#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1	56451	3	0	0	0	0	Along with Thermal and Hydropower Plants, should Nuclear Power Plants be discussed for water consumption. How about processing and manufacturing industries. (Archis Ambulkar, Brinjac Engineering Inc.)	Water use by thermal power plants (including nuclear power plants) are covered in section 3.5.2.2. Manufacturing water use is implicitly covered in 3.5.2.3.
2	56851	3	0	0	0	0	General comment - Chapter 3: Please check formatting/consistency - e.g. Pg 8 Lines 26-27. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Done.
3	56852	3	0	0	0	0	General comment - Executive Summary: There are a number of points on the science but only two on adaptation. There is some very good information in Sections 3.6 and 3.7 that needs to be included in the Executive Summary as these would provide guidance for decision makers on how to address climate change related issues. Synergies/conflicts between adaptation and mitigation efforts need to be highlighted to maximise effectiveness and prevent maladaptation. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	The ES now contains 3-4 paragraphs about adaptation.
4	57943	3	0	0	0	0	This chapter has improved compared to FOD. In terms of overall presentation styles, now Chapter 3 is in line with other chapters e.g. Chapter 26. Also, role of internal climate variability is recognized in the SOD. There are still some major issues those, I think, should be addressed. Two specific major issues are: (1) land use change as non-climatic drivers (Figure 3-1, and several places in the chapter 3 e.g. Page 4, Line 42): There are a number of studies which have shown significant hydro-climatic impacts of land use/land cover change through land-atmosphere feedback mechanisms e.g. positive soil moisture and precipitation feedback mechanism, surface albedo feedback mechanism, and changes in Bowen Ratio (ratio of sensible to latent heat flux). There are also studies, based on obsrevations, which have documented climate impacts of land use change. Below I provide only few selected recent publication's references: ********** continued (1 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	Land use change was described as one of non-climatic drivers in 3.3.2 and Figure 3-1.
5	57944	3	0	0	0	0	(1) Avila, F. B., A. J. Pitman, M. G. Donat, L. V. Alexander, and G. Abramowitz (2012), Climate model simulated changes in temperature extremes due to land cover change, J. Geophys. Res., 117, D04108, doi:10.1029/2011JD016382. (2) Fall, S., D. Niyogi, A. Gluhovsky, R. A. Pielke Sr., E. Kalnay, and G. Rochon (2010), Impacts of land use land cover on temperature trends over the continental United States: assessment using the North American Regional Reanalysis, Int. J. Climatol., 30, 1980–1993, DOI: 10.1002/joc.1996. (3) Kumar S., P. A. Dirmeyer, V. Merwade, T. DelSole, J. M. Adams, and D. Niyogi, 2013(d): Land Use/Cover Change Impacts in CMIP5 Climate Simulations –A New Methodology and 21st Century Challenges. Journal of Geophysical Research (Atmospheres), doi:10.1002/jgrd.50463, in press. (4) Kumar, S., V. Merwade, W. Lee, L. Zhao, and C. Song (2010), Hydroclimatological impact of century long drainage in midwestern United States: CCSM sensitivity experiments, J. Geophys. Res., 115, D14105, doi:10.1029/2009JD013228. (5) Lawrence et al. (2012), Simulating the Biogeochemical and Biogeophysical Impacts of Transient Land Cover Change and Wood Harvest in the Community Climate System Model (CCSM4) from 1850 to 2100, J. Clim., 25, 3071–3095. DOI: 10.1175/JCLI-D-11-00256.1 **********continued (2 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	They are only references.
6	57945	3	0	0	0	0	(6) Loarie, S. R., D. B. Lobell, G. P Asner, Q. Mu and C. B. Field (2011), Direct impacts on local climate of sugar-cane expansion in Brazil, Nature Climate Change, 1, 105-109, doi:10.1038/nclimate1067. (7) Noblet-Ducoudre et al. (2012), Determining Robust Impacts of Land-Use-Induced Land Cover Changes on Surface Climate over North America and Eurasia: Results from the First Set of LUCID Experiments, J. Clim., 25, 3261–3281. DOI: 10.1175/JCLI-D-11-00338.1. (8) Pielke, R. A., Sr. (2011), Land use/land cover changes and climate: modeling analysis and observational evidence, WIREs Climate Change, 2, 828-850, doi: 10.1002/wcc.144. ******** continued (3 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	They are only references.
7	57946	3	0	0	0	0	Authors can find many more references in the above-referred papers. In view of above evidences: I urge the authors to reconsider their representation of land use/land cover change as non-climatic drivers. I also understand author's viewpoints. One idea could be to make a special class which has both climatic as well as non-climatic influences and include land use /land cover in this special class. -********** continued (4 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	Land use change was described as one of non-climatic drivers in 3.3.2 and Figure 3-1.
8	58260	3	0	0	0	0	In order to reflect contributions made by developing countries in the aspect of climate change adaption, it is suggested to increase the adaptive policymaking and measures of fresh water resources incorporated in "The Second National Assessment of Climate Change which was adopted as the formal reference literature (Juqi Duan, National Climate Center, Chinese Meteorological Administration)	some of the references from the report should have been included in the revised draft, but the report itself was not referred because the report itself is comprehensive and beyond the scope of "freshwater".

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
9	58641	3	0	0	0	0	First, this chapter assesses climate change impacts on freshwater resources by citing many research literatures, but the literatures cited cannot definitely prove that the changes happened or the impacts suffered in freshwater resources can be directly attributed to climate change. The attribution issue also exists in chapter 4. Therefore, I suggest IPCC should further emphasizes the importance of taking further studies on attribution of changes in freshwater resources and terrestrial ecosystems, identifying the percentage of climate change in the attribution of the changes in freshwater and ecosystems. Second, the literatures cited are not in balance, with more literatures cited coming from developed country, but less from developing countries. The study outcomes from different regions and the academic views have not been adequately and evenly reflected. A few viewpoints expressed in chapter 3 have not adequately reflected the status and progress of relevant scientific studies. In the revisions followed, these aspects should be effectively addressed. (chunfeng wang, State Forestry Administration, China)	These general comments will be difficult for us to address because no specific parts of the text requiring change are identified. We do not agree that our coverage of the literature is imbalanced. First, our geographical coverage is very evenly distributed, Second, our cited sources do tend to originate in developed countries, but that is a consequence of the greater funding for research on freshwater resources in such countries.
10	58681	3	0	0	0	0	I wish to thank the authors and the review editors for considering my comments on the first draft and addressing some of them. Not all of my review comments were addressed, neither those addressed were made in a perfect way, but this is understandable as the authors's views apparently are different from mine. But I am generally satisfied that my comments were considered. (Demetris Koutsoyiannis, National Technical University of Athens)	We have derived great benefit from Dr. Koutsoyiannis' thoughtful analyses of successive drafts, and are very grateful for them.
11	58683	3	0	0	0	0	[This comment does not refer to the substance of the chaper but to the IPCC procedures] I found it very disturbing that the Second-Order Draft files do not allow any use of reviewing/annotating tools on the pdf. Comments on the pdf were not allowed also in the first draft, but at least the latter allowed copy and paste, which enabled some indirect use of reviewing tools. The Second-Order Draft has disabled even copy-paste, so if a reviewer wishes to refer to a phrase in the Draft, he must retype it. Certainly, this discourages reviewing more than in the first draft. I hope that in any next phase these restrictions be removed so that a reviewer can inserts his comments in his personal draft when reading it, before he organizes them in Excel format. (Note: The comment that is mentioned in this review for Chapter 3 is pasted above, and added to the General Comments for the report.) I see that the Second-Order Draft may contain substantial changes at points. However, given the above caveat/discouragement, I decided not to review the entire document but to check it with respect to addressing my review comments on the earlier draft. In particular, based on my earlier review report, I will only suggest a few additions, which I regard very important. (Demetris Koutsoyiannis, National Technical University of Athens)	We agree with this comment. We too have found the review process technically cumbersome, and consider that Microsoft Excel is not a suitable medium for the purpose.
12	58824	3	0	0	0	0	Cross-reading with chapers 4,5, 23 and 28 would be good (Katri Rankinen, Finnish Environment Institute)	This has been done by various members of the chapter 3 author team.
13	59259	3	0	0	0	0	It would be very useful for the reviewer to see the figures and tables of the report at the point of citation. The figures and the tables are presented at the end of draft report.(Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	We agree. During drafting we have generally kept the figures and tables "in place", moving them to the end only for purposes of the review (as required by IPCC specifications).
14	59822	3	0	0	0	0	General comment: Note that there is an inconsistency in the chapter referencing the SREX report by 'author' or 'IPCC'. Please be consistent. (AUSTRALIA)	Author' means specific chapter in SREX, and 'IPCC' means whole SREX.
15	59823	3	0	0	0	0	General comment: Long sentences make the chapter hard to read. Suggest trying to keep sentences short, as long sentences at times make the meaning difficult to interpret. (AUSTRALIA)	We have tried to take this suggestion into account.
16	59824	3	0	0	0	0	General comment: This chapter could benefit from some discussion on El Niño Southern Oscillation (ENSO), La Niña and other climate drivers that have an inpact on water resources. (AUSTRALIA)	We think that treatment of the climatic drivers at this level of detail is properly in the purview of WG1.
17	60928	3	0	0	0	0	There is a missing clarity in the terminology, because certain comments mix up global and regional scale. This becomes obvious when talking about river-discharges, it is well-known that for certain rivers the situation can be very different. This can be measured only at a certain gauge (local). When discussing about global discharges one would expect catchment assessments, but in Fig. 3-7 the reader see only general changes. Is it possibly the surface run-off, or really river discharge. In the latter case I would suggest to change the figure. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Figure 3-7 shows projected changes of river discharge as computed by global hydrological models with a spatial resolution of 0.5°C. So the resolution is higher than (zero-order) catchments/river basins. Spatial resolution will be mentioned in figure caption.
18	62649	3	0	0	0	0	The SOD of Chapter 3 is well done incorporating many latest research results and some 2013 published papers, they expand reader's perspective and scientific insights in the field of impact of climate change on freshwater resources and adaptation as well. Congratulations to all CLA and LA. It needs to finalize some figures and text in final report. (Liu Chunzhen, Ministry of Water Resources)	Thank you.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
19	62828	3	0	0	0	0	Regarding glacier melt impact to downstream flow, IPCC 2007 report made high confidence statements such as “as these glaciers retreat due to global warming, river flows are increased in the short term, but the contribution of glacier melt will gradually decrease over the next few decades”(Chapter: Freshwater PP 184) and “the enhanced melting of glaciers leads at first to increased river runoff and discharge peaks and an increased melt season” (IPCC, 2007). These statements mirror the point of view expressed in the IPCC 2001 report as well. These statements have had huge impact on policy formulations and overall understanding of the society regarding the impact of glacier melt, especially in the South Asian region. (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	We assess "peak meltwater" at P14 L42-50 of the SOD.
20	62829	3	0	0	0	0	It is welcome that the IPCC 2007 statements mentioned above in the section–A are not repeated in the present draft. However no justification is provided for the present shift in such a high confidence statements of the previous assessment. (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	See response to #19.
21	62830	3	0	0	0	0	Thayyen, R. J. and Gergan, J. T. (2010) Role of glaciers in watershed hydrology: a preliminary study of a ''Himalayan catchment'', The Cryosphere, 4, 115-128, doi:10.5194/tc-4-115-2010, 2010: (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	Unfortunately we were obliged to delete this reference from an earlier draft that was too long.
22	62831	3	0	0	0	0	pointed ou that these statements linking glacier melt with river runoff is flawed as the downstream flows variation in response to glacier melt could vary across various glacio-hydrologic regimes. The essence of the argument is that rise in temperature will indeed result in to enhanced “glacial degraded runoff component” in the stream flow but that is not necessarily translate into increased stream discharge downstream. Contrary, it is showed that the glaciers under the monsoon regimes could produce higher catchment discharge during the period of mass gain by the glaciers. (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	Regrettably we were obliged to drop a citation of this paper from our Zero Order Draft under the pressure of space limitations.
23	62832	3	0	0	0	0	Ref for " glacial degraded runoff component" UNESCO.: Variations of snow and ice in the past and at present on a global and regional scale (Ed. Kotlyakov, V.M.), IHP-IV Project H4.1, Paris,1996 (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	"degraded runoff component" is not a current technical term in glacier hydrology. P16 L7-12 of the SOD may be relevant to this comment.
24	62845	3	0	0	0	0	Suggesting low confidence in the precipitation projection (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	We cannot trace this comment to any place in our text.
25	62939	3	0	0	0	0	The synthesis on the freshwater resources changes in Chapter 3 of the IPCC report is generally successful and relatively complete. However, as already mentioned in my previous review, the section 3.2 on the trends from the observations and measurements is incomplete and the bibliography is incomplete. Indeed, the section of the measurements is limited to a summary of trends. However, in recent years, there are studies that have focused on methods other than the trend tests, using methods such as signal processing, such as wavelet analysis, to search modes of variability in hydrological and climate parameters in different hydrosystems in the world and thus investigate the relationships between hydrological variability and climate fluctuations. This work has highlighted the relationship between the flows variability and those of climate indices such as NAO, ENSO, PDO, but also major discontinuities in the 70s and 90s. It therefore seems important to summarize thèse works. Moreover, in this observations and measurements section, the authors do nothing on satellite data, such as change in sea level, but also on the variability of the global reserve of water (surface water + soil moisture + groudwater, eg GRACE data I think a methodology section about the main methods to stud the relationship between climatic parameters and hydrological variables is necessary (Benoit Laignel, University of Rouen)	We could not incorpolate the suggested contents because of the limitation of the space and the less relationship with "freshwater resources", thus lower priorities.
26	65899	3	0	0	0	0	There are several interesting figures such as relative change in annual discharge (figure 3-7), flood hazard change (figure 3-8), etc. Taking into account that the figures of the SODreview version usually has not got the best resolution, we want to encourage authors to set the highest resolution to the figures of the final version in order to have some notion of these projections in small territories, for example the Canary Islands. (SPAIN)	This comment is welcome, but we must emphasize that projections for regions as small as the Canaries are likely to be so uncertain as to be of little value to policy makers.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
27	66328	3	0	0	0	0	The issue of assessing hydrological changes and identifying the impacts of climate change among other dynamics and impacts of other changes is a key one - as expressed in this second draft version. Very recent publications should be refered to, especially Koutsoyiannis, D., 2013. Hydrology and change. Hydrological Sciences Journal, in press, DOI: 10.1080/02626667.2013.804626 - available in early view at http://www.tandfonline.com/doi/abs/10.1080/02626667.2013.804626#.UZ80XUqyo9M. Further, one emerging key reference is adressing this particular issue in terms of formulating the scientific questions and setting the scientific agenda from the hydrological community through the launching of the new decade called 'Panta Rhei' of the IAHS - International Association of Hydrological Sciences. See the scientific article Montanari A., Young G., Savenije H., Hughes D., Wagener T., Ren L., Koutsoyiannis D., Cudennec C., Grimaldi S., Blöschl G., Sivapalan M., Beven K., Gupta H., Arheimer B., Huang Y., Schumann A., Post D., Taniguchi M., Boegh E., Hubert P., Harman C., Thompson S., Rogger M., Hipsey M., Toth E., Viglione A., Di Baldassarre G., Schaefli B., McMillan H., Schymanski S., Characklis G., Yu B., Pang Z., Belyaev V. "Panta Rhei – Everything Flows": Change in hydrology and society – The IAHS Scientific Decade 2013-2022. Hydrological Sciences Journal, in press, very soon available at http://www.tandfonline.com/toc/thsj20/current#.UZ9MQEqyo9M (Christophe Cudennec, Agrocampus Ouest)	Space does not permit citation of these valuable contributions to debate about strategy in the hydrological sciences.
28	70703	3	0	0	0	0	This chapter is very comprehensive and generally well-written. I don't see any gaps in the writing other than those already flagged by the authors. (Cate Macinnis-Ng, University of Auckland)	Thank you.
29	71757	3	0	0	0	0	The authors should establish a clear bar (consistent across the chapters) for what is included in each executive summary. It would strengthen the summaries to only include summary statements where there is "high agreement" supported by "robust evidence." We recommend that the authors not include statements supported by limited evidence in summaries. (UNITED STATES OF AMERICA)	On the contrary, there are some pressing questions for which it is important to emphasize that the evidence is limited.
30	71758	3	0	0	0	0	With regard to the use of qualifying terms (E.g., high confidence, high agreement, robust evidence, etc), we recommend the following: ¥ Each of the terms used should be defined in a box within the chapter and should be consistent with their usage throughout the document. ¥ The terms should be applied consistently and should be independent. I.e., the statement on page 2 line 43 has three qualifying terms but the statement on page 2 line 49 has two. The term "high confidence" is redundant and a dependent on "agreement" and "evidence." ¥ The context and linkage between these qualifiers should be consistent with their definitions. E.g., page 9 line 41 "low confidence with limited evidence" versus page 9 line 49 "low confidence due to limited evidence." The former suggests these are independent variables; the latter suggests they are dependent. Another example of inconsistent usage is on page 3 line 1 where there is "high confidence" dispute the fact that there is "limited evidence." This suggests a bias towards over-confidence not supported by evidence. (UNITED STATES OF AMERICA)	Qualifying terms will be harmonized.
31	77137	3	0	0	0	0	The chapter uses alternatively the terms "climate change" and "anthropogenic climate change". I doubt that when the second is used the authors can really make a precise reference to the anthropogenic sources. In case they are used as synonymous , I'd disagree, because that would mean that CC is only of anthropogenic origin (ITALY)	We have been careful only to use the adjective "anthropogenic" when it is needed.
32	77839	3	0	0	0	0	The second-order draft of the IPCC WGH AR5 Chapter 3 "Freshwater Resources" includes: A. Executive summary of about 1.5 page; B. Main body of the report divided into 8 sections: (1) Introduction, (2) Observed hydrological impacts of CC, (3) Drivers of change for freshwater resources, (4) Projected hydrological changes, (5) Impacts, vulnerabilities and risks, (6) Adaptation and managing risks, (7) Linkages with other sectors and services, and (8) Research and data gaps. of about 30 pages, illustrated by about 16 pages of figures and tables. C. Frequently Asked Questions of about 1.5 page; D. Cross-Chapter Boxes (CC-RF, CC-VW, CC-WE) on three issues of particular importance for CC: (1) Impact of CC on freshwater ecosystems due to altered river flow regimes, (2) Active role of vegetation in altering water flows under CC, and (3) The Water-Energy-Food nexus as linked to CC, of about 7.5 pages (text and literature) and 4 figures RF-1, RF-2, VW-1 and WE-1. E. Literature – 21 pages (42 to 63) One of the principal question concerning chapter 3 of AR5 is how much this assessment has changed since publication of a similar part of AR4, it means chapter 3 "Freshwater resources and their management" published in 2007. Although in Chapter 3 under review the AR4 is mentioned in some sections, but it's not easy at all to judge how much the situation has changed in the last 5 years and what's new. It is suggested that in the future each chapter of AR (including of course the one concerning freshwater resources) ends with a brief evaluation how much the situation has changed since the last assessment and what's new, what are the new approaches, methods and other guidance. (POLAND)	We summarize AR4 Ch 3 in section 3.1, and draw attention to advances since 2006 in several places elsewhere in the chapter.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
33	77840	3	0	0	0	0	The next general comment concerning Chapter 3 concerns the Executive Summaries. Some of them in the present draft of Chapter 3 are pretty obvious and well known, like for example the one about the glaciers – this is something what the school children know. But here are others which say that depending on the circumstances "..the operating costs will rise or fall", or "… certain approaches … imply greater risks … than others". The people to whom we address the executive summaries usually know well that all depends on the context. In addition, compare executive summaries of chapters 3 in AR5 and AR4 – they have nothing in common. (POLAND)	Our summary paragraph about glaciers (P3 L7-12) makes points that are by no means obvious and indeed have been misunderstood in recent public discussions.
34	77841	3	0	0	0	0	To summarize, on the whole Chapter 3 in AR5 is certainly much more informative than the corresponding chapter in AR4. I suggest to keep in principle the same table of contents in the next editions of the AR. The cross-chapter boxes is a good idea and in a way similar are case studies (3.6.6). (POLAND)	Noted. Thank you.
35	77842	3	0	0	0	0	All coordinating lead, lead and contributing Authors should be congratulated on the work well done. (POLAND)	Noted. Thank you.
36	78082	3	0	0	0	0	didn't see a good place to put in the reference, but in a number of countries there has been work on the iinteraction of extreme drought and flood protection levies -- the NL is very worried about this, since their earthen dams tend to become much more likely to fail during droughts as a result of floods. (John Matthews, Conservation Internatonal)	Thanks. It is very point. Probably a very local point for this report.
37	78085	3	0	0	0	0	Water diversions are almost completely ignored in this chapter but already represent a major investment strategy by many countries. China's South-North project, for instance, is more than biblical in its scope. And this is not the only large project either planned or already underway by China. India too has had massive plans for moving water to drier regions on maps that make almost no hydrological sense. Even in the US, there are regular, credible calls for moving Mississippi River water >1000 km to Nevada, or to preserve large cities such as Dallas and Los Angeles at the expense of ecosystems and more rural and small town livelihoods and economies as a result of water diversions almost as large in scope. These are highly political issues to be sure, but they are also very important ones. (John Matthews, Conservation Internatonal)	diversions are not explicitly described in this chapter, but included in general in the "water infrastructure", for example in Table 3-3.
38	79372	3	0	0	0	0	I think this chapter needs significant more work. The use of literature is highly selective and it is not clear how the authors have chosen particular references as not detail is given on how they searched the literature and what caveats and limitations should be applied. The chapter is particularly weak on water and sanitation services and does not refer to existing literature that tries to address these issues. The sections dealing with groundwater also need further editing to reflect more recent evidence and sections on hydropower need better balance as they routinely fail to address run of the river schemes and only focus on hydropower with associated storage. Generally coverage of developing countries is weak. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We will do what we can to respond to this comment, but in general this kind of criticism is unhelpful because it gives us little or nothing to go on. Note that we are assessing the literature, not reviewing it.
39	79380	3	0	0	0	0	Table 3.3: this includes only two studies from Uganda focused on north and east but ignores, for instance, Howard et al 2003 (Water Research vol 37) on the impact of rainfall on shallow groundwater in urban areas of that country. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	This comment refers to Table 3.2: The IPCC report is intended to be an assessment and not a (complete) literature review.
40	81033	3	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 3 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)	Accepted and revised
41	81607	3	0	0	0	0	1) Overall -- The chapter team has developed a strong 2nd-order draft. In the final draft, the chapter team is encouraged to continue prioritizing compact and rigorous assessment, effective figures, clear writing, and high specificity. (Katharine Mach, IPCC WGII TSU)	Thank you. We revised text a lot.
42	81608	3	0	0	0	0	2) Coordination across Working Group II -- In developing the final draft of the chapter, the chapter team should continue to ensure coordinated assessment, both in the chapter text and at the level of key findings. As appropriate, cross-references to the sections of other chapters and/or their assessment findings should be used, continuing to ensure that overlaps are reduced and assessment harmonized. (Katharine Mach, IPCC WGII TSU)	We checked other chapters in WGII, and some chapters are cited now.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
43	81609	3	0	0	0	0	3) Harmonization with the Working Group I contribution to the AR5 -- Given the climate/impacts handoffs particularly relevant in the context of chapter 3, the chapter team should ensure all cross-references to the Working Group I contribution are updated, with assessment in this chapter harmonized with the findings of the Working Group I contribution. Where chapter 3 cross-references findings from a special report on extremes, the author team should also consider the key findings of the Working Group I contribution to the 5th assessment report. Especially for conclusions highlighted in the executive summary of the chapter, clear interpretation with respect to findings on similar topics within the Working Group I contribution should be ensured. (Katharine Mach, IPCC WGII TSU)	We checked chapters in WGI, and some chapters are cited now.
44	81610	3	0	0	0	0	4) Calibrated uncertainty language: likelihood terms versus levels of confidence -- In some sections of the chapter text, levels of confidence may be preferable to likelihood terms currently used. The chapter team is encouraged to ensure that all likelihood terms used are supported by its assessment of available probabilistic information in the corresponding literature. If such a probabilistic basis is not available, presenting a level of confidence would be preferable. In such cases, summary terms for evidence and agreement also could be presented. Throughout, casual usage of the reserved likelihood terms should be avoided wherever possible, and all calibrated uncertainty language (summary terms for evidence and agreement, levels of confidence, and likelihood terms) should be italicized. (Katharine Mach, IPCC WGII TSU)	We used calibrated uncertainty language cafully.
45	81611	3	0	0	0	0	5) Report release -- The chapter team should be aware that the final drafts of the chapters will be posted publicly at the time of the SPM approval, before final copyediting has occurred. Thus, the chapter team is encouraged to continue its careful attention to refined syntax and perfected referencing. (Katharine Mach, IPCC WGII TSU)	We checked cafully as much as possible.
46	81612	3	0	0	0	0	6) Tightening the assessment and supporting a maximally rigorous executive summary -- In developing the final draft, the chapter team is encouraged to revise each section so that the core nuanced key findings emerge clearly from each section with full and traceable support. Revision geared towards highlighting the key findings will further support an executive summary that richly communicates the assessment. The chapter team should prioritize revision as well within sections that could benefit from further strengthening, such as in some parts of 3.5 and 3.6. (Katharine Mach, IPCC WGII TSU)	We revised executive summary a lot.
47	81613	3	0	0	0	0	7) Characterization of future risks -- In characterizing future risks for freshwater resources, to the degree appropriate the chapter team should indicate the extent to which risks (or key risks) can be reduced through mitigation, adaptation, or other responses. That is, is it possible to indicate how risks may increase as the level of climate change increases or, potentially, to indicate 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? And then, how much can risks be reduced through adaptation or development, 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 socio-economic/climate scenarios) and for the era of climate options (the 2nd half of the 21st century and beyond). As might be helpful to the chapter, the framing of table SPM.4 could be considered in characterizing future risks, along with the key and emergent risk typology of chapter 19. (Katharine Mach, IPCC WGII TSU)	We tried to illustrate the demanded factors in the comment in Table 3-4.
48	81614	3	0	0	0	0	8) Informing the summary products -- To support robust and insightful summary products for the report, the chapter team is encouraged to maximize nuance and traceability in its key findings, continuing to use calibrated uncertainty language. In addition to highlighting key findings throughout the chapter and characterizing future risks (see the previous comments), the chapter team is encouraged to consider themes emerging across chapters, indicating for example how extreme events have demonstrated adaptation deficits and vulnerability to date and may relate to future risks, how limits to adaptation may be relevant in the context of this chapter, how adaptation experience has been relevant to date, and how interactions among mitigation, adaptation, and sustainable development may occur. (Katharine Mach, IPCC WGII TSU)	We used calibrated uncertainty language cafully.
49	85010	3	0	0	0	0	GENERAL COMMENTS: I congratulate the author team for their work on an interesting and informative SOD. 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)	Thank you. We checked the following comments.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
50	85011	3	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 3, 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 3 and other chapters at LAM4? (Michael Mastrandrea, IPCC WGII TSU)	We revised executive summary a lot.
51	85202	3	0	0	0	0	Based too heavily on "projections" which are not happening. There has been no warming for 15 years. A failure to accept that water supplies are dependent on expenditure on reservoirs, dams and supply pipes. Most of the water that arrives from the heavens drains into the sea and an improved supply depends on trapping more of it. (Vincent Gray, Climate Consultant)	Spending more on reservoirs and dams may be part of the solution to water-resources problems, but the comment fails to recognize the multi-dimensional nature of those problems.
52	77144	3	0	35	0	35	coupled (ITALY)	Almost all the text of this comment has been lost.
53	60929	3	1	1	0	0	There is some very good information in Sections 3.6 and 3.7 that needs to be included in the Executive Summary as these would provide guidance for decision makers on how to address climate change related issues. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We added the information in 3.6 and 3.7 into executive summary.
54	60930	3	1	1	0	0	Potential synergies/conflicts between adaptation options and also between adaptation and mitigation efforts need to be highlighted to maximise effectiveness and prevent maladaptation. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, that is concerned to be relevant, and described in sections 3.6.3 in terms of economic effectiveness, and 3.7.2.2 in terms of maladaptation.
55	66084	3	1	42	1	50	Section 3.4, like "Glaciers" and "Ground Water", Subheading "Precipitation" need to be added and discussed the projected changes in precipitation and their impacts on stream flows as explained under projected hydrological changes started from page # 12 (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	For the purposes of section 3.4, we regard precipitation as a climatic driver. It is treated in section 3.3.1, and projected changes are mentioned as appropriate elsewhere.
56	66085	3	1	52	2	5	Section 3.5, the impact of climate change on potable water and related health risks in particular, water bone diseases may be discussed under separate subheading (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	This cannot been done in Ch3 due to space constraints. Please note that there is a whole chapter on WGII only on health aspects (Ch11), also Ch12 and 13 address the theme.
57	81615	3	2	41	0	0	Characterizing Future Risks In the Executive Summary-- As much as possible, the chapter team should specify 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? The chapter team should also consider options for providing more quantitative information on the ranges of possible outcomes, potentially indicating differing levels of confidence for statements about overall directions of change as compared to the specific quantitative results. (Katharine Mach, IPCC WGII TSU)	We revised executive summary a lot.
58	85012	3	2	41	0	0	Executive Summary: Please work to refine the detail and clarity of the executive summary as you revise the chapter--I have made various specific suggestions along these lines below. For example, to the extent possible as supported by the literature, please also emphasize what risks are projected to emerge over different time horizons (e.g., mid-century vs. end-of-century), as well as the potential or lack of potential for mitigation and adaptation to reduce them. In addition, please consider the usage of calibrated uncertainty language in the executive summary, as in many cases it appears that assignment of a level of confidence may be appropriate, based on agreement/evidence evaluations already made. In cases where a finding is based on quantitative evidence, likelihood should also be considered. The TSU would be happy to consult with you on this if desired. Please also continue to ensure clear line of sight to underlying chapter sections--in general this is done well at present, but I have noted places where further clarity is needed in my specific comments. (Michael Mastrandrea, IPCC WGII TSU)	We revised executive summary a lot.
59	71759	3	2	41	4	14	In general, the Executive Summary conveys more "high confidence, high agreement, robust evidence" than may be warranted given the uncertainties noted in the chapter. (UNITED STATES OF AMERICA)	We do not agree. We think that we have harmonized the ES paragraphs accurately with their corresponding sections of the text and with the evidence as reported in the literature.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
60	71760	3	2	41	4	14	When characterizing future physical impacts, the executive summary should offer a statement as to why it makes sense to have "high agreement" and/or "high confidence" about a future impact when there's "limited evidence" of past change. (UNITED STATES OF AMERICA)	When using IPCC "calibrated" language, the breadth of scientific consensus and the quantity of empirical evidence are regarded as independent quantities .
61	80360	3	2	41	4	14	ES: Several bullets are thematically linked to WGI. It will therefore be crucially important to maintain inter-working group consistency for these key findings. Very strong statement on floods (high agreement/robust evidence) is now partially based on WGI precip projections (p2l49), please reconsider this link; In addition, uncertainty assessments are sometimes not consistent, e.g., high agreement/medium evidence is declared for GHG influence on transpiration, runoff and groundwater recharge (p3l10); can this impact be very uncertain and locally specific then? Please consider to link the glacier bullet to the WGI assessment (p3l14). (Gian-Kasper Plattner, IPCC WGI TSU)	I do not understand: In addition, uncertainty assessments are sometimes not consistent, e.g., high agreement/medium evidence is declared for GHG influence on transpiration, runoff and groundwater recharge (p3l10); can this impact be very uncertain and locally specific then?
62	56435	3	2	43	0	0	Since this is the beginning of the chapter, can term "global warming" be used instead of "warming" only. (Archis Ambulkar, Brinjac Engineering Inc.)	The executive summary text has change completely, and this term has been deleted
63	65458	3	2	43	2	43	last decades' = ? 20 -30 years? (Stuart Bunn, Griffith University)	The sentece was deleted
64	81616	3	2	43	2	43	If appropriate, the chapter team could consider further specifying the approximate number of decades relevant here. Possible options include "since 1950," "since 1990," etc. (Katharine Mach, IPCC WGII TSU)	The sentece was deleted
65	85013	3	2	43	2	43	Please specify the timeframe meant by the last decades. (Michael Mastrandrea, IPCC WGII TSU)	The sentece was deleted
66	76971	3	2	43	2	45	It isn't clear whether the phrase "in regions with seasonal snow cover" refers to all of the preceding phenomena, or just the final one(s), although I think it is the former. I suggest putting that phrase earlier, right before "warming…" (Christopher Milly, U.S. Geological Survey)	The sentece was deleted
67	60931	3	2	43	4	0	The Executive summary presents several conclusions, but a significant portion of these is based on limited evidence, despite the high agreement. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	When using IPCC "calibrated" language, the breadth of scientific consensus and the quantity of empirical evidence are regarded as independent quantities .
68	60932	3	2	43	4	0	The Executive summary does not provide any statements on the influence of the lack of data on the conclusions made in many of the analyses, despite several references in the report to this effect. I feel this is a missed opportunity and it would be important to underline the importance of observations to improve confidence in conlusions made on the impact of climate change. This is particularly so for impacts to the hydrological given the importance of considering impacts on the regional and local scale. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This point is made forcefully in section 3.8, but it is not appropriate for an ES.
69	85014	3	2	45	2	45	Please ensure that this finding is fully supported in section 3.2.3, as the reference to chapter 26 should be removed. (Michael Mastrandrea, IPCC WGII TSU)	The sentece was deleted
70	59825	3	2	45	2	46	Consider re-wording sentence "Where more winter precipitation falls as rain than snow, winter low flows have increased significantly" as it is difficult to interpret. (AUSTRALIA)	The sentece was deleted
71	76972	3	2	45	2	46	Does first clause mean "Where winter precipitation is more snow than rain," or does it mean "Where a trend in winter precipitation from snow toward rain is present?" I suggest re-wording to make the meaning clear. (Christopher Milly, U.S. Geological Survey)	The sentece was deleted
72	76867	3	2	46	2	46	"winter low flows have increased significantly" - this is ambiguous. It could mean the flow levels have increased (in other words, they are 'less low'), or that the occurrence of low flows has increased ('more lows'). (Rutger Dankers, Met Office Hadley Centre)	The sentece was deleted
73	65459	3	2	46	2	47	exacerbate summer low flows - is it worth adding that this has intensified competition for water during this period? (Stuart Bunn, Griffith University)	The sentece was deleted
74	77013	3	2	46	2	47	Should be "Where stream flow is low in summer", not "lowest". Decreases in late-summer low-flows exist and are practically important even in hydroclimatic regions where the lowest flows of the year occur in a season other than summer. (Sean Fleming, Meteorological Service of Canada)	The sentece was corrected

