#	Ch	From Page	From Line	To Page	To Line	Comment
1	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. (Joly, Kyle, US National Park Service)
2	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? (Kasurinen, Anne, University of Eastern Finland)
3	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. (Duan, Juqi, National Climate Center, Chinese Meteorological Administration)
4	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. (wang, chunfeng, State Forestry Administration, China)
5	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. (wang, chunfeng, State Forestry Administration, China)
6	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)
7	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)
8	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)
9	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)
10	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)

#	Ch	From Page	From Line	To Page	To Line	Comment
11	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
12	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 (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
13	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. (Zhang, Xiaochun, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences)
14	4	0	0	0	0	If Chapter 4 talks about ecosystems, it was better to discuss with different ecosystem types. (Zhang, Xiaochun, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences)
15	4	0	0	0	0	in places too many calls to references. Try to limit them to the mains ones. (leroy, Suzanne, brunel university)
16	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)
17	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 (Loustau, Denis, INRA)
18	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. (Loustau, Denis, INRA)
19	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. (Fronzek, Stefan, Finnish Environment Institute)
20	4	0	0	0	0	This chapter is internally consistent and represents a comprehensive coverage of the issues. (Macinnis-Ng, Cate, University of Auckland)

#	Ch	From Page	From Line	To Page	To Line	Comment
21	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. ‰Û¢ 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. ‰Û¢ The main body, stylistically, has three problems: o First, there need to be more ‰ÛÏtopic sentences‰Û 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 ‰ÛÏsupporting material‰Û 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)
22	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 speciific 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)

#	Ch	From Page	From Line	To Page	To Line	Comment
23	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)
24	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)
25	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)
26	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)
27	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)
28	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)
29	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
30	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)
31	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 (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
32	4	0	0	0	0	Species richness declines and biotic homogenisation have slowed down for NW-European pollinators and plants (Carvalheiro et al. in press). Carvalheiro, 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 (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
33	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. (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
34	4	0	0	0	0	With respect to trends in burned area, Giglio et al. (2013) found a “gradual decrease of 1.7Mhayr−1 (−1.4%yr−1) in Northern Hemisphere Africa since 2000, a gradual increase of 2.3Mhayr−1 (+1.8%yr−1) in Southern Hemisphere Africa also since 2000, a slight increase of 0.2Mhayr−1 (+2.5%yr−1) in Southeast Asia since 1997, and a rapid decrease of approximately 5.5Mhayr−1 (−10.7%yr−1) 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−1 (−1.2%yr−1)”. 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. (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)

#	Ch	From Page	From Line	To Page	To Line	Comment
35	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? (Strong, Aaron, Stanford University)
36	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. (Schrier, Arina, Wetlands International)
37	4	0	0	0	0	Measures: no development in high carbon areas, including forest and peat. (Schrier, Arina, Wetlands International)
38	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 (Schrier, Arina, Wetlands International)
39	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. (Schrier, Arina, Wetlands International)
40	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. (Schrier, Arina, Wetlands International)
41	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 then 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. (Schrier, Arina, Wetlands International)

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42	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). (Schrier, Arina, Wetlands International)
43	4	0	0	0	0	Find additional information on deforestation rates in the attachement to wg2-ar5-supportingmaterial@ipcc-wg2.gov (Schrier, Arina, Wetlands International)
44	4	0	0	0	0	The chapter gives a very broad overwiev 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 wast 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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
45	4	0	0	0	0	in general chapter 4 could be better matched with evidence from chapter 18, specifically 18.3.2 (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
46	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. (Chatterjee, Monalisa, IPCC WGII TSU)
47	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. (Mach, Katharine, IPCC WGII TSU)
48	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. (Mach, Katharine, IPCC WGII TSU)
49	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. (Mach, Katharine, IPCC WGII TSU)
50	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. (Mach, Katharine, IPCC WGII TSU)
51	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. (Mach, Katharine, IPCC WGII TSU)

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52	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. (Mach, Katharine, IPCC WGII TSU)
53	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. (Mach, Katharine, IPCC WGII TSU)
54	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. (Mach, Katharine, IPCC WGII TSU)
55	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
56	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. (Mastrandrea, Michael, IPCC WGII TSU)
57	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? (Mastrandrea, Michael, IPCC WGII TSU)
58	4	1	1	1	1	Title"water system" is confusing with chapter 3. Rally better to say "Terrestrial and freshwater ecosystems". (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
59	4	1	13	1	13	Correct the spelling of the last name of Contributing Author Patrick Gonzalez (it ends with a "z") (Gonzalez, Patrick, National Park Service)
60	4	1	15	1	22	Marten Winter is listed as both, CA and VCS. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
61	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)
62	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. (Mach, Katharine, IPCC WGII TSU)
63	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
64	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. (Mach, Katharine, IPCC WGII TSU)
65	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. (Mach, Katharine, IPCC WGII TSU)
66	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. (Mastrandrea, Michael, IPCC WGII TSU)
67	4	2	46	0	0	should read '...anthropogenic climate change will approach...' (Friend, Andrew, University of Cambridge)
68	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)
69	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. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
70	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
71	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)
72	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” (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
73	4	2	46	2	47	The sentence must be phrased more carefully.. During the Earth history (billions years ago)², very large variations occured from ocean temperatures of some 50 °C to total glaciation. (Petit, Michel , CGIET rue de Bercy)
74	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
75	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)
76	4	2	46	2	54	This paragraph is not very clear (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
77	4	2	46	4	8	Everything so far is very (too) general with no specific useful content. (Friend, Andrew, University of Cambridge)
78	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… (Friend, Andrew, University of Cambridge)
79	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)
80	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)
81	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. (Mastrandrea, Michael, IPCC WGII TSU)
82	4	2	48	2	48	Suppress service as you speak of past climatic events (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
83	4	2	48	2	48	"this change" should gramatically be future climate change, which makes the sentence meaningless (Petit, Michel , CGIET rue de Bercy)
84	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? (Strong, Aaron, Stanford University)
85	4	2	49	2	49	apart (the meteoritic impact at) the Cretaceous/tertiary boundary (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
86	4	2	49	2	54	The key role of the climate change rate should be more clearly expressed in this introductory paragraph (Petit, Michel , CGIET rue de Bercy)
87	4	2	52	0	0	..most ecosystems will change.. (Spitttlehouse, Dave, BC Ministry Forests, Lands and Natural Resource Operations)

#	Ch	From Page	From Line	To Page	To Line	Comment
88	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. Strebel, 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)
89	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. (Loustau, Denis, INRA)
90	4	3	5	3	5	Please be sure that the definition for 'primary forest' is included in the glossary of terms for the report. (Webb, Robert, NOAA OAR ESRL)
91	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. (Gonzalez, Patrick, National Park Service)
92	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)
93	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)
94	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. (Webb, Robert, NOAA OAR ESRL)
95	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. (Mastrandrea, Michael, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
96	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)
97	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. (Schrier, Arina, Wetlands International)
98	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)
99	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. (Mastrandrea, Michael, IPCC WGII TSU)
100	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. (Mastrandrea, Michael, IPCC WGII TSU)
101	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? (Mach, Katharine, IPCC WGII TSU)
102	4	3	19	0	0	What is meant by " large-scale ecosystem character" ? This sentence is absolutely unclear. (Loustau, Denis, INRA)
103	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….. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
104	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)
105	4	3	31	3	31	Add soil degradation (Petit, Michel , CGIET rue de Bercy)
106	4	3	32	0	0	increasing CO2 will not constrain the capacity of many species to respond - it will likely increase their capacity... (Friend, Andrew, University of Cambridge)
107	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
108	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 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
109	4	3	34	3	36	Is it possible to specify the approximate time frame for these changes within the 21st-century? (Mach, Katharine, IPCC WGII TSU)
110	4	3	34	3	37	There is some overlap between this finding and the finding on page 4 lines 32-39. (Mastrandrea, Michael, IPCC WGII TSU)
111	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 sensitivites 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)
112	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. (Mastrandrea, Michael, IPCC WGII TSU)
113	4	3	39	0	0	and by the ability of the impact models and the understanding therein (Friend, Andrew, University of Cambridge)
114	4	3	39	3	39	Suggest changing "projections by WGI" to "projections reviewed by WGI" (CANADA)
115	4	3	41	0	0	there is no uncertainty about this, so should read 'There is certainty that…' (Friend, Andrew, University of Cambridge)
116	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. (Mach, Katharine, IPCC WGII TSU)
117	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. (Mastrandrea, Michael, IPCC WGII TSU)
118	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
119	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. (Mastrandrea, Michael, IPCC WGII TSU)
120	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. (Mach, Katharine, IPCC WGII TSU)
121	4	3	45	3	46	Please clarify what is meant by distant and recent past. (Mastrandrea, Michael, IPCC WGII TSU)
122	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. (Mastrandrea, Michael, IPCC WGII TSU)
123	4	3	49	3	49	What is the approximate timeframe for this statement? Within the 21st-century? (Mach, Katharine, IPCC WGII TSU)
124	4	3	50	3	52	Support is needed for this statement, as it is currently not clear where in the chapter text it occurs. (Mastrandrea, Michael, IPCC WGII TSU)
125	4	3	53	3	53	The relevance of section 4.4.1.1 to the previous statement is not completely clear. (Mastrandrea, Michael, IPCC WGII TSU)
126	4	3	54	0	0	disrupt' is too judgemental; better to use 'affects' (Friend, Andrew, University of Cambridge)
127	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
128	4	4	4	0	0	unclear (Friend, Andrew, University of Cambridge)
129	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…' (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
130	4	4	6	4	6	Mismatch of singular and plural tenses: change 'is' to 'are'. (Burt, Peter, University of Greenwich)
131	4	4	6	4	6	The intended timeframe of the "past climate changes" meant here should be indicated more specifically. (Mach, Katharine, IPCC WGII TSU)
132	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
133	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, …. (Webb, Robert, NOAA OAR ESRL)
134	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. (Strong, Aaron, Stanford University)
135	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. (Urban, Mark, University of Connecticut)
136	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
137	4	4	11	4	12	This is not clear. Is there a reference to support this statement? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
138	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)
139	4	4	14	0	0	and by increased susceptibility of stressed ecosystems to invasion (Friend, Andrew, University of Cambridge)
140	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? (Strong, Aaron, Stanford University)
141	4	4	16	4	17	What is the approximate timeframe for this statement within/beyond the 21st century? (Mach, Katharine, IPCC WGII TSU)
142	4	4	16	4	17	Please specify the timeframe for this finding--over the 21st century, for example? (Mastrandrea, Michael, IPCC WGII TSU)
143	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 inlcude additional sentences that reference the interactions between ability to migrate and fragmentation. (UNITED STATES OF AMERICA)
144	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)
145	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)
146	4	4	18	4	18	insert 'millennia, centuries and' before 'decades' (Webb, Robert, NOAA OAR ESRL)
147	4	4	18	4	19	What has been the result of inability to track recent climatic changes? (Mastrandrea, Michael, IPCC WGII TSU)
148	4	4	20	0	0	this should read 'may find themselves in unfavorable climates and unable' (Friend, Andrew, University of Cambridge)
149	4	4	20	4	20	replace 'are' with 'will be' since sentence is about tracking future climate change (Webb, Robert, NOAA OAR ESRL)
150	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)
151	4	4	21	4	22	Suggest moving 'than species in mountainous regions' to after 'distances' to improve clarity and English (Burt, Peter, University of Greenwich)
152	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
153	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
154	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. (Webb, Robert, NOAA OAR ESRL)
155	4	4	23	0	0	trees are plants! (Friend, Andrew, University of Cambridge)
156	4	4	23	4	23	Amphibians -- e.g. salamanders -- are another example of a taxon with generally low migration capacity. (UNITED STATES OF AMERICA)
157	4	4	27	0	0	There is certainty that barriers…' (Friend, Andrew, University of Cambridge)
158	4	4	29	0	0	ditto (Friend, Andrew, University of Cambridge)
159	4	4	29	4	27	The authors should consider adding 'large lakes, large urbanized areas" (UNITED STATES OF AMERICA)
160	4	4	29	4	30	Support is needed for this statement on outlier populations, as it is currently not clear in the chapter text. (Mastrandrea, Michael, IPCC WGII TSU)
161	4	4	30	4	30	The word "migration" apllies to whole populations, but the examples are better characterized by the term "dispersal", meaning the transport of fewer individuals. (UNITED STATES OF AMERICA)
162	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)
163	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. (Mastrandrea, Michael, IPCC WGII TSU)
164	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)
165	4	4	41	4	41	Please clarify what is meant by increased here. (Mastrandrea, Michael, IPCC WGII TSU)
166	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. (Urban, Mark, University of Connecticut)
167	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. (Strong, Aaron, Stanford University)
168	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. (Mach, Katharine, IPCC WGII TSU)
169	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). (Burt, Peter, University of Greenwich)
170	4	4	45	4	45	Is it possible to specify what is meant by "an extremely broad range"? (Mach, Katharine, IPCC WGII TSU)
171	4	4	48	4	49	Is it at least possible to specify a range for extinction risks with full characterization of relevant uncertainties? (Mach, Katharine, IPCC WGII TSU)
172	4	4	49	0	0	meaning of 'accurately'? (Friend, Andrew, University of Cambridge)
173	4	4	51	0	0	meaning of 'many'? Everything is very vague… (Friend, Andrew, University of Cambridge)
174	4	4	52	0	0	why the suggen restriction of 'climate change' to 'warming'? Inconsistent… (Friend, Andrew, University of Cambridge)
175	4	5	4	5	5	"virtually certain" is ambigious. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)

#	Ch	From Page	From Line	To Page	To Line	Comment
176	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 enhence the water DIC and POC concetration with rising of the atmospheric CO2 "in the section. (Jiang, Zhongcheng, Institute of Karst Geology,CAGS)
177	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)
178	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. (Friend, Andrew, University of Cambridge)
179	4	5	6	0	0	I struggle with interpretting "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 thnk 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 (Jones, Chris, Met Office)
180	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
181	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)
182	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? (Mach, Katharine, IPCC WGII TSU)
183	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. (Mastrandrea, Michael, IPCC WGII TSU)
184	4	5	7	0	0	similar rate' is ambiguous (Friend, Andrew, University of Cambridge)
185	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)
186	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? (Mastrandrea, Michael, IPCC WGII TSU)
187	4	5	7	5	10	'There is high confidence that the terrestrial carbon sink….through forest degradation'. (Schrier, Arina, Wetlands International)
188	4	5	8	5	8	With chapter team says "is offset" what is the relevant time frame--over the past 2 decades? (Mach, Katharine, IPCC WGII TSU)
189	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)
190	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). (Mastrandrea, Michael, IPCC WGII TSU)

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191	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)
192	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. (Strong, Aaron, Stanford University)
193	4	5	9	5	12	Please clarify the direct effects, in addition to the information on indirect effects already provided. (Mastrandrea, Michael, IPCC WGII TSU)
194	4	5	10	5	10	For this carbon storage "thus far" is the chapter team referring to carbon stored due to climate change? (Mach, Katharine, IPCC WGII TSU)
195	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)
196	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)
197	4	5	17	0	0	N deposition should also be mentioned (Friend, Andrew, University of Cambridge)
198	4	5	17	0	0	Also mention N-deposition here (as covered well during the chapter) (Jones, Chris, Met Office)
199	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. (Mastrandrea, Michael, IPCC WGII TSU)
200	4	5	20	0	0	Where does '600 ppm' come from? Seems rather precise… (Friend, Andrew, University of Cambridge)
201	4	5	22	0	0	Also mention disease/pests (Friend, Andrew, University of Cambridge)
202	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)
203	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. (Mastrandrea, Michael, IPCC WGII TSU)
204	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)
205	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. (Mastrandrea, Michael, IPCC WGII TSU)
206	4	5	29	0	0	Either they have or have not been detected ('medium confidence' makes no sense in this context) (Friend, Andrew, University of Cambridge)
207	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 (Webb, Robert, NOAA OAR ESRL)

#	Ch	From Page	From Line	To Page	To Line	Comment
208	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? (Mach, Katharine, IPCC WGII TSU)
209	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. (Mastrandrea, Michael, IPCC WGII TSU)
210	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)
211	4	5	35	5	42	Delete “global trend” or change it into “regional trend” (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
212	4	5	36	0	0	does not make sense logically (Friend, Andrew, University of Cambridge)
213	4	5	37	5	37	Can the regions relevant to this statement be specified? (Mastrandrea, Michael, IPCC WGII TSU)
214	4	5	38	0	0	threat' rather than 'risk' (Friend, Andrew, University of Cambridge)
215	4	5	40	5	42	agree (fleming, richard arthur, canadian forest service)
216	4	5	41	0	0	observed is detectable' does not make sense (Friend, Andrew, University of Cambridge)
217	4	5	41	5	41	What is the timeframe for observed mortality being detectable--over the last decade? (Mach, Katharine, IPCC WGII TSU)
218	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." (Mach, Katharine, IPCC WGII TSU)
219	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 futre climate change than reported in IPCC AR4; however, the section 4.3.3.1 does not necessarily compared with the information in the AR4. Also most of the tree mortality are caused by drought, not temperature rise. (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
220	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
221	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)
222	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)
223	4	5	45	0	0	Does Cox et al. (doi:10.1038/nature11882) not contradict this? (Friend, Andrew, University of Cambridge)

