#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1	56342	30	0	0	0	0	A very good balanced chapter overall (Michael James Crabbe, University of Bedfordshire)	We thank the reviewer for his comment.
2	57009	30	0	0	0	0	IOC-UNESCO, 2011. Methodology for the GEF Transboundary Waters Assessment Programme. Volume 6. Methodology for the Assessment of the Open Ocean, UNEP, vi + 71 pp. (Salif Diop, UNEP - SAB - DEWA)	We do not understand this particular comment and have not responded. Primarily this is a government agency document which doesn't seem to be relevant here.
3	57344	30	0	0	0	0	The vast STGs of the Atlantic, Pacific and Indian oceans are warming in response to increasing air temperatures. Warming is projected to continue etc. (Erica Head, Fisheries and Oceans Canada)	We agree. The relatively short period of these studies plus evidence of long-term variability reduces confidence in future trends. The text has been modified here and in other places accordingly.
4	57595	30	0	0	0	0	I found this chapter to be in excellent shape. The analyses are thorough yet presented in a concise and clear manner. The tables in particular summarize an enormous number of topics/data. The writing is outstanding. This chapter is a good complement to Chapter 6. There is a good deal of appropriate linkages to Chapter 6, but I found no significant examples of redundancy. There is not the variation in quality I found in some sections of Chapter 6. I have no major recommendations to make and jot down below only a few minor suggestions that may help improve the text a bit and allow correction of a few typographical errors. (George Somero , Stanford University)	We thank the reviewer to this comment and agree that the two chapters make important and independent contributions.
5	58618	30	0	0	0	0	The authors have done a great job in pulling together a coherent chapter about the vast topic of "The Ocean". Although I think it still needs work, the fundemental material is all here. There needs to be a focus on consistency amongst the different section in terms of including "Evidence/Confidence" assessments and also in referencing the primary scientific literature (at present, some sections, largey reference other Reports/Chapters of AR5). (Janice Lough, Australian Institute of Marine Science)	We thank the reviewer for their comment. We have rewritten several sections to improve our referencing of the primary literature. We have referenced other chapters within the IPCC assessment as instructed by the technical support unit. This is the most economical way of presenting and linking the vast information set underpinning the fifth assessment report of the IPCC.
6	60251	30	0	0	0	0	This Chapter is well written and easy to read. (AUSTRALIA)	We thank the reviewer for his comment.
7	60252	30	0	0	0	0	It needs to be made clearer exactly what oceans information chapter 6 and chapter 30 cover and how they differ from each other. There seems to be dulplicated information between the chapters. Both chapters could benefit The report could benefit from clarifying why two chapters on oceans is required. (AUSTRALIA)	Chapter 6 is focused on ocean systems while chapter 30 is focused on oceans as a region. We respectfully disagree that there is significant overlap (which concurs with several other comments and general statements in this spreadsheet). As you will notice, chapter 30 focuses on physical, chemical, biological and social economic aspects of oceans in a geographical context (hence the large number of maps and discussions within chapter 30 that investigate climate impacts from the regional context). We have added text to clarify the different roles of the two chapters.
8	61927	30	0	0	0	0	Different wording has been used to express uncertainty. E.g:, “very high confidence” (page 3, line 18),” robust evidence, high agreement” (page 3, line 28), “high confidence” (page 3, line 31), “high confidence, $p < 0.01$” (page 3, line 38,39), “medium confidence”, “medium evidence, medium agreement” (page 4, line 21), “limited evidence, medium agreement” (page 4, line 38), “high confidence, $p<0.05$” (page 4, line 34). Furthermore, the terms “virtually certain” (page 3, line 6), “likely” (page 4, line 25) and “very likely” (page 4, line 45) are frequently used. It is unclear how and why these different uncertainties have been assigned.The quality of the chapter might be substantially improved by a reduction in the numbers of uncertainty descriptors together with a brief description. I also question whether statements that are assigned “limited evidence” should be part of the executive summary as this term sounds like insufficient evidence. E.g. (page 5, Line 36-37) “Projected change to ocean ecosystems as a result of ocean warming and acidification will reduce access to food, and increase poverty and disease in many countries”. It is not obvious which studies referred to in the chapter that this statement is based upon. Furthermore, the validity of the statement disappears by the uncertainty that has been assigned to it in the following parenthesis: medium agreement, limited evidence. Why include the strong statement in the first place? And what does “agreement” refers to? (Dag Lorents Aksnes, University of Bergen)	We agree that there are needs to be better alignment of the calibrated language across chapter 30. Consequently, we have explored each of these statements and have realigned some of them to be more consistent. Questions regarding the terminology (e.g. "what does agreement refer to" will be referred to the TSU to ensure that the glossary answers these types of fundamental questions.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
9	61928	30	0	0	0	0	The word “impact” is used excessively throughout Chapter 30 in a way that tends to diffuse the message. E.g. (page 5, line 37-38): “Key fisheries throughout the world are being impacted by climate change, through direct physiological and ecological impacts.” Rather than providing an answer on how key fisheries have been affected, two new questions are implied by the statement: How is physiology affected and how is ecology affected by climate change. I believe the text can be significantly improved by substituting “impacts” with the specific effects and mechanisms that the authors have in mind. (Dag Lorents Aksnes, University of Bergen)	We thank the reviewer for this useful comment. We have gone through the chapter and looked at the use of impact and varied it in a number of ways to resolve the issues, as pointed out by the reviewer. We have reduced the use of impact by approximately 50%.
10	61932	30	0	0	0	0	It is not always obvious whether statements in the text, like the one I have already commented (page 57, line 9-11), are based on actual observations or rather reflect mechanisms (hypotheses) that the authors find plausible. Another example of an apparent mixture of observational evidence and mechanisms that are considered plausible are found on line 34-38 page 4: “Significant warming over this period has resulted in increased water column stratification and mixed layer depth. This has reduced the vertical transport of nutrients into the upper layers of the Ocean and has reduced primary production by phytoplankton in these vast areas...” Which studies have actually demonstrated reduced transport of nutrients to the euphotic zone and decreased primary production of the Ocean? In Chapter 6 there appears to be a better distinction between direct observational evidence from published papers and plausible mechanisms that are used by the authors. This distinctino appears to be partly facilitated by subchapter “6.5. Future projections of climate change impacts through modeling approaches“. I think chapter 30 also will benefit from a structure where hypothetical evidence and future projections are more clearly distinguished from direct observational evidence reported in published studies. (Dag Lorents Aksnes, University of Bergen)	We agree with the reviewer that we need to distinguish between observational data and plausible mechanisms. We have gone through the chapter and have addressed this issue in a number of places.
11	61933	30	0	0	0	0	There is overlap between Chapter 30 “The Ocean” and Chapter 6 “Ocean Systems”. This is not surprising as it is not straightforward to make a strict border between these chapters. On the issue of climate change – stratification – nutrients – primary production, but also elsewhere, a check for consistency with Chapter 6 is needed. (Dag Lorents Aksnes, University of Bergen)	Chapter 6 is focused on ocean systems while chapter 30 is focused on oceans as a region. We respectfully disagree that there is significant overlap (which concurs with several other comments and general statements in this spreadsheet). As you will notice, chapter 30 focuses on physical, chemical, biological and social economic aspects of oceans in a geographical context (hence the large number of maps and discussions within chapter 30 that investigate climate impacts from the regional context). We have added text to explain the relationship between the two chapters.
12	64625	30	0	0	0	0	References to chapter 6 should be checked and updated as the structure of chapter 6 has been changed and simplified. (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	We have gone through the chapter and have carefully re-examined and corrected linkages to chapter 6. We have reviewed the linkages after the slight reorganisation of different chapters across WGI in the preparation of the final draft.
13	65290	30	0	0	0	0	The draft mostly covered the "Open Ocean" characteristics and was well written. However, the facts already emerged and those projected are still mixtured in some sections. More clear separation of thoes items are helpful for readers. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We have edited the text to make this clearer. After the last set of comments, we decided to discuss observational records together with projected records in the case of the physical and chemical data sets for consistency and a logical flow.
14	65291	30	0	0	0	0	Nonlinearlity of the biological response is partly described. Linear regression analysis is very dangerous for biological data. This fact must be expressed in the beggining of the discussion. Please add more discussion on the nonlinearlity; e.g. critical temperature, distinction of spawning area, match/mismatch between prey and predator, migration pattern change, etc. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We have reviewed this situation - and have included discussion. However, precise evidence of the relationship (linear versus non-linear) of climate change impacts is missing from the primary literature.
15	65307	30	0	0	0	0	Finally, regarding chapter 30, I could not find any connection with chapter 6. These two chapters are closely related. I hope good organization between them. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	There are numerous references to chapter 6 in chapter 30 (e.g. pages 18, 42, 69, 72). However, now that chapter 6 (as with the other chapters) is close to completion, we have added many more references and linkages between chapter 6 and chapter 30.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
16	65721	30	0	0	0	0	General Comments – This is a very nicely put together chapter on which I have few comments. There is a need to disentangle the effects of fishing pressure from climate. Genner et al., 2010 did this with a 100 year data set from the Western English Channel. We showed that small fish, most of which were non-commercial tracked climate change, whilst abundance of larger fish was largely driven by fishing pressure. This took further Genner et al., 2004 which concentrated on temperature alone. Simpson et al 2011 took a wider view of shelf fisheries. This work should also be mentioned. Genner MJ, Sims DW, Wearmouth VJ, Southall EJ, Southward AJ, Henderson PA, Hawkins SJ. 2004. Regional climatic warming drives long-term community changes of British marine fish. Proceedings of the Royal Society of London, Biological Sciences 271: 655-661. Genner MJ, Sims DW, Southward AJ, Budd GC, Masterson P, Mchugh M, Rendle P, Southall EJ, Wearmouth VJ, Hawkins SJ. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Global Change Biology 16: 517-527. Simpson SD, Jennings S, Johnson MP, Blanchard JL, Schon PJ, Sims DW, Genner MJ. 2011. Continental shelf-wide response of a fish assemblage to rapid warming of the sea. Current Biology 21 (18): 1565-1570. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	We thank the reviewer for us comments and have made appropriate linkages. We respectfully point out that there is some discussion around the Simpson paper with respect to methodology, and the Kennett papers with respect to their local nature. We have taken the point regarding disentangling fishing from other drivers on board and have expanded the discussion of this problem in a number of relevant places.
17	66210	30	0	0	0	0	The chapter is well written and well organized. However, there is rather extensive use of new (unpublished) figures and some new analyses. It is positive that the figures and analyses are based on well-documented data sets, but it is still new analyses which has not been through an scientific peer-review before. For excample figures 30-10, 30-13 and 30-14 seems to contain substantial new analyses. Due to the different scientific relability of already peer-review material and new analyses, this should be adressed in the beginning of the capter (e.g., in the Executive summary). (Randi Ingvaldsen, Institute of Marine Research)	We respectfully disagree. These datasets with views have all been published (e.g. HADsst) and hence our treatment is to represent the data in a visual format. Other analyses such as those in the Poloczanska et al (in press, in PNAS) have been reviewed and will appear in the primary literature well before the publication of the AR5 report. UPDATE: Poloczanska et al 2013 has been published in Nature Climate Change
18	66258	30	0	0	0	0	Chapters 6 and 30 must be coordinated! There is too much overlap. This being said, I find Chapter 30 generally well written and the structuring into different regions very useful. However, the first parts of the chapter are partly a repetition of information already fully given in Chapter 6. E.g., 30.3 and 6.1.1 address the same general issues. I have a problem with "Open Oceans" (the title given in the Contents), and even more so "The Ocean" (the title given in the chapter) being classified as a region. The Oceans cover, as written in page 6, line 43, 71 % of the earth's surface! In some way the principle difference between chapters 6 and 30 must be made clearer, as must the classification of the oceans as a region. This may already have been done in Ch. 1, which I must admit I haven't read, but should also be dealt with early in chapter 30 (Chapter 6 now refers briefly to Chapter 30, Chapter 30 refers to sections of Ch 6 in the excellent Executive Summary, but not in the Introduction). (Geir Ottersen, Institute of Marine Research)	Chapter 6 is focused on ocean systems while chapter 30 is focused on oceans as a region. We respectfully disagree that there is significant overlap (which concurs with several other comments and general statements in this spreadsheet). As you will notice, chapter 30 focuses on physical, chemical, biological and social economic aspects of oceans in a geographical context (hence the large number of maps and discussions within chapter 30 that investigate climate impacts from the regional context). We have modified the text in various places in order to better specify why chapter 6 and chapter 30 are distinct and have particular roles within the AR5 IPCC report - have added text to clarify the different roles of the two chapters.
19	71478	30	0	0	0	0	In general, it seems like there is significant repetition between Chapter 6 and this chapter. The distinction between chapters is not really made clear in the introduction. Suggest clarifying how they differ in terms of focus. It may be possible to cut back further on some of the discussion on the physical and chemical impacts on oceans by referring the reader to Chapter 6. (CANADA)	Chapter 6 is focused on ocean systems while chapter 30 is focused on oceans as a region. We respectfully disagree that there is significant overlap (which concurs with several other comments and general statements in this spreadsheet). As you will notice, chapter 30 focuses on physical, chemical, biological and social economic aspects of oceans in a geographical context (hence the large number of maps and discussions within chapter 30 that investigate climate impacts from the regional context). We have modified the text in various places in order to better specify why chapter 6 and chapter 30 are distinct and have particular roles within the AR5 IPCC report.
20	75786	30	0	0	0	0	Authors appear to be using confidence which is a qualitative measure rather than certainty/likelyhood. Whenever possible use certianty/likelyhood (UNITED STATES OF AMERICA)	We thank the reviewer for their comments and have adopted this principle in many places within the final draft.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
21	75787	30	0	0	0	0	Both MOC and AMOC are used early in chapter. Is this deliberate, to distinguish global vs Atlantic? (UNITED STATES OF AMERICA)	We have modified the text here given the potential confusion - we meant MOC.
22	75788	30	0	0	0	0	Can the first time RCP is spelled out it be given a simple definition? The name is not intuitive. The representative concentration pathways, or greenhouse gas concentration trajectories. This is in other chapters and is a fundemental IPCC definition, but for utility of stand alone chapters, repeating the defintion would be helpful. (UNITED STATES OF AMERICA)	We now have spelt out RCP the first time it was used. "Projections of future sea temperature changes were examined using ensemble averages from AOGCM simulations available in the CMIP-5 archive (Table 30-3) for the four scenarios of the future (Representative Concentration Pathways: RCP2.6, RCP4.5, RCP6.0 and RCP8.5; [van Vuuren et al., 2011]). "
23	75789	30	0	0	0	0	Executive Summary - The introductory paragraph states that the chapter focuses on 8 regional divisions but the first 4 ES conclusions, and several others are about the whole ocean system, overlapping Ch 6. Consider having ES summaries for the 8 regions as stated. (UNITED STATES OF AMERICA)	We respectfully disagree with the reviewer on this point. Chapter 30 is about the ocean as a region and a series of 8 sub-regions as defined. Chapter 6 focuses on ocean systems and does not look at the Ocean as a whole or as a set of regions. Its principal focus is on inheritance systems. We have added text to the introduction to clarify this issues.
24	75790	30	0	0	0	0	It is recommended that Executive Summary statements be limited to the regional differences in climate change impacts as is summarized in Figure 30-15. (UNITED STATES OF AMERICA)	We have done this (see previous comment on a regional approach adopted 5 chapter 30 as opposed to the Systems approach adopted by chapter 6) stop
25	75791	30	0	0	0	0	It is surprising that there are not more studies cited using sateliite remote sensing data and the long time series analysis of changes in coccolithophorids, calcite, POC, etc. by e.g. Barney Balch. It is suggested in the text that the remotely sensed time series of biological data is not long enough to show sustained responses of biology/ecology/chemistry to climate shifts, but SeaWiFS has a nearly 13 year time series, MODIS-Aqua nearly 12 years, MERIS about 13 years, and this is longer than some of the ship-based collection records cited in the published studies. Also, remotely sensed data can show truly global trends, which could be useful in this document. (UNITED STATES OF AMERICA)	We respectfully point out to the reviewer that time series of 13 years in length are too short when it comes to separating climate change influences from long-term 'natural' multi-decadal oscillations. There is also considerable uncertainty regarding remote measurements and what they mean (e.g. recent debate over trends in ocean chlorophyl and productivity). We discuss this issue now within the Ch30 and the various relevant chapters (mainly chapter 6 and chapter 30) have developed a cross chapter box on the net primary productivity on climate change (Box CC-NPP).
26	75792	30	0	0	0	0	Most of the chapter discusses fish and other faunal patterns, and SST, from recent decades. In many cases attribution of causality to these patterns is made. There is virtually no discussion of longer term, late Holocene ocean circulation or SST and its causes even though there are dozens of papers from the Nordic Seas and North Atlantic using sediment cores and many SST proxies [incluing faunal, phytoplankton, and geochemical proxies]. Paleoceanography and past faunal/floral patterns are an essential part of detection and attribution of human-induced changes. Thus the chapter seems to send a message that prior to human record keeping and the Anthropocene, ocean circulation, SST, faunal assemblages and phytoplankton activity were somehow stable which we know is not the case. It would be valuable to add a section on Holocene paleo-records, and acknowledge the challenge of attribution of cause given known centennial and multi-decadal variability. At least, the chapter should make appropriate references to ocean observations and paleo chapters of WG1. Additionally, perhaps this historic context could be valuably presented in an FAQ. (UNITED STATES OF AMERICA)	We respectfully point out to the reviewer that paleological perspectives were not part of the current chapter - and indeed have been dealt with in working group 1, chapter 5, to a large extent. Ch30 is tasked to explore regional trends as opposed to the more mechanistic studies of ch6.
27	75793	30	0	0	0	0	PDO, AMO, NAO & other internal modes of climate variability are discussed in many places in the chapter. It is well known that they significantly influence ocean biota etc. These modes of variability are frequently mentioned as a major source of uncertainty, but they are summarized in a single line on p. 57. It would be useful to put a table and introductory paragraph early in the chapter discussing these modes, their dominant timescales and areas and seasons of greatest impact [ie teleconnections]. These are WG1 concepts that will not necessarily be known to the typical WG2 reader. (UNITED STATES OF AMERICA)	We originally had a diagram which showed this information. However, chapter 6 presents this information in one of its figures and hence we refer to figure as opposed to discuss it directly. We now refer to CH6 on this issue.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
28	75794	30	0	0	0	0	Sometimes units have dots (mmol.kg-1 and sometimes no dots; sometimes oxygen is spellled out and sometimes shown as O2 even in same sentence (e.g., p 18, line 34-35). (UNITED STATES OF AMERICA)	We thank the reviewer for the comment and have addressed this issue through careful editing.
29	75795	30	0	0	0	0	Suggest that the Blue Carbon concept/write up p.54 be moved to "Emerging Issues" section p.56 (UNITED STATES OF AMERICA)	We thank the reviewer this comment and have moved the blue carbon concept text to the emerging issues section.
30	75796	30	0	0	0	0	The 8 regions are not addressed until Page 20. Please consider condensing the early introductory material that is very repetitive with Chapter 6. (UNITED STATES OF AMERICA)	We have significantly reduced the introductory text. We disagree with respect to the comment regarding the repetitiveness of chapter 6 and chapter 30. See various comments above - we have change the text in various places in order to make the distinction between chapter 6 and chapter 30 much clearer (see Introduction).
31	75797	30	0	0	0	0	The authors are encouraged to reconsider the balance of discussion given to scientific topical areas. The "Oceans" chapter seems to focus very heavily on ocean acidification, some corals, and fisheries. While these are important areas, only a paragraph is given to sea level, heat budget, etc. The report is light on ocean physics, and much of the biogeochemistry (carbon cycling, nitrogen, major nutrients, etc.) has been excluded. Southern Hemisphere only gets two paragraphs. If the authors feel this is outside the scope of this chapter, they should confer with Ch 6 authors to see where these issues can be most appropriately addressed. Additionally, beyond the intra-WG2 coordination, references to the WG1 report would be valuable, as well. (UNITED STATES OF AMERICA)	We respectfully disagree with the reviewer. Firstly, given that WG1 is focused on ocean physics and chemistry, we have reduced the text in this regard and refer to WG1 on these topics. Secondly, the meta-analysis of hundreds of papers contained within the chapter (now published as Poloczanska et al 2013 - Nature Climate Change) contains information on a broad range of organisms and issues from invertebrates, whales, seabirds, plankton and many other organisms.
32	75798	30	0	0	0	0	The chapter is missing a discussion of the impact of climate change on marine mammals. The discussion should include impacts on marine mammals directly (including increased die off in disease) as well as impacts from changes in their food supply and habitats, as well as from climate-related changes in commercial fishing, as well as native and cultural practices. This could be addressed in the marine organism response, social impacts and regional sections. The regional sections, especially the Arctic should be well coordinated with the Arctic chapter. Suggested references include: Sue E. Moore and Henry P. Huntington 2008. ARCTIC MARINE MAMMALS AND CLIMATE CHANGE: IMPACTS AND RESILIENCE. Ecological Applications 18:S157–S165. http://dx.doi.org/10.1890/06-0571.1; Ashjian, C.J.et al 2010. Climate variability, oceanography, bowhead whale distribution and Inupiat subsistence whaling near Barrow, Alaska. Arctic 63(2): 179-194; Grebmeier, et al. 2010. Biological response to recent Pacific Arctic sea ice retreats. EOS 91(18): 161-162.; Kovacs, K.M., et al 2010. Impacts of changing sea ice conditions on Arctic Marine Mammals. Marine Biodiversity: 51-65.; Moore, S.E. 2010. Whales facing climate change in the Pacific Arctic. Whalewatcher 39(2): 7-11.; Moore, S.E., et al.2010. Bowhead whale distribution and feeding near Barrow, AK in late summer 2005-06. Arctic 63(2): 195-205; Learmonth et al 2006 ; Slenning 2010;K. Burek, DM Lavigne, CT Tynan, MP Simmonds (review) (UNITED STATES OF AMERICA)	We will look at the references that have been suggested. However, the meta-analysis which has now been published as Poloczanska et al 2013 contains on marine mammals and indeed a very large number of other organisms. We also respectfully point out that we do not deal with polar oceans which is the rematch of chapter 28.
33	75799	30	0	0	0	0	The chapter is missing a discussion of the impact of climate change on marine mammals. The discussion should include impacts on marine mammals directly (including increased die off in disease) as well as impacts from changes in their food supply and habitats, as well as from climate-related changes in commercial fishing, as well as native and cultural practices. This could be addressed in the marine organism response, social impacts and regional sections. The regional sections, especially the Arctic should be well coordinated with the Arctic chapter. Suggested references include: Sue E. Moore and Henry P. Huntington 2008. ARCTIC MARINE MAMMALS AND CLIMATE CHANGE: IMPACTS AND RESILIENCE. Ecological Applications 18:S157–S165. http://dx.doi.org/10.1890/06-0571.1; Ashjian, C.J.et al 2010. Climate variability, oceanography, bowhead whale distribution and Inupiat subsistence whaling near Barrow, Alaska. Arctic 63(2): 179-194; Grebmeier, et al. 2010. Biological response to recent Pacific Arctic sea ice retreats. EOS 91(18): 161-162.; Kovacs, K.M., et al 2010. Impacts of changing sea ice conditions on Arctic Marine Mammals. Marine Biodiversity: 51-65.; Moore, S.E. 2010. Whales facing climate change in the Pacific Arctic. Whalewatcher 39(2): 7-11.; Moore, S.E., et al.2010. Bowhead whale distribution and feeding near Barrow, AK in late summer 2005-06. Arctic 63(2): 195-205; Learmonth et al 2006 ; Slenning 2010;K. Burek, DM Lavigne, CT Tynan, MP Simmonds (review). (UNITED STATES OF AMERICA)	As above

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
34	75800	30	0	0	0	0	The chapter lacks adequate discussion on the connection between climate change and marine mammal species. There is a body of literature on this topic (e.g., the work of Sue Moore) (UNITED STATES OF AMERICA)	As above
35	75801	30	0	0	0	0	The Executive Summary seems extremely long. Suggest that it be condensed. (UNITED STATES OF AMERICA)	We have looked carefully at the executive summary and have reduced the length from over 4 to 2.3 pages.
36	75802	30	0	0	0	0	The repetition between chapters 30 and 6 also carries over into the executive summaries of both chapters. The first two pages of the Executive Summary is information that should actually be included in chapter 6 with the exception of lines 32-41 on page 4. In some cases, where material is repetitive, the statements seem contradictory, and some of these have been pointed out in individual review comments. Since the executive summaries may be the only sections that are read by many readers, it is imperative that the space and content be used efficiently to relay the most important issues. It is also recommended that the authors of chapters 30 and 6 review both of these chapters, and relevant sections of the WGI document to minimize unnecessary redundancy, optimize cross referencing and insure consistency of both factual information and use of confidence and likelihood statements. (UNITED STATES OF AMERICA)	Chapter 6 focuses on ocean systems while chapter 30 focuses on oceans as a region and set of sub regions. Consequently, there is little overlap between the two chapters. However, we have looked carefully at the executive summary and have reduced the repetition that has occurred in a small number of places. We have also added a sentence in the introduction to explain the relationship between the two chapters.
37	75803	30	0	0	0	0	The topic and concluding sentences in many areas of the chapter are vague and feel "tacked on" just for transition purposes. Given that space is a consideration, all of the text should be important and well-considered. (UNITED STATES OF AMERICA)	We have revisited these sentences and have eliminated those which are vague and trivial.
38	75804	30	0	0	0	0	The use of confidence and likelihood statements is inconsistent within this chapter and between chapter 30 and 6. There are some sections in which confidence or likelihood statements are included after almost every sentence, and in other areas there are entire chapter sections without a single confidence statement. In some cases there is evidence of statistical confidence (for example p values are listed) however a confidence statement is applied instead of a likelihood statement. In general, for many of the statements including information on chemical concentrations or physical properties of ocean systems, likelihood statements can and should be applied; for many of the biological observations, it is more difficult to apply likelihood statements, and in these cases, confidence statements should be used. There are also instances in which the wrong language is used in a confidence statement (e.g. moderate confidence instead of medium confidence, etc.). (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 into chapter.
39	75805	30	0	0	0	0	There are many repetitive ideas in Chapter 30. One is the notion that warming will increase stratification, decrease nutrient upwelling, and decrease primary productivity. Another is that warming temperatures will increase microbrial respiration and low-oxygen conditions. These universal concepts would be best addressed once and not repeated in every section and explained with different citations every time they occur. (UNITED STATES OF AMERICA)	We thank the reviewer for this comment and have managed to reduce some of the overlap in terms of describing particular dynamics. This has resulted in Ch30 being 15 pages shorter.
40	75806	30	0	0	0	0	There are periodic uses of "moderate confidence" - example on p.45. This does not appear to be consistent with IPCC-approved terminology. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 into chapter 6. As part of this we have changed four (all) incidences of 'moderate confidence' to 'medium confidence'.
41	75807	30	0	0	0	0	There is a bewildering array of jargon and acronyms in this chapter. For the sake of the non-expert, the authors are strongly encouraged to simplify their discussions. (UNITED STATES OF AMERICA)	Was gone through chapter 30 and have reduced the jargon and acronyms (defining those where used for the first time) where possible.
42	75808	30	0	0	0	0	There is a tendency throughout the chapter to make statements of speculation rather than to focus on just facts, and as such, the text seems a bit "jargony" in places. The authors should take care in addressing certainty when discussing topics where outcomes or information is unknown, especially in predicting future conditions. Unqualified, speculative statements are potentialy problemmatic and should be avoided where possible. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 into chapter 6. We have significantly shortened the text and have added text that explains the relationship between ch6 and ch30.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
43	75809	30	0	0	0	0	There is considerable repetition of material between the Chapters 30 and 6. It is understood that these chapters should be readable as stand-alone. However, clear statements should be made in the introductions on the objective of each chapter, the need to review some fundamental concepts for an understanding of the chapter material, and the differences between chapters 6 and 30. The objective of chapter 30 is to focus on regional impacts. However, the first 20 pages of the chapter is a reiteration of information that should be in chapter 6. Discussion of regional impacts does not start until section 30.5 on page 20. It is suggested that the information in sections up to 30.4 be merged with Chapter 6 to reduce repetition and streamline the focus of Chapter 30. (UNITED STATES OF AMERICA)	Chapter 6 focuses on ocean systems while chapter 30 focuses on oceans as a region and set of sub regions. Consequently, there is little overlap between the two chapters. However, we have looked carefully at the executive summary and have reduced the repetition that has occurred in a small number of places. We have also explained the different roles of ch6 versus ch30 in the Introduction.
44	75810	30	0	0	0	0	There is far too much overlap with Chapter 6 and both chapters are long. (UNITED STATES OF AMERICA)	Chapter 6 focuses on ocean systems while chapter 30 focuses on oceans as a region and set of sub regions. Consequently, there is little overlap between the two chapters. However, we have looked carefully at the executive summary and have reduced the repetition that has occurred in a small number of places. We have also explained the different roles of ch6 versus ch30 in the Introduction.
45	75811	30	0	0	0	0	This chapter seems to make irregular use of uncertainty estimates as per the IPCC system. Some paragraphs have an estimate after almost every sentence, and then some pages have nothing. More consistency is needed in the number of estimates given and the types of information that estimates are used on. For example, passages that review the literature have either citations everywhere or nowhere. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 into chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
46	75812	30	0	0	0	0	To ensure consistency, chapter 30 authors should review chapter 6 and vice versa. (UNITED STATES OF AMERICA)	Several members of our team have looked at chapter 30 quite closely as indeed members of chapter 6. Comments are included in the spreadsheet.
47	75813	30	0	0	0	0	We believe that Blue Carbon should be removed from p 47 and p. 54 and included in Emerging Themes (UNITED STATES OF AMERICA)	We thank the reviewer to this suggestion and have implemented it.
48	75814	30	0	0	0	0	While Chapter 30 intro mentions Chs 3 and 10, for differentiation, it does not mention Ch 6. This needs attention: to explain the role of Ch 6 relative to Ch 30. (UNITED STATES OF AMERICA)	There are numerous references to chapter 6 in chapter 30 (e.g. pages 18, 42, 69, 72). However, now that chapter 6 (as with the other chapters) is close to completion, we have added many more references and linkages between chapter 6 and chapter 30.
49	77321	30	0	0	0	0	The authors have answered and addressed my previous questions from the first round of review. (Maria Caffrey, National Park Service and University of Colorado, Boulder)	We are pleased that the reviewer considers that we have answered and addressed their previous concerns.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
50	77952	30	0	0	0	0	This chapter has improved markedly since the FOD, but there are still places where it seems confused regarding what exactly is the question we are trying to answer. Is it (a) “Does climate affect marine ecosystems?” or (b) “Does specifically anthropogenically driven climate change affect ecosystems in ways that can be detected against the background of natural variability?” In a number of cases the stated levels of confidence seem more appropriate to (a) than (b), or the reference frame seems to shift back and forth between (a) and (b) when evidence to assign a high confidence level to (b) is lacking. I think this chapter still needs some clarification of what its mandate is and what is the overarching the question it is trying to answer, particularly in the Executive Summary. There are a number of places where I think the stated confidence level is too high or too low. In the case of ocean acidification, I would say it is virtually certain that pH has declined, that it will continue to do so, and that this trend is caused by anthropogenic CO2. On the other hand, a variety of climate and ecosystem impacts are given confidence higher than I would say is warranted, and I genuinely can not tell whether this is intended to be an attribution to anthropogenic forcing, or simply a statement that these phenomena are affected by 'climate', in a broad sense that includes both climate variability and anthropogenic climate change. This is what I meant by shifting of reference frame above. There is still some conflation of climate and other anthropogenic impacts (e.g. top p.18). On 18/9-12 "climate change at decadal time scales" is invoked. I can not tell what is meant by this. Trends at this time scale involve diverse regional effects and do not have single direction or cause globally. 57/32-34 conflates variability and change, and sheds little light on what is known about how climate variability or its impacts will change in the future. (James Christian, Government of Canada)	We thank the reviewer for their initial comment. We have also looked at each of these concerns and have made appropriate responses. Firstly, we have continued to tighten the language up so that it aligns betterwith the purpose of chapter 30, which is to assess the extent to which changes can be detected and attributed to climate change within the ocean. We have also ensured that the statements of purpose are more clearly stated at the beginning of the chapter. Secondly, we have gone through the chapter carefully and have looked at the confidence and likelihood statements and have made them even more consistent than previous drafts. Thirdly, we point out respectively that we have had the meta-analysis published (Poloczanska et al 2013) which deals likely which the issues raised in the second part of this comment.
51	77953	30	0	0	0	0	References to climate modes as "cycles" have been scaled back but not eliminated. The paragraph at top p. 19 is quite good but I can not make sense of the reference to "climate oscillation" in the final sentence. 23/1-20 implies that AMV is a cyclic process. 23/29 refers to the 'periodicities' of the PDO. (James Christian, Government of Canada)	We thank the reviewer for their comment and have gone through the manuscript to eliminate the last confusing use of 'cycles'. Lastly, we have rewritten the text that previously included 'climate oscillation'.
52	77954	30	0	0	0	0	I think it is a misconception to state that temperature effects on respiration will result in a general decline in subsurface oxygen concentrations. Temperature controls the remineralization rate, but organic matter supply controls the net change (since almost all of the organic matter supply is eventually remineralized). It is possible that an increasing rate will result in localized decline in O2 in certain depth strata (because organic particles would otherwise have sunk to greater depths), but the current text presents an effect of remineralization rate on O2 concentration as being much more general than it is. I don't understand how declining primary production can generate a general increase in subsurface remineralization (e.g., 57/11). I don't see why it is necessary to cite terrestrial analogues for a very general 'ballpark' estimate of the Q10 of microbial communities (45/43); there are plenty of marine data. Brown et al 2004 is not a particularly appropriate reference for what is a basic fact of biochemistry (46/1). (James Christian, Government of Canada)	In the matter of temperature being the dominant control we cite Helm et al. (2010) in which only 15% of the observed O2 decrease is due purely to solubility, and 85% is due to a combination of increased microbial activity and reduced ventilation, both of which are dominantly temperature dependent processes. The argument that almost all organic matter is remineralized neglects the enormous reservoir of organic carbon on continental shelves. The rates of O2 consumption, and H2S and CH4 production there are significant forces. Much of our fossil fuels come from this carbon reservoir. The Brown et al reference addresses fundamental processes and marine species provide the greater part of the examples used. If the reviewer has a superior reference to suggest we would be happy to examine this for possible inclusion.
53	79686	30	0	0	0	0	It seems that this chapter (especially the executive summary) repeats a lot of material in chapter 6. It is clear that chapter 6 and 30 were written by a completely different set of authors, with very little communication during the writing process. There are very few cross references between chapters and there are many worrying inconsistencies in the evidence and certainty/confidence assessments that should have been cross-checked. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Chapter 6 focuses on ocean systems while chapter 30 focuses on oceans as a region and set of sub regions. However, we have looked carefully at the executive summary and have reduced the repetition that has occurred in a small number of places. We have also looked carefully for overlaps/synergies - and have significantly shortened the text as well as add text that explains the relationship between ch6 and ch30. Consequently, there is now little overlap between the two chapters. We have also looked at the draft carefully to identify inconsistencies both internally and between chapters. We have corrected a small number of issues.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
54	79687	30	0	0	0	0	This chapter frequently uses "very likely" (throughout the chapter) based on flimsy and anecdotal information. It does not use a systematic nomenclature for uncertainty or consensus (unlike chapter 6) and hence it reads as if it is an opinion pieces rather than a rigorous assessment . It could be VERY VULNERABLE TO EXTERNAL CHALLENGE unless it is tightened up considerably. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
55	81051	30	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 30 and is available in the supporting material web page. Chapter team may wish to rectify these errors before starting to work on SOD revisions and FGD preparation. (Monalisa Chatterjee, IPCC WGII TSU)	We have now reviewed those inconsistencies and have corrected them.
56	81457	30	0	0	0	0	Robinson projection is the recommended projection for global maps. Please ensure this projection is used wherever possible to have a consistent presentation across the volume. (Yuka Estrada, IPCC WGII TSU)	Unfortunately, the software that we are currently using does not use the Robinson projection. It would be very difficult for us to adopt this particular projection. However, given that the current projection methodology performs well in terms of illustrating the regional differences in different parameters, we have decided not to use the Robinson projection the global maps in chapter 30. UPDATE: we have modified maps to Robertson projections where possible.
57	84120	30	0	0	0	0	1) Overall -- This chapter team has developed a very robust 2nd-order draft. In the final draft, the chapter team is encouraged to continue its prioritization of effective figures, rigorous assessment, high specificity, and clear writing. (Katharine Mach, IPCC WGII TSU)	We thank the reviewer for her comments.
58	84121	30	0	0	0	0	2) Coordination across Working Group II -- In developing the final draft of the chapter, the author team should continue to ensure coordinated assessment, both in the chapter text and at the level of key findings. Such coordination is relevant across many of the sectoral and regional chapters, but especially across chapters 5, 6, and 30. Where cross-references are made to other chapters, they should preferably cross-referenced specific sections and/or assessment findings of the chapters, continuing to ensure that overlaps are reduced and assessment harmonized. (Katharine Mach, IPCC WGII TSU)	We have spent most of our recent meeting in Slovenia identifying and inserting the linkages while at the same time investigating inconsistencies both internally and between chapters . We feel our final draft is much greater consistency and linkage to the other chapters within the AR5 manuscript.
59	84122	30	0	0	0	0	3) Harmonization with the Working Group I contribution to the AR5 -- In developing the final draft, the chapter team should also ensure all cross-references to the Working Group I contribution are updated, with discussion of climate, climate change, and climate extremes referencing the assessment findings in that volume. Where cross-references are made, wherever possible and appropriate they should specify the specific relevant sections of Working Group I chapters, instead of generic references to whole chapters. (Katharine Mach, IPCC WGII TSU)	We have gone carefully through chapter 30 and have re-examined/corrected the linkages to working group 1. This has resulted in a much closer alignment with WGI.
60	84123	30	0	0	0	0	4) Shortening and tightening the chapter -- The chapter team is strongly encouraged to shorten the text of the chapter as much as possible, ideally by 20 pages. Material that overlaps with chapter 6 and working group 1 should be reduced especially, with concise cross-referencing used here. The effectiveness of the chapter will be much greater if it is substantially shorter. (Katharine Mach, IPCC WGII TSU)	We have significantyly reduced the length of the chapter as requested. We respectfully point out, however, that chapter 30 represents a pinnacle within AR5 and draws together a global picture of the detection and attribution of climate change at large regional scales. When one looks carefully at chapter 6 and chapter 30, there is not as much overlap as is implied here. We therefore feel that require slightly more space than seen with the other regional chapters. All this said, we have reduced the length (by more than the 15 pages requested in Bled) and have endeavoured to identify those possibilities in terms of cross-referencing. This said, we have been careful not to undermine the integrity of the chapter at this late stage.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
61	84124	30	0	0	0	0	5) Presentation of uncertainty language within parentheses -- As much as possible, the chapter team should present calibrated uncertainty language within parentheses at the end of sentences. Such placement maximizes the directness and clarity of statements. Wherever possible, formulations such as "there is high confidence that" should be nixed and replaced by "(high confidence)" at the end of the sentence. (Katharine Mach, IPCC WGII TSU)	We have gone through the document carefully and have corrected this issue.
62	84125	30	0	0	0	0	6) Report release -- The chapter team should be aware that the final drafts of the chapters will be posted publicly at the time of the SPM approval, before final copyediting has occurred. Thus, the chapter team is encouraged to continue its careful attention to refined syntax and perfected referencing. (Katharine Mach, IPCC WGII TSU)	We have taken this on board and will ensure that we do this. UPDATE: the team has spent the final weeks deliberately crosschecking linkages, doing fine scale copy editing and proofreading. The document no longer has the typographical errors and mislabels seen in the SOD.
63	84126	30	0	0	0	0	7) Characterization of future risks -- In characterizing future risks for the oceans, 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 the oceans, 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. (Katharine Mach, IPCC WGII TSU)	We have added text along these lines in several places within the manuscript - as well is revisiting our use of language such as adaptation and other management options. We have also proved our linkages to chapter 19 and table SPM.4.
64	84127	30	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 the oceans, how limits to adaptation may be relevant in the context of this chapter, and how interactions among mitigation and adaptation may occur. (Katharine Mach, IPCC WGII TSU)	We have revisited each of these suggestions and have added text accordingly.
65	84128	30	0	0	0	0	9) Likelihood terms versus levels of confidence -- Wherever likelihood terms are used, the chapter team should ensure their assignment stems from a probabilistic basis in the underlying evidence. If such a basis is not available, presentation of a level of confidence for the conclusion is more appropriate. (Katharine Mach, IPCC WGII TSU)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
66	84129	30	0	0	0	0	10) Care with extrapolation -- The chapter team should exercise care when making future-oriented statements based on observed changes. In some places, the saying "correlation does not equal causation" came to mind. Additionally, any such extrapolation should be robustly supported by the analyses in the underlying literature. (Katharine Mach, IPCC WGII TSU)	We have gone through the chapter carefully looking at the issue of extrapolation and have avoided the pitfalls of correlations not equating to causality.
67	84130	30	0	0	0	0	11) Scientific characterization of risk -- As a core part of its mandate, the chapter team should assess risks for the oceans, from a scientific and technical perspective. In some places in the chapter, the author team may be too much asserting value judgments about those risks, going beyond the expert judgments that are part of its mandate. (Katharine Mach, IPCC WGII TSU)	We've gone to the chapter carefully and have looked at assertions with respect to risk and have modified them to ensure that our judgements about risk are consistent with the expert literature.
68	84131	30	0	0	0	0	12) Acknowledging uncertainties -- In some places where the chapter team provides best estimates for various projected variables, it would be helpful to further indicate that these are estimates with uncertainties, not exactly determined values. This applies for example in discussion in the chapter text of value summarized in table 30-4. (Katharine Mach, IPCC WGII TSU)	We have gone through the chapter, especially table 30-4 and have inserted appropriate uncertainty/values.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
69	84132	30	0	0	0	0	13) Conventions for calibrated uncertainty language -- All calibrated uncertainty language used in the chapter should be italicized for clarity. Casual usage of the reserved likelihood terms should be avoided. I have tried to flag relevant instances within the chapter. (Katharine Mach, IPCC WGII TSU)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
70	85082	30	0	0	0	0	GENERAL COMMENTS: I congratulate the author team for all their work on the 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. In addition, where likelihood terms are used ("likely," "very likely," etc.), it is also not always clear whether they are intended as calibrated language or not--please carefully check this and avoid casual usage. (Michael Mastrandrea, IPCC WGII TSU)	We thank the reviewer for his comments and have endeavoured to carefully look at the issues that have been raised. The text has been modified in a number of places.
71	85083	30	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 30, this includes presentation of observed impacts and vulnerabilities in section A.i and sectoral and regional risks in section C.i, 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 30 and other chapters at LAM4? (Michael Mastrandrea, IPCC WGII TSU)	We have prepared a document which outlines linkages into the SPM and TS. We have also considered in this document how the various sections feed into the summary products.
72	85161	30	0	0	0	0	The notation p< is used in this chapter several times. What does it mean ? (Michel Petit, CGIET rue de Bercy)	This is standard use for indicating the probability of type I error. Table reference now has: "The table includes the slope of the regression (°C decade-1), the p-value for the slope being different from zero and the total change over 50 years (i.e., the slope of linear regression multiplied by 5 decades) for each category. P values (>0.05) indicating slopes that were not significantly different from zero or no slope are shown in red. Note, changes at high p-values may still be valid but have lower levels of confidence (< 95%) associated with them."
73	65722	30	1	0	0	0	Comments restricted mainly to summary, 30.4 and 30.5 (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	Acknowledged
74	57004	30	1	1	1	1	The tile" The Ocean" is hanging. Let the title capture the sprit of the underlying text in the entire document. In otherwords, the title always prepares the reader what he expects in the text of the document (KENYA)	This has been decided by the TSU and is something we can't change.
75	64635	30	1	1	1	1	the original chapter title was "Open Oceans" (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	The change in the ocean title occurred because we are not just looking at the open oceans but are looking at the oceans from a regional scale.
76	75831	30	3	0	4	0	In general, much of the information in Ch. 30 ES is repetitive of the Ch. 6 ES, especially on pages 3 and 4. Ch. 30 ES should focus on statements regarding region specific climate change impacts and observations. The ES statements on pages 5 and 6 are good examples of the type of information that should be included. Figure 30-15 is an excellent summary of the primary points in this chapter and could be used as a guide to restructure the Ch. 30 ES to remove repetitious materials, focus on the intended objective of the Chapter and shorten the document's overall length. (UNITED STATES OF AMERICA)	We've gone through the two executive summaries and have modified them so that they are shorter, more consistent and compatible between each other. We have also developed a clear line of sight to chapter 30 executive summary statements.
77	84133	30	3	1	0	0	Length of the Executive Summary -- The chapter team should reduce the length of the executive summary to 2.5 pages as the maximum length. (Katharine Mach, IPCC WGII TSU)	We have reduced the length of the executive summary to 2.6 pages.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
78	84134	30	3	1	0	0	Characterizing Future Risks in the Executive Summary -- As much as possible and as a core way to reduce length and increase focus , the chapter team should specify risks and key risk for ocean regions and the oceans overall. The chapter team, as possible, should indicate the degree to which future risks change or increase with increasing levels of climate change. Which risks emerge in the near-term, and which emerge in the long-term? What is the potential for reducing risks through adaptation and mitigation? (Katharine Mach, IPCC WGII TSU)	We have now added text that more clearly identifies future risks to the ocean from rising CO2, ocean acidification and climate change. We have also developed a joint table between the different marine related chapters in order to specify risks and vulnerabilities clearly and consistently within working group II.
79	84135	30	3	1	0	0	Use of Likelihood Terms -- Wherever likelihood terms are used within the executive summary, the chapter team should ensure a probabilistic basis is available for their assignment. If such basis is not available, presentation of a level of confidence for the conclusion is more appropriate. (Katharine Mach, IPCC WGII TSU)	We have gone through each of the cases where we have used likelihood terms and either change them to levels of confidence or have added the level of confidence to make the executive summary more consistent with the protocol and form used across AR5.
80	85084	30	3	1	0	0	Executive Summary: Please continue to refine the focus and clarity of the executive summary as you revise the chapter--it is currently too long. In addition, to the extent possible as supported by the literature, please 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 ensure clear line of sight to underlying chapter sections and full support for all findings in chapter 30. It is appropriate to include cross-references to other chapters and Working Group I in the chapter text, but not in the executive summary in most cases--I would recommend moving all references to chapter 6 to the chapter text, making it clear how they are relevant to the findings of chapter 30. Right now, some paragraphs present findings that are not fully support in chapter 30--I have pointed these out in specific comments. I have also noted places where further clarity in terms of traceability is needed in my specific comments. (Michael Mastrandrea, IPCC WGII TSU)	See above. We have modified the text of the executive summary so it shorter, and that it is more internally consistent as far as confidence and likelihood statements, and have identified future risks more pointedly within the text.
81	58309	30	3	1	6	36	Cut the ES reasonably and make it as concise as possible. (Juqi Duan, National Climate Center, Chinese Meteorological Administration)	See above, we have shortened the length of the executive summary.
82	80649	30	3	1	6	36	The Executive Summary is too lengthy, it should be shorten. (Jiahua PAN, Chinese Academy of Social Sciences)	See above, we have shortened the length of the executive summary.
83	60253	30	3	3	3	20	The intro to the Executive Summary is well written and useful. The Executive Summary itself is very good, providing the main points in easy to understand language. (AUSTRALIA)	We thank the reviewer for their comments.
84	85085	30	3	6	3	18	I would recommend against presenting findings in this introductory text, given that no line of sight is included. Present the findings after the introduction, if retained. (Michael Mastrandrea, IPCC WGII TSU)	Have done so.
85	75815	30	3	7	3	7	Change "ocean" to "open ocean". This makes the phrase "virtually certain" true. In the coastal ocean it is not certain that pH is changing from anthropogenic activities. (UNITED STATES OF AMERICA)	We agree with the reviewer and have adapted the text accordingly.
86	60254	30	3	10	3	13	Executive Summary defines Polar Seas by the presence of sea ice, and notes these are dealt with in Ch 28. However, Ch 28 (pg 5) defines the Antarctic polar region as the continent and surrounding Southern Ocean south of the polar front (generally around 58 degrees south). Suggest the two chapters adopt a more consistent aprpoach, or that Executive Summary (Ch 30) more clearly note that the Southern Ocean (south of the polar front) will be considered in Ch 28. (AUSTRALIA)	We have investigated this issue and have changed this accordingly.
87	75816	30	3	12	3	12	The Deep Ocean is commonly defined as > 2000 m, not greater than 1000 m. (UNITED STATES OF AMERICA)	There are many definitions of the Deep Sea In our case, we chose 1000 m.
88	84136	30	3	14	3	14	Casual usage of "unlikely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We agree and have modified the text accordingly.
89	75817	30	3	22	3	22	"Changed significantly over the past 60 years" relative to what? before 60 years ago? Or since observations have been made? Or within the period of observations? A qualification is necessary here to clarify the statement. (UNITED STATES OF AMERICA)	We have rewritten the exec summary and clarified time periods in statements
90	84137	30	3	22	3	22	Given the use of "significant" in statistical context, it may be clearest to avoid "significantly" here. (Katharine Mach, IPCC WGII TSU)	We have modified the use of significantly here.
91	85086	30	3	22	3	22	Please clarify what is meant by significantly here. (Michael Mastrandrea, IPCC WGII TSU)	See above
92	85087	30	3	24	3	27	This statement is not well supported in the cited sections of chapter 30, although section 30.5 provides further discussion of this material. Please consider the appropriate line of sight to include during revisions. (Michael Mastrandrea, IPCC WGII TSU)	We have updated