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
75	71761	3	2	49	2	49	There is no material presented in section 3.4.5 that supports the assessment of high agreement and robust evidence. The phrase "large changes" does not indicate whether the change will be an increase or a decrease. The supporting text in the chapter states "considerable variability in estimated impact in each catchment across the seven scenarios and also show non-linear response to increasing forcing (in the Mitano catchment). The uncertainty is largely driven by differences in projected changes in precipitation between different climate models." In section 3.4.9 the text states, "uncertainty is still large at the global and continental scales particularly about the magnitude of changes. At local scales, even the sign of the change do not necessarily agree among GCMs". Suggest changing the assessment to (low to medium agreement, limited evidence). (UNITED STATES OF AMERICA)	This sentece was changed in the new Executive summary, as well as the calibrated language.
76	85015	3	2	49	2	49	Please specify this finding further--what is meant by large changes and when and where are these projected to occur? (Michael Mastrandrea, IPCC WGII TSU)	This sentece was changed in the new Executive summary.
77	66035	3	2	49	2	50	It is the same paragraph of TS p.31 lines1-4, and consequently, my comments are the same (Maria-Carmen Llasat, University of Barcelona)	This sentece was changed in the new Executive summary.
78	76973	3	2	49	2	52	I have not read the WGI SOD, but the present text seems to imply ("limited extent") that more frequent/intense rainfall is only expected at small space and time scales. Is this the case? (Christopher Milly, U.S. Geological Survey)	This sentece was changed in the new Executive summary.
79	76974	3	2	49	2	52	"Projected climate changes imply PROJECTED large changes…" would be better wording. Let us not forget that the antecedent is uncertain. (Christopher Milly, U.S. Geological Survey)	This sentece was changed in the new Executive summary.
80	79373	3	2	49	2	52	Why is there no statement of the confidence on frequency of floods? Also I do not understand the comment on the uncertainty of large catchments because of the limited extent of extreme events. Localised flooding is an will continue to be a major issues in large as well as small catchments, so does this comment refer to floods moving down main stems? I think this paragraph needs re-wording to clarify what is meant and acknowledge the impact of localised flooding (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	This sentece was changed in the new Executive summary.
81	63108	3	2	49	3	2	The climate projections do not indicate more frequent intense rainfall events all areas of the world. Neither do the field observations. (Sabine Wurzler, LANUV NRW)	This sentece was changed in the new Executive summary.
82	66030	3	2	49	3	2	There are not enhough agreement and evidence about the increase of intense rainfall events and floods as a consequence of climatic change in all the world (as the same report tells in SPM, p.3, lines 40-41, and in other places), neither in the future. On the other hand, floods also depends on hydrological and geomorphological factors. Consequently, this paragraph should be rewritten. One possibility would be to introduce acclarations like "in some regions", and decrease the level of certainty and robustness. This is a weak point of the report, because there are some inconsistencies between different chapters and paragraphs, in relationship with the increase/decrease of floods and the degree of evidence and robustness. Please, see my comments on this, in relationship with different paragraphs, below. (Maria-Carmen Llasat, University of Barcelona)	This sentece was changed in the new Executive summary.
83	81617	3	2	49	3	2	The support for this statement should be clarified. Line-of-sight to supporting chapter 3 section should be provided (3.4.9?). Additionally, the reference to working group 1 could be clarified in terms of the specific finding relevant here. (Katharine Mach, IPCC WGII TSU)	This sentece was changed in the new Executive summary.
84	85016	3	2	49	3	2	Line of sight to chapter 3 sections is needed for this paragraph. It appears that sections 3.4.5, 3.4.9, and 3.5.3 include relevant information. Please also clarify the line of sight for the statement in line 52 regarding spring flood peaks. (Michael Mastrandrea, IPCC WGII TSU)	This sentece was changed in the new Executive summary.
85	58642	3	2	52	2	52	"In some areas, reduced snowfall will reduce spring flood peaks." But In some area such as northwest of China,spring flood is increasing and snowfall flood peaks is higher. (chunfeng wang, State Forestry Administration, China)	This sentece was changed in the new Executive summary.
86	76562	3	2	53	2	53	I am surprised to not see Europe (especially Mediterranean region) mentioned here (Claudio Cassardo, University of Torino)	This sentece was changed in the new Executive summary.
87	68800	3	3	2	3	2	Please add reference to the (sub)section in which these statements are mentioned/underpinned. (NETHERLANDS)	The subsection is now indicated
88	79374	3	3	2	3	2	This statement is so broad as to be meaningless. The authors should be clearly about what adaptation will reduce vulnerability and whether this is the same as investing in greater resilience. They should also provide some assessment of the quality of the evidence to support this comment. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	This sentece was changed in the new Executive summary.
89	85017	3	3	2	3	2	Please expand on this point--to what extent can vulnerability be reduced and how? (Michael Mastrandrea, IPCC WGII TSU)	This sentece was changed in the new Executive summary.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
90	81618	3	3	4	3	4	Can any further information be provided on what "hydrological regimes" means? (Katharine Mach, IPCC WGII TSU)	timing of flows.
91	65460	3	3	4	3	8	This point should be made earlier in the ES (Stuart Bunn, Griffith University)	removed during revision, remains in ES paragraph on impacts on freshwater systems.
92	79375	3	3	5	3	6	The situation for groundwater recharge is much less certain in dry regions than implied - see the recent paper by Taylor et al who suggest that in some dry areas recharge in any cases occurs in widely spaced (and up to decadal) intervals and that the more intense rainfall expected as a consequence of climate change could in fact have a positive impact on recharge in some catchments. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Still, the general picture remains correct for groundwater recharge, too.
93	76975	3	3	6	3	7	As written, I think this is incorrect. When rainfall to a basin changes by X liters, runoff does not change by 1X to 3X liters. It is the percentage or relative changes that tend to obey the 1-3X rule of thumb, no the changes themselves. (Christopher Milly, U.S. Geological Survey)	"Changes" replaced by "percent changes".
94	77014	3	3	6	3	7	After "...greater than changes in precipitation" suggest adding "all else being equal." (Sean Fleming, Meteorological Service of Canada)	The paragraph was revised.
95	81619	3	3	6	3	7	It would be helpful to clarify what is meant by "1 to 3 times greater"--in terms of percentage change, amount of water, etc.? (Katharine Mach, IPCC WGII TSU)	see answer to #639.
96	85018	3	3	6	3	7	Does this ratio of changes in runoff to precipitation hold generally across timeframes and scenarios? Please clarify. (Michael Mastrandrea, IPCC WGII TSU)	not appropriate to specific this only very approximate relationship.
97	71762	3	3	7	3	7	We suggest the authors replace the term "brings forward" with "results in an earlier" for greater clarity. (UNITED STATES OF AMERICA)	We do not agree.
98	85019	3	3	7	3	8	Page 17 associates this effect of warming with regions where increases in precipitation are sufficient to result in increased snow accumulation, rather than very cold regions. Please clarify whether these are equivalent. (Michael Mastrandrea, IPCC WGII TSU)	Last sentence of 3.4.5 not clear to me (ask Nigel to reformulate).
99	71763	3	3	10	3	11	Authors should explain the logic of " high agreement" if the following sentence states "This impact is very uncertain and locally specific, " or we change the assessment to (low to medium agreement, limited evidence). (UNITED STATES OF AMERICA)	no change necessary as there is high agreement about "affecting", but not how? But maybe change to medium confidence.
100	76976	3	3	10	3	11	This sentence seems to me to be so limited in information content as to be meaningless. Everything in the system affects everything else. The two sentences that follow are more informative. (Christopher Milly, U.S. Geological Survey)	Disagree, as the active role of vegetation is not being considered normally be hydrologists doing impact studies.
101	85020	3	3	10	3	12	Please specify this finding further--how will vegetation be affected and how does this change transpiration, runoff, and groundwater recharge? (Michael Mastrandrea, IPCC WGII TSU)	not possible to be specific.
102	57677	3	3	11	3	11	"groundwater recharge" should be changed into "groundwater resources(including recharge and discharge)" (Zhongcheng Jiang, Institute of Karst Geology,CAGS)	paragraph removed.
103	81620	3	3	11	3	11	Given that lines 5-6 in the previous paragraph refer to runoff and groundwater recharge, the focus of the distinct point being made here could be clarified. How do these vegetation-related changes interact with the broader projections described above? Especially since the 2nd paragraph asserts the impact is "very uncertain and locally specific" it is critical to specify more precisely what "this impact" is here. Also, how should the assertion of a "very uncertain and locally specific" impact be interpreted with respect to the bold sentence in the same paragraph, which provides high agreement and medium evidence for a broad statement? (Katharine Mach, IPCC WGII TSU)	paragraph removed.
104	71764	3	3	12	3	12	State-of-the-science models do include biophysical responses to atmospheric CO2 and detailed, cross-correlated climate variables, which have been studied in several of the cited papers. (UNITED STATES OF AMERICA)	Yes, but they show very different reactions of vegetation to climate chnage and CO2 increase.
105	62833	3	3	14	0	19	The term meltwater production is very vague. What is certain is the increase in the" glacier degraded component" of meltwater (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	We clarify by saying "total meltwater production", but we are not prepared to accept the suggested alternative.
106	81621	3	3	14	3	14	The phrase "eventually diminishing" implies that meltwater yields may 1st increase and then decrease, which could be clarified more explicitly. The point is made in further detail later in the paragraph, but clearer articulation in the 1st sentence could be beneficial. (Katharine Mach, IPCC WGII TSU)	We have made more precise the description of what is expected to happen.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
107	58906	3	3	14	3	19	With glacier shrinking, numerous lakes have formed and many more are likely to form in the near future (cf. Linsbauer, A., Paul, F. and Haeberli, W. (2012): Modeling glacier thickness distribution and bed topography over entire mountain ranges with GlabTop: Application of a fast and robust approach. Journal of Geophysical Research 117, F03007, doi:10.1029/2011JF002313). Many presently still existing glacier landscapes of cold mountains are, in fact, transforming within decades and for long time periods to come into lake landscapes. This should also be made clear on page 9 (see next comment - pg 9, line 34). (Wilfried Haeberli, University of Zurich)	The expansion of glacier-fed lakes is an interesting and important subject, but we do not think that it merits a mention in our Executive Summary.
108	81622	3	3	14	3	25	For the findings across these paragraphs, if possible the chapter team should consider indicating how the specific risks may decrease across differing levels of climate change, in the near-term and long-term. (Katharine Mach, IPCC WGII TSU)	The evidence for these matters of detail from modelling is too slender to justify an insertion.
109	77015	3	3	17	3	18	The sentence, "In many regions meltwater production will increase during the next few decades but decrease thereafter" is unnecesarily simplistic and a bit misleading. Different regions are currently at different stages along this glacial runoff curve: some are in the increasing-runoff phase, whereas others are already in the decreasing-runoff phase. Overall, both situations appear equally common over the historical record. The wording of this passage should be improved. If the author wishes to follow up on this more comprehensively, a couple of very useful overview papers include Cassassa et al. (2009) and Moore et al. (2009). The full references are: (i) Casassa G and others (2009), Detection of changes in glacial run-off in alpine basins: examples from North America, the Alps, central Asia, and the Andes, Hydrological Processes, 23:31-41; and (ii) Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrological Processes, 23:42-61. (Sean Fleming, Meteorological Service of Canada)	We consider "In many regions" to be an adequate, and correct, qualification of the general statement. The comment omits to note that the date from which one reckons the evolution of meltwater yield is crucial. We are not committing here to an estimate relative to, for example, the culmination of the LIttle Ice Age.
110	62834	3	3	18	0	18	This statement give away wrong message: Glacier mass loss is determined by the prevailing weather that we calculate in annual net mass balance. The long response time ensure delayed response by the glacier in terms of glacier size and extent (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	The target text has been removed.
111	85021	3	3	18	3	19	Please specify the line of sight for this statement, as it is currently unclear. (Michael Mastrandrea, IPCC WGII TSU)	The target text has been removed.
112	77844	3	3	19	30	46	some examples with numbers are expected (POLAND)	Examples and numbers are in general not appropriate for the Executive Summary.
113	81623	3	3	21	3	21	Where a level of confidence and summary term for agreement are provided here, the chapter team should consider presenting only the level of confidence or, alternatively, also presenting a summary term for evidence, given the framework of the uncertainties guidance. (Katharine Mach, IPCC WGII TSU)	The calibrated languague was modified here.
114	60933	3	3	21	3	22	This statement is given to be medium confidence, high agreement, which is slightly different than all other statements that are valued in terms of evidence - I would suggest to make this uniform (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The calibrated languague was modified here.
115	64276	3	3	21	3	22	The explanation isn´t good, and offer small clarity (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	The sentece was corrected
116	65461	3	3	21	3	22	Not convinced that the significance of this point comes through - especially the second sentence. (Stuart Bunn, Griffith University)	The sentece was corrected
117	76563	3	3	21	3	22	not sure I have correctly understood. You says that "drying of soils is projected in most dry regions". This is a change. Then you says that "projected changes in droughts depend partly on the definition of drought". I suppose you mean that the amount (of dry days) depends on the definition of drought, even if its trend, in any way the amount is defined, is well defined, because soils are drying. If this is true, I suggest to change "changes" with "trends" in line 21. Alternatively, I suggest to clarify better what you mean. (Claudio Cassardo, University of Torino)	The sentece was corrected
118	85022	3	3	21	3	22	This finding needs elaboration based on the discussion on page 20. For example, regions are discussed in the chapter text, rather than a reference to "most dry regions," and the implications of the definition of drought are better specified. (Michael Mastrandrea, IPCC WGII TSU)	The sentece was corrected
119	56436	3	3	24	0	0	In addition to "Renewable" water resources term, terms such as "re-usable, re-cyclable, potable, domestic" might also be more relevant in certain sentences. (Archis Ambulkar, Brinjac Engineering Inc.)	ES revised accordingly
120	64277	3	3	24	3	25	The explanation isn´t good, and offer small clarity (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	ES revised accordingly

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
121	76977	3	3	24	3	25	I searched for but did not find the supporting statements for this. Furthermore, what exactly is meant by "most … regions?" How many semi-arid and arid regions are there in the world, and how many of them have projected reductions in WR? One needs to be more precise. Are we talking about fractional areas, or population-weighted areas, or subjectively geopolitically important regions of varying sizes, or...? (Christopher Milly, U.S. Geological Survey)	ES revised accordingly
122	77016	3	3	24	3	25	Fine, but it should perhaps be mentioned either here or elsewhere in the executive summary that in other regions, renewable water resources may in principle increase due to greater precipitation, although such increases may occur only in specific seasons and may be difficult to harness effectively. (Sean Fleming, Meteorological Service of Canada)	ES revised accordingly
123	85023	3	3	24	3	25	Section 3.5.1 (page 21) discusses the Mediterranean and South Africa only, rather than "most semi-arid and arid regions." Please reconcile. This finding also needs elaboration based on the discussion in the chapter text. (Michael Mastrandrea, IPCC WGII TSU)	ES revised accordingly
124	60935	3	3	25	2	35	Some studies show that presence of forests is essential to maintain water availability, e.g. New York State (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	ES revised accordingly
125	60934	3	3	25	3	25	Could also reduce energy security as hydroelectric output would also fall. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	added
126	65462	3	3	25	3	25	suggest re-word this to "This constitutes a key risk to food security and the environment" (refer also to 4.3.3.3) (Stuart Bunn, Griffith University)	ES revised accordingly
127	81624	3	3	25	3	25	Where a key risk is asserted here, is it possible to indicate the potential for risk reduction via adaptation? (Katharine Mach, IPCC WGII TSU)	ES revised accordingly
128	81625	3	3	27	3	27	If possible, it may be beneficial to specify more precisely the ways that climate change changes river flow regimes. (Katharine Mach, IPCC WGII TSU)	Not possible, depends on local conditions.
129	57678	3	3	27	3	29	"by changing river flow regimes" should be chenged into "by changing water regimes and hydrologic situation"."due to human water withdrawals and dams" should be changed into "due to frequent human water exploitation engineering ". (Zhongcheng Jiang, Institute of Karst Geology,CAGS)	This formulation is not considered to be an improvement.
130	77017	3	3	27	3	29	Strongly suggest softening the wording around the phrase, "...this ecological impact may be stronger than that of historic alterations due to human water withdrawals and dams." This is an extremely bold statement, and while it may be true in some areas, it is almost certainly not true in many other regions. Perhaps preface the statement with something like, "in some areas", or follow it with something like, "but this is likely not universally true" (Sean Fleming, Meteorological Service of Canada)	Statement was qualified by saying "except in areas with intensive irrigation".
131	85024	3	3	27	3	29	This finding should also include CC-RF in its line of sight. In addition, please specify what is meant by "may be stronger," based on the discussion in CC-RF. (Michael Mastrandrea, IPCC WGII TSU)	Reference to CC-RF included.
132	81626	3	3	28	3	28	Where the chapter team states that the impact may be stronger than historic alterations, is this outcome expected for all levels of climate change, for all regions, etc.? A more nuanced characterization of the multiple stressors could be beneficial. (Katharine Mach, IPCC WGII TSU)	would be too specific given the large uncertainties.
133	65463	3	3	28	3	29	The second sentence is not consistent with the literature. There is certainly evidence that climate change has and will lead to changes in flow regimes and that this will have ecological consequences (refer also to CC-RF). However, with some regional exceptions, these effects are dwarfed by the impacts from modifications to flow regimes from dams, water abstraction, hydropower operation etc. (Stuart Bunn, Griffith University)	Statement was qualified by saying "except in areas with intensive irrigation".
134	76978	3	3	31	3	32	This sentence is almost meaningless. Would anyone expect all approaches to have identical risks? (Christopher Milly, U.S. Geological Survey)	Was slightly reformulated. The sentence should be read as an overall statement that is specified regarding three approaches in the following sentences.
135	56863	3	3	31	3	36	Especially Lines 31-32 - needs to explicitly highlight the potential synergies and conflicts between mitigation and adaptation initatitves, as well as the cross-sectoral and multi-disciplinary issues. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	One sentence was added.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
136	58643	3	3	31	3	36	Based on para 3.7.2.1, the assessment on afforestation and bioenergy crops can only arrive at following primary conclusions: 1) the implementation of CDM A/R may reduce runoff in certain area, especially dry region; 2) planting bioenergy crops, such as switch grass, corn, Jatropha (Jatropha actually is a tree, not a crop) in certain condition of afforestation site, it may consume more water for irrigation. I don't think para 3.7.2.1 can support the conclusion that afforestation and bioenergy crops can consume more water than other mitigation measures. Therefore, I suggest the revision should be as follows: Certain approaches to reduce greenhouse gas might imply some negative effects for freshwater systems. Some bioenergy crops can require larger amounts of water for irrigation. Hydropower at large scale may cause negative effects on freshwater ecosystems, which can be reduced by appropriate management .Carbon capture and storage can decrease groundwater quality. In dry regions, afforestation can reduce renewable water resources but also flood risk (medium agreement, limited evidence).【3.7.2.1】. (chunfeng wang, State Forestry Administration, China)	Renewable water resources are reduced by afforestation not only in dry but also in humid areas. There is evidence that bioenergy production requires much more water than e.g. the mitigation measure energy efficiency management.
137	60936	3	3	31	3	36	Especially Lines 31-32 - needs to explicitly highlight the potential synergies and conflicts between mitigation and adaptation initatitves, as well as the multi-disciplinary issues. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	One sentence was added.
138	85025	3	3	32	3	34	Please ensure support for these statements in the chapter text. There is no comparison of water requirements for different mitigation measures, and the potential for management to reduce the negative effects of hydropower is not discussed. (Michael Mastrandrea, IPCC WGII TSU)	Reference to CC-WE included where water demand of irrigated biofuels is discussed.
139	64278	3	3	33	3	34	This affirmation about hydropower is very emphatic maybe written as: ¨Hydropower CAN HAVE ANY negative effects….. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	Disagree, based on literature and discussions with freshwater ecologists there is no doubt that increased hydropower development will further impact negatively on freshwater (river) ecosystems. No examples for positive impacts have been reported.
140	68172	3	3	33	3	34	This sentence should read: "Hydropower CAN have negative effects on freshwater ecosystems that can be reduced by appropriate management." Currently, it appears to state that hydropower will in every circumstance have negative effects which is too broad a statement to support. (International Hydropower Association (IHA))	Disagree, based on literature and discussions with freshwater ecologists there is no doubt that increased hydropower development will further impact negatively on freshwater (river) ecosystems. No examples for positive impacts have been reported.
141	79376	3	3	33	3	34	The comment on hydropower should be edited to say hydropower may have adverse impacts on freshwater ecosystem, I do not believe it is always the case and differentiation is needed between run of the river systems and those with storage. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Disagree, based on literature and discussions with freshwater ecologists there is no doubt that increased hydropower development will further impact negatively on freshwater (river) ecosystems. No examples for positive impacts have been reported.
142	62712	3	3	34	3	34	The description of "Carbon capture and storage can decrease ground water quality" should be deleted. CO2 is injected into deep saline aquifer at depth below about 900 m (typically about 1000-2000 m) in CCS operation. CCS is little relationships to freshwater accessed. (Keigo Akimoto, Research Institute of Innovative Technology for the Earth (RITE))	In 3.7.2.1 literature is cited that state some risk.
143	65824	3	3	34	3	34	"Carbon capture and storage can decrease ground water quality", might lead to a misunderstanding that CCS in any regions will make problems for ground water quality, although a few number of studies for very limited areas (as mentioned in section 3.7.2.1) imply this concern. The description should be revised or deleted. (Ayami HAYASHI, Research Institute of Innovative Technology for the Earth (RITE))	Not changed. The useage of "can" implies that CCS will not cause problems in all regions.
144	56437	3	3	34	3	36	Typically sentences include "Not only" and "but also" phrases together. The present sentence can be revised as "afforestation can reduce renewable water sources and also flood risk." (Archis Ambulkar, Brinjac Engineering Inc.)	Expression not changed. The but stresses that reduction of water resources is bad, while reduction of flood risk is not.
145	62065	3	3	35	3	36	The afforestation with a non native tree specie could create some problem, there are ther species adequate for afforestation not so water consummer. I consider the afforestation as a good measure to flood risk, stop erosion…for the water balance. Would be reasonable to highlight on the ES a particular case of malafforestion. (Avelino Suarez, Institute of Ecology and Systematic, Cuban Environmental Agency)	Not done due to need for conciseness.
146	60617	3	3	37	3	37	Replace "to increase" by "to change" (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Where is "to increase"?

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
147	63109	3	3	38	3	38	Please exchange "rainfall" with "precipitation". Precipitation includes also snow, hail etc. not only liquid water. (Sabine Wurzler, LANUV NRW)	The studies reported on the impact of climate change on water quality specifically refer to rainfall.
148	71765	3	3	38	3	39	The authors should ensure that the assessment matches the supporting text in the chapter: "Water quality changes are linked to changes in rainfall, and climate-related erosion, deforestation and will be further impacted by future warming (medium agreement, limited evidence)." (UNITED STATES OF AMERICA)	The paragraph was revised.
149	81627	3	3	39	3	43	In the approach taken for interpreting uncertainty language within paragraphs of the executive summaries and summary for policymakers, the chapter team should assume that all non-bold statements have the same degree of certainty as the bold statement of the paragraph, unless otherwise specified. Thus, the repeated summary terms for evidence and agreement within the non-bold sentences of this paragraph could be deleted, as for the terms on the lines 35-36. (Katharine Mach, IPCC WGII TSU)	We checked.
150	71060	3	3	41	0	0	More intense precipitation especially in agricultural areas increases likelihood on non-point source nutrient and sediment load to rivers, lakes and can increase eutrophication and algal blooms; what about the potential increase in blue-green algae with warmer temperatures? (CANADA)	It is covered in a generic way on the first part of the statement, the second one refers only to positive impacts.
151	81628	3	3	42	3	42	A more qualified description of changes in storms and hurricanes may better match the assessment of working group 1. For example, a more conditional construction could be used, and possible changes in frequency and/or intensity may be relevant. (Katharine Mach, IPCC WGII TSU)	Text modified
152	58644	3	3	45	3	46	I think the "while" in this sentence should be changed into "no matter". Therefore, the sentence should be changed as： Climate change increases investment costs in water and wastewater treatment, no matter operating costs could rise or fall. (chunfeng wang, State Forestry Administration, China)	The paragraph was revised.
153	81629	3	3	45	3	46	If possible, the chapter team might consider indicating how these risks may vary across levels of climate change. (Katharine Mach, IPCC WGII TSU)	This is not possible to be done from the available literature.
154	85026	3	3	45	3	46	Please clarify whether "could rise or fall" means that costs are projected to rise in some places and fall in others, or that they could rise or fall in places where analyses have been done. (Michael Mastrandrea, IPCC WGII TSU)	It is the first situation, as the results depends on local conditions. Text modified accordingly.
155	81630	3	3	48	3	48	Casual usage of "likely" should be avoided as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Accepted
156	70695	3	3	50	3	52	The last sentence of this paragraph is vague and sweeping but not informative. Provide more detail or examples to indicate how overcoming previous water supply and quality issues will inform appropriate approaches to solving climate change water issues. Otherwise delete. (Cate Macinnis-Ng, University of Auckland)	Comment not clear, misplaced?
157	70803	3	3	51	3	52	If it is only evidence produced with the help of mathematical models or even physical models (not observations in a larger scale) it should be said in this item. (Sarka D. Blazkova, T.G. Masaryk Water Research Institute)	not changed as it is obvious that these statements can only be derived from mathematical models.
158	81631	3	3	51	3	52	Is it possible to specify further what is meant by "hydrological impacts" here? All of them, the aggregate impacts, etc.? Are the increasing impacts quantifiable across levels of climate change in any sense or metric? (Katharine Mach, IPCC WGII TSU)	Some specification added, no general quantification possible, but specific quantifcation provided in Table 3-2.
159	60816	3	3	51	3	54	Does this statement need any modification in light of the uncertainties around CO2 impacts on runoff, identified in box CC-VW? (Peter Falloon, Met Office Hadley Centre)	No.
160	85027	3	3	51	3	54	In line with my general comments, it would be useful to work this element of the potential for mitigation to reduce impacts into other findings. (Michael Mastrandrea, IPCC WGII TSU)	We added some specification.
161	81632	3	3	53	3	53	Casual usage of "likely" should be avoided as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
162	81633	3	4	2	4	2	Expanding upon the concept of opportunity, is it possible to provide a more nuanced key finding here? (Katharine Mach, IPCC WGII TSU)	We revised the paragraph.
163	71766	3	4	2	4	6	How should one interpret this pairing of high agreement and low evidence with respect to adaptive water management techniques? Is IPCC saying that authors & experts agree that these techniques should hold potential, but past practice offers little evidence that they actually do? This should be clarified. (UNITED STATES OF AMERICA)	Limited evidence does not mean there is little evidence that adaptive water management techniques hold potential, but merely mean there is limited literature supporting that they actually do.
164	77131	3	4	4	4	5	unclear what it is meant by 'resilient to uncertainty' (ITALY)	It means "flexible and low-regret solutions are resilient to uncertainty."

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
165	85028	3	4	5	4	6	Please ensure that this statement is fully supported in the chapter text. In addition, the reference to section 3.6.2 should be 3.6.3 instead. (Michael Mastrandrea, IPCC WGII TSU)	We checked and new 3.6.1, 3.6.2 and 3.6.4 are cited now.
166	65464	3	4	6	4	39	This caption needs some editing for grammar (Stuart Bunn, Griffith University)	We revised the caption.
167	81634	3	4	8	4	8	Here, it may be preferable to refer to "low regrets" improvements rather than "no regrets" improvements. (Katharine Mach, IPCC WGII TSU)	We revised the paragraph.
168	81635	3	4	9	4	10	For the described global cost of adaptation, what estimates are being referred to here? For example, it would be good to clarify what time frame is being considered & what the total global cost being referenced for this statement actually is, and to more clearly indicate whether this statement refers to the global cost of adaptation for the water sector only. On the next line, it would be helpful to specify the "amounts", in addition to comparing them to the estimates for the MDGs. (Katharine Mach, IPCC WGII TSU)	We revised the paragraph.
169	85029	3	4	10	4	11	The comparison to the MDGs is not supported by the chapter text. (Michael Mastrandrea, IPCC WGII TSU)	MDGs has been deleted.
170	79377	3	4	11	4	12	I am dubious that the figures on the investment costs for adaptation in WASH are those suggested - there is insufficient evidence from developing countries to make this assessment and as these countries are those where coverage is low, resilience to climate change can be built into the design of systems now and this is unlikely to add large additional costs. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We revised the paragraph.
171	81636	3	4	11	4	12	For the described percentages, what is the relevant time frame, and what are the overall costs being referred to (beyond provided percentages)? (Katharine Mach, IPCC WGII TSU)	Percentaged have been deleted.
172	85030	3	4	11	4	12	Please clarify the line of sight for this statement. It appears to be based on material in 3.6.5 (page 29) that is presented in different terms. (Michael Mastrandrea, IPCC WGII TSU)	We revised the paragraph.
173	81637	3	4	13	4	13	In place of "low evidence," the chapter team should use "limited evidence" following the guidance for authors. (Katharine Mach, IPCC WGII TSU)	We replaced it.
174	77018	3	4	13	4	14	Last sentence of paragraph - the wording doesn't seem exactly right: should this instead be "For example, wetland conservation or restoration maintains or increases carbon storage"? (Sean Fleming, Meteorological Service of Canada)	Correct. Changed to "For example, wetland conservation or restoration maintains or increases carbon storage".
175	57949	3	4	19	4	19	“An adequate, and secure water supply is essential for human well being (Oki and Kanae, 2006)…..”. Do you really need reference for this statement? Is it not a universal truth? I think, authors are making this grandiose statement belittle by putting a reference to the statement. (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	We revised the first paragraph in 3.1.
176	56438	3	4	19	4	21	Sentence "An adequate, secure water…….and water management (Figure 3-1)" seems too long and need gramatical improvements. Probable it can be split into two sentences as "An adequate secure water supply is essential for human well-being (Oki and Kanae, 2006). Changes in the hydrological cycle can generate different water-related hazards and potentially interact with non-climatic drivers and water management (Figure 3-1)". (Archis Ambulkar, Brinjac Engineering Inc.)	We revised the first paragraph in 3.1.
177	78072	3	4	19	4	23	Perhaps as a last point, it would be good to point out that most of the variation in water resources in particular places over long timescales is a result of climate shifts. Even relatively small shifts during the Holocene over the past 4k years have resulted in shifts in orders of magnitude for Lake Chad, African Rift lakes, and the Nile, among many other places. And the climate link role in determining flow regime is extremely strong. Issar, Climate Changes During the Holocene and their Impact on Hydrological Systems is the now classic reference (John Matthews, Conservation Internatonal)	Thank you very much. However, it was difficult to judge "most of the variation in water resources in particular places over long time scales is a result of climate shift."
178	77132	3	4	21	0	22	Unclear or incomplete sentence (ITALY)	We revised the sentence.
179	71767	3	4	21	4	21	Change from "Water is the delivering mechanism of climate change impacts," to "Water is a primary delivering mechanism of climate change impacts." (UNITED STATES OF AMERICA)	We revised the sentence.
180	59826	3	4	21	4	22	This sentence is incomplete/lacks clarity, and the meaning is lost due to poor drafting. Suggest re-phrasing. (AUSTRALIA)	We revised the sentence.
181	63110	3	4	21	4	22	The sentence "Water is .... And transport." makes no sense. I think there are parts of the sentence missing. (Sabine Wurzler, LANUV NRW)	We revised the sentence.
182	76979	3	4	21	4	23	The language is awkward, and I don't understand the first of these two sentences. (Christopher Milly, U.S. Geological Survey)	We revised the sentence.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
183	56439	3	4	22	4	23	Can the sentence be revised as "Even though water circulates on Earth and within its atmosphere, it is a locally variable source and vulnarabilities to water-related hazards differ from region to region." (Archis Ambulkar, Brinjac Engineering Inc.)	We revised the sentence.
184	59828	3	4	26	4	30	This sentence is very long and hard to follow with a lot of different concepts incorporated. Suggest breaking the sentence up. (AUSTRALIA)	We revised the caption.
185	59827	3	4	26	4	38	The legend for FIGURE 3-1 lacks clarity and the meaning is obscured by poor English expression (e.g. major grammatical errors, extremely long sentences, incorrect use of plural and singular forms). Suggest re-phrasing to provide clarity. (AUSTRALIA)	We revised the caption.
186	76980	3	4	26	4	39	The language is opaque. (Christopher Milly, U.S. Geological Survey)	We revised the caption.
187	59829	3	4	33	4	34	The meaning of this sentence is lost due to poor drafting. (AUSTRALIA)	We revised the caption.
188	64279	3	4	33	4	34	I suggest add: AQUEDUCT AND SEWERAGE SYSTEMS that is vital for developing countries. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	We revised the caption.
189	77019	3	4	41	4	42	"Non-climatic drivers such as population increase..." Phrasing isn't quite right - while the statement is correct, it should be briefly but explicitly acknowledged here that population growth additionly serves as a major driver of anthropogenic climate change. (Sean Fleming, Meteorological Service of Canada)	Yes, that is right, but from water sector point of view, population growth is one of non-climatic drivers and also one of major drivers of anthropogenic climate change.
190	63112	3	4	41	4	43	I miss pollution here. (Sabine Wurzler, LANUV NRW)	Water quality also decreases the available supply of water related to population grouwth, urbanization, economic development and land use changes, and both quantity and quality issues are included in the description.
191	64280	3	4	42	4	42	Isuggest add: ¨ .....land use AND LAND-USE CHANGES, …… (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	Thank you very much. We wanted to describe there are anthropogenic land use changes and natural geomorphological changes.
192	71768	3	4	43	4	44	Authors should also note that actions taken to improve the reliability or sustainability of a water supply in reponse to increased population and land use changes may also be seen as useful adaptation strategies. (UNITED STATES OF AMERICA)	Thank you very much. We have revised the text as "In this context, adaptation to climate change in the water sector can contribute to improving the availability of water."
193	77133	3	4	44	0	44	imprvement of what? (ITALY)	We added "the availability of water" after "improving".
194	81638	3	5	5	5	18	This paragraph could be tightened, compressed, and simplified. (Katharine Mach, IPCC WGII TSU)	We revised the paragraph.
195	66086	3	5	12	5	12	The word chapter will be more appropriate to be added before 11 & 12 (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	We added "Chapter".
196	76564	3	5	14	5	14	remove "below" (that section is not below but several pages later) (Claudio Cassardo, University of Torino)	We deleted "below".
197	62940	3	5	21	0	0	As noted earlier, this section is limited to trend tests and their results. It is important and necessary to synthesize both the methods and results of other methods: characterization of hydrological regimes, Signal Processing (spectral analysis, wavelet analysis ...) to determine the patterns of variability in hydrological signals and their origins, including mainly climate (Benoit Laignel, University of Rouen)	We discuss multidecadal variability and changes in seasonality at various places in the chapter, but we think that analyses in the spectral domain do not warrant explicit separate recognition.
198	80361	3	5	23	6	20	Section 3.2.1: Please check and ensure consistency in D&A with Ch18 WGII and Ch10 WGI AR5. The section does not include a single reference to WGI Ch10 (except for Figure 3.2 caption); Overall, the WGII D&A concept does not seem to match entirely the one applied by WGI. Please define the applied D&A concept in order to clarify the differences between the two WGs, and also how the WGII D&A approach differs from the IPCC Good Practice Guidance Paper on D&A, the agreed on result of a cross-WGI/II Expert Meeting back in 2009. (Gian-Kasper Plattner, IPCC WGI TSU)	Figure 3-2 has been deleted, but the citation of WG1 chapter 10 has been transferred to the text. We have clarified that our use of "detection" and "attribution" agrees with the definitions in the WG2 Glossary, which in turn are consistent with the Good Practice Guidance Paper mentioned in the comment.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
199	71769	3	5	25	5	36	The IPCC should use only robust detection and attribution to assess the regional to local impacts of anthropogenic global climate change. Otherwise, the IPCC is carrying a logic forward that can result in the detection and attribution of an anthropogenic climate impact where either there is no corresponding WG1 detection and attribution of an anthropogenic global climate change in relevant local to regional climate conditions, or the change in local to regional climate condition has been shown to be the result of natural climate variability, especially multiyear to multidecadal. Within the proposed approach in this chapter there is a significant under appreciation of the potential role of natural variability within "multi-step attribution, in which hydrological changes are shown to be consistent with climatic changes that may in turn be attributable to human activities." Therefore, we suggest that Chapter 3 authors adopt the language and approach used in AR5 WG2 Chapter 4, and described on page 20, lines 7-12: "Note that a slightly different definition than Chapter 18 for detection is used, because detection here is based solely on the presence of a temporal trend and does not attempt to distinguish natural from climate related variation. Confidence in attribution to climate change is very high when three criteria are satisfied: changes correspond to a sound mechanistic understanding of responses to climate change; time series of observations are sufficiently long to detect trends correlated with climate change; and confounding factors can be accounted for or are of limited importance." The approach used and described in AR5 WG2 Chapter 4 is highly defensible because it documents connections of impacts to changes in regional and local climate (both natural variability and anthropogenic climate change) and will only go further (given the challenges in making causal linkages between observed regional to local changes in climate conditions and anthropogenic climate change) when there is robust detection and attribution of the regional to local climate conditions. Using this approach, valuable information on the impacts of local to regional changes in climate can be communicated to decision makers without waiting for the robust detection and attribution of local to regional climate change that may be forthcoming as the science advances and/or time series of observations become sufficiently long to detect local to regional trends that can be demonstrated to be the result of anthropogenic global climate change. (UNITED STATES OF AMERICA)	We use "detection" in the sense given in the WG2 Glossary. The extended definition of chapter 4 is open to the objection that natural variability includes trends. We are careful, for example in Table 3-1, to say what is being attributed to what, and we are not disposed to alter what we say in this paragraph in light of this comment. In short, we consider multi-step attribution to be an acceptable stopgap until the science advances. Note that detected changes can require policy responses no matter to what they are attributable.
200	71770	3	5	25	6	20	Detection and Attribution. The terminology, methodology and definitions used in section 3.2.1 needs to be used consistently throughout the entire WG 2 document. (UNITED STATES OF AMERICA)	Our usages are consistent with those in the WG2 Glossary.
201	60618	3	5	26	5	26	The follwoing additional reference (to include at the end of line 26) is sugested "However, additional indicators, besides the rainfall amount, need to be considered when trying to understand the role of the climate. In fact, regional studies evidenced that changes in the intra annual pattern of the rainfall with statistical meaning may occur under unchanged amounts of rain, Portela and al., 2010". The complete reference is Portela, M.M.; Santos, J.F.; Quintela, A.C.; Vaz, C.; Martins, C., 2010, “About the trend detection in Portuguese long hydrologic time series and the climate change”. Regional Rainfall 2010, Regional Expert Meeting on Rainfall-Runoff analysis and Climate Change at the Balkans, Faculty of Civil Engineering, University of Belgrade. Serbia and Montenegro. (Maria Manuela Portela, Instituto Superior Tecnico (IST))	This comment is not about the text at P5 L26.
202	81639	3	5	26	5	26	Would it be relevant to specify that demonstrating that part of the documented changes not due to variability is done through statistics? (Katharine Mach, IPCC WGII TSU)	Done.
203	71771	3	5	29	5	30	This statement is ambiguous. The preface states that attribution to climate change is difficult. The statement has two interpretations: 1. Despite the difficulty, researchers are still able to correctly attribute impacts to climate change, or 2. In spite of this difficulty, researchers merely claim that the impacts are due to climate change confidently (in language only), but it is not rigorous. Either of these statements would require some sort of evidence, as would the entire assertion of Table 3-1. Nevertheless, this appears to be a valuation statement that could be damaging to scientific credibility. In its present state, the statement and table 3-1 should be removed. (UNITED STATES OF AMERICA)	Our text can not be construed by a reasonable reader as bearing the commenter's meaning 2. Meaning 1 is a nearly admissible paraphrase of our text (we say "climatic causes", not "climate change"). It also coheres with universally accepted physical understanding; at the level of generality of this scene-setting paragraph, it is unnecessary to provide evidence.
204	71772	3	5	30	5	32	Authors should clarify this sentence. It seems to be saying that "end to end" attribution would require running climate models with external forcings turned on and off so the two results can be compared. (UNITED STATES OF AMERICA)	The comment repeats what our text says. We see no need to clarify what is already clear.
205	76981	3	5	32	5	34	I don't agree with this statement. Attribution of changes in the water cycle (a global cycle with regional and local facets) can be done at many scales, including those resolved by all (GCM-based) climate models. Indeed, one expects attribution to be successful first at the larger scales, as has been seen for temperature. (Christopher Milly, U.S. Geological Survey)	We have inserted "most catchment-scale" before "hydrological impacts".