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224	4	5	47	5	47	tree ranges could be large (ambigious statement) (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
225	4	5	47	5	49	You've said high conficence 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 varous factors such as drought and insect attack, etc. Therefore it may be better to lower the degree of your confidence from "high" to "medium". (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
226	4	5	49	5	49	What is meant by "details"--magnitude, geographic distribution, etc.? (Mach, Katharine, IPCC WGII TSU)
227	4	5	51	0	0	illogical (Friend, Andrew, University of Cambridge)
228	4	5	51	5	51	It would be helpful to indicate more specifically what is meant by "increasingly greater caution." (Mach, Katharine, IPCC WGII TSU)
229	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)
230	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. (Mastrandrea, Michael, IPCC WGII TSU)
231	4	6	2	0	0	Provide more specifics for "forest loss" since this is a very broad concept. (UNITED STATES OF AMERICA)
232	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)
233	4	6	3	6	4	Should "land use" be "land-use change" instead? (CANADA)
234	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. (Mach, Katharine, IPCC WGII TSU)
235	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? (Cassardo, Claudio, University of Torino)
236	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)
237	4	6	8	6	8	Please specify what is meant by "affect" here--do you mean an increase in fire risk? (Mastrandrea, Michael, IPCC WGII TSU)
238	4	6	10	0	0	can' becomes 'will' in next sentence (Friend, Andrew, University of Cambridge)
239	4	6	10	6	11	"pushed by climate change". The word "push" seems a bit awkward. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
240	4	6	10	6	11	"There is … and function": is this valid at global, regional or local scale? (Cassardo, Claudio, University of Torino)
241	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)
242	4	6	10	6	13	Please clarify line of sight for the bold statement here. (Mastrandrea, Michael, IPCC WGII TSU)

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243	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
244	4	6	10	6	29	This paragraph is difficult to follow. Consider revising. (CANADA)
245	4	6	11	0	0	is there real evidence that these tipping points exist? (Friend, Andrew, University of Cambridge)
246	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)
247	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)
248	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)
249	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)
250	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? (Webb, Robert, NOAA OAR ESRL)
251	4	6	18	0	0	adaptation'? (Friend, Andrew, University of Cambridge)
252	4	6	18	6	18	The word 'adaption' seems strange here, I think it should be 'adaptation'. (Burt, Peter, University of Greenwich)
253	4	6	20	6	22	LONG SENTENCE. Consider re-wording (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
254	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)
255	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)
256	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)
257	4	6	28	6	28	"decreased": worldwide? (Cassardo, Claudio, University of Torino)
258	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)
259	4	6	29	0	0	It is hard to believe in this level of confidence for this exact magnitude (Friend, Andrew, University of Cambridge)
260	4	6	29	0	0	"1.5%" 1.5 percent in what time interval? (UNITED STATES OF AMERICA)
261	4	6	31	6	41	Overlap with text in Ch 4, P 4, L 32 to L39. Could be removed. (CANADA)
262	4	6	31	6	41	Please consider ways to integrate information on adaptation such as that summarized here into the other findings on impacts. (Mastrandrea, Michael, IPCC WGII TSU)

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263	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. (Urban, Mark, University of Connecticut)
264	4	6	34	6	34	change "that this is" with "that it will be", as it refers to the future (Cassardo, Claudio, University of Torino)
265	4	6	35	0	0	over what timescale are the RCPs considered? (Friend, Andrew, University of Cambridge)
266	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)
267	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) (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
268	4	6	37	6	37	… " other stresses operating on them; for e.g. reducing the rate and magnitude… " (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
269	4	6	37	6	37	Not clear what is meant with "change" in the following phrase "reducing the rate and magnitude of change" (NETHERLANDS)
270	4	6	41	6	41	It appears that 4.4.2 is also relevant to this paragraph. (Mastrandrea, Michael, IPCC WGII TSU)
271	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)
272	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)
273	4	6	46	6	46	The word "abstraction" is strange here -- "extraction" or some other term would be better. (UNITED STATES OF AMERICA)
274	4	6	47	6	47	Section 4.3.4.5 does not exist, please update this line of sight. (Mastrandrea, Michael, IPCC WGII TSU)
275	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
276	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. (wang, chunfeng, State Forestry Administration, China)
277	4	6	47	6	50	Conclusion is not based on section 4.2.4.1 (NETHERLANDS)
278	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)
279	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. (Loustau, Denis, INRA)
280	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)
281	4	6	49	0	0	change 'may' to 'will' (Friend, Andrew, University of Cambridge)
282	4	6	49	0	0	Suggest changing the term'forest' to 'natural forest' (UNITED STATES OF AMERICA)
283	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
284	4	6	50	0	0	This sentence about a specific scenario does not fit well with the very general statements made so far. (Friend, Andrew, University of Cambridge)
285	4	6	50	6	51	The last sentence of the page seems not linked with the previous ones (Cassardo, Claudio, University of Torino)
286	4	7	9	0	0	any confidence'? perhaps 'high confidence'? (Friend, Andrew, University of Cambridge)
287	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. (Friend, Andrew, University of Cambridge)
288	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%. (Mach, Katharine, IPCC WGII TSU)
289	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. (Loustau, Denis, INRA)
290	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. (Friend, Andrew, University of Cambridge)
291	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. (Shaohong, Wu, Chinese Academy of Agricultural Sciences)
292	4	7	19	0	0	Suggesting rephrasing sentence and delete "no longer" since ecologists don't generally view ecosystems as unchanging historicaly 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)
293	4	7	22	0	0	What does 'relatively constant environment' reall mean? (Friend, Andrew, University of Cambridge)
294	4	7	22	7	22	It would be helpful to clarify what is meant by "attempts to restrict this intrinsic variation." (Mach, Katharine, IPCC WGII TSU)
295	4	7	23	0	0	Why is this relevant? Surely the chapter should focus on facts? (Friend, Andrew, University of Cambridge)
296	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. (Strong, Aaron, Stanford University)
297	4	7	26	7	26	Gunderson and Holling, 2001 reference now 13 years old. Consider updating. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
298	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
299	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. (Mach, Katharine, IPCC WGII TSU)
300	4	7	34	0	0	Tipping points may be redox changes rendering aquatic systems from sinks (oxic) to sources (anoxic) of CO2, e.g. after increased terrestrial DOC input… (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
301	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
302	4	7	36	7	36	'et al' should be in italics, with a full stop after the 'l' and a comma before the date. (Burt, Peter, University of Greenwich)
303	4	7	37	0	0	Not clear what this means. (Friend, Andrew, University of Cambridge)
304	4	7	39	0	0	include: or changes in intraguilt 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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
305	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)
306	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)
307	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)
308	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. (Mach, Katharine, IPCC WGII TSU)
309	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)
310	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)
311	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 diretional, stabilizing or disruptive. (Urban, Mark, University of Connecticut)
312	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)
313	4	8	7	8	8	A particular case of what? Plasticity? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
314	4	8	7	8	8	This statement could be clarified. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
315	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. (Urban, Mark, University of Connecticut)
316	4	8	9	8	18	Should it be explicitly mentioned that range shifts and changes in distribution are forms of adaptation through ecological change? (Mach, Katharine, IPCC WGII TSU)
317	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)
318	4	8	11	0	0	….by other species with similar functional attributes (Scharfenberger et al. 2013). (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
319	4	8	11	8	11	And why not by species with different functional attributes? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
320	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 Llusià, Martin Garbulsky, Iolanda Filella and Alistair S. Jump 2013, DOI: 10.1111/gcb.12143 (Penuelas, Josep, CREAF-CSIC)
321	4	8	16	8	16	The distinction between formal and informal attribution is unclear. (UNITED STATES OF AMERICA)
322	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 (Webb, Robert, NOAA OAR ESRL)
323	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) (http://biogeosciences-discuss.net/7/7449/2010/bgd-7-7449-2010.pdf) are additional global sets of projections that could be compared here. (Moritz, Max, University of California, Berkeley)
324	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)
325	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)
326	4	8	21	8	21	"Biomes shifts from 1700AD" (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
327	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). (Webb, Robert, NOAA OAR ESRL)
328	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)
329	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. (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
330	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)? (Estrada, Yuka, IPCC WGII TSU)
331	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. (Webb, Robert, NOAA OAR ESRL)
332	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)? (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
333	4	8	36	8	36	If the "Arrows indicate general direction of shifts" then make the arrows bigger in the figure. (Webb, Robert, NOAA OAR ESRL)
334	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. (Loustau, Denis, INRA)
335	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)
336	4	8	39	8	39	How is "severe ecosystem change" defined--biome shifts? (Mach, Katharine, IPCC WGII TSU)
337	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)
338	4	8	40	8	40	all? What means "all"? Figure shows seven lines. Are they only seven ecosystem models in the world? (Cassardo, Claudio, University of Torino)
339	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. (Estrada, Yuka, IPCC WGII TSU)
340	4	8	42	0	0	centered (Loustau, Denis, INRA)
341	4	8	42	8	42	Correct typo in middle of line ('cente4red'). (Burt, Peter, University of Greenwich)
342	4	8	42	8	42	correct the typo in "cente4red" (Cassardo, Claudio, University of Torino)
343	4	8	44	8	44	It would be clearest to remove the parentheses around "annual." (Mach, Katharine, IPCC WGII TSU)
344	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
345	4	8	49	8	50	Is there good agreement? It would be helpful to clarify this. (Mach, Katharine, IPCC WGII TSU)
346	4	9	1	0	0	The chapter is rather haphazard. What is the overall aim? No plan seems evident. (Friend, Andrew, University of Cambridge)

#	Ch	From Page	From Line	To Page	To Line	Comment
347	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 anthropgenic 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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
348	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)
349	4	9	6	0	0	It read inconsistently to now include simple definitions along with the likelihood statements. (Friend, Andrew, University of Cambridge)
350	4	9	12	9	12	precise "…ca 65 Ma; for comparison with actual state, see Barnovsky et al., 2011". (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
351	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. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
352	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 (Macinnis-Ng, Cate, University of Auckland)
353	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). (Burt, Peter, University of Greenwich)
354	4	9	20	0	0	speciation also! (Friend, Andrew, University of Cambridge)
355	4	9	20	9	20	"potentially" ??!! Suppress (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
356	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)
357	4	9	23	0	0	remove 'of a speed' (Friend, Andrew, University of Cambridge)
358	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" (Silvertown, Jonathan, The Open University)

#	Ch	From Page	From Line	To Page	To Line	Comment
359	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
360	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). (Burt, Peter, University of Greenwich)
361	4	9	23	9	23	Suggest deletion "of a speed" (CANADA)
362	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)
363	4	9	26	9	26	Change 'humans' to 'human'. (Burt, Peter, University of Greenwich)
364	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 exterpated, not extinct. (Caffrey, Maria, National Park Service and University of Colorado, Boulder)
365	4	9	28	9	28	small number' is imprecise (and poor scientific expression): please quantify. (Burt, Peter, University of Greenwich)
366	4	9	29	9	29	The phrase "climate excursions" is unclear, suggest clarifying or using another term. (UNITED STATES OF AMERICA)
367	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.” (Plattner, Gian-Kasper, IPCC WGI TSU)
368	4	9	42	0	0	and atmospheric CO2 change (Friend, Andrew, University of Cambridge)
369	4	9	50	0	0	The word "ecosystem" seems to be missing after "terrestrial" (UNITED STATES OF AMERICA)
370	4	9	50	9	50	… state of the art vegetation models… (such as ??) (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
371	4	9	51	0	0	I assume 'terrestrial vegetation' (Friend, Andrew, University of Cambridge)
372	4	9	51	9	51	Insert "ecosystems" after "terrestrial". (CANADA)
373	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)
374	4	9	53	0	0	Could also cite Friend et al. (PNAS submitted) (Friend, Andrew, University of Cambridge)
375	4	9	53	0	0	could also cross-reference to WG1 Ch.6, sec 6.4 (Jones, Chris, Met Office)
376	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). (Burt, Peter, University of Greenwich)
377	4	9	53	9	53	Suggest "forced by projected 21st century climate change" in place of "applied to 21st century climate change". (CANADA)
378	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)
379	4	10	2	0	0	Better to say 'if future climate is different from the recent past…' (Friend, Andrew, University of Cambridge)
380	4	10	4	10	4	remove bracket ")" (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
381	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
382	4	10	7	10	7	It is not clear whether “aquatic” refers only to inland waters. (Strong, Aaron, Stanford University)
383	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). (Burt, Peter, University of Greenwich)
384	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. (Urban, Mark, University of Connecticut)
385	4	10	24	10	25	"State of the art climate and Earth systems models " (provide examples) (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
386	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. (Friend, Andrew, University of Cambridge)
387	4	10	26	10	26	Is confidence in earth system models to capture "the full range of abrupt change" low rather than medium? (CANADA)
388	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)
389	4	10	26	10	28	What are the implications of this? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
390	4	10	31	0	0	Section 4.2.3. This paragraph could be shortened and merged into 4.2.1. (Mach, Katharine, IPCC WGII TSU)
391	4	10	31	10	38	Authors could consider toucing 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)
392	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)
393	4	10	37	10	37	Delete ' at start of line. (Burt, Peter, University of Greenwich)
394	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. (Strong, Aaron, Stanford University)
395	4	10	38	10	39	Berkes et al., 2003 is somewhat outdated. This is good, but are there others ? (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
396	4	10	41	11	6	Please consider including "fragmentation" as an important cause. (NORWAY)
397	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)
398	4	10	43	0	0	CO2 as well (Friend, Andrew, University of Cambridge)
399	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)
400	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
401	4	10	44	10	44	"biological invasions" ?? (this could be changed to "biological invasive species" (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
402	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)
403	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
404	4	10	47	10	47	experiment Larsen -> experiment (Larsen (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
405	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)
406	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)
407	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)
408	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 (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
409	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
410	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)
411	4	11	3	0	0	…future changes predicted (Huber et al. 2008) (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
412	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)
413	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)
414	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)
415	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 ecosystens/species in itself or in combination with climate change. (NORWAY)
416	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." (Plattner, Gian-Kasper, IPCC WGI TSU)
417	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 (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
418	4	11	11	0	0	Missing: changes in water usage, e.g. increase in aquaculture and river daming which greatly alter ecosystem function… (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
419	4	11	11	11	14	Suggest inlcuding a mention of industrial logging here, especially for the tropics. (UNITED STATES OF AMERICA)
420	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)
421	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)
422	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)
423	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)
424	4	11	18	11	20	The sentence "In the future climate change is…" need to be rephrased. (Ambulkar, Archis, Brinjac Engineering Inc.)
425	4	11	18	11	22	I suggest the conclusion in this part should be supported by references.Please provide references cited. (wang, chunfeng, State Forestry Administration, China)
426	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)
427	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
428	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)
429	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 emittors of CO2. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
430	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)
431	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. (Pope, Edward, Met Office)
432	4	11	34	11	46	Paragraph is difficult to follow. Clearly state the effect of latitude on albedo and transpiration. (CANADA)
433	4	11	34	11	46	de Noblet et al, and Brovkin et al studies are relevant here [give refs] (Jones, Chris, Met Office)
434	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: http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00623.1] (Jones, Chris, Met Office)
435	4	11	35	0	0	Absorption changes, but it is the partitioning of that energy that has a large effect as well (Friend, Andrew, University of Cambridge)
436	4	11	35	11	35	, as well as through evaporation (as stated line 38) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
437	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
438	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) Bigeosciences Discussions 9: 14369-14687. (CANADA)
439	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. (wang, chunfeng, State Forestry Administration, China)
440	4	11	45	0	0	Could more specific examples be provided for "changes" ? Are these Increases? (UNITED STATES OF AMERICA)
441	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)
442	4	11	46	11	46	Place references in alphabetical order (Burt, Peter, University of Greenwich)
443	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. (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)

#	Ch	From Page	From Line	To Page	To Line	Comment
444	4	11	48	11	48	Suggest adding "and reforestation/restoration" after "Afforestation" (UNITED STATES OF AMERICA)
445	4	11	48	11	50	Please add comma i.e. "over the long term, afforestation". (Ambulkar, Archis, Brinjac Engineering Inc.)
446	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)
447	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)
448	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. (Gonzalez, Patrick, National Park Service)
449	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)
450	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 responsability. They have strong conflicting interest with the topic as there firm developp bioenergy crops in developping countries. So suppress your sentence. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
451	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)
452	4	11	52	12	2	This seems too vague - please specify "other biophysical effects". (CANADA)
453	4	12	4	0	0	Sentence "The reported effects on precipitation due to conversion of forest…" might be easier to understand. (Ambulkar, Archis, Brinjac Engineering Inc.)
454	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. (wang, chunfeng, State Forestry Administration, China)
455	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. (Pope, Edward, Met Office)
456	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. (Loustau, Denis, INRA)
457	4	12	12	12	12	Delete comma after 'al.'. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
458	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)
459	4	12	19	12	21	This sentence is standing alone as a paragraph. Is it possible to integrate it elsewhere? (CANADA)
460	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)
461	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). (Burt, Peter, University of Greenwich)
462	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)
463	4	12	25	13	37	Box 4.1: Coordination with WGI Ch6 and Ch12 is strongly suggested. (Plattner, Gian-Kasper, IPCC WGI TSU)
464	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)
465	4	12	31	12	31	'per capita' should be in italics. (Burt, Peter, University of Greenwich)
466	4	12	32	0	0	Term OECD used for first time in this chapter is not defined here. (Ambulkar, Archis, Brinjac Engineering Inc.)
467	4	12	32	0	0	Suggest spelling out OECD (UNITED STATES OF AMERICA)
468	4	12	33	12	39	The sentence is too long to comprehend, if possible, please split it into more than one sentence. (Ambulkar, Archis, Brinjac Engineering Inc.)
469	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) (https://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp) might give evidence for that. (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
470	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)
471	4	12	41	12	41	'per capita' should be in italics. (Burt, Peter, University of Greenwich)
472	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)
473	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)
474	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)
475	4	12	52	0	0	"RCP" = Representative Concentration Pathway, not "Regional". (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
476	4	13	8	13	8	should read …"a number of climate change related socioeconomic and policy driven pathways" (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)

#	Ch	From Page	From Line	To Page	To Line	Comment
477	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 ‰ÛÒ 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)
478	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) (Jones, Chris, Met Office)
479	4	13	9	13	9	" title should be "Land Use Cover Change (LUCC)" (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
480	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? (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
481	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). (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
482	4	13	15	13	17	Is RCP2.6 compatible with the aforementioned possibilty that increased forest cover means increased warming? Page 11, lines 48+. (UNITED STATES OF AMERICA)
483	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 (Cassardo, Claudio, University of Torino)
484	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)
485	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)
486	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). (Webb, Robert, NOAA OAR ESRL)
487	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. (Kasurinen, Anne, University of Eastern Finland)
488	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. (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
489	4	13	42	0	0	Role of freshwaters and wetlands are particularly important for denitrification, this is comletely 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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)