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
93	75818	30	3	25	3	27	This sentence implies that long-term variability (which may be natural) could be bad, that's likely not the intent. Suggest editing to "Temperatures in many sub-regions are influenced by both long-term variability.... AMO) and anthropogenic climate change...." (UNITED STATES OF AMERICA)	We agree with the reviewer and have modified the text as suggested.
94	75819	30	3	28	3	28	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We have gone through the manuscript and have carefully and have added probabilistic measures where appropriate.
95	75820	30	3	30	3	31	"...changes in wind speed..." may be too general here, given that it refers to increased thermal stratification. Recommend changing 'changes' to increases' or making the subsequent comment on stratification more general. (UNITED STATES OF AMERICA)	We agree with the reviewer and have modified the text as suggested.
96	75821	30	3	31	3	34	"unprecedented in millions of years" seems vague. Can you specify? (UNITED STATES OF AMERICA)	We have tightened up the text in this respect.
97	75822	30	3	31	3	34	The language in these statements (i.e., that increased uptake of atmospheric CO2 has caused a fundamental change in ocean chemistry; and that the state and rate of change is unprecedented in millions of years) seems contradictory with the statement in Ch. 6, p5, L5-6 that changes in water chemistry have been limited from pre-industrial times and today. It is suggested that these types of broad statements regarding ocean conditions be limited to the Chapter 6 Executive Summary, while Chapter 30 should retain focus on regional observations and trends. (UNITED STATES OF AMERICA)	We agree. And have made this change.
98	58485	30	3	32	3	33	rather virtually certain (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We agree and have adapted the text to make sure it is consistent.
99	75823	30	3	32	3	33	Why use "Very High Confidence" here when WG1 Ch3 uses "very likely"? (UNITED STATES OF AMERICA)	We have investigated the two pieces of text and have made then consistent.
100	75824	30	3	34	3	34	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We have gone through the manuscript and have carefully and have added probabilistic measures where appropriate.
101	85160	30	3	37	3	38	The bold introductory sentence should be divided into two parts : the first one reletive to the future evolution in the long run should be kept in bold, but the end of the sentence from "although", about the next 20 years, is not a summary of the paragraph and should be typed using normal characters. This would permit to clarify whether the qualification high confidence applies to one or the other or both statements. What is the meaning of p< 0,01 ? (Michel Petit, CGIET rue de Bercy)	This has been done
102	75825	30	3	37	3	48	The information in the Executive Summary statements seems more suited for Ch. 6 ES. Recommend focusing these types of broad statements regarding ocean impacts to Ch. 6 ES. (UNITED STATES OF AMERICA)	We agree
103	85242	30	3	37	3	48	The temperature is not rising and the pH changes metrely alter variability with no evidence of harm (Vincent Gray, Climate Consultant)	This runs counter to the evidence of multiple research groups and peer-reviewed publications. Firstly, temperature has been increasing in the world's oceans (see WGI and the majority of primary literature). Secondly, there is abundant evidence of detrimental changes to marine organisms when exposed to reduced pH (see recent reviews, plus Ocean Acidification Cross Chapter box and the report of the IPCC ocean acidification conference).
104	84138	30	3	38	3	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
105	75826	30	3	38	3	39	"high confidence, p<0.01" Is this approach of combining confidence and likelihood statements consistent with IPCC guidance? (UNITED STATES OF AMERICA)	Agreed, we have deleted this P value reference.
106	85088	30	3	39	3	39	The inclusion of a p-value here is confusing, what is the intent? Is it meant as a counterpart to the calibrated confidence statement, and in what context? I would recommend deletion here and including explanation in the supporting chapter text or the nonbold sentences here in the ES if needed. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, we have deleted this P value reference.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
107	85089	30	3	40	3	42	This statement is not supported by text in chapter 30. Please provide support, and also specify what this range of temperatures represents--is this across RCP scenarios, and for what timeframe? (Michael Mastrandrea, IPCC WGII TSU)	We have clarified the text here and rectified this problem.
108	79688	30	3	41	3	42	Delete "and hence ocean temperatures". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed. We have done this.
109	75827	30	3	42	3	42	The fact that the blanket term "chemistry" needs to be immediately qualified with parentheses suggests that it's not the right term. Suggest changing to : "Ocean pH, carbonate concentrations, and oxygen concentrations are virtually..." (UNITED STATES OF AMERICA)	Agreed. We have done this. UPDATE: We have replaced the term 'ocean chemistry' with 'ocean carbonate chemistry' where appropriate.
110	84139	30	3	42	3	44	For this statement, it would be best to indicate the approximate time frame and scenarios of climate change for the comparison provided. (Katharine Mach, IPCC WGII TSU)	Agreed. We have done this. We are now specific about timeframes when referring to RCP models.
111	85090	30	3	42	3	44	Please specify the timeframe intended here. (Michael Mastrandrea, IPCC WGII TSU)	Agreed. We have done this.
112	57305	30	3	44	3	44	Repetition: "if atmospheric CO2 continues to increase in the atmosphere" omit "atmospheric" thus, "if CO2 continues to increase in the atmosphere" (Erica Head, Fisheries and Oceans Canada)	Agreed. We have done this.
113	58579	30	3	44	3	44	Remove "in the atmosphere". (Janice Lough, Australian Institute of Marine Science)	Agreed. We have done this.
114	79689	30	3	44	3	44	Delete "in the atmosphere" as this repeats (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed. We have done this.
115	84140	30	3	44	3	46	Is it possible to indicate more precisely what "substantial" and "fundamental and far-reaching" mean here? (Katharine Mach, IPCC WGII TSU)	We have rewritten the text to avoid the ambiguities in this respect.
116	85091	30	3	44	3	46	The phrases "substantial" and "fundamental and far-reaching" do not clearly communicate, as they will mean different things to different people. Please specify in clear terms what is meant. (Michael Mastrandrea, IPCC WGII TSU)	We have rewritten the text to avoid the ambiguities in this respect.
117	75828	30	3	47	3	47	Change "ocean ecosystems" to "many ocean ecosystems". It's not certain whether the microbiome will change and offer different goods and services. Without making this change, "they" later in the line is also going to be too broad. (UNITED STATES OF AMERICA)	We have done this.
118	84141	30	3	50	3	50	In place of "fundamental and extensive changes" it would be preferable to indicate broadly what specific changes have occurred. (Katharine Mach, IPCC WGII TSU)	Agreed. We have done this.
119	75829	30	3	50	3	54	This information is repetitive with statements in Ch. 6 Executive Summary, p4, L22-25. It is suggested that this information be limited to Ch. 6 ES (UNITED STATES OF AMERICA)	We have in investigated this and have made appropriate changes.
120	85092	30	3	50	4	5	Please ensure full support for this paragraph in chapter 30. Section 30.3.1 is relevant to the statement on page 3 lines 52-53. (Michael Mastrandrea, IPCC WGII TSU)	Agreed. We have done this.
121	84142	30	3	52	3	54	It would be helpful to specify the timeframe over which these changes have been observed. (Katharine Mach, IPCC WGII TSU)	Agreed. We have done this.
122	58580	30	3	53	3	53	Do we really have evidence that marine organisms arealready adapting "evolutionarily"? (Janice Lough, Australian Institute of Marine Science)	Evidence is extremely scant. We have rewritten this section.
123	75830	30	3	53	3	53	Is it true that evolutionary (not behavioral) adaptation is occurring? Is it not true that the rate of global change tends to be too fast to evince much true evolutionary adaptation over a few decades of generations. (UNITED STATES OF AMERICA)	Evidence is extremely scant. We have rewritten this section.
124	75832	30	4	1	4	1	"These changes" : vague. The previous sentences talk about organism migration and isotherm movement -- which is being specifically talked about here? (UNITED STATES OF AMERICA)	We have clarified the text here and reduce the vagueness.
125	75833	30	4	1	4	1	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
126	75834	30	4	1	4	5	This information is repetitive with statements in Ch. 6 executive summary, p4, L22-25. It is suggested that this information be limited to Ch. 6 ES (UNITED STATES OF AMERICA)	We have carefully reviewed the text and eliminated repetition.
127	75835	30	4	1	4	5	This information is repetitive with statements in Ch. 6 executive summary, p4, L22-25. It is suggested that this information be limited to Ch. 6 ES (UNITED STATES OF AMERICA)	We have carefully reviewed the text and eliminated repetition.
128	75836	30	4	2	4	3	Diverse factors.... Alteration of coastlines": Seems like an odd combination. Does that encompass all of the factors at work, or is it just a sampling? (UNITED STATES OF AMERICA)	We have rewritten the text and reduce the ambiguity.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
129	75837	30	4	5	4	5	Not sure you can say "significantly altered" if there is only medium confidence? According to the guidance note on uncertainty, medium confidence includes limited, medium, or robust evidence with only medium agreement. To me that does not seem that a "significant" alteration has happened, no matter where you set your confidence interval? Is this just lose use of language? (UNITED STATES OF AMERICA)	We have rewritten the text and remove the word 'significant'.
130	75838	30	4	7	4	7	"Ocean....into the ocean" seems to go against the IPCC definition of OA. That is, OA can be caused by a number of proceses that alter the pH and saturation state of seawater. OA itself represents a fundamental challenge, but the attribution of OA to a specific cause needs to be justified if that is the authors' contention. (UNITED STATES OF AMERICA)	Agreed, we have rewritten the text here.
131	64638	30	4	7	4	16	this is extensively discussed in the mechanisms part in ch6 (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	We agree and have modified and shortened the text accordingly.
132	75839	30	4	7	4	16	This information is repetitive with information in Ch. 6. It is suggested that this information be limited to Ch. 6 ES. (UNITED STATES OF AMERICA)	We agree and have modified and shortened the text accordingly.
133	75840	30	4	7	4	16	This information is repetitive with information in Ch. 6. It is suggested that this information be limited to Ch. 6 ES. (UNITED STATES OF AMERICA)	We agree and have modified and shortened the text accordingly.
134	85241	30	4	7	4	16	Grossly exaggerated. The ocean has high variability. Carbon dioxide is actually emittd in some regons and it does not seem to harm the ecology. More carbon dioxide will merely increase the saturated regions slighly and decrease the CO2 depleted regions slightly. Evolution will adjust things (Vincent Gray, Climate Consultant)	We respectfully disagree with the reviewer as the comment runs at odds with the published literature - e.g. Fabricius, K. E., C. Langdon, S. Uthicke, C. Humphrey, S. Noonan, G. De'ath, R. Okazaki, N. Muehllehner, M. S. Glas, and J. M. Lough (2011) Nature Climate Change, 1(3), 165-169. Alternative literature (i.e. coral reefs flourishing at high CO2 levels) does not exist . Also, there is no evidence that key organisms such as corals and other long-lived invertebrates are able to undergo evolutionary change to counter the impacts of ocean acidification.
135	84143	30	4	8	4	8	It is not completely clear what "fundamental" means here. A more specific statement about sensitivities and impacts would be helpful. (Katharine Mach, IPCC WGII TSU)	Agreed, we have rewritten the effects and remove the word 'fundamental'.
136	80731	30	4	10	0	0	Larval stages are more affected in some taxa but such a general statement is not supported by the metaanalysis of Kroeker et al. (2013) which concluded that enhanced sensitivity of early life history stages is not universal across all taxonomic groups. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	Agreed, we have produced the generalised nature of this statement.
137	80732	30	4	10	0	0	The statement that "there is robust evidence, high agreement and high confidence..." is not supported by the literature and is in stark contrast with chapters 5 and 6. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have rewritten the text to ensure that we are in alignment with chapters 5 and 6 stop
138	75841	30	4	10	4	10	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
139	79690	30	4	10	4	10	"While there is robust evidence, high agreement and high confidence" - this is inconsistent with Chapter 6 which is much les confident and probably better informed. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
140	80733	30	4	14	0	0	Considerably less studies were performed at the community level. Hence "... there are few field studies..." (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	Agreed, text modified
141	85093	30	4	16	4	16	The relevance of section 30.3.1 here is unclear, as ocean acidification is discussed in section 30.3.2. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, text modified