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
206	57121	3	5	43	5	46	Data series used in the references “Piao et al (2010)” is short, and attribution of runoff change in this reference was also cited from another old reference. Therefore, we add three more references to Table 3-1 instead, which are listed as follows: “Wang and Yan et al (2013), Wang and Zhang, et al (2012), Bao et al (2012), ”. References (1) Wangm G. Q. Yan, X. L. Yan. Zhang, J.Y. et al., 2013: Detecting evolution trends in the recorded runoffs from the major rivers in China from 1950~2010. Journal of Water and Climate Change. 2013. (accepted,will be published in 2013) (2) Wang, G. Q. Zhang, J.Y.Pagano, T. C. et al. 2013: Identifying contributions of climate change and human activity to changes in runoff using epoch detection and hydrologic simulation. Journal of Hydrologic Engineering. 2012. doi:10.1061/(ASCE)HE.1943-5584.0000559 (accepted,will be published in 2013) (3) Bao, Z.X. Zhang, J.Y. et al., 2013: Attribution for decreasing streamflow of the Haihe River basin, northern China: Climate variability or human activities?". Journal of Hydrology. http://dx.doi.org/10.1016/j.jhydrol.2012.06.054 (Guoqing Wang, Nanjing Hydraulic Research Institute)	See response to #962.
207	60619	3	5	46	5	46	The sentence "... long-term records of soil moisture content ... " is ambiguos and imprecise . Perhaps it should be replaced by "... long-term records of soil moisture content in natural conditions are mostly..." (Maria Manuela Portela, Instituto Superior Tecnico (IST))	This comment is not about P5 L46.
208	66036	3	5	48	5	51	I would suggest to add a comment to this reflection about the uncertainties in the extreme hydrological events, telling that other hydrological factors, like changes in the use of soil and vegetation can also alter the flood regime, and contributes to increase the uncertainty to attribute completely some flood changes to climatic change. (Maria-Carmen Llasat, University of Barcelona)	Under pressure from the need to shorten our text we regret that we are unable to accommodate this reasonable suggestion.
209	77843	3	5	48	5	51	important thesis - it should be repeated before the Introduction (3.1) , in the summary (POLAND)	We discussed at length whether to raise this material to the status of an item in the Executive Summary, and decided not to for lack of space.
210	81640	3	5	48	6	10	This is an interesting discussion, and it would be beneficial to provide supporting citations for it. (Katharine Mach, IPCC WGII TSU)	The discussion is a summary of the work of Pall et al. 2011, which we now cite in the text (as opposed to the caption of the now-deleted Figure 3-2).
211	71061	3	5	53	6	2	Suggest simplifying the language in this paragraph. (CANADA)	We will work on this suggestion, including trying to reduce or eliminate the algebraic symbols. But our summary of a new method absolutely requires the idea of a ratio of simulated risks.
212	81641	3	5	54	5	54	Where "threshold" is mentioned, it might be helpful to clarify that this is a threshold in a model simulation, along with the "actual climate" and "climate in which there is no anthropogenic climate change." (Katharine Mach, IPCC WGII TSU)	Done.
213	63114	3	6	8	6	8	There is no such thing as "anthropogenic greenhouse radiation". I guess you wanted to say "anthropogenic greenhouse forcing". (Sabine Wurzler, LANUV NRW)	Anthropogenic greenhouse radiation is that emitted by molecules added to the atmosphere by human beings. The word "forcing" would be too technical, and indeed wrong, in this context.
214	76565	3	6	17	6	17	and also page 69. It is not clear to me which are the differences between the coloured lines. I mean, the real difference: how big is the difference between the "reference state"? I understand that the answer is written in the referenced paper, but I would like to understand better the figure without reading each paper... (Claudio Cassardo, University of Torino)	Figure 3-2 has been removed.
215	64282	3	6	23	6	23	In this subsection nothing is written about one of the factors: evapotranspiration. The plants transpiration is one of the main factors here, if we not have elements would be better put in the title evaporation, because evapotranspiration is different to evaporation. Maybe useful point 3.4.2 (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	Agreed,we reduced the paragraph on evaporation and put more information on evapotranspiration.
216	79378	3	6	23	7	18	I find it astonishing that this section makes no reference at all to the Himalayas, Karakoram and Hindu Kush range - or indeed to the Pamirs and Tien Shan, despite continued research and publication of papers since AR4. I can only conclude the authors wish to avoid mentioning them because of previous controversy. Nonetheless, there is compelling evidence that the glaciers in this region have shown consistent loss of mass and volume when studies have used the most robust methods. A systematic review on this has recently been published (Miller et al 2012). It is not really acceptable to ignore the largest volume of ice feeding freshwater resources in this way. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Agreed, this has been included in the last sub-paragraph of 3.2.2. And Himalayan glaciers are discussed in detail in Box 3-1, and central Asian glaciers are discussed in detail in chapter 24 (section 24.9.3, with additional material in 24.4.2.2).

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
217	60937	3	6	25	6	25	The different chapters (see also relevant comment for the SPM which makes reference to Chapter 1, p. 22, ln. 49) are sometimes contradictory on what concerns past and future drought occurrence. An effort should be made to maintain consistency, by appropriately citing the literature and fully describing the assumptions/limitations in the corresponding cited works. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	I find it not contradictory to the mentioned Chapter, but agree that different citations are confusing and we try to improve!
218	57950	3	6	25	6	33	You may find following reference useful here: Kumar S., V. Merwade, J. Kinter III, D. Niyogi (2013). Evaluation of Temperature and Precipitation Trends and Long-term Persistence in CMIP5 20th Century Climate Simulations. Journal of Climate. doi:10.1175/JCLI-D-12-00259.1, in press. Also, I do not agree: “models substantially underestimate observed trends (Line 30 to 31)”. In the above referred paper we have shown precipitation trends from each of 19 CMIP5 models. We found that individual model’s precipitation trends are comparable to observations. However, the multi-model mean generally underestimate local and regional precipitation trends. Because local/regional trends are not significantly correlated among different models (see Fig.8 in Kumar et al. 2013), mainly due to role of internal variability. This results into muted multi-model mean signal compared to observation (see Section 3.c in Kumar et al. 2013). (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	too specific
219	65361	3	6	29	6	29	"warming => warmer than before" because just warming is not the reason of the changes (REPUBLIC OF KOREA)	Accepted, sentence has been revised.
220	76982	3	6	29	6	30	I cannot tell what is meant by "warming" in this sentence. Is it used as shorthand for anthropogenic climate change? If so, then it is not caused by , but merely a facet of, the change. Or does it mean (as literally implied) regional changes in temperature--be they internal variability or forced? I don't think so. Also, what is meant quantitatively by "recent." I would think that most climate scientists would attribute _most_ regional, recent trends in precipitation to internal variability in the climate system. (Christopher Milly, U.S. Geological Survey)	Accepted, sentence has been revised.
221	70548	3	6	35	3	37	Please add information about the findings from Skaugen, T., Stranden, H.B., Saloranta, T. (2012) Trends in snow water equivalent in Norway (1931-2009). Hydrology Research 43 (3), p. 489-499, doi: 10.2166/nh.2012.109 as follows: In Norway, Skaugen et al. (2012) found a general negative trend in snow water equivalent below 850 masl and a positive trend in snow water equivalent above 850 masl. This indicates that at higher altitudes the observed increase in precipitation influences the snow water equivalent whereas at lower altitudes the increased temperature has reduced the snow water equivalent (a larger percentage of the percipitation is coming as rain). (Hege Hisdal, Norwegian Water Resources and Energy Directorate)	Accepted, we integrated some of their findings.
222	71773	3	6	35	6	36	Is it consistent to say that IPCC finds changes in snowfall to be indeterminant but changes in snowfall season are determinant? Shouldn't those two phenomena be related? Or do the authors mean that snowfall amounts could change within the season of snowfall (even if it's shortening) such that total seasonal snowfall doesn't change? (UNITED STATES OF AMERICA)	Accepted, we revised it to "amounts".
223	76983	3	6	36	6	37	"later end dates?" I haven't read the references, but that seems counterintuitive, and it does not support the snowfall season. Also, is this sentence about snowfall season or snowmelt season? I am confused. (Christopher Milly, U.S. Geological Survey)	revised
224	71774	3	6	37	6	37	Tedesco et al., 2009 is different than what is said here. (UNITED STATES OF AMERICA)	reference deleted
225	59260	3	6	39	3	50	It should be made clear that the "evaporation paradox" refers to evaporation and the ACTUAL evapotranspiration and not to evaportanspiration in general.(Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	entire paragraph revised
226	71775	3	6	39	6	50	This section starts out with a claim of an acceleration of the hydrologic cycle, which has been observed. There are two problems here: First, if the entire hydrologic cycle is accelerating, there should be some reference to second paragraph above that says, "Global trends in precipitation... are statistically insignificant,"in order to resolve the paradox that it suggests. Secondly, the evaporation paradox was hypothesized by Bouchet in response to pan evaporation liberally used to represent actual evaporation. In line 47, a decrease has been observed in pan evaporation. That was the point made in Fu et al., 2009. This is further explained in research on the evaporation paradox (and how pan evaporation does not measure actual landscape evaporation) of Hobbins et al., 2006 and Kahler and Brutsaert, 2006. (UNITED STATES OF AMERICA)	entire paragraph revised

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
227	76984	3	6	39	6	50	I find this paragraph unhelpful and confusing. The phrase "intensification of the hydrologic cycle" is sufficiently vague to be meaningless. Did Jung et al really analyze GLOBAL evaporation, or simply extrapolate land-based point observations to global land area (itself a minority fraction of the globe)? Oceans are where most of the global evaporation takes place. I have seen no substantial case for an "evaporation paradox;" if such a phenomenon is believed to be significant, then it would be good to give a more complete review. (Christopher Milly, U.S. Geological Survey)	entire paragraph revised
228	60938	3	6	39	7	18	In the discussion on evaporation it is not equally clear if this considers actual or potential evaporation. The impacts on these can be quite different and it would help clarify the text by always being explicit (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	entire paragraph revised
229	60939	3	6	39	7	18	There is little discussion on the importance of feedback between precipiation and evaporation (including moisture re-circulation). This is shown by van der Ent et al., 2010 to be important in several regions of the world. A research gap is the understanding of changes to such feedback loops in a changed climate Reference: van der Ent, R., Savenije, H., Schaefli, B. Steele-Dunne, S., 2010, Origin and fate of atmospheric moisture over continents, Water Resour. Res., 46(9), W09525 (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	entire paragraph revised
230	71776	3	6	40	6	50	Change 'evaporative' to 'evapotranspiration' to accurately reflect the cited paper. (UNITED STATES OF AMERICA)	entire paragraph revised
231	77134	3	6	42	6	50	The evaporation paradox is announced here, with high confidence, but the rest of the chapter seems to neglect it (ITALY)	entire paragraph revised
232	57452	3	6	44	6	44	Line 39 says " on a global scale, evaporation increased from the early 1980s up to the late 1990s " but line 43 & 44 says regional pan evaporation has been steadily decreasing since the 1960s. It is nice to further explain how this happens. (So Kazama, Tohoku University)	entire paragraph revised
233	64281	3	6	45	6	47	It is very difficult to accept this affirmation without a very clear explanation when the temperature is risen. We need deep in the literature with more peer review assessments. Particular heavy is this affirmation in water bodies. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	entire paragraph revised
234	57951	3	6	45	6	50	Thanks for explaining the "evaporation paradox". Studies have found complementary relationship between Pan Evaporation and actual Evaporation e.g. Brutsaert and 321 Parlange 1998. This complementary relationship is consistent with observation, i.e. decrease in PET and increase in ET. Is there still an "evaporation paradox"? Reference: Brutsaert, W., and M.B. Parlange, 1998. Hydrologic cycle explains the evaporation paradox. Nature 396: 30 (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	entire paragraph revised
235	57453	3	6	46	6	46	Explain the definition of evaporation paradox. (So Kazama, Tohoku University)	entire paragraph revised
236	77020	3	6	47	6	48	Not immediately clear why "The evaporation paradox is made more puzzling by robust oceanographic observations of changes in geographical patterns of salinity." What is it about these observations make the paradox "more puzzling"? A slightly clearer explanation would be useful. (Sean Fleming, Meteorological Service of Canada)	entire paragraph revised
237	70698	3	6	47	6	51	This sentence is unclear. Has the contribution of canopy transpiration decline to river discharge decline been detected or modelled? Or perhaps both? (Cate Macinnis-Ng, University of Auckland)	This comment is not about P6 L47-51.
238	70697	3	6	50	6	51	I didn't find Betts et al. 2007 in the reference list (Cate Macinnis-Ng, University of Auckland)	Betts et al. 2007 is not cited in 3.2.2.
239	71777	3	6	52	6	52	When authors reference a "long-term record", what period duration are they implying? (UNITED STATES OF AMERICA)	revised
240	76985	3	6	52	6	53	Are those measurements really in "natural conditions?" Aren't they in agricultural lands--maybe aritificially drained and formerly plowed--on carefully tended plots of grass? (Christopher Milly, U.S. Geological Survey)	Agreed, revised
241	81642	3	6	53	6	54	If possible, it would be preferable to specify the timeframe for this observed change. (Katharine Mach, IPCC WGII TSU)	Agreed, revised
242	81643	3	7	1	7	8	If possible, the timeframe for these observations should be specified. (Katharine Mach, IPCC WGII TSU)	Agreed, revised

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
243	70684	3	7	8	7	10	The sentence "Soil humidity in permafrost areas and permafrost degradation are strongly connected with active layer depth and influence the stability of steep slopes" is very confusing. There is a mix of concepts. By analysing what you might want to say, I think you mean that on one side "Active layer depth and permafrost degradation are closely dependent on soil ice content. In steep terrain, slope stability is highly affected by changes in permafrost". If needed, I will be happy to re-review or clarify questions in rephrasing. I suppose this problem might have arised due to shortening of sentences. (Goncalo Vieira, University of Lisbon)	Accepted, sentence has been revised
244	81644	3	7	14	7	16	If possible, the timeframe for these changes should be specified. (Katharine Mach, IPCC WGII TSU)	revised
245	62010	3	7	21	0	0	Section 3.2.3. The period when observed trends have been recorded should always be specified, as upward and downward trends may be observed over different periods, as shown by Giuntoli et al. (2013) in France and Hannaford et al. (2013) over different European regions, because of decadal oscillations in some climate characteristics. The list of detected trends in this paragraph must therefore be accompanied by the corresponding studied period in order to avoid potentially large misinterpretations. - Giuntoli, I., Renard, B., Vidal, J.-P., and Bard, A. (2013) Low flows in France and their relationship to large-scale climate indices. Journal of Hydrology, 482, 105-118. doi: 10.1016/j.jhydrol.2012.12.038 - Hannaford, J., Buys, G., Stahl, K., and Tallaksen, L. M. (2013) The influence of decadal-scale variability on trends in long European streamflow records. Hydrology and Earth System Sciences Discussions, 10, 1859-1896. doi:10.5194/hessd-10-1859-2013 (Jean-Philippe Vidal, Irstea)	The recorded periods have been added in each case.
246	62941	3	7	21	0	0	This part is incomplete. This lack of references, including all work on the relationship between hydrological variability and climate fluctuations and the presence of discontinuities that are not presented. Similarly, work from satellite data are not presented. (Benoit Laignel, University of Rouen)	Detail Studies from individual rivers cannot be provided, and only work dealing with regional or continental streamflow variability can be included in this section. Not sure what the reviewer means with satallite data, my understanding is that satallite image cannot record continuous streamflow data.
247	71778	3	7	21	7	21	The recent work by Fritze et al. (2011; J Hydrometeorology,12, 989, DOI: 10.1175/2011JHM1360.1) sheds some additional observations of shifts in western North American snowmelt runoff for the 1947 to 2008 period. (UNITED STATES OF AMERICA)	The reference is not cited here.
248	59830	3	7	21	7	45	Section 3.2.3 - Mention is made of possible effects on runoff of changes in transpiration of vegetation. In particular, increases in CO2 concentration, and subsequent increases in stomatal conductance in vegetation and reduced transpiration can lead to increases in global runoff. What is not mentioned in this paragraph are indirect effects of changes in precipitation and temperature through their effects on vegetation water use. In particular, the effects of changes in climate on the severity and frequency of events such as wildfire and pests and pathogens that can significantly change the water balance of vegetated areas. Changes in regimes of wildfire and in pests and diseases that result from changes in precipitation and temperature can potentially change evapotranspiration from vegetation canopies. For example, increased infestations of mountain pine beetle and subsequent forest mortality in Canada are likely to lead to accumulation of a larger snowpack as a result of thinner tree canopies and decreased snow sublimation (Pugh and Small, 2011). These thinned canopies also cause faster snow melt by allowing more sunlight through to the forest floor and lowering the snowpack albedo, as a result of needle litter on the snow surface. Augmented snowpack coupled with dead trees that no longer transpire will likely lead to more available water. Wildfire induced tree mortality has the potential to decrease streamflow in some forested catchments, as post-fire regeneration can lead to increases in evapotranspiration for several decades. Pugh, E., Small, E. 2011. The impact of pine beetle infestation on snow accumulation and melt in the headwaters of the Colorado River. Ecohydrology, DOI: 10.1002/eco.239. Kuczera, G.A. 1987. Prediction of water yield reductions following a bushfire in ash-mixed species eucalypt forest. J. Hydrol. 94, 215–236. (AUSTRALIA)	Note that this section is on observed records of runoff and stream flow and only recognize attribution can be included. Those facts related with ecological systems should be addressed in chapter 4.
249	76566	3	7	23	7	31	in my opinion, annual trends are not so meaningful. In several regions, seasonal trends are much bigger but sometimes are opposite between different seasons and so cancel each other, giving annual values less meaningful. For instance, since precipitation is the main source for aricultural purposes, the analysis of runoff during the vegetative season is a key point! (Claudio Cassardo, University of Torino)	Most water resource management uses annual values. Recognising that seasonal changes may be important, the seasonal interannual variability on stream flow may be even larger than annual ones, making trends on seasonal changes even more difficult to detect than annual ones. Only regions with snowmelt influence were analysed at seasonal scale.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
250	77021	3	7	23	7	31	The geographical coverage of this passage seems totally inadequate. Far more examples of overall water resource trends are needed here, and are available. For instance, the one-sentence summary about runoff changes across North America looks only at the US, to the exclusion of Canada and Mexico; and it is not even adequately descriptive of what is happening in the US. As one recent and relevant example, Fleming and Weber (2012) found that runoff has been steady or increasing across British Columbia, including the upper (Canadian) portion of the transboundary Columbia Basin, the largest river by runoff volume on the west coast of the Americas. There have also been many other analyses across North America. And then, of course, there is the rest of the world - again, insufficient geographic coverage is provided here. This appears to be the main location in the IPCC report that global runoff trends, one of the most significant impacts of climate change, are summarized. More detail is required here, as the current description is incomplete and potentially misleading. (The reference for the above citation is: Fleming SW and Weber FA (2012) , Detection of long-term change in hydroelectric reservoir inflows: bridging theory and practise, Journal of Hydrology, 470/471: 36-54). (Sean Fleming, Meteorological Service of Canada)	The section is not intended to present a literature review, but rather indicate the most significant evidences of trends which can be atributed to climate change. Regions with not trends were not cited since readers may undestand that uncited regions not changes were detected.
251	60940	3	7	23	7	39	Clarify that all changes in river basins mentioned are either at river stations that are unregulated, or that the discussion is on naturalised flows. Several of the basins mentioned are highly regulated (Yellow River, Columbia River). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	It seems evident that these changes were detected on sub-catchments of the cited rivers that are not significantlty regulated.
252	77025	3	7	23	7	45	Good start, but credibility and accuracy demands that this section (3.2.3) include some additional text around the impacts of glaciers on observed runoff trends, as this is a key issue in many parts of the world (i.e., rivers like the Danube, Columbia, Ganges, Yellow, etc with headwaters in the Alps, Himalayas, Rockies, Andes, etc). Such text would also help tie the contents of this section to the other sections in the chapter, e.g., 3.2.2. Just a short but accurate paragraph would be sufficient. Here is a suggestion: "Runoff trends associated with glacier change in a warming environment have been documented worldwide. The presence or absence of glacial ice in a mountain watershed can control the strength and even direction of local runoff trends. Further, glaciers have been observed to generate either increasing or decreasing water resource trends historically, depending on how far down the path of deglaciation a particular catchment is located." Eight key literature citations (this is a minimum required set, more could be legitimately cited) include the following: (i) Fleming SW and Clarke GKC (2003), Glacial control of water resource and related environmental responses to climatic warming: empirical analysis using historical streamflow data from northwestern Canada, Canadian Water Resources Journal, 28:69-86; (ii) Stahl K and Moore RD (2006), Influence of glacial coverage on summer streamflow in British Columbia, Canada. Water Resources Research, 42, doi:10.1029/2006WR005022; (iii) Casassa G and others (2009), Detection of changes in glacial run-off in alpine basins: examples from North America, the Alps, central Asia, and the Andes, Hydrological Processes, 23:31-41; (iv) Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrological Processes, 23:42-61; (v) Li Z and others (2010), Observed changes in streamflow at the headwaters of the Urumqi River, eastern Tianshan, central Asia, Hydrological Processes, 24:217-224; (vi) Baraer M and others (2012), Glacier recession and water resources in Peru's Cordillera Blanca, Journal of Glaciology, 58, doi:10.3189/2012JoG11J186; (vii) Fleming SW and Weber FA (2012), Detection of long-term change in hydroelectric reservoir inflows: bridging theory and practice, Journal of Hydrology, 470-471:36-54; and (viii) Dahlke HE and others (2012), Contrasting trends in hydrologic extremes for two sub-arctic catchments in northern Sweden: does glacier melt matter?, Hydrology and Earth System Science, 16:2123-2141. (Sean Fleming, Meteorological Service of Canada)	This comment is out of place with respect to the organization of the chapter, in which the impacts of changes in glacier meltwater are mentioned in Table 3.1 and treated in section 3.4.4 (with more references than we can retain in the final draft).