#	Ch	From Page	From Line	To Page	To Line	Comment
490	4	13	42	13	43	Please add the following literatures: (1) Canfield DE, Glazer AN, Falkowski PG. 2010. The evoluation 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. (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
491	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? (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
492	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. (Mach, Katharine, IPCC WGII TSU)
493	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)
494	4	13	52	13	52	in many terrestrial and oceanic ecosystems (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
495	4	13	52	14	3	Can this N deposition be traced back its sources? (Shaohong, Wu, Chinese Academy of Agricultural Sciences)
496	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. (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
497	4	13	54	0	0	Also cite doi: 10.1038/ngeo01207 (Friend, Andrew, University of Cambridge)
498	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
499	4	14	1	14	3	are there any examples of Nitrogen deposition in the Pacific or Oceania regions? (not just Western Europe)? (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
500	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. (Penuelas, Josep, CREAF-CSIC)
501	4	14	5	14	5	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Burt, Peter, University of Greenwich)
502	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 (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
503	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
504	4	14	24	0	0	The impact….in freshwater systems (reference: Weyhenmeyher et al. 2007), since they……(Weyhenmeyer, G.A., E. Jeppesen, R.Adrian, T. Blenckner, T. Jankowski, E. Jennings, J.P. Jensen, P. Nõges, T. Nõges & D. Straile (2007). Nitrate-depleted conditions on the increase in shallow northern European lakes. Limnology and Oceanography 52(4), 1346-1353. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
505	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
506	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. (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
507	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? (Burt, Peter, University of Greenwich)
508	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)
509	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 (Jones, Chris, Met Office)
510	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)
511	4	14	42	14	43	in line 42 change "hemisphere, however" with "hemisphere. However"; in line 43, remove "are" (Cassardo, Claudio, University of Torino)
512	4	14	43	0	0	Please correct "changes in precipitation are may exceed…" (Ambulkar, Archis, Brinjac Engineering Inc.)
513	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)
514	4	14	43	14	43	"are" (typo?) (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
515	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 (Cassardo, Claudio, University of Torino)
516	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 evoluation and future of Earth's nitrogen cycle. Science 330:192-196. (Chen, Minpeng, Insitution of Environment and Sustainable Development in Agriculture)
517	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)? (Kasurinen, Anne, University of Eastern Finland)
518	4	15	1	0	0	Lack of knowledge on effects on inland water systems (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
519	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. (wang, chunfeng, State Forestry Administration, China)

#	Ch	From Page	From Line	To Page	To Line	Comment
520	4	15	1	15	41	no mention of how tropopheric ozone is affecting humans directly in diffeent parts of the Earth (i.e Tropical vs. temperate lands,etc). (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
521	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." (Plattner, Gian-Kasper, IPCC WGI TSU)
522	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 centence of "certain amount of ozone in the atmosphere is necessary for mankind and other linving things, such as sterilization and preventing from rickets (citations)" before saying negative effects of ozone. (Shaohong, Wu, Chinese Academy of Agricultural Sciences)
523	4	15	3	15	4	You must give significant quantitative data in ppb (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
524	4	15	3	15	9	VOC is an important issue. (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
525	4	15	7	15	7	Change 'VOC' to 'VOCs'. (Burt, Peter, University of Greenwich)
526	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 (C5H8), monoterpene (C10H16), 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. Thereforec, 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). (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
527	4	15	12	15	12	change "focussed" in "focused" (Cassardo, Claudio, University of Torino)
528	4	15	14	15	14	For the percentage given here, is it possible to specify the relevant range/uncertainties? (Mach, Katharine, IPCC WGII TSU)
529	4	15	15	15	16	this means that NPP for other ecosystems than temperate forests is predicted to increase up to 50%? (Cassardo, Claudio, University of Torino)
530	4	15	22	0	0	A correction might be needed "generally reduced and resipration increased…" (Ambulkar, Archis, Brinjac Engineering Inc.)
531	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)

#	Ch	From Page	From Line	To Page	To Line	Comment
532	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. (Cassardo, Claudio, University of Torino)
533	4	15	27	15	27	Add perhaps This emphasizes the very great complexity of climatic chane impact. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
534	4	15	29	15	31	For this projection, what is the timeframe and range of projected values beyond the central estimate given? (Mach, Katharine, IPCC WGII TSU)
535	4	15	34	15	50	The term FACE is defined in line 50, however this abbrevation is used earlier in line 34. So, FACE should be defined in line 34 instead (as is used there for first time). (Ambulkar, Archis, Brinjac Engineering Inc.)
536	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 O3 resistant varieties smaller is 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 O3 concentrations in the near future)? (Kasurinen, Anne, University of Eastern Finland)
537	4	15	40	15	41	References should be in chronological order. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
538	4	15	44	17	41	4.2.4.4 Rising CO2 well express the impacts of rising CO2 on plant ecosystem,especilly 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 prograss.The karst system sensitively respond to clmate change, especially the karst processes have a closed relation with air CO2 contend（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. Rolf 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 vegetaion 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. Jounrnal 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. (Jiang, Zhongcheng, Institute of Karst Geology,CAGS)
539	4	15	46	0	0	Lack of studies of pCO2 effects on inland waters which is contrary to terrestrial or oceanic systems… Particularly, on nteractions between terrrestrial and aquatic systems! (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
540	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 (Jones, Chris, Met Office)

#	Ch	From Page	From Line	To Page	To Line	Comment
541	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. (wang, chunfeng, State Forestry Administration, China)
542	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? (Shaohong, Wu, Chinese Academy of Agricultural Sciences)
543	4	15	46	16	54	No mention of tropical forests and FACE. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
544	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)
545	4	16	2	0	0	The word 'system' may be changed to 'systems'. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
546	4	16	3	0	0	Please check if the word 'been' after 'assimilation' can be deleted. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
547	4	16	8	16	11	This sentence is unclear. Suggest revising. (CANADA)
548	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)
549	4	16	11	0	0	The end bracket after '(2012' may be added. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
550	4	16	11	16	11	(2012 did -> (2012) did (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
551	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. (Loustau, Denis, INRA)
552	4	16	17	16	18	Place references in chronological order (Burt, Peter, University of Greenwich)
553	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)
554	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) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
555	4	16	20	16	20	via' should be italics (Burt, Peter, University of Greenwich)
556	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)
557	4	16	24	16	24	Place Carney and Drake references in chronological order. (Burt, Peter, University of Greenwich)
558	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)
559	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
560	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)
561	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)
562	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)
563	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. Global Ecology and Biogeography 20: 597-608. (Penuelas, Josep, CREAF-CSIC)
564	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. (Strong, Aaron, Stanford University)
565	4	16	52	0	0	spatial' scale? (Friend, Andrew, University of Cambridge)
566	4	17	1	17	9	Difficult to understand. Consider revising. (CANADA)
567	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 CO2effects 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)
568	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)
569	4	17	4	17	5	Uncomprehensible (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
570	4	17	5	0	0	Also cite Friend et al. (submitted, PNAS) (Friend, Andrew, University of Cambridge)
571	4	17	6	17	6	Put as much as (than) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
572	4	17	7	0	0	I am not sure how formulations of photosynthesis would be influenced by FACE experiments as implied here (Friend, Andrew, University of Cambridge)
573	4	17	7	0	0	What are implications of DGVMs not including FACE experiments? (UNITED STATES OF AMERICA)
574	4	17	11	17	24	Good et al. (J. Climate, 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) (Jones, Chris, Met Office)
575	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)
576	4	17	28	17	28	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Burt, Peter, University of Greenwich)
577	4	17	29	17	29	Space reuired between number and unit (Burt, Peter, University of Greenwich)
578	4	17	32	0	0	The end bracket after 'ppmv)' may be removed. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
579	4	17	33	17	33	21st Century -> 21st century (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)

#	Ch	From Page	From Line	To Page	To Line	Comment
580	4	17	34	17	34	Rather RCP 4.5 (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
581	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)
582	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)
583	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)
584	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 productiviity and water resources (Friend, Andrew, University of Cambridge)
585	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 synthetize 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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
586	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)
587	4	17	46	0	0	Lack of knowledge on the effects of changes in radiation on inland waters. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
588	4	17	47	0	0	Please check if the word 'between' can be replaced with 'as'. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
589	4	17	48	0	0	with more diffuse 'is reduced' meaning 'has been'? over what timescale? (Friend, Andrew, University of Cambridge)
590	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)
591	4	17	49	0	0	Reduced by up to 30 W m-2 since when? Please clarify. (UNITED STATES OF AMERICA)
592	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)
593	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 (Jones, Chris, Met Office)
594	4	18	3	0	0	21st Century -> 21st century (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
595	4	18	3	18	3	Insert 'the' after'of'. (Burt, Peter, University of Greenwich)
596	4	18	5	18	6	Look up the Boucher et al. reference to see if a full, formal citation is avaialble yet. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
597	4	18	9	0	0	Section 4.2.4.6. “Invasive and Alien Species“. I think it would be important to explain the different between invasive and alien species (in the glossary?) (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
598	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 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
599	4	18	11	18	18	it should be add one comment that alien species occure in regions not only because of climate change but also because of human activity - for example inland water navigation, transport etc. (POLAND)
600	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. (Urban, Mark, University of Connecticut)
601	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. (Penuelas, Josep, CREAF-CSIC)
602	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 droghts etc., fascilitating invasion… (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
603	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.. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
604	4	18	23	18	24	This is not clear. Is there a reference to support this statement? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
605	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
606	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 habit where drought is an important filter? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
607	4	18	31	0	0	Define the term resource pulses (UNITED STATES OF AMERICA)
608	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. (fleming, richard arthur, canadian forest service)
609	4	18	34	18	34	Insert commas either side of 'however'. (Burt, Peter, University of Greenwich)
610	4	18	38	18	38	'chapter' should be 'Section' (with a capital 'S' as a proper noun in this context). (Burt, Peter, University of Greenwich)
611	4	18	39	18	40	Statement may not be entirely accurate. Suggest that authors review additional information or rephrase. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
612	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)
613	4	18	42	18	45	Difficult to follow. Examples of interactive effects are too disparate. (CANADA)
614	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)
615	4	18	52	0	0	Explain/define "threat syndromes" (UNITED STATES OF AMERICA)
616	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)
617	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
618	4	19	2	0	0	surprisingly little so far on freshwater ecosystems (Friend, Andrew, University of Cambridge)
619	4	19	9	0	0	Robinet and Roques refer to forest not crops. (Loustau, Denis, INRA)
620	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)
621	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?). (fleming, richard arthur, canadian forest service)
622	4	19	10	0	0	is this insect invasive? (Friend, Andrew, University of Cambridge)
623	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. (Loustau, Denis, INRA)
624	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)
625	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. (Gonzalez, Patrick, National Park Service)
626	4	19	17	0	0	Section 4.3. In preparing the final draft, the chapter team should shorten this section by 50%. (Mach, Katharine, IPCC WGII TSU)
627	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)
628	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..." (Gonzalez, Patrick, National Park Service)

#	Ch	From Page	From Line	To Page	To Line	Comment
629	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)
630	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. (Mastrandrea, Michael, IPCC WGII TSU)
631	4	19	20	19	20	An ecosystem cannot evolve, only populations can (Urban, Mark, University of Connecticut)
632	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? (Friend, Andrew, University of Cambridge)
633	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. J. Ecol. 84(4): 539–548. Muir, P.S., and Lotan, J.E. 1985. Disturbance history and serotiny of Pinus contorta in western Montana. Ecology, 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. Can. J. For. Res. 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. Ecol. Monogr. 75(4): 561–583. Moss, M., and Hermanutz, L. 2009. Postfire seedling recruitment at the southern limit of lichen woodland. Can. J. For. Res. 39(12): 2299–2306. doi:10.1139/X09-150. Baskerville, G.L. 1975. Spruce budworm: super silviculturist. For. Chron. 51(4): 138–140. Duchesneau, R., and Morin, H. 1999. Early seedling demography in balsam fir seedling banks. Can. J. For. Res. 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. Can. J. For. Res. 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. New Phytol. 170(4): 657–675. (CANADA)

#	Ch	From Page	From Line	To Page	To Line	Comment
634	4	19	29	0	0	components instead of "factors" (Loustau, Denis, INRA)
635	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." (Webb, Robert, NOAA OAR ESRL)
636	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)
637	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. (Urban, Mark, University of Connecticut)
638	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 (Urban, Mark, University of Connecticut)
639	4	19	36	0	0	predicted future change? (Friend, Andrew, University of Cambridge)
640	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)
641	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)
642	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)
643	4	19	37	19	39	This sentence appears to be incomplete. Suggest reviewing. (CANADA)
644	4	19	39	0	0	Something seems to be missing in this second part after the colon (Urban, Mark, University of Connecticut)
645	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 ? (Loustau, Denis, INRA)
646	4	19	39	0	0	Use of phrase 'outside this range they have adapted to' is unclear. (UNITED STATES OF AMERICA)
647	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)
648	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)
649	4	19	45	19	45	improve sentence (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
650	4	19	45	19	45	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
651	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
652	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)
653	4	19	47	19	49	Develop more. Consider the interplay between climate change, fuel structure and fire (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
654	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)
655	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? (Mach, Katharine, IPCC WGII TSU)
656	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)
657	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)
658	4	20	5	20	14	The calibrated uncertainty language used on lines 5-6, 9-10 and 14 should be italicized for clarity. (Mach, Katharine, IPCC WGII TSU)
659	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
660	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 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. (Webb, Robert, NOAA OAR ESRL)
661	4	20	12	0	0	Include reference at the end of line (Adrian et al. 2009)- is already in the reference list. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
662	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)
663	4	20	18	20	18	Delete 'the' and use capital 'S' for 'Section'. (Burt, Peter, University of Greenwich)
664	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)
665	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)
666	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 (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
667	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). (Burt, Peter, University of Greenwich)
668	4	20	22	20	22	"high confidence" should be italicized for clarity. (Mach, Katharine, IPCC WGII TSU)
669	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)
670	4	20	30	20	30	and also in Fig. 4-5 pag. 147: change "points" in "boxes" (Cassardo, Claudio, University of Torino)
671	4	20	33	20	43	Excellent overview of the state of the literature. (Wolkovich, Elizabeth, University of British Columbia)
672	4	20	33	22	43	For all these paragraphs, GIVE REFERENCES (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
673	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. (wang, chunfeng, State Forestry Administration, China)
674	4	20	33	22	43	These summaries seem out of place - perhaps include them in the relevant sections instead. (CANADA)
675	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
676	4	20	33	22	43	Such big part of text reads as a summary of the folloing text, it is very odd to have this "summary". Suggest deleting. (Shaohong, Wu, Chinese Academy of Agricultural Sciences)
677	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
678	4	20	36	20	36	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
679	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)
680	4	20	37	20	37	"medium agreement" should be used instead of "moderate agreement." (Mach, Katharine, IPCC WGII TSU)
681	4	20	41	0	0	low instead of "high" (Loustau, Denis, INRA)
682	4	20	41	20	41	Should text in italics read "low confidence" or "medium confidence"? The rest of the sentence implies it should do. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
683	4	20	45	0	0	Should it be "Primary Productivity, Biomass and C Stocks" - removing extra "and". (Ambulkar, Archis, Brinjac Engineering Inc.)
684	4	20	46	0	0	Define/explain eddy flux towers (UNITED STATES OF AMERICA)
685	4	20	46	20	46	Suggest including inventory-based models in this list (Pan et al., 2011), Ch 4, P 25, L 32. (CANADA)
686	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)
687	4	20	49	20	49	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
688	4	20	49	20	53	References required (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
689	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)
690	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)
691	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. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
692	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
693	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 (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
694	4	21	3	21	3	"low agreement" should be italicized for clarity. (Mach, Katharine, IPCC WGII TSU)
695	4	21	4	21	7	I don't think para 4.3.2.4 can support “The trend of rising……land management and irrigation.” (wang, chunfeng, State Forestry Administration, China)
696	4	21	5	0	0	The word 'in' after 'trend' is suggested to be deleted. (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
697	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
698	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 showning this is the case for birds (Tingley et al. 2012) and mammals (Mortiz et al. 2008). (Urban, Mark, University of Connecticut)
699	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)
700	4	21	14	21	15	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
701	4	21	18	21	18	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
702	4	21	22	21	22	Change 'importance' to 'important'. (Burt, Peter, University of Greenwich)
703	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…" (Ambulkar, Archis, Brinjac Engineering Inc.)
704	4	21	23	0	0	"that" after recognition is missing. (Loustau, Denis, INRA)
705	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)
706	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? (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
707	4	21	30	21	30	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
708	4	21	37	21	37	Add previsions 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. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
709	4	21	37	21	37	Suggest using "invasive pathogens" rather than "invasive disease". (UNITED STATES OF AMERICA)
710	4	21	39	21	40	Imprecise, and bad English. I suggest 'have increased' rather than 'are increasing' and 'since 19XX' rather than 'over ..decades'. (Burt, Peter, University of Greenwich)
711	4	21	39	21	40	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
712	4	21	45	21	48	It would be preferable to specify the approximate time frame for these changes. (Mach, Katharine, IPCC WGII TSU)
713	4	21	45	21	51	Tree mortality. If warming increases the stem height growth more than stem diameter growht, 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 precipatation comes as water, not snow): any information about this risk? (Kasurinen, Anne, University of Eastern Finland)
714	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)
715	4	21	49	21	49	It would be helpful to indicate more precisely approximately how many decades are meant by "the last several decades." (Mach, Katharine, IPCC WGII TSU)
716	4	21	52	22	20	What is meant by Regimes shift in each of the subsection titles? What regimes are being referred to? (CANADA)
717	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. (fleming, richard arthur, canadian forest service)
718	4	22	2	22	2	Suggest changing "morality" to "mortality" (CANADA)
719	4	22	2	22	2	typo: "morality" --> "mortality" (Cassardo, Claudio, University of Torino)
720	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)
721	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. (fleming, richard arthur, canadian forest service)
722	4	22	6	22	7	Perhaps insert "recent" before "climate change" at end of L. 6? (CANADA)