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
142	84144	30	4	18	4	19	Over what time frame have these changes been observed? (Katharine Mach, IPCC WGII TSU)	Timeframe added.
143	85094	30	4	18	4	30	Please ensure full support for this paragraph in chapter 30. In addition, this paragraph is a mix of observations and projections that is somewhat confusing--please present these distinctly. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, text modified to reduce confusion.
144	75842	30	4	19	4	19	Please provide a certainty estmate following "productivity" (UNITED STATES OF AMERICA)	Certainty estimate added.
145	84145	30	4	19	4	19	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. If being used as a likelihood term, reflecting a probabilistic basis for its assignment, "very likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
146	75843	30	4	19	4	21	It is not clear how our confidence in these changes is "very likely" when the accompanying confidence summary is "medium evidence, medium agreement" (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
147	75844	30	4	19	4	21	This sentence seems to imply that some fisheries will benefit from deoxygenation? Assuming that this is not intended, suggest editting to "positive consequences for some fisheries through higher productivity and negative ones for others...." (UNITED STATES OF AMERICA)	Agreed, text modified to reduce ambiguity.
148	75845	30	4	21	4	22	This sentence seems to repeat the first sentence in the paragraph. (UNITED STATES OF AMERICA)	Text modified to reduce repetition.
149	84146	30	4	21	4	22	Over what time frame have these changes been observed? Is it possible to specify more precisely what is meant by "major changes"? (Katharine Mach, IPCC WGII TSU)	Agreed - timeframe added.
150	75846	30	4	22	4	27	The confidence statements for this ES statement contradict a similar statement in Chapter 6, p4, L32-36. Ch 6 ES states "The direction, magnitude, and regional differences of a change of NPP in the open ocean as well as in coastal waters have limited evidence and low agreement for a global decrease projected by 2100. At high (polar) latitude an increase in NPP is also projected with low confidence." However, Ch 30 ES states "In regions where primary productivity has increased (or is predicted to increase) such as....., energy transfer to higher trophic levels is likely to increase along with microbial activity. Increased primary productivity is likely to lead to an increased transfer of organic carbon to deep sea habitats..." The confidence and likelihood statements in these two ES statements seem to contradict one another. It is suggested that the ES statement be limited to only one of the chapters and the text modified to clarify the confusing confidence and likelihood statement. (UNITED STATES OF AMERICA)	We have rewritten this statement to be consistent with chp 6. UPDATE: We have discussed this issue extensively with chapter 6 and other relevant marine chapters - and have developed a cross chapter box on net primary productivity which ensures consistency between the different chapters (Box CC-NPP).
151	85095	30	4	27	4	29	Section 30.5.4.1.4 states that OMZs have not increased since the 1960s in the Arabian Sea--please reconcile. In addition, support for the inclusion of the North Sea here is unclear. (Michael Mastrandrea, IPCC WGII TSU)	Contradiction resolved. Text modified. UPDATE: North Sea reference has been deleted.
152	85096	30	4	30	4	30	I believe the reference to 30.5.6 should be to 30.5.5 instead here. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, text modified.
153	58486	30	4	32	4	32	Tell here what is STG (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Done. STG has been defined when it was first used in the manuscript.
154	60255	30	4	32	4	32	Spell out STGs (AUSTRALIA)	Done. STG has been defined when it was first used in the manuscript.
155	75847	30	4	32	4	32	Specify chlorophyll concentrations in the mixed layer. The euphotic zone extends below the mixed layer and chlorophyll concentrations might be increasing there. (UNITED STATES OF AMERICA)	Text modified.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
156	85097	30	4	32	4	34	The inclusion of a p-value here is confusing, what is the intent? Is it meant as a counterpart to the calibrated confidence statement, and in what context? I would recommend deletion here and including explanation in the supporting chapter text or the nonbold sentences here in the ES if needed. (Michael Mastrandrea, IPCC WGII TSU)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter. UPDATE: in cases where we are detecting statistical differences (e.g., the difference between the detected slope in temperatures over time from a slope of zero, we have retained P-values and have crafted text to make sure that the distinction was clear between a statistical finding and the likelihood statements. In some cases, P-value is to support the use of particular language - however, we have tried to minimise that to avoid any confusion.
157	57306	30	4	32	4	37	First - "Chlorophyll concentrations have decreased in the STGs in the North Pacific, Indian and North Atlantic Oceans by 9%, 12% and 11%, over and above the inherent seasonal and interannual variability from 1998 to 2010 (high confidence; p<0.05)". (Erica Head, Fisheries and Oceans Canada)	Noted and text modified to note limitations of satellites. UPDATE: the issues are discussed in the cross chapter box Box CC-NPP
158	57307	30	4	32	4	37	As far as I know, satellite estimates of chlorophyll concentration have shown these decreases, while in situ observations in the North Pacific (HOT) and North Atlantic (BATS) have either shown no change or increases over the same study period (Saba et al. 2010). No matter how thorough a statistical analysis is done (e.g. Ventrepotte and Melin, 2011; Signorini and McLain, 2012), there is still no denying that satellites only look at the near-surface layers, which in the STGs are not where most of the chlorophyll is found. (Erica Head, Fisheries and Oceans Canada)	Noted and text modified to note limitations of satellites. See previous comment.
159	57308	30	4	32	4	37	Next "Significant warming over this period has resulted in increased water column stratification and reduced mixed layer depth." I do not think this sentence is entirely correct either, since at HOT, over the 1989-2007 period SST increased and the annual (and winter) average mixed layer depth increased (Saba et al. 2010). At BATS, between 1988 and 2006 there was no significant change in SST, but the winter (but not annual average) mixed layer depth deepened. Carton et al. (2008) analysed changes in mixed layer depth in the northern hemisphere between 1960 and 2004, and found a deepening trend over time, which they ascribed to trends in atmospheric and hydrographic processes (e.g. ENSO, PDO etc), i.e. in their analysis the anticipated long-term effect of ocean warming on MLD was not the dominant driver. Refs - Carton, J.A., Grodsky, S.A, Liu, H. (2008) Variability of the oceanic mixed layer, 1960-2004. Journal of Climate 21, 1029-1047/ Saba et al. (2010) as in Chapter 6 reference list (Erica Head, Fisheries and Oceans Canada)	Text modified and is now consistent with chapter 6 and these comments. UPDATE: the issues are discussed in the cross chapter box Box CC-NPP
160	57309	30	4	32	4	37	Next "This has reduced vertical transport of nutrients into the upper layers of the Ocean and has reduced primary production." Again, this statement is contrary to in situ observations at HOT and BATS. At these sites nutrient levels increased, and at these and several other low latitude time series stations (See Chapter 6, Figure 6-5) primary production has apparently been increasing. (Erica Head, Fisheries and Oceans Canada)	Text modified and is now consistent with chapter 6 and these comments. UPDATE: the issues are discussed in the cross chapter box Box CC-NPP
161	57310	30	4	32	4	37	Again - it is mainly the studies of Behrenfeld et al. (2006) and Vantrepotte and Melin (2011) based on remote sensing, I think, that are used as evidence that near surface chlorophyll concentrations, and the estimates of primary production based on them, decreased over the 1999-2005 period in the sub-tropical gyres. These results do get some support from in situ CPR (Continuous Plankton Recorder) observations in the eastern sub-tropical North Atlantic (Richardson and Shoeman, 2004), where phytoplankton biomass showed a downward trend, but the same study showed an increasing trend in phytoplankton biomass farther north in the NE Atlantic, in the region where Ventrepotte and Melin (2011) found decreasing (satellite) chlorophyll levels. As well, in the NW Atlantic phytoplankton biomass measured by the Continuous Plankton Recorder (and by inference primary production) has been increasing over the last few decades (Head and Pepin 2010a), including between 1998 and 2006, the latter being a period over which satellite observations showed little change (Head and Pepin, 2010b). Ref: Head, E.J.H., Pepin, P. (2010a) Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958-2006). J. Plank. Res. 32, 1633-1648 / (Erica Head, Fisheries and Oceans Canada)	Text modified and is now consistent with chapter 6 and these comments. UPDATE: the issues are discussed in the cross chapter box Box CC-NPP
162	57311	30	4	32	4	37	Head, E.J.H., Pepin, P. (2010b) Monitoring changes in phytoplankton abundance and composition in the Northwest Atlantic: a comparison of results obtained by continuous plankton recorder sampling and colour satellite imagery. J. Plank. Res. 32, 1649-1660 (Erica Head, Fisheries and Oceans Canada)	We have added this reference and referred to its implications.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
163	57312	30	4	32	4	37	Overall, I don't think we can have "high confidence" in the interpretation of any one set of observations, since the effects of long-term warming can be confounded by other environmental processes (e.g. ENSO, PDO, NAO, winds, eddies, advection) that operate on shorter time scales, and that are, for now, apparently counteracting the effects of ocean warming in some areas. Refs Behrenfeld et al. (2006) as in Chapter 30 refs/ Richardson ahd Schoeman (2004) as in Chapter 6 refs (Erica Head, Fisheries and Oceans Canada)	Agreed, level of confidence has been downgraded and is now consistent with chapter 6.
164	57313	30	4	32	4	37	I think Chapter 6 deals with this subject better, since it includes the uncertainty that the different lines of evidence provide. Thus, note the text in the executive summary (Chapter 6, Page 4, lines 32-36) and there is also the discussion/justification (more-or-less as I have outlined above) in Chapter 6, Page 12, Lines 1- 14. (Erica Head, Fisheries and Oceans Canada)	Agreed, level of confidence has been downgraded and is now consistent with chapter 6.
165	57314	30	4	32	4	37	I think it is important that statements in the executive summaries of two different Chapters do not contradict each other, so, overall I would prefer to see something like this here in Chapter 30: "Satellite observations showed broad-scale decreases in chlorophyll concentration in the STGs of about 10% in the North Pacific, North Atlantic and Indian Oceans between 1998 and 2010, although in situ observations at two sites did not (6.3.1, 6.3.2, 6.3.3, high confidence). In general, it appears that significant warming of the Ocean has resulted in increased water column stratification, reduced mixed layer depths, and reduced vertical transport of nutrients into the upper layers, leading to reduced primary production in the STGs. In situ observations at HOT and BATS (North Pacific and North Atlantic STGs) do not, however, follow these large-scale trends, suggesting that locally other processes (e.g. ENSO, PDO, NAO, winds, eddies, advection) can counteract general trends. Changes in primary production by phytoplankton are likely to impact food availability for pelagic fish species, although these effects may be mitigated by re-distributions of species among regions (medium confidence). The influence of variability over different spatial and temporal scales complicates attribution of past changes directly to climate change, but changes in ocean primary production, chlorophyll and other key biogeochemical processes etc" (Erica Head, Fisheries and Oceans Canada)	Agreed, level of confidence has been downgraded and is now consistent with chapter 6. UPDATE: we have revised our assessment here after conversations across the different marine chapters - and have developed a cross chapter box that discusses these issues and recognises the limitations of the short-term satellite records (plus other issues associated with satellite records of chlorophyll from space).
166	84147	30	4	33	4	33	"over and above" feels a bit colloquial and is also a bit ambiguous. Are the percentages given reflecting the long-term signal (not just seasonal or inter-annual variability), or they are in addition to trends over the 13 years that are attributed to natural variability? (Katharine Mach, IPCC WGII TSU)	We have worked on this section and reduced its length, and made it more consistent in chapter 6, and bade other modifications to the text to ensure that we don't overstate the case here.
167	75848	30	4	34	4	34	"high confidence, p<0.05": Not necessary to combine a confidence statement and a likelihood statement. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
168	75849	30	4	34	4	34	"Significant" usually connotes statistical certainty. If so, please include uncertainty estimate. If not, substitute another term like "substantial" or "measurable" (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
169	75850	30	4	39	4	39	Consider changing to "past observed changes" for more precision. (UNITED STATES OF AMERICA)	We have adopted this.
170	84148	30	4	40	4	40	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, see above
171	85098	30	4	41	4	41	The reference to 30.5.5.1 should be to 30.5.6.1 instead here. (Michael Mastrandrea, IPCC WGII TSU)	Correction has been made.
172	85243	30	4	42	4	50	The temperature has not been rising since 2000 (Vincent Gray, Climate Consultant)	This statement is unsupported and is at odds with measurements (e.g. NASA GISS). See working group 1 for comprehensive data sets and literature.
173	84149	30	4	43	4	44	Over what broad timeframe has this effect been observed? Also, it would be preferable to indicate more precisely what is meant by "significant impacts." (Katharine Mach, IPCC WGII TSU)	Timeframe added.
174	85099	30	4	43	4	44	Please specify what impacts on coastal ecosystems are meant here. (Michael Mastrandrea, IPCC WGII TSU)	Text has been modified-Impacts have been specified.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
175	80734	30	4	43	4	50	This issue concerns coastal systems and is therefore covered in chapter 5. A link to it seems needed. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	Linkage has been added
176	75851	30	4	44	4	44	"Very likely" seems to contradict the use of "may" in the next line. Suggest reconsidering which uncertainty modifier to use. (UNITED STATES OF AMERICA)	Text has been modified to remove the ambiguity.
177	84150	30	4	44	4	46	For the described projected degradation, what is the role of climate change versus other drivers of change in these systems, and what is the general time frame and levels of climate change that would be expected to pose "substantial challenges? (Katharine Mach, IPCC WGII TSU)	Timeframe added, role of other drivers are discussed and levels of climate change specified that pose significant challenges.
178	65723	30	4	45	4	45	Delete “intertidal” – littoral better as Mediterranean not tidal (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	Agreed. Text modified.
179	63813	30	4	46	4	46	Please, define "ecosystem health", add a reference or substitute the term. A scientific definition of the term and/or a definition of the difference between "healthy ocean ecosystems " and "sick ocean ecosystems" is necessary here. Please substitute in the text:'…on ecosystem health.' by '… on functioning ecosystems.'. (GERMANY)	Term ecosystem health has been removed and a clear return added.
180	85100	30	4	46	4	50	Please ensure full support for this passage in chapter 30. (Michael Mastrandrea, IPCC WGII TSU)	Support has been added.
181	75852	30	4	48	4	50	Likewise, making the point about the value of reducing other regional stressors to increase resilience is very important. (UNITED STATES OF AMERICA)	We have now emphasised the importance of reducing local and regional stresses in order to build resilience.
182	75853	30	4	49	4	50	Evaluate level of agreement in addition to quality of evidence. For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
183	84151	30	4	52	4	52	How are the systems "changing"? It would be preferable to specify this within the bold finding. (Katharine Mach, IPCC WGII TSU)	Agreed, and text modified accordingly.
184	69843	30	4	52	5	6	There seems to be no section 30.8.3 in the manuscript; Chapter 30.6.2.1.3 mifght be added as the source (NETHERLANDS)	Error has been rectified.
185	75854	30	4	54	4	54	When did observations begin? Stating that "changes observed since the late 1970s" seems unnecessarily vague. How much of the time span has been marked by large change? (UNITED STATES OF AMERICA)	Timeframes specified more precisely.
186	75855	30	5	5	5	5	"both positive and negative": vague. More specifics would be helpful. (UNITED STATES OF AMERICA)	Text has been modified to be more specific
187	85101	30	5	5	5	6	Section 30.8.3 does not exist. Please update this line of sight. (Michael Mastrandrea, IPCC WGII TSU)	Error has been rectified - see above.
188	75856	30	5	8	5	15	Are these usages of "likely" and "very likely" correct? It doesn't seem that these statements could be backed up with probabilities, but rather should be qualified with qualitative confidence statements instead. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 5 and 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
189	79691	30	5	11	5	11	The AMO is mentioned here, but what about the other climatic cycles that are cited throughout the rest of the chapter. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Text modified to include other long-term patterns and dynamics.
190	85102	30	5	13	5	15	Please ensure full support for this passage in chapter 30. In addition, it appears that the reference to section 30.5.6 should be to 30.5.3 instead here. (Michael Mastrandrea, IPCC WGII TSU)	Support has been added and ambiguity removed.
191	75857	30	5	14	5	14	Consider substituting "in early stages" instead of "undeveloped". (UNITED STATES OF AMERICA)	Text modified and the word 'undeveloped' has been replaced with 'in early stages'.
192	84152	30	5	17	5	17	It is not clear what is meant by "compelling" in this finding. (Katharine Mach, IPCC WGII TSU)	Text modified to be clearer.
193	85103	30	5	17	5	26	Please ensure full support for this finding in chapter 30. (Michael Mastrandrea, IPCC WGII TSU)	Support has been added.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
194	57596	30	5	18	5	18	To give a more complete description of the size of the deep sea, I think it would be good to include an estimate of the fraction of the biosphere's total volume that is found in the deep sea (below about 3,800 m). The number is greater than 90%. This percentage volume figure might have more impact than the surface area percentage that is given here. (George Somero , Stanford University)	The estimate has been added (based on present volume). UPDATE: - have done so but number is not too different - have added reference and calculated percent below 1000 m. Have checked calculations as follows: 361 km2 x 1 km (gives you the volume of the upper 1,000 m which is 361 million km3). Given the volume of the ocean is 1.3 Billion km3 then 361 million km3 /1300 million km3 is 27.7% which means the percent of the deep ocean is: 72.3%.
195	58581	30	5	21	5	21	Remove "(through intensified upwelling)". (Janice Lough, Australian Institute of Marine Science)	Phrase has been removed
196	75858	30	5	21	5	21	"through intensified upwelling in some regions (through intensified upwelling)" = typo? If not, I don't get this sentence at all. (UNITED STATES OF AMERICA)	Phrase has been removed
197	79695	30	5	21	5	21	Replace "strategies" with "opportunities". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Replacement has been made.
198	84153	30	5	21	5	21	It would be preferable to specify more precisely what is meant by "threatens"--"would increase the occurrence of hypoxia" in these systems? (Katharine Mach, IPCC WGII TSU)	We agree. Text has been made clearer.
199	75859	30	5	22	5	22	"Similarly" doesn't make sense here. (UNITED STATES OF AMERICA)	Text modified and ambiguity removed.
200	75860	30	5	24	5	24	"due to the amplifying influence of rising deep water temperatures..." Doesn't really make sense, since microbial metabolism isn't a cyclic signal. Consider instead, "due to the enhancement of microbial metabolism caused by rising deep water temperatures". (UNITED STATES OF AMERICA)	Agreed-text modified accordingly.
201	79692	30	5	24	5	24	"These changes are virtually certain" - How can this be true when the probability of a decline in plankton productivity is cited as highly uncertain in chapter 6!!!! Also standardisation of terms such as "virtually certain" is needed, as loose phrases like this are used throughout chapter 30. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Detection and attribution language has been clarified. In combination with comments above regarding phytoplankton and the ambiguities between chapter 6 and chapter 30, the section on phytoplankton has been rewritten and now is consistent with chapter 6 and with the broader literature. Many of these issues have been sorted out five the creation of a cross chapter box on net primary productivity (Box CC-NPP).
202	85104	30	5	24	5	25	It appears that this statement may be more appropriate for an assignment of very high confidence, given the available evidence. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, language modified accordingly.
203	75861	30	5	30	5	30	"as waters warm and acidify": it is still speculation as to whether distribution of fish/invertebrates will markedly change in response to acidification. Suggest revising to rely more on observed evidence. (UNITED STATES OF AMERICA)	Agreed-text modified accordingly.
204	84154	30	5	30	5	30	Wording on lines 30 and 33 ("will dictate the need" and "will require") should be carefully considered to ensure policy neutral statements. (Katharine Mach, IPCC WGII TSU)	Language modified to ensure that the statements are policy neutral.
205	58583	30	5	30	5	31	Define acronyms UNCLOS and LOSC. (Janice Lough, Australian Institute of Marine Science)	Acronyms defined in accompanying table. Text text indicates this now.
206	57315	30	5	31	5	31	Are all tuna species sensitive to changes in temperature? - I assume so, in which case there should be this change "For example, tuna, key fisheries species, are highly sensitive" (Erica Head, Fisheries and Oceans Canada)	Assumption of reviewer is correct. Language with respect to tune in now modified.
207	85105	30	5	34	5	34	Please check the line of sight here. It is not clear that 30.5.5.2 is relevant, and 30.6.2 also appears to contain relevant material. (Michael Mastrandrea, IPCC WGII TSU)	References examined and better aligned.
208	84155	30	5	36	5	37	For this statement, the relevant time frames and levels of climate change, assumptions underpinning the conclusion, and differences across geographic areas should be specified. (Katharine Mach, IPCC WGII TSU)	Text modified so that timeframes and levels of climate change are more clearly specified, with differences in geographic regions where observed make clearer.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
209	58582	30	5	36	5	44	Do you need to include here that climate change impacts are superimpoed on over-exploitation of many fisheries combined with the added pressure of population growth? (Janice Lough, Australian Institute of Marine Science)	We have text now that indicates the complexity of local/regional factors such as fishing pressure within the context of changing ocean conditions due to enhanced greenhouse effect. UPDATE: We have "The accumulating evidence indicating that fundamental ecosystem services within the Ocean are shifting rapidly should be of major concern, especially with respect to the ability of regulating and supporting ecosystem services to underpin current and future human population demands [Rockstrom et al., 2009; Ruckelshaus et al., 2013]."
210	75862	30	5	36	5	44	Here, and in Section 30.6, the authors should address the compounding effect of current and future overfishing to the impacts of climate change on food for coastal populations. Alternatively, the authors should coordinate with authors teams from Ch 7 and 10 to see where this discussion is best placed. (UNITED STATES OF AMERICA)	We have text now that indicates the complexity of local/regional factors such as fishing pressure within the context of changing ocean conditions due to enhanced greenhouse effect. We have this emphasised the fact that factors compound each other, and have made more appropriate links to chapter 7 and 10. UPDATE: we now have a common table on risk and vulnerability which includes a discussion of fisheries - developed in partnership with chapters 5, 6 and 7.
211	79693	30	5	36	5	44	This section doesn't say anything about the suggestion that high latitude counties will possibly benefit from increased fisheries (only mentions the negative effects). This issue is mentioned throughout chapter 6. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added this point in several places - e.g. "Climate change is projected to increase high latitude plankton production and displace zooplankton and fish species poleward. As a combined result of these future changes, the abundance of fish (particularly boreal species) may increase in the northernmost part of the high latitude region [Cheung et al., 2011], although increases will only be moderate in some areas."
212	84156	30	5	39	5	40	For the described fisheries decline, what are the other relevant drivers of change? It would seem important to acknowledge them here. (Katharine Mach, IPCC WGII TSU)	We have text now that indicates the complexity of local/regional factors such as fishing pressure within the context of changing ocean conditions due to enhanced greenhouse effect. This is also reflected in me combined marine risk and vulnerability table.
213	85106	30	5	40	5	40	Does rapid anthropogenic climate change here refer to specific scenarios, or is this a more general statement? Please clarify. (Michael Mastrandrea, IPCC WGII TSU)	It is a more general statement. We have modified the text to make it more specific.
214	75863	30	5	40	5	42	Repetitive -- already said in lines 36-37. (UNITED STATES OF AMERICA)	Agreed, text has been modified.
215	75864	30	5	43	5	44	Confusing as written. Suggest "Understanding of these changes ... is important although studies are limited." (UNITED STATES OF AMERICA)	Text modified and confusion removed.
216	79694	30	5	46	5	47	This sentence (in bold) doesn't make sense grammatically (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Text modified and confusion removed.
217	75865	30	5	48	5	48	Management doesn't "include" climate change. It "accommodates" or "plans for" climate change. Suggest revising (UNITED STATES OF AMERICA)	Agreed, text modified and confusion removed.
218	67941	30	5	50	0	0	"(e.g. bottom trawling, 'ghost' fishing)" should be changed to "(e.g. illegal, unreported and unregulated fishing)," because these two descriptions (bottom trawling, 'ghost' fishing) are not discussed in this chapter and "IUU fishing" is discussed in P.48, l.27. (JAPAN)	Agreed, text modified.
219	67942	30	5	52	0	0	The words "improved fishery management, including" should be inserted before "marine protected areas," because MPA is one of management measures in the field of fishery management (See p.34, l.17 - 18 and p.62, l.39 for information). (JAPAN)	Agreed, text modified.
220	84157	30	5	52	5	52	Use of "require" should be avoided here to ensure a policy neutral statement. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
221	75866	30	5	52	5	53	This sentence is awkwardly worded. Rather than "...movement of people and industry sectors", mention the [primary sectors, for example "...movement of people and ocean-based industries such as shipping, oil/gas, ..." (UNITED STATES OF AMERICA)	Agreed, text modified.
222	75867	30	5	53	5	53	"require similar strategies"is vague. Do the authors mean flexible thinking? Solutions that transcend geography? More specifics are needed. (UNITED STATES OF AMERICA)	We have modified the text to be more specific and have removed the source of confusion and vagueness.
223	85107	30	5	54	5	54	Section 30.6.2 also appears to be relevant here. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, linkage made in text.
224	75868	30	6	2	6	3	Suggest that the authors include fisheries as an industry sector that is particularly vulnerable to the climate change impacts listed here. (UNITED STATES OF AMERICA)	Agreed, and have done so. Links made to chapter 10.
225	75869	30	6	2	6	8	Are the impacts of changing surface winds, sea level, wave height, and storm intensity on shipping, oil, gas, and mineral extraction covered in another chapter? The authors should check for redundancy with Ch 10.4.4 and 10.2.2 and relevant pieces of Sec. 30.6 and make appropriate cross-references. (UNITED STATES OF AMERICA)	We have reduced overlap and have made appropriate links to chapter 10.
226	84158	30	6	5	6	5	Use of "require" here should be avoided to ensure a policy neutral statement. (Katharine Mach, IPCC WGII TSU)	Have removed term to ensure that we remain policy neutral.
227	75870	30	6	6	6	7	As written, this sentence suggests "new opportunities for international issue over access...". Suggest rewriting for clarity. (UNITED STATES OF AMERICA)	Text modified and made clearer.
228	85108	30	6	10	6	17	Please ensure full support for this finding in chapter 30. (Michael Mastrandrea, IPCC WGII TSU)	Support has been now provided.
229	75871	30	6	12	6	14	Encourage the authors to rephrase this statement to read: "Given the challenge of mitigating ocean warming and acidification directly, and the time it will take to accomplish this, adapting fisheries.... under climate change until then." (UNITED STATES OF AMERICA)	Agreed and text modified accordingly.
230	84159	30	6	12	6	14	In the 1st phrase of this sentence, would it be clearer to discuss climate change that is essentially locked in over the coming decades? For the 2nd half of the statement, it may be beneficial to broadly specify the relevant time frame (for example, near-term versus long-term within the century), levels of climate change, and other relevant drivers. (Katharine Mach, IPCC WGII TSU)	Agreed and text modified accordingly.
231	85109	30	6	19	6	27	Please ensure full support for this finding in chapter 30. (Michael Mastrandrea, IPCC WGII TSU)	Text modified and support added accordingly.
232	84160	30	6	20	6	21	The wording of "ecosystems...represent...strategies" seems a bit nonparallel and could be adjusted. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified.
233	63814	30	6	20	6	23	In the sentence "Reducing highly anoxic habitats through coastal restoration...." it is not clearly described, which habitats are meant. Please add examples. If habitats like mangroves, sea grass, salt marshes are meant, we do not support the idea "to reduce" these natural often protected habitats by "coastal restoration". (GERMANY)	Agreed, text has now been made clearer.
234	75872	30	6	21	6	21	Suggest changing to "significant local carbon sequestration" (UNITED STATES OF AMERICA)	Agreed, text modified.
235	75873	30	6	21	6	22	"significant mitigation opportunities" - this seems to be speculative since the research on blue carbon is still early. Suggest "may represent mitigation opportunities" or provide references to support the definitive nature of the original statement. (UNITED STATES OF AMERICA)	We tend to agree and have moved the blue carbon section to emerging opportunities.
236	75874	30	6	21	6	22	Move "(and hence the emission of methane)" to after "anoxic habitats" (UNITED STATES OF AMERICA)	We have done so.
237	69844	30	6	23	6	23	Chapter 30.6.1 and Chapter 30.6.4.2 should be added as the source, Chapter 30.7 does not seem to be the appropriate source of the texts (NETHERLANDS)	We have added the links and have re-examined the text and have modified it.
238	75875	30	6	23	6	23	It's not clear what is to be understood about these opportunities. Needs more specifics. (UNITED STATES OF AMERICA)	We have modified the text and added specifics.
239	75876	30	6	29	6	29	International frameworks haven't been proven yet; saying that they "represent vital tools" seems a bit strong. (UNITED STATES OF AMERICA)	We have toned the language down.
240	75877	30	6	29	6	36	In the Executive Summary, the relevant sub-sections of the chapter are not consistently cited (e.g., p. 6, line 29-36) (UNITED STATES OF AMERICA)	We have gone through the manuscript, including the executive summary and have provided updated links and, in this case added links.
241	85110	30	6	29	6	36	Please specify line of sight for this paragraph, which it appears should be 30.6.7. (Michael Mastrandrea, IPCC WGII TSU)	We have added the appropriate link.
242	75878	30	6	31	6	31	Suggesting using a synonym so that "common" doesn't appear twice in one sentence. (UNITED STATES OF AMERICA)	We have used a synonym?
243	75879	30	6	32	6	34	This passage seems to be rather subjective and not as balanced as it should be. Sugest revision or removal. (UNITED STATES OF AMERICA)	We have examined the text and revised so it's less subjective.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
244	75880	30	6	33	6	33	Insert "mounting" before "collaborative" to make the sentence construction parallel (UNITED STATES OF AMERICA)	We have added mounting as suggested.
245	75881	30	6	39	8	18	Somewhere in the Introduction, a comment on the relationship betwen this Chapter and Chapter 6, and perhaps the other regional chapters (e.g., Polar) is merited. (UNITED STATES OF AMERICA)	We agree with the reviewer and have added an appropriate piece of text. "Chapter 30 examines the extent to which regional changes to the Ocean can be accurately detected and attributed to anthropogenic climate change and ocean acidification, building on the conclusions of Chapter 6, which focuses on how marine physiological and ecological systems are responding to climate change and ocean acidification. Detailed assessment of the role of recent physical and chemical changes within the Ocean to anthropogenic climate change is provided in WGI (particularly Chapters 2, 3, 13 and 14). In Chapter 30, impacts, risks and vulnerabilities associated with climate change and ocean acidification are assessed for seven ocean sub-regions, and the expected consequences and adaptation options for key ocean-based sectors are discussed. Polar oceans (defined by the presence of sea ice in the north and by the Polar Front in the south) are considered in Chapter 28. "
246	75882	30	6	41	6	54	This section should include a statement that differentiates the objectives of Ch. 30 from Ch. 6 since there is so much repetitious material in these chapters. (UNITED STATES OF AMERICA)	We agree with the reviewer and have added an appropriate piece of text. See previous comment.
247	77957	30	6	44	6	44	gas content trace gas? greenhouse gas? (James Christian, Government of Canada)	The text refers to gas content of the atmosphere - in that it involves greenhouse gases as well is regular gases - e.g., oxygen versus carbon dioxide.
248	75883	30	6	44	6	46	The remit of this chapter is a bit confusing -- hypoxia is mentioned, but effects of climate change on other nutrient cycles (e.g., N, S, P), iron dust release to open oceans, mercury (and other metal) cycles' influence on the open oceans, etc. are not. It could provide a more even a view of the chemical cycling aspects of global change in the ocean. Many of these topics are associated with dust and particulates emitted by human activities that do alter planetary radiative forcing. Refer to section in Ch 19 on climate change / OA impact on N fixation and trace elements (e.g., Fe). The authors should coordinate with author team of Ch 6 to determine where this discussion is best placed. (UNITED STATES OF AMERICA)	We have added text as described above to clarify the relationship between chapter 6 (biological and ecological changes) and chapter 30 (regional changes). We do deal with some aspects such as hypoxia, nutrient recycling and mixing, but recognised that the other issues are important but the evidence for a direct role of climate change and/or ocean acidification is minimal at this stage. consequently, given the latter topics are potentially theoretical as opposed to having good regional examples, they are best dealt with in chapter 6.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
249	75884	30	6	50	6	50	"Key": how were these chosen? The major uses? Major moneymakers? The language is vague and should be clarified. (UNITED STATES OF AMERICA)	The text is very clear on how we chose these subregions: "Devising an appropriate structure in order to explore the influence of climate change across the entire Ocean region is consequently challenging. [Longhurst, 1998] identified over 50 distinct ecological provinces in the Ocean, defined by physical forcing, and the structure and function of phytoplankton communities. Longhurst's scheme, however, yields far more sub-regions than could be sensibly discussed in the space allocated here. Consequently, we have used comparable principles but have divided the non-polar ocean into seven larger sub-regions in a similar way to Barber [1988]. In this case, our sub-regions are unified by specific physical forcing and ecosystem structure that might be expected to respond to climate change in broadly distinct ways (Figure 30-1, Table 30-1). We recognize that these sub-regions do not always map perfectly over physical-chemical patterns or specific geographies, and that they interact strongly with terrestrial regions through weather systems and the exchange of materials. "
250	75885	30	7	3	7	33	Consider Marine Ecosystems of the World Regions for coasts (Spalding et al.) (UNITED STATES OF AMERICA)	We thank the reviewer for the suggestion that have chosen the regions to include both coastal and oceanic regions, and for the reasons outlined in the introduction.
251	75886	30	7	7	7	9	"Not only.... enormous region." Suggest that this sentence be deleted. It is vague and not informative. (UNITED STATES OF AMERICA)	The sentence has been deleted.
252	84161	30	7	10	7	11	This discussion overlaps with chapter 6, and material from Chapter 6 could potentially be dropped. If chapter 6 maintains its figure for these provinces, the figure could be cross-referenced here. (Katharine Mach, IPCC WGII TSU)	We have discussed this with chapter 6 and have reduced the overlap. It is vital for chapter 30 to retain this figure and the associated discussion in order to define the structure of our chapter through the regions discussed and exhibited by the figure.
253	75887	30	7	13	7	14	Unclear how subregions were determined if the approach is only "similar" to the way Barber did it. Please provide more detail. (UNITED STATES OF AMERICA)	The next sentence provides that detail: "Consequently, we have used comparable principles but have divided the non-polar ocean into seven larger sub-regions in a similar way to Barber [1988]. We recognize that these sub-regions do not always match physical-chemical patterns or specific geographies, and that they interact strongly with terrestrial regions through weather systems and the exchange of materials. Different ocean sub-regions may also have substantially different primary productivities and fishery catch. Notably, over 80% of fishery catch is associated with three ocean sub-regions: Northern Hemisphere High Latitude Spring Bloom Systems (HLSBS), Coastal Boundary Systems (CBS), and Eastern Boundary Upwelling Ecosystems (EBUE; Table S30.1, Figure 30.1). The DS (>1000m) is included as a separate category that overlaps with the six other ocean sub-regions dealt with in Chapter 30."
254	75888	30	7	15	7	19	Condense the description of caveats. (UNITED STATES OF AMERICA)	We have reduced the description of the caveats.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
255	57597	30	7	17	7	17	delete first "with" in this line. (George Somero , Stanford University)	We have deleted the extra word "with" from the sentence.
256	75889	30	7	17	7	17	Sentence has an extra "with" (UNITED STATES OF AMERICA)	We have deleted the extra word "with" from the sentence.
257	84162	30	7	20	7	20	As a minor point, presumably "systems" should be inserted after "spring bloom." (Katharine Mach, IPCC WGII TSU)	We have inserted the words "systems".
258	79696	30	7	24	7	33	Figure 30-1 generally ok, but the caption refers to region "7" deep sea, but this is not included on the map. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The deep sea is shown on the figure as a small insert graph on the bottom right hand corner.
259	79697	30	7	35	7	37	Table 30-1 OK but largely repeats data that is included in figure 30-1 (panel B) (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We respectfully disagree given that panel A is about chlorophyll and productivity, while panel B is about fisheries catch and the relative areas of each of the subregions.
260	57316	30	7	42	7	42	I see only one goal here, hence "The primary goal of Chapter 30 is to assess the recent literature etc" (Erica Head, Fisheries and Oceans Canada)	We have changed the word 'primary' to 'central'.
261	61680	30	7	42	7	43	I think this statement needs revising. Is the primary goal of this chapter really to assess literature pertaining to "detection and attribution" of changes in the Ocean? The term "detection and attribution" has a specific meaning which I don't think is really the central objective of the Chapter - I would suggest instead using something similar to that in the ES ("[...] we assess the evidence for changes due to anthropogenic climate change [...]"), since there is not much content in the chapter that refers to formalised detection and attribution. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The detection and attribution of changes to climate change and ocean acidification is central to the mission of chapter 30. Consequently, we have rewritten this paragraph to make it clearer and less ambiguous with respect to the mission of chapter 30 relative to the other chapters.
262	77958	30	7	46	7	46	ocean salinity on freshwater fluxes??? (James Christian, Government of Canada)	Agreed. This text has been removed.
263	75890	30	7	51	7	51	Change to "Whether the processes associated with climate change" since follow-on processes, like reduced upwelling etc. are discussed at length here (UNITED STATES OF AMERICA)	We have changed the text to correct this ambiguity.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
264	61681	30	7	51	7	52	This is quite a vague definition of attribution, which has a very specific meaning in D&A. Rather than exclusively investigate the role of climate change in an observed change, "attribution potentially includes antecedent conditions and natural variability among the multiple causal factors contributing to an observed change or event" [WG1 10.2.1]. Suggest to clarify or to amalgamate with the statement on Page 8, Line 2. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The detection and attribution of changes to climate change and ocean acidification is central to the mission of chapter 30. Consequently, we have rewritten this paragraph to make it clearer and less ambiguous with respect to the mission of chapter 30 relative to the other chapters. "Generally, successful attribution to climate change occurs when the full range of possible forcing factors is considered and those related to climate change are found to be the most probable explanation for the detected change in question [18.2.1.1]. Comparing detected changes with the expectations of well-established scientific evidence also plays a central role in the successful attribution of detected changes. We attempt to do this for the seven sub-regions of the Ocean. There are a number of general limitations to the detection and attribution of impacts to climate change and ocean acidification that are discussed elsewhere [18.2.1] along with challenges [18.2.2]. Different approaches and 'best practice' guidelines are discussed in WGI Chapters 10 and 18 as well as in several other places [Hegerl et al., 2010; Hegerl et al., 2007; Stott et al., 2010]. The fragmentary nature of ocean observing, structural uncertainty in model simulations, the influence of long-term variability, and confounding factors unrelated to climate change (e.g., pollution, introduced species, overexploitation of fisheries) represent major challenges [Halpern et al., 2008; Hoegh-Guldberg et al., 2011a; Parmesan et al., 2011]. Different factors may also interact synergistically or antagonistically with each other and climate change, further vexing the process of detection and attribution [Hegerl et al., 2010; Hegerl et al., 2007]. "
265	75891	30	7	54	7	54	"challenges" = Biological challenges? Measurement challenges? It is confusing as to what is meant here. (UNITED STATES OF AMERICA)	This text has been removed.
266	80441	30	8	6	8	6	There is no Chapter 18 in AR5 WGI. Please correct the reference. (Gian-Kasper Plattner, IPCC WGI TSU)	Text has been modified and link has been moved.
267	84163	30	8	6	8	6	The reference to working group 1 is unclear, as the volume does not contain a chapter 18. (Katharine Mach, IPCC WGII TSU)	Text has been modified and link has been moved.
268	61682	30	8	11	8	11	It is specifically the "structural uncertainty" in model simulations which confound D&A (e.g. Hegerl and Zwiers, 2011). i.e. model errors in terms of the magnitude of forced response are accounted for by D&A methods. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree and have modified the text - phrase "structural uncertainty in model simulations" now added. See previous response (#264)
269	63815	30	8	15	8	15	Please change the term "frustrating". The term describes an emotion. To our opinion such "emotional terms" should not be part of a scientific text. (GERMANY)	We have replaced the term "frustrating" to ensure unemotional language.
270	75892	30	8	17	8	17	"Stressors" = jargon. Define or rephrase. (UNITED STATES OF AMERICA)	We respectfully disagree - the word 'stressor' is in common use and does not need definition. It is a well established biological term.
271	75893	30	8	21	8	52	It is advisable that some reference be made to the Ch. 6 discussion at the end of this section, indicating that Ch. 6 provides the foundation for this discussion. (UNITED STATES OF AMERICA)	We respectfully disagree. This section is about previous assessments - meaning AR4 and previous. We have made reference to chapter 6 and the fact that it is examining oceans from a sectoral/Systems point of view in the introductory text which captures the essence of their contribution to the current assessment of oceans at a regional scale.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
272	75894	30	8	21	9	29	Check this section for repetition with other chapters. (UNITED STATES OF AMERICA)	We have checked this section for repetition and have reduced some of the overlap with chapter 6. That said, chapter 6 is approaching oceans from a sectoral/Systems point of view, while chapter 30 is taking many of the principles from chapter 6 and examining them with respect to climate change D and A from a regional perspective. UPDATE: we have developed a series of five cross chapter boxes with chapter 6 and other marine relevant chapters. These are ensuring that we have reduced the length of the individual chapters while at the same time maintaining consistency with respect to central issues such as ocean acidification, coral reefs, upwelling, net primary productivity and biogeographical changes response to rising greenhouse gas concentrations.
273	75895	30	8	27	8	27	"reducing a key opportunity to synthesize": This statement is confusing. Presumably having information spread throughout multiple places would provide a synthesis opportunity? (UNITED STATES OF AMERICA)	We agree and have rewritten the text to make it less confusing. It now reads: "The fact that assessments for ocean and coastal systems are spread throughout previous assessment reports reduces the important opportunity for synthesizing the detection and attribution of climate change and ocean acidification across the physical, chemical, ecological and socio-economic components of the Ocean and its sub-regions. "
274	75896	30	8	31	9	36	Page 8 line 31 states that the ocean has taken up over 80% of the heat, while page 9 line 36 states > 90 %. Please confirm the correct value and edit as appropriate. (UNITED STATES OF AMERICA)	The former is a direct quote from AR4 for while the second - a more recent and supposedly accurate number - comes from the assessment done by WGI during AR5. UPDATE: The correct number is 93% - which comes from working group 1 AR5 consensus. This section of Ch30 was to report on - albeit briefly - the essence of what was captured in AR4 by way of comparison to the current assessment (AR5). consequently, we are reporting the number from AR4 which is in the quote that we used and reflects the fact that our understanding has improved with respect to the amount of heat being trapped by the oceans since AR4.
275	84164	30	8	37	8	37	"very likely" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	We have italicised "very likely" - and checked and done so for the entire text of chapter 30.
276	84165	30	8	39	8	29	By "definitive evidence" does the chapter team mean evidence that slowing had already occurred? This could be clarified. (Katharine Mach, IPCC WGII TSU)	We have removed 'definitive' - this was referring to the fact that theoretically oceanographers feel the MOC must be changing but mesurement systems are not advanced enough to measure it. Have added 'limited' to description.
277	75897	30	8	39	8	39	The MOC is not really discussed in this chapter. Should this passage be revised or refer to other sections of AR5 (e.g., Sec. 3.6.3 of WG1)? (UNITED STATES OF AMERICA)	This section is only meant to refer to the previous assessments (AR4). Also - we do mention the MOC but recognise that there is little to report that is different from AR4 in AR5 (i.e. changes have still not been reported, with the suspicion that this is about our instruments being able to detect change as opposed to no change.
278	79698	30	8	41	8	41	It should read "United States and in the United Kingdom" or otherwise it reads as if talking only about the eastern coasts of the UK (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text modified

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
279	57317	30	9	4	9	4	Surely there must be a better reference than Hayes et al. 2001 for this. The Hayes et al article is about potential causes of "disease epidemics, mass mortalities, harmful algal blooms and other population explosions" during a particular period, when the authors suspected increased Fe supply to the N Atlantic may have caused increased primary production, including that of pathogens. (Erica Head, Fisheries and Oceans Canada)	Agreed, text modified
280	79699	30	9	17	9	18	It would be useful to include a paragraph highlighting the differences in scope between AR5 chapters 6, 29 and 30 as this is not immediately obvious. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added text along these lines to clarify the different roles and perspectives of the chapters. And to clearly specify the mandate and mission of chapter 30 by comparison. See responses to similar questions above.
281	69845	30	9	19	9	19	The plots and tables in this section were prepared by the authors of this assessment report, rather than taken from the literature or from the WG I report. That raises question of how the plots were made (corrections to data, accounting for known problems, etc.). Furthermore, this is no longer purely an assessment of the literature. We think that this creates an undesirable situation. (NETHERLANDS)	The datasets have all been published independently and hence are legitimate (HADsst etc - see Raynor et al 2003 for example). However, we have now taken many of the figures (where possible) from the WGI consensus and AR5 Atlas.
282	84166	30	9	22	9	22	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have searched for and modified the word "likely" to avoid these casual usages.
283	84167	30	9	23	9	24	For this statement, the description of changes in chemistry should presumably more precisely match wording use within working group 1. Additionally, the specific supporting chapter (or charter sections) should be specified. (Katharine Mach, IPCC WGII TSU)	We have reduced the length of this section to act as a simple, short introduction.
284	80442	30	9	24	9	25	Please specify the reference to AR5 WGI Ch3. (Gian-Kasper Plattner, IPCC WGI TSU)	As above, we have reduced the length of this section to act as a simple, short introduction.
285	58584	30	9	25	9	29	What is an "expert" archive or "expert" data set? (Janice Lough, Australian Institute of Marine Science)	As above, we have reduced the length of this section to act as a simple, short introduction. It now reads: "Data archives such as HadISST1.1 contain reconstructed sea surface temperatures (SST) from a range of sources, allowing an opportunity to explore mean monthly, gridded, global SST from 1870 to the present [Rayner et al., 2003]. We used the published HadISST1.1 data set (higher temporal and spatial resolution than HadSST3) to explore trends in historic SST within our sub-regions (Figure 30.1a). The median SST for 1871–1995 from the Comprehensive Ocean-Atmosphere Data Set (COADS) were merged with data from the UK Met Office Marine Data Bank (MDB) to produce monthly globally-complete fields of SST on a 1o latitude-longitude SST grid from 1870 to date."
286	61683	30	9	32	18	48	Sections 30.3.1 and 30.3.2 are very similar to WG2 Section 6.1.1. More work is required to improve the consistency of messages between Chapters 6 and 30 of WG2. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree and point to the fact that we are the regional chapter for the oceans and should be reflecting these types of map-based assessments. We have discussed ways to minimise this type of overlap with chapter 6. We have now compared each statement/conclusion in CH6 with those of Ch30 and have ensured consistency. UPDATE: we have also develop joint products together with chapter 6 - five cross chapter boxes and one common table which draws together the risks and vulnerabilities across the marine related chapters.
287	75898	30	9	36	9	36	There is a missing "the" in this sentence - i.e., "that the Ocean..." (UNITED STATES OF AMERICA)	Has been corrected.
288	84168	30	9	36	9	37	The broad timeframe (since preindustrial?) could be specified. (Katharine Mach, IPCC WGII TSU)	We have now specified timeframe.
289	85111	30	9	36	9	37	The executive summary specifies a timeframe of since 1950 for this statement--please clarify here. (Michael Mastrandrea, IPCC WGII TSU)	We now specify the timeframe.
290	69846	30	9	39	9	40	in section 30.3.1.6 (page 15, lines 16-17) it is stated that warming of the ocean resulted in a 4% increase in thermal stratification in the upper layers in the ocean EXCEPT in the Southern Ocean (NETHERLANDS)	We have added the nuance requested.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
291	58487	30	9	40	9	40	4% of what ? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	4% of thermal stratification in the upper layers of the ocean - this is explained in the text and in WGI.
292	61684	30	9	40	9	41	Since Gleckler et al. [2012] further D&A work has been done on ocean temperature. Suggest to include reference to Pierce et al. [2012], GRL, here. This study used the most recent CMIP5 data (rather than CMIP3 in Gleckler et al. [2012]) and corrects for spurious 1970s-80s warming in the observations. This is also more consistent with the analysis of CMIP5 models displayed in Table 30-3. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have added Pierce et al 2012
293	75899	30	9	41	9	41	"Virtually certain, p<0.01": is this double uncertainty language consistent with IPCC guidance? (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
294	84169	30	9	42	9	42	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have resolved the use of these types of terms across the manuscript, including here.
295	58585	30	9	46	9	50	What are ".2median SSTs"? Should also note that the "globally-complete fields" of HadISST are derived by interpolation/reconstruction for data sparse locations and time periods. Some comment about how this data set compares with other "reconstructions" from observations (e.g. ERSST) is also perhaps warrented; see, for example Deser et al (2010) Twentieth century tropical sea surface temperature trends revisited. Geophysical Research Letters 37, doi:10.1029/2010GL043321; Deser et al (2010) Sea surface temperature variability: patterns and mechanisms. Annual Review Marine Science 2: 115-143; Solomon & Newman (2012) Reconciling disparate twentieth-century Indo-Pacific ocean temperature trends in the instrumental record. Nature Climate Change doi:10.1038/NCLIMATE1591. (Janice Lough, Australian Institute of Marine Science)	We chose HADsst because it is used extensively through the AR5 assessment. Most of our use of HADISST SSTs are relative, meaning that we are either asking which regions are increasing SST fastest or we are applying anomaly analyses to describe heat stress. Both of these only require HadISST to be internally consistent. We started off using the Reynolds SST and were encouraged to move to HadISST by the AR5 assessment team.
296	75900	30	9	46	12	2	The text becomes difficult to read to the non-expert because of jargon. What is "published HadISST 1.1" What is ".2median SSTs"? It is suggested that phrases such as published long-term SST data (HadISST 1.1) be used. [perhaps also including information on how the data was collected, e.g. satellite, shipboard, etc.). Does this mean the SSTs for the nearest 0.2 meridional degree? Recommend something to make this more accessible yet retain the necessary citations. The precision is needed, for sure, but very few will know these terms which would be better in parentheses or set off by commas for the first use. (UNITED STATES OF AMERICA)	We have simplified the language and removed ambiguities. Where applicable we have directed readers to publications that explain aspects such as HadISST in more detail. Unfortunately the word limit (necessary to ensure that the IPCC assessment did not become too large) has prevented a great deal of detail and explaination to what is a very large topic. We have made good use of publications as support information to provide direction to readers who seek a greater understanding of what is being reported.
297	58488	30	9	47	9	47	.2 ?? (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Correction has been added
298	77959	30	9	47	9	47	0.2median ??? (James Christian, Government of Canada)	Correction has been added
299	58586	30	9	52	9	53	Probabkly more accurate to say that all ocean basins are warming but that rates of warming differ. (Janice Lough, Australian Institute of Marine Science)	Agreed, text modified accordingly.
300	75904	30	10	0	0	0	There is reference made to Figure 30-3 E in this section. However, there is no panel "E" in the figure. The caption, here and on page 108, the caption referest to "E" yet no "E" exists (UNITED STATES OF AMERICA)	Text and legends have now been corrected. Figure 30-3 has only one panel now.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
301	77956	30	10	0	0	0	Table 2 - I find the changes listed for the North Pacific and North Atlantic implausibly large (>3K over 50 years, over vast areas of ocean, and in one case >6) (see also 20/54 and 23/25). I do not have time to try to reproduce this analysis exactly but the data sets I have consulted don't show changes of anything like this magnitude, nor can I find anything in Ch. 3 of the WG1 report that supports this. I also don't see why 3 sf's are required for these numbers whose uncertainty is easily +/- 0.1K. (James Christian, Government of Canada)	We used HadISST 1.1 with all values less than -1.8 being set at -1.8 to allow for the fact that HadISST is air temperature above sea ice but the SST below it will be close to the -1.8 degrees (freezing point of sea water). The values presented in Table 2 are average values over the entire region, defined in Figure 30-1. The large changes over the past 50 years in the northern Pacific and Atlantic Oceans also attracted our scrutiny. We checked and re-checked our analyses and could not find anything wrong with them. So we then sought advice from SST climate experts who were also happy with our results and explained them via the massive change in sea ice in those regions over the past 50 years.
302	58589	30	10	1	10	1	Table 30.2 could benefit from a but of clarification: I do not understand why the years used in columns 3, 5 and 6 are different? How were values "Index of Varibility" calculated - it does not seem to be a simple ratio of the 2 values; also, not sure "Index of Varibility" is the appropriate term to use. This is, however, a useful exercise as linear trends can be distorted by start and end values so comparing averages for 2 different time period is more meaningful; probably also worth highlighting those values in column 6 which are significantly different between the 2 time periods. (Janice Lough, Australian Institute of Marine Science)	We have worked on the legend to make these elements clearer.
303	75901	30	10	2	10	3	Does "southern portions of the HLSBS" mean the southern hemisphere HLSBS ? Northern hemisphere HLSBS is also mentioned, so it is unclear as to if this means the southern portion of the northern hemisphere HLSBS, but the text doesn't indicate that. Please clarify. (UNITED STATES OF AMERICA)	Correct - meant southern hemisphere (corrected in text).
304	58590	30	10	12	10	12	Do you really mean to refer to Figure 30-12B here? (Janice Lough, Australian Institute of Marine Science)	Correct - problem corrected - have reduced number of figures so figure numbers have been double checked and modified within the text as a whole.
305	75902	30	10	15	10	16	"These more recent....long-term variability" seems to be explaining away the lack of significant change. This does not sound especially objective. (UNITED STATES OF AMERICA)	We agree. We have rewritten as to to reflect a more objective analysis.
306	58591	30	10	16	10	21	See also, regarding warming of tropical coral reef regions: Lough (2012) Small change, big difference: sea surface temperature distributions for tropical coral reef ecosystems, 1950-2011. J Geophysical Research 117, doi: 10.1029/2012JC008199. (Janice Lough, Australian Institute of Marine Science)	We have added this reference.
307	79700	30	10	32	10	36	Looking at figure 30-3, this seems to contradict some of the statements in the paragraph above about regional trends and changes. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Some of the values reported were capped at 0.15oC which matched the analysis of Burrows. We have, however, reduced this figure down to the single velocity analysis completed by Burrows.
308	58587	30	10	33	10	36	Figure 30-3 - caption needs clarifying; the analyses are for the global oceans and not "different ocean sub-regions"; also need to explain the "velocity" and "shift" calculations; is this based on Burrows et al (2011) work - if so, then should be stated. (Janice Lough, Australian Institute of Marine Science)	Figure modified (problem removed) and the methodology has been inserted into the legend.
309	58593	30	10	33	10	36	Figure 30-3 - caption needs clarifying; the analyses are for the global oceans and not "different ocean sub-regions"; also need to explain the "velocity" and "shift" calculations; is this based on Burrows et al (2011) work - if so, then should be stated. (Janice Lough, Australian Institute of Marine Science)	Figure modified (problem removed) and the methodology has been inserted into the legend.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
310	75903	30	10	34	10	34	Here and elsewhere in the chapter: Velocity = speed + direction, but no direction is ever given. Is the assumption that direction is poleward? Please specify. (UNITED STATES OF AMERICA)	Burrows et al. 2012 used global surface temperatures (HADsst 1.1) over 50 years (1960–2009; units oC/yr) to calculate the distribution of the velocity of isotherm migration over land and ocean to the two-dimensional spatial gradient in temperature (in °C/km, calculated over a 3°-by-3° grid), oriented along the spatial gradient. The calculations gives the velocity along the gradient observed which may be in any direction. We have now added direction arrows every 5 degrees latitude and longitude to the global plot (with the arrows scaled by velocity). Note that while many arrows point towards the polar regions, there are many arrows that point to other directions given local oceanography and other influences.
311	58489	30	10	35	10	36	Fig 30.3. Explain what is shift in season change that "drive natural history events". It is uncomprenhensible. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We have changed the text and reduces ambiguity. We has replaced the text "natural history" with "life history". I think this does a lot to clarify the issue. UPDATE: this part of chapter 30 has been placed in a cross chapter box with significant modifications.
312	58594	30	10	45	10	54	Table 30.2 could benefit from a but of clarification: I do not understand why the years used in columns 3, 5 and 6 are different? How were values "Index of Varibility" calculated - it does not seem to be a simple ratio of the 2 values; also, not sure "Index of Varibility" is the appropriate term to use. This is, however, a useful exercise as linear trends can be distorted by start and end values so comparing averages for 2 different time period is more meaningful; probably also worth highlighting those values in column 6 which are significantly different between the 2 time periods. (Janice Lough, Australian Institute of Marine Science)	We have reviewed the text and have reduced the ambiguity. The reason why the two columns of different is because one is based on a regression while the other involves subtracting the period 2000-2009 from the period 1950-1959. Because the first takes into account trends in the complete data set through regression analysis, the second may not exactly match. For example if there are large up-and-down deviations in the data set, then these will influence the calculation of the difference between 2000-2009 from the period 1950-1959. We have explained this in the legend. Note that this table is now table 30.1.
313	58490	30	10	54	10	54	Table 30.2….that exceed 0.05 (non significative) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	That is correct. Note we have clarified the use of p-values - pointing out the difference between statistical significance, and the use of p-values to give some understanding of confidence. That is, p-value may be greater than 0.05 - with the expectation that the reader can make an independent judgement as to the level of significance for the differences between the rate of change in temperature, for example, and a rate of change that is zero.
314	75909	30	11	0	0	0	First paragraph - "across the ocean", line 8 does not make sense. Please clarify. (UNITED STATES OF AMERICA)	We have rearranged the sentence to make it more understandable.
315	63096	30	11	6	11	6	Should be Hoegh-Guldberg, 2012, without the 'b' (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	Agreed. We have corrected this.
316	75905	30	11	6	11	6	Should 'aclimatize' be 'aclimate'? (UNITED STATES OF AMERICA)	This is correct. Acclimatise has been replaced by acclimate.
317	75906	30	11	7	11	10	Lower velocities (cooling) in central and north Pacific, and Atlantic seems to contradict the general statement above in line 8 that isotherms are moving at high velocities 'across the ocean'. The authors should clarify that is happening in low latitudes. (UNITED STATES OF AMERICA)	We have now put that emphasis into the text: "This analysis and others (e.g., North Atlantic, González-Taboada and Anadón [2012]) reveals that isotherms in the Ocean are moving at high velocities (up to 20 km yr-1), especially at lower latitudes (Figure 30-3B, high confidence). "

