG1 Figure 12.33 as it uses a different methodology and extends out to 2300 (Fig 12.33 only extends to 2100). The agreement between this new figure and WG1 Figure 12.33 up to 2100 helps support the confidence statements in both WG1 and WG2 on projected permafrost decline.
1765	81848	4	143	0	0	0	Figure 4-11. A color caption should be provided for the figure, indicating which color corresponds to which RCP. (Katharine Mach, IPCC WGII TSU)	This figure has been replaced with one which presents the permafrost projections from the CMIP5 multi-model ensemble, with one panel each for RCPs 2.6, 4.5 and 8.5.
1766	71288	4	144	0	0	0	Figure 4-12. NECB explanation is missing. Does the negative NECB indicate the biome shift is releasing C into the atmosphere due to high heterotrophic respiration and disturbance losses? Please provide a reference for the NECB estimates. (CANADA)	The figure has been substantially revised and the term NECB is no longer used
1767	81374	4	145	0	0	0	Figure EA-1: At first glance, this figure presents a "dichotomy" of two different approaches and it appears that Climate change impacts only affects the Business as Usual scenario while climate mitigation could only results from the EBA. I am afraid that this figure is a little too oversimplified and could be misleading that two scenarios create such black-and-white outcomes. I would focus more on the process of EBA by using a specific, tangible example to demonstrate how implementation of the EBA led to opportunities that otherwise would not have been realized. It may be enough to cross reference Figure 22-8 which illustrates a specific example of EBA? TSU can help further develop this figure (along with Figure 22-8). (Yuka Estrada, IPCC WGII TSU)	Figure redrawn in collaboration with TSU to be more clear and illustrative.
1768	59367	4	145	1	0	0	Please improve the phrase (unfinished sentences, and/or disagreement between subject and verb, and/or rather poor english) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)	Comment unclear on specifics, but the caption was rewritten to be more informative and fit with new version of the figure.
1769	76713	4	146	0	146	0	Fig. RF-1. In my opinion, these figures are too small: it should be better to enlarge them like the size of Fig. 4-7. (Claudio Cassardo, University of Torino)	The figure size cannot be increased because of space limitation
1770	71289	4	147	0	0	0	Fig RF-2. Suggest expanding the acronym and providing a definition of GCC. (CANADA)	This has been re-worded to "... as a function of glacial cover in catchment."
1771	57722	4	148	0	0	0	Figure VW-1. The titles in the figures should be revised. Figure a) should be Climate change only and b) climate change with CO2 effect. (Anne Kasurinen, University of Eastern Finland)	We disagree with including additional information in the panels which is common to both - we think it is clearer to only include the information which distinguishes the panels, and to present the rest in the legend.
1772	68083	4	148	0	0	0	Figure VW-1 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	The maps have been re-drawn without national borders.
1773	79061	4	148	0	0	0	Figure VW - 1: The legend and the headings of the two panels contain just opposite wording - please correct. (Joachim Rock, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)	This has been corrected.
1774	76714	4	149	0	149	0	Fig. WE-1: please remove the figure title, as in the caption is already explained. (Claudio Cassardo, University of Torino)	Box and figure accidentally appeared in chapter 4 and therefore will be removed
1775	85203	4	149	1	149	20	Based too heavily on "projections" which are not happening. There has been no warming for 15 years. A failure to accept that water supplies are dependent on expenditure on reservoirs, dams and supply pipes. Most of the water that arrives from the heavens drains into the sea and an improved supply depends on trapping more of it. (Vincent Gray, Climate Consultant)	Box and figure accidentally appeared in chapter 4 and therefore will be removed