#	Ch	From Page	From Line	To Page	To Line	Comment
723	4	22	9	22	10	It would be preferable to indicate more specifically the approximate timeframe for these changes. (Mach, Katharine, IPCC WGII TSU)
724	4	22	10	22	10	"medium confidence" should be used in place of "moderate confidence." (Mach, Katharine, IPCC WGII TSU)
725	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"... (Cassardo, Claudio, University of Torino)
726	4	22	20	22	20	It would be preferable to specify the approximate timeframe for these observed changes. (Mach, Katharine, IPCC WGII TSU)
727	4	22	20	22	27	can you say anything here on wetland extent changes and changes in lake (number or extent) (Jones, Chris, Met Office)
728	4	22	29	22	29	Cultural landscapes should have more diversified examples not just from Japan or Europe. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
729	4	22	29	22	31	It would be preferable to indicate the approximate timeframe for these changes. (Mach, Katharine, IPCC WGII TSU)
730	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)
731	4	22	32	22	32	Delete comma after 'al.'. (Burt, Peter, University of Greenwich)
732	4	22	35	22	35	Change 'are' to 'is' to avoid mismatch of singular and plural. (Burt, Peter, University of Greenwich)
733	4	22	35	22	36	Why is rapid evolutionary in quotes? This is a well-established concept - no need for quotes (Urban, Mark, University of Connecticut)
734	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. (Urban, Mark, University of Connecticut)
735	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
736	4	22	37	22	41	Need to define/explain phenotypic versus phonological (UNITED STATES OF AMERICA)
737	4	22	42	0	0	Suggestion "well-studied cases means that there…" (Ambulkar, Archis, Brinjac Engineering Inc.)
738	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
739	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 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
740	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)
741	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)
742	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 pelase check the rest of the Chapter). (Burt, Peter, University of Greenwich)
743	4	22	51	0	0	Suggestion to add comma - "Since the AR4, many…" (Ambulkar, Archis, Brinjac Engineering Inc.)
744	4	22	51	22	51	Do you mean the adaptive evolution here of phenology? If not just call them phenological changes (Urban, Mark, University of Connecticut)
745	4	22	52	22	52	Section 4.3.2.1 Phenology: Additional reference to phenological adaptions of amphibians to climate change, and also uniquely documenting local adaptation in phenology Phillimore, 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. (Oliver, Tom, Centre for Ecology and Hydrology)
746	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.) (Wolkovich, Elizabeth, University of British Columbia)
747	4	22	54	0	0	Add reference after primak 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. Global Change Biology 2013, DOI: 10.1111/gcb.12143 (Penuelas, Josep, CREAF-CSIC)
748	4	22	54	0	0	…Primack et al. 2009; marine and freshwater plankton: Adrian et al. 2009, Adrian et al. 2012) and meta analyses…. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
749	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 (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
750	4	23	4	0	19	When authors say the spring pheonology 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)
751	4	23	6	23	6	The acronym NDVI needs expanding here. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
752	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
753	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)
754	4	23	14	23	14	References required (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
755	4	23	15	23	19	in this sentence I cannot find the verb… (Cassardo, Claudio, University of Torino)
756	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)
757	4	23	18	23	18	Suggest changing "to reveal" to "reveals" (CANADA)
758	4	23	21	23	21	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 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
759	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). (Urban, Mark, University of Connecticut)
760	4	23	21	23	29	good to see causal links explained (fleming, richard arthur, canadian forest service)
761	4	23	23	23	23	Change 'on' to 'in'. (Burt, Peter, University of Greenwich)
762	4	23	24	23	25	change "-3.70 days/decade +/-0.7" with "-3.7 +/- 0.7 days/decade" (Cassardo, Claudio, University of Torino)
763	4	23	26	0	0	Please define/explain what is meant by: mean parturition (UNITED STATES OF AMERICA)
764	4	23	27	23	29	This sentence is incomplete. Suggest reviewing. (CANADA)
765	4	23	27	23	29	the "significant delay of the mean breeding date" is correlated to what? (Cassardo, Claudio, University of Torino)
766	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)
767	4	23	35	0	0	Suggested change "Insects also show…" (Ambulkar, Archis, Brinjac Engineering Inc.)
768	4	23	35	23	39	yes (fleming, richard arthur, canadian forest service)

#	Ch	From Page	From Line	To Page	To Line	Comment
772	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. Freshwater Biol. 41: 621–623. Weyhenmeyer G. A., T. BLENCKNER, AND K. PETTERSSON. 1999. Changes of the plankton spring outburst related to the North Atlantic Oscillation. Limnol. Oceanogr. 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. Limnology and Oceanography 45(5):1058-1066. Blenckner, T., R. Adrian, D. M. Livingstone, E. Jennings, C. N.Aonghusa, D. G. George, T. Jankowski, M. Järvinen, T. Nõges, D. Straile, K. Teubner, G. A. Weyhenmeyer (2007) Large-scale climatic signatures in lakes across Europe: A meta – analysis. Global Change Biology, 13, 1314-1326.

#	Ch	From Page	From Line	To Page	To Line	Comment
772.2	4	23	40	0	0	doi: 10.1111/j.1365-2486.2007.01364.x STRAILE, D. 2002. The North Atlantic Oscillation synchronizes food-web interactions in central European lakes. Proc. Royal Soc. B Bio. 269: 391–395. Gerten, D. & R. Adrian (2002) Species specific response of freshwater copepods to recent summer warming. Freshwater Biology 47: 2163-2173. Winder M., AND D. E. SCHINDLER. 2004. Climate change uncouples trophic interactions in a lake ecosystem. Ecology 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. Global Change Biology 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. Limnol. Oceanogr. 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. Ecology 86: 198–209. Søndergaard, M., Jensen, J.P. & Jeppesen, E. (2003) Role of sediment and internal loading of phosphorus in shallow lakes. Hydrobiologia, 506–509, 135–145. Mooij WM, Hülsman 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. Aquat Ecol 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. Freshwater Biology 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. PloSONE 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. TheScientificWorldJOURNAL 2: 586-606. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
773	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)
774	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)
775	4	23	45	23	45	and2002 -> and 2002 (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
776	4	23	45	23	45	Insert space after 'and'. (Burt, Peter, University of Greenwich)
777	4	23	45	23	45	typo: "and2002" --> "and 2002" (Cassardo, Claudio, University of Torino)
778	4	23	46	23	47	This sentence is not clear. Which factors explained "portions of variation in migratory changes"? (CANADA)
779	4	23	48	0	0	Instead of "attributed to changes in temperature changes…" should be revised to "attributed to temperature changes…" (Ambulkar, Archis, Brinjac Engineering Inc.)
780	4	23	52	23	52	Insert 'and' after 'temperature'. (Burt, Peter, University of Greenwich)
781	4	23	52	23	53	Suggest rewording as: "Interactions between temperature and precipitation determine snowmelt changes, which are reported to lead to…." (CANADA)
782	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)
783	4	24	1	24	3	yes - an adverse effect on insects. So be careful of broad generalizations. (fleming, richard arthur, canadian forest service)

#	Ch	From Page	From Line	To Page	To Line	Comment
784	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)
785	4	24	3	0	0	Suggested change "Mammals also show…" (Ambulkar, Archis, Brinjac Engineering Inc.)
786	4	24	3	24	2	Change 'show also' to 'also show' (better English) (Burt, Peter, University of Greenwich)
787	4	24	3	24	6	This sentence is hard to follow. Consider revising. (CANADA)
788	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
789	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. (Wolkovich, Elizabeth, University of British Columbia)
790	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. (Wolkovich, Elizabeth, University of British Columbia)
791	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: http://www.sciencemag.org/content/339/6127/1611.abstract). (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. (Wolkovich, Elizabeth, University of British Columbia)
792	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
793	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 (Opheroptera brumata L.) and pedunculate oak (Visser & Both 2005), and between sycamore and its associated aphid, Drepanosiphum platanoides 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, Zeiraphera diniana 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 Integrative Zoology 5: 132-142 Dixon AFG (2003). Climate change and phonological asynchrony. Ecological Entomology 28, 380–81. Visser ME, Both C (2005). Shifts in phenology due to global climate change: The need for a yardstick. Proceedings of the Royal Society of London B 272, 2561–9. Esper J, Büntgen U, Franck DC, Nievergelt D, Liebhold A (2007). 1200 years of regular outbreaks in alpine insects. Proceedings of the Royal Society of London B 274, 671-9. Visser ME, Both C (2005). Shifts in phenology due to global climate change: The need for a yardstick. Proceedings of the Royal Society of London B 272, 2561–9. Visser ME, Both C, Lambrechts MM (2004). Global climate change leads to mistimed avian reproduction. Advances in Ecological Research 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. Proceedings of the Royal Society of London B 275, 2005-13. Jonzen N, Hedenstrom A, Lundberg P (2007). Climate change and the optimal arrival of migratory birds. Proceedings of the Royal Society of London B 274, 269–74. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
794	4	24	32	24	32	Suggest changing "effect" to "affect" (CANADA)
795	4	24	33	24	33	What does the 'P.' stand for? Taxonomic rules dictate spelling out generic name on first usage. (Burt, Peter, University of Greenwich)
796	4	24	33	24	36	This sentence is hard to follow. Consider revising. (CANADA)
797	4	24	36	24	36	I don't understand this sentence (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
798	4	24	41	24	41	'per' should be in italics. (Burt, Peter, University of Greenwich)
799	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)
800	4	24	51	0	0	..(Cock et al 2008, Adrian etal. 2009) (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
801	4	24	51	24	51	"some studies": how many? Just two are mentioned… (Cassardo, Claudio, University of Torino)
802	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.) (Wolkovich, Elizabeth, University of British Columbia)
803	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)
804	4	24	52	24	53	Given the caveats expressed in previous sentences, suggest that "some" be inserted in front of "phenological shifts". (CANADA)

#	Ch	From Page	From Line	To Page	To Line	Comment
805	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)
806	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"? (Cassardo, Claudio, University of Torino)
807	4	24	53	24	53	'high agreement' should be in italics. (Burt, Peter, University of Greenwich)
808	4	25	0	0	0	Suggest using gender neutral language. Replace 'man' with 'human' (CANADA)
809	4	25	5	25	8	Suggest to delete the statement 'Primary production…..important indicators of ecosystem function' (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
810	4	25	6	25	6	Insert 'the' after 'of'. (Burt, Peter, University of Greenwich)
811	4	25	8	25	10	Suggested change "With a well-established theory, experimentation and observation, all agree…" (Ambulkar, Archis, Brinjac Engineering Inc.)
812	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). (Burt, Peter, University of Greenwich)
813	4	25	15	25	26	After "The first is", state where "The second is" (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
814	4	25	16	25	16	carbon dioxide' should be 'CO2'. (Burt, Peter, University of Greenwich)
815	4	25	18	25	19	Please define/explain sink term and source term (UNITED STATES OF AMERICA)
816	4	25	21	25	22	Use "estimated" rather than "postulated". Also, cite more recent Global Carbon Budget publications than 2009. (UNITED STATES OF AMERICA)
817	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 (Jones, Chris, Met Office)
818	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
819	4	25	23	0	0	ENSO term is not defined or elaborated in this chapter prior to being used in this sentence (Ambulkar, Archis, Brinjac Engineering Inc.)
820	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)
821	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 (Kukhta, Anna, Institute of Global Climate and Ecology of Roshydromet and RAS)
822	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)
823	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
824	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
825	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)
826	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)
827	4	25	34	25	40	This preamble about NDVI could be merged with the text on P. 23 and deleted from here. (CANADA)
828	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 (Kukhta, Anna, Institute of Global Climate and Ecology of Roshydromet and RAS)
829	4	25	35	25	35	NDVI is already used, define at first use. (UNITED STATES OF AMERICA)
830	4	25	39	25	39	This statement could be clarified. (Mach, Katharine, IPCC WGII TSU)
831	4	25	42	25	44	Please include a citation for the lack of a systematic change in growing season length. (CANADA)
832	4	25	48	25	48	Explain what a forb is. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
833	4	25	53	26	1	Suggest to delete the statement 'Tree ring record……to which the tree was exposed'. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
834	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-archaelogical 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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
835	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). (Burt, Peter, University of Greenwich)
836	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)
837	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)

#	Ch	From Page	From Line	To Page	To Line	Comment
838	4	26	20	26	25	Suggest to delete the statement 'Forest are routinely monitored for …….but have a lesser effect on trend detection' (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
839	4	26	21	26	21	Please provide a citation for "hundreds of small plots" for typical forest monitoring. (CANADA)
840	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. (Schrier, Arina, Wetlands International)
841	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)
842	4	26	29	0	0	REDD term is not defined or elaborated in this chapter prior to being used in this sentence (Ambulkar, Archis, Brinjac Engineering Inc.)
843	4	26	29	26	29	What is REDD+? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
844	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)
845	4	26	29	26	29	REDD+ should be defined and briefly described. (UNITED STATES OF AMERICA)
846	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 (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
847	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)
848	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)
849	4	26	35	26	37	Error, mature forests cannot withdraw CO2, unless extention or making coal. Correct. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
850	4	26	37	26	38	Give the quantity (Pecheux, Martin, Institut des Foraminifères Symbiotiques)

#	Ch	From Page	From Line	To Page	To Line	Comment
851	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., Balser 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 occuring) and changes in artic 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. (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
852	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
853	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 (Jones, Chris, Met Office)
854	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)
855	4	26	48	0	0	Phytoplankton and especially bloom forming cyanobacteria will profit from rising temperature through direct (Huismann 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, oyxgen concentration will deplete in the hypolimnion causing anaerobic conditions in the sediment near water layers and subsequent release of phosphorus (Mooiji 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 (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
856	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)
857	4	26	50	27	23	The following new reference should be includeded 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)

#	Ch	From Page	From Line	To Page	To Line	Comment
858	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… (Cassardo, Claudio, University of Torino)
859	4	26	54	26	54	change "are" with "have" (Cassardo, Claudio, University of Torino)
860	4	27	1	27	1	Change 'are' to 'is' to avoid mismatch of singular and plural. (Burt, Peter, University of Greenwich)
861	4	27	2	27	2	The Penman-Monteith equation is one of many equations available to estimate ET using meteorological data. Suggest clarifying. (CANADA)
862	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? (Iqbal, Muhammad Mohsin, Global Change Impact Studies Centre)
863	4	27	5	0	0	I suggest to replace x mm.y-2 by "(mean) annual change of x mm.yr-1" (Loustau, Denis, INRA)
864	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 (Cassardo, Claudio, University of Torino)
865	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 (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
866	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. (Urban, Mark, University of Connecticut)
867	4	27	28	27	29	Please define/explain difference between genotypic and phenotypic adaptation (UNITED STATES OF AMERICA)
868	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. 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. 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. (UNITED STATES OF AMERICA)
869	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. Global Change Biology 2013, DOI: 10.1111/gcb.12143 (Penuelas, Josep, CREAF-CSIC)
870	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). (Burt, Peter, University of Greenwich)

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871	4	27	34	27	34	Relevent to this point is the Zarnteske 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. Science 336, 1516-1518 (2012). (Urban, Mark, University of Connecticut)
872	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)
873	4	27	35	27	35	And genes themselves will be lost, not just specific combinations of them (Urban, Mark, University of Connecticut)
874	4	27	37	27	37	Delete 'the' and 'report' to avoid tautology ('the Fourth Assesment Report report'). (Burt, Peter, University of Greenwich)
875	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)
876	4	27	41	27	41	'vice versa' should be in italics (Burt, Peter, University of Greenwich)
877	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)
878	4	27	45	28	26	Repetition of the "upward and poleward" and "complex responses" ideas occurs in this section. (CANADA)
879	4	27	46	27	46	Delete 'the' and 'report' to avoid tautology ('the Fourth Assesment Report report'). (Burt, Peter, University of Greenwich)
880	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)
881	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)
882	4	28	3	28	4	Close) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
883	4	28	4	28	4	typo: change "et al. (2011" with "et al., 2011" (Cassardo, Claudio, University of Torino)
884	4	28	5	0	0	Do the authors mean mountain areas or timberline? (CANADA)
885	4	28	9	28	0	'vs' should be in italics. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
886	4	28	11	0	0	include species range shifts for freshwater algae: The invasive cyanobacterium Cylindrospermopsis raciborskii 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. Cylindrospermopsis raciborskii (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 Cylindrospermopsis raciborskii (Nostocales, Cyanobacteria) isolates from Africa and Europe. Harmful Algae: 7: 692-701. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
887	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)
888	4	28	12	28	26	There are examples ofgreater 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. (Berry, Pam, Oxford)
889	4	28	14	28	18	Over what time frame were these rates of change observed? (Mach, Katharine, IPCC WGII TSU)
890	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)
891	4	28	16	28	17	I don't understand this sentence (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
892	4	28	18	28	18	'per' should be in italics. (Burt, Peter, University of Greenwich)
893	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)
894	4	28	22	28	22	Delete 'the' and 'report' to avoid tautology ('the Fourth Assesment Report report'). (Burt, Peter, University of Greenwich)
895	4	28	25	28	25	replace 'recent changes' with 'recent detected changes" (Webb, Robert, NOAA OAR ESRL)
896	4	28	28	28	28	Delete 'report' (Burt, Peter, University of Greenwich)
897	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)
898	4	28	28	28	52	The greatest limitation is that it is not known if species will track their climates or undrego 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)
899	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
900	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)
901	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)
902	4	28	40	28	41	realistic displacement rates and species interactions as well (Urban, Mark, University of Connecticut)
903	4	28	44	0	0	AR4 (Loustau, Denis, INRA)
904	4	28	44	0	0	A4 --> AR4 (Estrada, Yuka, IPCC WGII TSU)
905	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)
906	4	28	44	28	44	Delete 'the' and 'report' to avoid tautology ('the Fourth Assesment Report report'), and change 'A4' to 'AR4'. (Burt, Peter, University of Greenwich)
907	4	28	45	28	46	explain better climate velocity (e.g., include units). Include definition in the glossary? (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
908	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
909	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). (Burt, Peter, University of Greenwich)
910	4	29	6	29	24	The term 'climate velocity' should appear in the glossary. (AUSTRALIA)
911	4	29	19	0	0	It would be useful to define/explain "climate velocity" - or drop the term altogether. (UNITED STATES OF AMERICA)
912	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). (Urban, Mark, University of Connecticut)
913	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)
914	4	29	33	29	33	References wellcome (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
915	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. (Urban, Mark, University of Connecticut)
916	4	29	48	29	48	"arrow on right pointing donward" what it is ? (Pecheux, Martin, Institut des Foraminifères Symbiotiques)