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
253	78084	3	7	23	7	45	This section talks about "flows" but almost nothing until the last paragraph about flow regime. As flow regime is both the "master variable" for freshwater ecosystem and tightly linked to precipitation regime (Poff, BioScience, 1997), a series of strong statements are really necessary here. Quantity and quality are both linked intimately to flow regime/water timing, and one of the real weaknesses of climate models to date is that they tend to presented and analyzed at annual timescales. In part this is because this maximizes confidence, but it also masks very significant intra-annual changes that may be occurring at a seasonal scale, which is far more important for livelihoods, economies, infratructure, and ecosystems. In talks, I sometimes explain that I have killed a lot of plants by watering them two weeks too late, though the amount of water that I applied at an annual scale looks identical to a "good" harvest year. This is also a key point in Matthews/Wickel/Freeman, PLoS Biology, 2011. IN terms of the major shifts for the AR5, flow regime is likely to be the driver of "transformation" (to use the excellent term suggested in the first two chapters) for freshwater resources. Shifts from perennial to intermittent, for instance, constitute transformation by essentially any definition. Lastly, I think it is also important to consider shifts in precip timing in particular for a variety of sectors. This is not really discussed in signficant detail, but there is evidence that these shifts are occurring. Reports from the past few years in Kenya, for instance, see a clear identification of "drought" conditions by farmers and urban water managers though regional meterological patterns show slight increases in annual precip. The gap is in the timing of precipitation. The increasing variability of the Indian Monsoon is having the same effect in South Asia. In China's Qinghai, there is evidence from herders and farmers that intense spring rains are a transition in the past 15 years from previous spring "misting" conditions, which herders call "winter drought". The resulting rains trigger massive erosion and grassland degredation over a widespread area. Timing is one of the most critical aspects of water and our use and orientation to water, and I think it deserves a more significant treatment here. (John Matthews, Conservation Internatonal)	We are not sure what the reviewer means by "flow regime", especially since he describes it as a master "variable". It seems to have something to do with seasonality, changes in which we discuss at several places. We assess geographical variability of hydrological change to be more fundamental than changes of the seasonal distribution of water-balance variables.
254	57454	3	7	24	7	24	It is better to give a quantitative analysis other than qualitative . (So Kazama, Tohoku University)	Agree.
255	81645	3	7	24	7	24	If possible, the timeframe for these observed changes should be specified. (Katharine Mach, IPCC WGII TSU)	Former versions included the timeframe, but deleted in the SOD because the first line indicate that changes were observed since mid 20th Century. In the final draft, the specific periods are included again.
256	60941	3	7	24	7	25	Lower streamflow in Europe expected, particularly in south and east. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This section refers to observed changes, not on the expected changes which are addressed in section 3.4.5.
257	57952	3	7	26	7	27	There are many stream flow trends studies in North America, particularly in the United States e.g. Kumar et al. 2009. Also, trends should be discussed also with its statistical significance and uncertainties in statistical significance. For example: in Kumar et al. 2009, we found that number of stations showing significant trends gets considerably reduced when we consider long-term persistence in stream flow trends. Reference: Kumar, S., V. Merwade, J. Kam and K. Thurner (2009), Streamflow trends in Indiana: effects of long term persistence, precipitation and subsurface drains, Journal of Hydrology, Vol. 374 (1-2), pp. 171–183 (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	The section is not intended to present a literature review, but rather indicate the most significant evidences of trends at large regions or continental scale.
258	57123	3	7	27	7	29	Data series used in the references “Piao et al (2010)” is short, and attribution of runoff change in this reference was also cited from another old reference. Therefore, we add three more references to illustrate changes in runoff and stream flow in Line 27-29, Page 7 as follows, “In china, recorded runoffs of the major rivers have all presented decreasing trends, with detectable significant decreases occurring in the most of the northern rivers (Wang et al, 2013). Declining flows in the Yellow and Haihe river basins are mostly due to human activities including land use change, human consumption etc (Wang and Zhang, et al, 2013; Bao et al, 2012), whereas climate change is already a major factor affecting the Yangtze and Pearl Rivers (Wang and Yan, et al, 2013)” References (1) Wang, G. Q. Yan, X. L. Zhang, J.Y. et al. 2013: Detecting evolution trends in the recorded runoffs from the major rivers in China from 1950~2010. Journal of Water and Climate Change. 2013. (accepted and will be published in 2013) (2) Bao, Z.X. Zhang, J.Y. et al., 2012: Attribution for decreasing streamflow of the Haihe River basin, northern China: Climate variability or human activities?". Journal of Hydrology. 2012. http://dx.doi.org/10.1016/j.jhydrol.2012.06.054 (3) Wang, G. Q. Zhang, J.Y. Pagano, T. C. et al, 2013: Identifying contributions of climate change and human activity to changes in runoff using epoch detection and hydrologic simulation. Journal of Hydrologic Engineering. 2012. doi:10.1061/(ASCE)HE.1943-5584.0000559 (accepted,will be published in 2013) (Guoqing Wang, Nanjing Hydraulic Research Institute)	Noted. But due to lack of space, we cannot added.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
259	71779	3	7	29	7	31	The cautions from Jones, 2011, are important, but they're secondary relative to the issue of misinterpreting whether local trends in hydroclimate are linked to past global climate change rather than to past natural climate variations and teleconnection. Narrative should address the latter. (UNITED STATES OF AMERICA)	Not understand the point of the reviewer. Climate change/variability is critical factor in the cited examples, but other human factors may be important in the detected trends.
260	76986	3	7	33	7	33	"Significant" with respect to what null hypothesis, based on what assumed model of internal variability? Would fewer trends be significant if a more realistic model of persistence were allowed? On the other hand, why is the word "only" used? It seems to imply that we are seeing less change than we should if ACC is real, but that's not the case, in my opinion. (Christopher Milly, U.S. Geological Survey)	The word "only" was deleted in the sentence to avoid bias in the readers interpretation.
261	77022	3	7	33	7	39	This passage, examining trends in "simulated" (i.e., presumably model-based) discharges, is potentially useful - but it has some problems, and has not been well-integrated into the remainder of the content of Section 3.2.3. I suggest making 4 changes to this passage. (1) Move this passage to the end of Section 3.2.3. (2) Precede the passage by something like the following: "Observational assessments of the hydrologic impacts of climate change are necessarily and justifiably based primarily on statistical and time series analysis of historical datasets. However, a very small proportion of the world's rivers have hydrometric records of sufficient length and quality to permit credible climate impact analysis. Important complements to such work are therefore provided by both model-based assessments and paleohydrologic studies." (3) Adjust the passage itself slightly. Note that the trend analysis results are only as good as the model used to generate the "data." There appear to be errors in the summary statement as well, e.g., streamflows have not been decreasing uniformly across "Western Canada," as in fact flows in British Columbia (for example) have been constant or increasing at many locations. (4) Follow this passage with a brief discussion of paleohydrologic results. Here is a suggestion: "Proxy-based estimates of pre-instrumental streamflows, though also having limitations, are another valuable means for providing long-term context on hydroclimatic change. For example, dendrochronological reconstructions of flows for the Colorado (USA; e.g., Meko et al., 1995) and Saskatchewan (Canada; e.g., Fleming and Sauchyn, 2013) basins in the dry western interior of the North American continent have revealed that the late 19th and early 20th centuries - when large-scale settlement and conversion to agricultural and other land uses occurred, and precedents were set for water use and allocation - were far wetter (e.g., Cook et al., 2011) than typical over the long term for these regions. In fact, for the Saskatchewan River, the most anomalous water supply availability, volatility, and stability conditions of the last 1000 years may have occured during this period (Fleming and Sauchyn, 2013). Such results have implications for understanding both the broader significance of shifts recorded in the much shorter instrumental record, and how larger-than-previously recognized natural variations may superimpose on anthropogenic climate change impacts." The full citations for the references cited above are: (i) Cook BI and others (2011), On the causes and dynamics of the early twentieth-century North American pluvial, Journal of Climate, 24:5043–5060; (ii) Meko DM and others (1995), The tree-ring record of severe sustained drought, Journal of the American Water Resources Association, 31:789–801; and (iii) Fleming SW and Sauchyn DJ (2013), Availability, volatility, stability, and teleconnectivity changes in prairie water supply from Canadian Rocky Mountain sources over the last millenium, Water Resources Research, 118:1-11. (Sean Fleming, Meteorological Service of Canada)	The authors appreciate very much this comment. However, the chapter is currently exceeding its lenth in about 25% and new sentence that do not address specific new facts cannot be included. It is clear that the use of simulated discharges avoid problems of regulated catchments and it is not necesary to explain it again in order to maintain the chapter length.
262	57455	3	7	34	7	34	Which is level of significance? (So Kazama, Tohoku University)	The sentence was changed. Significance was reported in statistical terms,but it is not possible to include many details in this report.
263	60620	3	7	34	7	34	The follwoing additional reference (to include in line 34 after the period finishing in "processes.") is sugested "Another study for the South-western Europe also showed a decrease in the frequency of the flood events since the 1960's as well as a close connection between the occurrence of such events and the cyclic behaviour of the winter NOA indices, Silva et al., 2012". The complete reference is Silva, A. T., Portela, M. M., and Naghettini, M., 2012, “Nonstationarities in the occurrence rates of flood events in Portuguese watersheds”, Hydrol. Earth Syst. Sci., 16, 241-254, doi:10.5194/hess-16-241-2012. (Maria Manuela Portela, Instituto Superior Tecnico (IST))	This comment may be misplaced because I cannot identify the sentence finishing in "processes" within section 3.2.3.
264	57456	3	7	37	7	39	Decrease of plant transpiration is not proper place under topic of “runoff and stream flow”, because it is about decrease of stomatal opening of crop or plant species that influenced from temperature and slightly related to runoff and stream flow. Actually, it should move to evapotranspiration section. (So Kazama, Tohoku University)	This section addresses the impacts of climate change variables in runoff, and it is worth to cite in this section how ecological factors may influence runoff.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
265	57953	3	7	37	7	39	“global increase in runoff … reduced transpiration …..”. In previous page (Page 6, Line 39 to 50), you have discussed increase in evaporation (I guess, you are talking about evapotranspiration), and now you are saying decrease in transpiration. Is it not contradictory? Also, you are missing one major driver of runoff trend that is precipitation trends at local/regional scales (e.g. Kumar et al. 2009; McCabe and Wolock, 2002). Reference: Kumar, S., V. Merwade, J. Kam and K. Thurner (2009), Streamflow trends in Indiana: effects of long term persistence, precipitation and subsurface drains, Journal of Hydrology, Vol. 374 (1-2), pp. 171–183 McCabe, G.J., Wolock, D.M., 2002. A step increase in streamflow in the conterminous United States. Geophysical Research Letters 29 (24), 2185. doi:10.1029/ 2002GL0159999. (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	In section 3.2.2. it is explained the evaporation paradox that although an increase of evaportion should be expected due to increased temperature, the observed records since late 1990s shows a decreasing evaporation. Therefore, there is no contradiction with the statements indicated in 3.2.3 regarding a reduction in transpiration due to decrease in stomatal opening.
266	77023	3	7	41	7	43	This statement would benefit from further refinement. Because decreases in the wintertime snow:rain ratio also affect basins with dual winter-rain and spring-snowmelt freshets, such as are very common in Pacific coastal North America for instance, I strongly suggest changing "...has increased winter low flows..." to "...has increased winter flows..." (i.e., just omit the word "low"). Some additional references are needed as well; a good example is Cannon AJ (2005), Defining climatological seasons using radially constrained clustering, Geophysical Research Letters, 32, doi:10.1029/2005GL023410. There are certainly other papers which should probably be referenced here as well. (Sean Fleming, Meteorological Service of Canada)	Agree. The word low was omited. The indicated reference is quite old and there are indicated in the same sentence other recent ones.
267	81646	3	7	41	7	45	If possible, the timeframe over which these changes have been observed should be specified. (Katharine Mach, IPCC WGII TSU)	It was included "since 1970s" in the sentence.
268	70549	3	7	43	7	43	Add the refernces Stahl et al., 2010 and Wilson et al., 2010 (already in the reference list) as these papers also focus on low flows (Stahl et al.) and floods (Wilson et al.) (Hege Hisdal, Norwegian Water Resources and Energy Directorate)	There are already other cited papers more especific of high latitude regions.
269	63204	3	7	44	7	44	"Smith, 2000": this reference is old. (Asa Sjostrom, Swedish Meteorological and Hydrological Institute)	Not other good references showing this for the Artic Russian rivers.
270	70298	3	7	44	7	44	Smith, 2000: this reference is old. (SWEDEN)	Not other good references showing this for the Artic Russian rivers.
271	76987	3	7	44	7	45	It isn't clear whether this sentence is meant to be true in general, or to apply only to places with seasonal snow storage. I think it is the latter, but this should be made more clear. (Christopher Milly, U.S. Geological Survey)	Agree, the sentence now specified that is related to regions with snow storage.
272	77024	3	7	44	7	45	Should be "Where stream flow is low in summer", not "lowest". Decreases in late-summer low-flows exist and are practically important even in hydroclimatic regions where the very lowest flows of the year occur in a season other than summer. It should perhaps also be noted here that these climatically driven changes in summer low flows can be deeply exacerbated by urbanization and certain watershed management practises. (Sean Fleming, Meteorological Service of Canada)	It was changed to "LOW" as suggested. Regarding the second suggestion, it was not inluded to avoid misunderstandings in the sentence. This impacts in water management practices are addressed in later sections.
273	70550	3	7	45	7	45	It is suggested to include a reference to Stahl et al. (2010) also here - see above comment (Hege Hisdal, Norwegian Water Resources and Energy Directorate)	In this sentence, two references are enough.
274	62942	3	7	48	0	0	As already mentioned in my previous review, this section is very punctual and insufficient. There are many other works concerned with the evolution of groundwater. (Benoit Laignel, University of Rouen)	3.2.4 is to deal exclusively with observed impact of climate change on groundwater, and broader issues of e.g. the impact of increased water abstraction of groundwater.
275	78073	3	7	48	0	0	This section is terribly inadequate. At a minimum, there are different types of groundwater, of different ages and sources. Groundwater is in many ways like an underground glacier and can be "mined" and profoundly and permanently exploited, at least by any meaningful human timescale. The ancient water from the central US Plains is an example of water that is essentially not replenishable in many regions, and some maps suggest that eastern portions may be showing rising water levels in recent decades while other are declining quite rapidly as a result of increasing demand (due in part to higher ET rates from increased drought/dry period duration). New USGS groundwater ref: http://pubs.usgs.gov/sir/2013/5079/ (John Matthews, Conservation Internatonal)	3.2.4 is to deal exclusively with observed impact of climate change on groundwater, and broader issues of e.g. the impact of increased water abstraction of groundwater.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
276	57457	3	7	48	8	6	Here are not descriptions of relationship to flooding and GW temperature. Kazama et al.(Evaluation of groundwater resources in wide inundation areas of the Mekong River basin, Journal of Hydrology, 3-4, 340, pp.233-243, 2007) pointed out groundwater decrease caused by urban area expansion and less rainfall. Gunawardhana, et al. (Statistical and numerical analyses of the influence of climate variability on aquifer water levels and groundwater temperatures: The impacts of climate change on aquifer thermal regimes, Global and Planetary Change, Vol.86-87, pp.66-78, 2012) mentioned the increase of GW temperature and it influences lowland ecosystem. (So Kazama, Tohoku University)	In Kazama et al. (2007), reduced groundwater recharge was related to urbanization/flood controls, but not trends in precipitation. In Gunawardhana and Kazama (2012), the impact of urbanization confounds the impact of climate change, and the statements regarding observed climate change impacts refer to ground surface warming.
277	57679	3	7	48	8	6	3.2.4 Groundwater shows that observed change of groundwater level,storage and discharge to climate change is difficult,and the groundwater discharge decrease with precipitaion decrease and temperature increase by using two case study respectively.I think that the context of this part is not perfect. Firstly, groundwater is called as "the continental paleo-climatic archives"(FONTES J C, STUTE M, SCHIOSSER P, et al. Aquifers as archives of paleoclimate. EOS Trans AGU, 1993, 74:21 (Zhongcheng Jiang, Institute of Karst Geology,CAGS)	Comment not clear.
278	71780	3	7	50	8	6	Inasmuch as it is difficult to ascertain impacts of current climate change on groundwater, it is perhaps instructive to examine (or not forget) studies of historical (paleohydrologic) impacts on groundwater (as noted in Taylor et al., now 2013, not 2012). Some subsurface regimes still exhibit transient hydrologic relaxation effects (c.g., Tyler et al., 1996, Water Resourc. Res., 32(6), 1481; et al., 2010, Glob. Plan. Change, 72, 412) from those time periods, suggesting, in some cases, that defining "baselines" against which contemporary changes may be compared need to be carefully considered. (UNITED STATES OF AMERICA)	In 3.2., we restrict our assessment to observed impacts of anthropogenic climate change.
279	77026	3	7	50	8	6	Section 3.2.4 is well-done, but I might suggest also adding something like the following: "Also, for deeper or confined aquifers more isolated from driving climate, it can be challenging to robustly detect climate-groundwater interactions." (Sean Fleming, Meteorological Service of Canada)	Suggestion not followed due to lack of literature.
280	56441	3	7	52	0	0	The sentence needs revision such as "The extent to which groundwater abstractions have already been affected by climate change is not known." (Archis Ambulkar, Brinjac Engineering Inc.)	Revised as suggested.
281	81647	3	8	1	8	2	If possible, the timeframe for these observed changes should be specified. (Katharine Mach, IPCC WGII TSU)	"since the 1980s " was added.
282	70699	3	8	2	0	0	Define PDSI (Cate Macinnis-Ng, University of Auckland)	wrong page/line numbers, PDSI already correctly defined in 3.2.7.
283	71781	3	8	5	8	5	Changes in evapotranspiration cannot be attributed to temperature changes alone. The study (Aguilera and Murillow, 2009) used a simplistic empirical model using monthly values of precipitation and temperature. The authors noted the need for finer temporal resolution. There is also a need for a biophysically based model. (UNITED STATES OF AMERICA)	Agree, sentence was reformulated without mentioning temperature.
284	76988	3	8	5	8	5	Temperature increase does not cause more evaporation; energy availability--mainly net radiation--causes evaporation. Reduced evaporation causes warming more than warming causes more evaporation. (Christopher Milly, U.S. Geological Survey)	Sentence was reformulated, without mentioning temperature.
285	85031	3	8	9	0	0	Please carefully check the calibrated language in this section, as usage is currently nonstandard. Each usage should either present a level of confidence or descriptors for both evidence and agreement (not evidence or agreement alone). Ideally, a consistent approach should be adopted across the chapter. (Michael Mastrandrea, IPCC WGII TSU)	Checked
286	59831	3	8	9	9	6	Section 3.2.5 - A number of potential effects of climate change on water quality are discussed. One omission is that of the effects of wildfire on water quality. Many cities around the world rely on good quality water from forested catchments that requires very little treatment. The increased risk of wildfire frequency and severity in these areas could have severe consequences on the quality of water derived from these catchments. Hugh G. Smith , Gary J. Sheridan, Patrick N.J. Lane , Petter Nyman, Shane Haydon 2011. Wildfire effects on water quality in forest catchments: A review with implications for water supply. Journal of Hydrology 396: 170–192 (AUSTRALIA)	Thanks for the refrence. Comment accepted but for section 3.5.2.3 (Water supply/municipalities), as the paper is oriented to vulnerabilities rather than assessing impacts attributed to climate change.
287	63115	3	8	9	9	6	I miss a word about the role of air pollutants on water quality as well as on the effects of increased meat consumption and thus increased stock farming and thereby increased liquid manure on water quality. (Sabine Wurzler, LANUV NRW)	Me too, but this section refers to impacts attributed to climate change I have not found bibliography with the standrads required by IPCC for this effect. If available please provide it.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
288	57458	3	8	11	8	39	Water quality usually is more influenced by human activity, so the context should add impact of human on water quality. (So Kazama, Tohoku University)	The idea was already on the text. Anyway it was reinforced as follows "Linkages between observed effects on water quality and climate variability should be interpreted cautiously, at a local level, considering the type of water source and pollutant, the hydrological regime and the sources of pollution, notably because many human activities impacts water quality".
289	76989	3	8	11	9	2	I think this section is saying mainly that climate affects water quality, while not making any kind of two-step claims related to climate change. Am I correct? Can the message be made more clear? Page 8 line 47-49 is acknowledged, but even it fails to mention that local climatic variability tends to be dominated by internal variability in the climate system. (Christopher Milly, U.S. Geological Survey)	TSU will provide a final editorial polishing of the text.
290	71782	3	8	12	8	13	The authors should consider deleting 'change' to read "Some observed impacts of climate on water quality are included in Table 3-1." The second sentence of the table caption points out "Observed hydrological changes are attributed here to their climatic drivers, **which are not all known to be anthropogenic**. (UNITED STATES OF AMERICA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
291	77027	3	8	13	8	15	This passage seems to imply that water temperature is distinct from water quality - many would disagree, suggesting that water temperature is a form of water quality. I would suggest refining the wording here. (Sean Fleming, Meteorological Service of Canada)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
292	71783	3	8	14	8	14	We recommend that authors insert 'multidecadal' to read 'are linked to either seasonal, interannual, or multidecadal variations in any of several variables. (UNITED STATES OF AMERICA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
293	71784	3	8	15	8	16	Is this sentence necessary?: "Droughts and the El Nino Southern Oscillation (ENSO) phenomenon can also affect water quality." It is true that droughts and ENSO affect water quality but so do other phenomena such as heat waves, extreme precipitation events, floods, and multidecadal climate oscillations. (UNITED STATES OF AMERICA)	Due to the number of references on these two natural phenomena and to the comments recieved for their introduction this sentence was not deleted but modified.
294	77028	3	8	15	8	16	I would suggest clarifying this text by adding "Natural variability, such as..." before "Droughts and the El Nino..." (Sean Fleming, Meteorological Service of Canada)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
295	77135	3	8	15	8	16	Drought and El Nino can affect water quality: very generic and without references. (ITALY)	References included
296	65465	3	8	18	8	18	Do you mean more intense algal blooms rather than eutrophication. The latter refers to the nutrient status, so this would imply that the loading increases with temperature. (Stuart Bunn, Griffith University)	Both, text modified.
297	65466	3	8	18	8	29	One consequence of warmer temperatures, particularly in temperate regions, is the increased incidence of blue-green algal blooms, which tend to dominate under warmer conditions - and the risk of toxic forms. Also, more prolonged and intense thermal stratification and the increased thermal stability can lead to additional water quality problems in lakes and reservoirs. (Stuart Bunn, Griffith University)	Text modified.
298	81649	3	8	20	8	25	It would be preferable to specify the relevant geographic area and timeframe for this observed effect. (Katharine Mach, IPCC WGII TSU)	A map is provided for that effect.
299	81648	3	8	20	9	5	In these paragraphs, where levels of confidence and summary terms for agreement are presented together, the chapter team should consider 2 alternatives that would be preferable: 1) presenting only a level of confidence, or 2) presenting a level of confidence and summary terms for BOTH evidence and agreement (Katharine Mach, IPCC WGII TSU)	Text modified.
300	60817	3	8	21	8	21	Insert reference Boxall et al: Boxall ABA, Hardy A, Beulke S, Boucard T, Burgin L, Falloon PD, Haygarth PM, Hutchinson T, Kovats RS, Leonardi G, Levy LS, Nichols G, Parsons SA, Potts L, Stone D, Topp E, Turley DB, Walsh K, Wellington EMH, Williams RJ (2008). Impacts of Climate Change on the Health Risks of Pathogens and Chemicals from Agriculture. Environmental Health Perspectives, 117, 508-514. doi:10.1289/ehp.0800084 (Peter Falloon, Met Office Hadley Centre)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
301	81650	3	8	25	8	26	Please note that, in the guidance for authors, a level of confidence is assigned based on the chapter team's evaluation of evidence and agreement. Thus, a level of confidence here should be based on summary terms for evidence and agreement, not vice versa. (Katharine Mach, IPCC WGII TSU)	Text modified.
302	77136	3	8	26	0	26	reservoir in (ITALY)	Accepted and revised

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
303	59261	3	8	26	8	26	Typo. "In a reservoirin Spain….." Please correct to "In a reservoir in Spain….." (Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	Accepted and revised
304	56442	3	8	26	8	27	Terms "reserviorin" and "increasesin" should be "reservior in" and "increases in" respectively. (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted and revised
305	76567	3	8	26	8	27	two times the preposition "in" is attached to the previous word "reservoirin" and "increasesin" (Claudio Cassardo, University of Torino)	Accepted and revised
306	59262	3	8	27	8	27	Typo. "… temperature increasesin…." Please correct to "…. Temperature increases in….."(Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	Accepted and revised
307	60942	3	8	28	8	29	States that nutrients could be flushed from lakes and estuaries by more frequent storms, reducing eutrophication and algal blooms. But, lines 31-32 state increased runoff from storms might make the situation in rivers worse. Could increased runoff into lakes also worsen eutrophication? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Good point, text modified to mention that this has been reported in some cases.
308	81651	3	8	29	8	29	A more qualified description of changes in storms and hurricanes may better match the assessment of working group 1. For example, a more conditional construction could be used, and possible changes in frequency and/or intensity may be relevant. (Katharine Mach, IPCC WGII TSU)	Text modified.
309	81652	3	8	31	8	31	For the phrase "all of the reported impacts," is not completely clear what impacts are being referred to--"all assessed impacts"? (Katharine Mach, IPCC WGII TSU)	Text modified.
310	58822	3	8	31	8	36	Only higher runoff is mentioned as a reason for higher pollutant concentrations in rivers. On the other hand, in chapter 28 (Polar regions, page 8 onwards) higher temperature has increased nutrient and humic acid loadings from catchments to watersleading to changes in species composition. (Katri Rankinen, Finnish Environment Institute)	This has been clarified on the sentence "In streams in semiarid and arid areas, temperature changes have more impact than precipitation changes on the content INCREASE of organic matter, nitrates and phosphorus (Benítez-Gilabert et al., 2010; Chang, 2004; Ozaki et al., 2003) (medium confidence, limited evidence, medium agreement)".
311	60818	3	8	33	8	34	Insert reference Boxall et al: Boxall ABA, Hardy A, Beulke S, Boucard T, Burgin L, Falloon PD, Haygarth PM, Hutchinson T, Kovats RS, Leonardi G, Levy LS, Nichols G, Parsons SA, Potts L, Stone D, Topp E, Turley DB, Walsh K, Wellington EMH, Williams RJ (2008). Impacts of Climate Change on the Health Risks of Pathogens and Chemicals from Agriculture. Environmental Health Perspectives, 117, 508-514. doi:10.1289/ehp.0800084 (Peter Falloon, Met Office Hadley Centre)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
312	58821	3	8	37	8	39	Why temperature has more influence than precipitation? (Katri Rankinen, Finnish Environment Institute)	Because there is almost NO precipitation in arid regions.
313	77029	3	8	41	8	41	Suggest changing the wording slightly to "Studies of groundwater quality responses to climate change are still limited." (Sean Fleming, Meteorological Service of Canada)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
314	58820	3	8	41	8	45	I wonder if there were any studies of nutrient concentrations available, e.g. related to Nitrates Directive in Europe. This sounds now that only studies of feacal pollution were included. (Katri Rankinen, Finnish Environment Institute)	There are, but linked to the use of fertilizers rather than to climate change.
315	79379	3	8	41	8	45	Why do the authors not provide any references on faecal pollution and groundwater during heavy rainfall events despite these being numerous in both developed and developing countries? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Some cited, we have space constraints.
316	71785	3	8	47	8	47	Delete 'variability' to read "Linkages between observed effects on water quality and climate should be interpreted cautiously, at a local level, considering the type of water source and pollutant, the hydrological regime and the sources of pollution (high confidence, high agreement)." It is unclear why the text states: 'Linkages between observed effects on water quality and climate variability should be interpreted cautiously.' Why only the caution with in linkages between observed effects on water quality and climate variability, should there be a similar caution in linkages between observed effects on water quality and climate change? (UNITED STATES OF AMERICA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
317	71786	3	8	53	9	2	The sentence starting with "If the observed deterioration of water qualtiy..." seems unsupported by the cautions and uncertainties identifed before it in this paragraph. Please reconcile. (UNITED STATES OF AMERICA)	Done.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
318	62943	3	9	9	0	0	As already mentioned in my previous review, in the parameters outlined in influencing soil erosion and sediment fluxes, it lacks the geomorphological parameters such as area, elevation. Further work could be cited. Moreover, there is confusion about the role of dams on soil erosion and sediment fluxes. The presence of the dam reduces the amount of sediment reaching the mouth, but does not protect the soil from erosion and does not reduce soil erosion remains the same. (Benoit Laignel, University of Rouen)	The section is not a review of parameters influencing soil erosion and sediment yield, but try to understand the impacts of climate change, if any, in sediment production. Moreover, the section address both soil erosion and sediment load in rivers, and in the later dams is a major factor in the conectivity of the sediment loads transported by rivers. Therefore, in sediment load records, the presence of dams are important factors to consider.
319	59832	3	9	9	9	44	Section 3.2.6 - Soil Erosion and sediment loads are discussed as a function of changes in precipitation erosivity. Little mention is given the role of vegetation in erosion control, and therefore the risk of increased erosion after changes in vegetation structure. For example, high-magnitude erosion events after wildfire have been documented in south-eastern Australia. Petter Nyman, Gary J. Sheridan, Hugh G. Smith, Patrick N.J. Lane, 2011. Evidence of debris flow occurrence after wildfire in upland catchments of south-east Australia. Geomorphology 125: 383–401. (AUSTRALIA)	A sentence with the role of increasing risk of wildfires have been added, together with the indicated reference.
320	60943	3	9	9	9	44	Wind-born erosion of soils is not mentioned here – could add a link to the relevant chapter. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This chapter deals with erosion by water, it is not intented to review soil erosion as a whole.
321	71787	3	9	9	9	44	The phrases "low confidence" and "limited evidence" are clear. However the statement on line 43 that "human impacts are more significant" is not well supported, so the last sentence of this section could be deleted. (UNITED STATES OF AMERICA)	"human impacts" was changed to "land-use changes" in that sentence.
322	60944	3	9	11	9	11	Another paper worth referencing used an ensemble of regional climate models to assess freshwater availability: Sanderson, Wiltshire and Betts, Potential impacts of climate change on water resources in the United Kingdom, Water Resources Res., 48, No.8, doi:10.1029/2012WR011881 (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	There may be some misplace on this comment because the referred section is not dealing with climate models and water resources.
323	81653	3	9	11	9	16	The distinction between projections and observations should be carefully considered in this paragraph. In the 1st sentence, it is unclear if the "expected" effect is referring to observed or projected changes. As much as possible, the paragraph should remain focused on sensitivities, vulnerabilities, and observed impacts given the scope of this section. (Katharine Mach, IPCC WGII TSU)	The sentence is now changed. The word expected was changed to ·"which suggest an increase in rainfall erosivity…."
324	77030	3	9	13	9	14	Calling snow "non-erosive" and rainfall "erosive" seems a bit oversimplistic - this passage would benefit from refined wording. (Sean Fleming, Meteorological Service of Canada)	This was changed. The word "non-erosive" was deleted.
325	76868	3	9	14	9	14	"melting of permafrost" - thawing is a more appropriate word. The reference to Kundzewicz et al. (2007) is outdated and inappropriate as they do not specifically study permafrost melt. Please see section 3.2.2 or refer to the corresponding chapter in WG1. (Rutger Dankers, Met Office Hadley Centre)	The part of the sentece referred to permafrost was deleted
326	66384	3	9	14	9	15	It is mentioned "melting of permafrost" but permafrost does not melt, it thaws. Therefore, replace with "thawing of permafrost". In next line, it should read "obscured" and not "obscure". (Carla Andreia Silva Mora, University of Lisbon)	Agree. The part of the sentece referred to permafrost was deleted
327	76568	3	9	15	9	15	add "d" after "obscure" (Claudio Cassardo, University of Torino)	Changed
328	71062	3	9	18	0	23	This section is hard to follow - suggest reviewing and revising. (CANADA)	Re-writing has undertaken
329	58645	3	9	18	9	18	It is not clear about how many "reduced precipitation" can contribute about 30% to a total reduction in sediment yield during 1970-2008, I suggest the reduced precipitation should be given or expressed in quantitative result. (chunfeng wang, State Forestry Administration, China)	The rainfall reduction was about 10%.
330	56443	3	9	18	9	23	The paragraph cum sentence is too long to comprehend. Please split it into more than one sentence for easier understanding of the readers. (Archis Ambulkar, Brinjac Engineering Inc.)	Sentences were split into several.
331	57459	3	9	18	9	44	In the case of whole Japan, soi erosion and yields are exponentially increased depending on extreme rainfall according to reservior deposition data (Ono et al., Distributed specific sediment yield estimations in Japan attributed to extreme-rainfall-induced slope failures under a changing climate, Hydrology and Earth System Science, Vol.15, pp.197-207, 2011) (So Kazama, Tohoku University)	This section is on observed contribution of climate in changes on sediment production. The cited paper is no future projections.
332	59833	3	9	21	9	23	Sentence appears to contradict itself with decrease and increase. Possibly the word increase in line 22 should be replaced with decrease? Otherwise please explain this increase in th context of decreasing total sediment. (AUSTRALIA)	The second part of the sentence refers to the whole sediment budget reaching the sea which is negative

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
333	78074	3	9	25	9	32	A discussion of sublimation vs melting may be important to add here. Sublimation, for instance, is a largely impossible factor to model at large spatial scales in any meaningful way, but there is some evidence that sublimation is driving significant losses in both glaciers and snowpack globally, especially in tropical, subtropical, and temperate frozen resources. Kehrwald, Thompson et al., Geophysical Research, 2008; and Thompson et al. 2011, Annals of Glaciology, are both quite relevant. THe role of sublimation has also been posited by peole like Jeff McDonald and Pat Mulroy in North American snowpack as a recent trend.The research around sublimation is limited, but we cannot yet rule out at the mixed data around "missing" floods from glacial melting is a result of increased sublimation processes. If this is true, then the droughts predicted to come after glacial melts may come quite soon. My read is that the data is suggestive but has not been systematically explored to date. (John Matthews, Conservation Internatonal)	In the context of this section about sediment yield, mentioning sublimation as a component of glacier mass loss would be a distraction. It is only KNOWN (strictly, BELIEVED) to be a dominant term in the glacier mass balance in very dry and/or very cold regions (e.g. the Dry Valleys of Antarctica, the highest glaciers in Bolivia and Tibet); and sublimation does not alter the fact that glacier-fed rivers are expected to receive more meltwater.
334	62835	3	9	26	0	27	Please refer to the general comment above: " Increase in glacial degraded runoff component" and "glacial discharge" or "glacier river discharge" are not interchangeable (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	The suggested alternative term is non-standard and would not be understood by most readers. "See response to #23"
335	58646	3	9	28	9	31	The references provided do not support the result that the sediments decreased. Glacier areas have shrunk about 2-10% is not exact. The references supported my view include: Ding Yongjian, Liu Shiyin,Li Jing, et al. 2006. The retreat of glaciers in response to recent climate warming in western China. Annals of Glaciology, 43, 97-105; Ren Jiawen et al. 2006. Glacier variation and climate change in the central Himalayas over the past few decades. Annals of Glaciology, 43,218-222. (chunfeng wang, State Forestry Administration, China)	Sorry to desagree, but the data provided by Li et al. 2008 are in the right ballpark with their 2-10% estimate for recent glacier shrinkage. This Li et al 2008 reference is more recent than the ones indicated by the reviewer. Another recent reference supporting Li et al. data is Zhang et al. 2012, that estimated about 10% area loss in China over about four decades. Zhang, M., Wang, S., Li, Z., and Wang, F., 2012, Glacier area shrinkage in China and its climatic background during the past half century: Journal of Geographical Sciences, v. 22, p. 15-28.
336	58647	3	9	28	9	32	The whole sentence is about glacier, I suggest it should be moved to para 3.2.2, which is about the assessment of glacier. (chunfeng wang, State Forestry Administration, China)	The paragraph is about sediment yield in glacierized drainage basins, and its most appropriate location is in this section 3.2.6.
337	71063	3	9	34	0	39	Suggest including more explanation about why discussion of landslides is includes in this chapter on water (e.g., more intense precipitation due to climate change, relevance to water quality, etc?). (CANADA)	A couple of sentences were introduced.
338	58907	3	9	34	9	44	Quantitative evidence exists in the Alps that the frequency of large rock avalanches is increasing due to warming-induced glacier debuttressing and permafrost degradation (Fischer, L., Purves, S.R., Huggel, C., Noetzli, J., Haeberli, W., (2012): On the influence of topographic, geological and cryospheric factors on rock avalanches and rockfalls in high-mountain areas. Natural Hazards Earth System 12, 241–254. http://dx.doi.org/10.5194/nhess-12-241-2012). This development is especially critical in connection with the formation of new lakes and the growing probability of impact waves from rock/ice avalanches into new lakes (Haeberli, W. (2013): Mountain permafrost — research frontiers and a special long-term challenge. Cold Regions Science and Technology. http://dx.doi.org/10.1016/j.coldregions.2013.02.004; cf. also Carey, M., Huggel, C., Bury, J., Portocarrero, C. and Haeberli, W. (2012): An integrated socio-environmental framework for glacier hazard management and climate change adaptation: lessons from Lake 513, Cordillera Blanca, Peru. Climatic Change112, 3, 733-767). Concerning landslides, the climate influence may well predominate in cold mountains. The statement on lines 43/44 should therefore be adjusted to something like " ... with the exception of cold high-mountain regions human impacts may be ...". Correct references should be given to the high-mountain aspect (cf. also Gruber, S., and Haeberli, W. (2007): Permafrost in steep bedrock slopes and its temperature-related destabilization following climate change. Journal of Geophysical Research, 112, F02S18; doi:10.1029/2006JF000547). (Wilfried Haeberli, University of Zurich)	The area covered by Fisher et al 2012 paper is quite small, and not global trends can be traced from that study. The incrase in avalanche events is produced at high elevations, and Fisher et al. 2012 indicate that this trend may be related to an increase in the recording activity in high mountain areas. All this brings quite a lot of uncertainty to generalise these results, and atribute it to climate change (the aim of this report).
339	77138	3	9	41	9	44	this sentence is an example of what stated in the previous comment (ITALY)	Not understand this comment.
340	81654	3	9	41	9	49	It would be preferable to also provide summary terms for agreement for the statements. A line-of-sight reference is also needed for the statement on lines 49-50 in order to draft to the reader to the source of the finding. (Katharine Mach, IPCC WGII TSU)	The statement was written in terms of agreement and evidence. A new reference was added to line 49-50.
341	77031	3	9	43	9	44	More precise wording is required - change "the human impacts" to "local human impacts", and insert "global anthropogenic" before "climate change." (Sean Fleming, Meteorological Service of Canada)	The term "human impacts" was replaced by "land use changes" that seems more especific.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
342	80110	3	9	47	10	50	According to the information presented of vulnerability related to extreme hydrological events and their impacts on the natural and built, is that in Chile, the National Irrigation Strategy envisages the construction of dual-purpose infrastructure, which is able on the one hand, to control floods caused by the increase in the intensity of rainfall, and secondly, to store this water in times of surplus for use in times of shortage (CHILE)	Thanks for the information.
343	71788	3	9	49	9	50	This statement says that limited evidence leads to low confidence, but that logic isn't applied in numerous preceding sections where observed changes with limited evidence were also associated with medium to high confidence (e.g., p. 3 line 1, p. 8 lines 25-26). The relationship between level of evidence and level of confidence needs to be made consistent across impacts discussions. Also, the start of the chapter should include summary descriptions of what is meant by agreement, confidence and evidence, and how they relate; or, it should reference the some other section of AR5 that includes this explanation. (UNITED STATES OF AMERICA)	Thanks for the comment. It has been reviewed all the reference to calibrated language in this chapter. The explanation of this lenguage cannot is addressed by previous special report of IPCC, which we follow to complete this report.
344	66037	3	9	49	10	16	It says that there is a low confidence due to limited evidence that CC has affected the frequency and magnitude of floods at global scale. I would suggest to include the reference of Llasat et al, (2005) showing that no trend on catastrophic floods has been produced in Catalonia since 14th century, but an increase in extraordinary floods have been produced in coastal catchments, mainly produced as a consequence of changes in vulnerability and exposure (see Barnolas and Llasat, 2007 or Llasat et al, 2010). This trend has been also found in other Mediterranean catchments (i.e. Llasat et al, 2013). References: Llasat, M.C., M. Barriendos, Barrera, A., and Rigo, T., 2005: Floods in Catalonia (NE Spain) since the 14th century. Climatological and meteorological aspects from historical documentary sources and old instrumental records. Journal of Hydrology. Applications of palaeoflood hydrology and historical data in flood risk analysis, 313, 32-47; Barnolas, M. and M.C. Llasat, 2007: A flood geodatabase and its climatological applications: the case of Catalonia for the last century. Natural Hazards and Earth System Sciences, 7, 271-281; Llasat, M. C., Llasat-Botija, M., Petrucci, O., Pasqua, A. A., Rosselló, J., Vinet, F., Boissier, L., 2013. Towards a database on societal impact of Mediterranean floods in the framework of the HYMEX project. Nat. Hazards Earth Syst. Sci., 13, 1–14, 2013. www.nat-hazards-earth-syst-sci.net/13/1/2013/ doi:10.5194/nhess-13-1-2013; Llasat, M.C., Llasat-Botija, M., Rodríguez, A., Lindbergh, S.: Flash floods in Catalonia: a recurrent situation. Advances in Geosciences, 26, 105-111, 2010. (Maria-Carmen Llasat, University of Barcelona)	Thanks for the comment, which is very timely. The proposed cites refer to local studies, and same conclussion have been reached by many local studies around the world. Due to the limited length of the report, comments or new additions regarding local results cannot be taken. It would be considered along other sections of this report.
345	71789	3	9	52	9	54	We recommend that authors replace 'suggests an increase likelihood of' with 'should increase the risk for' to read "However, recent detection of changes in extreme precipitation and discharge trends (at some catchments) should increase the risk for flooding at regional scales (medium confidence). (UNITED STATES OF AMERICA)	Changed as suggested by the reviewer.
346	58684	3	10	3	10	4	In the phrase "There is no strong evidence for trends in flooding in the USA (Hirsch and Ryberg, 2012)…" the adjective "strong" is not necessary. In addition the work by Lins and Cohn (2011; already in the reference list) should be added here. (Demetris Koutsoyiannis, National Technical University of Athens)	Here, strong is meant to say generalised, becacuse there may be some studies finding some trends, but their attribution (climate or landuse) it is in many instance quite polemic. For th sake of simplicity, better to use only one reference for each region.
347	77032	3	10	4	10	16	Suggest citing Dahlke et al. (2012) in this passage - has important implications for flood trends in Nordic countries. The reference is Dahlke HE and others (2012), Contrasting trends in hydrologic extremes for two sub-arctic catchments in northern Sweden: does glacier melt matter? Hydrology and Earth System Science, 16:2123-2141. (Sean Fleming, Meteorological Service of Canada)	The reference was added at the end of this paragraph.
348	81655	3	10	6	10	44	For many statements in these paragraphs, it would be preferable to further specify the relevant time frame for the observed changes, more so than done already. (Katharine Mach, IPCC WGII TSU)	There is common time framework covering record since 1950s. This was added to the text. To include further details on the specific recording times at each study will make this sentence difficult to read, and it is not going to add any relevant income to the section.
349	56266	3	10	8	10	8	The reference to Renard et al. 2008 is not really relevant. Renard et al. (2008) found a decreasing trend in low, high and mean flows (i.e. magnitude). The flood frequency was not analyzed. (Simon Gascoin, CNRS)	That reference was deleted as suggested
350	57954	3	10	8	10	8	"..Pyrenees…". Where is it? (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	It is one of the highest mountain range in Europe, dividing France and Spain. The word "mountains" was added to avoid confusion.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
351	76990	3	10	13	10	16	I don't understand how "no compelling evidence" is supported by the citation of two studies that sound like they provide compelling evidence. (However, "significant" is a word that needs more specifics: by what measure? what kind of persistence is assumed in the null hypothesis?) (Christopher Milly, U.S. Geological Survey)	The sentence was changed. Significance was reported in statistical terms,but it is not possible to include many details in this report.
352	71064	3	10	14	0	0	Suggest indicating that the results for Cunderlik and Ouarda (2009) and Burn et al (2010) are for Canada, otherwise the region is not clear. (CANADA)	Thanks. Canada was added.
353	58685	3	10	17	10	17	I reiterate my earlier comment on Hurst. I strongly insist that mentioning the Hurst-Kolmogorov phenomenon (long-term persistence) in the Freshwater Chapter is absolutely necessary and relevant. If hydrologists fail to refer to it, how can we expect from climatologists and scientists from other disciplines to mention it in other chapters? I suggest to refer to it by adding the following paragraph: “It should be mentioned that many of the trend analyses in the literature are based on classical statistical tests that are based on the assumption of time independence for the tested process. However, the pioneering work by Hurst (1951) has shown that hydrological and other geophysical processes are not independent in time but, on the contrary, are characterized by long-range dependence, also known as long-term persistence. The Hurst behaviour is a prominent characteristic of climate (Markonis and Koutsoyiannis, 2013; Koutsoyiannis, 2013). If this behaviour is accounted for, many of the trends rendered as significant by classical statistical tests become insignificant (Cohn and Lins, 2005).” References to be added Cohn, T. A., and H. F. Lins, Nature's style: Naturally trendy, Geophysical Research Letters, 32 (23), doi:10.1029/2005GL024476, 2005. Hurst, H. E., Long term storage capacities of reservoirs, Trans. Am. Soc. Civil Engrs., 116, 776-808, 1951. Koutsoyiannis, D., Hydrology and Change, Hydrological Sciences Journal, doi: 10.1080/02626667.2013.804626, 2013. Markonis, Y., and D. Koutsoyiannis, Climatic variability over time scales spanning nine orders of magnitude: Connecting Milankovitch cycles with Hurst–Kolmogorov dynamics, Surveys in Geophysics, 34 (2), 181–207, 2013. (Demetris Koutsoyiannis, National Technical University of Athens)	That is a conceptual work that is beyond the scope of this chapter.
354	71790	3	10	20	10	20	Unqualified generalizations can be taken out of context. E.g., page 10 line 20 "It is very likely..." While true in context, if this sentence is removed it could have much broader implications. Suggest, in cases which potentially far reaching conclusions could be drawn if the sentence is takeout of context, that a clause is added to anchor it in the data source, or the specific location of the observation. (UNITED STATES OF AMERICA)	Ther reference of Min et al 2011 was provided to set up the context.
355	77139	3	10	20	10	21	Is this referred only to Germany? (ITALY)	Yes, as indicated in the sentence.
356	66038	3	10	23	10	32	When insured losses due to floods are adjusted considering the premiums paid by customers and the total value of dwellings per year, the adjusted data reveals no significant trend over the period 1971–2008 and confirms that at this juncture, societal influences remain the prime factors driving insured and economic losses from natural disasters (see Barredo et al (2012)). Reference: Barredo, J.I., D. Saurí, and M. C. Llasat, 2012. Assessing trends in insured losses from floods in Spain 1971–2008. Nat. Hazards Earth Syst. Sci., 12, 1723–1729, 2012. www.nat-hazards-earth-syst-sci.net/12/1723/2012/ doi:10.5194/nhess-12-1723-2012 (Maria-Carmen Llasat, University of Barcelona)	This is mentioned in the text.
357	76869	3	10	23	10	32	Increasing exposure etc. have potentially been offset by an improvement in warning systems longer lead times) and better flood protection measures. It may be worth emphasising better that climate is only one factor in a complex, multi-factor system. (Rutger Dankers, Met Office Hadley Centre)	I agree, but this is part of the trade off between higher exposure and flood management measures which in most cases cannot cope completely with increasing flood damages.
358	65366	3	10	31	10	31	The word 'Korea' need to check up whether it is only South Korea or the Republic of Korea. (REPUBLIC OF KOREA)	South Korea was added.
359	60945	3	10	34	10	46	The discussion on drought indexes considers only PDSI and CDD. The WMO recommendation is to consider also SPI - which will help compare the conclusions made with other studies. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This section on droughts was re-written
360	66039	3	10	34	10	46	The CDD index seems to be the one that shows the major agreement on its present and future increase in Europe (see as exemple Turco and Llasat, 2011). Reference: Turco, M. y M. C. Llasat, 2011. Trends in indices of daily precipitation extremes in Catalonia (NE Spain), 1951–2003. Nat. Hazards Earth Syst. Sci., 11, 3213–3226, doi:10.5194/nhess-11-3213-2011. (Maria-Carmen Llasat, University of Barcelona)	This section on droughts was re-written
361	60946	3	10	36	10	37	A box explaining exactly what the PDSI, CDD AND SMA are and how they are calculated would be useful - or at least references to such explanations. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This section on droughts was re-written

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
362	71791	3	10	37	10	39	The authors should consider deleting this entire sentence "The AR4 (Trenberth et al., 2007) reported that the global extent of very dry areas (PDSI -3.0) more than doubled since the 1970s, and that droughts have increased since then particularly in the tropics and sub-tropics (Dai et al., 2004)." The 2013 AR5 results are more current and Dai has redone this analysis multiple times since 2004. (UNITED STATES OF AMERICA)	This section on droughts was re-written
363	76991	3	10	39	10	41	Milly and Dunne (2011, On the hydrologic adjustment of climate-model projections: the potential pitfall of potential evaporaton, Earth Interactions, v 15, no 1, p. 1-14) present evidence that empirical, temperature-based estimates of PET (as used, e.g., in standard PDSI) grossly overestimate changes in PET associated with anthropogenic climate change, with consequent negative bias in runoff projections. (Christopher Milly, U.S. Geological Survey)	This section on droughts was re-written
364	76992	3	10	44	10	46	I question this attribution, but I have not read the citation recently. What physical mechanism was used to justify attribution to temperature? Temperature change does not cause evaporation change. Evaporation is driven by energy availability, and temperature is a result of both energy availability (positive influence) and actual ET (negative influence). (Christopher Milly, U.S. Geological Survey)	This section on droughts was re-written
365	56853	3	11	0	12	0	General comment - Section 3.3: It is necessary to highlight that the various climatic and non-climatic drivers may interact with each other to exercerbate or alleviate impacts. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	See response to #366.
366	60948	3	11	1	12	0	It is necessary to highlight that the various climatic and non-climatic drivers may interact with each other to exacerbate or alleviate impacts. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We will try to incorporate this point.
367	80362	3	11	1	12	16	Section 3.3.1: The amount of material in here on Climatic Drivers could be reconsidered, as this is essentially material that is assessed in the WGI contribution to AR5 and the risk of overlap and inconsistency should be avoided to the extent possible. Some WGI Ch12 ES statements seem to have been reworded and not all of them are consistent with WGI: "Arctic is warming most rapidly" (WG1) becomes "Warming is greatest over the Arctic"; "It is very likely that Northern Hemisphere snow cover will reduce..." (WG1) becomes "Less precipitation falls as snow and the extent and duration of snow cover decrease" without NH focus etc. Please revisit WGI type statements and ensure consistency (Gian-Kasper Plattner, IPCC WGI TSU)	We regard the material in this section as the minimum needed to convey adequate information about the physical science to non-climatologist readers. We have replaced "greatest" with "most rapid" in the first passage mentioned. The second may or may not be consistent with the WG1 chapter 12 ES but is certainly consistent with section 12.4.6.2 of that chapter. ADDENDUM (October 2013): We have now restored "greatest" (P10 L29 of FGD) because WG1 now says "greatest"!
368	64283	3	11	5	11	5	Potential evaporation or potential evapotranspiration ? (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	In this chapter, evaporation is understood to include transpiration.
369	71792	3	11	5	11	5	Principal "climatic drivers" are vapor content and temperature -- rather than precipitation and evapotranspiration (and snowmelt) processes -- which are responses to humidity and temperature levels. These responses should themselves be considered as the principal water inputs and outputs to the hydrologic system from the climate system. These drivers also affect snowmelt and related processes that serve to redistribute water across the terrestrial regime. (UNITED STATES OF AMERICA)	We think our usage is clear and suitable for our purpose. Explaining the distinction between "drivers" and "inputs and outputs" would take up space without helping to convey the essential message.
370	57460	3	11	5	11	24	The context should provide information about effect of ocean circulation and ocean surface temperature changes if any, because it is strongly influenced to climate pattern in land. (So Kazama, Tohoku University)	Links between land and ocean are certainly important, but a considerable amount of explanation of the physical science has already been deleted in advancing to the SOD, and we do not think that mentioning the ocean is important enough to warrant adding new text.
371	76993	3	11	5	11	24	I don't understand why T and actual E are mentioned after saying that P and PET are the main climatic drivers. Background assumptions about what controls what are apparently present but not being stated. (Christopher Milly, U.S. Geological Survey)	Temperature is mentioned in the third sentence for the reason given in the second sentence. The sentence that mentioned "actual" evaporation has been removed.
372	71065	3	11	9	0	10	This sentence is confusing; suggest revising. (CANADA)	The comment offers no guidance about what is confusing.
373	56444	3	11	15	0	0	Did authors meam "Evaluation" instead of "Evolution" (Archis Ambulkar, Brinjac Engineering Inc.)	The answer is No, but the word has disappeared during editing..