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
318	75907	30	11	9	11	9	"contracting isotherms" -- what direction? It is not obvious from the plots etc. (UNITED STATES OF AMERICA)	We have added the methodology to the legend and have now provided arrows scale to velocity to the diagram. Note while most point towards polar regions, there are many that point in other directions.
319	75908	30	11	13	11	13	"are likely to" -- is the uncertainty range of 66-100% probability meant here? Otherwise, change to "may have impacts" (UNITED STATES OF AMERICA)	We have reviewed the use of likelihood and confidence across the manuscript - including here.
320	84170	30	11	13	11	13	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have reviewed the use of likelihood and confidence across the manuscript - including here.
321	58595	30	11	30	11	32	Have bleaching events really occurred every 2-3 years in most coral reef sub-regions? Reference? (Janice Lough, Australian Institute of Marine Science)	Correct - it varies with region. The text has been modified to be consistent with the literature.
322	58596	30	11	44	11	47	Are these the same models used by WG1? (Janice Lough, Australian Institute of Marine Science)	Yes, CMIP5 is the collective resource for future projections for the IPCC and international community in general.
323	80443	30	11	44	12	2	Please update relevant SST projection statements to ensure consistency and cross-referencing with the relevant WGI AR5 chapters. (Gian-Kasper Plattner, IPCC WGI TSU)	We have checked the consistency and corrected it where necessary between chapter 30 and WG1 AR5 chapters.
324	61685	30	11	47	11	48	Looking at Figure 30-2, CMIP5 models forced with natural-only forcings are included ("historicalNat") along with shading for where there is overlap with the all forcings simulations. However these results are not discussed in the text (in terms of agreement with observations or the shaded overlap between "historical" and "historicalNat" experiments). This should be discussed in 30.3.1.1. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have now discussed these differences in the historical record: These changes have a significant anthropogenic signal (virtually certain; Gleckler et al. 2012, Pierce et al. 2012) with the surface waters of all three ocean basins are warming at different rates that all exceed that expected if there were no changes to greenhouse gas forcing over the past century (Figure 30-2 E-G). In the latter case, the observed record also falls within the range of historical model outputs that include observed changes to greenhouse gases as opposed to models that do not.
325	65292	30	12	4	12	5	I could not understand why the models were limited? CMIP-5 includes much more models and other models must be included. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	Only models that were accompanied with historical data runs were used. This was necessary for the anomaly analyses presented in this chapter. Were we to have used models that didn't have historic data then we would be in danger of creating eroneous anomalies. This said, we have included up to 28 models and hence have a good measure of the variability between models.
326	75910	30	12	23	12	23	It is assumed that the reference to (3.7.2) should be (WGI 3.7.2)? (UNITED STATES OF AMERICA)	We have corrected the link - see new text.
327	80444	30	12	23	12	23	Please specify the reference to WGI Ch3.7.2. (Gian-Kasper Plattner, IPCC WGI TSU)	We have corrected the link - see new text.
328	58598	30	12	23	13	4	This section only seems to have one reference to a scientific paper as opposed to other reports and chapters of IPCC-AR5? (Janice Lough, Australian Institute of Marine Science)	We are deliberately depending on the consensus provided by AR5 WG1 as instructed by the TSU and others. Given the key questions regarding the variability of sea level regionally are dealt with in WGI, which is laden with references, we have referred directly to the appropriate sections of the AR5 WGI report.
329	84171	30	12	26	12	26	In place of "confidence," it would be preferable to use "likelihood" given that confidence is a separate metric within the uncertainties guidance. (Katharine Mach, IPCC WGII TSU)	We have rewritten the section and have been careful about the use of terms such as confidence in line with the TSU recommendation. We have reviewed the use of likelihood and confidence across the manuscript - including here.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
330	58597	30	12	27	12	29	Were the relatively high rates of sea-level rise not in the early-mid Holocene? Also check references to correct figures and chapters in WG1 (Janice Lough, Australian Institute of Marine Science)	Not anywhere near to the rates recently seen (between 0.2 and 0.7 mm yr-1). We have referenced the latest consensus (WGI Ch13) which has evaluated the evidence carefully.
331	75911	30	12	31	12	31	Sealevel rise cannot be measured from bouys and floats, as you need full water column measurements of density. (UNITED STATES OF AMERICA)	Agreed. Text changed to remove this misleading statements.
332	84172	30	12	37	12	37	"very likely" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	We have made the change in this respect.
333	75912	30	12	37	12	38	A finding that includes a probabilistic measure of uncertainty does not require explicit mention of the level of confidence associated with that finding if the level of confidence is "high" or "very high" (UNITED STATES OF AMERICA)	We have reviewed the use of likelihood and confidence across the manuscript - including here.
334	75913	30	12	41	12	41	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Agreed, change made.
335	84173	30	12	41	12	41	"likely" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	Agreed, change made.
336	61686	30	12	41	12	42	The combination of a likelihood statement and a confidence statement in one sentence appears to be in contradiction with the IPCC uncertainty guidance. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed, change made.
337	75914	30	12	41	12	47	Reword to show uncertainty in SL projections. SL is likely to rise but the amounts given have large error bars. Is SL discussion needed in this chapter since it is covered elsewhere? (UNITED STATES OF AMERICA)	Agreed, text modified appropriately.
338	75915	30	12	47	12	47	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Agreed, change made.
339	84174	30	12	47	12	47	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, change made.
340	75916	30	12	49	12	49	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Agreed, change made.
341	84175	30	12	49	12	49	If being used as a likelihood term, "very likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	Agreed, change made.
342	80445	30	12	50	12	50	The reference here is not clear. Does it include Figure 13.18? (Gian-Kasper Plattner, IPCC WGI TSU)	We have rearranged the text here to make it more explicit.
343	77960	30	12	51	12	51	"topology, oceanography, and other factors" topography (James Christian, Government of Canada)	This has now been corrected.
344	75917	30	13	2	13	2	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Agreed, change made.
345	84176	30	13	2	13	2	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, change made.
346	77961	30	13	13	13	13	"ocean mixing driven by wind" ocean mixing and upwelling driven by wind (James Christian, Government of Canada)	Agreed, change made. In this section, we now recognise the significantly reduce certainty around long term changes due to accurate past records as well is the influence of long-term patterns of variability.
347	77962	30	13	16	13	16	I can not tell what is meant by "ocean circulation measurements" here (James Christian, Government of Canada)	Text changed, ambiguity removed.
348	75918	30	13	16	13	17	Ocean observations do not limit our understanding . They increase it. This sentence should be reworded to indicate that more ocean observations are needed (as it is assumed that this is the authors' intention). (UNITED STATES OF AMERICA)	Agreed, change made.
349	75919	30	13	17	13	17	"has changed" over what period? Since observations have begun? Since industrialization? (UNITED STATES OF AMERICA)	We have made changes and now indicate the length of time.
350	84177	30	13	21	13	22	"low" and "confidence" should be italicized on these lines for clarity. (Katharine Mach, IPCC WGII TSU)	Agreed, changes made
351	75920	30	13	23	13	23	"Wind stress (westerly winds) has increased since 1951 over the Southern Ocean" should be "Wind stress over the Southern Ocean (westerly winds) has increased since 1951" or something else to avoid confusion that wind stress is being described that way globally. (UNITED STATES OF AMERICA)	Section has been re-written.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
352	58599	30	13	32	13	37	Again, how about some primary literature references? (Janice Lough, Australian Institute of Marine Science)	We are deliberately depending on the consensus provided by AR5 WG1 as instructed by the TSU and others. Given the key questions regarding the variability of sea level regionally are dealt with in WGI, which is laden with references, we have referred directly to the appropriate sections of the AR5 WGI report. We have added reference is only where there is the need to fill gaps not available through the WG1 consensus.
353	75921	30	13	33	13	33	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
354	84178	30	13	33	13	33	If being used as a likelihood term, "likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
355	79701	30	13	35	13	36	This sentence ("Understanding how.....") doesn't make sense grammatically (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed - sentence has been re-written: This is low confidence in the current understanding how SWH will change over the coming decades and century for most of the Ocean. It remains an important knowledge gap (WG1 3.4).
356	75922	30	13	36	13	36	"uncertain" is not one of the official confidence summary terms. Please use IPCC uncertainty language or remove the italics. (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
357	84179	30	13	36	13	36	"uncertain" is not a calibrated term within the uncertainties guidance, and therefore it should not be italicized. (Katharine Mach, IPCC WGII TSU)	They have removed the use of "uncertain" throughout the manuscript. Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
358	58600	30	13	40	13	41	What does "consistent with Walker Circulation" mean? Do you mean a weakening of the WC? (Janice Lough, Australian Institute of Marine Science)	Text corrected to remove the ambiguity. Yes - Weakening of the Walker Cell circulation was intended. Sentence now reads: "There is high confidence, however, that the increase in northern mid-latitude westerly winds from the 1950s to 1990s, and the weakening of the Pacific Walker circulation from the late 19th century to the 1990s have been largely offset by recent changes [WGI, 2.7.5, 2.7.8, Box 2.5]."
359	75923	30	13	40	30	40	Change "analyzes" to "analyses" (UNITED STATES OF AMERICA)	Have made global change throughout manuscript along these lines.
360	84180	30	13	44	13	44	"low" and "agreement" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	Have italicised words as indicated.
361	75924	30	13	46	13	46	"evidence from the tropical Pacific": how robust is this evidence, or how representative of a trend is it? Without this kind of information, this detail seems to be speculation. (UNITED STATES OF AMERICA)	Have reworded to include a measure of how robustness evidence is with reference to how representative it is. UPDATE: note, previous typo was due to voice to text error!
362	84181	30	13	48	13	48	If being used as a likelihood term, "likely" should be italicized for clarity. Casual usage should be avoided. (Katharine Mach, IPCC WGII TSU)	Have italicised words as indicated.
363	58601	30	13	48	13	50	ENSO is short-term, i.e. interannual rather than long-term variability. Also, what about PDO/IPO as sources of decadal variability? (Janice Lough, Australian Institute of Marine Science)	Have rewritten text to resolve these issues.
364	58602	30	13	52	13	52	"ocean circulation" (Janice Lough, Australian Institute of Marine Science)	This nuance has been taken on board in the reorganised paragraph. We much more carefully reflect the consensus of working group 1.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
365	75925	30	13	52	13	52	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Have italicised words. Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
366	84182	30	13	52	13	52	"very likely" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	See above
367	75926	30	13	53	13	53	What is the meaning of strengthening of subtropical gyres? (UNITED STATES OF AMERICA)	Have reworded text to fix this vagueness and ambiguity.
368	77955	30	14	0	0	0	Figure 30.6 "solar insolation" (James Christian, Government of Canada)	Agreed, changes have been made through out Ch30.
369	75927	30	14	1	14	1	"limited evidence" should be accompanied by a statement about level of agreement (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion.
370	77963	30	14	2	14	2	rather abrupt change of topic here (James Christian, Government of Canada)	We are unsure about what the reviewer is referring to here. We have discussed this with the reviewing editors and feel that the text is appropriate.
371	75928	30	14	3	14	3	"large scale changes in wind" --- qualify. How big? What are these changes? (UNITED STATES OF AMERICA)	We have added this to the text.
372	58603	30	14	9	14	37	There is no assessment in this section of Evidence/Confidence (Janice Lough, Australian Institute of Marine Science)	Text has been rewritten to indicate a level of confidence with these measurements. UPDATE: this whole section has been reduced as a result of reviewer comments as well as the realisation that solar insolation and clouds going back beyond the satellite era have high degrees of uncertainty and hence discussion is a lot less fruitful in terms of tracking changes related to climate change.
373	75929	30	14	11	14	25	There are no confidence statements in this paragraph. Please consider appropriate use of them in this section. (UNITED STATES OF AMERICA)	Text has been rewritten to indicate a level of confidence with these measurements.
374	75930	30	14	22	14	25	This statement should be qualified with a confidence or likelihood statement. (UNITED STATES OF AMERICA)	See above
375	84183	30	14	23	14	23	If being used as a likelihood term, "likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	We have italicised words.
376	58605	30	14	23	14	24	PDO is "decadal" not interannual. (Janice Lough, Australian Institute of Marine Science)	Agreed, text has been amended.
377	75931	30	14	25	14	25	This line seems contradictory given that some reasons are provided above. Rewrite to be more precise a summary of where knowledge gaps exist. (UNITED STATES OF AMERICA)	We have rewritten the text and have removed this ambiguity.
378	58606	30	14	27	14	37	Is it possible to identify where the changes identified in the regression analyses in these figures are significant? This would contribute to "detecting" where significant changes have occurred in the oceans. (Janice Lough, Australian Institute of Marine Science)	After several other reviewers had problems with the use of NCEP data as far back as the 1950s for solar insolation, we have decided not to use it.
379	79702	30	14	32	14	32	In the caption for figure 30-6, insert the word "Surface" so it reads "Surface salinity as the percentage change from....". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We are now using a figure out of working group 1 instead of the figure that was in the SOD.
380	58607	30	14	42	14	42	Why not just call them "tropical cyclones". (Janice Lough, Australian Institute of Marine Science)	Agreed, have done so.
381	75932	30	14	43	14	43	The phrase "positive and negative influences" is vague. Does this mean good and bad? High and low? Please clarify. (UNITED STATES OF AMERICA)	Agreed, have amended language to make it less vague.
382	58608	30	14	46	14	47	De'ath et al (2012) do not provide evidence for coral reef recovery taking "decades". I am sure there must be other coral reef literature that can support this statement. (Janice Lough, Australian Institute of Marine Science)	Probably debatable but we have added a reference on Reef recovery taking decades. Sentnec now reads: "Storms are often highly destructive, however, and destroying coastal infrastructure and habitats such as coral reefs [De'ath et al., 2012] and mangrove forests which can take decades to recover (Lotze et al. 2011)."

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
383	69847	30	14	49	14	49	most intense cyclones => most intense tropical cyclones (NETHERLANDS)	Agreed, text has been amended. UPDATE: the third paragraph in this section has been reduced for reasons of space and the fact that a discussion of storms occurs within WG1 (e.g. WG1 2.6.4.
384	58609	30	14	49	14	53	Please use "tropical cyclones" to help distinguish from higher latitude "cyclones"; I think the conclusions from WG1 Ch 2 that there is no overall gobal trend in TC frequency discernible should be reiterated here; also make it clear that the Callaghan & Power (2011) refers to severe TCs (Janice Lough, Australian Institute of Marine Science)	Agreed, text has been amended.
385	57318	30	14	52	14	52	East Australian coast is the 19th century "is" should be changed to "since" (Erica Head, Fisheries and Oceans Canada)	Agreed, change made.
386	57598	30	14	52	14	52	7th word in line should be "in" (George Somero , Stanford University)	Agreed, change made.
387	79703	30	14	52	14	52	Is "in the 19th century" correct? Should this say "in the 20th century"? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, change made.
388	61687	30	14	54	15	1	Need to justify this claim with a citation or by referring to another AR5 section. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed, link made.
389	75939	30	15	0	0	0	There is reference to a figure 30-16. However, there is no figure 30-16. It seems that the reference in the text should have been made to Box Figure 30-1. (UNITED STATES OF AMERICA)	We have made the correction.
390	57319	30	15	4	15	4	is likely should be "are likely" (Erica Head, Fisheries and Oceans Canada)	Sentence has been in response to other reviewers comments.
391	84184	30	15	4	15	4	The chapter team should consider whether a level of confidence would be more appropriate here in place of the likelihood term used. (Katharine Mach, IPCC WGII TSU)	Sentence has been in response to other reviewers comments.
392	75933	30	15	4	15	11	There is inconsistent use of italics with likelihood statements. Please be consistent throughout the chapter to dinstiguish between formal IPCC uncertainty language and standard language. (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion. We have applied italicised nation appropriately now.
393	75934	30	15	5	15	5	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	See above.
394	84185	30	15	5	15	5	If being used as a likelihood term, "likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	See above.
395	75935	30	15	6	15	7	"frequency will decrease...likely to decrease" repeats line 1. (UNITED STATES OF AMERICA)	Section re-written - this statement is no longer included are text.
396	57320	30	15	7	15	7	Should be "numbers of extra-tropical and tropical storm events are likely" (Erica Head, Fisheries and Oceans Canada)	Text has been rewritten to be clearer, solving this issue.
397	84186	30	15	7	15	7	If the 2nd "likely" on this line is being used as a likelihood term, it should be italicized. (Katharine Mach, IPCC WGII TSU)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion. We have applied italicised nation appropriately now.
398	75936	30	15	9	0	0	"poleward" [remove the "s"]. (UNITED STATES OF AMERICA)	Agreed, have changed throughout manuscript.
399	84187	30	15	9	15	9	"medium confidence" could be placed within parentheses at the end of the sentence to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, change made.
400	69848	30	15	10	15	10	Please check the reference to WGI, 3.4.5. Sec. 3.4.5 in WGI is about waves, not storm tracks, and about observations, so they cannot support the statement that storm tracks WILL shift poewards. (NETHERLANDS)	Agreed, change made.
401	84188	30	15	10	15	10	If being used as a likelihood term, "likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion. We have applied italicised nation appropriately now.
402	75937	30	15	16	15	29	This section reiterates chapter 6 content. Is this necessary? (UNITED STATES OF AMERICA)	We have shortened this section significantly and made it much more condensed in terms of relating key information out of chapter 6 and working group 1 chapter 3.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
403	65293	30	15	17	15	20	In high latitude, several studies pointed out the increse of primary production by light availability under the stonger stratification. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We agree, and have rewritten the text to reflect this and the conclusions of chapter 6.
404	61688	30	15	18	15	19	What about increases in light availability to phytoplankton as mixed layer depth shoals (see 6.1.1.5)? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree, and have rewritten the text to reflect this and to link better with the conclusions of chapter 6.
405	57321	30	15	18	18	21	At the risk of repeating the comments I made about the paragraph in the executive summary on this same topic - "This in turn reduces the availability of inorganic nutrients and consequently limits primary production (medium confidence, 6.1.1, 6.2.21, 6.2.2.2.3). This has been observed in the STGs" These statements are not entirely correct. According to Saba et al. (2010), nutrient (0-150 m, nitrate + nitrite) levels increased at HOT and BATS between the late 1980s and mid-2000s, and primary production and chlorophyll concentrations also increased. It is the measurements of near-surface chlorophyll by remote-sensing and the estimates of primary production that are based on them that are showing decreases over the STGs. Thus, there is disagreement between trends in primary production depending on methodologies. As written in the Executive Summary of Chapter 6 (Page 4, Lines 33-35), "The direction, magnitude and regional differences of a change of NPP in the open ocean as well as in coastal waters have limited evidence and low agreement for a global decrease projected by 2100." There is also the discussion/justification in Chapter 6, Page 12, Lines 1- 14 (as discussed above) (Erica Head, Fisheries and Oceans Canada)	We recognise this shortcoming and have referred to discussion of these issues in the cross chapter box on Upwelling (Box CC-UP) and on Net Primary Productivity (Box CC-NPP).
406	57322	30	15	18	18	21	So, I might change the Chapter 30 text to this (Erica Head, Fisheries and Oceans Canada)	We agree. See previous responses to the comments.
407	57323	30	15	18	18	21	"This in turn reduces the availability of inorganic nutrients, leading to decreased primary productivity (6.1.1.1, 6.2.1.1, 6.2.3.3). In the STGs, which dominate the three major ocean basins, satellite derived estimates of surface chlorophyll and primary production decreased between 1999 and 2007 (6.1.3). By contrast, however, in situ observations at fixed stations in the North Pacific and North Atlantic STGs (HOT and BATS), showed increases in nutrient and chlorophyll levels and primary production over the same period, suggesting that at local scales other processes (e.g. ENSO, PDO, NAO, winds, eddies, advection) can counteract broad-scale trends." (Erica Head, Fisheries and Oceans Canada)	We have incorporated this text - and have discussion about the differences between on ground and satellite detection in terms of following chlorophyll concentrations in the cross chapter box on net primary productivity of the ocean (Box CC-NPP).
408	61689	30	15	24	15	25	It would be helpful to provide some extra details/citations regarding future stratification changes here, rather than exclusively referring to Chapter 6. For example Capotondi et al. [2012] or Sallée et al. (2013), JGR:Oceans [DOI: 10.1002/jgrc.20157]. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have referred to relevant sections of chapter 6 and WGI Ch3.
409	84189	30	15	24	15	25	Clear line of sight to the supporting assessment should be provided for this conclusion. (Katharine Mach, IPCC WGII TSU)	Agreed, we have taken this on board although the assessment has weakened when the wider issues are considered.
410	65294	30	15	25	15	27	Does the compensation occur as a global mean? It is unclear where the primary procutivity is compensated. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	Agreed, text changed to reduce complexity.
411	65295	30	15	33	0	0	I think it is better to insert the box to 30.3.1.3 Surface Wind and Ocean Circulation rather than 30.3.1.6 Thermal Stratification. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We are not sure what the reviewer is driving towards.
412	75938	30	15	33	16	5	Mendelssohn and Schwing (2002) demonstrated a strong relationship between trend in wind stress and SST in the California and Peru-Chile EBUEs on the sub-ecosystem scale, confirming the Bakun (1990) hypothesis and consistent with Garcia-Reyes and Largier (2010). Further, the subecosystem patterns correspond to the distribution of principal fisheries stocks, (Parrish et al. (1983), suggesting that these trends will have significant effects on those populations. Citations - Mendelssohn, R. and F.B. Schwing. 2002. Common and uncommon trends in SST and wind stress in the California and Peru-Chile Current Systems Progress in Oceanography 53: 141-162. Parrish, R.H., A. Bakun, D.M. Husby, and C.S. Nelson. 1983. Comparative climatology of selected environmental processes in relation to eastern boundary current fish production. FAO Fish Rep. 291:731-778. (UNITED STATES OF AMERICA)	Reference has been added. "As for other EBUE, there is lack of studies that have rigorously attempted to detect and attribute changes to anthropogenic climate change, although at least two studies [Gutierrez et al., 2011; Mendelssohn and Schwing, 2002] provide additional evidence that the northern Humboldt Current has cooled (due to upwelling intensification) since the 1950s, a trend matched by increasing primary production. "
413	66211	30	15	36	0	0	Figure 30-16 does not exist. (Randi Ingvaldsen, Institute of Marine Research)	Error has been corrected. Number of figures has been reduced and there has been significant relabelling.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
414	58610	30	15	36	15	36	I cannot find Figure 30-16. (Janice Lough, Australian Institute of Marine Science)	Error has been corrected. Number of figures has been reduced and there has been significant relabelling.
415	58256	30	15	40	0	0	I suggest to introduce changes in seasonality (frequency and intensity) of the upwelling events in their northen liomit (Canary current in the northen Iberian Peninsule) as is referred in: Llope, M., Anadón, R., Viesca, L., Quevedo, M., González-Quirós, R., Stenseth, N.C. 2006 Hydrography of the Southern Bay of Biscay shelf break region: integrating the multi-scale physical variability over the period 1993-2003. J. Geophys. Res. 111, C0921 (doi:10.1029/2005JC002963). (Ricardo Anadon, University of Oviedo)	We currently do not have room to cover these issues in this short section. These issues are more appropriate to chapter 6 where the influence of these processes on biological and ecosystem is discussed.
416	58257	30	15	51	0	0	I suggest to incorporate to the paragraph the term curl upwellingdue to increasing importance to describe the biological responses to upwellings. References could be the Rykaczewski and Dunne but also the Pickett, M.H. and Schwing, F.B. 2006 Evaluating upwelling estimates off the west coast of North and South America. Fisheries Oceanogr. 13(3): 256-269 (Ricardo Anadon, University of Oviedo)	We currently do not have room to cover these issues in this short section. These issues are more appropriate to chapter 6 where the influence of these processes on biological and ecosystem is discussed.
417	79704	30	16	5	16	5	Need to check consistency with chapter 6, which also talks about changes in ocean productivity. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	See above. We have rewritten the section and have found commonality with chapter 6. We now have a cross chapter box on net primary productivity (Box CC-NPP) to help coordinate information on this issue.
418	60256	30	16	14	16	33	This is a good summary of salinity changes that draws on relevant recent research. (AUSTRALIA)	We thank the reviewer for their comment.
419	79705	30	16	14	16	33	This section says nothing about salinity differences with depth, or the observed freshening of the deep ocean. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added discussion of the conclusions from WGI with respect to changes in the ocean interior. For example: "It is very likely that large scale trends in salinity have also occurred in the ocean interior deriving from modifications to salinity at the surface and subsequent subduction (WGI 3.3.2-3.3.4)".
420	58611	30	16	18	16	18	I cannot find Figure 30-5D. (Janice Lough, Australian Institute of Marine Science)	Error has been corrected.
421	75940	30	16	18	16	18	This sentence should reference figure 30.6D not 30.5D (UNITED STATES OF AMERICA)	Error has been corrected.
422	84190	30	16	18	16	20	The confidence metric is explicitly non-quantitative and thus "99%" should not be used here. The likelihood scale is quantitative and may be more appropriate. (Katharine Mach, IPCC WGII TSU)	Have removed 99%.
423	75941	30	16	19	16	19	Incorrect use of confidence. Since a quantified value (99%) is given, then a likelihood statement should be applied. (UNITED STATES OF AMERICA)	Error has been corrected.
424	58612	30	16	31	16	31	"temperature increases". (Janice Lough, Australian Institute of Marine Science)	Error has been corrected.
425	63086	30	16	39	16	39	'decreased ocean pH as well as carbonate ion concentration' don't mention bicarbonate ion since this one increases its concentration (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We thank the reviewer for their comment. Error has been corrected. UPDATE: Have done so. Now reads: "Increased atmospheric CO2 from human activities has the continued accumulation of anthropogenic CO2 in the Ocean, resulting in decreased ocean pH as well as carbonate ion concentrations, and increased bicarbonate ion concentrations (Box CC-OA, WG1 Box 3.2)."
426	75942	30	16	39	16	39	"decreased ocean pH as well as carbonate and bicarbonate ion concentrations"...This statement is incorrect. Under acidification bicarbonate increases. (UNITED STATES OF AMERICA)	We thank the reviewer for their comment. Error has been corrected. See above.
427	77965	30	16	39	16	39	why reduced bicarbonate ion? as CO2 is added, HCO3- goes up and CO3-- goes down (James Christian, Government of Canada)	We thank the reviewer for their comment. Error has been corrected. See above.
428	63087	30	16	39	16	42	Consider fragmenting this phrase. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	See above - text changed to correct error regarding by carbonate ion. See above
429	75943	30	16	39	16	42	For "The extent to which the added influx of CO2 into the Ocean has acidified and influenced the tendency for aragonite or calcite (polymorphs of calcium carbonate) to precipitate into the shells and skeletons of marine organisms depends mostly on the solubility of CO2 and calcium carbonate," perhaps rewrite to "... to precipitate into or dissolve the shells and skeletons..." or something similar to avoid confusion that added CO2 increases precipitation. The sentence as written is absolutely correct, just may not be understood correctly by non-experts. (UNITED STATES OF AMERICA)	We thank the reviewer for their comment and have rewritten these sentences and have removed the potential misunderstanding.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
430	77966	30	16	40	16	40	delete "acidified and" (James Christian, Government of Canada)	Have deleted text.
431	75944	30	16	40	16	41	"tencency for.... into the shells" makes it sound as though calcification is a chemically spontaneous process, which it is not. Organisms exert different levels of biological control over the process. It is suggested that this passage be rewritten to encompass the notion that it might be harder for organisms to preciptate the minerals. (UNITED STATES OF AMERICA)	Have modified text to include this subtlety. The paragraph now reads "Ocean, resulting in decreased ocean pH as well as carbonate ion concentrations, and increased bicarbonate ion concentrations (Box CC-OA). Factors such as atmosphere-ocean temperature and circulation, and land-sea interactions (WGI 6.4) play significant roles in determining the saturation state of seawater for polymorphs (different crystal forms) of calcium carbonate. Consequently, pH and the solubility of aragonite and calcite are naturally lower at high latitudes and in upwelling areas (e.g., eastern Pacific upwelling, Californian Current), the organisms and ecosystems of which may be relatively more vulnerable to ocean acidification as a result ([Feely et al., 2012; Gruber et al., 2012]; Figure 30.7a, b). Aragonite and calcite concentrations vary with depth, with under-saturation occurring at deeper depths in the Atlantic (calcite: 3500–4500 m, aragonite: 400–3000 m) as opposed to the Pacific and Indian Oceans (calcite: 100–3000 m, aragonite: 100–1200 m; [Feely et al., 2009; Feely et al., 2004; Orr et al., 2005]; Figure S30-2)."
432	79706	30	16	41	16	41	Calcite doesn't just "precipitate into shells" - see chapter 6, the deposition of calcium carbonate in shells requires complex physiological processes (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	See above
433	58491	30	16	42	16	42	….or depth INCREASES. Solubility of CaCO3 decreases with depth till no deposition below the Calcite Compensation Depth (as stated later) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Agreed, see above
434	75945	30	16	43	16	45	"Other factors.... Upwelling areas" seems contradictory to the preceding sentence. (UNITED STATES OF AMERICA)	Have modified text to reduce this confusion.
435	75946	30	16	47	16	47	Suggest the authors cite Feely et al 2008; Gruber et al 2012; Hauri et al; 2013 (UNITED STATES OF AMERICA)	We thank the reviewer for the comment and have now quoted Feely et al 2012.
436	75947	30	16	47	16	49	This statement should be revised. The averages given here do not properly indicate the large north-south and east-west gradients in saturation states in the North and South Pacific. (UNITED STATES OF AMERICA)	We have corrected these entries and included values from Feely et al 2004, 2009 and others.
437	77964	30	16	48	16	48	The ASH is much shallower than this in much of the Pacific. (James Christian, Government of Canada)	See previous response
438	75948	30	16	49	16	49	Change to read "saturation horizon between 200 m and 2500 m in the Pacifc... (Orr et al., 2005; Feely et al., 2012). (UNITED STATES OF AMERICA)	See previous response
439	75949	30	16	49	16	49	See also The Oceanic Sink for Anthropogenic CO2, Christopher L. Sabine, Richard A. Feely, Nicolas Gruber, Robert M. Key, Kitack Lee, John L. Bullister, Rik Wanninkhof, C. S. Wong, Douglas W. R. Wallace, Bronte Tilbrook, Frank J. Millero, Tsung-Hung Peng, Alexander Kozyr, Tsueno Ono, and Aida F. Rios; Science 16 July 2004: 305 (5682), 367-371. [DOI:10.1126/science.1097403] (UNITED STATES OF AMERICA)	We have made reference to the work of Sabine and others through working group 1 and esleweher.
440	58492	30	16	51	16	51	Surface Ocean pH has declined by 0.122 unit for mean Ocean seawater (+32.4% more proton H+ concentration) since… (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We use an approximate number
441	75950	30	16	52	16	53	Why use "Very High Confidence" here when WG1 Ch3 uses "very likely"? Please be consistent. (UNITED STATES OF AMERICA)	We have modified the text so we are consistent with WG1 CH3.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
442	77967	30	16	52	16	53	"significant shoaling of the saturation horizons of both polymorphs of calcium carbonate". Orr et al show data only for aragonite and do not demonstrate that the preindustrial-present difference is significant. (James Christian, Government of Canada)	We have added reference to the Feely et al 2012 who demonostrates from data and writes: CO2 increase"has caused an upward migration of the aragonite and calcite saturation horizons toward the ocean surface on the order of 1–2 m yr 1." Shoaling is also a straight out physical/chemical consequence of the penetration of CO2 into the oceans, which has been observed. We have made reference to working group 1 who concluded that: It is virtually certain that the increased storage of carbon by the ocean will increase acidification in the future, continuing the observed trends of the past decades. Ocean acidification in the surface ocean will follow atmospheric CO2 while it will also increase in the deep ocean as CO2 continues to penetrate the abyss. The CMIP5 models consistently project worldwide increased ocean acidification to 2100 under all RCPs. The corresponding decrease in surface ocean pH by the end of the 21st century is 0.065 (0.06–0.07) for RCP2.6, 0.145 (0.14–0.15) for RCP4.5, 0.203 (0.20–0.21) for RCP6.0, and 0.31 (0.30–0.32) for RCP8.5 (CMIP5 model spread). Surface waters become seasonally corrosive to aragonite in parts of the Arctic and in some coastal upwelling systems within a decade, and in parts of the Southern Ocean within 1 to 3 decades in most scenarios. Aragonite undersaturation becomes widespread in these regions at atmospheric CO2 levels of 500–600 ppm. [6.4.4, Figures 6.28 and 6.29]
443	58493	30	16	54	16	54	...-0.0015 to -0.0024 (Martin Pecheux, Institut des Foraminifères Symbiotiques)	We are using the consensus developed in WG1 3.8.2, figure 3.17.
444	75951	30	16	54	16	54	Change to read -0.0014 and -0.0024 pH units per year; WG1 3.8.2, Table 3.2). (UNITED STATES OF AMERICA)	We have made the change.
445	75952	30	17	1	17	1	Change to read (WG1 3.8.2, Figure 3.18) (UNITED STATES OF AMERICA)	We have reduced the number of graphics and hence the numbering has been revised.
446	84191	30	17	1	17	3	The syntax of this statement is ambiguous, in that it seems the latter part of the sentence ("at least 10 times faster than accumulation of atmospheric CO2 during the PETM") is referring to recent increases in atmospheric CO2 rather than to "these changes," which presumably are decline in ocean pH and saturation state. (Katharine Mach, IPCC WGII TSU)	Has been revised - now reads: "The impacts of ocean acidification on marine organisms and ecosystems has emerged as a major concern especially given that the current rate (at least 10-100 faster than the recent series of ice age transition, {Hoegh-Guldberg, 2007 #368} of ocean acidification is unprecedented within the last 65 Ma (high confidence, {Ridgwell, 2010 #815} or even 300 Ma of Earth history (medium confidence, {Hönisch, 2012 #830}(Figure 30-9 A-F; 6.1.2)." UPDATE: have checked this paragraph with the Paleo group - Dani Schmidt.
447	58494	30	17	2	17	2	at least 10-100 faster (CO2 rise happened in 10-20 000 years) (Martin Pecheux, Institut des Foraminifères Symbiotiques)	Have clarified text - see previous statement
448	75953	30	17	5	17	6	"current chemistry of the ocean is outside where it has been for million years" is too vague a statement. Level of agreement with this statement has not been summarized. Please provide detail to clarify. (UNITED STATES OF AMERICA)	Have clarified text - see previous statement
449	57599	30	17	6	17	6	should the word "many" (or something equivalent) be the first word in this line; something seems needed before "millions". (George Somero , Stanford University)	Have clarified text - see previous statement