#	Ch	From Page	From Line	To Page	To Line	Comment
917	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. (Ferrone, Andrew, Public Research Centre - Gabriel Lippmann)
918	4	30	7	30	7	Insert commas either side of 'reviewed below'. (Burt, Peter, University of Greenwich)
919	4	30	29	3	33	here or elswhere, 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 (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
920	4	30	34	30	35	optimistic? Not for insect pests? (fleming, richard arthur, canadian forest service)
921	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)
922	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. (Mach, Katharine, IPCC WGII TSU)
923	4	30	50	30	50	'per' should be in italics. (Burt, Peter, University of Greenwich)
924	4	31	0	38	0	This 4.2.3 part is vague, poorly referenced and useless. (Loustau, Denis, INRA)
925	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)
926	4	31	17	31	17	"very low confidence" should be italicized for clarity. (Mach, Katharine, IPCC WGII TSU)
927	4	31	20	31	20	100m/yr, not 100km/yr (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
928	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 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 athogenic chytrid fungus. Integrative Zoology 5: 143-153 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)

#	Ch	From Page	From Line	To Page	To Line	Comment
929	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 (Niveoscincus ocellatus Gray, 1845) in Tasmania, Australia (Cadby et al. 2010; Wapstra et al. 2010). Warming temperatures have resulted in offspring of the common lizard (Lacerta vivipara Von Jacquin, 1787) being born larger (Chamaille-Jammes et al. 2006). (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
930	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 (Locusta migratoria manilensis) 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, Busuioc 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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)

#	Ch	From Page	From Line	To Page	To Line	Comment
931	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 Lacerta vivipara. Global Change Biology 12, 392–402. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
932	4	31	26	31	26	"is reviewed above": please mention explicitly the paragraph (Cassardo, Claudio, University of Torino)
933	4	31	27	31	27	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Burt, Peter, University of Greenwich)
934	4	31	28	31	28	replace 'regional climate change' with 'regional changes in climate' (Webb, Robert, NOAA OAR ESRL)
935	4	31	30	0	0	include reference for freshwater. Adrian et al. 2009 (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
936	4	31	36	0	0	include reference for freshwater. Scharfenberger et al. 2013 (reference is given somewhere above) (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
937	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). (Urban, Mark, University of Connecticut)
938	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
939	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. (Urban, Mark, University of Connecticut)
940	4	31	47	31	49	In which species ? (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
941	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)
942	4	31	53	32	2	it depends also on which side of the mountain is considered! (Cassardo, Claudio, University of Torino)
943	4	31	54	31	54	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Burt, Peter, University of Greenwich)
944	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. (Oliver, Tom, Centre for Ecology and Hydrology)
945	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
946	4	32	9	32	30	no confidence statements about homogenization or loss of genetic diversity (UNITED STATES OF AMERICA)
947	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)
948	4	32	11	32	12	What are the broad time frames and scenarios of climate change for these projections? (Mach, Katharine, IPCC WGII TSU)
949	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)
950	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)
951	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). (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
952	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)
953	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)
954	4	32	26	32	29	This sentence is not understandable, please consdier rephrasing. (NORWAY)
955	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)
956	4	32	29	0	0	Suggested change "losses of genetic diversity that are already occuring due to other global changes…" (Ambulkar, Archis, Brinjac Engineering Inc.)
957	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)
958	4	32	33	32	33	!! In the fossil record during the Big Five mass extinction (theit p; 55) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
959	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. l. 38-39). (NORWAY)
960	4	32	38	32	38	Section 4.3.2.5: 'Mollusk' should be 'Mollusc' and in Figure 4-6 (Oliver, Tom, Centre for Ecology and Hydrology)

#	Ch	From Page	From Line	To Page	To Line	Comment
961	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)
962	4	32	39	32	39	I sugest replacing the hyphen with a comma, I misread this as 'pollution-changes' and the sentence initially did not make sense. (Burt, Peter, University of Greenwich)
963	4	32	43	33	4	It would be useful to clearly explain the assignment of medium confidence that appears in the executive summary here. (Mastrandrea, Michael, IPCC WGII TSU)
964	4	32	45	32	45	Insert '(Bufo periglenes)' in italics after 'toad'. (Burt, Peter, University of Greenwich)
965	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)
966	4	32	48	32	48	Insert comma after 'since'. (Burt, Peter, University of Greenwich)
967	4	32	50	32	50	Insert commas either side of 'and'. (Burt, Peter, University of Greenwich)
968	4	32	53	33	1	Very informative observation that should be more highlighted and discussed, as well as reflected in TS (NORWAY)
969	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
970	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 (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
971	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. (Urban, Mark, University of Connecticut)

#	Ch	From Page	From Line	To Page	To Line	Comment
972	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 disucssion 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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
973	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)
974	4	33	12	33	39	Hannah (ed) 2012 and in reference p 94 line 52 (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
975	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 (Akcakaya 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)
976	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)
977	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
978	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. (Oliver, Tom, Centre for Ecology and Hydrology)
979	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)
980	4	33	32	33	32	…Holocene, probably due to human hunting - (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
981	4	33	32	33	32	Replace hyphens with commas for clarity. (Burt, Peter, University of Greenwich)
982	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)
983	4	33	35	33	35	Insert 'as' after 'such'. (Burt, Peter, University of Greenwich)
984	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 (Abies mariesii) of subalpine coniferous forests after climate change. Plant Ecology, 213, 603-612. doi: 10.1007/s11258-012-0025-5 (Tsuyama, Ikutaro, Forestry and Forest Products Research Institute)
985	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. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)

#	Ch	From Page	From Line	To Page	To Line	Comment
986	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 vulnerabilites. 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 disctinction 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. (Gonzalez, Patrick, National Park Service)
987	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. (Moritz, Max, University of California, Berkeley)
988	4	33	46	0	0	Section 4.3.3. In preparing the final draft, the chapter team should shorten this section by 50%. (Mach, Katharine, IPCC WGII TSU)
989	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)
990	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. (Mastrandrea, Michael, IPCC WGII TSU)
991	4	33	48	34	26	Many spelling and grammatical mistakes. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)
992	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 . (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
993	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
994	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)
995	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." (Good, Peter, UK Metoffice)
996	4	34	2	34	2	Casual usage of "likely" should be avoided. If being used as a likelihood term, it should be italicized. (Mach, Katharine, IPCC WGII TSU)
997	4	34	3	34	23	There is a "there" too much (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
998	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)
999	4	34	11	0	0	Suggested change "there are a number of…" (Ambulkar, Archis, Brinjac Engineering Inc.)
1000	4	34	11	34	11	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Burt, Peter, University of Greenwich)
1001	4	34	11	34	11	please add "is" after "there" (Cassardo, Claudio, University of Torino)
1002	4	34	12	34	12	change "that" with "for which" (Cassardo, Claudio, University of Torino)
1003	4	34	15	34	15	add "in winter" after "climates" (Cassardo, Claudio, University of Torino)
1004	4	34	17	34	22	Different styles for writing 'high northern latitudes'! (Burt, Peter, University of Greenwich)
1005	4	34	22	34	22	…warming (and change in precipitation in sub-tropical belt) vs... (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1006	4	34	22	34	22	'vs' should be in italics. (Burt, Peter, University of Greenwich)
1007	4	34	23	0	0	Suggested change "However, there are good indications…" (Ambulkar, Archis, Brinjac Engineering Inc.)
1008	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)
1009	4	34	23	34	23	typo: remove the second "there are" (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
1010	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, Theor. Appl. Climatol., 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, Biogeosciences 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, Int. J. Climatol., 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. P. Natl. Acad. Sci. USA, 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, PNAS, 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, J. Geophys. Res., 115, D21119, doi:10.1029/2010JD014307, 2010. (Falloon, Peter, Met Office Hadley Centre)
1011	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. Perhpas show both seasons for both quantities and make this a 4-panel plot? (Jones, Chris, Met Office)
1012	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)
1013	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? (Cassardo, Claudio, University of Torino)
1014	4	34	31	34	31	Are the temperatures described on this line average temperatures over the window? (Mach, Katharine, IPCC WGII TSU)
1015	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1016	4	34	40	34	45	These statements are redundant with 4.2.1 and overlap should be reduced. (Mach, Katharine, IPCC WGII TSU)
1017	4	34	42	0	0	may be difficult to slow or reverse' (Good, Peter, UK Metoffice)
1018	4	34	53	34	53	…recent past (but coral reefs with mass bleaching, Chapter 5, Box CC-CR) (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1019	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)
1020	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)
1021	4	35	7	35	8	generally I do not report comma mistakes, but here commas are misleading; remove commas after "woodlands" and "food and" (Cassardo, Claudio, University of Torino)
1022	4	35	7	35	10	Suggest to delete the statement 'Forests and woodlands,.regions(Gibson et al, 2011). Climate change and forests interact strongly.' (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
1023	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. http://siteresources.worldbank.org/intforests/Resources/SustainingForest... (UNITED STATES OF AMERICA)
1024	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)
1025	4	35	8	0	0	Suggestion to remove comma - "including food and cultural services…" (Ambulkar, Archis, Brinjac Engineering Inc.)
1026	4	35	8	35	8	What is meant with "good quality water"? Quality that suffices for drinking water? (NETHERLANDS)
1027	4	35	11	0	0	are amonge major drivers of forest productivities and forest dynamics in most places. (Jafari, Mostafa, TPS for LFCCs - RIFR - IRIMO)
1028	4	35	11	35	15	Here, you miss that the uptake of C by forests is equaly (or even more) important than the storage of C. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1029	4	35	12	35	12	Suggest to change the word 'controlling' into 'affecting'. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
1030	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1031	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). (Gonzalez, Patrick, National Park Service)
1032	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.) (Gonzalez, Patrick, National Park Service)
1033	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? (Schrier, Arina, Wetlands International)
1034	4	35	20	35	23	Further studies need to be done in Tropical region as deforestration 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)
1035	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)
1036	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)
1037	4	35	21	35	21	"due to land-use change": includes also forest fires? (Cassardo, Claudio, University of Torino)
1038	4	35	21	35	22	"due to tropical deforestaton": only tropical? Why extratropical deforestation is not considered? Too small? (Cassardo, Claudio, University of Torino)
1039	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. (Jones, Chris, Met Office)
1040	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1041	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1042	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 covrage type, like bare soil? I suggest to add this explaination… (Cassardo, Claudio, University of Torino)
1043	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1044	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)
1045	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)
1046	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 bee said (Cassardo, Claudio, University of Torino)
1047	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)
1048	4	35	36	35	40	Clarify that forest loss is excluded. (UNITED STATES OF AMERICA)
1049	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-Andrì© 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. http://dx.doi.org/10.1890/ES11-00345.1 (UNITED STATES OF AMERICA)
1050	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1051	4	35	37	35	37	These dates are not possessive, delete the apostrophes. (Burt, Peter, University of Greenwich)
1052	4	35	38	35	40	Suggest "stimulation", in place of "simulation". (CANADA)
1053	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)
1054	4	35	42	0	0	susceptibility to fire' is imprecise. Perhaps 'meteorological conditions favouring fire' (Good, Peter, UK Metoffice)

#	Ch	From Page	From Line	To Page	To Line	Comment
1055	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 (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
1056	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)
1057	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' (Good, Peter, UK Metoffice)
1058	4	35	46	35	47	"as well as … tundra": but this will extend forested area, so it is not a risk!!! (Cassardo, Claudio, University of Torino)
1059	4	35	53	35	53	I know is a fussiness, but 1980-2010 and 2070-2100 are 31-years periods, not 30-years (Cassardo, Claudio, University of Torino)
1060	4	36	4	36	5	Please check for consistency with figure 6.3 in CH 6 WG III. (NORWAY)
1061	4	36	7	36	7	via' should be in italics. (Burt, Peter, University of Greenwich)
1062	4	36	12	36	19	This text seems to overlap with Section 4.2.4.1. Suggest editing or removing. (CANADA)
1063	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)
1064	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)
1065	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)
1066	4	36	16	36	16	Change 'are' to 'is' to avoid mismatch of singular and plural. (Burt, Peter, University of Greenwich)
1067	4	36	16	36	16	"a number of signs": please be more precise: which signes? (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
1068	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 growht, 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 precipatation comes as water, not snow): any information about this risk?) (Kasurinen, Anne, University of Eastern Finland)
1069	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) (Jones, Chris, Met Office)
1070	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...' (Good, Peter, UK Metoffice)
1071	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)
1072	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)
1073	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)
1074	4	36	54	0	0	don't you mean '_longer_ than recent drought return intervals'? (Good, Peter, UK Metoffice)
1075	4	36	54	0	0	longer instead of "shorter"? Why "recent" ? (Loustau, Denis, INRA)
1076	4	37	2	37	2	Delete 'up' to avoid tautology (expansion in altitude can only be upwards). (Burt, Peter, University of Greenwich)
1077	4	37	2	37	3	"may also … mortality": but some insects, as for instance pollinators, can be useful (Cassardo, Claudio, University of Torino)
1078	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)
1079	4	37	16	0	0	There are two papers here listed prior to 2009, whiche shouldn't be here : 1998 and 2007 (UNITED STATES OF AMERICA)
1080	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1081	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 expantion', 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 tentitively 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?) (Good, Peter, UK Metoffice)
1082	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... (Jones, Chris, Met Office)
1083	4	37	38	0	0	widely expected, with medium confidence'. Perhaps drop 'widely', as the confidence statement should say it all. (Good, Peter, UK Metoffice)
1084	4	37	38	37	38	"to increase as …": yes, but only if they do not die (see lines 33-36)!!! (Cassardo, Claudio, University of Torino)
1085	4	37	42	37	44	This statement needs further explanation. If fire is corrrelated 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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1086	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1087	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)
1088	4	37	45	37	45	Suggest connecting vapor- pressure deficit argument to section 4.3.2.4 (CANADA)
1089	4	37	47	37	49	This text seems to overlap with Section 4.3.2.2. Suggest editing or removing. (CANADA)
1090	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? (Good, Peter, UK Metoffice)
1091	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? (Cassardo, Claudio, University of Torino)
1092	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. (Good, Peter, UK Metoffice)
1093	4	38	1	38	1	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the sentence. (Mach, Katharine, IPCC WGII TSU)
1094	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1095	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)
1096	4	38	9	38	9	Insert 'in' after 'changes'. (Burt, Peter, University of Greenwich)
1097	4	38	17	38	17	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the sentence. (Mach, Katharine, IPCC WGII TSU)
1098	4	38	17	38	28	I know of an interesting case study of the effect of forest fire on the climate of Tuntsa in nrothern 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. (Pope, Edward, Met Office)
1099	4	38	20	38	20	Capital 'B' for 'boreal' (as used elsewhere in chapter/document). (Burt, Peter, University of Greenwich)
1100	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. (Jones, Chris, Met Office)
1101	4	38	32	0	0	_could_ exacerbate additional warming' (Good, Peter, UK Metoffice)
1102	4	38	33	0	0	could cross-reference here to WG1-Ch6-sec 6.4.3 (Jones, Chris, Met Office)
1103	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1104	4	38	36	38	36	What is "thermokarsting", what are the "different substrates" and why is topography important? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1105	4	38	36	38	36	Thermokarsting is not defined and should be cross-referenced to other permafrost sections (UNITED STATES OF AMERICA)
1106	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1107	4	38	44	0	0	Suggestion to add comma - "to winter temperatures (xxx), are impractical…" (Ambulkar, Archis, Brinjac Engineering Inc.)
1108	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)
1109	4	38	48	40	4	Overlap with Section 4.3.2.2. Suggest reviewing. (CANADA)