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
374	59834	3	11	15	11	15	It is not clear what is meant by 'the evolution of climate drivers' in this context - evolution over what time period? The paragraph is phrased in the negative - could this be balanced by a statement on what we do understand about how climate drivers are changing? (AUSTRALIA)	The phrase has disappeared during editing. This assessment is timeless, although it is to be hoped that the second source of uncertainty, inaccurate modelling, will diminish with time. And the paragaph is about what we do not know. What we do know is assessed elsewhere in the chapter.
375	71793	3	11	15	11	24	Is this section on climate drivers and variability consistent with how climate drivers are defined in the Technical Summary? Commenter believes that internal ocean or coupled ocean-atmosphere variability has greater influence on climate variability than internal atmospheric variability. (UNITED STATES OF AMERICA)	The term "climate driver", which is defined in the Glossary, does not appear in the Technical Summary.
376	57947	3	11	16	11	17	The second major issue is: "…inaccurate modeling of the atmospheric response to external forcings …. (page 11, Line 16-17)". I do not agree with this comment. Can authors provide specific references for this? At its minimum expectations, climate models are expected to model the response of external forcings e.g. green house gas emissions. There could be (in fact there are) uncertainties in modeling the response of external forcings e.g. land use land cover change (Pitman et al. 2009; Kumar et al. 2013d). However, saying '…inaccurate modeling …" is like questioning the basic foundations of climate modeling. I have raised this issue in the FOD too, but it has not been addressed satisfactory in the SOD. I would suggest following revision in this respect: " …uncertainties in modeling of atmospheric response to external forcings ….". ******** continued (5 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	We think that "inaccurate" is the right word. Models vary widely in their responses to identical forcing. It is a mistake to think of this variation as representing only uncertainty when inspection makes clear that it is often due to weak parameterizations, omission of important physics, etc.
377	57948	3	11	16	11	17	Reference: Pitman, A. J., et al. (2009), Uncertainties in climate responses to past land cover change: First results from the LUCID intercomparison study, Geophys. Res. Lett., 36, L14814, doi:10.1029/2009GL039076 Kumar S., P. A. Dirmeyer, V. Merwade, T. DelSole, J. M. Adams, and D. Niyogi, 2013(d): Land Use/Cover Change Impacts in CMIP5 Climate Simulations –A New Methodology and 21st Century Challenges. Journal of Geophysical Research (Atmospheres), doi:10.1002/jgrd.50463, in press. ********continued (6 of 6) (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	See response to #376.
378	60621	3	11	17	11	18	Correct the sentence "The water balance of the surface excludes aquifers and the atmosphere, and when there are no substantial lakes, wetlands or glaciers the annual change of storage in the soil is often assumed to be zero" by "The water balance of the surface excludes aquifers (except in their direct contribution to the river flow) and the atmosphere, and when there are no substantial lakes, wetlands or glaciers the change of storage in the soil at the annual scale or at a larger period of time is often assumed to be zero". (Maria Manuela Portela, Instituto Superior Tecnico (IST))	This comment is not about P11 L17-18. It appears to be about text that was deleted from the First Order Draft of chapter 3.
379	71794	3	11	18	11	20	This sentence refers to CMIP5 projections, but figure 3-4 shows results from a study informed by CMIP3. The authors should reconcile. (UNITED STATES OF AMERICA)	Figure 3-4 has been removed. "CMIP5" has been corrected to "CMIP3".
380	81656	3	11	19	11	19	Should "all" within "all of the uncertainty" be qualified at all--"almost all"? (Katharine Mach, IPCC WGII TSU)	"all" is correct in the everyday sense that the other source of uncertainty (scenarios) is negligible.
381	76569	3	11	19	11	20	CMIP5: the mentioned Fig. 3.4 at page 71 (as also reported in captions, line 29) reports CMIP3 and not CMIP5 results (Claudio Cassardo, University of Torino)	Figure 3-4 has been removed. "CMIP5" has been corrected to "CMIP3".
382	59835	3	11	20	11	23	The negative phrasing of this sentence and multiple time periods and sources of uncertainty make it hard to interpret. Suggest the sentence is broken up to gain clarity. (AUSTRALIA)	Sentence broken up and simplified.
383	56445	3	11	29	0	0	Term "GCM" needs to be defined here, as it is used for first time in this chapter. (Archis Ambulkar, Brinjac Engineering Inc.)	This text has been removed.
384	59263	3	11	32	11	32	CMIP5. It should be spelled out (Acronyms are sometime frustrating for the reader) (Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	Done.
385	71795	3	11	32	11	32	Suggest authors replace 'of' with 'projected changes in' to read "CMIP5 simulations projected changes in the water cycle." (UNITED STATES OF AMERICA)	Our use of the future-present tense saves space and improves readability.
386	81657	3	11	32	11	54	Given the statement on lines 21-24, is it possible to indicate how any of these projected changes vary with level of climate change, general time frame in the future, etc.? (Katharine Mach, IPCC WGII TSU)	Unfortunately this would require either an unmanageable increase of bulk or deletion of one or more bullets, which we do not think we can afford.
387	60947	3	11	33	11	37	There are further non-structural measures to water management, including water allocation, economic and regulatory instruments, water efficiency improvements etc. Measures aimed at water demand management are completely ignored in this part of the text. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This comment is not about P11 L33-37.
388	71796	3	11	35	11	35	Suggest authors replace 'increases' with 'is projected to increase.' (UNITED STATES OF AMERICA)	See response to #385.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
389	71797	3	11	36	11	36	Suggest authors replace 'is' with is projected to be.' (UNITED STATES OF AMERICA)	See response to #385.
390	77033	3	11	36	11	36	Is "zonally" the correct term to use here? The preceding content seems to imply meridional (N-S) rather than zonal (E-W) variability... (Sean Fleming, Meteorological Service of Canada)	"zonally" changed to "latitudinally".
391	71798	3	11	38	11	38	Suggest authors replace 'falls' with "is projected to fall.' (UNITED STATES OF AMERICA)	See response to #385.
392	77034	3	11	38	11	40	The author might wish to add here that in many cold (high-latitude and/or high-altitude) regions, winter temperatures may be sufficiently low overall that the impacts of rising air temperatures on rain:snow ratios may be hydrologically significant only in the shoulder seasons of autumn and spring. (Sean Fleming, Meteorological Service of Canada)	We are not aware of a reference that would support this plausible conjecture, nor is it mentioned in the source we aere summarizing (WG1 chapter 12).
393	71799	3	11	41	11	41	Suggest authors replace 'become' with 'are projected to become.' (UNITED STATES OF AMERICA)	See response to #385.
394	71800	3	11	44	11	44	Suggest authors replace 'tends' with 'will tend.' (UNITED STATES OF AMERICA)	See response to #385.
395	59836	3	11	47	11	48	Could some regions where projections lie within the range of natural variability be given? There is also no reference given for this statement, but there needs to be. (AUSTRALIA)	Under pressure to shorten the text, we prefer not to add regional examples here. Text rearranged to clarify that the reference is Mahlstein et al. 2012.
396	71801	3	11	51	11	51	Suggest authors replace 'increases' with 'is projected to increase.' (UNITED STATES OF AMERICA)	See response to #385.
397	76570	3	11	51	11	54	I do not see any mention to wilting point. I suppose soil moisture will exceed (in negative) for a larger amount of time the wilting point (Claudio Cassardo, University of Torino)	The supposition is doubtless correct, but we do not see a way to introduce a plant-physiological concept into an assessment of climatic drivers.
398	76994	3	11	51	11	54	Increase of E in concert with P leads to decrease in soil moisture? I don't follow the physics. Increase in P generally leads to increase in E and soil moisture. Different processes are apparently being mixed without sufficient explanation in this brief pair of statements. (Christopher Milly, U.S. Geological Survey)	We have expanded our citation of WG1 chapter 12 to include section 12.4.5.3, but like us the reviewer will probably find the state of the art in soil-moisture simulation, as assessed there, unsatisfactory.
399	71066	3	11	53	0	0	Suggest clarifying what is meant by "southern North America (e.g., is this referring to Mexico or to the interior of North America?). (CANADA)	We hope that interested readers will be motivated to consult WG1 Figure 12-23, where they will find an RCP-dependent decrease for 2081-2100 over all of Mexico, much or all of the conterminous USA, and some or most of soutehrn Canada.
400	56854	3	12	0	12	0	General comment - Section 3.3.2 More examples (other than agricultural-related) of non-climatic drivers needed, e.g. socio-economic ones. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Not possible due to restricted space
401	60951	3	12	1	12	0	More examples (other than agricultural-related) of non-climatic drivers needed, e.g. socio-economic ones. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Not possible due to restricted space
402	60819	3	12	14	12	16	Insert reference (this paper is now accepted in HESS): . H. Taylor, E. Burke, L. McColl, P. Falloon, G. R. Harris, and D. McNeall, 2012.Contributions to uncertainty in projections of future drought under climate change scenarios. Hydrology and Earth System Sciences Discussions, 9, 12613?12653, doi:10.5194/hessd-9-12613-2012. (Peter Falloon, Met Office Hadley Centre)	We do not see any reason for accepting this suggestion.
403	60949	3	12	14	12	16	Mediterranean and central Europe may experience longer and more frequent droughts. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This comment restates what is already in the text.
404	60622	3	12	19	12	19	Replace evaporation by evapotranspiration (Maria Manuela Portela, Instituto Superior Tecnico (IST))	The word "evaporation" does not appear here.
405	60950	3	12	19	12	37	Section 3.3.2 on "non-climatic drivers" is very limited and ignores aspects of current water management practices that could increase future vulnerability, such as the depletion of groundwater reserves, environmental damage that can impact on water bodies, etc. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Section is not about current vulnerabilities but future development of drivers.
406	77036	3	12	21	12	36	It seems important to specifically mention other forms of land use change, such as forestry and urbanization. The latter in particular has absolutely huge implications for both flooding and drought. (Sean Fleming, Meteorological Service of Canada)	Suggestion was followed.
407	64284	3	12	32	12	36	I suggest to revise the affirmation that ¨ irrigation accounts for about 90% of global water consumption ¨ because not is the situation of Latin America and the Caribbean (neither in Cuba) that is about 70-75%, neither North America, neither Europe. However I agree with second part of the line where affirm that: ¨ severely impacts freshwater availability for humans and ecosystems ¨ (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	not revised as it is clear that 90% is a global average.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
408	71802	3	12	32	12	36	The number most frequently used for the percentage of freshwater withdrawn for irrigation globally is 70% (FAO). Of that amount, 90 percent is consumptive usage (FAO) (i.e. not available for reuse). Authors should use the FAO language so as not to exaggerate for lay readers the amount of freshwater absorbed for irrigation. (UNITED STATES OF AMERICA)	For freshwater availability for humans and ecosystems, values for consumptive use are more meaningful than values for withdrawals as part of the withdrawn water returns to groundwater or surface waters.
409	76571	3	12	33	12	34	regarding these percentages, I suggest also, on Hydrol. Earth Syst. Sci., 14, 1863–1880, 2010, the paper "Groundwater use for irrigation – a global inventory", by Siebert et al. (available here http://www.fao.org/docrep/013/al816e/al816e00.pdf) (Claudio Cassardo, University of Torino)	Siebert et al. 2010 focus on groundwater use.
410	77035	3	12	34	12	35	Though having various facets, ultimately, anthropogenic global climate change is a direct result of human population growth, not something apart from it - so please rephrase this passage. This is obvious from the SRES scenarios, for instance. Also, for an interesting recent paper on this, worthy of citation, see Murtaugh PA, Schlax MG. (2009), Reproduction and the carbon legacies of individuals, Global Environmental Change, 19:14-20. (Sean Fleming, Meteorological Service of Canada)	not reformulated, as it is correct to say that irrigation is affected directly by climate change and indirectly by increasing food demand caused by population and economic growth. Publication not cited due to space constraints.
411	71803	3	12	36	12	36	In Taylor et al (now 2013, not 2012) land use change (largely agriculture) may indirectly influence terrestrial hydrology more than direct climate change. This suggests that aspects of climate change that influence land use change are fairly important in this calculus (e.g., Lobell and Field, 2007; Climatic Change, 81(2),187). (UNITED STATES OF AMERICA)	"caused by climate change" added. Lobell and Field (2007) focus on crop yiel losses in the past due to climatic changes.
412	80363	3	12	39	20	26	Section 3.4: WGI references are still rare, please include the corresponding WGI links in your assessment; Section 3.4.2: WGI is not cited correctly, i.e., evapotranspiration changes are not very likely according to Ch12. Section 3.4.4: Please refer to the WGI glacier assessment, e.g., swap the specific Church et al ref for Glacier Mass Loss with the corresponding WGI reference (Gian-Kasper Plattner, IPCC WGI TSU)	revised in 3.4.2 3.4.4: Church et al. 2013 is WG1 Ch13.
413	58823	3	12	41	12	47	This idea could be developed further. According to e.g. table 4.1 in chapter 4 we are not going to have a situation with future climate but current land use. Though this is assumed to be the reference state in several modelling studies, and thus scenarios are copared to 'unrealistic' reference. Maybe better ideas are welcome? (Katri Rankinen, Finnish Environment Institute)	Not developed further here as land use changes are not considered in studies included in Table 3-2.
414	58679	3	12	49	12	51	Future change in flood exposure by Hirabayashi, Y. et al. (2013) (ref. in the page 50, Nature Climate Change, in print) would be suitable to be included in Table 3-2. Two ways of presentation, RCP scenario-based or degree of global warming (GW) can be provided (see below). Other numbers (number of exposure in millions, in addition to % to global population) can be provided, if required. (1) [Type of hydrological change or impact] Flood exposure, global scale, [Description of indicator] Number of people annually exposed to a flood corresponding to 100-year flood discharge in 20C (1971-2000) with population fixed at the level in the year 2005, in % of world population in 2005 (1971-2000 for historical and 2071-2100 for future, mean and range of multi models), [Hyd. change or impact in different emissions scenarios or different degrees of global warming] historical (11GCM): 0.1% (0.04-0.16%), RCP2.6 (8 GCMs): 0.4% (0.2-0.5%), RCP4.5 (11 GCMs): 0.6% (0.4-1.0%), RCP6.0 (5GCMs): 0.7% (0.3-1.1%), RCP8.5 (11 GCMs): 1.2% (0.6-1.7%). (2) [Type of hydrological change or impact] Flood exposure, global scale, [Description of indicator] Number of people annually exposed to a flood corresponding to 100-year flood discharge in 20C (1971-2000) with population fixed at the level in the year 2005, in % of world population in 2005 (mean and range of multi models and scnearios), [Hyd. change or impact in different emissions scenarios or different degrees of global warming] GW, no change in population (fixed at the level in the year 2005): 1℃: 0.3% (0.2-0.5%), 2℃: 0.4% (0.3-0.6%), 4℃: 1.0% (0.7-1.7%). (Yukiko Hirabayashi, The University of Tokyo)	Now included.
415	58825	3	13	0	0	0	Explaining modelling technologies is very good idea, and probably benefits policy makers very much (Katri Rankinen, Finnish Environment Institute)	Thanks for the comment
416	64285	3	13	1	14	7	This point 3.4.1 need a conclusion of Lead Authors after are shown different Methodological Developments. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	It is not really appropriate to draw a conclusion about the different methodological developments; we are here just reporting them

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
417	57128	3	13	8	13	14	A new publication in Hydrological Processes addressed a hydrological model(TOPMODEL) based on the use of seven climate projected scenarios. Talking about given the present several scenarios, it illustrated that weighting the scenarios was not more reasonable and acceptable than ensemble results,which argued the idea of "probability distribution of future impacts".It could be addressed as a opposing view in LINE 14.It could be changed as "to give to each scenario(Brekke et al., 2009b;...)..., while other sutdies argued that given the present situation weighting the scenarios was not more reasonable and acceptable than ensemble results.(Liu et al,2013) " . Liu, Y., Zhang, J., Wang, G., Liu, J., He, R., Wang, H., Liu, C. and Jin, J., 2013: Assessing the effect of climate natural variability in water resources evaluation impacted by climate change. Hydrological Processes, 27(7): 1061–1071. doi: 10.1002/hyp.9251 (Guoqing Wang, Nanjing Hydraulic Research Institute)	This is another example relating to the point made in the text.
418	60820	3	13	11	13	11	Insert references (thie first paper is now accepted in HESS): H. Taylor, E. Burke, L. McColl, P. Falloon, G. R. Harris, and D. McNeall, 2012.Contributions to uncertainty in projections of future drought under climate change scenarios. Hydrology and Earth System Sciences Discussions, 9, 12613?12653, doi:10.5194/hessd-9-12613-2012 ; Burke, E. J.: Understanding the sensitivity of different drought metrics to the drivers of drought under increased atmospheric CO2, J. Hydrometeorol., 12, 1378–1394, doi:10.1175/2011JHM1386.1, 2011 ; Burke, E. J. and Brown, S. J.: Evaluating uncertainties in the projection of future drought, J. Hydrometeorol., 9, 292–299, doi:10.1175/2007JHM929.1, 2008. (Peter Falloon, Met Office Hadley Centre)	Now mentioned in the drought section
419	70308	3	13	11	13	14	Two other examples of probabilistic hydrological impact assessments which could be mentioned here have been provided by Weiss (2011, doi:10.5194/nhess-11-2163-2011) and Wetterhall et al. (2011, doi:10.5194/nhess-11-2295-2011). An example for impacts on permafrost (also covered in this chapter) has been presented by Fronzek et al. (2011, doi:10.5194/nhess-11-2981-2011). (Stefan Fronzek, Finnish Environment Institute)	These are simply additional examples; there are many others that could be included, but we have just included a few for illustrative purposes
420	77140	3	13	18	13	18	delta method' may not be clear to all (ITALY)	It should now be more clear from the text
421	77037	3	13	18	13	34	Downscaling discussion is a good start, but currently remains mediocre. What about dynamical downscaling (RCMs)? Or more sophisticated statistical downscaling approaches, like TreeGen for instance? Or intermediate-complexity physically oriented approaches, like simplified orographic precipitation models, say? All of these have been extensively and productively used for assessing the hydrologic impacts of projected future climatic changes. (Sean Fleming, Meteorological Service of Canada)	The downscaling discussion has been expanded, but we have not gone into specific details about individual methods; there are too many
422	62011	3	13	20	13	23	The downscaling uncertainty has also been recently highlighted by Lafaysse et al. (2013) in a study using several stochastic statistical downscaling methods driven by ENSEMBLES GCMs over a catchment located in the Southern French Alps. Their study fully supports the statement that downscaling uncertainty can be as large as GCM uncertainty. - Lafaysse, M., Hingray, B., Terray, L., Mezghani, A., and Gailhard, J. (2013) Sources of uncertainty in future climate and hydrological projections: the Alpine Durance basin. Water Resources Research, accepted. (Jean-Philippe Vidal, Irstea)	Another example. Does not change text.
423	60952	3	13	22	13	22	Another key reference discussing different bias correction methods is: Hawkins, Osborne, Ho & Challinor, 2013, 'Calibration and bias correction of climate projections for crop modelling: an idealised case study over Europe', Agric. For. Meteorol., 170, 19-31. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Not a hydrological example
424	57129	3	13	27	13	29	This sentence indicates the shortage of the delta method. Otherwise how much impacts are there on runoff, evapotranspiration, and soil moisture causeded by the changes in variability of climatic variables? One paper published in the Hydrological Processes, entitled "Sensitivity of hydrological variables to climate change in the Haihe River basin, China" (Bao et al., 2012) investigated the impacts of the inter-annual variability of precipitation on hydrological variables, and could be added to this part. A sentence could be added to this part is "Besides the change of annual mean temperature, there is a significant impact of inter-annual distribution of precipitation change on runoff. Further more the sensitivity of runoff to the inter-annual distribution of precipitation is higher than it to annual mean temperature (Bao et al., 2012)." [1] Bao Z., Zhang J., Liu J., Wang G., Yan X., Wang X., Zhang L., Sensitivity of hydrological variables to climate change in the Haihe River basin, China, Hydrological Processes, 2012, 26(15): 2294-2306, doi: 10.1002/hyp.8348. (Guoqing Wang, Nanjing Hydraulic Research Institute)	We have rephrased this section

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
425	76870	3	13	29	13	30	"…can cause discrepancy…" Better to say it adds uncertainty. Relevant references: Hagemann et al. 2011 (http://dx.doi.org/10.1175/2011jhm1336.1) and Ehret et al., 2012 (doi:10.5194/hess-16-3391-2012). It has been argued that bias correction hides rather than reduces the uncertainties, compared to uncorrected climate simulations (Ehret et al., 2012). To what extent bias correction affects the impact *projections* has not been explored in great detail. (Rutger Dankers, Met Office Hadley Centre)	We have rephrased the text
426	59264	3	13	30	13	30	After "(Watanabe et al., 2012)", the following sentense could be added: "Hagemann et al. [2011] analyzed the impact of a state-of-the-art statistical bias correction method on the hydrological changes obtained from two hydrological models and three GCMs, finding that the introduced level of uncertainty of the correction could potentially be comparable to the uncertainty related to the choice of the GCM. Nonetheless there is still ongoing research on the reduction of uncertainty of statistical bias correction techniques like the piecewise correction presented in Grillakis et al. [2013]." Hagemann, S., C. Chen, J. O. Haerter, J. Heinke, D. Gerten, and C. Piani (2011), Impact of a statistical bias correction on the projected hydrological changes obtained from three GCMs and two hydrology models, J. Hydrometeorol., 12, 556–578, doi:10.1175/2011JHM1336.1. Grillakis, M. G., Koutroulis, A. G., Tsanis I.K. Multi-segment statistical bias correction of daily GCM precipitation output. Journal of Geophysical Research (2013), 118, 1–13, doi:10.1002/jgrd.50323. (Aristeidis Koutroulis, Water Resources Management & Coastal Engineering Laboratory, Technical University of Crete, Greece) (GREECE)	We gave rephrased the text
427	60822	3	13	30	13	30	Insert references on bias correction in hydrology: Sperna Weiland, F. C., van Beek, L. P. H., Kwadijk, J. C. J., and Bierkens, M. F. P.: The ability of a GCM-forced hydrological model to reproduce global discharge variability, Hydrol. Earth Syst. Sci., 14, 1595-1621, doi:10.5194/hess-14-1595-2010, 2010; Ehret, U., Zehe, E., Wulfmeyer, V., Warrach-Sagi, K., and Liebert, J.: HESS Opinions "Should we apply bias correction to global and regional climate model data?", Hydrol. Earth Syst. Sci., 16, 3391-3404, doi:10.5194/hess-16-3391-2012, 2012; Hagemann, Stefan, Cui Chen, Jan O. Haerter, Jens Heinke, Dieter Gerten, Claudio Piani, 2011: Impact of a Statistical Bias Correction on the Projected Hydrological Changes Obtained from Three GCMs and Two Hydrology Models. J. Hydrometeor, 12, 556–578.doi: http://dx.doi.org/10.1175/2011JHM1336.1 (Peter Falloon, Met Office Hadley Centre)	Some of these references have been added
428	67847	3	13	30	13	31	The horizontal resolution of the GCMs used in the papers cited here is rather coarse. Nakaegawa et al. (2013) used a 20-km mesh AGCM for river discharge projections and used a 60-km mesh AGCM forced with four different projected SSTs to quantify the uncertainties. The projections by the 60-km mesh AGCM with the quantified uncertainties are used as regional projections for all the regions in the IPCC WG1 AR5 SOD. To ensure consistency between WG I and WG II is important in AR5, Nakaegawa et al. (2013) shown below should be cited here. Besides, Nakaegawa et al. (2013) should be taken into consideration in subsection 3.4.5. Nakaegawa, T., A. Kitoh, and M. Hosaka. 2013: Discharge of major global rivers in the late 21st century climate projected with the high horizontal resolution MRI-AGCMs -overview-. Hydrological Processes. 27. DOI: 10.1002/hyp.9831 (JAPAN)	Reference added.
429	57851	3	13	31	0	0	How high horizontal resolution does these global climate models have? These models seemed to have coarser horizontal resolution than a state-of-art model.Nakaegawa et al. (2013) used a 20-km mesh AGCM for river discharge projections and used a 60-km mesh AGCM forced with four different projected SSTs to quantify the unceratinties. The projections by the 60-km mesh AGCM with the quantifed uncertainties are used as regional projections for all the regions in AR5 WG I.. A liasion between WG I and WG II is an important aspect in AR5, the following article may be cited here: Nakaegawa, T., A. Kitoh, M. Hosaka. 2013: Discharge of major global rivers in the late 21st century climate projected with the high horizontal resolution MRI-AGCMs -overview-. Hydrological Processes. 27. DOI: 10.1002/hyp.9831 (Toshiyuki Nakaegawa, Meteorological Research Institute)	see above
430	68185	3	13	31	13	31	Include Nakaegawa et al., 2013 as a cite after Hirabashi et al, 2008. The corresponding reference is: T. Nakaegawa, A. Kitoh, M. Hosaka. 2013: Discharge of major global rivers in the late 21st century climate projected with the high horizontal resolution MRI-AGCMs-overview. Hydrological Processes. 27 DOI:10.1002/hyp. 9831. (José Fábrega, Universidad Tecnológica de Panamá)	See above

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
431	60821	3	13	34	13	34	I would recommend replacing the sentence "however this has not yet been systematically evaluated" with "Comparisons of GCM-simulated riverflow with observations suggests reasonable skill at annual timescales but less confidence in monthly predictions (Falloon et al. 2011), and results are strongly dependent on the quality of GCM input data and basin size (Sperna Wieland et al. 2012)." References: Falloon, P, Betts R, Wiltshire A, Dankers R, Mathison C, McNeall D, Bates P, Trigg M (2011). Validation of river flows in HadGEM1 and HadCM3 with the TRIP river flow model. Journal of Hydrometeorology,12,1157-1180. doi: 10.1175/2011JHM1388.1 ; Weiland, F. C. Sperna, L. P. H. van Beek, J. C. J. Kwadijk, M. F. P. Bierkens, 2012: On the Suitability of GCM Runoff Fields for River Discharge Modeling: A Case Study Using Model Output from HadGEM2 and ECHAM5. J. Hydrometeor, 13, 140–154. doi: http://dx.doi.org/10.1175/JHM-D-10-05011.1 (Peter Falloon, Met Office Hadley Centre)	Sentence rephrased
432	57127	3	13	36	13	41	In the recent publication of "Quantifying Uncertainty in Catchment-scale Runoff Modeling under Climate Change (Case of the Huaihe River, China)", it discussed the uncertainty of hydrological model uncertainty, emission scenatios, and global climate model outputs(including the downscaling techniques) in a quantitative manner, the results show for runoff the GCM uncertianty is larger than that due to emission scenarios, and after calibration, model parameter uncertainty was much smaller and in different magnitude compared with other uncertainties. It demonstrated the view of "hydrological model parameter uncertainty smaller than climate scenarios", and pointed out the climate uncertainty may be in larger magnitude than hydrological model uncertainty. It could be recommended as a supplemental view in LINE39 before"However".That is to say, after LINE36-37,"...large number of climate scenarios, and even the emission scenarios uncertainty are smaller than global climate model uncertainty, a study show that the hydrological model parameter uncertainty even smaller than them on magnitude.(Liu et al, 2012)". Liu, Y., Zhang, J., Wang, G., Liu, J., He, R., Wang, H., Liu, C. and Jin, J., 2012: Quantifying Uncertainty in Catchment-scale Runoff Modeling under Climate Change (Case of the Huaihe River, China), Quaternary International, 282:130-136. (Guoqing Wang, Nanjing Hydraulic Research Institute)	We have added the reference
433	62012	3	13	36	13	46	Christierson et al. (2012) showed that climate uncertainties (20-member sampled UKCP09 projections) are larger then hydrological uncertainties (2 model structures + GLUE parameters) for monthly flows in 70 UK catchments. However, the part of uncertainties due to the hydrological modelling step (2 model structures) can be much larger than those due to the GCM uncertainty (7 GCMs) for low flow characteristics over the whole of France, as shown by Chazot et al. (2013). Indeed, low flow characteristics are much more dependent on catchment-related processes and on the way they are implemented in each hydrological model structure. - Chazot, S., Chauveau, M., Perrin, C., Bourgin, P.-Y., Sauquet, E., Vidal, J.-P., Rouchy, N., Martin, E., David, J., Norotte, T., Maugis, P., and de Lacaze, X. (2013) What impacts of climate change on surface hydrology in France by 2070? Houille Blanche-revue Internationale De L Eau, accepted - Christierson, B. v., Vidal, J.-P., and Wade, S. D. (2012) Using UKCP09 probabilistic climate information for UK water resource planning. Journal of Hydrology, 424-425, 48-67. doi: 10.1016/j.jhydrol.2011.12.020 (Jean-Philippe Vidal, Irstea)	Cannot find Chazot et al. but the paper appears just to provide another example. The paragraph has been rephrased
434	76995	3	13	36	13	46	Milly and Dunne (2011, On the hydrologic adjustment of climate-model projections: the potential pitfall of potential evaporaton, Earth Interactions, v 15, no 1, p. 1-14) have shown that the main difference in hydrology downstream of climate-model output is associated with inappropriate translation of atmopsheric input to hydrologic model inputs, not to details of how the hydrologic response is modeled. In an assessment of this type (AR5), I recommend that the authors critically review the possibility that apparent substantial effects of model uncertainty could in fact be spurious methodological artifacts. (Christopher Milly, U.S. Geological Survey)	Reference added.
435	60823	3	13	41	13	41	after "evaporation", insert "particularly the uncertain impact of CO2 on evapotranspiration (Davie et al. 2013)" and provide a link to box CC-VW (Peter Falloon, Met Office Hadley Centre)	No change, because the uncertain effect of CO2 is only part of the evaporation uncertainty
436	60623	3	13	45	13	46	The sentence which starts line 45 must clarify if its content is based on scenarios or if it results from real observations. In this last case the regions to which the sentence apllies need to be identified. (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Do not understand comment
437	77038	3	13	53	13	54	"It is not necessary to use the hydrological model to simulate future hydrologic characteristics" - I suspect this has been mis-stated. (Sean Fleming, Meteorological Service of Canada)	Sentence rephrased
438	76871	3	14	4	14	7	The sensitivity / response surface approach does require running the impact model over a much wider range of climate changes, calling into question the plausibility of the results (especially where impact models are tuned to current conditions). (Rutger Dankers, Met Office Hadley Centre)	Sentence rephrased
439	76996	3	14	10	14	17	Global ET is dominated by oceanic ET. Why is it the focus of the ET section of a freshwater chapter? (Christopher Milly, U.S. Geological Survey)	we think the importance of ET for freshwater resources should at least be mentioned!