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
450	63084	30	17	6	17	6	millions' in plural and, in addition to Pelejero et al., 2012 and Zeebe et al., 2012, you can also add Hönisch et al., 2012 as a reference (Hönisch, B., Ridgwell, A., Schmidt, D.N., Thomas, E., Gibbs, S.J., Sluijs, A., Zeebe, R., Kump, L., Martindale, R.C., Greene, S.E., Kiessling, W., Ries, J., Zachos, J.C., Royer, D.L., Barker, S., Marchitto Jr., T.M., Moyer, R., Pelejero, C., Ziveri, P., Foster, G.L., Williams, B., 2012. The geological record of ocean acidification. Science 335, 1058-1063.) (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	Have clarified text - see previous statement
451	75954	30	17	6	17	6	After "years", add "and many organisms demonstrate negative responses to ocean acidification" to show the total motivation for concern. (UNITED STATES OF AMERICA)	Have added text.
452	75955	30	17	6	17	8	This statement should be qualified with a confidence or likelihood statement (UNITED STATES OF AMERICA)	Sentence has been replaced by statement consistent with Ch6. See above
453	80735	30	17	6	17	8	The citations of Hogh-Guldberg and Raven are certainly not the best ones. Consider: Caldeira K. & Wickett M. E., 2003. Anthropogenic carbon and ocean pH. Nature 425:365. Zeebe R. E. & Ridgwell A., 2011. Past changes of ocean carbonate chemistry. In: Gattuso J.-P. & Hansson L. (Eds.), Ocean acidification, pp. 21-40. Oxford: Oxford University Press. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have Added Caldeira and Wickett 2003 and have left Hoegh-Guldberg et al 2007 given that the latter calculates rates of change using Vostok ice core data and makes this point specifically in 'Table 1' of the same paper.
454	58495	30	17	8	17	8	possibly 300 million years outside the asteroidal Cretaceous/Tertiary event. (Martin Pecheux, Institut des Foraminifères Symbiotiques)	This text with text that is consistent with chapter 6, see above.
455	79707	30	17	14	17	18	This contradicts chapter 6 where confidence in biological responses is judged as being low, because of huge variability in responses among species and strains of similar organisms. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have discussed as with chapter 6. The fact that there is variability between organisms does not mean there are very consistent responses by organisms such as corals and pteropods, for example. We have modified the text to indicate that there is a variability between different organisms but some very consistent responses for particular organisms.
456	58613	30	17	14	17	20	Munday et al (2008) Climate change and the future for coral reef fishes. Fish & Fisheries 9, 261-285 is a useful review. (Janice Lough, Australian Institute of Marine Science)	These issues are discussed extensively in chapter 6 - hence the reference. Chapter 6 does a good job of summarising this important area - as per its mandate of assessing climate change with respect to marine systems.
457	80736	30	17	15	0	0	Is it justified to cite two papers from one of the CLAs to support this statement? Many others could be cited, among which: Manzello D. P., Kleypas J. A., Budd D. A., Eakin C. M., Glynn P. W. & Langdon C., 2008. Poorly cemented coral reefs of the eastern tropical Pacific: possible insights into reef development in a high-CO2 world. Proceedings of the National Academy of Science U.S.A. 105:10450-10455. Andersson A. J. & Gledhill D., 2013. Ocean acidification and coral reefs: effects on breakdown, dissolution, and net ecosystem calcification. Annual Review of Marine Science 5:321-348. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have added the references that point out that Manzello is not an experimental study and is therefore subject to a lot of speculation. The paper's review. I think taken together, however, with the experimental studies, that there is robust support for this idea. hence, have added Manzello et al 2008 to the discussion here.
458	69849	30	17	19	17	20	Please consider replacing the wording 'there are a growing …processes that' by 'a growing number of organisms and processes'. (NETHERLANDS)	We have adopted the suggested change.
459	75956	30	17	22	17	25	Specify in the surface ocean, the deep ocean will experience much smaller changes. (UNITED STATES OF AMERICA)	We have adopted the suggested change. See text.
460	61690	30	17	22	17	31	This might be also an issue with WG1, but it would be good to include more results from the CMIP5 ESMs. E.g. Bopp et al, 2013, BGD (doi:10.5194/bgd-10-3627-2013) have looked at future ocean acidification and deoxygenation in the CMIP5 models. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree and have modified the text accordingly. We have added Figures 30.9 and 30.10 (which are reprinted from chapter 6. These figures include modelling from the CMIP5 series of climate models.
461	80738	30	17	22	17	31	The following, more recent, paper of the same author would provide better estimates. Orr J. C., 2011. Recent and future changes in ocean carbonate chemistry. In: Gattuso J.-P. & Hansson L. (Eds.), Ocean acidification, pp. 41-66. Oxford: Oxford University Press. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	To maintain consistency and to reduce the number of references, we are explicitly referring to working group 1 and chapter 3 in chapter 6. See new figures.
462	80737	30	17	23	0	0	Doubling with respect to which value/year? (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have modified the text to be more specific.
463	84192	30	17	23	17	23	The baseline for "doubling CO2" could be clarified--compared to preindustrial? (Katharine Mach, IPCC WGII TSU)	See above.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
464	58496	30	17	23	17	24	Doubling CO2 to 540 ppm will decrease pH by another 0.12 unit (+73% proton H+ concentration). (Martin Pecheux, Institut des Foraminifères Symbiotiques)	See above.
465	75957	30	17	24	17	24	Units on 100 mmol kg-1 are wrong. These units should be µmol kg-1. (UNITED STATES OF AMERICA)	We have corrected this typographical error here and in other places. Sentence is no longer included - was removed in response to other reviewers comments.
466	77968	30	17	24	17	24	mmol/kg (two times) (James Christian, Government of Canada)	We have corrected this typographical error here and in other places. Sentence is no longer included - was removed in response to other reviewers comments.
467	75958	30	17	25	17	26	This sentence is confusing. The trends in the saturation state migration vary significantly in both the north-south and east-west directions (see Feely et al., 2012). (UNITED STATES OF AMERICA)	We have modified the text to capture this point. And use the Feely et al 2012 reference.
468	75959	30	17	27	17	27	See also The Oceanic Sink for Anthropogenic CO2, Christopher L. Sabine, Richard A. Feely, Nicolas Gruber, Robert M. Key, Kitack Lee, John L. Bullister, Rik Wanninkhof, C. S. Wong, Douglas W. R. Wallace, Bronte Tilbrook, Frank J. Millero, Tsung-Hung Peng, Alexander Kozyr, Tsueno Ono, and Aida F. Rios; Science 16 July 2004: 305 (5682), 367-371. [DOI:10.1126/science.1097403] (UNITED STATES OF AMERICA)	Have now added this reference
469	77969	30	17	28	17	28	more rapid onset of undersaturation in high latitudes is partially, but not entirely, due to temperature (James Christian, Government of Canada)	We have modified the text to ensure that this point comes across.
470	75960	30	17	28	17	29	The trends in aragonite undersaturation are different within each polar region (see Steinacher et al., 2009). If polar saturation states are discussed in the chapter, then the authors should consider adding some detail to clarify. (UNITED STATES OF AMERICA)	We have modified the text to capture this point - However, chapter 28 is specifically dealing with polar oceans.
471	63088	30	17	29	17	31	Maybe this 'likely' in the phrase should be relaxed a bit in view of the recent experimental findings regarding experiments with cold water corals such as the work by Maier et al., 2013 (Maier, C., Schubert, A., Berzunza Sànchez, M.M., Weinbauer, M.G., Watremez, P., Gattuso, J.-P., 2013. End of the century pCO2 levels do not impact calcification in Mediterranean cold-water corals. PLoS ONE 8, e62655.) (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have modified the text and have downgraded the likelihood statement accordingly. We have also added Maier et al 2013 and incldued references to dissolution and loss of deep water habitat. Sentence now reads: 'While initial investigations suggested that ocean acidification (reduced by 0.15 and 0.30 pH units) would result in a reduction in the calcification rate of deep water corals (30% and 6%, respectively [Maier et al., 2009]), there is accumulating evidence that ocean acidification may have far less impact on the calcification of deep water corals but may reduce important habitats given that dead unprotected coral mounds are likely to dissolve in under-saturated waters. [Form and Riebesell, 2012; Maier et al., 2013; Thresher et al., 2011].'
472	75961	30	17	29	17	31	However other studies found deep water corals robust to OA (see citations in Chapter 6). (UNITED STATES OF AMERICA)	See above
473	75962	30	17	30	17	30	"very likely" seems to be an overstatement... that assumes 90-100% confidence? We don't know how strongly deep water communities depend on corals vs. other substrates for habitat. (UNITED STATES OF AMERICA)	See above
474	75963	30	17	34	17	38	The Arctic Ocean is completely missing in these plots yet the text includes some discussion of Arctic Ocean saturation states. While this may be addressed in the Polar Chapter, it would be valuable to include here (or at least reference the pertinent sections) for context. Suggest using the plots from Feely et al. (2009). The chapter text briefly discusses Arctic, but by excluding the polar regions from figures (Fig. 30-7), there is an inconsistency in the chapter. (UNITED STATES OF AMERICA)	Chapter 30 does not deal specifically with polar oceans - we have taken this point on board and have made some reference to the polar oceans, albeit brief. Chapter 28 is charged with the responsibility of assessing the published literature on the Arctic and Antarctic oceans.
475	75964	30	17	41	17	41	Note, unless the water parcel is at the surface, changes in solubility cannot change the concentration of a gas in water. (UNITED STATES OF AMERICA)	Noted - We have ensured that we haven't violated this observation/principle.
476	75965	30	17	41	18	48	Section 30.3.2.3 is poorly/illogically organized. Reorganization is needed. (UNITED STATES OF AMERICA)	We have significantly re-organised the text so that it is clearer.
477	61691	30	17	46	17	47	Long term records of oxygen are also available for the North Pacific (Whitney et al. [2007] and Ono et al [2001]) and show long term secular decreases in oxygen. Suggest to include these results here. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have added Whitney et al 2007.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
478	65296	30	17	46	17	47	The authors mentioned "Long-term records of oxygen concentration in ocean waters are rare". But after that the authors showed oxygen data since 1960 as an example of long data. However, there are many data as long as such data. For example, Aoyama et al. (2008) Marine biogeochemical response to a rapid warming in the main stream of the Kuroshio in the western North Pacific. Fisheries Oceanography, 17, 206-218. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	The fact that there are long-term records is reflected in the document now (and the sentence: "long-term records of oxygen concentrations in ocean waters are rare" has been removed.
479	84193	30	17	47	17	47	"high agreement" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	We have done so.
480	61692	30	17	49	17	54	Work has been done by Andrews et al. [2013], BG [doi:10.5194/bg-10-1799-2013] demonstrating that an external influence on recent changes in oceanic oxygen is detectable using an optimal fingerprinting method. This should be included as further support for a climate-driven component to historical changes in oceanic oxygen. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have added text and these references.
481	75966	30	17	52	17	53	"phenomenon....change." seems to contradict the statement in line 48. (UNITED STATES OF AMERICA)	The point we are making is that the observed decline has two mechanistic components.
482	84194	30	18	4	18	4	It could be helpful to indicate more precisely what waters are defined as "deep." (Katharine Mach, IPCC WGII TSU)	We have defined deep in the previous section on OA and saturation horizons.
483	85112	30	18	4	18	4	Usually, likelihood assignments are associated with high confidence, which is not the case here--the logic here needs further explanation. This may be a situation where a confidence statement is more appropriate. (Michael Mastrandrea, IPCC WGII TSU)	We have corrected this and are now going with 'high agreement' given that we are referring to the similarity of outcomes among modelling studies.
484	75967	30	18	4	18	7	Confidence statements in this sentence seem contradictory (limited evidence, medium agreement -> high confidence?) (UNITED STATES OF AMERICA)	See above
485	75968	30	18	6	18	9	This idea is repeated many times elsewhere. Shorten or cut. (UNITED STATES OF AMERICA)	We have cut this discussion as recommended.
486	77971	30	18	12	18	14	I agree that the subarctic Pacific is a region where the physical forcings of deoxygenation are beginning to be understood, but I wouldn't assume that Nakanowatari et al's hypothesized mechanisms are the final word on this. (James Christian, Government of Canada)	We agree and have removed this inference.
487	75969	30	18	16	18	41	There is no agreement between units for O2. Should be micromoles per kg. (UNITED STATES OF AMERICA)	We are using umol kg-1.
488	69850	30	18	17	18	17	Are "Black and Baltic Seas" an example of SES or are these the SES in which the development of hypoxic conditions is observed? (NETHERLANDS)	We have removed confusion. Now reads: "… wide array of ocean sub-regions including some SES (e.g. Black and Baltic Seas), …"
489	75970	30	18	23	18	23	pO2 should have pressure units and cannot be converted to concentration unless temperature is known. (UNITED STATES OF AMERICA)	We have converted pO2 to concentration of O2.
490	77970	30	18	23	18	23	mg/L should be ml/L? (James Christian, Government of Canada)	See above - the correct units are mg/L
491	84195	30	18	27	18	27	It would be helpful to indicate more precisely what is meant by "threatened." (Katharine Mach, IPCC WGII TSU)	have added "by respiratory stress".
492	75971	30	18	30	18	32	"The calculation... and/or temperature" makes no sense and seems out of place. (UNITED STATES OF AMERICA)	Agreed - we have removed this term and have re-written the sentence.
493	84196	30	18	32	18	32	Casual usage of "likely" should be avoided as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have done so,
494	75972	30	18	37	18	38	This sentence is repetitive. (UNITED STATES OF AMERICA)	Agreed - has been re-written.
495	75973	30	18	47	18	48	Why is the Gulf of Mexico not shown in this figure? Seems like a large omission. (UNITED STATES OF AMERICA)	The hpoxia in the Gulf of Mexico falls below the resolution of Figure 3-10. It is discussed extensively in later sections however. UPDATE: figure has now changed and includes much greater amounts of information and is 100% consistent with the consensus from working group 1.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
496	65297	30	18	51	0	0	It seem strange that the 30.4 only explains the result of Poloczanska et al. 2013. That is very good paper but the fact the whole section was occupied by one literature seems strange. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We have substantially broadened section 30.4. Section 30.4 now presents to the process-understanding provided in Chp 6 and a number of meta-analyses to date for marine systems. Poloczanska et al represents the major part of our analysis of the literature in terms of the detection and attribution of climate change on organisms and communities, as such this has now been summarised in a Box. This meta-analysis of 208 studies from every ocean was undertaken in parallel to the IPCC AR5 process and is a rigorous and effective and most up-to-date way of way of undertaking this analysis. UPDATE: We have developed a cross chapter box with information from Poloczanska et al 2013 and other sources - in order that this information is available the chapter 6 and other relevant marine chapters. Several of the comments that follow from reviewers relate to when this information was still part of the text in chapter 30.
497	75974	30	18	51	18	52	It is unlcear as to why ocean acidification is specifically called out in this section as opposed to other responses by marine organisms to climate change (changing megafauna migration pattersn due to warming/shifting ocean physics, shifts in timing of spawning, etc.) (UNITED STATES OF AMERICA)	Our heading for this section refers to "climate change and ocean acidification" as we distinguish between these processes, even though they share the same primary cause (increase atmospheric carbon dioxide), not because we are specifically calling out ocean acidification. Ocean acidification is a major risk for the oceans and is addressed in cross-chapter boxes in WGI and WGII.
498	80740	30	19	1	0	0	This section heavily relies on a paper submitted (Poloczanka et al.), not published in 2013 as indicated in the citations. This section cannot be properly evaluated as the manuscript is not available to reviewers of this chapter. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	The paper is now published in Nature Climate Change. Its content and structure is essentially what has been presented in SOD for chapter 30.
499	75975	30	19	16	19	16	"consistent with climate change" - What does this mean? What the expected response is? Who determines what is expected? Is this an objective determination? NOTE - this comment also applies to lines 25 and 32. (UNITED STATES OF AMERICA)	We have modified section 30.4 to provide process understanding and evidence of recent climate change impacts (see response to comment 496). Detail of the study is now given in a cross-section box (Observed global responses of marine biogeography, abundance and phenology to climate change (including ocean acidification)). We have clarified consistency and expected response "in a direction that was consistent with theoretical responses to climate change"

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
500	75976	30	19	16	19	16	Is there a way to connect the blue-red-yellow system with IPCC confidence scheme? (UNITED STATES OF AMERICA)	At one level, we could consider an inconsistent direction would be equivalent to a "very unlikely" category - whereas an outcome which is equivocal would be equivalent to about "as likely as not". In the case where organisms are showing consistent behaviour with the expected trends and climate change, you might proposed that this is equivalent to "very likely" or "virtually certain". However, confidence in individual studies is highly variable depending on data set characteristics, hypothesis development and testing, and statistical analysis so even a study that shows a consistent responses may have a low confidence level assigned. The outcome of the meta-analysis provides a assessment across studies which is relevant to the IPCC confidence scale.
501	57324	30	19	21	19	21	Should be the "North-west Atlantic (Poloczanska et al. 2013)" (Erica Head, Fisheries and Oceans Canada)	This figure panel was removed when we shortened the chapter so comment is no longer relevant
502	77972	30	19	37	19	37	"The overall mean rate of re-distribution" I would specify latitudinal redistribution. This new topic sort of comes out of the blue and could use an introductory sentence or two. (James Christian, Government of Canada)	This discussion has now moved to a cross-chapter box. We have modified to provide a lead-up to this topic "The distribution of benthic, pelagic and demersal species and communities have shifted their distributions by 10s to 100s of km, although the range shifts have not been uniform across taxa or ocean regions"
503	79708	30	19	37	19	44	Needs to cross reference to chapter 6 where there is a similar description of range shifts, although using different datasets/analyses (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have moved the discussion on range shifts from this section to a cross-chapter box, we produced in collaboration with Chp 6. Chp 6 has also been modified to align with the new structure
504	75977	30	19	41	19	44	State what the positive/negative value for spring timing means (later/earlier). (UNITED STATES OF AMERICA)	We have moved this discussion to a cross-chapter box. We have modified the text to clarify spring events are becoming earlier "spring events have shifted earlier for many species over the last decades with an average advancement "
505	77973	30	19	43	19	44	data or literature reference needed here (James Christian, Government of Canada)	We have moved this discussion to a cross-chapter box. This sentance has been deleted
506	75978	30	19	49	19	49	extra text 'O (brown)' in figure caption. (UNITED STATES OF AMERICA)	We have moved this figure to a cross-chapter box. The legend has been corrected
507	75979	30	19	53	19	53	There are no asterisks in the figure but the figure caption implies they should be in the figure. (UNITED STATES OF AMERICA)	We have moved this figure to a cross-chapter box. The legend has been corrected
508	75980	30	20	3	20	3	Direction is needed to go with 'velocity', which is speed + direction. NOTE this comment also applies to line 8. (UNITED STATES OF AMERICA)	We have moved this discussion to a cross-chapter box and modified text to include direction
509	84197	30	20	3	20	3	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have moved this discussion to a cross-chapter box. This sentance has been deleted
510	75981	30	20	12	20	12	"diagnostic fingerprints" = ? It is unclear as to what these are. Explanation is needed. (UNITED STATES OF AMERICA)	We have moved this discussion to a cross-chapter box. This sentance has been deleted
511	75982	30	20	12	20	12	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We have added a confidence level (High)
512	64626	30	20	21	0	0	30.5. Authors should consider refering to other regional chapters of WG2 (ch 22-29) where ocean issues have been dealt with. (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	We have modified section 30.5 to create the linkages with other regional chapters

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
513	84198	30	20	31	0	0	Section 30.5.1. This section should be reduced in length as much as possible. (Katharine Mach, IPCC WGII TSU)	We have shortened our entire chapter, and saved much space by shortening section 30.3 physical and chemical changes. The regional assessment in 30.5.1 is central to this chapter so we have kept as much length as possible
514	75983	30	20	32	0	0	35 degrees seems mid-latitude, definition of the regions might be strengthened throughout. (UNITED STATES OF AMERICA)	We agree that 35 degrees is mid latitude but much of the area of this "High-Latitude Spring Bloom" regions are at higher latitudes. As we discuss in 30.1.1 our regions are defined by unifying physical forcing and ecosystem structure and may not map perfectly over specific geographies.
515	64647	30	20	44	23	20	strong overlap with ch6. Box 6-1 The Atlantic Example: Long-Term Responses of Pelagic Organisms and Communities to Temperature. Needs balancing in order to avoid redundancies in the two chapters (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	We agree that there is a strong overlap but the northeast Atlantic is an area with a rich and long history of research and warrants examination in both chapters. We have worked with Chp 6 to identify cross-linkages and eliminate redundancies UPDATE: we have developed a number of cross chapter boxes with chapter 6 and hence have reduced overlap and improved consistency between chapter 6 and chapter 30 (and other marine chapters).
516	75984	30	20	47	20	47	Should be "North American" not "American." (UNITED STATES OF AMERICA)	We have modified the text to refer to 'North American' as opposed to 'American'.
517	66212	30	20	53	0	0	Considering the warming of the North Atlantic HLSBS: It should be stated explisity that this statement applies for the surface. Most of the North Atlantic HLSBS is sub-surface, and the temperature increase below surface is substantially weaker. (Randi Ingvaldsen, Institute of Marine Research)	We have modified the sentance to read "North Atlantic HLSBS surface waters show "
518	69851	30	20	54	21	1	It is stated that from 1970 Atlantic Ocean is the basin which warmed more (0.3 referencing to table 30-2). However, checking the table the North Pacific warmed 0.38 0/decade. It seems that the table is based in data dating from 1955. Which might explain but gets pretty confusing. (NETHERLANDS)	We have added the warming rate from 1950 to reduce confusion
519	75985	30	21	4	21	5	This statement would be strengthened by a confidence estimate. (UNITED STATES OF AMERICA)	We may modified the sentance after referring to working group 1
520	65724	30	21	12	21	12	Insert Genner at al., 2004, 2010 Genner MJ, Sims DW, Wearmouth VJ, Southall EJ, Southward AJ, Henderson PA, Hawkins SJ. 2004. Regional climatic warming drives long-term community changes of British marine fish. Proceedings of the Royal Society of London, Biological Sciences 271: 655-661. Genner MJ, Sims DW, Southward AJ, Budd GC, Masterson P, Mchugh M, Rendle P, Southall EJ, Wearmouth VJ, Hawkins SJ. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Global Change Biology 16: 517-527. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	We thank the reviewer for the suggestions, we have added Genner et al 2010 as this considered both climate and fishing, but not the earlier study Genner et al 2004 as this dataset is used in Genner et al 2010
521	75986	30	21	19	21	40	This passage seems unduly detailed. It is recommended that the passage be condensed. (UNITED STATES OF AMERICA)	We have split this paragraph in 2, as it covers observations and predictions. We have reduced the section discussing changes in the Barents Sea and referenced Chp 28 (polar chapter)
522	84199	30	21	27	21	27	The timeframe of the "recent warming period" should be specified. During the 1980s? (Katharine Mach, IPCC WGII TSU)	We have rewritten this section to be clear which time-frame we are referring to.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
523	66213	30	21	27	21	28	Considering the feeding distribution of blue whiting, it is worth mentioning that the stock increased during the same period. When the stock size decreased the whiting disappeared from the Barents Sea, despite high temperatures in the resent years. (Randi Ingvaldsen, Institute of Marine Research)	Toresen and Østvedt (2000) showed the relationship between multidecadal climate variability and spawning-stock biomass of Norwegian spring-spawning herring. During the recent warming from the early 1980s we have also data on Atlantic mackerel and blue whiting. These three major pelagic species in the Nordic Seas (i.e. Atlantic mackerel, blue whiting, and Norwegian spring-spawning herring) have increased substantially in abundance during this recent warming period. However, since they largely feed on the same zooplankton species we see shorter-term opposite oscillations , particularly between blue whiting and herring. As they oscillate in abundance they also oscillate in northward distribution: Larger stocks imply more northerly and westerly di+I556stributions towards arctic waters. Blue whiting dropped in abundance during the early 2000, but is now on the way up again. The herring peaked in 2009. Mackerel has increased substantially, and was this summer found not only north in the Barents Sea but even westwards in the arctic East Greenland waters! So, it is correct that the blue whiting has been absent from the Barents Sea since the early 2000, because of transient decrease in stock size, but this is shorter-term oscillations. But for the general trend of the multidecadal change large stocks = northerly distributions. This is also valid for the gadoid fishes (Drinkwater 2006; Sundby and Nakken 2008). We have modifed the text to say the expansion occured during the warm period
524	79709	30	21	28	21	28	Blue whiting (Micromesistius poutassou) is a different species to whiting (Merlangus merlagius) so the authors need to be careful here. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have ensured that all references to M poutassou are as blue whiting not whiting.
525	66214	30	21	30	21	34	It is stated that the zooplankton production in the Barents Sea will increase by 20% by 2100. This applies only for the Atlantic zooplankton production and should be stated. In addition the following result coming from the same publication should be included: "At the same time, Arctic zooplankton is projected to decrease significantly (50%) causing the total Barents Sea production to decrese (Ellingsen et al., 2008)." (Randi Ingvaldsen, Institute of Marine Research)	We agree with the reviewer, however our chapter does not cover the Arctic part of the Barents Sea, this is covered in Chp 28 Polar Regions. We have added text to show a decrease in Arctic zooplankton.
526	79710	30	21	31	21	31	"Virtually certainly going to" is inconsistent terminology (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The terminology is correct here as this is from model output. We have however, downgraded the likelihood to Likely as based on one model and one scenario
527	84200	30	21	31	21	33	For the projection given, it would be preferable to specify the relevant scenario of climate change and baseline for the percentage increase provided. (Katharine Mach, IPCC WGII TSU)	We have added the scenario (SRES -B2)

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
528	61693	30	21	34	21	35	This statement from Cheung et al. [2011] (projecting increases in fish biomass and catch in the N. E. Atlantic) is high impact and 'very likely'. As such, I suggest this point by including it in the Executive Summary (Page 5, Line 5). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have added a statement to the executive summary which now reads: "Changes to ocean temperature, chemistry and other factors are generating new challenges for fisheries as well as benefits (high agreement). Climate change is a risk to the sustainability of capture fisheries and aquaculture development, adding to the threats of over-fishing and other non-climate stressors. In EUS, shifts in the distribution and abundance of pelagic top predator fish stocks will have the potential to create 'winners' and 'losers' among island economies. As a result of 30 years of increase in temperature there has been a boost in fish stocks of high-latitude fisheries in the HLSBS of the North Pacific and North Atlantic which is very likely to continue although some fish stocks will decline. A number of practical adaptation options and supporting international policies can minimize the risks and maximize the opportunities. [30.6.2.1, 7.4.2] "
529	66215	30	21	34	21	37	It is stated that substantial increases in fish biomass and catch is very likely, and in the next sentence it is stated that discountinous changes in life cycles conditions of fish like capelin is very likely. If it is VERY LIKELY with discontinous changes for important species, how can it be VERY LIKELY with substantial increases in biomass and catch of the species depending on them? A very likely substantial increase in biomass and catch is also not entirely consistent with the statement on p.50, line 33 stating that the abundance of fish (mostly boreal species) MAY INCREASE. (Randi Ingvaldsen, Institute of Marine Research)	We have altered the likelihood of fish catch biomass increass to a confidence statement .....recognising that the modelling studies are based on a limited scenario group
530	84201	30	22	1	22	2	"high confidence" could be placed within parentheses at the end of the statement to maximize clarity and directness of wording. Additionally, it would be preferable to specify the general time frame for the observation. (Katharine Mach, IPCC WGII TSU)	We have done so.
531	57325	30	22	1	22	4	Replace "in the North Sea is" with in the North Sea are". Replace "Phenological responses of zooplankton were" with "Phenological responses of zooplankton have been" (Erica Head, Fisheries and Oceans Canada)	Agreed - text has been modified accordingly.
532	57326	30	22	5	22	5	Replace "it's" with "its" (Erica Head, Fisheries and Oceans Canada)	Agreed - text has been modified accordingly.
533	65725	30	22	5	22	5	replace "it's" with "its" (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	Agreed - text has been modified accordingly.
534	77974	30	22	6	22	8	does not state whether change in meroplankton phenology has actually been observed (James Christian, Government of Canada)	We deleted this sentence as discussion of energy flow through foodwebs is covered in chp 6, and we now refer the reader to box Chp 6 6-1 in this paragraph
535	65726	30	22	29	22	29	Insert Genner at el., 2004, 2010 Genner MJ, Sims DW, Wearmouth VJ, Southall EJ, Southward AJ, Henderson PA, Hawkins SJ. 2004. Regional climatic warming drives long-term community changes of British marine fish. Proceedings of the Royal Society of London, Biological Sciences 271: 655-661. Genner MJ, Sims DW, Southward AJ, Budd GC, Masterson P, Mchugh M, Rendle P, Southall EJ, Wearmouth VJ, Hawkins SJ. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Global Change Biology 16: 517-527. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	We have added just Genner et al 2010 as this uses the same dataset as Genner et al 2004. Please note this sentance has now been moved earlier in this section
536	57327	30	22	34	22	34	Insert "northward" thus "has been contracting northward at a rate of" (Erica Head, Fisheries and Oceans Canada)	Agreed - text has been modified accordingly.
537	65727	30	22	42	22	43	Line 43 Genner et al., 2010 separated out fishing impacts from climate Genner MJ, Sims DW, Southward AJ, Budd GC, Masterson P, Mchugh M, Rendle P, Southall EJ, Wearmouth VJ, Hawkins SJ. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Global Change Biology 16: 517-527. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	The dataset used by Genner et al is described in Southward et al 2005 so we haven't added the Genner et al here
538	57328	30	22	44	22	44	Replace "this region" with "the North-east Atlantic" (Erica Head, Fisheries and Oceans Canada)	Agreed - text has been modified accordingly.
539	84202	30	22	45	22	48	How is "long" defined here for the "long-term data sets," and over what time frame where they collected? (Katharine Mach, IPCC WGII TSU)	Timeframe has been added

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
540	64257	30	22	50	22	50	"ICES Working Groups". Here the "ICES" abbreviation should be explained, i.e. "International Council for the Exploration of the Sea" (ICELAND)	Agreed - text has been modified accordingly.
541	61694	30	23	1	23	20	This long term perspective is very interesting and relevant, however I think it needs to be revised to make the key message of competing natural and anthropogenic forcings more clear. Also some phrasing changes: " […] an almost similar large-scaled temperature increases […]". (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed - text has been modified accordingly.
542	65729	30	23	1	23	20	General comment – There was much discussion by Cushing, Dickson, Colebrook, Russell, Southward about climate fluctuations in the 1970s and 1980s. This is often forgotten by the younger authors. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	Thank you for calling us young. Yes certainly there is much ground-breaking research by these authors. However, we have selected more recent publications that integrate this valuable research.
543	75987	30	23	1	23	20	This paragraph seems to need to be split up and interspersed elsewhere, with repetitive bits taken out. (UNITED STATES OF AMERICA)	Agreed - text has been modified accordingly.
544	79711	30	23	4	23	5	Another long-term study that could be cited is Engelhard et al. (2011) – ICES Journal of Marine Science, 68: 1090–1104. This is mentioned in chapter 6. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Yes but this paper does acknowledge a lack of data of the earlier decades
545	65728	30	23	7	23	7	Insert Hawkins et al., 2003 and Southward et al., 2005 Hawkins SJ, Southward AJ, Genner MJ. 2003. Detection of environmental change in a marine ecosystem – evidence from the western English Channel. Science of the Total Environment 310: 245-246. Southward AJ, Langmead O, Hardman-Mountford NJ, Aiken J, Boalch GT, Dando PR, Genner MJ, Joint I, Kendall M, Halliday NC, et al. 2005. Long-term oceanographic and ecological research in the Western English Channel. Advances in Marine Biology 47: 1-105. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	We have replaced Southward et al 1995 with Southward et al 2005 as the latter presents a comprehensive picture for change in the Western English Channel from montioring and datasets, tphysical change to biological change and charts advances in understanding climate variability, and includes the datasets in the 1995 paper. We have therefore selected this study rather the Hawkins et al 2003
546	57329	30	23	7	23	9	Replace "The major lesson etc." with "The most important lesson from these reports is that in the high-latitude North Atlantic there was a large-scale temperature increase between the 1910s and 1940s that was similar to the one of the last 30 years that had similar basin-scale impacts on marine ecosystems." (Erica Head, Fisheries and Oceans Canada)	Agreed-text has been modified.
547	57330	30	23	11	23	12	Replace "has unfortunately discontinued." with "was unfortunately discontinued." (Erica Head, Fisheries and Oceans Canada)	Agreed-text has been modified.
548	65730	30	23	11	23	12	"…long term cooling in the 1960s/1970s" delete "impacts has" and replace with "responses". See Southward 1980 Southward, AJ. 1980. The Western English Channel – an inconstant ecosystem? Nature 258: 361-366. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	Agreed-text has been modified.
549	75988	30	23	11	23	20	A figure supporting this could be helpful. (UNITED STATES OF AMERICA)	Yes, but we have a limited number of figures in our chapter so refer the reader to publications where such a fig can be found
550	84203	30	23	11	23	20	These statements should be deleted, as there are no citations provided and they are overly editorializing. (Katharine Mach, IPCC WGII TSU)	Instead we have rewritten the text and now refer readers to WG1 where the cumulative influence of AMV and climate warming are discussed. This is an important subject
551	75989	30	23	12	23	14	"centennial-long.... over the next..." doesn't seem to make a lot of impact. It makes it sound as though shorter term variability is simply masking the signal. This point is made elsewhere. (UNITED STATES OF AMERICA)	Agreed-text has been modified
552	57331	30	23	20	23	20	Replace "recorded" with "before" (Erica Head, Fisheries and Oceans Canada)	Agreed-text has been modified.
553	75990	30	23	23	23	23	Section 30.5.1.1.2 needs certainty language (UNITED STATES OF AMERICA)	Agreed, we have added certianty language
554	84204	30	23	27	23	27	Presumably "average sea surface temperature" is meant?? (Katharine Mach, IPCC WGII TSU)	Agreed-text has been modified.
555	75991	30	23	30	23	30	The source reference for the NPGO is - Di Lorenzo E., Schneider N., Cobb K. M., Chhak, K, Franks P. J. S., Miller A. J., McWilliams J. C., Bograd S. J., Arango H., Curchister E., Powell T. M. and P. Rivere, 2008: North Pacific Gyre Oscillation links ocean climate and ecosystem change. Geophys. Res. Lett., 35, L08607, doi:10.1029/2007GL032838. (UNITED STATES OF AMERICA)	Thank you, we have added this reference
556	57332	30	23	40	23	40	Replace "are" with "were" (Erica Head, Fisheries and Oceans Canada)	Agreed-text has been modified.
557	75992	30	23	42	23	42	Should state 'these chages indicate how' not 'indicate of how'. (UNITED STATES OF AMERICA)	Agreed-text has been modified.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
558	84205	30	23	44	23	44	It may be preferable to use "regime shifts" here rather than "climate regime shifts" in accord with terminology use elsewhere in the report. (Katharine Mach, IPCC WGII TSU)	We have changed the wording here following discussion with WGI
559	65298	30	23	51	24	2	Section 30.5.1.1.2 does not include the issue of current speed of the gyres. Many of small pelagic fish spawns in the upstream of the Kuroshio and spread out to the offshores and the North Pacific HLSBS. The current speed change is important issue for their recruitment (e.g. Pacific saury: Ito S., H. Sugisaki, A. Tsuda, O. Yamamura and K. Okuda, 2004, Contributions of the VENFISH program: meso-zooplankton, Pacific saury (Cololabis saira) and walleye pollock (Theragra chalcogramma) in the northwestern Pacific, Fish. Oceanogr., 13. Suppl. 1, 1-9). Additionally, Sakamoto et al. (2005) detected enhancement of Kuroshio from the data and predicted futher intensification under global warming. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We have addressed this point. Firstly, we have modified the final sentance to capture the point re dispersal and added the Ito et al ref.
560	61695	30	24	9	24	9	There is more recent work which builds on Gillett et al. [2003] with regard to the detection and attribution of changes in Sea Level Pressure (SLP; as reviewed in WG1 Ch10 Sect. 10.3.3.4). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Thank you, we have added this reference, and referred to WGI Chp 10
561	75993	30	24	27	24	30	The two halves of this sentence don't go together. Suggest that they be split apart or that the sentence be revised. (UNITED STATES OF AMERICA)	agreed, text has been modified.
562	75994	30	24	31	24	31	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Use of probabilities as well as the Detection and attribution language has been checked across the manuscript to ensure consistency and to reduce confusion. We have applied italicised nation appropriately now.
563	84206	30	24	48	24	49	"high confidence" could be placed within parentheses at the end of the statement for clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified
564	84207	30	25	1	25	3	"very high confidence" could be placed within parentheses at the end of the sentence to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified
565	75995	30	25	3	25	3	Consider including mention of the impacts of ocean acidification on pteropods using Bednarsek et al. (2012) as an exanple. (UNITED STATES OF AMERICA)	Agreed, text modified and we have also directed readers to the polar chapter (28)
566	84208	30	25	12	25	12	Is it possible to indicate more precisely what is meant by "even modest warming"--what levels of time change, what time frames? (Katharine Mach, IPCC WGII TSU)	Text has been modified
567	75996	30	25	12	25	14	What is the basis for this statement? A direct connection between this statement and the scientific results reported is unclear. (UNITED STATES OF AMERICA)	Text has been modified - literature sources have been added
568	75997	30	25	12	25	18	This passage is choppy and vague. Please reconsider it. (UNITED STATES OF AMERICA)	Agreed, this has been rewritten
569	65299	30	25	18	25	20	In basic, decrease in primary production connects to the decrease of fish production. But in some case it does not occur. For example, Okunishi et al. (2012) projected the compensation of food limitation by the farther north migration by Japanese sardine. Moreover, Ito et al. (2010) and Ito et al. (accepted) projected increase of egg production because of migration route change which is triggered by the food limition. So, fish response is much more complex. This kind of issue must be denoted. Okunishi T., S. Ito, T. Hashioka, T. T. Sakamoto, N. Yoshie, H. Sumata, Y. Yara, N. Okada, Y. Yamanaka, 2012, Impacts of climate change on growth, migration and recruitment success of Japanese sardine (Sardinops melanostictus) in the western North Pacific, Climatic Change, 3-4, 485-503, DOI 10.1007/s10584-012-0484-7. Ito S., K. A. Rose, A. J. Miller, K. Drinkwater, K. M. Brander, J. E. Overland, S. Sundby, E. Curchitser, J. W. Hurrell and Y. Yamanaka, 2010, Ocean ecosystem responses to future global change scenarios: A way forward, In: M. Barange, J.G. Field, R.H. Harris, E. Hofmann, R. I. Perry, F. Werner (Eds) Global Change and Marine Ecosystems. Oxford University Press., 287-322, pp440. Ito S., T. Okunishi, M.J., Kishi, M. Wang, 2013, Modeling ecological responses of Pacific saury (Cololabis saira) to future climate change and its uncertainty, accetped to ICES Journal of Marine Science. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We thank the reviewer for their important comment. We agree that the relationship between primary productivity and fish production is complex, probably non-linear and uncertain. We have discussed this issue extensively in CC-NPP. Consequently, we have modified the text to include reference to the discussion in CC-NPP. "Mechanisms are complex, and tend to be non-linear, with impacts on ecosystems, fisheries and biogeochemical cycles being hard to project with any certainty (CC-NPP).
570	77975	30	25	19	25	19	The changes documented by Behrenfeld et al are based on only ~10 years of data and are almost entirely driven by tropical (ENSO) variability. They are not a good analogue for the sort of mid-latitude stratification changes expected under AGW. I know B06 make this claim but their data do not support it. (James Christian, Government of Canada)	Agreed, we have modified text
571	75998	30	25	20	25	21	Onset of spring warming information is repetitive with other sections. The should consider an approach to deling with information that is common to multiple regions without being overly repetitive. (UNITED STATES OF AMERICA)	Agreed, we have modified the text accordingly.
572	84209	30	25	20	25	21	The timeframe for this observed trend should be specified. (Katharine Mach, IPCC WGII TSU)	This sentance was removed in reducing the chapter