#	Ch	From Page	From Line	To Page	To Line	Comment
1110	4	39	2	39	2	"With the exception of Europe": and what about Europe? It is not said… (Cassardo, Claudio, University of Torino)
1111	4	39	6	0	0	perhaps '(high confidence due to robust evidence and high agreement)' (Good, Peter, UK Metoffice)
1112	4	39	6	42	39	Like the explanations of the confidence level used here and in tropical forest section. Could be used more widely (Good, Peter, UK Metoffice)
1113	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 (Cassardo, Claudio, University of Torino)
1114	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 (Good, Peter, UK Metoffice)
1115	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). (Burt, Peter, University of Greenwich)
1116	4	39	29	0	32	Rather long sentence (Good, Peter, UK Metoffice)
1117	4	39	34	39	34	Suggest inserting "rates" after "carbon storage" for accuracy and clarity. (UNITED STATES OF AMERICA)
1118	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)
1119	4	39	42	39	42	Delete 'up' to avoid tautology (expansion in altitude can only be upwards). (Burt, Peter, University of Greenwich)
1120	4	39	44	0	45	most probably cannot achieve' unclear. Do you mean 'cannot be achieved'? (Good, Peter, UK Metoffice)
1121	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)
1122	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1123	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. (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
1124	4	39	51	39	51	In this line, 'modelling' is used in its (correct) spelling, but most other usages in the Chapter are 'modeling'. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
1125	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 (Tsuga diversifolia) 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, Tsuga diversifolia? Footprint of climate in the glacial period on current habitat occupancy. Journal of Forest Research. doi: 10.1007/s10310-013-0399-9 (Tsuyama, Ikutaro, Forestry and Forest Products Research Institute)
1126	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). (Burt, Peter, University of Greenwich)
1127	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)
1128	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)
1129	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. (Good, Peter, UK Metoffice)
1130	4	40	9	40	16	The chapter team should consider presenting citations or calibrated uncertainty language for these statements. (Mach, Katharine, IPCC WGII TSU)
1131	4	40	13	0	0	to fire ignition sources' (Good, Peter, UK Metoffice)
1132	4	40	14	0	15	influences of humans and current understanding is largely through' (Good, Peter, UK Metoffice)
1133	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. (Good, Peter, UK Metoffice)
1134	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). (Burt, Peter, University of Greenwich)
1135	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1136	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 (Jones, Chris, Met Office)
1137	4	40	30	40	41	Overlap with Section 4.3.2.4 . Suggest reviewing. (CANADA)
1138	4	40	33	40	33	There is no WGI Annex A, but WGI Annex I. (Plattner, Gian-Kasper, IPCC WGI TSU)
1139	4	40	37	40	38	Full stop missing after "used". Also there are two (xxx) (xxx) for references after "used". Should they be together. (Ambulkar, Archis, Brinjac Engineering Inc.)
1140	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. (Good, Peter, UK Metoffice)
1141	4	40	38	40	38	what is exactly the meaning of "medley studies"? (Cassardo, Claudio, University of Torino)
1142	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. (Good, Peter, UK Metoffice)
1143	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. (Mach, Katharine, IPCC WGII TSU)
1144	4	40	40	40	40	In this line, 'modelled' is used in its (correct) spelling, but most other usages in the Chapter are 'modeled'. (Burt, Peter, University of Greenwich)
1145	4	40	44	40	44	Suggest deleting "in moist tropical forests" (CANADA)
1146	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)
1147	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...'? (Good, Peter, UK Metoffice)
1148	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(?) (Good, Peter, UK Metoffice)
1149	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)
1150	4	41	1	41	3	Replace second "in moist tropical forests" with "in these ecosystems" (CANADA)
1151	4	41	2	0	0	What indirect role of climate change do you mean? It's effect on fire frequency/intensity? (Good, Peter, UK Metoffice)
1152	4	41	12	42	12	"in sum" --> "in summary" (Cassardo, Claudio, University of Torino)
1153	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1154	4	41	15	41	15	Cochrane, 2003' should be in brackets (Burt, Peter, University of Greenwich)
1155	4	41	15	41	15	Insert comma after 'itself'. (Burt, Peter, University of Greenwich)
1156	4	41	15	41	15	typo: put "Cochrane, 2003" between round brakets (Cassardo, Claudio, University of Torino)
1157	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)
1158	4	41	16	41	16	Replace semi colon with '(' and put following references in chronological order (Burt, Peter, University of Greenwich)
1159	4	41	16	41	16	typo: insert "(" before "Uhl" (Cassardo, Claudio, University of Torino)
1160	4	41	16	41	17	Missing "(" before Uhl and Kauffman… (Ambulkar, Archis, Brinjac Engineering Inc.)
1161	4	41	17	0	0	Land use _also_ often increases' (Good, Peter, UK Metoffice)
1162	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)
1163	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)
1164	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)
1165	4	41	24	41	27	The scenario of climate change for this projected outcome should be specified. (Mach, Katharine, IPCC WGII TSU)
1166	4	41	26	41	26	Use degree symbol instead of 'deg.' (Burt, Peter, University of Greenwich)
1167	4	41	26	41	26	Suggest changing "temperate" to "temperature". Presumably this is mean annual temperature? (CANADA)
1168	4	41	26	41	26	typo: change "temperate" in "temperature" (Cassardo, Claudio, University of Torino)
1169	4	41	26	41	26	change "deg .C" in "°C" (Cassardo, Claudio, University of Torino)
1170	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) (Cassardo, Claudio, University of Torino)
1171	4	41	29	41	29	It would be helpful to specify--at risk of what? (Mach, Katharine, IPCC WGII TSU)
1172	4	41	31	42	31	Box 4.3: This box should include cross-references to WGI/SREX wherever possible, currently there are none. (Plattner, Gian-Kasper, IPCC WGI TSU)
1173	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: http://onlinelibrary.wiley.com/doi/10.1002/jgrg.20067/abstract] (Jones, Chris, Met Office)

#	Ch	From Page	From Line	To Page	To Line	Comment
1174	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 Amaozn 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? (Jones, Chris, Met Office)
1175	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. (Good, Peter, UK Metoffice)
1176	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? (Good, Peter, UK Metoffice)
1177	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 < -100GtC/K is 'typically associated with models projecting dieback'. However, the only models in this ensemble with dynamic vegetation were the four HadCM3 varients - insufficient for a statistical link. Second, it is unclear that their observeable 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) (Good, Peter, UK Metoffice)
1178	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. (Good, Peter, UK Metoffice)
1179	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? (Jones, Chris, Met Office)
1180	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. (Good, Peter, UK Metoffice)

#	Ch	From Page	From Line	To Page	To Line	Comment
1181	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. (Good, Peter, UK Metoffice)
1182	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?? (Jones, Chris, Met Office)
1183	4	41	39	41	39	"principle" --> "main"? (Cassardo, Claudio, University of Torino)
1184	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. (Good, Peter, UK Metoffice)
1185	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)
1186	4	42	14	42	14	For the percentage giving here, is it possible to specify the range/uncertainties associated with the projection? (Mach, Katharine, IPCC WGII TSU)
1187	4	42	17	42	17	Delete comma after '2005'. (Burt, Peter, University of Greenwich)
1188	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1189	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? (Jones, Chris, Met Office)

#	Ch	From Page	From Line	To Page	To Line	Comment
1190	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)
1191	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)
1192	4	42	34	42	34	delete "including Miditerranean-type Systems", because the system is not a type of land. (Jiang, Zhongcheng, Institute of Karst Geology,CAGS)
1193	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)
1194	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. (Pope, Edward, Met Office)
1195	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 (Mwangi, Margaret, Pennsylvania State University)
1196	4	43	7	43	7	'per' should be in italics. (Burt, Peter, University of Greenwich)
1197	4	43	13	43	13	Insert comma after 'yet'. (Burt, Peter, University of Greenwich)
1198	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)
1199	4	43	17	43	17	typo: "saplings" --> "samplings" (Cassardo, Claudio, University of Torino)
1200	4	43	20	43	23	Invasive species will likely play a large role as well. (UNITED STATES OF AMERICA)
1201	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) (Pope, Edward, Met Office)

#	Ch	From Page	From Line	To Page	To Line	Comment
1202	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1203	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)
1204	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)
1205	4	43	29	0	0	The phrase "forests will be moving into savannas and grasslands" is not clear. (UNITED STATES OF AMERICA)
1206	4	43	30	43	31	Is there evidence/ nuanced reasoning for why forest has expanded into former savannah areas in Northern Australia- ? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1207	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)
1208	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)
1209	4	43	36	45	15	This section could be condensed - summarize results rather than presenting case studies. (CANADA)
1210	4	43	39	0	0	Full stop missing after "Chen, 2013)". (Ambulkar, Archis, Brinjac Engineering Inc.)
1211	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)
1212	4	43	40	0	0	There are two "are" in the sentence. Needs revision. (Ambulkar, Archis, Brinjac Engineering Inc.)
1213	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). (Burt, Peter, University of Greenwich)
1214	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). (Burt, Peter, University of Greenwich)
1215	4	43	51	43	52	Suggest insertion of "they" before "highlight". (CANADA)
1216	4	43	52	43	52	Change 'highlight' to 'highlighting'. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
1217	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. (Penuelas, Josep, CREAF-CSIC)
1218	4	44	9	44	10	Delete extra "to" so that sentence becomes "led to decreases in plant productivity and delayed flowering." (Ambulkar, Archis, Brinjac Engineering Inc.)
1219	4	44	17	0	0	Change "accompanies" to "accompany" (Ambulkar, Archis, Brinjac Engineering Inc.)
1220	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1221	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)
1222	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)
1223	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)
1224	4	44	37	44	37	Change 'nitrogen' to 'N' (as in lines 30 and 43). (Burt, Peter, University of Greenwich)
1225	4	44	46	44	46	Change 'fifty' to '50' for consistency. (Burt, Peter, University of Greenwich)
1226	4	44	53	45	1	Is the increase in species richness dependent on sufficient water availability? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1227	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)
1228	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1229	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)
1230	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 2Â Â°C global warming. Global and Planetary Change 68:209-224" (Moreira, Bruno, Centre for Functional Ecology - University of Coimbra)
1231	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.) (Ooi, Mark, University of Wollongong)
1232	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. (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
1233	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 occuried 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 Daoxoan, 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 M inu tes 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}. (Jiang, Zhongcheng, Institute of Karst Geology,CAGS)

#	Ch	From Page	From Line	To Page	To Line	Comment
1234	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)
1235	4	45	24	0	0	Define/explain the Hadley circulation (UNITED STATES OF AMERICA)
1236	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)
1237	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) (Mwangi, Margaret, Pennsylvania State University)
1238	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)
1239	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. (Kasurinen, Anne, University of Eastern Finland)
1240	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 channge 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. (Ooi, Mark, University of Wollongong)
1241	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… (Cassardo, Claudio, University of Torino)
1242	4	45	32	45	45	The content of the lower paragraph is already included in the last part of the other paragraph. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1243	4	45	40	45	45	Repetition (Pecheux, Martin, Institut des Foraminifères Symbiotiques)

#	Ch	From Page	From Line	To Page	To Line	Comment
1244	4	45	40	45	45	This para seems repeating the line 32-38 of this page, please combining the two parts. (wang, chunfeng, State Forestry Administration, China)
1245	4	45	40	45	45	Suggest deleting this paragraph. It is a repeat of L. 32-38. (CANADA)
1246	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)
1247	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1248	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)
1249	4	46	3	0	0	Suggest not using the abbreviation 'pa' here, especially for such a key statistic (UNITED STATES OF AMERICA)
1250	4	46	3	43	3	What is 4% pa? Per decade ? (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1251	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)
1252	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)
1253	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 . (Schrier, Arina, Wetlands International)
1254	4	46	9	46	19	also mention the importance of pluvial carbon loss in disturbed peat regions (Moore et al., 2013, Nature) (Jones, Chris, Met Office)
1255	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)
1256	4	46	15	46	15	Delete comma after 'drainage' (all processes mentioned refer to the Indonesian peat swamp, not only burning). (Burt, Peter, University of Greenwich)
1257	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1258	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. (Harrison, Paula, University of Oxford)
1259	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
1260	4	46	27	46	27	Capital 'A' for 'Arctic'. (Burt, Peter, University of Greenwich)
1261	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. (Fleming, Sean, Meteorological Service of Canada)
1262	4	46	44	46	44	Hyphen required after 'warm'. (Burt, Peter, University of Greenwich)
1263	4	46	49	46	49	Perhaps define the meaning of 'epilmnectic' i.e. as 'the layer of water above the thermocline' to make it clearer to non-specialists. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)

#	Ch	From Page	From Line	To Page	To Line	Comment
1264	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 effetcs 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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
1265	4	47	2	47	2	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
1266	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)
1267	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1268	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. (Fleming, Sean, Meteorological Service of Canada)
1269	4	47	28	47	28	typo: "Mire" --> "More" (Cassardo, Claudio, University of Torino)
1270	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)
1271	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. (Harrison, Paula, University of Oxford)