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
440	77039	3	14	10	14	24	Section 3.4.2 might be a good place to revisit the so-called "evaporation paradox" discussed in Section 3.2.2 - otherwise, there would appear to be an internal inconsistency in the chapter...? (Sean Fleming, Meteorological Service of Canada)	we deleted the "..paradox" section
441	71804	3	14	12	14	13	The statement "it is projected that global evapotranspiration is very likely to increase in a warmer climate" is not supported as such by Collins et al., 2013 (WGI Chapter 12). To reference Collins et al., 2013 (WGI Chapter 12), rewrite text as: "it is projected that potential evapotranspiration over most land areas is very likely to increase in a warmer climate." (UNITED STATES OF AMERICA)	Accepted, sentence has been revised
442	57955	3	14	12	14	14	You may want to add “increase in land evaporation can become limited by the water availability” see Fig.10 in kumar et al. 2013(d). This is because increase in precipitation with warming does not follow the Clausius-Clapeyron relationship i.e. 7% increase in precipitation per 1K warming. Model simulations show much weaker response of precipitation to global warming (~ 2% increase in precipitation per K warming; see Held and Soden 2006 for details). Reference: Kumar S., P. A. Dirmeyer, V. Merwade, T. DelSole, J. M. Adams, and D. Niyogi, 2013(d): Land Use/Cover Change Impacts in CMIP5 Climate Simulations –A New Methodology and 21st Century Challenges. Journal of Geophysical Research (Atmospheres), doi:10.1002/jgrd.50463, in press. Held, I. M., and B. J. Soden (2006). Robust response of hydrologic cycle to global warming. Journal of Climate, 19, 5686-5699. (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	too specific
443	59837	3	14	12	14	17	In discussing how global evapotranspiration may increase under climate change, no mention is made of indirect and opposing effects such as changes in wildfire regimes or changes in the frequency and intensity of pest and diseases on vegetation water use. These, together with drought deaths, have the potential to reduce interception and transpiration from these landscapes. (AUSTRALIA)	Accepted, but too specific
444	60953	3	14	12	14	24	As previous, indicate explicitly if actual or potential evaporation is considered (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed, revised
445	81658	3	14	13	14	13	"very likely" as a likelihood term should be italicized. (Katharine Mach, IPCC WGII TSU)	Accepted and revised
446	76572	3	14	14	14	15	"Many … apparent": at which scale? Global? Regional? All? (Claudio Cassardo, University of Torino)	We deleted the sentence.
447	76573	3	14	14	14	15	"radiation": I think you means "net radiation" (Claudio Cassardo, University of Torino)	yes, we added "net".
448	60954	3	14	19	14	24	Does this paragraph mean that PET isn't a very useful metric for assessing climate change impacts on hydrology? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	entire paragraph revised
449	71067	3	14	19	14	24	This section describes uncertainties in PET estimates as an important source of uncertainty in hydrological projections. However, no reference is made to the number of hydrological projections that use PET and whether it is indeed a good idea to do hydrological projections using PET. In many cases the use of PET may not be advisable and moreover the fact that there are no negative feedbacks in many PET models (e.g., soil water store computation) suggest that uncertainties in PET may exceed uncertainties in ET for projections. Suggest increasing discussion of methods used for ET estimates in this section. (CANADA)	entire paragraph revised
450	76997	3	14	19	14	24	Relevant missing citations are Milly and Dunne (2011, On the hydrologic adjustment of climate-model projections: the potential pitfall of potential evaporaton, Earth Interactions, v 15, no 1, p. 1-14) and Shaw and Riha (2011, Assesssing temperature-based PET equations under a changing climate in temperate, deciduous forests, Hydrol. Proc., 25, 1466-1478). (Christopher Milly, U.S. Geological Survey)	entire paragraph revised
451	76574	3	14	22	14	22	"Penman-Monteith formula": are you talking of ET or PET? (Claudio Cassardo, University of Torino)	entire paragraph revised
452	76575	3	14	22	14	24	it is not clear to me the meaning of the percentages. 100% refers to the difference between BC formulation and PM formula? If so, how you can talk about "smaller changes"? And, if uncertainty (with respect to data?) is just 20% to 40%, in case of a difference of 100% it may be possible to assess which method is better. Have I understood wrongly? Also, which is the reference for the percentages? (Claudio Cassardo, University of Torino)	entire paragraph revised
453	70312	3	14	27	0	0	The permafrost paragraph could also refer to relevant section in Chapter 28. (Stefan Fronzek, Finnish Environment Institute)	We can not refer due to lack of space.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
454	59838	3	14	29	14	36	It is difficult to follow the distinction between general/regionally specific statements and discussion on soil moisture/drought in this paragraph. E.g. 'Low soil moisture episodes of 3-6 month duration doubles in extent and frequency and droughts longer than 12 months become three times more common' - Do these statements refer only to the regions specified in the first sentence? The next sentence states (presumably in relation to the statement on drought) that 'this is particularly the case where reductions in soil moisture are projected' - are these different regions to where low soil moisture doubles? The final sentence appears to be a more globally specific statement that generally monotonic increases are not statistically different from current climate. If this statement is in relation to the specific regions where soil moisture reduces, an explanation of how drought can become three times more common but not be statistically different may be needed. (AUSTRALIA)	We revised the paragraph.
455	57085	3	14	38	14	38	ofnorthern -> of northern (Alexey V. Eliseev, A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)	Accepted and revised
456	76576	3	14	38	14	38	"ofnorthern" separate (Claudio Cassardo, University of Torino)	Accepted and revised
457	77141	3	14	38	14	38	of northern (ITALY)	Accepted and revised
458	70685	3	14	38	14	41	in line 38, add a space between "of northern". In line 41, please check if an increase of permafrost area is really expected in scenario RCP2.6 after na initial decrease…may be due to changing landcover it could happen... (Goncalo Vieira, University of Lisbon)	Thank you very much. Please see Figure 12.33 of WGI.
459	76577	3	14	38	14	41	what about the "second half" of 21st century for the permafrost? (Claudio Cassardo, University of Torino)	Due to lack of space, we can not treat it.
460	77040	3	14	38	14	41	Would be good to briefly summarize the hydrological implications of the discussed permafrost changes, e.g., soil meltwater generation, increased aquifer storage, etc. (Sean Fleming, Meteorological Service of Canada)	Due to lack of space, we can not treat it.
461	81659	3	14	40	14	41	The timeframe for this projection should be specified, both in terms of the stabilization and in terms of the subsequent increase. (Katharine Mach, IPCC WGII TSU)	Thank you very much. We missed to reflect your comments to the submitted FGD. -21% at 2016-2035 compared to 1986-2005 (WGI Ch11), and stabilizes 2060-2100, please see Fig. 12.33 of WGI. In this sense, the submitted FGD should better be revised the number "at near 20%" to "at near 37%" based on WGI Ch12.
462	57852	3	14	44	0	0	The following article is cited in AR5 WG I as one of the lines of projected amount of global glaciers: Hirabayashi, Zang, i Watanabe, Koirala, and Kanae. 2013: Projection of glacier mass changes under a high-emission climate scenario using the global glacier model HYOGA2. Hydrological Research Letters. 7. 6-11. http://dx.doi.org/10.3178/hrl.7.6 (Toshiyuki Nakaegawa, Meteorological Research Institute)	Hirabayashi et al. 2013 is a valuable contribution to the expanding literature on global glacier-climate modelling, but it does not rely on as many CMIP5 models and RCPs as Radic et al.2013 (cited in Box 3-1).
463	77041	3	14	44	15	14	Although this is a good start, the referencing is too light in this section, as reflected in the oversimplistic content. In fact, one of the most basic messages of the passage - that "peak meltwater" is coming - is quite misleading, as in many parts of the world it has already happened. Five key references to follow up on are as follows: (i) Baraer M and others (2012), Glacier recession and water resources in Peru's Cordillera Blanca, Journal of Glaciology, 58:134-150; (ii) Stahl K and Moore RD (2006), Influence of watershed glacial coverage on summer streamflow in British Columbia, Canada. Water Resources Research, 42, doi:10.1029/2006WR005022; (iii) Stahl K and others (2008), Coupled modelling of glacier and streamflow response to future climate scenarios. Water Resources Research, 44, doi:10.1029/2007/WR005956; (iv) Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality. Hydrologic Processes 23: 42–61; (v) Jost G and others (2012), Hydrology and Earth System Science, 16:849–860. (Sean Fleming, Meteorological Service of Canada)	Baraer et al. 2012 is cited in Table 3-1. We see no strong case for adding the other references pointed to here. As qualified, our assessment of "peak meltwater" is reasonable; the concept has meaning only if referred to a starting date, and we do not assume, as the comment apparently does, that that date should be the culmination of the Little Ice Age.
464	62836	3	14	47	0	48	Such shifts are region specific and governed by the glacio-hydrologic regimes. It is not fair to construct it as a globally valid response. In precipitation dominant glacier regimes like monsoon dominated "Himalayan catchments" (Thayyen and Gergan, 2010), the annual peak runoff will remain in July & August irrespective of the change in glacier meltwater flow regime. This is in fact being stated at page-15 Line 49 and it may be appropriate to reflect in the global synthesis rather than regional analysis (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	As suggested, the point is now made here rather than in Box 3-1.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
465	59717	3	14	48	14	48	This phenomenon maybe only occurred in the Alps where glacier areas are smaller, but not other regions which is not found at least in China Reference: LIU Shiyin, ZHANG Yong, ZHANG Yingsong,DING Yongjian. 2009. Estimation of glacier runoff and future trends in the Yangtze River source region, China. Journal of Glaciology, Vol. 55, No. 190, 353-362 Shiqiang Zhang, Xin Gao,Xiaowen Zhang and Stefan Hagemann. 2012. Projection of glacier runoff in Yarkant River basin and Beida River basin, Western China. HYDROLOGICAL PROCESSES, 26, 2773–2781. (Xiucang Li, National Climate Center, China Meteorological Adiministration)	Liu et al. 2009 *do* show the seasonal shift of the projected discharge peak, in their Figure 9b. However the shift is now qualified in the text as being projected for "most regions".
466	76578	3	14	53	14	53	"12% of 2008 extent by 2100": if possible, separate by areas. Some areas will lose much more than (100-12)% of ice by 2100 (Claudio Cassardo, University of Torino)	This text has now been removed. (12% is an average over the entire mountain range. Space would not allow more specific regional detail even if it were available.)
467	81660	3	14	53	14	53	For the mentioned 12%, is it possible to also specify the range of projected values? (Katharine Mach, IPCC WGII TSU)	This text has now been removed. (The source gives only the median of simulations run with 16 regional climate models.)
468	76579	3	15	2	15	2	what means "stored glacier ice"? (Claudio Cassardo, University of Torino)	This text has now been removed.
469	66093	3	15	2	15	5	This is very important information but the peak melt water and peak melt water dates from the glacier have been projected between 2010 and 2050 for different regions of China. It will be more appropriate to mention the basis for spread of 40 years (i.e. from 2010 - 2050) (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	The peak is now described as "broad", to take account of modelling uncertainty and simulated internal variability.
470	62837	3	15	3	0	3	As mentioned earlier “peak meltwater” term may not ne interchangeable with “ peak of glacier degraded runoff” (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	The suggested alternative term is non-standard and would not be understood by most readers.
471	58908	3	15	3	15	5	The value given by Radic and Hock relates to remote areas of large glaciers and is primarily important concerning sea level. The peak discharge for water supply in densely inhabited regions with smaller and steeper mountain glaciers is much earlier and has already been passed in many catchments with small glaciers. This difference shoud be made clear. (Wilfried Haeberli, University of Zurich)	This text has now been removed. (Note that as with other comments about "peak meltwater", this one seems to make the latent assumption that the reference date should be the culmination of the Little Ice Age.)
472	59718	3	15	3	15	5	"peak meltwater" will occur in modeling single glacier and the peak depend mainly on warming rate. If glacier sizes in a glacerized basin are smaller (for instance <2sqkm),it is possible for occurrence of peak. However, if scales of glacier areas in a glacerized basin are quite different, peak will not occur in future decades which glacier runoff will increase sequentially. (Xiucang Li, National Climate Center, China Meteorological Adiministration)	See response to #489.
473	64235	3	15	4	15	6	The timing of peak runoff in the Nordic Countries has been studied extensively within the energy sector. There is a large uncertainty associated with differences in climate projections as modelled by different GCMs and RCMs. Most GCMs and RCMs still have spatial resolutions that are far coarser than needed for realistic mass balance modelling, making it necessary to apply special downscaling techniques and bias corrections in the glaciological modelling. However, the results of this indicates that in peak runoff is likely to occur in Iceland and Norway in the latter part of the century. These results should be discussed along with those from China, the European Alps and the world. The relevant reference is Jóhannesson, T., G. Aðalgeirsdóttir, A. Ahlstrøm, L. M. Andreassen, S. Beldring, H. Björnsson, P. Crochet, B. Einarsson, H. Elvehøy, S. Guðmundsson, R. Hock, H. Machguth, K. Melvold, F. Pálsson, V. Radić, O. Sigurðsson and Th. Thorsteinsson. 2012. Hydropower, snow and ice. In: Thorsteinsson, Th., and H. Björnsson, eds. Climate Change and Energy Systems. Impacts, Risks and Adaptation in the Nordic and Baltic Countries. Nordic Council of Ministers, TemaNord 2011:502, 91–111 (available online from norden.org) ; see especially example figure 5.7 p. 104 and figure 5.9 p. 107. See also discussion on reference on ch. 3 p.51 line 37 (ICELAND)	We have added this reference.
474	81661	3	15	5	15	8	It could be helpful to specify if this outcome is expected across scenarios. (Katharine Mach, IPCC WGII TSU)	The necessary multiple-RCP simulations have not yet been done, and moreover regional-scale simulations lag behind global-scale simulations in this respect.
475	62838	3	15	12	0	13	This may be the most appropriate statement regarding the role of glaciers to the downstream flow and contradictory to the statement of IPCC 2007 as stated in general comment and reflected in Thayyen and Gergan(2010). (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	Statement relocated to section 3.4.4 as suggested.
476	62839	3	15	13	0	23	These statements give rise to the impression that the major flow regimes of the Himalayan Rivers from its origin to the confluence are affected by the glacier contribution. In fact the role of glaciers in regulating the stream flow variations limit at 20-40% glacierisation, in varying glacio- hydrological regimes. Hence it is important to point out that the direct effect of glacier shrinkage is limited to the headwater region alone (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	This point, which we consider to be somewhat overstated, is addressed at P16 L8-12.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
477	81662	3	15	18	0	0	Box 3-1. Given the relevance of this box to both chapters 3 and 24, the chapter team could consider making it a cross-chapter box. In such a case, the box would have greater visibility within the report and the authors who have developed it would be directly recognized within the box. (Katharine Mach, IPCC WGII TSU)	Direct exposure of names on this slightly sensitive subject might not be welcome to all the authors. Chapters 3 and 24 are, however, in close contact to ensure appropriate cross-referencing and consistency, particularly between Box 3-1 and section 24.9.3, the latter being focussed on the Tien Shan glacierrs.
478	80364	3	15	18	16	12	Box 3.1: Please ensure there are no inconsistencies with the available information from Chapter 4 of WGI AR5. Careful additional checks needed, i.e., statement "It is virtually certain that these projections are more reliable than an earlier suggestion of complete disappearance by 2035" has to go. This phrase is misleading and wrong as it currently reads like the factual WGII AR4 error was a "not-so-reliable suggestion". (Gian-Kasper Plattner, IPCC WGI TSU)	Box 3-1 is mainly the responsibility of an LA who is also a CA in WG1 chapter 4. The "virtually certain" statement is neither misleading nor wrong, but we have altered "suggestion" to "erroneous assessment". Whether the WG2 AR4 error was "factual" is doubtful to say the least.
479	79381	3	15	18	16	14	This box could also usefully reference the systematic review by Miller et al referred to above that shows when assessments only include studies that use robust methods for estimating glacier loss, the evidence is a consistent reduction in glacier mass and volume in the Hindu Kush-Karakoram-Himalayan chain. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Bolch et al. 2012 is a more immediately relevant, and also more detailed, review than Miller et al. 2012.
480	62840	3	15	25	0	26	These are unsubstantiated observations. There is no peer reviewed study suggested about a possible higher melt rate after 1995. Or please give references. More over it is hard to understand the purpose of this sentence. (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	The reviewer has not noticed the traceable account for these observations (from Figure 3-5 to Bolch et al. 2012).
481	81663	3	15	25	15	26	Is it possible to use calibrated uncertainty language to characterize the author team's degree of certainty regarding this potential increase? (Katharine Mach, IPCC WGII TSU)	We do not think that calibrated language would be appropriate here, for what is an informal judgement about what is seen in the figure.
482	56904	3	15	26	0	0	I would add here that there are very few field measurements of glacier mass balance in Himalaya and that the compilation is based on an evolving sample of mostly small accessible glaciers, not necessarily representative of the region where there are located (Etienne Berthier, LEGOS)	This point is now made in the text.
483	59839	3	15	41	15	42	Question if the statement 'It is virtually certain that these projections are more reliable than an earlier suggestion of complete disappearance by 2035 (Cruz et al 2007)' is needed. The IPCC has acknowledged that the 2007 WGII statement was 'poorly substantiated' and issued an errata. If this statement is kept, it should be re-written to make clear that the Cruz reference is the 'earlier suggestion' rather than the reference for the new projections being more reliable. eg 'It is virtually certain that these projections are more reliable than an earlier suggestion by Cruz et al 2007 of complete disappearance by 2035.' (AUSTRALIA)	See response to comment 478. The citation has been relocated as suggested.
484	81664	3	15	41	15	42	It might be clearest to acknowledge that this was an "erroneous suggestion." (Katharine Mach, IPCC WGII TSU)	Done.
485	56905	3	15	42	0	0	Cogley et al. 2010 could also be cited here to explain the origin of the 2035 date in the 2007 WGII report (Cogley, J. G., et al. (2010), Tracking the Source of Glacier Misinformation, Science, 326, 924-925.) (Etienne Berthier, LEGOS)	We think that it is enough to acknowledge that the Cruz et al. Himalayan assessment was in error.
486	62842	3	15	45	0	0	Bhutiyani, M. R., Kale, V.S., and Pawar, N. J.: Changing streamflow patterns in the rivers of northwestern Himalaya: implications of global warming in the 20th century, Curr. Sci., 95(5), 618-626, 2008.) (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	Bhutiyani et al. 2008 focuses on discharge observations, which are made some distance downstream from the glaciers on which this box is focussed and are affected by diversions and other human interventions. Moreover the box is focussed mainly on projections.
487	62844	3	15	45	0	0	Thayyen, R. J. and Gergan, J. T. (2010) Role of glaciers in watershed hydrology: a preliminary study of a ''Himalayan catchment'', The Cryosphere, 4, 115-128, doi:10.5194/tc-4-115-2010, 2010. (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	Unfortunately we were obliged to delete this reference from an earlier draft that was too long.
488	62841	3	15	45	0	49	But the actual discharge shows declining trend (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	This paragraph is about projected glacier meltwater, not observed total stream discharge. The latter can be affected strongly by non-glacial components of the water balance.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
489	59719	3	15	45	15	47	"peak meltwater" will occur in modeling single glacier and the peak depend mainly on warming rate. If glacier sizes in a glacerized basin are smaller (for instance <2sqkm),it is possible for occurrence of peak. However, if scales of glacier areas in a glacerized basin are quite different, peak will not occur in future decades which glacier runoff will increase sequentially. For the above reasons, occurrence of peak meltwater is impossible in 50 to 70 years at linear warming rate of 0.06K/a in Himalaya where glacier sizes are such wide from A few square kilometers to Dozens of square kilometers. (Xiucang Li, National Climate Center, China Meteorological Adiministration)	This particular sentence has now been removed. (The distribution of glacier sizes is certainly one of the basin-scale controls on the epoch of peak meltwater, tending to make the peak broader and so less valuable as a guide for policy-making. But we do not agree that it is "impossible in 50-70 years …" in the hypothetical basins modelled by Rees and Collins 2006.)
490	59720	3	15	51	15	52	"70-200mm/year of additional meltwater", this result is unbelievable. The result originates from Yasunari (2010) who cited Gao' result. Gao's result was estimated in a small glacier of central Tanggla Mountains, Glacier Dongkemadi using Fujita's method. It is only simple estimation. It is not able to extend to south side of Himalayas. Data of Black carbon and albedo was assumptive and estimation of ablation is obviously higher. Reference: Hongkai Gao, Xiaobo He,Baisheng Ye1 and Jianchen Pu. 2012. Modeling the runoff and glacier mass balance in a small watershed on the Central Tibetan Plateau, China, from 1955 to 2008. Hydrol. Process. 26, 1593–1603 Koji Fujita, Takeshi Ohta and Yutaka Ageta. 2007. Characteristics and climatic sensitivities of runoff from a cold-type glacier on the Tibetan Plateau. Hydrol. Process. 21, 2882–2891. (Xiucang Li, National Climate Center, China Meteorological Adiministration)	Yasunari et al. (2010) did not cite Gao et al. (2012) (not surprisingly considering the dates). Their calculations were based on the work of Fujita et al. (2007), and we do not think that their simplicity invalidates them as a source for an approximate assessment of the possible glacier-hydrological significance of black carbon.
491	58909	3	16	2	16	5	Dam safety is not the only criterion as the probability of catastrophic floods from impact waves triggered by large rock/ice avalanches into new lakes is systematically increasing with the increasing number of new lakes in proximity to large destabilizing icy rock walls (cf. Haeberli, W. (2013): Mountain permafrost — research frontiers and a special long-term challenge. Cold Regions Science and Technology. http://dx.doi.org/10.1016/j.coldregions.2013.02.004) (Wilfried Haeberli, University of Zurich)	This correct observation is covered by our statement that "the hazard has increased". We have revised this paragraph to take account of a promising recent publication (Fujita et al., 2013, Natural Hazards and Earth System Sciences, 13, 1827-1839).
492	62846	3	16	9	0	10	Contradictory to the statement in Page 15 Line21 (RENOJ THAYYEN, NATIONAL INSTITUTE OF HYDROLOGY)	The statement at P15 L21 has been removed. (That statement should have been understood to include dwellers in the headwater regions, and in most of the Indus basin and enclosed-drainage basins.)
493	62944	3	16	17	0	0	There are other references on flow projections, such as those of Ducharne et al (2007, 2009), on the Seine and the Somme in NW France. (Benoit Laignel, University of Rouen)	Do not add anything different
494	56864	3	16	17	16	17	Please elaborate the definitions of "runoff" and "streamflow". (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Addressed earlier in chapter
495	60955	3	16	17	16	17	Please elaborate the definitions of "runoff" and "streamflow". (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Addressed earlier in chapter
496	59840	3	16	17	17	12	Section 3.4.5 - There is no mentionof indirect effects of changes in precipitation and temperature through their effects on vegetation water use. In particular, the effects of changes in climate on the severity and frequency of events such as wildfire and pests and pathogens that can significantly change the water balance of vegetated areas. Changes in regimes of wildfire and in pests and diseases that result from changes in precipitation and temperature can potentially change evapotranspiration from vegetation canopies. (AUSTRALIA)	True, but this is likely to be a small effect compared to climate model / hydrological model uncertainty. And there is no literature
497	57461	3	16	19	16	54	It gives an example of climate projection only from Had GCM. It should explain other GCMs data or models, from other institutions. (So Kazama, Tohoku University)	Text and caption rephrased
498	71805	3	16	26	16	26	Vis a vis the text "using the same seven climate model patterns", authors should specify which seven climate model patterns. This portion needs to be redraftedfor greater clarity. (UNITED STATES OF AMERICA)	Text and caption rephrased. The actual models used are not particularly relevant
499	60624	3	16	28	16	28	The acronym PET is used for the first time without previous explanation of what it represents. (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Incorrect reference
500	77142	3	16	31	16	31	shows (ITALY)	Accepted and revised
501	60625	3	16	33	16	34	Correct the sentence "This uncertainty is several times that (20 to 40%) of observed between these methods over the baseline period (1961-1990)". (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Incorrect reference
502	76580	3	16	40	16	40	and also page 73: which line refers to 2°C and which one to 4°C? (Claudio Cassardo, University of Torino)	Caption and text rephrased
503	60824	3	16	44	16	45	Insert reference Falloon & Betts (2006) - this is already in the chapter reference list. (Peter Falloon, Met Office Hadley Centre)	Done.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
504	60825	3	16	46	16	46	Insert reference Davie et al. (2013) which used CMIP5 models - this is already in the chapter reference list (Peter Falloon, Met Office Hadley Centre)	Not relevant here
505	57853	3	16	47	16	48	Normalized spatial patterns of precipitationminus evaporation by global mean surface air temperatures between two RCPs may be relevant to this part. The results in the following article support this sentences. Ishizaki, Y., T. Yokohata, S. Emori, H. Shiogama, K. Takahashi, T. Nozawa, T. Nakaegawa, N. Hanasaki, T. Ogura and M. Yoshimori 2013: Validation of a pattern scaling approach for determining the maximum available renewable freshwater resource. Journal of hydrometeorology. In second review. (Toshiyuki Nakaegawa, Meteorological Research Institute)	Not included: paper has not appeared
506	76581	3	16	47	16	54	as I have told previously, the analysis of regional trends could reveal more interesting and bigger patterns (Claudio Cassardo, University of Torino)	Do not understand comment: misplaced?
507	57124	3	16	49	16	54	add Three more references to highlight uncertainty projections for China, some changes for this part are as follows, “However, there are some regions……change, specifically China (highlight), south Asia and……., with uncertainty in projected changes in precipitation (not rainfall) across some catchments in China, south Asia being particularly significant. Changes in average annual runoff are typically between 1 and 3 times as large as changes in average annual precipitation with higher responses occurring in arid regions and lower responses occurring in humid areas (Tang and Lettenmaier, 2012; Wang et al, 2012; Zhang et al, 2013; Wang et al, 2013) ” References (1) Wang, G. Q. Zhang, J.Y. Jin, J.L. et al., 2012: Assessing water resources in China using PRECIS and VIC model, Journal of Hydrology and Earth System,2012, 16: 231–240 (2) Zhang, J.Y.Zhang. Wang, G.Q. Pagano, T. C. et al., 2013: Using hydrologic simulation to explore the impacts of climate change on runoff in the Huaihe River basin of China. Journal of Hydrologic Engineering, 2012, doi:10.1061/(ASCE)HE.1943-5584.0000581. (accepted, will be published in 2013) （3） Wang, G.Q. Zhang, J.Y. Xuan, Y.Q. et al., 2013: Simulating the impact of climate change on runoff in a typical river catchment of the Loess Plateau, China. Journal of Hydrometeorology, 2013. DOI: 10.1175 / JHM- D-12-081.1 (Accepted and will be published in 2013) (Guoqing Wang, Nanjing Hydraulic Research Institute)	Some of the references added
508	80365	3	16	52	16	52	Please refer to AR5 WGI Ch12 (Gian-Kasper Plattner, IPCC WGI TSU)	Done.
509	60956	3	16	52	16	54	Could add a brief explanation of why runoff changes are much larger than precip changes (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Space does not allow this
510	77042	3	16	53	16	53	"...between 1 and 3 times as large..." A brief explanation seems in order here. (Sean Fleming, Meteorological Service of Canada)	Sentence rephrased
511	76582	3	17	2	17	12	again, I think that it could be interesting also to show some figures related to seasons (Claudio Cassardo, University of Torino)	No evidence in literature
512	81665	3	17	3	17	3	It might be helpful to clarify if "annual discharge" is the same as runoff. (Katharine Mach, IPCC WGII TSU)	See definitions earlier
513	85032	3	17	9	17	10	As mentioned in the context of the executive summary, the ES says "very cold regions." Please clarify whether this is equivalent to the description here. (Michael Mastrandrea, IPCC WGII TSU)	ES changed
514	77043	3	17	12	17	12	It could be mentioned here that projected fundamental changes in the hybrid flow regimes of the Pacific coast of Canada provide a particularly clear example of these effects. Some references include: (i) Whitfield PH and others (2002), Modelling streamflow in present and future climates: examples from the Georgia Basin, British Columbia. Canadian Water Resources Journal 27, 427–456; and (ii) Schnorbus MA and other (2011), Hydrologic Impacts of Climate Change in the Peace, Campbell and Columbia Watersheds, British Columbia, Canada. Pacific Climate Impacts Consortium, University of Victoria, Victoria, BC, 157 pp. (Sean Fleming, Meteorological Service of Canada)	These additional references are not necessary: also, first is too old and second is 'grey' and does not add additional information
515	62945	3	17	15	0	0	There are other works such as those of Ducharne et al (2009), on the groundwater in the Seine and the Somme basins in NW France. (Benoit Laignel, University of Rouen)	Not included due to space constraints.
516	59841	3	17	19	17	23	Suggest a review be undertaken of the references to research conducted by Crosbie et al in 2010 and 2012. The 2010 paper examined groundwater systems nationally, the 2012 paper focussed on the Murray Darling Basin. (AUSTRALIA)	Reference Crosbie et al. 2013a and b was included in the first paragraph, and also Crosbie et al 2013a in Table 3-2.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
517	71806	3	17	24	17	27	The range of projected (simulated) changes in groundwater recharge is largely due to "uncertainty in climate models" and due to natural variability of soils and vegetation. This has been shown for using a single GCM (CSIRO9) with a "double-CO2" scenario and a biophysically based model (Green, T.R., B.C. Bates, S.P. Charles and P.M. Fleming. 2007. Physically based simulation of potential effects of carbon dioxide altered climates on groundwater recharge, Vadose Zone J. 6:597-609). Different soil-vegetation combinations producted dramatically different changes in groundwater recharge, which also differed between to climate zones (spatially). Crosbie et al. (2012) subsequently simulated the spatial variability across Australia using the same approach, but with an ensemble of GCMs to estimate probabilities. Thus the statement on these lines is correct, but should not imply that uncertainty of GCM results is the only or main driver. Recharge is very sensitive to soils, vegetation and land management. (UNITED STATES OF AMERICA)	The statement does not imply that uncertainty of GCM results is the only or main driver. Two sentences have been added to clarify this.
518	71807	3	17	29	17	31	When considering a particular climate scenario, land areas where total runoff are projected to increase (or decrease) roughly coincide with the areas where groundwater recharge and thus renewable groundwater resources are projected to increase (or decrease) (Kundzewicz and Doll, 2009). Split into two sentences : "When considering a particular climate scenario, land areas where total runoff are projected to increase roughly coincide with the areas where groundwater recharge and thus renewable groundwater resources are projected to increase (Kundzewicz and Doll, 2009). Likewise, for land areas where total runoff are projected to decrease, renewable groundwater resources are projected to decrease." (UNITED STATES OF AMERICA)	Advise not followed due to length constraints.
519	76966	3	17	32	17	33	The statement, "Increased precipitation intensity, for example, may decrease groundwater recharge due to an exceedance of infiltration capacity (typically in humid areas)…", is a speculative theoretical argument. There are very few observations not only of sub-daily precipitation intensities but also soil infiltration capacities. Evidence from tropical soils in humid areas of Uganda shows, in contrast, that groundwater recharge results preferentially from heavy (>10mm/day) rainfalls (Owor et al. 2009. Environ. Res. Lett. Vol. 4, 035009). The role of macropores in enabling rain-fed recharge to largely bypass the soil matrix in both humid and semi-arid environments (as subsequently indicated on lines 33 and 34) has not been sufficiently considered (Beven and Germann, 2013. Water Resour. Res. DOI: 10.1002/wrcr.20156), particularly by the modelling community. (Richard Taylor, UC London)	It is appropriate to state that increasing precipitation intensity could have both increasing and decreasing effect as it is not proven that there could be no limitation of recharge due to the infiltration capacity under a relevant part of recharge situations.
520	71808	3	17	37	17	38	In addition to noting that the "vegetation adapts", a more explicit statement is needed regarding the importance of existing vegetation responses to atmospheric CO2 in terms of carbon assimilation rates and stomatal conductance, which increases water use efficiency and may increase biomass with increasing CO2. (UNITED STATES OF AMERICA)	Agree, revised.
521	60957	3	17	43	17	43	Should this read 'reduced groundwater recharge' instead of 'increased groundwater abstractions'? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	No.
522	81666	3	17	49	17	49	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
523	71809	3	17	49	17	50	An additional reference (Loaiciga et al., 2011, Ground Water; 50(1),37) describes a analysis of potential impacts of sea level rise to groundwater in a California coastal urban aquifer. (UNITED STATES OF AMERICA)	Reference added.
524	66087	3	17	50	17	54	The sentence started from "Assuming……..to (Webb and Howard, 2011) on line 54" is an important impact on fresh water resources, in particular due to sea level rise. Hence, required a little bit more explanation for the sake of clarity as it is a bit difficult to understand at a glance. (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Revised.
525	77044	3	17	53	17	53	"...saltwater intrusion is a very slow process that may take centuries..." Strongly suggest refining the phrasing here. Saltwater intrusion can in fact happen very quickly under groundwater extraction (pumping), a common problem in coastal areas, and especially in island locations. (Sean Fleming, Meteorological Service of Canada)	Specified as "salt-water intrusion due to sea-level rise".
526	71810	3	18	2	18	3	Regarding groundwater studies in atolls, suggest citing: White, I., Falkland, T., Metutera, T., Metai, E., Overmars, M., Perez, P., and Dray, A. (2007). "Climatic and Human Influences on Groundwater in Low Atolls." Vadose Zone J, 6(3), 581-590. (UNITED STATES OF AMERICA)	Not specific to see level rise problem.
527	71811	3	18	9	18	15	Taylor et al. (Nature Climate Change, 3(4): 322-329, 2013. DOI:10.1038/NCLIMATE1744) cited studies (Table 1) attributing a significant portion of historical sea level rise to groundwater abstraction. This could be included in this paragraph. (UNITED STATES OF AMERICA)	This section is about projected hydrological changes as related to clmate change.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
528	71812	3	18	9	18	15	This paragraph could be split in two; one to address issues of groundwater-streamflow interactions, and the other to address the growing recognition of groundwater interactions with the climate. The former is a well-known process and could also be generalized to include impacts on surface water springs, which are also dependent on groundwater elevations and their intersection with the ground surface. The latter (as also summarized in Taylor et al. 2013) can be broadened to include soil moisture and irrigation topics (e.g., Lobell et al., 2008, J. Climate, 22, 2248) and the treatment of groundwater in land surface models. Indeed, it seems there is an increasing interest in using integrated hydrologic (and climate) models (e.g, Maxwell et al., 2007; Adv Wat. Resourc., 12, 2447;) to examine more carefully climate change issues in the "critical zone" between the Planetary Boundary Layer (PBL) and the water table. (UNITED STATES OF AMERICA)	Paragraph was not split, in particular because it was further condensed.
529	76583	3	18	15	18	15	"7 m below ground": in this case, the ET is almost null and has no effects? Also in case of heavy rainfall? (Claudio Cassardo, University of Torino)	reformulated.
530	62946	3	18	18	0	0	There are other works such as those of Ducharne (2008) and Ducharne et al (2009) on the quality of waters of the Seine. (Benoit Laignel, University of Rouen)	Ducharne 2008 already on text and text redundant with Ducharne 2009.
531	59842	3	18	18	18	39	Section 3.4.7 - A number of potential effects of climate change on water quality are discussed. One omission is that of the effects of wildfire on water quality. Many cities around the world rely on good quality water from forested catchments that requires very little treatment. The increased risk of wildfire frequency and severity in these areas could have severe consequences on the quality of water derived from these catchments. Hugh G. Smith , Gary J. Sheridan, Patrick N.J. Lane , Petter Nyman, Shane Haydon 2011. Wildfire effects on water quality in forest catchments: A review with implications for water supply. Journal of Hydrology 396: 170–192 (AUSTRALIA)	Accepted but for section 3.5.2.3 (Water supply/municipalities), as the paper is oriented to vulnerabilities rather than assessing impacts attributed to climate change.
532	71813	3	18	18	18	39	Section co-minlges climate and water quality with projections of climate and water quality in a hard to follow mode. Most projections are useful in affirming that observed impacts will be likely to prevail in the future. The authors need to clarify if the observed impacts are 'climate impacts' or 'climate change impacts' (UNITED STATES OF AMERICA)	Text ammended as shorter as possible as this section has to not exceed 0.25 page.
533	76584	3	18	27	18	28	change "and this is available where the" with "and, where this is available, the" (Claudio Cassardo, University of Torino)	Accepted.
534	59844	3	18	42	18	42	This section could recognise the impact of changed fire regimes on soil erosion, sediment load and water quality. Chapter 25, page 24, lines 43-45 recognise this connection for Australia and provide references. (AUSTRALIA)	The sentece was corrected
535	65468	3	18	42	18	42	Do you have any information on the consequences of sedimentation on water storage capacity and risks to water supply? (Stuart Bunn, Griffith University)	This aspect of resevoir sedimention is not addressed in this AR5
536	59843	3	18	42	19	25	Section 3.4.8 - Soil Erosion and sediment loads are discussed as a function of changes in precipitation erosivity. Little mention is given the role of vegetation in erosion control, and therefore the risk of increased erosion after changes in vegetation structure. For example, high-magnitude erosion events after wildfire have been documented in south-eastern Australia. Petter Nyman, Gary J. Sheridan, Hugh G. Smith, Patrick N.J. Lane, 2011. Evidence of debris flow occurrence after wildfire in upland catchments of south-east Australia. Geomorphology 125: 383–401 (AUSTRALIA)	This section is on projected soil erosion in relation to climate changes. This mention was already done in 3.2.6 and it cannot repeat here.
537	80366	3	18	42	19	25	Section 3.4.8: Please add references to the corresponding and most up to date WGI assessment, e.g., p18l44 regarding heavy rainfall events. (Gian-Kasper Plattner, IPCC WGI TSU)	It was added a reference to WGI, chapter 11
538	71814	3	18	45	18	45	Authors should change "total rainfall contribution" to " total rainfall contribution in many regions." (UNITED STATES OF AMERICA)	It has been changed as suggested.
539	81667	3	18	45	18	47	As appropriate, it would be helpful to specify the relevant scenarios of climate change for this projection. (Katharine Mach, IPCC WGII TSU)	Scenario was added
540	81668	3	18	49	18	49	Instead of "up to," the full range, including the lower bound, should be specified for this expected outcome. (Katharine Mach, IPCC WGII TSU)	up to was deleted.
541	81669	3	18	51	18	51	Instead of "up to," the full range, including the lower bound, should be specified for this expected outcome. (Katharine Mach, IPCC WGII TSU)	up to was deleted.
542	71815	3	18	54	18	54	Authors should replace 'giving rise to a decline' with 'and thus a decline." (UNITED STATES OF AMERICA)	Changed
543	61007	3	19	1	0	0	Chapter 3 on Freshwater has a structural problem. Chapt. 3.2 is about observed hydrological impacts of climate change and chapt. 3.4 on projected hydrological changes. In chapt. 3.4.9 (i.e. a sub-chapter dealing with projections) there are several statements dealing with the past. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Please, be more specific indicating where it was detected