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
573	75999	30	25	44	25	44	Sections 30.5.2 and 30.5.2.1 need uncertainty language. (UNITED STATES OF AMERICA)	30.5.2 is the initial orientation for the reader of this section and hence has not made statements requiring certainty langauge.
574	58614	30	25	54	26	5	Make it clear that these changes in upwelling with ENSO refer to the Pacific. (Janice Lough, Australian Institute of Marine Science)	We have made it clear that these changes refer to the Pacific.
575	76001	30	26	0	0	0	There is reference to figure 30-12 in this section. However, this figure is not inserted until page 35. Figure should be inserted in the section in which it is first refereneced. (UNITED STATES OF AMERICA)	We have inserted the relevant figure closer to the text (now Figure 30-5).
576	79712	30	26	8	26	9	It would be useful to include a sentence upfront to differentiate equatorial upwelling systems from eastern boundary ecosystems , as this is not immediately obvious until later. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added a sentence to make the distinction between equatorial upwelling and that associated with the eastern boundary systems.
577	58615	30	26	14	26	15	What does "spatial variation in SST" mean and why is it related to ENSO Modoki? Unclear. (Janice Lough, Australian Institute of Marine Science)	We have reworked sentence to make this clearer and also referred the reader to WG1 Chp 14 for further information
578	84210	30	26	43	26	43	What are the uncertainties/ranges for these values? (Katharine Mach, IPCC WGII TSU)	We have inserted appropriate uncertainties/likelihood language. See also above.
579	76000	30	26	46	26	47	"Further increases... further" Is this true in both basins on a near-term timescale? Perhaps some comment about timing is warranted. The upwelling of low-pH water in the Pacific Northwest had to do with the local physics rather than penetration of anthropogenic CO2 to deep waters. (UNITED STATES OF AMERICA)	This is a valid point - the reference should not be to upwelling waters specifically and consequently we have modified the text to remove reference to upwelling waters. Text now reads: "Further increases in atmospheric CO2 will cause additional decrease in pH and aragonite saturation of surface waters (adding to the low pH and aragonite saturation of upwelling conditions), with significant differences between emission trajectories by the middle of the century."
580	61696	30	27	11	27	12	The statement that fisheries supported by Equatorial Upwelling Regions (EUS) will experience increased vulnerability is an important one Further elaboration on this point and an associated uncertainty level for these projections would be helpful. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have text that elaborates on this issue.
581	57600	30	27	17	27	17	"a" subset (George Somero , Stanford University)	Correction has been made.
582	76002	30	27	17	27	17	Should be 'a subset' not 'an subset' (UNITED STATES OF AMERICA)	Correction has been made.
583	84211	30	27	19	27	19	Further qualification of "significant" may be appropriate here given that 3.3% of global production does not seem a huge sum--significant recognizing the small area of these water bodies? (Katharine Mach, IPCC WGII TSU)	Have changed test to"small but regionally significant"
584	79713	30	27	19	30	19	The text should read "support significant fisheries". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text modified accordingly.
585	84212	30	27	38	27	38	"low agreement" should be used here in place of "limited agreement." (Katharine Mach, IPCC WGII TSU)	Agreed, text modified accordingly.
586	57333	30	27	42	27	42	Insert thus "loss of fish species that eat coral-associated invertebrates while herbivores" (Erica Head, Fisheries and Oceans Canada)	Agreed, text modified accordingly.
587	79714	30	28	5	28	5	Does "coral size" refer to colony size or polyp size, this isn't clear from the text. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The text has been modified to make the distinction (added 'colony'. We are actually referring to the size of the coral population.
588	76003	30	28	6	28	6	"moderate" confidence should be "medium" to follow IPCC standards. (UNITED STATES OF AMERICA)	Agreed, text modified accordingly.
589	76004	30	28	7	0	0	Should the mechanism by which the decline in coral size is connected to heat-mediated bleaching be mentioned? (UNITED STATES OF AMERICA)	There is a statement already: "The decline in average coral colony size is ascribed to significant heat-mediated bleaching in 1998 and again in 2010 [Riegl et al., 2012]."
590	76005	30	28	10	28	10	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	Agreed, text modified accordingly.
591	84213	30	28	10	28	10	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. If being used as a likelihood term, "very likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified accordingly.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
592	84214	30	28	13	28	13	The scenario of climate change for this projection should be specified. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified accordingly.
593	58616	30	28	13	28	14	Will need to check about status of this paper as not sure whether it has been resubmitted yet. (Janice Lough, Australian Institute of Marine Science)	Agreed, we have removed the reference as it appears the paper was not published
594	79715	30	28	29	28	29	The text should read "Temperatures in the surface waters of the Black Sea...". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text modified accordingly.
595	84215	30	28	29	28	29	For the described temperature increase, is it possible to indicate the uncertainties/range for the estimate? (Katharine Mach, IPCC WGII TSU)	The uncertainty range around the estimates were not provided by Belkin 2009.
596	84216	30	28	36	28	36	The timeframe over which this change occurred should be specified. (Katharine Mach, IPCC WGII TSU)	We have added the appropriate timeframe information to the text.
597	84217	30	28	51	28	51	For the described temperature increase, is it possible to indicate the uncertainty/range for the estimate? (Katharine Mach, IPCC WGII TSU)	The uncertainty range around the estimates were not provided by Belkin 2009.
598	79716	30	29	8	29	8	Possibly edit the text to read "in the deeper basins (in particular the Bornholm Basin), producing conditions..." (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have modified the text accordingly.
599	61929	30	29	11	29	12	“The decrease in phytoplankton and abundance and primary productivity since 1978 is very likely to be a response to increasing sea temperature (Madsen and Hojerslev, 2009),.....”. To my knowledge the study of Madsen and Hojerslev does not report any results on phytoplankton and primary productivity as a response to sea temperature and it is unclear what this statement is based upon. I cannot see that chapter 30 provide any published evidence for linking reduced primary production in the Baltic Sea or elsewhere with increased temperature. (Dag Lorents Aksnes, University of Bergen)	We have corrected this confusion. The text now reads: "The annual biomass of phytoplankton has declined almost threefold in the Baltic Transition Zone (Kattegat, Belt Sea) and Western Baltic Sea since 1978 {Henriksen, 2009 #423} which appears to have been due to changing nitrogen loads in the Danish Straits and increasing sea temperature which is consistent with other observations of long-term trends [Madsen and Højerslev, 2009]."
600	76006	30	29	12	29	12	Is the use of "very likely" here linked to a probability? If so, it should be italicized. NOTE - the same comment also applies to line 27 on this page. (UNITED STATES OF AMERICA)	The text has been modified in response to comment 599 and no longer uses "likely"
601	84218	30	29	12	29	12	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See comment above (600)
602	76007	30	29	12	29	13	"very likely... almost certainly played a role" seems nearly contradictory. Revise to show better what role decreased nutrients may have played relative to the magnitude of the response from temperature. (UNITED STATES OF AMERICA)	Agreed, text modified accordingly. Now reads: "The annual biomass of phytoplankton has declined almost threefold in the Baltic Transition Zone (Kattegat, Belt Sea) and Western Baltic Sea since 1978 [Henriksen, 2009] which appears to have been due to changing nitrogen loads in the Danish Straits medium confidence in addition to increasing sea temperature (very likely, [Madsen and Højerslev, 2009]. Reduced phytoplankton production may have reduced the productivity of fisheries in the western Baltic Sea and the transition zone (low to medium confidence wake-up low to medium confidence, [Chassot et al., 2007]."
603	84219	30	29	27	29	27	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified accordingly.
604	76008	30	29	32	29	32	Section 30.5.3.1.5 lacks confidence estimates in several places (e.g. sea level rise point in line 52, increasing possibility of disease organisms, p. 30, line 9, and ecosystem changes cited on page 29, lines 37-39) (UNITED STATES OF AMERICA)	We have added appropriate uncertainty/likelihood language.
605	84220	30	29	34	29	35	For the described temperature increase, is it possible to indicate the uncertainties/range for the estimate? (Katharine Mach, IPCC WGII TSU)	We have added appropriate uncertainty/likelihood language.
606	63099	30	29	38	29	38	Close parenthesis after references. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected this typographical error.
607	63100	30	29	40	29	40	It is Vargas-Yáñez (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected this typographical error.
608	76009	30	29	40	29	41	"Natural... trend" This idea is repeated many times elsewhere. Find a way to deal with issues that affect many areas consistently. (UNITED STATES OF AMERICA)	Agreed, we have modified. However it is important to discuss the regional climate variability within sections
609	63101	30	29	52	29	52	It is Jordà (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected this typographical error.
610	63102	30	30	10	30	10	It is Sabatés (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected this typographical error.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
611	63103	30	30	11	30	11	Should be Serrano et al., 2013 (Serrano, E., Coma, R., Ribes, M., Weitzmann, B., García, M., Ballesteros, E., 2013. Rapid northward spread of a zooxanthellate coral enhanced by artificial structures and sea warming in the Western Mediterranean. PLoS ONE 8, e52739. doi:52710.51371/journal.pone.0052739. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected the reference.
612	57334	30	30	15	30	15	Replace "the spread of tropical invasive species from the eastern Mediterranean basin" with "the spread of tropical invasive species into the eastern Mediterranean basin" (Erica Head, Fisheries and Oceans Canada)	Agreed, text modified accordingly.
613	79717	30	30	24	30	25	Delete "during events such as those in 1999, 2003 and 2006 in the Mediterranean" as this repeats text in the same paragraph. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have modified the text and have removed the repetition.
614	76010	30	30	27	30	27	Is the use of "very likely" here linked to a probability? If so, it should be italicized. NOTE - the same comment also applies to page 31, line 14. (UNITED STATES OF AMERICA)	We have modified the text to make this clearer. And have italicised confidence/likelihood of information.
615	84221	30	30	27	30	27	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. If being used as a likelihood term, "very likely" should be italicized. (Katharine Mach, IPCC WGII TSU)	We have modified the text to make this clearer. And have italicised confidence/likelihood of information.
616	80741	30	30	30	30	39	It is true that there are few studies of the impact of ocean acidification in the Med. Two papers were missed though. Rodolfo-Metalpa et al. Showed that a zooxanthellate coral was unaffected a levels expected this century. They also showed a significant interaction with temperature in several invertebrates, suggesting that temperature is the overriding driver.. Rodolfo-Metalpa R., Lombardi C., Cocito S., Hall-Spencer J. M. & Gambi M. C., 2010. Effects of ocean acidification and high temperatures on the bryozoan Myriapora truncata at natural CO2 vents. Marine Ecology 1-9. Rodolfo-Metalpa R., Martin S., Ferrier-Pagès C. & Gattuso J.-P., 2010. Response of the temperate coral Cladocora caespitosa to mid- and long-term exposure to pCO2 and temperature levels projected for the 2100 AD. Biogeosciences 7:289–300. Rodolfo-Metalpa R., Houlbrèque F., Tambutté É., Boisson F., Baggini C., Patti F. P., Jeffree R., Fine M., Foggo A., Gattuso J.-P. & Hall-Spencer J. M., 2011. Coral and mollusc resistance to ocean acidification adversely affected by warming. Nature Climate Change 1:308-312. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have expanded the text and added these papers
617	63104	30	30	31	30	31	In addition to Durrieu de Madron, 2011, Calvo et al., 2011 could also be cited here. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have adjusted the references here and now cite Calvo- We have cited the Durrieu de Madron study as MerMex group and also added the Calvo et al study - note the MerMex group is the only way to cite this study as it has over 60 individual names!
618	84222	30	30	33	30	33	"Medium confidence" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	We have italicised the appropriate terms.
619	76011	30	30	33	30	34	"which the greatest relative changes" doesn't mak sense. Missing a word? (UNITED STATES OF AMERICA)	We have corrected the tangled grammar and modified the text accordingly.
620	79718	30	30	33	30	34	This sentence ("Even the deepest.....") doesn't make sense grammatically (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have corrected the tangled grammar and modified the text accordingly.
621	63105	30	30	35	30	35	After 'rare', a couple of references could be included such as Movilla et al., 2012 (Movilla, J., Calvo, E., Pelejero, C., Coma, R., Serrano, E., Fernández-Vallejo, P., Ribes, M., 2012. Calcification reduction and recovery in native and non-native Mediterranean corals in response to ocean acidification. Journal of Experimental Marine Biology and Ecology 438, 144-153.) and Martin and Gattuso, 2009 (Martin, S., Gattuso, J.-P., 2009. Response of Mediterranean coralline algae to ocean acidification and elevated temperature. Global Change Biology 15, 2089-2100.) (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have added these references as suggested
622	61697	30	31	4	31	5	This prognostic statement about sea temperatures in Semi-Enclosed Seas is made with "very high confidence" and therefore should be included in the Executive Summary. This result contextualises "very likely" points about increasing thermal stratification and hypoxia in the ES (Page 5, Line 11). Suggest to replace "Further warming" with this more robust statement. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have modified the text accordingly.
623	84223	30	31	4	31	5	"very high confidence" could be placed within parentheses at the end of the sentence to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.
624	84224	30	31	12	31	12	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
625	84225	30	31	14	31	14	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.
626	84226	30	31	14	31	14	It would be helpful to specify the mechanism leading to reduced oxygen levels. (Katharine Mach, IPCC WGII TSU)	We have added text on this line.
627	76012	30	32	18	32	18	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We have adjusted the confidence/likelihood language so it is consistent with chapter 6 and elsewhere in chapter 30.
628	84227	30	32	18	32	21	The summary terms for evidence and agreement on these lines could be placed within parentheses at the end of the respective sentences, to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.
629	57335	30	32	26	32	26	I think the giant jellyfish species should be "Nemopilema nomurai", not "Nemopile manomurai" (Erica Head, Fisheries and Oceans Canada)	Agreed, text has been modified.
630	84228	30	32	49	32	53	The summary terms for evidence and agreement on line 50 could be placed within parentheses at the end of the sentence to maximize clarity and directness of wording. If possible, the timeframe for these changes should also be specified. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified. We have also added the timeframe for the changes is much as we can..
631	56340	30	32	54	0	0	I have just come back from looking at reefs in the South China Sea around Hainan. There is evidence of climate-change degradation in addition to other athropogenic activities - reference: Zhao, MX, Yu, KF, Zhang, QM, Shi, Q and Price, GJ. 2012 Long-termdecline of a fringing coral reef in the Northern South China Sea. J. Coastal Research 28, 1088-1099. (Michael James Crabbe, University of Bedfordshire)	We have added this reference and referred to its implications.
632	76013	30	33	1	33	1	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have modified the text to avoid a casual use this term.
633	84229	30	33	1	33	1	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have modified the text to avoid a casual use this term.
634	76014	30	33	19	33	19	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
635	84231	30	33	19	33	19	The summary terms for evidence and agreement could be placed within parentheses at the end of the sentence to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	We have modified the text accordingly.
636	76015	30	33	20	33	20	Is the use of "very likely" here linked to a probability? If so, it should be italicized. NOTE - this same comments applies to lines 38 and 47 of this page. (UNITED STATES OF AMERICA)	See above
637	84230	30	33	20	33	20	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and removed the casual use of these terms.
638	84232	30	33	44	33	44	It would be helpful to clarify further if the "where" part of the sentence pertains only to the Bay of Bengal. (Katharine Mach, IPCC WGII TSU)	We have modified the text to make it clearer.
639	57601	30	34	7	34	7	replace "has" with "have"; 11th word from beginning of line. (George Somero , Stanford University)	Agreed, text has been modified
640	65300	30	34	8	0	0	"with within" must be "within" (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	Agreed, text has been modified
641	76016	30	34	22	0	0	There is no use of uncertainty language at all in this section. (UNITED STATES OF AMERICA)	We have applied certainty/uncertainty language to this part of chapter 30. We've also looked at other parts of the chapter where certainty/likelihood is similarly missing.
642	84233	30	34	27	34	28	For the temperature increases described here, it would be preferable to specify the uncertainties/ranges for the estimates. (Katharine Mach, IPCC WGII TSU)	The uncertainty range around the estimates were not provided by Belkin 2009.
643	58258	30	34	35	0	41	A very interesting results that shows a rapid shift in oceanographic conditions plus a dramatic biologicval response appears in Taylor, G.T., Muller-Karger, F.E. , Thunell, R.C., Scranton, M.I. , Astor, Y., Varela, R., Troccoli Ghinagliae, L. , Lorenzoni, L., Fanning, K.A. , Hameed, S., Doherty, O. 2012. Ecosystem responses in the southern Caribbean Sea to global climate change. PNAS 109 (47) www.pnas.org/cgi/doi/10.1073/pnas.1207514109. (Ricardo Anadon, University of Oviedo)	We thank the reviewer - and have added this interesting reference reference.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
644	84234	30	34	38	34	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have applied certainty/uncertainty language to this part of chapter 30. We've also looked at other parts of the chapter where certainty/likelihood is similarly missing.
645	84235	30	34	41	34	41	It would be preferable to specify the relevant subsections of chapters 5 and 29. (Katharine Mach, IPCC WGII TSU)	We have added appropriate linkages to chapters 5 and 29.
646	79719	30	34	43	34	52	The impact of ocean acidification on Caribbean corals is not mentioned, yet there is quite a lot of research in this area. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added "Coral ecosystems in the Caribbean Sea are at risk from ocean acidification (Albright et al 2010, Albright and Langdon 2011), although impacts are yet to be observed"
647	57336	30	34	47	34	49	Should be "Increasing sea temperatures in the Caribbean have also been implicated in the spread of disease organisms (Harvell et al., 2002b; Harvell et al., 1999; Harvell et al., 2004) and of some introduced species" (Erica Head, Fisheries and Oceans Canada)	Agreed, text has been modified accordingly.
648	57337	30	35	3	35	5	Suggested change "World wide 850 million people live within 100 km of coral reefs, and are likely to derive some benefits from them (Burke et al., 2011), including food, coastal protection, cultural services and income from industries such as fishing and tourism. Similar benefits are provided to others by other coastal ecosystems (e.g. mangroves) and the offshore areas within the CBS regions." (Erica Head, Fisheries and Oceans Canada)	We thank the reviewer and have modified the text accordingly.
649	84236	30	35	15	35	17	For these increases, the baseline year should be specified. (Katharine Mach, IPCC WGII TSU)	We have added the baseline year - 2010.
650	84237	30	35	18	35	21	Other than extrapolation, what evidence basis supports this statement? Should it be qualified further, for example indicating the role of other stressors to date? (Katharine Mach, IPCC WGII TSU)	We have clarified this with the sentence: "Given the large-scale impacts (e.g., mass coral bleaching and mortality events) that have occurred in response to much smaller changes in the past over the CBS regions (0.10-0.67°C from 1950-2009, Table 30.1), the projected changes of 2.44-3.32°C by 2099 are very likely to have large-scale and negative consequences for the structure and function of many CBS ecosystems (Figure 30.11). These trends are supported by the behavior of coral reefs in response to relatively small increases in temperature such as those seen on reefs throughout the world recently {Hoegh-Guldberg, 1999 #31}{Eakin, 2010 #316}. "
651	76017	30	35	21	35	23	A finding that includes a probabilistic measure of uncertainty does not require explicit mention of the level of confidence associated with that finding if the level of confidence is "high" or "very high". (UNITED STATES OF AMERICA)	Agreed, text has been modified accordingly.
652	58617	30	35	27	35	28	Should it be "coral reef ecosystems as they exist today"? i.e. likely that some sort of coral reefs but with very different community makeup? (Janice Lough, Australian Institute of Marine Science)	Agreed, text has been modified accordingly. We have added a nuance that reefs are likely to have less of the goods and services that we value them for today. But is a coral reef without coral a coral reef?
653	84238	30	35	27	35	28	Does this statement apply to all coral reefs, or is there any variability in projected outcomes? (Katharine Mach, IPCC WGII TSU)	It does but we have modified the text to indicate "coral reefs within the CBS and generally".
654	76018	30	35	32	35	35	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	Agreed, text has been modified accordingly.
655	80052	30	35	32	35	35	These statements also supported by van Hooidonk et al. 2013 (R. van Hooidonk, J. A. Maynard, S. Planes. Temporary refugia for coral reefs in a warming world. Nature Climate Change, 2013; DOI: 10.1038/nclimate1829). (Mark Eakin, National Oceanic and Atmospheric Administration)	Agreed. We have added reference to this study
656	76019	30	36	13	36	13	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
657	84239	30	36	13	36	13	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
658	84240	30	36	27	36	27	"agreement" should also be italicized. Additionally, is it possible to also specify a summary term for evidence? (Katharine Mach, IPCC WGII TSU)	We have specified the summary term for evidence (added p values) and removed the causual use of agreement.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
659	65301	30	36	31	0	0	"since from" must be "from" (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	Correction made.
660	84241	30	36	38	36	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
661	84242	30	36	41	36	41	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
662	61698	30	37	12	37	13	Henson et al. [2010] analyse global data separated into a number of different biomes - what is the rationale for only including the study in the section on the Canary Current? Justification needed for the specific inclusion of this citation here, or else it should be included in a more general section. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We are using Henson to support the conclusion that the satellite record is too short to detect a separate anthropogenic signal - "We find that detection of climate change-driven trends in the satellite data is confounded by the relatively short time series and large interannual and decadal variability in productivity." We have ensured that people understand that we are referring to Henson in a general sense. It now reads: "Clear attribution of these changes depend on the linkage between the Azores High and global temperature, and on longer records for both physical and biological systems as pointed out for data sets in general [Arístegui et al., 2009; Henson et al., 2010]." We also agree the Henson et al should be addressed in a more general section, so it is now discussed in the primary productivity cross section box
663	84243	30	37	34	37	34	Is it possible to also specify a summary term for evidence, following the guidance for authors? (Katharine Mach, IPCC WGII TSU)	We have and have included it.
664	80744	30	38	0	0	0	I strongly advise not to use the word “acidic”. The definition of “acidic” in the Oxford English dictionary is “having the properties of an acid; having a pH of less than 7”. Despite the process of ocean acidification (the acidity of seawater has increased 26% since preindustrial time), the oceans are alkaline (pH higher than 7) and will not become acidic in the foreseeable future. Hence, the "acid" or “acidic” should not be used when referring to seawater. Note that there are few exceptions, seawater can be acidic in the immediate vicinity of CO2 vents or in purposeful perturbation experiments, but this is not a real concern of this chapter. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have made the modification to avoid the term acidic - we now use 'acidfied' or relatively acidified.
665	79720	30	38	8	38	9	This sentence doesn't make sense - It should probably read "Fish catches from the California Current have been around 0.6 million tons/yr since 1950....". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have modified the sentence to correct this ambiguity and confusion.
666	76020	30	38	18	38	38	Peterson and Schwing (2003) demonstrate the relationship across multiple trophic levels, and the importance of changes in ecosystem structure as well as productivity due to climate variability CITATION - Peterson, W.T. and F.B. Schwing. 2003. A new climate regime in northeast Pacific ecosystems, Geophysical Research Letters 30 (17): 1896, doi:10.1029/2003GL017528. (UNITED STATES OF AMERICA)	We have added this reference.
667	76021	30	38	30	38	33	This is a general statement that applies to more than this region. Include it in thinking about how to handle repetition through the chapter. (UNITED STATES OF AMERICA)	We thank the reviewer for their recommendation. The references here are very specific for the California Current so we have decided to leave the paragraoh here.
668	76022	30	38	40	38	40	Evaluate level of agreement in addition to quality of evidence. For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
669	76023	30	38	43	38	44	There appears to be a reference missing here. (UNITED STATES OF AMERICA)	Statement is supported by Bograd et al. 2008, which comes at the end of the second sentence.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
670	76024	30	38	45	38	45	Change mmol to µmol (UNITED STATES OF AMERICA)	This has been corrected.
671	76025	30	38	48	38	48	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	This has been corrected.
672	84244	30	38	48	38	48	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	This has been corrected.
673	76026	30	38	50	38	53	This statement should be qualified with a confidence or likelihood statement(s) (UNITED STATES OF AMERICA)	This has been corrected.
674	76027	30	39	28	39	31	Mendelssohn and Schwing (2002) previously showed this upwelling intensification pattern in the Humboldt Current (Peru and southern Chile), matching the trend found in the California Current. CITATION - Mendelssohn, R. and F.B. Schwing. 2002. Common and uncommon trends in SST and wind stress in the California and Peru-Chile Current Systems Progress in Oceanography 53: 141-162. (UNITED STATES OF AMERICA)	We have explored this reference and have added to the discussion about the Humboldt current.
675	84245	30	39	33	39	33	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
676	76028	30	39	39	39	39	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
677	84246	30	39	39	39	39	The chapter team should consider placing the summary terms for evidence and agreement within parentheses at the end of the sentence to maximize clarity and directness of wording. (Katharine Mach, IPCC WGII TSU)	We have adopted this format.
678	84247	30	39	44	39	44	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
679	58259	30	40	5	0	14	To discuss properly the effects os changes in fisheries could be interesting the above mentioned results of Taylor. From a theoretical point of view the references of Rykaczewski and Checkley and Pickett and Schwing could be interesting because introduce a more complete vision of upwellings (Ricardo Anadon, University of Oviedo)	We thank the reviewer for their contribution. We have added this to the Cross chapter box on Upwelling - which discusses these ideas in detail.
680	57602	30	40	5	40	5	"likely" (George Somero , Stanford University)	We have removed the use of very likely here given the limited process understanding
681	76029	30	40	11	40	11	There is reference made to Figure 30-16 in this section. However, there is no such figure. (UNITED STATES OF AMERICA)	Error has been corrected.
682	76030	30	40	18	40	18	Doesn't seem like this use of "likely" should be italicized (UNITED STATES OF AMERICA)	We have replaced the casual use of likely with appropriate replacement terms.
683	76031	30	40	20	40	20	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	See above
684	84248	30	40	20	40	20	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
685	84249	30	40	44	40	44	The chapter team could consider placing "very likely" with the main verb of the sentence to maximize directness of wording: "have very likely expanded." (Katharine Mach, IPCC WGII TSU)	We have made this change.
686	57338	30	40	46	40	46	Insert thus "Chlorophyll levels, as determined by remote-sensing of ocean colour, have decreased etc" (Erica Head, Fisheries and Oceans Canada)	We agree and have modified the text appropriately.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
687	61930	30	40	46	41	4	(see also executive summary on page 4, line 32-34) There are several cautions that need to be mentioned concerning the repeated claim/hypothesis that chlorophyll (and primary production) of the oceans have decreased. As pointed out in Chavez et al. (2011) and "Chapter 6 Ocean systems" the evidence for a reduction in chlorophyll and primary production is limited and conflicting. The study of Vantrepotte and Melin (2011) which is the main citation in Chapter 30 is based on SeaWifs derived chlorophyll (surface) and not on the chlorophyll of the water column (per m2) and represent a short time period. This needs to be clarified. The euphotic zone of the tropical gyres is deep and a decrease in surface chlorophyll will generally increase the depth of the euphotic zone even more (due to reduced surface shading). Hence, decrease in surface chlorophyll is not equivalent to decreased water column chlorophyll and primary production as implied in the paragraph at page 40-41 and in the executive summary at page 4. Furthermore, in their conclusions Vantrepotte and Melin (2011) warn: " Ultimately, the diversity of temporal patterns shown here (for Chla and for its relation with SST) and the rather short time period considered (10 years) caution that more work is needed to validate the proposed scenario at the scale of separate regions, particularly in the context of climate change, and to unravel how other factors perturb it." (Dag Lorents Aksnes, University of Bergen)	We have significantly modified the text to make it more consistent with chapter 6 and this broader literature. We now conform to the prevailing view that there are many errors creeping in from satellite records trying to detect total chlorophyll - and the fact that reliable records are too short. UPDATE: we have significantly reduced the section and have removed the graphic which, given uncertainties, was not a good use of space. We now reference the new Cross-chapter box (CC-NPP) which has allowed us to find consensus and consistency between chapters across WGII.
688	84250	30	41	18	41	18	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of 'likely' and has firmed up our use of competence/likelihood language across chapter 30.
689	76032	30	41	19	41	19	"uncertain" is not one of the official confidence summary terms; please replace or remove italics (UNITED STATES OF AMERICA)	We have removed the casual use of this term and replacement with appropriate language
690	84251	30	41	19	41	19	"uncertain" is not a calibrated term within the uncertainties guidance and thus it should not be italicized. (Katharine Mach, IPCC WGII TSU)	See above
691	76033	30	41	36	41	36	"moderate" confidence should be "medium" (UNITED STATES OF AMERICA)	We have corrected this error.
692	76034	30	42	6	42	6	Also see: Expansion of oxygen minimum zones may reduce available habitat for tropical pelagic fishes; Lothar Stramma, Eric D. Prince, Sunke Schmidtko, Jiangang Luo, John P. Hoolihan, Martin Visbeck, Douglas W. R. Wallace, Peter Brandt & Arne K_rtzinger; Nature Climate Change 2, 33_37 (2012) doi:10.1038/nclimate1304; Received 06 June 2011 Accepted 02 November 2011 Published online 04 December 2011 (UNITED STATES OF AMERICA)	We have added this discussion and reference
693	76035	30	42	21	42	22	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We've gone through chapter 30 and have carefully examined the confidence and likelihood statements to ensure that they are internally consistent, as well is being consistent between chapter 30 and other chapters such as chapter 6. We have also made sure that the frequency of use of this type of language is more uniform throughout chapter.
694	76036	30	42	32	42	32	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	See above
695	84252	30	42	32	42	32	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
696	84253	30	42	32	42	34	The broad timeframes within the sentence should be clarified. Does "these impacts" refer to observed impacts, whereas "major changes" are future projections?? (Katharine Mach, IPCC WGII TSU)	We have clarified the timeframes involved.
697	84254	30	42	37	42	37	It would be preferable to cross-reference the specific relevant sections of chapter 29. (Katharine Mach, IPCC WGII TSU)	We agree and have cross-linked the text to chapter 29.
698	57339	30	42	39	42	39	Suggested insertion/change "(leading to a deepening of the mixed layer in the west and a shoaling in the east) coincided with" (Erica Head, Fisheries and Oceans Canada)	Agreed, text modified accordingly.
699	76037	30	42	41	42	47	Suggest that this passage be condensed. It reads as a recitation of publications rather than an assessment. (UNITED STATES OF AMERICA)	We have reduced this text,
700	79721	30	42	48	41	48	Replace "climate change" with "climate variability" (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text modified accordingly.
701	57340	30	42	48	42	48	I note that Robinson et al. 2010 show a negative chlorophyll anomaly in the west, but a positive anomaly in the west. So I suggest the following insertion "modest reduction in primary productivity in the west." (Erica Head, Fisheries and Oceans Canada)	Agreed, text modified accordingly.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
702	76038	30	43	1	43	12	This section on Atlantic Ocean STGs is lacking the detail and rigor with which the sections on Pacific and Indian Ocean STGs was written. Specifically, supporting facts, details, and statistics on the impacts of increased temperature on coral reefs and pelagic fisheries have not been included for this section as they were in the other STG sections. This section should be expanded to include this level of detail. (UNITED STATES OF AMERICA)	We agree with the reviewer and have added significant detail with respect to the changes that are occurring in the two Atlantic guyres.
703	79722	30	43	10	43	12	This sentence ("Observations to changes.....") doesn't make sense grammatically (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have fixed the grammar in the sentence.
704	61699	30	43	15	44	17	Given the global importance of the subtropical gyres I suggest that a statement from 30.5.6.2 be included in the Executive Summary. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have added key information on this issue and others related to the STGs. Executive summary now has mention of SCGs.
705	57342	30	43	17	43	27	What does "are responsive" mean here? That they are warming as the atmosphere warms? If that's what it meant, why not say so? Also the next part of this sentence (Lines 17-19) is more-or-less repeated later in the paragraph (Lines 24-26) (Erica Head, Fisheries and Oceans Canada)	We have clarified the text and clarify this issue. We have also removed the repetitive sections as indicated.
706	57343	30	43	17	43	27	I would suggest omitting them the first time round, so that paragraph starts (Erica Head, Fisheries and Oceans Canada)	We agree and have modified the text accordingly.
707	76039	30	43	21	43	21	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have removed the casual use of likely, here and throughout the manuscript.
708	84255	30	43	21	43	21	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
709	84256	30	43	26	43	26	"uncertain" is not a calibrated term within the uncertainties guidance and thus it should not be italicized. (Katharine Mach, IPCC WGII TSU)	See above
710	57345	30	43	29	43	31	The phrase "if a large part of recent changes have an origin in climate change." seems to be unnecessarily vague. How about replacing the entire sentence, and part of the next one, thus "The world's most oligotrophic ocean sub-regions are very likely to expand over the coming decades, with consequences for ecosystem services such as gas exchange, fisheries and carbon sequestration. Polovina et al. (2011) explored this issue for the North Pacific etc" (Erica Head, Fisheries and Oceans Canada)	We agree with this suggestion and have adopted it.
711	65302	30	43	29	43	37	Yes the oligotrophic ocean will continue to expand. However, in STG, eddy activity is very important for the primary production. The eddy activity under future climate is still unclear. Such argument is needed to be addressed. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We agree and have added a sentence indicating the uncertainties associated with the behaviour of eddy systems and the implications for primary productivity and water column mixing. In this case, we have referred to to cross chapter boxes which have been developed to describe our understanding of this important area of oceans in climate change.
712	84257	30	43	31	43	37	It might be preferable to move this text to this corresponding geographic section? (Katharine Mach, IPCC WGII TSU)	We respectively disagree, this is an example to strengthen our statements in this section
713	57346	30	43	36	43	37	The catch in the STG only increased because the area of the STG increased. I think this point should be made more clearly here - thus "The total primary production and fish catch of the STG is projected to increase by 26%, although this is because the area it covers will increase by 30% (Polovina et al., 2011)." (Erica Head, Fisheries and Oceans Canada)	Agreed
714	84258	30	43	39	43	39	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of likely, here and throughout the manuscript.
715	84259	30	43	44	43	44	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
716	84260	30	43	45	43	45	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
717	84261	30	43	45	43	45	"medium to high confidence" could be placed within parentheses at the end of the sentence to maximize directness of wording. (Katharine Mach, IPCC WGII TSU)	Done.
718	57341	30	43	48	43	48	Considering the amount of work that has been done in the N Atlantic STG, I found this section a bit short on detail compared with the descriptions given for the other STGs. (Erica Head, Fisheries and Oceans Canada)	We have increased the amount of detail above. Much of the information overlaps with the quite extensive treatment that we have given the high spring bloom systems in the north Atlantic. Together, we believe this does do justification to the extensive work undertaken on the Atlantic STG.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
719	84262	30	43	48	43	48	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of likely, here and throughout the manuscript.
720	84263	30	44	1	44	4	It would be preferable to specify the relevant scenarios of climate change for these projections. (Katharine Mach, IPCC WGII TSU)	We have specified the different scenarios in figure 30.10. In that analysis, we compare historic as well as RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5.
721	80053	30	44	2	0	0	Based on more recent models of future coral bleaching and mortality, annual bleaching is likely to occur much sooner. See and cite van Hooidonk et al. 2013. (Mark Eakin, National Oceanic and Atmospheric Administration)	Agreed, we have modified the language to reflect this and have included the relevant paper.
722	77976	30	44	13	44	13	"decreasing carbonate ion situations" concentrations (James Christian, Government of Canada)	We have corrected the word 'situation' which should be 'concentrations'
723	76040	30	44	15	44	15	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have italicized word.
724	84264	30	44	15	44	15	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
725	84265	30	44	17	44	20	Given that "medium confidence" is presented at the beginning and end of this sentence, the instance at the start of the sentence could be deleted to increase directness of wording. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified accordingly
726	84266	30	44	22	44	43	It may be preferable to move this material to 30.5.6.1.1, just briefly summarizing it here. (Katharine Mach, IPCC WGII TSU)	Agreed, change adopted
727	79723	30	44	32	44	32	Is this correct - that a compressed depth range will "reduce" vulnerability - surely vulnerability would be "increased"? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Yes, a typing error, we have corrected
728	76041	30	44	37	44	43	This section is not well integrated with the chapter. Suggest that it be revised or removed. (UNITED STATES OF AMERICA)	We have moved this discussion to the Pacific STG 30.5.6.1.1. where it is better integrated
729	57603	30	44	40	44	40	Mako shark (George Somero , Stanford University)	Corrected.
730	57347	30	44	42	44	43	What does "an opportunity to participate and apply anticipate change" mean? Maybe this is what is meant "These predictions of species range displacements, contractions and expansions in response to anticipated changes in the oceans present both a challenge and an opportunity for the development of large-scale management strategies to preserve these valuable species." (Erica Head, Fisheries and Oceans Canada)	We have corrected the text to make this less ambiguous.
731	76042	30	44	42	44	43	This sentence is very difficult to understand. Not sure what the authors are trying to say. Please rewrite it. (UNITED STATES OF AMERICA)	We have rewritten the sentence to make it clearer see above
732	79724	30	44	42	44	43	This sentence ("These directional changes.....") doesn't make sense grammatically, and can be deleted (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have rewritten the sentence to make it clearer see above
733	57348	30	45	5	45	6	Suggested insertion "there is indirect evidence (medium confidence)" (Erica Head, Fisheries and Oceans Canada)	Text has been rewritten
734	79725	30	45	16	45	18	I think this sentence is inconsistent with chapter 6, which suggests that deep sea species typically occur over huge areas as there is very little variability in conditions. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have discussed with Chp 6 and corrected this discrepency
735	69852	30	45	22	45	23	The CO2 is not the fuel it self but the product of the fuel burning process. "The patterns … tracers and the CO2 produced after burning fossi-fuel signal …." (NETHERLANDS)	Agreed,
736	76043	30	45	27	45	27	"Moderate" confidence should be "medium". (UNITED STATES OF AMERICA)	Correction made.
737	76044	30	45	27	45	28	Do the authors mean medium confidence as opposed to moderate confidence? (UNITED STATES OF AMERICA)	Yes, we have corrected
738	84267	30	45	36	45	36	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have modified the text
739	76045	30	45	36	45	37	The first line of this paragraph needs a reference. (UNITED STATES OF AMERICA)	Have removed sentence as it was felt that it was not contributing anything to the discussion.
740	76046	30	45	37	45	37	A citation is needed for the 20% value. (UNITED STATES OF AMERICA)	This sentence was removed during text corrections
741	77977	30	45	41	45	41	5% of 20% or 5% of 100%? (James Christian, Government of Canada)	This sentence was removed during text corrections
742	76047	30	45	42	45	42	"Moderate" confidence should be "medium". (UNITED STATES OF AMERICA)	Agreed, text has been corrected.
743	84268	30	45	42	45	42	"moderate confidence" should be "medium confidence" following the guidance for authors. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been corrected.
744	84269	30	45	45	45	45	"medium confidence" should be italicized for clarity. (Katharine Mach, IPCC WGII TSU)	Done.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
745	76048	30	46	4	46	4	Awkward sentence ' oxygen concentrations will be less well oxygenated'. Please reword this sentence. (UNITED STATES OF AMERICA)	Agreed, text has been rewritten appropriately.
746	77978	30	46	4	46	4	"oxygen concentrations will be less well oxygenated"??? (James Christian, Government of Canada)	See above
747	57349	30	46	4	46	5	"Oxygen concentrations will be less well oxygenated" Is this the same as "Oxygen concentrations will be lower"? If so, please use the latter! (Erica Head, Fisheries and Oceans Canada)	See above - suggestion added.
748	79726	30	46	8	46	12	In chapter 6 it cites evidence that some deep water corals can adapt to OA (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, we have added this point with appropriate references
749	80742	30	46	9	46	12	This paragraph does not adequately summarize the effect of ocean acidification on deep-sea corals. Despite an initial report of a an initial study suggesting a large negative impact on calcification (Maier et al., 2009), recent evidence suggests little or no impact in the range of pCO2 projected for 2100. Form A. U. & Riebesell U., 2012. Acclimation to ocean acidification during long-term CO2 exposure in the cold-water coral Lophelia pertusa. Global Change Biology 18:843-853. Maier C., Hegeman J., Weinbauer M. G. & Gattuso J.-P., 2009. Calcification of the cold-water coral Lophelia pertusa under ambient and reduced pH. Biogeosciences 6:1671-1680. Maier C., Watremez P., Taviani M., Weinbauer M. & Gattuso J.-P., 2011. On board experiments to determine calcification rates and the effect of ocean acidification on Mediterranean cold-water corals. Proceedings of the Royal Society of London. Series B: Biological Sciences 279:1716-1723. Maier C., Watremez P., Taviani M., Weinbauer M. G. & Gattuso J.-P., 2012. Calcification rates and the effect of ocean acidification on Mediterranean cold-water corals. Proceedings of the Royal Society of London. Series B: Biological Sciences 279:1716-1723. Maier C., Schubert A., Berzunza Sànchez M. M., Weinbauer M. G., Watremez P. & Gattuso J.-P., 2013. End of the century pCO2 levels do not impact net calcification in Mediterranean cold-water corals. PLoS ONE 8:e62655. Maier C., Bils F., Weinbauer M. G., Watremez P., Peck M. & Gattuso J.-P., 2013. Respiration of Mediterranean cold-water corals is not affected by ocean acidification as projected for the end of the century. Biogeosciences Discussions 10:7617-7640. Jantzen C., Häussermann V., Försterra G., Laudien J., Ardelan M., Maier S. & Richter C., in press. Occurrence of a cold-water coral along natural pH gradients (Patagonia, Chile). Marine Biology Thresher RE, Tilbrook B, Fallon S, Wilson NC, Adkins J (2011) Effects of chronic low carbonate saturation levels on the distribution, growth and skeletal chemistry of deep-sea corals and other seamount megabenthos. Mar Ecol Prog Ser 442:87-99 (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We thank the reviewer for their comments. We have rewritten the text to reflect this wider literature, and have worked with chapter 6 to ensure that we have consistent positions on the effect of OA on cold water corals. UPDATE: Point taken - have now included reference to mounds. Text now reads: 'While initial investigations suggested that ocean acidification (reduced by 0.15 and 0.30 pH units) would result in a reduction in the calcification rate of deep water corals (30% and 6%, respectively [Maier et al., 2009]), there is accumulating evidence that ocean acidification may have far less impact on the calcification of deep water corals although it may reduce important habitats given that dead unprotected coral mounds are likely to dissolve in under-saturated waters. [Form and Riebesell, 2012; Maier et al., 2013; Thresher et al., 2011].'
750	69853	30	46	15	46	24	The entire 30.5.7.2 has no reference, despite the fact that has a statement with high confidence. (NETHERLANDS)	We have now added references to underpin the statements here.
751	76049	30	46	18	46	21	These two sentences make the same statement. Please restructure to avoid repetition. (UNITED STATES OF AMERICA)	We have deleted the repetition
752	76050	30	46	19	46	19	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
753	84270	30	46	19	46	19	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See above
754	76051	30	46	20	46	20	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	This sentance was removed as it was a repetition of the preceding sentence
755	84271	30	46	20	46	20	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	This sentance was removed as it was a repetition of the preceding sentence
756	76052	30	46	22	46	22	The statement "as with the deep sea generally" is a confusing segue. Please revise for clarity. (UNITED STATES OF AMERICA)	We have amended this
757	61700	30	46	27	46	45	This is a very important section (30.5.8) and figure (Figure 30-14). However it would be helpful to include more information about how the expert assessment has been conducted. How has a degree of confidence in detection and attribution across sub-regions and processes been established? Further description of Figure 30-14 would also be helpful here to make the key messages clear to readers. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We refer the reader to chp 18, where further detail is given
758	76053	30	46	29	46	32	The first three sentences in this paragraph should be condensed as they are wordy and a bit repetitive. (UNITED STATES OF AMERICA)	Agreed, and text has been modified accordingly.
759	57604	30	46	34	46	34	I think a word is missing before "Physical and chemical changes…" Perhaps, "For" or "In the case of" should be added at the beginning of this sentence? (George Somero , Stanford University)	Agreed, and text has been modified accordingly.
760	84272	30	46	35	46	35	The chapter team should preferably use a level of confidence, presented within italics, in place of "extremely high" confidence. (Katharine Mach, IPCC WGII TSU)	Agreed, text changed .