#	Ch	From Page	From Line	To Page	To Line	Comment
1272	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. (Adrian, Rita, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
1273	4	47	43	0	0	Please include "and" as "Tundra, Alpine and Permafrost Systems" (Ambulkar, Archis, Brinjac Engineering Inc.)
1274	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! (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1275	4	47	46	0	0	Include ")" after Hartmann et.al. in press. (Ambulkar, Archis, Brinjac Engineering Inc.)
1276	4	47	46	47	46	in press -> in press) (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
1277	4	47	46	47	46	closing brackets needed after "in press." (Silva Mora, Carla Andreia, University of Lisbon)
1278	4	47	46	47	46	typo: add ")" after "press" (Cassardo, Claudio, University of Torino)
1279	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1280	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. (Vieira, Goncalo, University of Lisbon)
1281	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)
1282	4	48	1	48	1	21st Century -> 21st century (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
1283	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 (Fronzek, Stefan, Finnish Environment Institute)
1284	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. (Jones, Chris, Met Office)
1285	4	48	11	48	11	Capital 'A' for 'Arctic'. (Burt, Peter, University of Greenwich)
1286	4	48	17	48	17	For consistency elsewhere, please give taxonomic details of species mentioned. (Burt, Peter, University of Greenwich)
1287	4	48	32	48	32	Capital 'A' for 'Arctic'. (Burt, Peter, University of Greenwich)
1288	4	48	34	48	34	"leap frogging" term use is inconsistent with pg 50, line 9 (UNITED STATES OF AMERICA)
1289	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1290	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1291	4	48	42	48	42	What does the term "cryoturbation" mean? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1292	4	48	45	0	0	consistency check required with WG1. Ch12 state "virtually certain" future thawing of permafrost (Jones, Chris, Met Office)
1293	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 (Plattner, Gian-Kasper, IPCC WGI TSU)
1294	4	48	45	48	51	This statement and Figure 4-11 require a source. (CANADA)
1295	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) (Jones, Chris, Met Office)
1296	4	49	3	49	3	Insert space between number and unit. (Burt, Peter, University of Greenwich)
1297	4	49	3	49	3	remove "deep" (Cassardo, Claudio, University of Torino)
1298	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)
1299	4	49	7	49	11	Suggest specifying the positive feedback sources and their relative contribution. (CANADA)
1300	4	49	8	0	0	can you quantify (and justify!) "soon" (Jones, Chris, Met Office)
1301	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. (Vieira, Goncalo, University of Lisbon)
1302	4	49	22	0	0	One of the reasons scientists are predicting dramatic impacts to caribou is declining lichen abundance (see above) (Joly, Kyle, US National Park Service)
1303	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. (Joly, Kyle, US National Park Service)
1304	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)
1305	4	49	26	0	40	Can anything be said about movement of the tree line in this paragraph on alpine systems? (CANADA)
1306	4	49	32	0	0	Term "already" is used twice, please delete one. (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1307	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) (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
1308	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). (Matsui, Tetsuya, Forestry and Forest Products Research Institute)
1309	4	49	32	49	40	Consider moving this to Section 4.3.2.5 (CANADA)
1310	4	49	36	49	36	It would be helpful to clarify the terminology used to describe vascular plant species here. (Mach, Katharine, IPCC WGII TSU)
1311	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. (Jones, Chris, Met Office)
1312	4	49	48	49	48	remove "far" (Cassardo, Claudio, University of Torino)
1313	4	49	53	49	53	Capital 'E' for 'Earth' (you mean the planet, not soil). (Burt, Peter, University of Greenwich)
1314	4	50	2	50	2	Capital 'E' for 'Earth' (you mean the planet, not soil). (Burt, Peter, University of Greenwich)
1315	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 compositionRoland et al. 2013 Landscape-scale patterns in tree occupancy and abundamce in subarctic Alaska. Ecological Monographs 83:19-48. http://dx.doi.org/10.1890/11-2136.1. 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. (Joly, Kyle, US National Park Service)
1316	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? (Mach, Katharine, IPCC WGII TSU)
1317	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1318	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)
1319	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)
1320	4	50	38	50	38	Bad English: replace 'on' with 'regarding'. (Burt, Peter, University of Greenwich)
1321	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). (Burt, Peter, University of Greenwich)
1322	4	50	41	50	41	the percentage "7%" is global or refers to forested areas only? Please specify… (Cassardo, Claudio, University of Torino)
1323	4	50	41	50	41	It would be helpful to clarify the phrase "with 7%" at the start of this sentence. (Mach, Katharine, IPCC WGII TSU)
1324	4	50	41	50	42	Suggest rewording as follows: "Plantations cover only about 7% of global forest area, with the largest areas in…" (CANADA)
1325	4	50	45	50	45	Change 'area' to 'areas'. (Burt, Peter, University of Greenwich)
1326	4	50	47	50	47	Cumbersome: replace hyphen with comma. (Burt, Peter, University of Greenwich)
1327	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)
1328	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. (Loustau, Denis, INRA)
1329	4	51	6	0	0	Kurz results do not concern plantation forest. (Loustau, Denis, INRA)
1330	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)
1331	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. l. 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. (Loustau, Denis, INRA)
1332	4	51	16	51	16	Suggest deleting "even" here. (CANADA)
1333	4	51	19	51	19	For consistency, give common names as well as taxonomic details. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
1334	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)
1335	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1336	4	51	25	0	0	Include ")" after Dale et.al. 2010. (Ambulkar, Archis, Brinjac Engineering Inc.)
1337	4	51	25	51	25	2010. -> 2010). (Eliseev, Alexey V., A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)
1338	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)
1339	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 w (NORWAY)
1340	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1341	4	51	40	0	0	Change to "in general on decline" (Ambulkar, Archis, Brinjac Engineering Inc.)
1342	4	51	45	51	46	Text in parentheses is unclear. Suggest rewording to: "(given that many forest plantations are grown for bioenergy purposes)" (CANADA)
1343	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). (Burt, Peter, University of Greenwich)
1344	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 elevanted 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'. (Oliver, Tom, Centre for Ecology and Hydrology)
1345	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 (Jones, Chris, Met Office)
1346	4	52	3	0	0	Change to "in a 20 years perspective there is..." (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1347	4	52	3	52	3	Change 'it' to 'there'. (Burt, Peter, University of Greenwich)
1348	4	52	3	52	3	typo: change "it is" with "there is" (Cassardo, Claudio, University of Torino)
1349	4	52	4	0	0	Term "EU RES" referred here does not seem to be defined in this chapter. (Ambulkar, Archis, Brinjac Engineering Inc.)
1350	4	52	4	52	4	EU RES policy needs explaining. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1351	4	52	8	0	0	Change to "with a global reduction of forest stocks by 2%..." (Ambulkar, Archis, Brinjac Engineering Inc.)
1352	4	52	12	52	13	References should be in chronological order. (Burt, Peter, University of Greenwich)
1353	4	52	15	52	16	change "many species rich grasslands" in "many rich grassland species" (Cassardo, Claudio, University of Torino)
1354	4	52	21	0	0	The intent of the section on cultural landscapes is unclear. (UNITED STATES OF AMERICA)
1355	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)
1356	4	52	33	52	33	Cumbersome: replace hyphens with commas. (Burt, Peter, University of Greenwich)
1357	4	52	33	52	39	Discusses the management of cultural landscapes in maintaining species mix, particularly endangered species. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1358	4	52	44	52	44	Suggest inserting "and" before "while" (CANADA)
1359	4	52	44	52	45	Section 4.3.3.5.3 Cultural landscapes: Note that there is also a paper sugegsting 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. (Oliver, Tom, Centre for Ecology and Hydrology)
1360	4	52	45	52	46	Split infinitive: move 'better' to after 'picture'. (Burt, Peter, University of Greenwich)
1361	4	52	47	52	49	Discussing the adaptation of protected are networks to take into account shifts in climate with relevance to species migration and dispersal. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1362	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1363	4	53	1	53	1	Section 4.3.3.5.4. This section should be shortened to focus on ecosystem impacts. (Mach, Katharine, IPCC WGII TSU)
1364	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1365	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)
1366	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. (Plattner, Gian-Kasper, IPCC WGI TSU)
1367	4	53	1	55	11	This section is hard to follow. Suggest reworking. (CANADA)
1368	4	53	3	0	0	Urban systems are often characterized by disconnecting land and water thereby affecting thier role for ecosystem functioning and hence element and nutrient cycles. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1369	4	53	3	53	3	cumbersome: change text in brackets to 'see Chaper 8 for definition'. (Burt, Peter, University of Greenwich)
1370	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.). (Kazama, So, Tohoku University)
1371	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! (Cassardo, Claudio, University of Torino)
1372	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)
1373	4	53	10	53	10	Insert 'by' after 'or'. (Burt, Peter, University of Greenwich)
1374	4	53	10	53	10	Insert comma after 'however'. (Burt, Peter, University of Greenwich)
1375	4	53	11	53	11	Insert comma after ')' (Burt, Peter, University of Greenwich)
1376	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." (Ambulkar, Archis, Brinjac Engineering Inc.)
1377	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)
1378	4	53	15	53	15	Insert comma after 'however'. (Burt, Peter, University of Greenwich)
1379	4	53	16	0	0	Should it be "significantly higher" (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1380	4	53	18	53	19	This sentence is unclear. Suggest revising. (CANADA)
1381	4	53	21	53	21	I don't know what 'traits compositions' means. (Burt, Peter, University of Greenwich)
1382	4	53	23	0	0	Change to "this effect might also continue in the future..." (Ambulkar, Archis, Brinjac Engineering Inc.)
1383	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. (Kasurinen, Anne, University of Eastern Finland)
1384	4	53	27	53	28	BVOC emissions may also affect air quality in and downwind of urban centres (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1385	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. (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
1386	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. (Mach, Katharine, IPCC WGII TSU)
1387	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. (Mach, Katharine, IPCC WGII TSU)
1388	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)
1389	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)
1390	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 Milliennium Ecosystem Assessment, many national assessments, such as the UK NEA (see http://uknea.unep-wcmc.org/ 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. Biodiversity and Conservation, 19: 2791-2821. (Harrison, Paula, University of Oxford)
1391	4	53	33	53	33	The glossary could be cross-referenced here to reduce this paragraph. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
1392	4	53	37	53	37	What is TEEB ? (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1393	4	53	37	53	37	What is TEEB and why is it important here? The reference needs completing. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1394	4	53	37	53	37	Suggest referencing and spelling out TEEB. (UNITED STATES OF AMERICA)
1395	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)
1396	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). (Burt, Peter, University of Greenwich)
1397	4	53	41	53	41	The reference to chapter 13 here does not seem most appropriate. Presumably chapter 10 is meant? (Mach, Katharine, IPCC WGII TSU)
1398	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 (Berry, Pam, Oxford)
1399	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)
1400	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. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1401	4	53	47	53	48	Insert colon after 'inducing' and commas either side of 'and'. (Burt, Peter, University of Greenwich)
1402	4	53	51	53	51	The specific relevant section(s) in chapter 28 should be specified, and further citations should be provided here. (Mach, Katharine, IPCC WGII TSU)
1403	4	54	0	0	0	Freshwater change in their function as pathways for pest, deseases etc. (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1404	4	54	1	54	12	Water is also important factor in habitat, which is influenced by climate change. Higher fluctuation of water sream 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.). (Kazama, So, Tohoku University)
1405	4	54	2	54	2	Imprecise: please quantify 'large distances'. (Burt, Peter, University of Greenwich)
1406	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. (Mach, Katharine, IPCC WGII TSU)
1407	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…" (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1408	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1409	4	54	11	54	12	Is it possible to provide citations for this statement? (Mach, Katharine, IPCC WGII TSU)
1410	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)
1411	4	54	15	54	15	It would be helpful to indicate more precisely what is meant by "non-analog climates." (Mach, Katharine, IPCC WGII TSU)
1412	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). (Burt, Peter, University of Greenwich)
1413	4	54	32	55	11	Need to make explicit what this will mean for the delivery of pollination as an ES (Berry, Pam, Oxford)
1414	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). (Urban, Mark, University of Connecticut)
1415	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!!! (Cassardo, Claudio, University of Torino)
1416	4	54	35	54	35	Insert comma after 'interactions' and replace 'like' with 'such as'. (Burt, Peter, University of Greenwich)
1417	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)
1418	4	54	43	54	43	'via' should be in italics. (Burt, Peter, University of Greenwich)
1419	4	54	44	54	44	'via' should be in italics. (Burt, Peter, University of Greenwich)
1420	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)
1421	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)
1422	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: http://www.sciencemag.org/content/339/6127/1611.abstract) and Bartomeus et al. 2011. Climate-associated phenological advances in bee pollinators and bee-pollinated plants. PNAS. (Wolkovich, Elizabeth, University of British Columbia)
1423	4	54	53	54	53	Clarity: replace hyphen with comma. (Burt, Peter, University of Greenwich)
1424	4	54	53	54	54	It would be preferable to be more precise as compared to "less than feared." (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
1425	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)
1426	4	55	1	0	1	should be phenological (not phonological) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)
1427	4	55	1	55	1	phenological (leroy, Suzanne, brunel university)
1428	4	55	1	55	1	typo: phonological --> phenological (Cassardo, Claudio, University of Torino)
1429	4	55	1	55	1	phonological' should be 'phenological'. Also two lines down 'proof' should be 'prove' (Oliver, Tom, Centre for Ecology and Hydrology)
1430	4	55	1	55	2	It would be preferable to be more precise than "grossly underestimate." (Mach, Katharine, IPCC WGII TSU)
1431	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)
1432	4	55	5	0	0	Suggest adding a sentence re: some context about the importance of honey bees being a important pollinator (CANADA)
1433	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. (Oliver, Tom, Centre for Ecology and Hydrology)
1434	4	55	9	0	0	Remove space between change and comma i.e. "change ," (Ambulkar, Archis, Brinjac Engineering Inc.)
1435	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). (Wolkovich, Elizabeth, University of British Columbia)
1436	4	55	9	55	9	Insert comma after 'environments' (Burt, Peter, University of Greenwich)
1437	4	55	9	55	9	delete space after 'change' (Burt, Peter, University of Greenwich)
1438	4	55	10	55	10	that is (leroy, Suzanne, brunel university)
1439	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' (Webb, Robert, NOAA OAR ESRL)
1440	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)
1441	4	55	16	55	22	Citations should be provided for these statements. (Mach, Katharine, IPCC WGII TSU)
1442	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 (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)

#	Ch	From Page	From Line	To Page	To Line	Comment
1443	4	55	30	55	30	Change 'indicates' to 'indicate' (Burt, Peter, University of Greenwich)
1444	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1445	4	55	37	55	37	change "have" with "has" (Cassardo, Claudio, University of Torino)
1446	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. (Plattner, Gian-Kasper, IPCC WGI TSU)
1447	4	55	44	55	44	A level of confidence may be more appropriate here as compared to a likelihood term. (Mach, Katharine, IPCC WGII TSU)
1448	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. (Mach, Katharine, IPCC WGII TSU)
1449	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-asssisted adapation as a supplementary approach. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1450	4	56	18	56	24	Reference to glossary entry should appear on line 18, not line 24. (Burt, Peter, University of Greenwich)
1451	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)
1452	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)
1453	4	56	24	56	24	The phrase "autonomous adaptation" is not in the glossary and thus the glossary should not be referenced here. (Mach, Katharine, IPCC WGII TSU)
1454	4	56	27	0	0	replace "necessary for" by " part of" (Loustau, Denis, INRA)

#	Ch	From Page	From Line	To Page	To Line	Comment
1455	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)
1456	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). (Urban, Mark, University of Connecticut)
1457	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)
1458	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. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)
1459	4	57	2	57	2	Suggest replacing "it" with "that species" (CANADA)
1460	4	57	2	57	31	These paragraphs mostly duplicate previous sections; combine their content with those, and drop them here. (UNITED STATES OF AMERICA)
1461	4	57	7	57	7	'Daylength' should be one word, remove hyphen. (Burt, Peter, University of Greenwich)
1462	4	57	9	57	9	I would add 'many' to 'late succession trees' -- we do not know the cues for all late-succession trees. (Wolkovich, Elizabeth, University of British Columbia)
1463	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1464	4	57	13	57	13	Capital 'M' for 'Mountains'. (Burt, Peter, University of Greenwich)
1465	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)
1466	4	57	18	57	20	The timeframe for this observation should be specified. (Mach, Katharine, IPCC WGII TSU)
1467	4	57	19	57	19	Suggest replacing "while that" with "while those that" (CANADA)
1468	4	57	21	57	21	It could be even clearer to specify which 2 decades are relevant here. (Mach, Katharine, IPCC WGII TSU)
1469	4	57	23	0	0	Change to "shown to be stronger..." (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1470	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)
1471	4	57	23	57	23	to be stronger (leroy, Suzanne, brunel university)
1472	4	57	23	57	23	typo: "to stronger" --> "to be stronger" (Cassardo, Claudio, University of Torino)
1473	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 (Choristoneura spp.) biotype reactions to forest and climate characteristics. Global Change Biol. 13(8): 1630–1643. Schwartz, M.D., Ahas, R., and Aasa, A. 2006. Onset of spring starting earlier across the Northern Hemisphere. Global Change Biol. 12(2): 343–351. doi: 10.1111/j.1365-2486.2005.01097.x. (CANADA)
1474	4	57	33	57	33	Plasticity can also evolve. (Urban, Mark, University of Connecticut)
1475	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. (Burt, Peter, University of Greenwich)
1476	4	57	51	0	0	Microbes are important ecosystem components for gene pools and ecosystem functioning, but are not mentionend at all? (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1477	4	57	51	57	51	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Burt, Peter, University of Greenwich)
1478	4	58	1	58	1	Perhaps define, 'Epigenetics' in line for non-specialists. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1479	4	58	11	58	11	Delete 'the' and 'report' to avoid tautology ('the Fourth Assessment Report report'). (Burt, Peter, University of Greenwich)
1480	4	58	15	58	15	Insert '(Strix aluco)' in italics after 'owl'. (Burt, Peter, University of Greenwich)
1481	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. (Urban, Mark, University of Connecticut)
1482	4	58	17	58	17	Insert '(Rana temporaria)' in italics after 'frog'. (Burt, Peter, University of Greenwich)
1483	4	58	20	58	20	Change 'a' to 'an'. (Burt, Peter, University of Greenwich)
1484	4	58	25	58	25	Change 'weakness' to 'weaknesses'. (Burt, Peter, University of Greenwich)
1485	4	58	25	58	25	Split infinitive: move 'clearly' to after demonstrate'. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
1486	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. (Urban, Mark, University of Connecticut)
1487	4	58	33	58	33	"…there is good evidence that environmental niches are conserved…" Good evidence is rather ambiguous. (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
1488	4	58	48	58	48	Extant instead of extent. (Anastasios Legakis, Department of Biology, University of Athens, Greece) (GREECE)
1489	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. Nature Climate Change, 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. Evolutionary Applications 5, 154-167 (2012). (Urban, Mark, University of Connecticut)
1490	4	59	4	59	4	Delete 'the' and 'report' to avoid tautology ('the Fourth Assesment Report report'). (Burt, Peter, University of Greenwich)
1491	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)
1492	4	59	6	59	6	Split infinitive: move 'significantly' to after 'change'. (Burt, Peter, University of Greenwich)
1493	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. (Loustau, Denis, INRA)
1494	4	59	9	0	0	Term "rates" is used twice in sentence "modest rates of projected rates…", please edit (Ambulkar, Archis, Brinjac Engineering Inc.)
1495	4	59	11	59	11	Which particular species of insect was studied? Can it be regarded as representative species? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1496	4	59	14	0	0	Term "future" is used twice in sentence "future rates of future climate change…", please edit (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1497	4	59	17	0	0	should be ectotherms (not ecotherms) (Despoina Vokou, Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece) (GREECE)
1498	4	59	17	59	17	I think 'ecotherms' should be 'ectotherms'. (Burt, Peter, University of Greenwich)
1499	4	59	18	59	18	'per' should be in italics. (Burt, Peter, University of Greenwich)
1500	4	59	31	59	35	Discussion of phenotype plasticity is very technical and meanings are not clear. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1501	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)
1502	4	59	37	59	37	A specific reference to the relevant chapter needs to be provided here, following the recommended citation format. (Mach, Katharine, IPCC WGII TSU)
1503	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). (Burt, Peter, University of Greenwich)
1504	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)
1505	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. NUÌáNEZ, 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)
1506	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 -- ecoystem interactions clearly can be maintained as composition changes. (UNITED STATES OF AMERICA)
1507	4	60	12	62	24	This chapter could benefit from considerable imrpovement. 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)
1508	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..! (Grossart, Hans-Peter, Leibniz Institute of Freshwater Ecology and InlandFisheries Berlin)
1509	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
1510	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). (Pope, Edward, Met Office)
1511	4	60	15	0	0	Change term to "socio-ecological" (Ambulkar, Archis, Brinjac Engineering Inc.)
1512	4	60	16	0	0	Add a full stop after sentence - "of climate change (see glossary)." (Ambulkar, Archis, Brinjac Engineering Inc.)
1513	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). (Burt, Peter, University of Greenwich)
1514	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)
1515	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.' (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1516	4	60	25	0	0	Change to "all forms of human-assisted..." (Ambulkar, Archis, Brinjac Engineering Inc.)
1517	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)
1518	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1519	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)
1520	4	60	36	60	37	This sentence would be better in the previous section e.g. Line 24 (Berry, Pam, Oxford)
1521	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)
1522	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1523	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)
1524	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 agroecoystems, the "quality of the matrix", private-lands management, etc. Authors may want to include this concept in this section. (UNITED STATES OF AMERICA)
1525	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. (Oliver, Tom, Centre for Ecology and Hydrology)
1526	4	60	49	60	51	For what scenarios of climate change does this projection hold? (Mach, Katharine, IPCC WGII TSU)
1527	4	60	50	0	0	Term "and concluded that" repeated twice in the sentence, please edit. (Ambulkar, Archis, Brinjac Engineering Inc.)
1528	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). (Burt, Peter, University of Greenwich)
1529	4	60	50	60	50	Suggest deleting first "and concluded that" (CANADA)
1530	4	61	1	61	1	Suggest deleting ";" (CANADA)
1531	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1532	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. (Kazama, So, Tohoku University)
1533	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. (Oliver, Tom, Centre for Ecology and Hydrology)

#	Ch	From Page	From Line	To Page	To Line	Comment
1534	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 (http://www.cef-cfr.ca/uploads/Membres/girardin-new-phytol.pdf) . 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)
1535	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. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
1536	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 ? (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
1537	4	61	9	61	9	Delete comma and put '2009' in brackets. (Burt, Peter, University of Greenwich)
1538	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)
1539	4	61	20	0	0	There appears successive comma and full stop in the sentence - "LANDIS-II, (xxx)." Please edit (Ambulkar, Archis, Brinjac Engineering Inc.)
1540	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1541	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
1542	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 http://www.for.gov.bc.ca/hti/climate_based_seed_transfer/3cbst_project.htm 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. (Spitttlehouse, Dave, BC Ministry Forests, Lands and Natural Resource Operations)
1543	4	61	30	61	31	There appears successive comma and full stop in the sentence - "climate change, (xxx)." Please edit (Ambulkar, Archis, Brinjac Engineering Inc.)
1544	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)
1545	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. Minteer, 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.) (Gonzalez, Patrick, National Park Service)
1546	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' (Webb, Robert, NOAA OAR ESRL)
1547	4	61	44	61	45	Change to "species, rather it may decrease..." (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1548	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)
1549	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)
1550	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). (Burt, Peter, University of Greenwich)
1551	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)
1552	4	62	2	62	2	Delete second occurrence of "could" (CANADA)
1553	4	62	2	62	3	Sentence appears incomplete - probably remove second "that" from the sentence. (Ambulkar, Archis, Brinjac Engineering Inc.)
1554	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)
1555	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 (www.frozenark.org), a reunion of 23 institutions aims to cryopreserve threatened species, and the Global Genome Initiative (ggi.si.edu) and the Global Genome Biodiversity Network (ggbn.org) 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 (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1556	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? (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)