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
544	71068	3	19	2	0	0	This sentence seems incorrect. GCMs do not "project" soil erosion. Suggest clarifying regarding scenarios used, etc. (CANADA)	GCM and scenarios were specified
545	77143	3	19	3	19	3	5-195%: is this the right range? is it meaningful for the report? (ITALY)	Yes.
546	81670	3	19	6	19	6	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	It is a very general statement
547	81671	3	19	7	19	8	For this projection, it could be helpful to specify the relevant baseline and scenarios of climate change. (Katharine Mach, IPCC WGII TSU)	Scenario was added
548	59845	3	19	9	19	9	It is unclear if 'Projected rivers sediment flux' refers to Danish projected rivers in previous sentence or projected sediment flux in rivers more broadly. (AUSTRALIA)	It is a general statement
549	81672	3	19	10	19	14	It would be helpful to specify the relevant scenarios of climate change or temperature increase for these projections. (Katharine Mach, IPCC WGII TSU)	annual temperature may be 0.2 to 1.4 °C in the 2030s and 0.6 to 3.8 °C for 2080s
550	77045	3	19	17	19	17	Suggest adding another citation to Lu et al (2010) - Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrologic Processes 23: 42–61. (Sean Fleming, Meteorological Service of Canada)	The Li reference is enough for ilustration of the topoc
551	81673	3	19	18	19	18	Going beyond the provided 26%, it would be preferable to specify the range for this projected outcome. (Katharine Mach, IPCC WGII TSU)	No understand this question
552	81674	3	19	18	19	19	For this statement, the relevant findings of working group 1 could be cross-referenced. (Katharine Mach, IPCC WGII TSU)	It was cited before
553	81675	3	19	21	19	21	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Difficult to be more precise
554	56446	3	19	23	0	0	Should it be "The or These" instead of "There" impacts of climate change…. In the sentence. (Archis Ambulkar, Brinjac Engineering Inc.)	Thanks. Changed
555	76585	3	19	23	19	23	change "There" with "These" (Claudio Cassardo, University of Torino)	Thanks. Changed
556	76586	3	19	24	19	24	change "is" with "are" and "one" with "ones" (Claudio Cassardo, University of Torino)	Thanks. Changed
557	81676	3	19	28	0	0	Section 3.4.9. The chapter team should make sure that this section clearly and directly supports the corresponding key findings within the executive summary (for example, paragraph 2 within the executive summary?). (Katharine Mach, IPCC WGII TSU)	The new ES reflect the outcome from this section
558	80367	3	19	28	20	26	Section 3.4.9: Please include references to the corresponding WGI assessment, WGI TSU FOD comment: "Extreme Hydrological Events (Floods, Drought) – includes an assessment of regional and global scale droughts and floods. Relevant WGI AR5 Chapters need to be referred to as the primary basis here. (Gian-Kasper Plattner, IPCC WGI TSU)	Reference is made to chapter 11
559	70701	3	19	30	19	31	The text states that leaf area is modelled to decrease in a warmer climate in Australia. This is inconsistent with the observed pattern of woody thickening throughout Australia and across semi-arid regions of the globe. See Macinnis-Ng, C., Zeppel, M., Williams, M., Eamus, D. (2011) Applying a SPA model to examine the impact of climate change on GPP of open woodlands and the potential for woody thickening. Ecohydrology, 4: 379-393 and references cited there-in. We postulate that extra soil moisture remaining in the soil due to water savings associated stomatal responses to rising CO2 stimulate additional plant growth, indicating the the role of climate change in driving woody thickening (increasing density of strubs and trees in the landscape). Whatever the cause of woody thickening, it causes an increase (not decrease) in leaf area across the landscape as grasslands are converted to woodlands. What type of model is predicting leaf area will decrease in a warmer climate? It is not consistent with analysis of areal photos and other approaches. For instance, see Fensham, RJ, Fairfax, RJ and Archer, R 2005, 'Rainfall, land use and woody vegetation cover in semi-arid Australian savannah', Journal of Ecology, vol. 95, pp 596-606. I argue that leaf area is not decreasing across the landscape and I therefore question whether groundwater recharge will increase (especially if rainfall is decreasing). See chapter 4 page 39 lines 5-13 (Cate Macinnis-Ng, University of Auckland)	Something wrong with this comment. It is out of place and it may refer to other section

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
560	58680	3	19	30	20	4	Here, Figure 3-8 by Dankers et al. (2013) is used to show future flood hazard changes, while both Dankers et al. (2013) and Hirabayashi et al. (2013) are cited in text. However, the figures provided in Hirabayashi et al. (2013) are more comprehensive and informative than that of Dankers et al. (2013) in terms of three aspects. Those three aspects are 1) inclusion of all multiple RCP scenarios rather than RCP8.5 only, 2) larger number of models (11 GCMs including all models from independent institutes providing runoff data, rather than 5 GCMs), 3) evaluation of uncertainty in change by counting model agreement in showing the same direction (increase or decrease of flood) of change, and a new bootstrap-based analysis, and 4) application of a recent state-of-the-art global river model with inundation scheme to estimate river discharge and inundation area, rather than using a relatively simple river routing model. An advantage of Dankers et al. (2013) is the use of runoff simulation of nine global hydrology and land surface models forced by climate projections by GCMs with bias correction. Even though, their calculated river flow is less biased than the calculation of Hirabayashi et al. (2013), who used runoff simulation by GCMs directly, future change of disastrous flood hazard having return period of 30-year or 100-year could be captured even in the runoff estimation in GCMs. The calculation using different global hydrology and land surface models can be a source of additional uncertainty, as shown by numerous model Intercomparison projects until now, while the estimation of Hirabayashi et al. (2013) is only influenced by model spread among GCMs. Dankers et al. (2013) showed changes in discharge having return period 30-year, while Hirabayashi et al. (2013) showed the result of flood corresponding to 100-year return period. As shown in Figure S8 of Hirabayashi et al. (2013), global distribution of future changes in 10-, 30- and 100-year flood are similar. Figures of future projection of 30-year flood with uncertainty range for 11 GCMs and 4 RCP scenarios are ready to be provided, if required. Hence, I suggest the authors to consider including figures and analysis by Hirabayashi et al. (2013) in Figure 3-8, not because I am an author of that paper, but figures by Hirabayashi et al. (2013), in general, are scientifically more comprehensive and relevant than the current one used in this paragraph. (Yukiko Hirabayashi, The University of Tokyo)	Hirabayashi is now used in the chapter
561	66040	3	19	31	19	31	Low confidence in projections of changes of fluvial floods. (Maria-Carmen Llasat, University of Barcelona)	That was the result of the SREX REPORT, not here
562	76587	3	19	35	19	35	change "couple" with "coupled" (Claudio Cassardo, University of Torino)	changed
563	76872	3	19	37	19	37	"… with a great variability *even* at the scale…" Better: but with great variability at the scale of individual river basins. At the global scale, the increase is more robust. (Rutger Dankers, Met Office Hadley Centre)	Thanks. Changed
564	76588	3	19	39	19	39	"East Africa, Central and Western Africa": why you do not say simply Africa? Also page 33 line 20 (Claudio Cassardo, University of Torino)	No, because the results are referred to tropical and humid subtropical regions. On the rest, Sahara, northern Africa and Southern Africa uncertatines are sso large that there were no modelled
565	85033	3	19	43	19	44	Please clarify whether this statement is the basis for the agreement/evidence presented in the executive summary. (Michael Mastrandrea, IPCC WGII TSU)	Yes, this is included in the ES
566	76873	3	19	45	19	46	Not just among GCMs, but also among impact models (hydrological and land surface models). This means that impact models contribute to the uncertainty in the projections. A consequence of this is that studies relying on a single impact model may underestimate uncertainty, even if they are applied to single river basins. Reference: Dankers et al., 2013. (Rutger Dankers, Met Office Hadley Centre)	Thanks. This idea was added
567	76874	3	20	6	20	7	Kay & Jones (2012) is not "catchment or river basin scale", but country scale. Similarly, Rojas et al. (2012) is at continental scale. (Rutger Dankers, Met Office Hadley Centre)	Changed
568	60958	3	20	6	20	9	Include a brief summary of the results from the catchment-scale studies. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Detail proyections should be given in the regional chapters.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
569	67848	3	20	8	20	9	Several projections in developing countries were recently published, and these publications listed below should be cited here: * Mekong River in Vietnam: Kwak, Y., K. Takeuchi, K. Fukami, and J. Magome 2012: A new approach to flood risk assessment in Asia-Pacific region based on MRI-AGCM outputs. Hydrological Research Letters 6, 70-75.doi: 10.3178/HRL.6.70 * Chao Phraya River in Thailand: Kure, S., and T. Tebakari 2012: Hydrological impact of regional climate change in the Chao Phraya River Basin, Thailand. Hydrological Research Letters 6, 53-58. DOI: 10.3178/HRL.6.53 * Tana River in Kenya: T. Nakaegawa, C. Wachana, and KAKUSHIN Team-3 Modeling Group. First impact assessment of hydrological cycle in the Tana River basin, Kenya, under a changing climate in the late 21st Century. Hydrological Research Letters., Vol. 6, pp.29-34, (2012) . * Chao Phraya River in Thailand. Champathong, A. D. Komori, M. Kiguchi, T. Sukkhapunnapan, T. Nakaegawa, and T. Oki. 2013: Future projection of mean river discharge climatology for the Chao Phraya River basin. Hydrological Research Letters. Vol.7, in press. * Panama: J. Fabrega, T. Nakaegawa, R. Pinzon, K. Nakayama, O. Arakawa, SOUSEI Theme-C modeling group. 2013: Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters. Vol.7., in press. * Tigris River: Akio Kitoh, Akiyo Yatagai and Pinhas Alpert: "First super-high-resolution model projection that the ancient "Fertile Crescent" will disappear in this century", Hydrological Research Letters, Vol. 2, pp.1-4, (2008) . (JAPAN)	Detail proyections should be given in the regional chapters.
570	57854	3	20	9	0	0	Several projections in developing countries are recently published and may be cited here: * Mekong River in Vietnamn: Kwak, Y., K. Takeuchi, K. Fukami, and J. Magome 2012: A new approach to flood risk assessment in Asia-Pacific region based on MRI-AGCM outputs. Hydrological Research Letters 6, 70–75.doi: 10.3178/HRL.6.70 * Chao Phraya River in Thailand: Kure, S., and T. Tebakari 2012: Hydrological impact of regional climate change in the Chao Phraya RiverBasin, Thailand. Hydrological Research Letters 6, 53–58. DOI: 10.3178/HRL.6.53 * Tana River in Kenya: T. Nakaegawa, C. Wachana, and KAKUSHIN Team-3 Modeling Group. First impact assessment of hydrological cycle in the Tana River basin, Kenya, under a changing climate in the late 21st Century. Hydrological Research Letters., Vol. 6, pp.29-34, (2012) . * Chao Phraya River in Thailand. Champathong, A. D. Komori, M. Kiguchi, T. Sukkhapunnapan, T. Nakaegawa, and T. Oki. 2013: Future projection of mean river discharge climatology forthe Chao Phraya River basin. Hydrological Research Letters. Vol.7, in press. * Panama: J. Fábrega, T. Nakaegawa, R. Pinzón, K. Nakayama, O. Arakawa, SOUSEI Theme-C modeling group. 2013: Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters. Vo.7., in press. * Tigris River: Akio Kitoh, Akiyo Yatagai and Pinhas Alpert: “First super-high-resolution model projection that the ancient “Fertile Crescent” will disappear in this century”, Hydrological Research Letters, Vol. 2, pp.1-4, (2008) . (Toshiyuki Nakaegawa, Meteorological Research Institute)	Detailed projections should be given in the regional chapters.
571	68186	3	20	9	20	9	Include Fábrega et al., 2013 as a cite after Khazaei et al., 2012. The corresponding reference is: J. Fábrega, T. Nakaegawa, R. Pinzón, K. Nakayama, O. Arakawa, SOUSEI Theme-C modeling group. 2013: Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters Vol. 7, in press. (José Fábrega, Universidad Tecnológica de Panamá)	That work do not address flood projections, just rainfall. It should be cited in chapter 11 WGI
572	60959	3	20	11	20	13	Southern and central Europe may experience longer and more frequent droughts. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The drought section was re-written
573	81677	3	20	11	20	19	For these statements, the chapter team should consider cross-referencing relevant findings in the working group 1 contribution to the 5th assessment report as well. (Katharine Mach, IPCC WGII TSU)	The drought section was re-written
574	60826	3	20	11	20	26	Taylor et al. 2012 provides a new reference on global drought assessment using different metrics, and a large ensemble, and also looks at the impact of mitigation. The paper is now accepted in HESS and the latest version includes a runoff based index. I. H. Taylor, E. Burke, L. McColl, P. Falloon, G. R. Harris, and D. McNeall, 2012.Contributions to uncertainty in projections of future drought under climate change scenarios. Hydrology and Earth System Sciences Discussions, 9, 12613?12653, doi:10.5194/hessd-9-12613-2012. (Peter Falloon, Met Office Hadley Centre)	The drought section was re-written
575	62013	3	20	11	20	26	The paragraphs on drought are very poorly populated with references. There should be some more detailed information on the definitional issues (se e.g., Vidal et al., 2010), but also much more informed regional projection results (see, e.g., Vidal and Wade., 2009, Vidal et al., 2012). - Vidal, J.-P.and Wade, S. D. (2009) A multimodel assessment of future climatological droughts in the United Kingdom. International Journal of Climatology, 29(14), 2056-2071. doi: 10.1002/joc.1843 - Vidal, J.-P., Martin, E., Franchistéguy, L., Habets, F., Soubeyroux, J.-M., Blanchard, M., and Baillon, M. (2010) Multilevel and multiscale drought reanalysis over France with the Safran-Isba-Modcou hydrometeorological suite. Hydrology and Earth System Sciences, 14(3), 459-478. doi: 10.5194/hess-14-459-2010 - Vidal, J.-P., Martin, E., Kitova, N., Najac, J., and Soubeyroux, J.-M. (2012) Evolution of spatio-temporal drought characteristics: validation, projections and effect of adaptation scenarios. Hydrology and Earth System Sciences, 16(8), 2935-2955. doi: 10.5194/hess-16-2935-2012 (Jean-Philippe Vidal, Irstea)	The drought section was re-written

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
576	76875	3	20	11	20	26	A key reference on droughts based on the ISI-MIP project (hence using the CMIP5 simulations) is Prudhomme et al. (submitted to PNAS); you may wish to contact the lead author Christel Prudhomme (chrp@ceh.ac.uk). One of their findings is that impact model formulation is a key uncertainty in drought projections. Models that do not include the effect of changes in vegetation under higher CO2 concentrations (like most hydrological models) give different results compared to those models that do (mostly land surface and ecosystem models). See also Davie et al. 2013 (already referenced). (Rutger Dankers, Met Office Hadley Centre)	The drought section was re-written
577	62947	3	20	29	0	0	This part is particularly clear, interesting and relatively complete. (Benoit Laignel, University of Rouen)	Thank you.
578	59846	3	20	31	21	32	Section 3.5.1 - No mention is made of water resources derived from forested areas, and the potential of indirect effects of climate change on vegetation and how the quantity and quality of water resources can be compromised. (AUSTRALIA)	Not relevant here - we mention other drivers earlier in the chapter
579	80111	3	20	31	21	32	According to the diagnosis made by the World Bank about water resources management in Chile, the availability of water in the country is much higher than the world average value and the threshold considered for sustainable development, but this availability is distributed in a very uneven way throughout the country. Considering this reality and adding the projections of climate change impacts on water resources, the proposed solutions and adaptation measures should consider aspects of distribution and sustainable resource use (CHILE)	Comment, rather than a suggestion
580	79382	3	20	33	20	37	This does not include the middle east, which is very odd given it is a region under major threat of water insecurity (see HDR 2006) (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Sentence rephrased
581	80590	3	20	35	20	35	"eastern and northeastern China", "northeastern" is advised to be removed (chaozong xia, academy of forest inventory and planning)	Sentence rephrased
582	65827	3	20	44	20	44	The resent studies for the water-stress based on water withdrawal-to-availability ratio should be added. For example, Hanasaki et al. (2012) and Hayashi et al. (2013). N. Hanasaki, S. Fujimori, T. Yamamoto, S. Yoshikawa, Y. Masaki, Y. Hijioka,M. Kainuma, Y. Kanamori, T. Masui, K. Takahashi, and S. Kanae (2012) A global water scarcity assessment under shared socio-economic pathways – Part2: Water availability and scarcity, Hydrol. Earth Syst. Sci. Discuss., 9, 13933–13994. A. Hayashi, K. Akimoto, T. Tomoda, M. Kii (2013) Global evaluation of the effects of agriculture and water management adaptations on the water-stressed population, Mitig Adapt Strateg Glob Change, 18:591–618, DOI 10.1007/s11027-012-9377-3. (Ayami HAYASHI, Research Institute of Innovative Technology for the Earth (RITE))	Hanasaki et al (2013) is added
583	59847	3	20	49	20	49	Unclear if the additional 7% per 1 degree applies below 2.7 degrees of warming or above 2.7. Consider replacing 'Up to this temperature rise' with 'After this temperature rise' to make clear. (AUSTRALIA)	Rephrased
584	60960	3	20	54	21	9	"There is a strong degree of consistency in projections… and the specific measure of stress or scarcity used." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	?
585	57855	3	20	54	21	21	Normalized spatial patterns of precipitationminus evaporation by global mean surface air temperatures between two RCPs may be relevant to this part. The results in the following article support this sentences. Ishizaki, Y., T. Yokohata, S. Emori, H. Shiogama, K. Takahashi, T. Nozawa, T. Nakaegawa, N. Hanasaki, T. Ogura and M. Yoshimori 2013: Validation of a pattern scaling approach for determining the maximum available renewable freshwater resource. Journal of hydrometeorology. In second review. (Toshiyuki Nakaegawa, Meteorological Research Institute)	Not relevant here, and paper not yet published
586	79383	3	21	0	0	0	Figure 3.9. I am not sure this warrants inclusion - it is one study and does not necessarily reflect the consensus on the impacts of CC on groundwater and hence impacts on human populations. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Included as there are no other global studies on groundwater recharge and in particular vulnerability (including not only physical components)
587	56855	3	21	0	22	0	General comment - Section 3.5.2.1: This section has focused on irrigation only. A discussion on water use on livestock (including feed and indirectly feed transportation costs) seems necessary. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Now irrigated and rainfed agriculture are being discussed, and livestock is briefly mentioned in the beginning (most results considered here are implicitly about areas for feed production and grazing as well, while there appears to be no study that addresses climate change effects on water use specifically on these areas.
588	71069	3	21	1	0	2	Are there results available for North and South America that could be included in this paragraph? (CANADA)	See regional chapters

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
589	57125	3	21	1	21	2	Add three more reference to highlight great variation in projected availability as follows, "…..but much greater variation in projected availability in South and East Asia, in particularly China (Zhang et al., 2013; Wang et al., 2012; Wang et al, 2013). Second,……". References (1) Wang, G. Q. Zhang, J.Y. Jin, J.L. et al., 2012: Assessing water resources in China using PRECIS and VIC model, Journal of Hydrology and Earth System,2012, 16: 231–240 (2) Zhang, J.Y.Zhang. Wang, G.Q. Pagano, T. C. et al., 2013: Using hydrologic simulation to explore the impacts of climate change on runoff in the Huaihe River basin of China. Journal of Hydrologic Engineering, 2012, doi:10.1061/(ASCE)HE.1943-5584.0000581. (accepted, will be published in 2013) （3） Wang, G.Q. Zhang, J.Y. Xuan, Y.Q. et al., 2013: Simulating the impact of climate change on runoff in a typical river catchment of the Loess Plateau, China. Journal of Hydrometeorology, 2013.DOI: 10.1175 / JHM- D-12-081.1 (Accepted and will be published in 2013) (Guoqing Wang, Nanjing Hydraulic Research Institute)	References not relevant here
590	60965	3	21	1	22	0	This section has focused on irrigation only. A discussion on water use on livestock (including feed and indirectly feed transportation costs) seems necessary. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Incorrect reference
591	58648	3	21	3	21	7	I don't think the sentence of "climate change would, however, regionally exacerbate or offset population pressures" has a close and logical nexus with the main contents in the literature cited (Fung et al., 2011） , the meaning is not expressed clearly. Therefore, I suggest delete "Third, over the next few decades and for increases in global mean temperature of less than around 2℃ above pre-industrial, changes in population will generally have a greater effect on changes in resources availability, relative to the present day, than climate change (Fung et al., 2011).Climate change would, however, regionally exacerbate or offset population pressures"。 Otherwise, it is necessary to revise this point so as to have a much clear expression. (chunfeng wang, State Forestry Administration, China)	Section rephrased
592	77046	3	21	5	21	6	Passage is mis-phrased, as changes in population are not separate from climate change - in fact, population growth is a key driver of climate change. This is explicitly recognized in the SRES scenarios, for instance. For some additional relevant thoughts on the subject, consult Murtaugh PA, Schlax MG. (2009), Reproduction and the carbon legacies of individuals, Global Environmental Change, 19:14-20. (Sean Fleming, Meteorological Service of Canada)	Section rephrased, but reference not added as it is not relevant
593	60961	3	21	6	21	7	The statement needs a confidence qualifier and further explanation (for which regions and when). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Space does not allow this
594	60827	3	21	9	21	9	A key aspect of uncertainty here is the impact of elevated CO2 on transpiration and hence runoff - comment should be made on this here, with a link to box CC-VW (Peter Falloon, Met Office Hadley Centre)	Reference is made to box elsewhere; not specifically relevant here
595	85119	3	21	11	21	17	Exposure and vulnerability are now considered separately in the context of AR5 (see AR5 WGII Glossary). As characterized in Chapter 19 and the draft SPM and TS, both interact with physical changes to determine risks. The results presented in Figure 3-9 combine elements of exposure and vulnerability as defined in the AR5 WGII Glossary, and more nearly are an indication of future risks under different scenarios. Please consider the terminology here and its consistency with the glossary. (Michael Mastrandrea, IPCC WGII TSU)	The index shown in Figure 3-9 is consistent with the Glossary entry "Vulnerability index: A metric characterizing the vulnerability of a system to a change in climate. A vulnerability index is typically derived by combining, with or without weighting, several indicators assumed to represent hazards or physical impacts, exposure, sensitivity, resilience, or adaptive capacity".
596	57462	3	21	12	21	16	Especially mountainous areas with small catchment and with dry season make more severe water resources rising water conflicts. (Ekkawatpanita et al., Assessment of water conflict in Mae Chaem River Basin, Northern Thailand, Water International, Vol.34, No.2, pp. 242-263, 2009). (So Kazama, Tohoku University)	accepted
597	81678	3	21	19	21	19	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
598	60962	3	21	19	21	25	"Under climate change, reliable surface water supply is… and thus renewable groundwater resources (Kundzewicz and Doll, 2009)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Comment not clear.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
599	71816	3	21	19	21	32	The concept and application of "conjunctive use," managing groundwater and surface water supplies together, is increasingly used to add reliability to water supply systems (in California, see, for example, "Groundwater and Surface Water in Southern California: A Guide to Conjunctive Use", published by Association of Groundwater Agencies, 2000, www.agwa.gov, or Pulido-Velazquez et al., 2004, Water Resource. Res., 40(3), DOI: 10.1029/2003WR002626; Hanson et al., 2012, Water Resource. Res., W00L08, doi:10.1029/2011WR010774). Although often developed to augment existing supplies, reduce uncertainty in imported supplies, or bank water in aquifers for droughts, their utility may be equally, if not more relevant for climate change adaptation purposes. The Orange County Water district, for example, has developed and maintained a significant groundwater recharge effort (http://www.ocwd.com/ProgramsProjects/GroundwaterRecharge.aspx) which is augmented by additional recycled water from an advanced waste water treatment plant (http://gwrsystem.com/about-gwrs.html). (UNITED STATES OF AMERICA)	Conjunctive use is covered in section 3.6.1.
600	79384	3	21	22	21	23	The statement 'However, this option is only sustainable where groundwater withdrawals remain well below groundwater recharge' is not justified. Why only if withdrawal remains below recharge and not simply just below? What is the authors definition of 'well below'? This needs to be provided. On what timescales do the believe this balance should happen over ? This needs to be defined. My view is that given greater fluctuations in surface water flow, there may be a case to be made that groundwater withdrawals that exceed recharge on annual basis or even multi-year basis may be justified provided over longer time periods (e.g. decadal) withdrawals do not exceed recharge. This statement needs either to be deleted, nuanced and if kept much better evidenced as currently it is not helpful nor accurate. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Statement was nuanced regarding time period.
601	81679	3	21	22	21	23	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. Also, please note that the relevant likelihood term may be "unlikely," as "not likely" is not a designated likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
602	59848	3	21	26	21	26	Please spell out the acronym GWR (AUSTRALIA)	Revised.
603	77047	3	21	26	21	26	GWR = ground water resources...? I don't see this acronym explicitly defined. Further, I suggest avoiding three-letter acronyms whenever possible. (Sean Fleming, Meteorological Service of Canada)	Revised.
604	56447	3	21	31	0	0	Terms "cprojected" and "1% to s a" need to be revised in the sentence. (Archis Ambulkar, Brinjac Engineering Inc.)	Revised.
605	59849	3	21	31	21	31	Words missing at the end of line 31. Possibly should read 'is projected to suffer a'. (AUSTRALIA)	Revised.
606	77048	3	21	32	21	32	Suggest adding something to the effect of, "Further, many aquifers worldwide contain so-called fossil water, and virtually any extraction is in excess of recharge rates, constituting groundwater mining; the Ogallala Aquifer of the midwestern US is a well-known example." (Sean Fleming, Meteorological Service of Canada)	Not added, as it does not relate to an impact of clmate change.
607	80112	3	21	35	21	54	According to the diagnosis on the management of water resources in Chile, made by the World Bank, irrigated agriculture represents a 73% of water use in the country, so it is vital that adaptive processes aimed at a more efficient use , which can be promoted through bonus systems to technification irrigation systems. The modernization can pass from an efficiency rate of 30% (gravity irrigated) at rates close to 90% (drip irrigation). In Chile, Law No. 18,450 for the Promotion of Private Investment in Irrigation, promotes the construction of irrigation projects in order to increase the irrigated area and encourage more efficient use of water resource (CHILE)	This is a about water management in Chile, too specific to be included here, and not about climate change. The general options (increasing irrigated and rainfed water productivity) are mentioned though.
608	71817	3	21	35	22	30	An agricultural systems model, including CO2 effects on crops, simulated decreased wheat grain yield with increased transpiration under projected climate change, and adaptation in planting dates did not mitigate yield declines (Ko, J., L.R. Ahuja, S.A. Anapalli, T.R. Green, L. Ma, D.C. Nielsen and C.L. Walthall. Climate change impacts on dryland cropping systems in the Central Great Plains, USA. Climatic Change. 111(2):445-472. 2012). This study may be worth citing as an example for non-irrigated agriculture. (UNITED STATES OF AMERICA)	Not cited, as study is too specific and more on adaptation.
609	63494	3	21	37	21	47	Irrigation water requirement is decreasing by the 2080s ? What is the reason for this and what is the probability for this estimation? This is in contrast to the expected increase in Sothern Europe, China, USA and Russia. Should it be an "increase" instead of decrease? (GERMANY)	"Decrease" is correct, but only in the presence of CO2 effects. Clarified and expanded.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
610	71818	3	21	37	22	30	The agriculture section (3.5.2.1) is notably weak. Some statements are made twice, while other seemingly contradictory statements on CO2 fertilization vs. water limitation are presented back-to-back with inadequate explanation. The content appears to be acceptable, if properly explained, but the section needs a careful rewrite to ensure that it is clear to the reader. (UNITED STATES OF AMERICA)	Section completely revised.
611	60963	3	21	39	21	47	This paragraph needs rephrasing. Lines 39-40 state that irrigation demand is likely to rise with higher temperatures, but lines 43-44 say it could decrease or remain the same. Then, lines 46-47 say irrigation demand could rise. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Clarified (with / without CO2 effects) and statements made sound by citation of further studies
612	81680	3	21	41	21	41	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Level of confidence indicated where appropriate
613	76589	3	21	42	21	42	why "a" global vegetation and hydrology? Do you mean that 19 climate models were used to drive a single model for vegetation and hydrology? (Claudio Cassardo, University of Torino)	Yes, clarified.
614	71819	3	21	42	21	45	Where authors say "would decrease by" ... Did they mean to say "increase"? The thoughts that preceed and follow this statement suggest irrigation requirement increases, so this statement suggesting a decrease is confusing. (UNITED STATES OF AMERICA)	Clarified while revising the entire section.
615	81681	3	21	42	21	45	As appropriate, the relevant scenarios of climate change for these projections could be specified. (Katharine Mach, IPCC WGII TSU)	Clarified (statements referred to following sentence).
616	59850	3	21	44	21	44	Please explain why irrigation water requirements would decrease. The decrease is confusing in the context of this paragraph which refers to increasing irrigation water demands. (AUSTRALIA)	Clarified: decrease due to CO2 effects
617	60964	3	21	49	21	49	"Irrigating crops can influence regional… key elements for food security in the future." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	No specific advice given here, but sentence now revised anyway.
618	65358	3	21	49	21	49	"over 40%" => "about 40%": In FAO fact book, 80% rainfed area produce more than 60% of food (REPUBLIC OF KOREA)	Statement deleted.
619	76590	3	21	49	21	49	change "considerable" in "considerably" (Claudio Cassardo, University of Torino)	Deleted.
620	56865	3	21	49	21	50	Consider rephrasing and better linked to subsequent section. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Rephrased/removed.
621	76591	3	21	52	22	2	this sentence refers to past, present or future? You says "alters", "can be" (so, now) and then "warmed" (in the past)… please check! (Claudio Cassardo, University of Torino)	Paragraph removed, as not about climate impacts on water use but feedbacks to climate.
622	63495	3	21	52	22	9	Cooling and warming effects of irrigation seem to be very significant (Canada is warmed by about 1 °). This should be explained in more detail and reflected as a world wide feasible adaption strategy. (GERMANY)	Paragraph deleted.
623	66088	3	21	53	22	4	The paragraph is a bit ambiguous, in particular, when it is mentioned that increase in cloud cover have cooling effect in southern US, China and in parts of Asia whereas, 1 Degree C warming is reported in Canada. It needs proper citation and brief explanation for such a contrasting effects in different regions. (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Paragraph removed.
624	70702	3	21	54	21	54	The phrase 'climate change will deteriorate soil erosion' is unclear. Perhaps 'climate change will exacerbate soil erosion' is a better way of saying it. (Cate Macinnis-Ng, University of Auckland)	Phrase was not part of this chapter nor this entire report.
625	65359	3	22	0	0	0	Please insert comments: "In mosoon area for paddy rice cultivation, irrigation water requirement would be possibly decreased due to rainfall increasing and crop growing period shortening [ref: Yoo, S. H., J.-Y. Choi, S.-H. Lee, Y.-G. Oh, D. k. Yun, 2013, Climage change impacts on water storage requirements of an agricultural reservoir considering changes in land use and rice growing season in Korea, Agricultural Water Management, Vol. 117, 43-54 (REPUBLIC OF KOREA)	Reference not considered as it is a single-model, single-GCM and single-site study.
626	78076	3	22	0	0	0	One of the fundamental assumptions in this chapter is apparently that climate change impacts freshwater resources primarily through shifts in variability. Nowhere is there is a kind of clear, consistent vision about transformation seen in other chapters. Shifts in variability are critically important, and long term shifts in a wide variety of mean climate states are extremely important, especially since water infrastructure (a) lasts over climate relevant timescales, and (b) embodies critical assumptions about future eco-hydrological conditions. Resilience in the context of water can refer to either returning to a "norm" condition following an extreme event or to enduring transformation. These concepts are discussed in Le Quesne et al. 2010, Flowing Forward, World Bank (see figure 2.1). A more recent version of the same figure is in 2013 OECD document ENV/EPOC/WPBWE(2013)2/REV1. (John Matthews, Conservation Internatonal)	True, but not specifically discussed, as this is only about adaptation strategies (not the focus in this chapter).