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
761	76054	30	46	35	46	37	Please use the following to replace the beginnng of this sentence: "ecological responses also fall in the upper corner of Figure 30-14" (UNITED STATES OF AMERICA)	Agreed, text changed .
762	76055	30	46	44	46	44	Whose expert assessment? Is it based on each item mentioned or some other dataset? Please clarify. (UNITED STATES OF AMERICA)	We have rewritten and described the detection and attribution process throughout the section.
763	57350	30	46	44	46	45	For clarity please insert "across sub-regions, as designated in Fig 30-1A, and processes" (Erica Head, Fisheries and Oceans Canada)	Agreed, text changed .
764	57351	30	46	44	46	45	Also, in Fig 30-14 there is no symbol associated with "Ocean warming" for the HLSBS region (i.e. region 1) and the same symbol is associated with "Ocean warming" twice for the EBUE (i.e. region 3). Maybe one of the 3s should be a 1! Finally, I might have put the symbol indicating "Declining primary productivity" in regions 4 and 6 slightly lower on both scales, to reflect the point made in Chapter 6 executive summary "The direction, magnitude and regional differences of a change in NPP in the open ocean as well as in coastal waters have limited evidence and low agreement for a global decrease projected by 2100." (Erica Head, Fisheries and Oceans Canada)	We have modified our figure so there is clear line of sight to our chapter. Hence these issues have been accounted for. UPDATE: figure has been further developed and modified with some of these issues taken care of.
765	79727	30	46	48	54	40	This whole section (but particularly the text on tourism, shipping, mitigation) seems to be poorly researched. Considerable attention needs to be paid to improving the text (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have paid attention to this text, and improved cross-linkages to chapters in WGII and WGIII where in-depth discussion may be found for certain issues
766	76056	30	46	50	46	50	"supports numerous sectors" is kind of vague.What kind of sectors? Suggest deleting this sentence as the following sentence provides an adequate introduction. (UNITED STATES OF AMERICA)	Agreed, text rewritten accordingly and sectors identified.
767	76057	30	47	1	47	3	The statement that "Many climate change impacts can be avoided, reduced or delayed by mitigation" seem too broad and sweeping and should be reconsidered. In addition, this entire passage is vague and may be unnecessary or condense-able. (UNITED STATES OF AMERICA)	Agreed, We have deleted this sweeping sentence
768	76058	30	47	14	47	16	Coastal influences cited here are especially important to semi-enclosed seas yet are not really thoroughly addressed there. Are these issues dealt with elsewhere - e.g., Ch 5 and possibly Ch 29 - and, if so, the authors need to make the appropriate cross-references. (UNITED STATES OF AMERICA)	We agree that statement was too general, there are a lot of factors determining these influences so we have directed the reader to sections in our chapter and chpater 5
769	63816	30	47	17	47	17	Please delete "dramatically". The term should not be used here in combination with "..potentially dramatically..". The "opportunities" described in the sentence are an hypothesis, to our knowledge currently there is not enough scientific evidence available to universally accept this hypothesis. (GERMANY)	Agreed, text has been rewritten accordingly.
770	76059	30	47	17	47	17	Suggest also citing: Mitigating Local Causes of Ocean Acidification with Existing Laws. R. P. Kelly,M. M. Foley,W. S. Fisher, R. A. Feely,B. S. Halpern,G. G. Waldbusser, and M. R. Caldwell. Science 27 May 2011: 332 (6033), 1036-1037. [DOI:10.1126/science.1 (UNITED STATES OF AMERICA)	We have investigated this paper and have done so.
771	76060	30	47	19	47	19	Suggest also citing: Mitigating Local Causes of Ocean Acidification with Existing Laws. R. P. Kelly,M. M. Foley,W. S. Fisher, R. A. Feely,B. S. Halpern,G. G. Waldbusser, and M. R. Caldwell. Science 27 May 2011: 332 (6033), 1036-1037. [DOI:10.1126/science.1203815] (UNITED STATES OF AMERICA)	We haven't cited this paper here but have cited it in other places in this section
772	76061	30	47	22	48	8	Uncertainty language is needed throughout this passage. Also, it reads as fairly speculative. More distinction needs to be made about what can be said with certainty, and what knowledge gaps and potential parallels with other ecological changes (etc.) exist. (UNITED STATES OF AMERICA)	Agreed, and text has been rewritten accordingly and certainty added
773	57605	30	47	28	47	28	Again, a word seems to be missing: should "for" be added between"evidence" and "fundamental"? (George Somero , Stanford University)	Agreed, text modified to include 'indicating that'.
774	57352	30	47	28	47	29	The accumulating evidence etc. What is this sentence supposed to mean? I showed it to a few people, and no-one could figure it out! (Erica Head, Fisheries and Oceans Canada)	We have clarified what we mean here by rewriting the sentence.
775	76062	30	47	28	47	31	This sentence is not clear. Please reread carefully and revise to ensure that the authors' message is trasmitted clearly. (UNITED STATES OF AMERICA)	See above
776	76063	30	47	33	47	33	Change "transcend" to some other verb. As written it suggest they are immune from demands, which they are not. (UNITED STATES OF AMERICA)	We respectively disagree
777	79728	30	47	36	47	39	Just because you are able to 'value' something doesn't mean that this is itself providing adaptation options. The sentence doesn't make sense. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have rewritten the sentence to make it clearer.
778	76064	30	47	45	47	48	Adaptation strategies that reduce the impact of climate change on ocean ecosystems are addressed in Chapter 6, section 6.4 and should probably be referenced here. (UNITED STATES OF AMERICA)	We agree and have improved links to chapter 6.
779	84273	30	47	45	48	8	It would be preferable to provide further citations in support of these statements. (Katharine Mach, IPCC WGII TSU)	We have added citations.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
780	76065	30	47	52	47	52	Change to "may provide opportunities" (UNITED STATES OF AMERICA)	We have made this change.
781	76066	30	47	53	47	53	Does "phytoplankton" really belong in this list for blue carbon components. Please double check. (UNITED STATES OF AMERICA)	Yes it does - as a major sink for carbon dioxide. The idea of using iron fertilisation in the oligotrophic fees was all about increasing the flux of carbon into the ocean. See UNEP report Blue Carbon available at http://www.grida.no/publications/rr/blue-carbon/ we have also cited this publication
782	77979	30	47	53	47	53	hard to see how standing crop of phytoplankton could increase significantly (James Christian, Government of Canada)	We have modified the test so phytoplankton are included in the Blue Carbon concept but clarified that discussion around adaptation and mitigation is focused on coastal vegetated ecosystems
783	77980	30	48	1	48	1	This seems to imply that the respiration will be subaerial. The CO2 will be available for exchange with the atmosphere but the respiration will occur in the aqueous phase. (James Christian, Government of Canada)	Agreed, We have rewritten this section
784	76067	30	48	13	49	3	Ocean acidification will certainly impact shellfish capture and aquaculture, and shoud be included here. (UNITED STATES OF AMERICA)	Agreed, we have added a new section on aquaculture (30.6.2.1.4) that discusses this issue - and refer to several other sections that make this case (and it is now in a combined risk and vulnerability table that is part of the chapter)
785	84274	30	48	16	48	16	It could be helpful to clarify whether the estimate of kilograms of food per person is a straight average of amount caught divided by the number of people who eat fish or if it excludes fish used for fertilizer and other non-food purposes. (Katharine Mach, IPCC WGII TSU)	This has been clarified in the text.
786	69854	30	48	18	48	19	Please consider replacing 'from 80 to 77 million tonnes per year' by 'from 80 million tonnes in 2006 to 77 million tonnes in 2010'. (NETHERLANDS)	Agreed, our text has been modified.
787	69855	30	48	25	48	26	Replace 'overexploitation of another 30% of fisheries' by 'overexploitation of 30% of the world's fisheries'. (NETHERLANDS)	Agreed-we have changed the text with this in mind.
788	79729	30	48	28	48	36	Taken together, these statements give the misleading impression that heavily industrialised fisheries are good and small-scale fisheries are bad. Perhaps the text could be revised slightly. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, this is certainly not the point we want to convey. We have modified the text slightly
789	84275	30	48	33	48	33	The wording of this statement should be adjusted to ensure a policy neutral formulation. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified to be policy neutral.
790	84276	30	48	36	48	36	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of likely, here and throughout the manuscript.
791	67943	30	48	38	48	40	In the case of small-scale fisheries (especially, where the management system is primitive), adaptive management is considered effective. This should be reflected in this document. For example, description should be revised as follows: "... achieved through adaptive management strategy by (1) introduction of simple harvest controls ... , (2) flexible modification of these controls through close monitoring, and (3) investing in the ... (see the attached paper for reference, i.e. "Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan: Mitsutaky Makino, Hiroyuki Matsuda, Yasunori Sakurai) (JAPAN)	This is a good point. We have modified the text to include this perspective.
792	57606	30	48	44	48	44	The third from last word in this line should be "are." (George Somero , Stanford University)	Agreed, text as been modified.
793	84277	30	48	44	48	50	Citation should be provided for these statements. (Katharine Mach, IPCC WGII TSU)	Citations have been added.
794	76068	30	48	46	48	46	Qualifiers are backwards - should use "medium" for agreement and "robust" for evidence (UNITED STATES OF AMERICA)	Agreed, text modified accordingly.
795	76069	30	48	49	48	49	The authors should present evidence (i.e., citations) that gains in the higher latitudes would be short lived. What is meant by short term - Decades? (UNITED STATES OF AMERICA)	We have presented the projections from a model here, and added the details of model and timeframe
796	76070	30	49	1	49	2	This statement is vague. Please substantiate and provide citations. (UNITED STATES OF AMERICA)	Agreed, we have modified the text accordingly and presented citations
797	79730	30	49	29	49	29	The text should read "tuna stocks and quotas under climate change". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, we have modified the text accordingly.
798	76071	30	49	52	49	52	Overfishing should be added to the list of human activities pressuring coral reef fisheries. (UNITED STATES OF AMERICA)	Agreed, text modified accordingly.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
799	76072	30	49	53	49	53	Is the use of "very likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have removed the casual use of likely, here and throughout the manuscript.
800	84278	30	49	53	49	53	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of likely, here and throughout the manuscript.
801	76073	30	50	5	50	5	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have removed the casual use of likely, here and throughout the manuscript.
802	84279	30	50	5	50	5	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have removed the casual use of likely, here and throughout the manuscript.
803	61701	30	50	12	50	19	Suggest to include adaptation options for building the resilience of coral reef fisheries (tropical Pacific) to climate change in the Executive Summary. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have considered this point and have added a couple of examples and rewritten the executive summary points accordingly.
804	79731	30	50	12	50	19	What about MPAs to provide 'spill over' of eggs and larvae and therefore increase stock resilience. There is a wide literature base on this topic. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Yes, we agree but this was not relevant for this case study
805	76074	30	50	33	50	33	"changes future" there seems to be a word missing here. (UNITED STATES OF AMERICA)	Word order has been altered
806	65303	30	50	36	50	49	The examples shown here represent increase of the fish stock. It seems unbalanced. It is better to show some decrease examples. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	the examples given represent both
807	79733	30	50	38	50	44	A better description of the mackerel dispute and similar European territorial disagreements is included in the Cheung et al paper [Aquatic Conservation 22(3): 368-388, 2012] (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Thank you to the referee, we have included it now.
808	64258	30	50	40	50	43	The text says "The Atlantic mackerel has been a shared stock between EU and Norway due to its newer historical distribution. The recent advancement of the Atlantic mackerel into the Icelandic EEZ during summer has resulted in fishing from Iceland outside internationally agreed fishing quotas". To say "newer historical distribution" in the first sentence and then "recent advancement" in the latter is somewhat confusing. Therefore in the former case it is better to specify .e.g. "during the latter part of the 20th century" instead of "newer historical". Further, the latter part of the latter sentence states "has resulted in fishing from Iceland outside internationally agreed fishing quotas". It is not correct to state that "fishing from Iceland" is outside "internationally agreed fishing quotas". There are in the case of the mackerel no "internationally accepted quotas" and while that is the case all stake holders are responsible for fishing more than recommended The suggested text or phrasing for the latter sentence is therefore "The recent advancement of the Atlantic mackerel into the Icelandic EEZ during summer has resulted in fishing substantially outside recommended fishing advice". (ICELAND)	We have rewritten the text to reflect this subtlety and complexity.
809	79732	30	50	41	50	41	Delete "due to its newer historical distribution" and replace with "in the past". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text modified accordingly.
810	65731	30	50	53	50	53	Genner et al., 2010. Separated fishing impacts from responses to climate change fluctuations using a 100 year data set in the English Channel. Small fish tracked climate change; large fish species were primarily impacted by fishing pressure. Worth including? Genner MJ, Sims DW, Southward AJ, Budd GC, Masterson P, Mchugh M, Rendle P, Southall EJ, Wearmouth VJ, Hawkins SJ. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Global Change Biology 16: 517-527. (STEPHEN HAWKINS, UNIVERSITY OF SOUTHAMPTON)	We agree that these are excellent studies. However, they are restricted in scale for this discussion. We have included these papers in the North Atlantic section 30.5.1.1.1.
811	57607	30	51	3	51	3	I suggest replacing "adaption" with "adaptation" (George Somero , Stanford University)	Correction made.
812	79734	30	51	6	51	6	For a useful discussion about options that a fishery can adopt in light of climate change see the recent report by Frontier Economics In the UK for Defra (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18016) (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added reference to this document
813	84280	30	51	9	0	0	Section 30.6.2.2. The key findings of chapter 10 should be cross-referenced here, ensuring a harmonized assessment across these chapters. (Katharine Mach, IPCC WGII TSU)	We have done this and have included several linkages now to chapter 10.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
814	64636	30	51	9	51	49	30.6.2.2.this is a nice global summary for tourism issues. However, the tourism attractions here are all coastal. The chapter name was "Open Oceans" before, is this the correct place for a summary on coastal tourism? (although it was renamed "The ocean") (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	The focus of the chapter is on the oceans as a region. Our definition goes from the high tide mark to the open ocean. In text earlier in the chapter we point out that we link to these other issues but don't deal with them in great detail. Therefore, it is appropriate to talk about tourism and the issues.
815	79735	30	51	11	51	49	The tourism section does not mention many well researched topics, for example impacts of jellyfish blooms and HABs on tourism or the potential positive benefits for watersports, e.g. changes in wind and waves on sailing or surfing. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have been focused on the mission of chapter 30 which is to assess the extent to which changes are being detected that can be attributed to climate change. There are few examples mentioned here there are few that have datasets and methodologies that are designed to detect and attribute change to climate change. Consequently, many of these studies have not been listed in the 800+ references of this chapter.
816	76075	30	51	34	51	34	"Other forms of tourism... the whale..." Confusing segue. Suggest deleting the first sentence and beginning the second sentence with "in other regions" (UNITED STATES OF AMERICA)	We agree and removed the sentances regarding whale watching in favour of a more robust discussion around
817	76076	30	51	45	51	46	Not sure what is meant by "and visitors" since "challenges" is the antecedent. Missing word? This is confusing as written. (UNITED STATES OF AMERICA)	We have rewritten this sentence to make it clearer.
818	79736	30	52	3	52	11	There is a much fuller (quantitative) assessment of this issue in the UK Climate Change Risk Assessment - Marine & Fisheries sector report, including future projections and estimates of cost savings. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have referenced this report and refered the reader to chapters 10 and 28 where issues are discussed in more depth
819	57608	30	52	5	52	5	Insert "in" between "increase" and "economic" (George Somero , Stanford University)	Correction has been made.
820	79737	30	52	13	52	18	What about other shipping issues such as climate change impacts on storminess, and thus on ferry services, ports etc. There is an assessment of this issue in the UK Climate Change Risk Assessment - Marine & Fisheries sector report. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have reflected this in our text with appropriate references.
821	76077	30	52	21	52	40	Consider including a discussion of extraction of methane hydrates as fuel (recently done by Japanese company) (UNITED STATES OF AMERICA)	Yes, this is an emerging industry with the feasibility currently being explored by Japanese and other countries. As yet commercial extraction has not begun. We think a discussion of methane hydrates as fuel sources is better placed in WGIII
822	76078	30	52	21	52	40	Some discussion of renewable energy (offshore wind, current, tidal) opportunities/challenges in the face of climate change should be included in this section. (UNITED STATES OF AMERICA)	We have added discussion of renewable energy to this section and refered the reader to Chp 10 for more detail, we have also added a renewal section to 30.6.4 and referred the reader to WGIII
823	76079	30	52	34	52	34	Change "principle" to "principal" (UNITED STATES OF AMERICA)	Change has been made
824	76080	30	52	36	52	36	Is the use of "likely" here linked to a probability? If so, it should be italicized. NOTE - this same comment applies to lines 38 and 52 of this page, lines 19, 24, 36 and 39 of page 53 and line 26-27 of page 54. (UNITED STATES OF AMERICA)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
825	84281	30	52	36	52	36	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See previous response
826	84282	30	52	38	52	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See previous response
827	84283	30	52	45	0	0	Section 30.6.3.1. Assessment in this section should be coordinated with chapter 6 and 11, ensuring harmonized treatment. (Katharine Mach, IPCC WGII TSU)	We have modified the text in order to pick up some of the points made in chapter 6 and chapter 11.
828	79738	30	52	47	52	47	Revise the text as "Changing patterns of disease, marine biotoxins (harmful algal blooms), water and ....." (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The text has been revised appropriately.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
829	84284	30	52	50	52	53	It would be helpful to clarify further the logic of the interactions across these sentences. Are the "predominantly negative impacts" the impacts of disease in corals, mollusks, and other invertebrates for human populations in the low-income countries? When 1st reading the sentence, the impacts seem to be synonymous with the disease in the invertebrates, rather than implying the consequences of such disease for people. (Katharine Mach, IPCC WGII TSU)	We have reorganised the text to make it more clear we are discussing human health
830	79739	30	52	51	52	51	Include Baker-Austin et al 2013 (already in the reference list) among the studies listed. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have added Baker-Austin further down in paragraph as suggested in commetn 833
831	84285	30	52	52	52	52	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
832	79740	30	53	4	53	7	Revise the text as "enteric pathogens are correlated with heat waves, multidecadal fluctuations of ENSO....." (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Text has been revised to be clearer.
833	79741	30	53	6	53	7	Include Baker-Austin et al 2013 (already in the reference list) among the studies listed. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Reference has been included.
834	79742	30	53	12	53	27	This paragraph should be moved up to the fisheries section 30.6.2.1 (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, and implemented.
835	84286	30	53	19	53	19	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	please note this section is now in 30.6.2.1 We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
836	65304	30	53	23	50	25	I could not understand why in the western equatorial pacific has benefit with the eastward shift of tuna. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	please note this section is now in 30.6.2.1 We have revised the text to reduce confusion in this regard.
837	84287	30	53	24	53	24	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	please note this section is now in 30.6.2.1 We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
838	64637	30	53	24	53	25	Tuna is not mentioned in combination with the Pacific in 30.5.1 (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	please note this section is now in 30.6.2.1 We have amended and directed the reader to the correct section 30.6.2.1.1
839	61702	30	53	30	54	10	Given the prominence of possible mitigation strategies provided by ocean systems in the Executive Summary (Page 6, Line 19), could more be said here in terms of available evidence and the uncertainity associated with these options? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed, we have added text on these lines and referred the reader to WGIII.
840	84288	30	53	36	53	36	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
841	84289	30	53	39	53	39	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See previous response.
842	79743	30	53	39	53	40	The text seems to be very alarmist given that most CCS sites are several km below the seabed and a catastrophic release or seep of CO2 would only be expected following a major geological disaster. This is not acknowledged in the text - which gives the impression that major ecosystem consequences are a foregone conclusion. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have modified the text to reduce the impression of an alarmism while at the same time still preserving important message regarding risk.
843	76081	30	53	40	53	40	Suggest changing to "declining oxygen levels and changing trophic networks" (UNITED STATES OF AMERICA)	Agreed and text changed.
844	76082	30	53	42	53	42	This is vague as written. Suggest rewriting to point out that CO2 is either an exception or is treated in contradictory ways (the authors' intention was not clear from reading the paragraph). (UNITED STATES OF AMERICA)	We have modified the text in line with the suggestion.
845	64648	30	54	1	54	10	30.6.4.2 may rather concern a coastal topic? needs balancing with ch5 (Lena Menzel, Alfred Wegener Institute for Polar and Marine Research)	Note: this section has moved to 30.6.1. Chapter 5 does not provide discussion of blue carbon but we have linked to chp 17, which does discuss this as an adaptation strategy

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
846	69856	30	54	3	54	10	The paragraph could be improved to fill charisma gap between blue and green carbon sink. One could e.g. highlight the ability of mangrove, salt marsh, and seagrass to perform carbon burial in the sediment as a long-term carbon sequestration agent, as well as stress their advantages over green carbon sink. Several additional reference for Blue carbon sink can be mentioned, as e.g. : Pidgeon, E. (2009). Carbon Sequestration by Coastal Marine Habitats: Important Missing Sinks. In Laffoley, D.d'A. & Grimsditch, G. (Ed.). (2009). The management of natural coastal carbon sinks. Gland, Switzerland: IUCN, 53 pp. Pergent, G.. Romero, J., Pergent-Martini, C., Mateo, M.A., & Boudouresque, C.F. (1994). Primary production, stocks and fluxes in the Mediterranean seagrass Posidonia oceanica. Marine Ecology Progress Series, 106, 139- 146. Ong, J. E. (2002). The Hidden Costs of Mangrove Services: Use of Mangroves for Shrimp Aquaculture. International Science Roundtable for the Media – 4 June 2002. Bali, Indonesia. Joint event of ICSU, IGBP, IHDP, WCRP, DIVERSITAS, START. Mateo, M.A., Cebrian, J., Dunton, K., & Mutchler, T. (2006). Carbon flux in seagrass ecosystems. In W.D. Larkum, R.J. Orth, C.M. Duarte (Eds). Seagrasses: Biology, Ecology and Conservation. Springer, 567-593. Mateo, M.A., Romero, J., Pérez, Littler, M.M., & Littler, D.S. (1997). Dynamics of Millenary Organic Deposits Resulting from the Growth of the Mediterranean Seagrass Posidonia oceanica. Estuarine, Coastal and Shelf Science, 44, 103-110. Granek, E.F., & Ruttenberg, B.I. (2008). Changes in biotic and abiotic processes following mangrove removal. Estuarine, Coastal & Shelf Science 80, 555-562. Duarte, C.M., Middelburg, J.J., & Caraco, N. (2005). Major role of marine vegetation on the oceanic carbon cycle. Biogeosciences, 2, 1-8. Chmura, G.L., Anisfeld, S.C., Cahoon, D.R., & Lynch, J.C. (2003). Global carbon sequestration in tidal, saline wetland soils. Global Biogeochemical Cycles, 17, 1111. Bouillon, S., Borges, A.V., Castañeda-Moya, E., Diele, K., Dittmar, T., Duke, N.C., Kristensen, E., Lee, S.Y., Marchand, C., Middelburg, J.J., Rivera-Monroy, V.H., Smith, T.J., & Twilley, R.R. (2008). Mangrove production and carbon sinks: a revision of global budget estimates. Global Biogeochemical Cycles, 22. (NETHERLANDS)	Note: this section has moved to 30.6.1. We also highlight blue carbon in the emerging themes section. As with done this, we have taken these important suggestions on board and added some of the suggested references.
847	79744	30	54	3	54	10	What about marine biofuels or offshore renewable energy? These mitigation solutions are not mentioned at all. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Note: this section has moved to 30.6.1.We have added discussion of renewable energy to 30.6.2.4
848	84290	30	54	13	0	0	Section 30.6.5. The chapter team should ensure that statements within this section are rigorously supported by the literature. If the author team asserts hypotheses beyond what is robustly supported by available evidence, these hypotheses should be appropriately qualified. (Katharine Mach, IPCC WGII TSU)	Agreed, and text are probably changed and references added. UPDATE: We have supplimented the references with linkages to appropriate WGII chapters.
849	84291	30	54	17	54	17	The chapter team should be careful with the phrase "climate change related disasters," in that attributing individual events to climate change can be challenging. (Katharine Mach, IPCC WGII TSU)	Agreed, text modified to be more cautionary.
850	76083	30	54	25	54	25	The line "people smuggling and arms and drug trafficking" should be rewritten to read "human, arms, and drug trafficking." (UNITED STATES OF AMERICA)	Agreed, text has been modified.
851	84292	30	54	26	54	26	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
852	85113	30	54	26	54	27	Please remove these likelihood terms, as they are not based on quantitative evidence. (Michael Mastrandrea, IPCC WGII TSU)	See previous response.
853	84293	30	54	27	54	27	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See previous response.
854	76084	30	54	37	54	37	"Greenhouse footprint" is not a commonly used term. Consider changing to "carbon footprint"; Do naval activities emit other greenhouse gases (e.g., methane)? (UNITED STATES OF AMERICA)	Agreed and change made.
855	77981	30	54	40	54	40	not clear why "independence from foreign sources of energy" is relevant to this chapter (James Christian, Government of Canada)	Agreed, text modified.
856	84294	30	54	43	0	0	Section 30.6.6. For all statements in this section, the chapter team should provide line-of-sight references to the specific chapter sections supporting the findings and/or citations in the literature. (Katharine Mach, IPCC WGII TSU)	We have removed this sector in an attempt to reduce the page length of chapter 30 - and because this section did not have a lot to say given the relatively loose interaction of different sectors using the ocean. Key messages have been incorporated into 30.7.
857	84295	30	55	19	55	19	Given the usage of a level of confidence in this statement, it would be much clearer to delete "there is little credible doubt." (Katharine Mach, IPCC WGII TSU)	Done. UPDATE: This section has been moved to 30.7.2 - after 30.7.1 'Key risks and vulnerabilities'
858	61703	30	55	19	55	20	I find this (important) statement confusing due to the two uncertainty statements used - suggest to replace "little credible doubt" with "very high confidence". (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We agree-change made.
859	84296	30	55	21	55	21	This statement is potentially prescriptive, and wording should be considered. (Katharine Mach, IPCC WGII TSU)	Agreed, text changed accordingly.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
860	84297	30	55	23	55	24	Wording here should be considered to avoid a prescriptive formulation. (Katharine Mach, IPCC WGII TSU)	Agreed, text changed accordingly.
861	76085	30	56	4	56	4	Suggest changing "significant" to "important" and reserve significance for statistically-based declarations. (UNITED STATES OF AMERICA)	Agreed, text changed accordingly.
862	79745	30	56	4	56	32	There are many existing international conventions and agreements that explicitly recognise climate change and are not mentioned here e.g. the UN Straddling Stocks Agreement, aimed at enhancing the cooperative management of fisheries resources . – There is both explicit mention of climate change and implicit understanding that management needs to viewed from perspective of the prevailing environmental conditions. Under Article 6, States are required to take into account “existing and predicted oceanic, environmental and socio-economic conditions”; in Annex 1, Article 3 - States are required to conduct “research on environmental factors affecting stock abundance, and oceanographic and ecological studies”. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Thank you for this comment. We now mention some of these other agreements.
863	67944	30	56	8	0	0	It should be stressed that there are several Regional Fisheries Management Organization/Bodies, which have responsibility of management and conservation of living marine resources on the high seas. For example, after 'commons' on the L.8 of P.56, add the words as follows: ", while recognizing several Regional Fisheries Management Organizations/Bodies which are responsible for management and conservation of living marine resources on the high seas" (JAPAN)	We agree with this comment and have added the text suggested with some other modifications.
864	85114	30	56	35	0	0	Section 30.7: Sections 30.7.1 and 30.7.2 confusingly overlap with the executive summary, and I would recommend that material that overlaps be deleted here, ensuring that the executive summary presents the major conclusions of the chapter. For any material retained, please ensure clear line of sight to other chapter sections where this material is discussed, and consistent usage of calibrated uncertainty language. Conclusions of the chapter should not be presented here without such language. (Michael Mastrandrea, IPCC WGII TSU)	Agreed, we have tried as much as possible to reduce the overlap between the concluding remarks and the executive summary. We have also ensured that any remaining material has a clear line of sight to other chapter sections where this material is discussed and have ensured that a consistent usage of calibrated uncertainty language has been implemented/retained. UPDATE: We have rewritten the final sections and have made it more consistent, shorter in blank and with a greater line of sight developing back through chapter 30.
865	61704	30	56	40	56	41	The importance of "rates of change" in ocean variables and the impact of this on ocean ecosystems is clearly expressed here yet is missing from the Executive Summary (aside from with reference to Ocean Acidification). I suggest to include this point as made in 30.7. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We have included this point in the executive summary now.
866	84298	30	56	40	56	41	This overarching finding could be more specific. What does "fundamental" mean, and how does the assertion differ across different levels of climate change and time frames? (Katharine Mach, IPCC WGII TSU)	We have rewritten the text to make it clearer in this respect.
867	77982	30	56	41	56	41	This statement is probably only true (at the "virtually certain" level) for high-emission scenarios. It probably will happen, but it is scenario-dependent. (James Christian, Government of Canada)	We respectfully disagree. The rigorous analysis undertaken in 30.4 already shows major, fundamental changes occurring in ecosystem structure and function. One has only to consider the fact that a large number of organisms are migrating polewards to be able to support the statement that changes in key variables are virtually certain to drive fundamental change in ocean ecosystem structure and function.
868	84299	30	56	44	0	0	Section 30.7.1. For all key findings in this section, the chapter team should ensure that it provides line-of-sight references to the supporting chapter sections. For projections given, the relevant levels of climate change and time frames (near-term versus long-term, for example) should be specified as much as possible, enhancing the nuance of these statements. (Katharine Mach, IPCC WGII TSU)	We have rewritten the text to take on board these important comments. UPDATE: the entire 30.7 section has been shortened and rewritten in response to reviewers comments about it repeating messages already delivered, and overlapping significantly within chapter 30 and with other chapters. The result of the rewrite is a much tighter, efficient and impactful final section to chapter 30.
869	76086	30	56	46	56	46	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. (UNITED STATES OF AMERICA)	We have corrected this