#	Ch	From Page	From Line	To Page	To Line	Comment
1557	4	62	23	62	24	'ex-situ' should be in italics. (Burt, Peter, University of Greenwich)
1558	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. (Mach, Katharine, IPCC WGII TSU)
1559	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)
1560	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)
1561	4	62	29	0	0	Change to "will plausibly lead to..." (Ambulkar, Archis, Brinjac Engineering Inc.)
1562	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)
1563	4	62	29	62	31	Under this defintion all the above actions in Section 4.4.2 would be 'mitigation'- reducing damages from climate change. Is the terminology of adapation 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 emmisions. (Oliver, Tom, Centre for Ecology and Hydrology)
1564	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)
1565	4	62	33	0	0	A word appears to be missing in the sentence - "increasing costs that result from xxxx must be…" (Ambulkar, Archis, Brinjac Engineering Inc.)
1566	4	62	33	0	0	Comment: a word is missing after "increasing costs that result from…".. Please check the original publication for supplement. (GERMANY)
1567	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)
1568	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)
1569	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. (wang, chunfeng, State Forestry Administration, China)

#	Ch	From Page	From Line	To Page	To Line	Comment
1570	4	62	35	0	0	Should it be "in terms of water provision" (Ambulkar, Archis, Brinjac Engineering Inc.)
1571	4	62	35	0	0	Suggest changing the word "is" to "may be" for accuracy. (UNITED STATES OF AMERICA)
1572	4	62	35	62	35	typo: "terms water" --> "terms of water" (Cassardo, Claudio, University of Torino)
1573	4	62	37	0	0	Suggest changing "but due" to "but often due" for accuracy. (UNITED STATES OF AMERICA)
1574	4	62	37	62	37	'per' should be in italics. (Burt, Peter, University of Greenwich)
1575	4	62	40	0	0	Should word "ten" before Brink et.al. be deleted or replaced. (Ambulkar, Archis, Brinjac Engineering Inc.)
1576	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)
1577	4	62	40	62	40	typo: remove "ten" at the bottom (Cassardo, Claudio, University of Torino)
1578	4	62	41	62	41	It would be helpful to clarify what the "2010 biodiversity goals" are. (Mach, Katharine, IPCC WGII TSU)
1579	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)
1580	4	62	43	62	43	Where €14 trillion are described here, it would be preferable to present the range/uncertainties for the estimate. (Mach, Katharine, IPCC WGII TSU)
1581	4	62	48	62	48	'via' should be in italics (Burt, Peter, University of Greenwich)
1582	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?) (Orcherton, Dan F., PACE-Pacific Centre for Envionment and Sustainable Development)
1583	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)
1584	4	62	52	62	52	Convert costs to current dollars. Estimates of carbon costs from compliance markets could be included. (CANADA)
1585	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 (Berry, Pam, Oxford)
1586	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. (wang, chunfeng, State Forestry Administration, China)

#	Ch	From Page	From Line	To Page	To Line	Comment
1587	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)
1588	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. (Mach, Katharine, IPCC WGII TSU)
1589	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. (Hole, David, Conservation International)
1590	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)
1591	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. Turner1, Bethany A. Bradley2, Lyndon D. Estes3, David G. Hole1, Michael Oppenheimer4, & David S. Wilcove5 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)
1592	4	63	16	0	0	Bioenergy can also occur at small scale without affecting ag or natural resources. Authors may consdier changing 'Bio-energy' to 'Large-scale bioenergy' (UNITED STATES OF AMERICA)
1593	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)
1594	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. (Cassardo, Claudio, University of Torino)
1595	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). (Jones, Chris, Met Office)
1596	4	63	26	63	26	Text missing: I think you need 'are estimated' or 'will' after 'crops'. (Burt, Peter, University of Greenwich)

#	Ch	From Page	From Line	To Page	To Line	Comment
1597	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. (Lane, Tracy, International Hydropower Association (IHA))
1598	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)
1599	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)
1600	4	63	36	63	36	Subscript '4' required. (Burt, Peter, University of Greenwich)
1601	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)
1602	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)
1603	4	63	42	63	43	per' should be in italics. (Burt, Peter, University of Greenwich)
1604	4	63	43	63	43	Poor English: delete comma and 'although' . (Burt, Peter, University of Greenwich)
1605	4	63	43	63	43	Suggest changing "and while" to "while" (CANADA)
1606	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). (Marbaix, Philippe, Université catholique de Louvain)
1607	4	63	49	0	0	Change to "positive radiative force on..." (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1608	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)
1609	4	64	2	64	2	Adaption' should be 'Adaptation'. (Burt, Peter, University of Greenwich)
1610	4	64	4	64	6	This mention of assisted migration should refer back to section 4.4.2.4. (UNITED STATES OF AMERICA)
1611	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). (Moritz, Max, University of California, Berkeley)
1612	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)
1613	4	64	27	64	27	It is unclear what "plausible and immanent" means here. (CANADA)
1614	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. (Loustau, Denis, INRA)
1615	4	64	43	0	46	yes but this Ozone - CO2 interaction has been studied for long in fumigation chambers . (Loustau, Denis, INRA)
1616	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? (Kasurinen, Anne, University of Eastern Finland)
1617	4	64	44	64	44	Change "suture" to "future" (CANADA)
1618	4	64	44	64	44	typo: "suture" --> "future" (Cassardo, Claudio, University of Torino)
1619	4	64	45	0	0	Change to "since they are of..." (Ambulkar, Archis, Brinjac Engineering Inc.)

#	Ch	From Page	From Line	To Page	To Line	Comment
1620	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 acccumulation in the atmosphere. There is no more room for a permissible(for who, what ?) change nor to tolerate. Wrong message. (Loustau, Denis, INRA)
1621	4	64	49	0	0	UNFCCC term is not defined or elaborated in this chapter prior to being used in this sentence (Ambulkar, Archis, Brinjac Engineering Inc.)
1622	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 (Berry, Pam, Oxford)
1623	4	64	53	64	54	This sentence is unclear. Suggest revising. (CANADA)
1624	4	64	54	0	0	? See N Stern Assessment. (Loustau, Denis, INRA)
1625	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)
1626	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. (Chatterjee, Monalisa, IPCC WGII TSU)
1627	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 athogenic chytrid fungus. Integrative Zoology 5: 143-153 (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
1628	4	65	5	66	35	Suggest reworking this section for clarity and readability. (CANADA)
1629	4	65	7	65	9	Presumably this sentence refers to a "recent past" within human recorded history, and that should be made clear. (CANADA)
1630	4	65	17	65	17	…quantify the risk, but it is probable that we are facing the 6th mass extinction. (Pecheux, Martin, Institut des Foraminifères Symbiotiques)

#	Ch	From Page	From Line	To Page	To Line	Comment
1631	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. (Chatterjee, Monalisa, IPCC WGII TSU)
1632	4	65	23	65	23	Poor English: replace 'like' with 'such as'. (Burt, Peter, University of Greenwich)
1633	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)
1634	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)
1635	4	65	36	0	0	FAQ 4-3 The language is too technical. (Chatterjee, Monalisa, IPCC WGII TSU)
1636	4	65	42	0	0	The statement 'which cannot be grown under low pH' is vague. (UNITED STATES OF AMERICA)
1637	4	65	42	65	42	change "cannot be grown" with "cannot grow" (Cassardo, Claudio, University of Torino)
1638	4	65	44	0	0	Should this FAQ specifying that it is referring to "economic" costs? (CANADA)
1639	4	65	44	0	0	FAQ 4-4 Same currency would be useful. Perhaps some mention why it is difficult to evaluate the costs. (Chatterjee, Monalisa, IPCC WGII TSU)
1640	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)
1641	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)
1642	4	65	48	65	48	'per' should be in italics. (Burt, Peter, University of Greenwich)
1643	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"!!! (Cassardo, Claudio, University of Torino)
1644	4	65	48	65	51	Please clarify whether the estimate of the value of pollinators is for Europe only or global. (CANADA)
1645	4	65	50	65	50	'per' should be in italics. (Burt, Peter, University of Greenwich)
1646	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)
1647	4	66	1	0	0	FAQ 4-5 The FAQ is too general and may be dropped. (Chatterjee, Monalisa, IPCC WGII TSU)
1648	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)
1649	4	66	2	66	2	Delete space after 'change'. (Burt, Peter, University of Greenwich)
1650	4	66	2	66	2	Insert comma after 'exmaple'. (Burt, Peter, University of Greenwich)
1651	4	66	3	66	5	Suggest also considering whether pest control should be included as a management option. (CANADA)
1652	4	66	4	0	0	Suggest changing the term 'excessive harvest' to 'nonsustainable silviculture' which is a broader term. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
1653	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)
1654	4	66	6	66	6	…out of the wild in zoos, genebanks or cryogenic tanks until such time… (Pecheux, Martin, Institut des Foraminifères Symbiotiques)
1655	4	66	9	0	0	FAQ 4-6 The FAQ should be supported with some facts about observed land cover change and estimated impacts. (Chatterjee, Monalisa, IPCC WGII TSU)
1656	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)
1657	4	66	9	66	15	Please consider to mention that land use strategies can also substitute for fossil emissions. Furthermore the precentage given in line 14 is it about antropogenic emissions? (NORWAY)
1658	4	66	10	66	11	it can also affect evapotranspiration and, more in general, the components of the hydrological balance (Cassardo, Claudio, University of Torino)
1659	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)
1660	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. (Chatterjee, Monalisa, IPCC WGII TSU)
1661	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. (Zhang, Zhibin, Institute of Zoology, Chinese Academy of Sciences)
1662	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. (Urban, Mark, University of Connecticut)
1663	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)

#	Ch	From Page	From Line	To Page	To Line	Comment
1664	4	66	24	66	24	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
1665	4	66	28	66	28	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
1666	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. (Estrada, Yuka, IPCC WGII TSU)
1667	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)
1668	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)
1669	4	67	10	67	10	Date missing in reference. (Burt, Peter, University of Greenwich)
1670	4	68	23	68	34	Some of this information could be presented in Section 4.3.2. (CANADA)
1671	4	68	32	68	32	Poor English: replace 'like' with 'such as'. (Burt, Peter, University of Greenwich)
1672	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)
1673	4	68	38	68	38	Define Q90 (Burt, Peter, University of Greenwich)
1674	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). (Burt, Peter, University of Greenwich)
1675	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)
1676	4	70	34	70	34	typo: insert a space before "Numerous" (Cassardo, Claudio, University of Torino)
1677	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)
1678	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)
1679	4	71	2	71	2	typo: insert a space before "effects" (Cassardo, Claudio, University of Torino)
1680	4	71	4	71	4	typo: insert a space before "change" (Cassardo, Claudio, University of Torino)

#	Ch	From Page	From Line	To Page	To Line	Comment
1681	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)
1682	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1683	4	71	15	71	16	Delete duplicated references outside brackets. (Burt, Peter, University of Greenwich)
1684	4	71	15	71	16	typo: remove ", 2011" (Cassardo, Claudio, University of Torino)
1685	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)
1686	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)
1687	4	71	20	71	20	typo: insert a space before "(i.e." (Cassardo, Claudio, University of Torino)
1688	4	71	21	71	21	typo: insert a space before "is still" (Cassardo, Claudio, University of Torino)
1689	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)
1690	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 (Burt, Peter, University of Greenwich)
1691	4	71	24	71	24	typo: insert a space before "21st" (Cassardo, Claudio, University of Torino)
1692	4	71	30	71	33	This sentence is difficult to follow. Do you mean runoff changes are following precipitation changes? (CANADA)
1693	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)
1694	4	71	34	71	34	Delete comma after 'al.'. (Burt, Peter, University of Greenwich)
1695	4	72	2	72	2	typo: insert a space before "Removal" (Cassardo, Claudio, University of Torino)
1696	4	72	3	72	3	typo: insert a space before "in" (Cassardo, Claudio, University of Torino)
1697	4	72	4	72	4	typo: insert a space before "Changes" (Cassardo, Claudio, University of Torino)
1698	4	72	9	72	9	remove "e.g." (Cassardo, Claudio, University of Torino)
1699	4	74	17	0	54	Please check and correct (format 'et al.' everywhere) (GREECE)

#	Ch	From Page	From Line	To Page	To Line	Comment
1700	4	74	21	74	21	Delete comma after 'energy'. (Burt, Peter, University of Greenwich)
1701	4	74	25	74	25	Replace 'Chapter' with 'Section' (these are section numbers not individual chapters). (Burt, Peter, University of Greenwich)
1702	4	74	26	74	26	'per' should be in italics. (Burt, Peter, University of Greenwich)
1703	4	74	36	74	36	Replace 'Chapter' with 'Section' (these are section numbers not individual chapters). (Burt, Peter, University of Greenwich)
1704	4	74	37	74	37	'et al' should be in italics, with a full stop after the 'l' and a comma before the date. (Burt, Peter, University of Greenwich)
1705	4	74	38	74	38	'et al' should be in italics, with the date in brackets after. (Burt, Peter, University of Greenwich)
1706	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)
1707	4	74	43	74	43	change "region and future" with "region. Future" (Cassardo, Claudio, University of Torino)
1708	4	74	45	74	45	'et al.' should be in italics. (Burt, Peter, University of Greenwich)
1709	4	74	49	74	49	'per' should be in italics. (Burt, Peter, University of Greenwich)
1710	4	74	51	74	52	'et al.' should be in italics. (Burt, Peter, University of Greenwich)
1711	4	74	53	0	0	The text '40% in some countries' requires a citation. (UNITED STATES OF AMERICA)
1712	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)
1713	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). (Burt, Peter, University of Greenwich)
1714	4	87	36	87	37	This citation lacks page numbers. Could provide DOI: 10.1029/2007GL029678 (CANADA)
1715	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)
1716	4	106	20	106	25	References should appear in line 12. (Burt, Peter, University of Greenwich)
1717	4	108	7	109	2	Block of references out of alphabetical order. (Burt, Peter, University of Greenwich)
1718	4	120	0	0	0	Fig. 4-2. What do the numbers in this figure represent? (Macinnis-Ng, Cate, University of Auckland)
1719	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. (Estrada, Yuka, IPCC WGII TSU)
1720	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. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
1721	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 (Cassardo, Claudio, University of Torino)
1722	4	131	0	132	0	Table 4-1: Please adjust column width and set numbers right-bound (except time period). (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1723	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)
1724	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1725	4	135	0	0	0	Figure 4-1contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)
1726	4	135	0	0	0	Numbers need to be explained in the caption or a legend needs to be added. (Fronzek, Stefan, Finnish Environment Institute)
1727	4	135	0	0	0	Figure 4-1. How is an elevation shift indicated by the arrows? (CANADA)
1728	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)
1729	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)
1730	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)
1731	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1732	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. (Estrada, Yuka, IPCC WGII TSU)
1733	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? (Mach, Katharine, IPCC WGII TSU)

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1734	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? (Mach, Katharine, IPCC WGII TSU)
1735	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. (Cassardo, Claudio, University of Torino)
1736	4	135	0	135	0	Fig. 4-2: in the captions, what mens "all ecosystem models"? How many models are they? (Cassardo, Claudio, University of Torino)
1737	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. (Estrada, Yuka, IPCC WGII TSU)
1738	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 explaning what database and/or datasets it is based on or it should be removed to avoid misleading the reader. (Caffrey, Maria, National Park Service and University of Colorado, Boulder)
1739	4	136	0	0	0	Figure 4-3. What is considered non-forest? Grasslands, tundra, savannas? And how is secondary defined? (CANADA)
1740	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1741	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) (Gutknecht, Jessica, Helmholtz Centre for Environmental Research-UFZ)
1742	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. (Estrada, Yuka, IPCC WGII TSU)
1743	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. (Estrada, Yuka, IPCC WGII TSU)
1744	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. (Mach, Katharine, IPCC WGII TSU)

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1745	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. (Cassardo, Claudio, University of Torino)
1746	4	137	0	0	0	Figure 4-5. Why is tree mortality considered as both "evidence" and as "impact". (CANADA)
1747	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. (Mach, Katharine, IPCC WGII TSU)
1748	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)
1749	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 a s 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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1750	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. (Estrada, Yuka, IPCC WGII TSU)
1751	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. (Mach, Katharine, IPCC WGII TSU)
1752	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? (Cassardo, Claudio, University of Torino)
1753	4	139	0	0	0	Figure 4-7contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)
1754	4	139	0	0	0	Figure 4-7 B probably isn't needed and could be omitted. (CANADA)
1755	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) (Cassardo, Claudio, University of Torino)

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1756	4	140	0	0	0	Figure 4-8 Please alter colour-bar to correspond with FFDI categories listed in upper right. (CANADA)
1757	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? (Estrada, Yuka, IPCC WGII TSU)
1758	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. (Cassardo, Claudio, University of Torino)
1759	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)
1760	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. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1761	4	143	0	0	0	Fig. 4-11 Recommend including a legend. (CANADA)
1762	4	143	0	0	0	Fig. 4-11. Insufficient documentation (UNITED STATES OF AMERICA)
1763	4	143	0	0	0	Figure 4 - 11: The legend does not explain what the differently coloured lines should show. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1764	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. (Plattner, Gian-Kasper, IPCC WGI TSU)
1765	4	143	0	0	0	Figure 4-11. A color caption should be provided for the figure, indicating which color corresponds to which RCP. (Mach, Katharine, IPCC WGII TSU)
1766	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)

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1767	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). (Estrada, Yuka, IPCC WGII TSU)
1768	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)
1769	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. (Cassardo, Claudio, University of Torino)
1770	4	147	0	0	0	Fig RF-2. Suggest expanding the acronym and providing a definition of GCC. (CANADA)
1771	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. (Kasurinen, Anne, University of Eastern Finland)
1772	4	148	0	0	0	Figure VW-1contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)
1773	4	148	0	0	0	Figure VW - 1: The legend and the headings of the two panels contain just opposite wording - please correct. (Rock, Joachim, Johann Heinrich von Thuenen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries)
1774	4	149	0	149	0	Fig. WE-1: please remove the figure title, as in the caption is already explained. (Cassardo, Claudio, University of Torino)
1775	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. (Gray, Vincent, Climate Consultant)