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
870	57353	30	56	47	56	47	What is "the Earth Ocean"? Do you mean "Earth's Ocean" - which is anyway a pretty weird combination. How about "world's oceans"? (Erica Head, Fisheries and Oceans Canada)	We have corrected this typographical error.
871	60257	30	56	47	56	47	The term 'Earth Ocean' is a little odd, suggest rephrasing to the 'Earth's oceans' or 'global oceans'. (AUSTRALIA)	We have corrected this typographical error.
872	77983	30	56	49	56	49	"thousands to millions of years" I would say millions to tens of millions. (James Christian, Government of Canada)	Agreed, we have made those changes.
873	84300	30	57	4	57	4	It would be helpful to clarify what is meant by "ecosystem assemblages that have no recent analog"--recent on what timescale? (Katharine Mach, IPCC WGII TSU)	We have rewritten this to be clearer and have provided the time scale.
874	84301	30	57	8	57	8	The phrase "serious ramifications" is not particularly clear--is it possible to indicate more precisely what is meant? (Katharine Mach, IPCC WGII TSU)	We have rewritten this section to be more precise with respect to the phrase 'serious ramifications'.
875	61931	30	57	9	57	11	The paragraph 30.7.1 Major Conclusions (see also executive summary page 5, line 8-15) says " In several of the world's semi-enclosed oceans (Baltic, Black, and Mediterranean Seas), ocean warming is leading to greater water column stability, which in turn has reduced mixing and primary productivity, leading to increased hypoxia at depth." Concerning these three semi-enclosed oceans I was not able to find, in chapter 30, the observational evidence for this proposed mechanism. This suggestion also appears counterintuitive in several aspects. First, isn't oxygen transported to depth in the Mediterranean Sea as a result of local deep water formation by sinking dense water due to increased salinity because of heating of the surface layer? Shouldn't we then expect more oxygen transport to depth with more warming? Second, wouldn't reduced primary production cause less sedimentation of organic material to the depth and thereby reduced respiration/oxygen consumption in the basin waters of these enclosed Seas. Third, a decrease in the primary production of the surface water causes deepening of the euphotic zone, deeper primary production, and so also of the associated oxygen production. My main concern, however, is that the statement appears to be based on a general hypothesis rather than specific observations for the areas considered. (Dag Lorents Aksnes, University of Bergen)	UPDATE: the entire 30.7 section has been shortened and rewritten in response to reviewers comments about it repeating messages already delivered, and overlapping significantly within chapter 30 and with other chapters. The result of the rewrite is a much tighter, efficient and impactful final section to chapter 30.
876	84302	30	57	14	57	16	Wording here could be adjusted to avoid a prescriptive formulation. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.
877	84303	30	57	18	57	23	Line-of-sight references should be provided for these statements. (Katharine Mach, IPCC WGII TSU)	Line of sight references have been added.
878	84304	30	57	30	57	30	Is it possible to indicate more precisely what is meant by "fundamental changes"? (Katharine Mach, IPCC WGII TSU)	We have modified the text to be more specific with respect to the phrase 'fundamental changes'.
879	76087	30	57	30	57	32	"Fundamental changes... composition of plankton communities... key fisheries." Where is this shown? It is unclear as to what 30.14B refers to. It is uncertain that the composition of plankton communities affecting fisheries has been attributed to acidification. Some revision is necessary, but the meaning is unclear so it is difficult to recommend an edit. (UNITED STATES OF AMERICA)	Text has been modified to be clearer.
880	77984	30	57	30	57	32	This is a very far-reaching statement and not substantiated to my knowledge. Data reference is unclear. There is no section 30.14 or Figure 30.14B. Figure 30.14 is the expert-elicitation exercise. I have participated in such exercises where the consensus is that such ecosystem reorganizations are likely to happen in the fairly near future, but that's different from saying that there is strong evidence that such changes are already occurring. (James Christian, Government of Canada)	Text has been modified to be clearer.
881	57354	30	57	35	57	35	At the end of this paragraph should there be a mention of the widespread ongoing over-fishing that is probably currently a greater threat to fish populations than climate change, and that will exacerbate the effects of the latter in future? (Erica Head, Fisheries and Oceans Canada)	Agreed, we have now added this to the text.
882	76088	30	57	39	57	39	Is the use of "likely" here linked to a probability? If so, it should be italicized. (UNITED STATES OF AMERICA)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
883	84305	30	57	39	57	39	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	See previous comment
884	84306	30	57	45	57	52	Line-of-sight references must be provided for these statements. (Katharine Mach, IPCC WGII TSU)	Line of sight references have been added.
885	84307	30	58	1	0	0	Section 30.7.2. The chapter team should strongly consider deleting this section. If retained, all statements must be directly supported by assessment in previous sections, with line-of-sight references provided to indicate the traceable account for each statement. Additionally, the chapter team should ensure that ambiguous value judgments that overstep the mandate of the chapter are avoided. To do so, terminology such as "concern" and "serious" should be deleted, with calibrated uncertainty language used instead. (Katharine Mach, IPCC WGII TSU)	UPDATE: The section has been rewritten and now focuses on 10 emerging issues, gaps and research need themes.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
886	60258	30	58	1	58	50	The Emerging Themes section is a really interesting and useful section. It is well written and provides a good overview of some new areas of importance. This would be a useful section to include in all chapters (AUSTRALIA)	We thank the reviewer for their generous comment.
887	57355	30	58	3	58	3	Change "world oceans" to "world's oceans" (Erica Head, Fisheries and Oceans Canada)	Change has been made.
888	84308	30	58	5	58	7	Line-of-sight references and calibrated uncertainty language are especially needed for this statement. (Katharine Mach, IPCC WGII TSU)	This section has been removed.
889	60259	30	58	9	58	9	Please define what is meant by 'ocean core'? (AUSTRALIA)	We have amended this
890	57356	30	58	11	58	11	This should be "temperature influences on the rate of" (i.e. omit the ratio) (Erica Head, Fisheries and Oceans Canada)	Agreed, change made.
891	84309	30	58	14	58	14	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
892	76089	30	58	17	58	19	Is the oceans' ability to maintain O2 in the atmosphere really an issue? If so, please provide supporting references. (UNITED STATES OF AMERICA)	We have deleted this sentence
893	77985	30	58	18	58	19	Not clear how any plausible climate change scenario could appreciably change the oxygen content of the atmosphere. (James Christian, Government of Canada)	We have deleted this sentence
894	76090	30	58	29	58	29	Is "robust" being used her as an official confidence statement? If so, it should be italicized and accompanied by a statement about the degree of agreement. (UNITED STATES OF AMERICA)	We have modified to "large body of evidence"
895	76091	30	58	30	58	30	Revise to "years and that some organisms experience negative impacts from this change." It's important to show the relevance to ecosystems after the setup at the beginning of the paragraph (UNITED STATES OF AMERICA)	Agreed, the text has been modified.
896	80743	30	58	31	0	0	I wonder whether the citations of Hogh-Guldberg and Raven are the best ones. Consider: Caldeira K. & Wickett M. E., 2003. Anthropogenic carbon and ocean pH. Nature 425:365. Zeebe R. E. & Ridgwell A., 2011. Past changes of ocean carbonate chemistry. In: Gattuso J.-P. & Hansson L. (Eds.), Ocean acidification, pp. 21-40. Oxford: Oxford University Press. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We have made the appropriate changes.
897	84310	30	58	32	58	36	These statements should be harmonized with assessment in chapter 6 and 5, with cross-reference provided here. (Katharine Mach, IPCC WGII TSU)	We have harmonised these statements with chapters 5 and six, an appropriate references and linkages have been provided.
898	84311	30	58	38	58	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
899	65305	30	58	38	58	50	It seems better to add biological feedback to CO2 absorption. If the primary production decreases, the CO2 absorption by Ocean will decrease and accelerate the warming. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	Agreed, and change has been made.
900	57357	30	58	42	58	50	I am uncomfortable with the "certainty" expressed here that primary production has decreased in the major ocean basins in light of conflicting satellite-based and in situ observations, and the fact that the executive summary of Chapter 6 expresses uncertainty about whether there will be an increase or decrease in NPP by 2100. I would rewrite things thus (Erica Head, Fisheries and Oceans Canada)	We have modified the text here in line with the other substantial changes made with respect to the phytoplankton communities and climate change. Our position has been harmonised now and is in consensus with the conclusions of chapter 6 and the scientific literature in general. we have now added a cost chapter box (CC-NPP) which integrates the understanding of phytoplankton communities and climate change across several chapters of working group II.
901	57358	30	58	42	58	50	"While productivity in the major ocean basins has been reported to have decreased (satellite-based observations) or increased (based on in situ observations) in recent decades, it is highly likely that it will decrease in future over the longer term. Recent and future changes need to be considered in the light of natural climate variability such as ENSO, PDO and NAO, however, and it is necessary that we develop a greater understanding of the potential implications of changes that may occur over both the short and long term. Decreased primary production will lead to a reduction in ocean services with potentially serious consequences in the coming decades and century. In combination with changes to sea temperature etc" (Erica Head, Fisheries and Oceans Canada)	See previous response.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
902	57359	30	58	42	58	50	In Line 50 I would replace "current changes" with "recent and ongoing changes" (Erica Head, Fisheries and Oceans Canada)	Agreed, this change has been made. UPDATE: this phrase no longer exists in the rewrite of this section.
903	76093	30	59	0	59	0	This section could be more specific about research and data gaps. It is hard from the current text to prioritize data needs. See Himli (2012) et al. for a review of knowledge gaps preventing economists from estimating welfare impacts of ocean acidification. Hilmi, Nathalie, et al. "Towards improved socio-economic assessments of ocean acidification impacts." Marine Biology (2012): 1-15. (UNITED STATES OF AMERICA)	We have taken on board this comment and have modified the text appropriate leave. We make great a reference to these key papers. UPDATE: these papers have now been added at appropriate points within the ocean acidification discussion of gaps etc.
904	65306	30	59	1	59	54	We may be able to consider about change of the current state. However, it is nearly impossible to project new species emergence in the future. This is very big issue for us. It seems better to denote about it. (Shin-ichi Ito, Fisheries Research Agency, Tohoku National Fisheries Research Institute)	We thank the reviewer for the comment. The emergence of new species will take hundreds if not thousands of years, and is not part of the current assessment.
905	57360	30	59	6	59	7	Suggested replacement "comprehensive measurements of many parameters have only been available for the past 50 years or less, and then only for some ocean regions." (Erica Head, Fisheries and Oceans Canada)	Agreed, text replacement made. UPDATE: this last section has been completely rewritten to be more efficient, shorter and with a greater line of sight to the rest of the chapter.
906	84312	30	59	7	59	7	This statement should be reworded to avoid a prescriptive formulation. (Katharine Mach, IPCC WGII TSU)	We have deleted this sentence
907	84313	30	59	8	59	8	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have deleted this sentence
908	57361	30	59	14	59	16	Suggested replacement "ocean basins is especially important given the significant influence of short-term natural climate variability (e.g. ENSO, PDO, AMO) that is superimposed on the long-term trends. Understanding how the variability that key fisheries currently face will be affected by ocean warming and acidification presents another important knowledge and research gap. " (Erica Head, Fisheries and Oceans Canada)	Agreed, text replacement made. UPDATE: have now referred to Hilmi et al 2013
909	57362	30	59	18	59	18	Replace "abundant" with "extensive" (Erica Head, Fisheries and Oceans Canada)	Agreed, text replacement made.
910	76092	30	59	18	59	18	Change "most abundant" to "largest". Abundance implies bounty. (UNITED STATES OF AMERICA)	We have changed to extensive (see above)
911	57363	30	59	20	59	20	What are the "non-climate change factors" that are impacting, or might impact, the deep ocean? I didn't see anything in the section on "Deep Sea" that started on Page 44 that would fit the bill. (Erica Head, Fisheries and Oceans Canada)	We have added a couple of sentences in the DC section to cover this.
912	57364	30	59	29	59	29	Replace "copepods" with "zooplankton" (Erica Head, Fisheries and Oceans Canada)	Agreed, text replacement made.
913	57365	30	59	31	59	31	Most of the cnidarians studied are free swimming, not benthic, so omit "cnidarians", or "benthic", or replace cnidarians with some other much studied benthic invertebrate. (Erica Head, Fisheries and Oceans Canada)	Agreed, text has been changed.
914	84314	30	59	35	59	35	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
915	84315	30	59	36	59	37	Calibrated uncertainty language and line-of-sight references should be provided for this statement. Harmonization with chapter 6 should also be ensured. (Katharine Mach, IPCC WGII TSU)	We have harmonised these statements with chapters 5 and six, and appropriate references and linkages have been provided.
916	84316	30	59	39	59	39	Wording here ("it is an imperative") should be adjusted to avoid a prescriptive formulation. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified.
917	57366	30	59	48	59	48	Change thus "be applied at a scale which will help us to understand and project" (Erica Head, Fisheries and Oceans Canada)	Agreed, text replacement made.
918	84317	30	59	48	59	48	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	We have gone through the manuscript and have corrected/avoided the casual use of terms like 'likely' and 'very likely'.
919	79746	30	60	3	60	3	Need to make sure these FAQs have some consistency (or at least do not conflict with) those in Chapter 6 (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Given the changes with respect to issues like phytoplankton communities and climate change, we have modified the text of our FAQ so that they are harmonised with chapter 6.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
920	70558	30	60	7	60	8	"These changes can be reversed if emissions are stopped". I think there are no evidences demostrating "reversed". Need to show evidence of being reversed. (AKIHIKO MURATA, Japan Agency for Marine-Earth Science and Technology)	Working Group I provides evidence. We have rewritten this FAQ and recognise that there are changes that will not be reversible
921	57367	30	60	8	60	8	Replace "slower" with "more slowly" (Erica Head, Fisheries and Oceans Canada)	Replacement has been made.
922	71479	30	60	14	0	0	This FAQ seems to have no specific link to the oceans and therefore does not seem relevant for this chapter. Suggest revising or deleting. (CANADA)	We recognise the reviewers point. We have added 'in the ocean?' at the end of the question to clarify.
923	81289	30	60	14	0	0	FAQ 30-2 Authors may wish to highlight other acions besides better management like managing consumption, etc. (Monalisa Chatterjee, IPCC WGII TSU)	This is a good point and we have added a sentence with this sentiment.
924	57368	30	60	14	60	15	Suggested replacement "FAQ 30.2: How can we manage the effects of climate change in the ocean? Natural systems are exposed to a variety of stressors in addition to climate change. We need to etc" (Erica Head, Fisheries and Oceans Canada)	See previous response. We agree and have made the appropriate change.
925	84318	30	60	15	60	16	Wording here should be adjusted to avoid a prescriptive formulation. (Katharine Mach, IPCC WGII TSU)	Agreed, text has been modified accordingly.
926	57369	30	60	22	60	24	Suggested replacement "Developing ecosystem-based management for fishery resources where climate-induced changes in productivity are occurring will help maintain their sustainability." (Erica Head, Fisheries and Oceans Canada)	no longer relevant
927	79747	30	60	22	60	24	This sentence ("Developing ecosystem.....") doesn't make sense grammatically (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	no longer relevant
928	71480	30	60	26	0	0	This FAQ should specify that the focus is on marine plants and animals (not plants and animals generally). (CANADA)	Agreed, the word 'marine' has been added before the word 'plants'.
929	81290	30	60	26	0	0	FAQ 30-3 The land /ocean comarison is good. Perhaps the question could reflect it. (Monalisa Chatterjee, IPCC WGII TSU)	We thank the reviewer for their comment.
930	57370	30	60	27	60	27	Suggested replacement "The opportunities for adaptation and accommodation to climate change etc" (Erica Head, Fisheries and Oceans Canada)	This sentance has been rewritten
931	81291	30	60	38	0	0	FAQ 30-4 Authors may wish to explain marine primary productivity for the benefit of general audience. (Monalisa Chatterjee, IPCC WGII TSU)	We have made this change "phytoplankton are the dominant marine primary producers"
932	79748	30	60	39	60	47	Check consistency with discussion in chapter 6 on productivity, as seems to anticipate a decrease, not an increase. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We no longer refer to a decrease but highlight the uncertainty in anticipated change
933	57371	30	60	41	60	42	Suggested replacement "Their photosynthetic activity provides approximately etc" (Erica Head, Fisheries and Oceans Canada)	This text has been rewritten
934	63094	30	60	42	60	42	Change 'supports' by 'support' and 'influences' by 'influence' (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	This text has been rewritten
935	76094	30	60	42	60	42	"Their photosynthetic activity provides approximately half the oxygen we breath." Suggest deleting this statement as it is misleading. Oxygen consumption by humans is completely insignificant at planetary scales. (UNITED STATES OF AMERICA)	This text has been removed
936	57372	30	60	47	60	47	Replace "in-water" with "in situ" (Erica Head, Fisheries and Oceans Canada)	This text has been rewritten
937	84319	30	60	49	60	49	This question is not clear. Does "actual loss of life" mean extinction or local extinction or...? (Katharine Mach, IPCC WGII TSU)	We have rewritten the text to make it clearer.
938	76095	30	60	51	60	51	Solubility changes pO2 in a fractional sense . 14 umol/kg will only apply for O2 levels at saturation. (UNITED STATES OF AMERICA)	Agreed, text modified to make this clearer.
939	71481	30	60	54	0	0	Is it possible to clarify the extent of loss of life a little further? It will be hard for non-experts to put this text into perspective. (CANADA)	Agreed, this now has been clarified through changes to the text.
940	84320	30	61	3	61	3	Is this outcome expected at 2°C increase? It would be helpful to clarify this. (Katharine Mach, IPCC WGII TSU)	Good point,but not able to clarify this
941	76096	30	61	3	61	10	This passage seems extremely technical compared to the surrounding material and probably should have been discussed elsewhere in the chapter. Too much detail for a FAQ - who is the target audience for these FAQs? As written, it is not accessible to a lay audience (or a non-expert, for that matter). (UNITED STATES OF AMERICA)	We agree and have written this FAQ to be simpler and clearer.
942	57609	30	61	7	61	7	"Ocean data show…" (plural subject) (George Somero , Stanford University)	Change has been made.
943	57373	30	61	24	61	24	Insertion thus "cultural activities (religion, tourism)" (Erica Head, Fisheries and Oceans Canada)	We have not chosen to incorporate this perspective because we believe that it is fine to list culture services as all other services.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
944	76097	30	61	29	61	29	Change "Occur" to "be apparent". Warming and OA were presumably already occurring but were not sensed before then. (UNITED STATES OF AMERICA)	The text has been revised to make it clear that the disturbances became widespread in the 1980s, rather than began to occur in the 1980s.
945	79749	30	61	29	61	29	The text should read " the most important and pervasive environmental variables". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The sentence has been modified to read: "While many factors, such as overfishing and local pollution, are involved in the decline of coral reefs, climate change by changing fundamental variable such as sea temperature, ocean acidity, and storm strength can play an important role in determining the health and abundance of coral reefs (De'ath et al. 2012). "
946	57374	30	61	30	61	31	This last sentence makes no sense. It should be replaced with something like "Corals are extrememly important as ecosystem engineers, providing habitat for large numbers of species (Wild et al. 2011)." (Erica Head, Fisheries and Oceans Canada)	The text has been modified accordingly.
947	76098	30	61	38	61	38	Reference to figure "5X" needs to be updated with the appropriate figure number. (UNITED STATES OF AMERICA)	Yes.
948	76099	30	61	43	61	43	For findings with high agreement and robust evidence, present a level of confidence or a quantified measure of uncertainty. NOTE - this comment also applies to page 62, lines 6 and 9-10. (UNITED STATES OF AMERICA)	The text has been modified accordingly.
949	63097	30	62	12	62	12	Should be Frieler et al., 2012. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	2013 is correct as it is the final publication date (2012 was the publication on-line).
950	76100	30	62	22	62	46	References to figures in this section need to be updated with the appropriate figure numbers (e.g. lines 22 and 46). (UNITED STATES OF AMERICA)	The text has been modified accordingly.
951	79750	30	64	6	66	21	This box (on ocean acidification seems unnecessary as almost everything here is included in the chapter 6 text, where it is substantially better written! (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The cross-chapter boxes are included in all participating chapters. This is an editorial decision of the WG2 TSU.
952	69857	30	64	17	64	19	Box CC-OA. The definition of ocean acidification is quite confusing. We would suggest: "... the uptake of CO2 into mildly alkaline ocean results in an increase in dissolved CO2 that combined with water reduces the pH, dissolved carbonate ion and the capacity ....." (NETHERLANDS)	We have not chosen to incorporate this perspective because it is found more confusing. The present wording is scientifically sound and read well.
953	76101	30	64	21	64	21	Change to read...WGI Table 3.2 and Figure 3.18. (UNITED STATES OF AMERICA)	The text has been corrected accordingly.
954	76102	30	64	27	64	27	Reference to figure WGII, Figure 6.28 should actually be WGI, Figure 6.28. (UNITED STATES OF AMERICA)	The text has been corrected accordingly.
955	63089	30	64	35	64	35	Kroeker et al., 2013. Work published already. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	The text has been corrected accordingly.
956	69858	30	64	36	64	37	Box CC-OA. There is a reference to a Figure X.C, that does not exist. (NETHERLANDS)	The text has been corrected accordingly.
957	76103	30	64	37	64	37	Replace "X.C" with "OA-IC" (UNITED STATES OF AMERICA)	The text has been corrected accordingly.
958	57375	30	64	40	64	43	I don't think bivalves and snails compete with seaweeds, and neither do I think they are "ecosystem builders", so this paragraph needs re-working. (Erica Head, Fisheries and Oceans Canada)	The text has been corrected accordingly.
959	63091	30	64	41	64	41	Raven in press, which is this reference? Not in the list.. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	It is Raven (2011). The text has been corrected accordingly.
960	79751	30	64	41	64	41	Do seaweeds really compete with snails (this is how the sentence reads). Also I'm not sure I would label marine gastropods 'snails' as this might confuse the reader (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The text has been corrected accordingly.
961	79752	30	64	48	64	48	Should mention the possibility of potential 'bottom up' impacts through marie food-webs. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	This is addressed a little further in the box (p. 65 of the SOD, line 36 onwards).
962	76104	30	65	35	65	35	Confidence statements should be italicized. (UNITED STATES OF AMERICA)	Italics are now used.
963	76105	30	65	36	65	36	Add "limited evidence, medium agreement" at end of sentence. (UNITED STATES OF AMERICA)	The text has been revised accordingly.
964	76106	30	65	42	65	42	Add "limited evidence" at end of sentence. (UNITED STATES OF AMERICA)	The text has been corrected accordingly.
965	63092	30	65	47	65	47	Billé et al., submitted, which is this reference? Not in the list.. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	It is now in press and the reference has been added to the reference list.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
966	65063	30	65	48	0	50	Again, we suggest different wording: "Climate geoengineering techniques based on solar radiation management will not abate ocean acidification, and, in some cases, could increase it (Williamson and Turley, 2012). (Action Group on Erosion, Technology and Concentration (ETC Group))	The text has been corrected accordingly.
967	57510	30	65	48	65	50	See the comment to (Chapter 5, Page 50, Lines 26-28) (Alexey Ryaboshapko, Institute of Global Climate and Ecology)	See reply to comment #1147 on chapter 5.
968	76107	30	66	0	0	0	Presumably, there needs to be some reference to Figure OA-1A in the preceeding text. (UNITED STATES OF AMERICA)	Yes, reference added.
969	79753	30	66	6	66	6	Also see Roberts et al (2013) [Global Change Biology, 19: 340-351.] on the interaction between metal toxicity/pollution and ocean acidification. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have not chosen to incorporate this perspective because space is very strictly limited.
970	63093	30	66	18	66	18	Kroeker et al., 2013. Work published already. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	Yes, the text has been updated.
971	63085	30	71	5	71	5	Add accents to authors: Simó, Sabatés (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have added the accents as requested.
972	63095	30	78	5	78	6	Remove reference since the correct one is the previous one, lines 3-4. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have removed the reference.
973	63090	30	80	19	80	21	This paper is now published: Kroeker, K.J., Kordas, R.L., Crim, R., Hendriks, I.E., Ramajo, L., Singh, G.S., Duarte, C.M., Gattuso, J.-P., 2013. Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global Change Biology 19, 1884–1896. (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	We have corrected the reference.
974	63098	30	86	19	86	20	Poloczanska et al., 2013, Science, which is this reference? Has it been accepted? (Carles Pelejero, ICREA and Institut de Ciències del Mar, CSIC)	This paper is now in press in PNAS.
975	84321	30	94	0	0	0	Table 30-1. As a minor point, in some entries "system" is singular and in others "systems" is used. Should the same approach be used for each? For the 8th entry, it might be helpful to indicate also that the sub-region is not shown within figure 30-1, which is implied by the chapter 28 reference but not explicitly stated. For the 2nd footnote, what are the units of fish catches used? For the 3rd footnote, it would be helpful to clarify what the "<0.5%" means. (Katharine Mach, IPCC WGII TSU)	We have rectified this problem and have now a consistent use of single versus plural descriptions.
976	79754	30	94	0	94	0	Table 30-1 OK but largely repeats data that is included in figure 30-1 (panel B) (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We respectfully disagree. The data emphasise satellite derived productivity and fisheries numbers which are not represented in figure 30-1.
977	76108	30	95	0	0	0	Table 30-2 Comments - this table and its description in the text are quite confusing. There is a tremendous amount of unclear or undefined information. The methods are unclear (index of variability, how 1x1 squares results were consolidated). Columns 3 and 5 are redundant information. What does a "pink" index of variability mean, and what is the difference between a value <0.8 versus >1.2? Does this compare the two 10-year trends, the difference in the 10-year means, or some combination? This table needs to be reconsidered. (UNITED STATES OF AMERICA)	We have rewritten the legend to table 30-2 so that it is clear and less confusing. UPDATE: table has been reconstituted and is now clearer and more direct.
978	84322	30	99	0	0	0	Table 30-4. For the estimates provided in this table, is it possible to provide the uncertainties or associated ranges for the estimates? Also, for "difference RCP 8.5-2.6" it would be helpful to clarify that these values correspond to the long term. (Katharine Mach, IPCC WGII TSU)	We have added range of uncertainties into Table (detail would overwhelm table which is already complex - Instead, we have added text explaining these in legend - with a linkage to discussion of these - contained in the climate change projection chapters in WGI and the associated Climate Atlas.
979	76109	30	103	0	0	0	Tabel 30-6 Comments - In the table caption, the symbols for sea level rise increase and decrease are incorrect, these should be up and down arrows instead of boxes. (note - this issue seems to depend on the computer/system on which the file was viewed. Not all reviewers had this problem. (UNITED STATES OF AMERICA)	We thank the reviewer for identifying the problem and have corrected it.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
980	84323	30	103	0	0	0	Table 30-6. For these risks, the chapter team is strongly encouraged to consider indicating risks in the near-term (through the 2040s) and in the long-term (the 2nd half of the century and beyond, perhaps with focus on the end of the century). Please see table SPM.4, as its framing could be relevant here. (Katharine Mach, IPCC WGII TSU)	We agree and have put entries about the near-term (2040) and long-term (2100) where we feel we have enough information. In many cases, it is difficult to be so specific about near term and long term risks. UPDATE: we have added a joint cable for marine risks and vulnerabilities which will be added to this chapter (and have put several tables up as supplementary material). The key risks and vulnerability table gives information on how risks change in the short and long term, and hence come along way to satisfying the reviewers concern.
981	84324	30	106	0	0	0	Figure 30-1. As a minor point, it would be helpful to clarify the context at the start of this caption: "In this chapter, the world's non-polar oceans..." (Katharine Mach, IPCC WGII TSU)	Agreed, we have modified the text accordingly.
982	79755	30	106	0	106	0	Figure 30-1 generally ok, but the caption refers to region "7" deep sea, but this is not included on the map. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have clarified in the text - the small insert map towards the bottom right hand corner illustrates the seventh region.
983	76110	30	107	0	0	0	Figure 30-2 Comments - The caption should provide an explanation of the color legend indicating that the pink coloring indicates overalap of historical and natural conditions. (UNITED STATES OF AMERICA)	We have added this detail to the legend.
984	57610	30	107	0	107	0	Figure 30-2: The color codes given within the three frames are very hard to discern due to their tiny size. The same criticism applies to some of the other figures, e.g., 30-3 (George Somero , Stanford University)	We have corrected this problem by making the colour codes larger. In this figure and the others where relevant.
985	85244	30	107	1	107	20	The temperature record is running below any of the projections (Vincent Gray, Climate Consultant)	The observed record is shown on the graphs as a black line. At this point, it remains consistent with greenhouse forced back projections as opposed to back projections that do not include greenhouse forcing. In addition to this, there is an extensive literature at an WG1 and in the peer-reviewed literature about the significance of land records flattening out. The heat content of the ocean has continued to increase.
986	68150	30	108	0	0	0	Figure 30-3 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	Figure 30-3 now does NOT show national borders in contrast to the review is comment.
987	76111	30	108	0	0	0	Figure 30-3 Comment: caption has an "E" but no figure (UNITED STATES OF AMERICA)	We have rectified this error in the legend.
988	76112	30	108	0	0	0	Figure 30-3 Comments - Line 4 in the figure caption appears to reference a panel E. There is no panel E. (UNITED STATES OF AMERICA)	We have rectified this error in the legend.
989	76113	30	108	0	0	0	Figure 30-3 Comments - The legend for Figure 30-3 should mention what the positive/negative values of velocity and shift in SST mean (e.g., positive denotes poleward movement and earlier warming/later cooling). (UNITED STATES OF AMERICA)	We have modified the legend to make this clear.
990	76114	30	108	0	0	0	Figure 30-3 Comments - The purple-green color scheme used for C and D is very odd and difficult to interpret. Suggest changing to a blue/red scheme (UNITED STATES OF AMERICA)	We respectfully disagree given that we wish to ensure that figures a and B are not mixed up with C and D.
991	84325	30	108	0	0	0	Figure 30-3. As a minor point, it could be helpful for the reader to specify how the scales for parts C and D should be interpreted in terms of positive and negative values corresponding to earlier/later timing of sea surface temperature signals. (Katharine Mach, IPCC WGII TSU)	We have modified the legend to make this clear.
992	68151	30	109	0	0	0	Figure 30-4 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	Figure 30-4 now does NOT have national borders.
993	84326	30	109	0	0	0	Figure 30-5. For part B of this figure, is it possible to distinguish further the colors used in the scale bar, so that, for example, values between 50 and 100% could be distinguished more clearly? (Katharine Mach, IPCC WGII TSU)	We have worked with the scale to provide greater regulation.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
994	76115	30	110	0	0	0	Figure 30-6 Comments - Panel A. The magnitude and trends in NCEP winds do not match other prodcuts. In particualr the large decrease in wind in the equatorial Pacific does not match other records (UNITED STATES OF AMERICA)	NCEP is a blend of product and hence captures some of the variability between models. We have looked at other models and don't find them to be two different. UPDATE: we have dropped major discussion of wind and similar variables, and hence these figures have been dropped from chapter 30.
995	79756	30	110	0	110	0	In the caption for figure 30-6, insert the word "Surface" so it reads "Surface salinity as the percentage change from....". (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, text has been changed. UPDATE: we have dropped these figures given the uncertainties communicated by various expert reviewers.
996	57611	30	111	0	0	0	Figure 30-7: Remove "ppm" from the pH color-calibration bar near the center of the page (George Somero , Stanford University)	Change has been adopted. UPDATE: we are now using a figure from WG1 AR5 - this figure is now in the supplementary material up on the web.
997	76116	30	111	0	0	0	Figure 30-7 Comments - The Arctic Ocean is completely missing in these plots. Suggest using the plots from Feely et al (2009). (UNITED STATES OF AMERICA)	We are not focused on the polar oceans as this is the remit of chapter 28. We have indicated a link to those chapters in which greater detail on conditions within polar oceans can be found.
998	76117	30	111	0	0	0	Figure 30-7 Comments - What criteria were used to set the color divisions on Figure 30-7? For example, please explain why 3.3 is the only point shown on the colorbar for Figure B and seems to correspond to the transition from yellow to green. Also, it looks like the distance between 7.6-7.8 pH doesn't match that between 7.8 and 8.0. On A, remove "ppm" label next to colorbar. (UNITED STATES OF AMERICA)	We have explained the significance of the value 3.3. This represents a hypothetical point at which carbonate reef systems, for example, no longer accumulate net calcium carbonate over time. We have reviewed this element and have made a number of modifications to improve the clarity and relevance for a wider set of ecosystems.
999	80739	30	111	0	0	0	These data are from OCMIP-3. It would seem better to use the more recent estimates of CMIP-5 reported by Bopp L., Resplandy L., Orr J. C., Doney S. C., Dunne J. P., Gehlen M., Halloran P., Heinze C., Ilyina T., Séférian R., Tjiputra J. & Vichi M., 2013. Multiple stressors of ocean ecosystems in the 21st century: projections with CMIP5 models. Biogeosciences Discussions 10:3627-3676. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We agree with the reviewer and have included the projections from the CMIP5 models.
1000	76118	30	112	0	0	0	Figure 30-8 Comments - In line 1 of the figure caption and in the figure title, the critical value of partial pressure of O2 needs to be changed to 60 microatm instead of 60 matm. (UNITED STATES OF AMERICA)	Agreed, change has been made. UPDATE: we are using a figure from WG1 AR5 - to ensure consistency - using the geographical information in these figures which has not been generally discussed in detail by WG1.
1001	76119	30	114	0	0	0	Figure 30-10 Comments - What is "consistent with climate change predictions"? The nature and source of the predictions needs to be specified. More information/clarification is needed. (UNITED STATES OF AMERICA)	A definition to clarify what is meant by consistent with climate change predictions has now been included in the legend and in the main text.
1002	76120	30	116	0	0	0	Figure 30-12 Comments - In line 3 of the figure caption, there is reference to Figure 30.3. This should be Figure 30.4. Also in line 3, there is reference made to bar graphs for the period 1870-2009, however, there are no bar graphs. In line 11 of the figure caption, there is reference made to Figure 30.4, and this should be figure 30.3. (UNITED STATES OF AMERICA)	We have rewritten the caption to correct these errors.
1003	81459	30	116	0	0	0	Figure 30-12: Black lines depicting historic values are mostly invisible for many of charts. Please provide y-axis title. (Yuka Estrada, IPCC WGII TSU)	The figure has been re-drafted and the lines thickened up.
1004	84327	30	116	0	0	0	Figure 30-12. Within the caption, it would be helpful to more clearly distinguish parts A, B, and C of the figure. Additionally, the bar graphs within each panel should be darkened to make them more visible, as they are currently somewhat hard to see. (Katharine Mach, IPCC WGII TSU)	See previous comment.
1005	76121	30	117	0	0	0	Figur 30-13 Comments - In lines 2 and 3 of the figure caption, panel B should be switched with panel C. (UNITED STATES OF AMERICA)	We have corrected the error.
1006	84328	30	117	0	0	0	Figure 30-13. It would be helpful to clarify labeling across the panels so that each graph in parts B and C could be more clearly associated with a region in part A. (Katharine Mach, IPCC WGII TSU)	Agreed, changes have been made.
1007	76122	30	118	0	0	0	Figure 30-14 Comments - Text should be added to the figure caption stating that the numbers on the graph points indicate subregion (presumably) and matching the numbers to regions. Also, the axes should indicate direction of increasing confidence. (UNITED STATES OF AMERICA)	We have re-drafted the figures to capture these suggestions and others.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1008	76123	30	118	0	0	0	Figure 30-14 Comments - The Y-axis is degree of confidence in detection and attribution, while the X is degree of confidence in detection only? Please explain more how the two measures are determined separately. (UNITED STATES OF AMERICA)	We have provided a better explanation of the methodology and the way the graph has been constructed both in the legend and in that main text. We have also resolved confusion over the colours, symbols and numbering that we have used.
1009	76124	30	118	0	0	0	Section 30.5.8 addresses detection and attribution in a very short paragraph referencing Figure 30-14 - though it completely lacks confidence statements (despite being in the title of the section). These messages should also be referenced against Table 18-1. The concept of this kind of figure is good, but the figure is very problematic and confusing and should be strongly considered for deletion unless there is significant modification. How can you have an axis that embeds both detection and attribution? The placement of elements on the graph is likely subjective due to the lack of consistency throughout the chapter in the use of confidence and likelihood statements that should provide the foundation for this figure. It is recommended that the author revisit this figure after standardizing and revising confidence statements throughout the chapter, perhaps include a table summarizing the confidence and likelihood assignments for the sub-regions and processes, and include appropriate scales for each of the graph axes. Also, the caption does not state what the numbers embedded in the datapoints represent. Additionally, how can Detection be embedded on the y-axis when it is the independent variable on the x-axis. Said another way, how can the amount of "D&A" be greater than the amount of "D" (e.g., for reduced calcification). Perhaps this figure would be better framed as a confidence vs. evidence figure. (UNITED STATES OF AMERICA)	We agree with the reviewer - and have complete rebuilt 30.14 which now is 30.11. We have a clear line of sight to each entry on the figure, which complements the new Marine risk and vulnerability table, and map-based figure 30.12.
1010	80745	30	118	0	0	0	The meaning of the numbers shown in the symbols mean. Also, the levels of confidence in detection and in detection and attribution on the X and Y axes are missing. It seems to me that the degree of confidence in the detection of reduced calcification is higher than suggested in the figure and the degree of confidence in detection and attribution lower. (Jean-Pierre Gattuso, Centre National de la Recherche Scientifique)	We agree with the reviewer - and have complete rebuilt 30.14 which now is 30.11. We have a clear line of sight to each entry on the figure, which complements the new Marine risk and vulnerability table, and map-based figure 30.12.
1011	81458	30	118	0	0	0	Figure 30-14: The meaning of the values within the plotted shapes should be reiterated in the figure caption. (Yuka Estrada, IPCC WGII TSU)	We agree with the reviewer - and have complete rebuilt 30.14 which now is 30.11. We have a clear line of sight to each entry on the figure, which complements the new Marine risk and vulnerability table, and map-based figure 30.12.
1012	84329	30	118	0	0	0	Figure 30-14. The numbers used within the symbol should be clarified explicitly within the figure caption. Presumably they refer to the different sub-regions introduced in table 30-1? The chapter team should also consider presenting a table in which chapter sections supporting each example could be identified, along with any further information key to understanding each example. Such pairing of table and figure in the context of detection and attribution can be observed, for example, in chapter 3. (Katharine Mach, IPCC WGII TSU)	See previous comment and response. UPDATE: figure has been completely rebuilt - and these issues are no longer issues.
1013	76125	30	119	0	0	0	Figure 30-15 Comments - The authors should include references to underlying sections in chapters (UNITED STATES OF AMERICA)	This is a useful comment and we have tried to accommodate this as far as we can noting that there is a vast amount of material to link to in each case.
1014	76126	30	119	0	0	0	Figure 30-15 Comments - The text in this figure is so small that it is difficult to read. Please make sure final figure is more legilble. (UNITED STATES OF AMERICA)	We have produced a new version with larger text
1015	84330	30	119	0	0	0	Figure 30-15. For the key risks summarized in this figure, the chapter team should consider indicating how they differ with level of climate change and time frame, perhaps referencing the framing used for table SPM.4 within the summary for policymakers. (Katharine Mach, IPCC WGII TSU)	Wii remote these figures and now include consideration of timeframes and scenarios. This figure is complicated and may be dropped in the final version of chapter 30.
1016	76127	30	120	0	0	0	Box 30-16 Figure Caption Comments - This figure is refered to as Figure 30-16 in the text. The text needs to be updated to reflect the accurate figure numbering. (UNITED STATES OF AMERICA)	this has been communicated to Jean-Pierre gattuso, first author of the coral reef box
1017	76128	30	121	0	0	0	Figure CR-1 Comments - In the figure caption, there are references to figures XB and XA. These need to be updated with the appropriate references. (UNITED STATES OF AMERICA)	The text has been modified accordingly.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1018	76129	30	122	0	0	0	Figure OA-1 Comments - The ordering of sub-figures within this figure needs to be changed to reflect order of reference in the text. Figure B should be relabelled A, C should be relabelled B, and A should be relabelled C. Figure formatting should also be changed to reflect this ordering. Additionally, figure A is missing references to figures in the WGI report and from chapters 5, 6, and 30 of the WGII report. These need to be updated with the appropriate references. (UNITED STATES OF AMERICA)	The panels are now cited in the text (and in the right order).