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
627	78077	3	22	0	0	0	This largely only discusses the benign connections between mitigation and adaptation. There are a number of areas where these connections are competitive. For instance, many "clean energy" approaches may utlimately limit the options available for climate adptation. Hydropower - especially storage - is an obvious connection. But Infrastructure connected to high-value biofuels such as sugarcane and corn-based ethanal reflect extractive non-renewable consumption of water resources. Moreover, groundwater pumping itself may be a major consumer of energy, as in much of Indian agriculture. The Indian blackouts of 2012 in some way are a nexus of low hydro generation with elevated power consumption by farmers for irrigation. (John Matthews, Conservation Internatonal)	Synergies between mitigation, adaptation and energy use are not part of this subchapter.
628	71070	3	22	1	0	0	Most of Canada's land area does not have irrigation. Is this statement about warming in Canada specifically referring to the Canadian Prairies? Suggest reviewing and revising. (CANADA)	Removed.
629	77049	3	22	1	22	1	"It warmed" in what part of "Canada", the world's second largest nation by area, with irrigated agriculture occuring only in certain regions? The prairie provinces, perhaps? I rather doubt that irrigation affected the climate of the northern tundra or Canadian shield or Pacific Coast, for example. Please be specific - this passage, as written, seems of little use to readers and might be a little misleading. (Sean Fleming, Meteorological Service of Canada)	Removed.
630	71071	3	22	2	0	4	This sentence is confusing. Suggest reviewing. (CANADA)	Removed.
631	59851	3	22	3	22	3	Incomplete sentence, words missing following 'weaker summer'. (AUSTRALIA)	Removed.
632	60966	3	22	3	22	3	End of sentence missing "... weaker summer ..." what? Monsoon? (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Removed.
633	71820	3	22	3	22	3	Suggest authors replace 'weaker summer' with 'weaker summer monsoon in response to cooler temperatures.' (UNITED STATES OF AMERICA)	Removed.
634	80113	3	22	6	22	9	As indicated in this paragraph, irrigation is considered an adaptation strategy, but we think that is necessary to focus on the mechanized irrigation systems because efficiency rates are very different between one system to another (30% in tended irrigation systems to rates close to 90% in drip irrigation systems). (CHILE)	Not considered, as specific adaptation options cannot be discussed here; entire paragraph rewritten.
635	79385	3	22	6	22	22	This section is rather poor and appears to be written in isolation from the previous text. For instance, there is discussion of expanding irrigation in Africa, but no cross-reference to the previous section on groundwater that made some very bold statements on the limitations of groundwater use. This is particularly problematic given that in most countries expansion of irrigation is likely to involve groundwater development, but this may be constrained given changes in recharge. The authors should look at the recent Macdonald et al (Environmnetal Research lettewrs 2012) for discussion on this. Expansion of irrigation is likely to be more limited in Asia given current levels of development, although again there is some indication from work by the World Bank in India that in fact the scope for managed aquifer recharge in the middle Gangetic plain could support expansion of groundwater based irrigation. In my view this section needs re-writing. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Section rewritten.
636	64286	3	22	6	22	30	This point ¨Irrigation as adaptation strategy ¨is small developed and little demonstrated. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	Paragraph revised/expanded.
637	71072	3	22	7	0	8	It is not clear how fertilizer and pesticide use and irrigation can be used to change social, economic and climatic conditions. Suggest clarifying. This paragraph could also include some text regarding potential cautions associated with using irrigation as an adaptation option (e.g., over-use/reliance). (CANADA)	Statements deleted, paragraph substantially revised.
638	59852	3	22	7	22	8	This is a broad sweeping statement with little evidence to support assertions (e.g. that farmers could change climatic, political or economic conditions through their use of fertilizers, pesticides and irrigation water). (AUSTRALIA)	Deleted.
639	78075	3	22	7	22	22	This section seems a bit disconnected. Where is irrigation water coming from? Surface flows and groundwater sources both entail major tradeoffs between needs, one in real-time and one over time. Irrigation by itself is not a simple solution, and this is a complicated, emotional topic. Irrigation too - especially in semi-arid regions - can ultimately destroy crop yields as well by poisoning soils. (John Matthews, Conservation Internatonal)	Discussion on irrigation now more balanced.
640	63496	3	22	11	14	14	What is the climate cooling effect of 4 % irrigation in Sub-Saharan Africa? How much irrigation would be needed to stabilize regional climate conditions? Is this an option for mitigation and adaptation equally? (GERMANY)	Paragraph deleted -- irrigation not regarded as an option to mitigate climate change / stabilise climate, this was a misunderstanding.
641	66094	3	22	13	22	13	Replace "and" with word "an" (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Accepted and revised

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
642	76967	3	22	16	22	17	The statement, "A study quantifying global changes in irrigation requirement on areas presently equipped for irrigation of major crop types has been realized indicating results from 19 GCMs for the year 2080.", requires a reference! (Richard Taylor, UC London)	Reference made clear, text revised.
643	71821	3	22	16	22	18	Again, where authors say "would decrease by" ... did they mean to say "increase"? The thoughts that preceed and follow this statement suggest irrigation requirement increases, so this statement suggesting a decrease is confusing. (UNITED STATES OF AMERICA)	"Decrease" is correct in this place.
644	56866	3	22	16	22	19	Please specify source and consider rephrase. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Reference provided as text merged with section above.
645	59853	3	22	16	22	19	Include reference for study refered to in text. (AUSTRALIA)	Reference provided as text merged with section above.
646	56448	3	22	17	22	18	Sentence needs to be re-phrased such as "It found a decrease in global irrigation by about 17% in the ensemble median." (Archis Ambulkar, Brinjac Engineering Inc.)	Sentence / paragraph now revised.
647	56449	3	22	18	22	19	Sentence needs grammatical correction - present sentence "projected with (high likelihood) for..." (Archis Ambulkar, Brinjac Engineering Inc.)	Sentence merged with a previous paragraph and corrected.
648	56450	3	22	21	22	22	Did authors meam "Instance" instead of "Insance". Also, the sentence needs to be modified such as - "Shifts in sowing dates constitute an adaptation option, for instance, maize production in Switzerland..." (Archis Ambulkar, Brinjac Engineering Inc.)	Corrected, "instance", and sentence revised otherwise.
649	59854	3	22	24	22	24	Suggest 'Complementary' should be 'Complementarity'? (AUSTRALIA)	Obsolete, subtitle removed.
650	60967	3	22	24	22	30	"A comparison of optimal input levels of nitrogen... higher with more marked climatic conditions (Finger et al, 2011)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	No specific advice provided here; passage deleted anyway.
651	60968	3	22	25	22	30	This result is froma single study for one region of Switzerland and the results may not be applicable to ther areas. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Made clear that it is just an example.
652	59855	3	22	26	22	29	It is stated that “In rainfed production systems, reduced summer rainfalls lead to a reduction of the optimal production intensity for current and future scenarios. On the contrary, an increased application of nitrogen (i.e. a more intensive production) is an optimal response to climate change if irrigation is available”. The reference provided only refers to maize production in Switzerland and the findings are definitely not transferable to other production systems, especially tropical and subtropical systems. Further, the application of nitrogen fertilisers can have an adverse mitigation outcomes. Increasing the use of nitrogen rich fertilisers to boost production as a means to compensate for reduced rainfall is likely to be a maladaptive approach. The risk is excess nitrogen will enter freshwater ecosystems through runoff. Excessive nitrogen in freshwater ecosystems can result in eutrophication and stimulate excessive weed growth. There is a significant amount of scientific literature on the impacts of excessive nitrogen on freshwater ecosystems. An example is: Tian, H, C. Lu, J Melillo, W Ren, Y Huang, X. Xu, M Liu, C Zhang, G Chen, S Pan, J Liu and J Reilly, 2012, Food benefit and climate warming potential of nitrogen fertilizer uses in China, Environmental Research Letters, 7, 044020, https://darchive.mblwhoilibrary.org/bitstream/handle/1912/5757/1748-9326_7_4_044020.pdf?sequence=1 . Other references can be supplied if requested. (AUSTRALIA)	I fully agree and suggest to remove this sentence in the text.
653	77050	3	22	27	22	28	The idea proposed here - increasing nitrogen application as a climate change adaptation strategy - appears absolutely disastrous. It is very well-known that one of the most prolific and widespread environmental and water quality problems worldwide is eutrophication and other problems due specifically to excessive fertilizer (nitrogen) application. At an absolute minimum, some strong qualifying statements appear to be required here. It would seem very bad form for an IPCC report to recommend tackling one globablly crucial environmental problem (climate change) by exacerbating another (nitrogen pollution). (Sean Fleming, Meteorological Service of Canada)	I fully agree and suggest to remove this sentence in the text.
654	58910	3	22	33	23	2	The many new lakes forming in deglaciating mountain ranges offer new possibilities for hydropower generation (Terrier, S., Jordan, F., Schleiss, A.J., Haeberli, W., Huggel, C. and Künzler, M. (2011): Optimized and adapted hydropower management considering glacier shrinkage scenarios in the Swiss Alps. Proceedings of the International Symposium on Dams and Reservoirs under Changing Challenges - 79th Annual Meeting of ICOLD, Swiss Committee on Dams, Lucerne, Switzerland (Schleiss, A. & Boes, R.M., Eds), Taylor & Francis Group, London, 497 - 508. (Wilfried Haeberli, University of Zurich)	Not included.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
655	80114	3	22	33	23	2	According to some studies the potential of hidropower associated to irrigation channels is 1.600 MW, which could allow the building of small-scale run-of proyects taking advantage of the topography of the country, which would constitute an adaptation measure and a contribution to the diversification of the energy matrix with non-conventional renewable energies (CHILE)	Not included to to space constraints, and lack of references.
656	79386	3	22	33	23	8	Again this section is rather weak and seems almost exclusively focused on the developed world, despite the clear signals from developing countries (and most acutely in parts of Asia) are facing major problems in securing sufficient water for energy. I would have expected more discussion on water and energy needs will be balanced in fast growing economies and the potential adverse impacts on hydropower development from climate change in India, China and wore widely on continental West, South, South-East, East and Central Asia. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	A detailled geographically differentiated analysis is beyond the scope of a sectoral assesssment, please refer to the regional assessments in WGII.
657	71822	3	22	35	22	36	Large amounts of water are required in the hydraulic fracturing process used for production of natural shale gas. Another risk is pollution of both groundwater and surface water from the chemicals used in the fracking process. This is an emergent freshwater risk from a climate mitigating form of energy that is not covered in this chapter or other chapters of WG 2. Authors should add discussion of this risk to this chapter. (UNITED STATES OF AMERICA)	Now addressed in section 3.7.2.1.
658	77845	3	22	35	23	8	underline that the many storage reservoirs have a multi-task character-it affects on possible conflicts beetween different functions (POLAND)	Not specific enough, no literature identified.
659	78078	3	22	40	0	0	The discussion of hydropower here is quite unsophisticated. The issue of hydropower and climate change implies that storage is good, and more storage is better. It doesn't talk about feedbacks related to diminishing returns related to higher ET rates or the difficulty of managing storage and generation potential with the actual intake valve storage. Increasingly, we can expect dams to diverge from their ambient climate, as is evident in many regions globally. And in many cases they will need serious reoperating in keeping with profoundly altered seasonal/annual flow regime patterns, such as finding that generation rates are much declined. These issues are outlined in Matthews/Wickel/Freeman, 2011, listed above. Moreover, there is no mention of widespread diversion dams, such as run of the river dam, which tend to be smaller but quite widespread in developing countries. These can easily lose their potential from low flows or, in the case of many regions, operators divert all flows during drought periods, effectively killing rivers for long stretches. Sediment should also be a critical topic here. We don't know a lot about how sediment erosion patterns will alter, but the implications for hydro generation are very important to storage, operational lifetime, and turbine efficiency. Increased and more intense precip are very important impacts that seem based on first principles alone likely to alter sediment loads for hydropower. Some mention of natural storage mechanisms (such as aquifers) or the natural infrastructure that can be a mechanism for retaining water for droughts/storing water for floods may be useful. This has been a focus of Rwanda's hydro work, for instance, around the Rugezi marshlands (https://dl.dropboxusercontent.com/u/3903757/GEF_Rwandan_wetlands_VA_final.pdf), or also see Yu, Jiang, et al., Freshwater Management and climate change adapation, 2009, Climate and Development. (John Matthews, Conservation Internatonal)	Most aspects are mentioned already in the section, but, due to space constraints only quite general, but some specifications have been made. Some of the aspects mentioned in the comment are covered in other sections, e.g. 3.7.2.1.
660	81682	3	22	44	22	46	The timeframe for the decrease to 90% should be clarified. (Katharine Mach, IPCC WGII TSU)	Done.
661	81683	3	22	47	22	47	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
662	76592	3	22	48	22	49	"This makes … ecosystems": I do not understand completely what you would like to say with this sentence… Do you mean that energy availability will be bigger when demand will be bigger? Also you have evidenced that this is just valid for sweden, but despite the importance of Sweden this could be considered as representative just of the northern Europe (maybe Siberia excluded...). (Claudio Cassardo, University of Torino)	Revised.
663	78079	3	22	49	0	0	The line here about decreased storage capacity ultimately benefitting ecosystems is crazy; it reads as if it were written by the commercial hydro industry. It cannot be substantiated and will inflame serious ecological ire. I suggest deleting it. (John Matthews, Conservation Internatonal)	The reviewer misunderstood the sentence. Sentence was revised for clarification.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
664	77051	3	22	49	22	50	Statement starting with "This makes the annual hydrograph..." seems very naive, ignoring the complex dynamics of electricity free markets and regional or larger-scale distribution systems. Suggest softening the wording, and finding other examples of how climate change, hydrology, and hydroelectric generation may intertwine. One good place to look is the Columbia Basin, which has come under intensive study over the last few years due to upcoming questions around the Columbia River Treaty, which governs international joint (Canada-US) management of the basin. (Sean Fleming, Meteorological Service of Canada)	Sentence revised.
665	62014	3	22	50	22	51	Additional references for the need to adapt operating rules are Paiva et al. (2010) and Hendrickx and Sauquet (2013), with a case study of the Ariège catchment in the French Pyrenees. - Hendrickx, F. and Sauquet, E. (2013) Impact of warming climate on water management for the Ariège River basin (France). Hydrological Sciences Journal, 58(4), 1-17. doi: 10.1080/02626667.2013.788790 - Paiva, R., Collischonn, W., Schnetterling, E. B., Vidal, J.-P., Hendrickx, F., and Lopez, A. (2010) The Case Studies. Chapter 6 in Modelling the impact of climate change on water resources [Fung, F.; Lopez, A. & New, M. (ed.)], Wiley-Blackwell, Chichester, UK. pp. 203 (Jean-Philippe Vidal, Irstea)	For an assessment, a complete literature review is not required.
666	68173	3	23	1	23	2	Typo - This sentence should read: "Storage capacity expansion would help increase hydropower generation but might not be cost-effective. " (International Hydropower Association (IHA))	Revised.
667	71073	3	23	2	0	0	Should this paragraph also include some information on considerations related to public/socio-environmental acceptance of constructing more reservoirs? (CANADA)	No, out of scope.
668	66095	3	23	2	23	2	Replace "costed" with word "cost" (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Revised.
669	70551	3	23	2	23	2	It is strongly recommended to add the following: In snow dominated regions the need for storage capacity is expected to be reduced as lower inflow in summer and higher in winter will drastically reduce the need to transfer water from summer to winter when production is needed (Golombek et al., 2012) Golombek, R., Kittelsen, S.A.C., and Haddeland, I. (2012), Climate change: impacts on electricity markets in Western Europe, Climatic Change, 357-370, doi:10.1007/s10584-011-0348-6. (Hege Hisdal, Norwegian Water Resources and Energy Directorate)	Added.
670	60969	3	23	4	23	6	"Regarding water availability for cooling of… increased stream temperatures and occurrence of low flows (van Vliet et al., 2012)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Comment not clear.
671	76593	3	23	6	23	7	"Lower … change": what is the connection of this sentence with the others? Where this fact is mentioned in Tab. 3-2? I did not found any reference about. I think it should be better to reference the paper also in the text. (Claudio Cassardo, University of Torino)	Sentence removed.
672	79387	3	23	11	23	37	Why is the title for this section 'Municipal services'? And why is the text focused solely on supply to urban areas? The issues are as important for rural areas and in developing countries these are likely to be at significant threat. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Mention was made to the few available information of rural seeting and climate change. If relevant information fulfilling IPCC criteria is available please provide it.
673	64287	3	23	11	24	19	In this point 3.5.2.3 Municipal Services taking into account the problems with water availability in the present and the future, I think that is necessary write as a main adaptation measure the reuse of treated wastewaters . This is put as adaptationmeasure in Table 3.3 but not explained neither developed (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	Foot note added to table 3.3 (1) This includes water reuse and desalination, among others.
674	78080	3	23	13	0	0	Desal is a strange absence here, considering that desal is already going to scale in California and across the Gulf States and that some regions such as the Maghrib are making explicit investment choices already between desal for drinking water and irrigation. Holger Hoff at SEI is doing some of this in the Med/North Africa region, for instance. The potential for mitigation-adaptation conflict is all ove these suggestions, but is not mentioned. Countries will need to decide how to prioritize and sort through these issues. This simple insight is deeply ignored. (John Matthews, Conservation Internatonal)	Foot note added to table 3.3 (1) This includes water reuse and desalination, among others.
675	76594	3	23	13	23	13	"water utilities are confronted by the following": what it does mean this? Which one is the subject and which one the object? (Claudio Cassardo, University of Torino)	This section already exceed the assigned spcae (0.5 page); if readers are interesting on additional information they would have to consult the reference provided, sorry.
676	81684	3	23	13	23	16	It may be much clearer for the reader if the relevant citations were placed after each bullet. (Katharine Mach, IPCC WGII TSU)	This is no possible as many are repeated and it is hence space consuming.
677	56452	3	23	17	23	21	Please change as "Both impacts are…" and "higher ambient temperatures are…" (Archis Ambulkar, Brinjac Engineering Inc.)	Already changed on text.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
678	81685	3	23	17	23	43	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present levels of confidence for some or all of these statements, instead of likelihood terms. Additionally, all likelihood terms retained should be italicized for clarity, and otherwise, casual usage of the reserved likelihood terms should be avoided. (Katharine Mach, IPCC WGII TSU)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
679	60970	3	23	17	24	19	"Higher ambient temperatures is very likely to… (low to medium confidence, limited evidence) (Seidu et al., 2013)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Accepted but using IPCC guidelines.
680	76595	3	23	18	23	18	change "is" with "are" (Claudio Cassardo, University of Torino)	Accepted and revised
681	77052	3	23	18	23	18	The point made here around evaporation and aquifers might benefit from some refinement. Aquifers may be depleted due to higher evaporation rates, but in general, only indirectly - due to decreased infiltration to the saturated zone under increased ET losses in the uppermost soil column, or due to increased pumping of groundwater to compensate for increased evaporative losses or consumption elsewhere. Direct evaporation from aquifers is generally minimal, as evaporative loss rates decrease very quickly with depth. Some detailed fact-checking would appear in order here. (Sean Fleming, Meteorological Service of Canada)	The text already exceeds the allocated space so this is no possible to be done.
682	77145	3	23	18	23	18	impacts are (ITALY)	Accepted
683	76596	3	23	19	23	19	change "is" with "are" (Claudio Cassardo, University of Torino)	Accepted
684	71074	3	23	22	0	0	Suggest changing to "shifts in TIMING of river flow" (CANADA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
685	71823	3	23	22	23	22	Authors should replace "occurrence of droughts" with "amplification of drought intensity with warmer temperatures." (UNITED STATES OF AMERICA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
686	56453	3	23	24	23	25	Please change as "algal blooms in surface water will potentially demand for…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
687	71075	3	23	25	0	27	Sentence is difficult to understand. Suggest clarifying. (CANADA)	Text modified.
688	56454	3	23	26	0	0	Please change as "that are responsible for disinfection by-products…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
689	79388	3	23	30	23	32	It is not clear why the authors consider natural chemical contaminants will be further affected by climate change - is it because they consider it is more likely that contaminated water sources will be used as other sources become less secure (e.g. shallow groundwater in Bangladesh). This is a very contestable statement and one for which there is limited evidence. This sentence should be far more nuanced. Also, can the authors make sure that they are accurate when describing occurrence of major contaminants - e.g. arsenic is found through West, South, South East and East Asia (China has by far the largest number of identified cases). The current text is inaccurate. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Please provide references for the information cited, in order to include it.
690	56455	3	23	31	0	0	Should the sentence be "in areas already affected from including..." (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
691	59856	3	23	31	23	31	Suggest replacement of 'from' with 'including' (AUSTRALIA)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
692	59265	3	23	33	23	35	It should be noted the inability of the municipal drainage systems to store and/or route the increased storm runoff and peak flows (Due to changes in frequency and magnitued of the storm rainfall-runoff events), although it is presented at the following paragraphs.(Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	To include this, we need a reference supporting theis information under the framework of climate change. If available please provide it.
693	77053	3	23	33	23	35	Not clear why increased water-borne pathogen loading would render existing indicators obsolete. An explanation and literature citations are required. (Sean Fleming, Meteorological Service of Canada)	"different type of" pathogens was added.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
694	79389	3	23	33	23	35	The bullet point on the inadequacy of faecal indicators because of changes in storm frequency is highly misleading and inaccurate. There are well known flaws to the currently used indicators that led to the change in the approach recommended for managing water safety in the WHO Guidelines for Drinking Water Quality to a more risk based approach. It is simply incorrect to say climate change impacts will have any significant impact on the adequacy of indicators already known to have weaknesses. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	It is the higher flows that will demand use of different indicators thant bacteria to assess protozoa for instance.
695	56456	3	23	34	0	0	Please change "The indicators traditionally used…. are likely to be insufficient…" (Archis Ambulkar, Brinjac Engineering Inc.)	Text modified.
696	76597	3	23	35	23	35	change "is" with "are" (Claudio Cassardo, University of Torino)	Accepted
697	79390	3	23	39	23	46	This text is poor and only deals with one aspect of water supply - water treatment. Even in its handling of this it focuses solely on coagulation dosages required and makes no attempt to consider the impacts on multi-stage filtration more commonly used in developing countries. There is no discussion of the impact of piped distribution systems which will become more vulnerable, nor of the risks to non-piped supplies. No discussion is included on the importance of management models to manage risks and reduce vulnerability. No reference is made to literature dealing with climate change in developing countries - for instance Howard et al (2010) Journal of Climate Change in Water 1:2-16 gives an overview of global risks. The authors could also refer to the World Bank paper on utilities and climate change (Danilenko et al 2010). (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The comments related with the first reference were accepted, for both vulnerabilities and adaptation options sections.
698	60626	3	23	40	23	40	Replace the acronym DJF by its meaning (December, January and February?) (Maria Manuela Portela, Instituto Superior Tecnico (IST))	DFJ not found.
699	77846	3	23	40	23	40	after plants add in brackets : "(specially small ones)" (POLAND)	Accepted.
700	56457	3	23	40	23	41	When describing "extreme influent variations…", it would be helpful to list and identify the parameters (such as turbidity, organic content, temperature, etc.) (Archis Ambulkar, Brinjac Engineering Inc.)	We are already over the space limit, any change should be to reduce the extent of the text.
701	56458	3	23	41	23	42	The sentence might need to be revised as "infrastructure for treatment with periods ranging from one month to up to several months per year" (Archis Ambulkar, Brinjac Engineering Inc.)	Text modified to consider this comment.
702	56459	3	23	42	0	0	Start sentence "For example, in order to merely…." (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
703	56460	3	23	45	0	0	Please add a comma as "impacts and local conditions, resulting costs…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
704	60971	3	23	45	23	46	Is this last sentence a little alarmist? The alternative is no clean water supply - a situation unlikely to happen(?) (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Mention was made to refers to additional cost for treatment.
705	79391	3	23	48	24	19	This text is also rather weak. It only focuses on conventional sewerage and does not address the issues of on-site sanitation or non-conventional sewerage. The Howard et al reference noted above also covers sanitation. It does not discuss impacts on treatment or treatment technology selection and the impact this may have on emissions. Most of the text is only relevant to developed countries and very limited areas of developing countries. The final statement that the disposal of faecal sludge or wastewater in developing countries is only just beginning to be studies is highly misleading and inaccurate - it is very widely studied and it strikes me the authors have made little attempt to look at this literature. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Addressed as much as possible in the limited available space allocated to this theme, less than 0.2 page.
706	81686	3	23	50	23	50	It would be preferable to place the citations with the relevant bullets. (Katharine Mach, IPCC WGII TSU)	Not possible because of lack of space.
707	56461	3	23	54	0	0	Please add a comma as "In addition, new strategies…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
708	81687	3	23	54	23	54	Use of "must be" would preferably be avoided to ensure the statement is not prescriptive. (Katharine Mach, IPCC WGII TSU)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
709	56463	3	24	0	0	0	Considering the effects of heavy rainstorms and storm runoff, should any discussion be needed to reflect the need for separation of storm sewers from sanitary sewers. This would reduce the hydraulic as well as organic loads on wastwater treatment plants. (Archis Ambulkar, Brinjac Engineering Inc.)	No space available for discussion, readers can infer this.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
710	56856	3	24	0	24	0	General comment - Section 3.5.2.4: (1) This section does not seem to be appropriately categorised as "Water Uses" but a more general sectoral impact. (2) Water-related climate change impacts may also directly/indirectly affect terrestrial ecosystems, changing predation characteristics, wildfires, human health (e.g. water-borne diseases) and others - discussions on these are missing. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Title modified.
711	60973	3	24	1	24	0	This section does not seem to be appropriately categorised as "Water Uses" but a more general sectoral impact. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Title modified.
712	60974	3	24	1	24	0	Water-related climate change impacts may also directly/indirectly affect terrestrial ecosystems, changing predation characteristics, wildfires, human health (e.g. water-borne diseases) and others - discussions on these are missing. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This is mentioned on the text as far as the limited extention allocated to water quality allows it.
713	56462	3	24	5	0	0	It should be either "soils shrink as they lose" or "soil shrinks as it loses" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted and revised
714	76598	3	24	5	24	5	change "they" with "it" (Claudio Cassardo, University of Torino)	Accepted and revised
715	81688	3	24	9	24	9	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Accepted
716	81689	3	24	12	24	12	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Accepted
717	81690	3	24	15	24	15	Casual usage of "unlikely" should be avoided, as it is a reserved likelihood term. Additionally, further detail on what is meant by "feasible" could be helpful. (Katharine Mach, IPCC WGII TSU)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
718	77054	3	24	18	24	19	"Just beginning to be studied" in terms of climate change imapcts, yes? Please be specific and clear. (Sean Fleming, Meteorological Service of Canada)	Title modified.
719	81691	3	24	19	24	19	It would be preferable to also specify a summary term for agreement here, following the guidance for authors. (Katharine Mach, IPCC WGII TSU)	The references are indeed verly limited even to establish an agreement scale.
720	65467	3	24	22	24	22	It might be worth including here the consequences to freshwater ecosystems of adaptation strategies to secure water supply (increased dam building). You could also cross reference to 4.3.3.3. (Stuart Bunn, Griffith University)	Revised.
721	77847	3	24	24	24	40	that part needs wider elaboration with divisions among different regions (POLAND)	This is partly done in Box CC-RF, but regional details can only be provided in the regional chapters.
722	60972	3	24	29	24	50	"Climate change is an additional stressor… 2009; Hsiang et al., 2011)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Comment not clear.
723	81692	3	24	33	24	34	It could be helpful to qualify further what is meant by "endangered by extinction"--where, to what extent, etc. (Katharine Mach, IPCC WGII TSU)	not possible given the literature.
724	59857	3	24	33	24	35	The work of Zacharias and Zamparas, 2010 on Mediterranean pools has been poorly described. The relative magnitude of threats identified by the authors has not been adequately explained. (AUSTRALIA)	Here, the focus is on climate change impacts.
725	85126	3	24	33	24	35	Which category of wetland was being studied (i.e location) as the study might not reflect the wetlands in general (MALAYSIA)	Temporary ponds in dry areas, Mediterranean type. Revised.
726	79392	3	24	37	24	40	This comment only holds true is flood management is infrastructure based, but if integrated approaches are taken and environmental measures used it is not automatic that ecosystems will suffer. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Flow control structures imply "infra-structure based".
727	81693	3	24	38	24	38	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
728	71824	3	24	47	24	50	There are other points of view that suggest risks of violent conflict from water scarcity may actually avoided in lieu of more peaceful cooperation or are not as risky as some indicators would indicate (e.g., Wolf et al., 2003, Water Policy, 5 29; Jarvis et al., 2005, Ground Water, 43(5), 764; De Stefano et al., 2012, Journal of Peace Research, 49(1), doi: 10.1177/0022343311427416). Authors should acknowledge this body of literature and balance the language in this paragraph to explain that water is also often a tool for peace. (UNITED STATES OF AMERICA)	Agreed, we included the positive cooperation potential.
729	79393	3	24	47	24	50	It would be useful to clarify that conflicts over water are likely to occur within nations and the evidence suggests that inter-state conflict remains relatively unlikely, and to date has not really occurred (the authors could usefully look at work from the team at Oregon University (Aaron Wolf) on international water conflicts. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Accepted, we revised the sentence.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
730	81694	3	24	48	24	49	This statement must be coordinated with the key findings of chapters 12 and 19, as it does not seem consistent with their assessments. (Katharine Mach, IPCC WGII TSU)	Here, we focus on water related conflicts which are likely to increase according to the references.
731	78081	3	24	52	25	2	This section puzzlingly ignores many of the seminal papers in the area, such as by Carmen de Jong. I can send a list if you wish. (John Matthews, Conservation Internatonal)	Due to lack of space, we can not add.
732	81695	3	24	53	24	53	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Accepted
733	56857	3	25	0	26	0	General comment - Section 3.5.3: (1) This section has focused on extreme precipitation/floods; drought-related damages are not explicit or missing. (2) It is also worth mentioning other direct, indirect, intangible, environmental and social costs, e.g. loss of ecosystem services, agricultral land, health care, disaster and emergency response and recovery costs etc. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	A sentence on drought damages has been included
734	79394	3	25	1	25	2	What are the impacts on tourism referred? Are these likely to get worse or get better? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	the impacts are rather negative due to less glacier tourism and skiing possibilities
735	81696	3	25	7	25	8	It would be helpful to specify how much variability there is year-to-year in reported damages. (Katharine Mach, IPCC WGII TSU)	It is probably too much detail for the report
736	60975	3	25	7	26	0	This section has focused on extreme precipitation/floods; drought-related damages are not explicit or missing. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Additional sentences regarding drought impacts were added to section 3.2.6 and 3.4.9
737	56464	3	25	8	0	0	Should it be "to about 24 billion US$ per year in 2011…" (Archis Ambulkar, Brinjac Engineering Inc.)	Changed
738	81697	3	25	9	25	9	The relevant finding from the special report on extremes was broader than flood disaster losses, which should be reflected appropriately here. (Katharine Mach, IPCC WGII TSU)	The impacts of floods and droughts have been cut down due to lenght problems and moved to sections 3.2.6 and 3.4.9
739	66041	3	25	14	25	14	I would add that it is expected that this increase in the population living in flood prone areas, mainly those located neas the coast, will continue in the future. See for instance Llasat et al, 2008, or the "Plan Bleu (France)", or the European Flood Directive . Reference: Llasat, M.C., L. López, M. Barnolas and M. Llasat-Botija, 2008: Flash-floods in Catalonia: the social perception in a context of changing vulnerability. Advances in Geosciences, 17 , 63-70. (Maria-Carmen Llasat, University of Barcelona)	This idea is already explained in the text. Not additional references are needed.
740	56465	3	25	17	0	0	Needs to remove "are" from sentence as "with the highest number (75%) concentrated in…" (Archis Ambulkar, Brinjac Engineering Inc.)	Changed
741	76599	3	25	26	25	26	change "detail" in "detailed" (Claudio Cassardo, University of Torino)	The sentece was deleted
742	77055	3	25	26	25	29	Wording is quite bad, I'm afraid - the passage is almost unintelligible. (Sean Fleming, Meteorological Service of Canada)	The sentece was deleted
743	77146	3	25	28	25	28	require (ITALY)	The sentece was deleted
744	56466	3	25	33	0	0	Sentence needs revision as "as they are not…." (Archis Ambulkar, Brinjac Engineering Inc.)	The sentece was deleted
745	77147	3	25	33	0	33	they (ITALY)	The sentece was deleted
746	66042	3	25	34	25	34	To support this statment about the inclusion of local or regional events in national or global databases, I propose the reference Llasat et al, 2013, that shows a comparison between different flood data bases. Reference: Llasat, M. C., Llasat-Botija, M., Petrucci, O., Pasqua, A. A., Rosselló, J., Vinet, F., Boissier, L., 2013. Towards a database on societal impact of Mediterranean floods in the framework of the HYMEX project. Nat. Hazards Earth Syst. Sci., 13, 1–14, 2013. www.nat-hazards-earth-syst-sci.net/13/1/2013/ doi:10.5194/nhess-13-1-2013; (Maria-Carmen Llasat, University of Barcelona)	The sentece was deleted
747	76600	3	25	34	25	36	I understand what authors will say, but it is not clear as it is written: please rephrase this sentence. (Claudio Cassardo, University of Torino)	The sentece was deleted
748	56467	3	25	35	0	0	Sentence needs revision as "even small floods have…." (Archis Ambulkar, Brinjac Engineering Inc.)	The sentence was deleted
749	81698	3	25	45	25	47	For this projection, it would be helpful to specify the relevant time frame. (Katharine Mach, IPCC WGII TSU)	2080s. It is now added in the sentence
750	77148	3	25	48	0	48	related (ITALY)	The sentence was deleted
751	56468	3	25	51	0	0	Sence needs full stop "expected losses." (Archis Ambulkar, Brinjac Engineering Inc.)	Changed
752	71076	3	25	53	0	54	Suggest specifying region associated with this finding. (CANADA)	The sentence was deleted
753	77149	3	25	53	0	54	where those restrictions were implemented? what is the reference? (ITALY)	The sentence was deleted

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
754	81699	3	25	53	25	53	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	The sentence was deleted
755	59858	3	25	53	26	3	This paragraph on costs of inland waterway transport does not seem to fit within section 3.5.3 which focuses on hundreds of millions of people being exposed to flood risk with billion pound costs. Suggest deleting this paragraph. (AUSTRALIA)	The sentence was deleted
756	56469	3	26	1	26	2	Sentence needs revision as "high water levels in rivers are likely to increase…." (Archis Ambulkar, Brinjac Engineering Inc.)	The sentence was deleted
757	76601	3	26	2	26	2	change "increasing" in "increase" (Claudio Cassardo, University of Torino)	The sentence was deleted
758	81700	3	26	2	26	2	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	The sentence was deleted
759	80115	3	26	6	26	14	As part of measures to adapt to climate change and risk management, Chile has a national irrigation strategy, whose objectives are to expand the irrigated area, the promotion of technologies and efficient management, and the promotion of efficient and modern Water Users Organizations. Also the incorporation of multisectoral management that would ensure water availability for all economic sectors. The plan is based on two main pillars, which are infrastructure construction and management of user organization (CHILE)	To cite this information a reference o a copy of a should be send to TSU to assess it.
760	76602	3	26	8	26	8	remove "the" before "changes" (Claudio Cassardo, University of Torino)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
761	56470	3	26	9	0	0	Sentence needs revision as "there is a need…." (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted and revised
762	59859	3	26	9	26	10	This is a poorly drafted sentence, consider revising. (AUSTRALIA)	This will be performed during the editorial review.
763	56471	3	26	10	0	0	Sentence needs revision as "positive impacts, there is a need…." (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted and revised
764	78083	3	26	17	0	0	This section is remarkably out of date. There is no recognition of recent approaches or insights and problems. Some of the papers have weathered somewhat well (Sadoff and Muller, for instance). But most have not. A central problem around water is the conflict between the need for precise, accurate information about eco-hydrological information many decades from now and the utter inability to provide that information. Easily the most inciteful essay on this is Casey Brown's The End of Reliability, but there are a variety of works by Brown, Wilby, Dessai, and others that have a lot of insight into the special problems around water management. Climate change is not relevant to every part of water management, but it is relevant to a large part of it. It might also be worth pointing out that the argument that Parmesan et al. 2011 use in Overastretcing Attribution beautifully transfers over to water problems. It is very easy to get obsessed as KfW, GiZ, and the GEF have about "documenting" real or potential impacts that assumes that we can easily define in terms of infrastructure, institutions, information, etc., the "additionality" of climate adaptation options. Perhaps this works in terrestrial problems but I doubt it. There is no way that it works in freshwater areas. The material on IWRM needs to be completely removed. There is nothing inherent to IWRM that makes it particularly suitable or unsuitable for climate adaption. Eflows is arguably better as a general methodology, and it also lacks any clear connection to climate processes. This thinking is not in the mainstream. Moreover, approaches that claim to be no-regret are also quite awful. Infrastructure is an inherently regretful decision making process. I would argue that climate change offers fundamental challenges to the way we have been managing water, and that we need to make some major shifts, such as development as a proces rather than building or developing all at once, and becoming (in Brown's phrase) robust to multiple options. THis is clearly described in Le Quesne et al. 2010 Flowing Foward and in Matthews/Wickel/Freeman 2011. I would consider including some of the references in the Nairobi Work Pogramme briefing on water and climate that was publishined anonymously but was actually written by David Purkey from SEI and is actually quite good in describing these issues. It came out in 2012, a few months before the COP and is on the NWP site. (John Matthews, Conservation Internatonal)	Please send full references. And we do agree that IWRM do not solve climate change issues; in fact it is not a tool but a concept useful to use to try to plan in a more integral way.
765	79397	3	26	17	27	8	This section does not talk at all about adaptation in domestic water and sanitation services - there is literature available on this and I would have expected at least some discussion of this (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	The discussion on specific aspects of adaptation has to be short as we have only 30 pages to cover all water aspects, it was included as much as possible
766	56867	3	26	19	26	19	Change "3rd IPCC" to "Third IPCC" - in line with Page 4 Line 46. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	We deleted the sentence.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
767	56472	3	26	19	26	20	Sentence needs revision as "in the water sector, many of them…." (Archis Ambulkar, Brinjac Engineering Inc.)	We deleted the sentence.
768	81701	3	26	21	26	21	Here, it may be preferable to refer to "low regret" actions in place of "no regret" actions. (Katharine Mach, IPCC WGII TSU)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
769	56473	3	26	21	26	22	Sentence needs revision as "as "no regret actions" (which are the actions….economic benefits) can be implemented..." (Archis Ambulkar, Brinjac Engineering Inc.)	Editorial reiview will be done later.
770	64288	3	26	25	26	27	In Table 3.3 Categories of climate change adaptation measures regarding to freshwater - I suggest add other measures of adaptation that maybe useful as collect (¨harvest ¨) of rain waters but without adequate technological means, and the ¨harvest ¨ of dew waters utilized in countries with year small precipitation average as Peru in Latin America, both utilized in different developing countries. Both measures not are expensive and could be expanded. (CRISTOBAL FELIX DIAZ MOREJON, Ministry of Science, Technology and the Environment)	The table covers all these actions but can not contain so much detail due to lack of space, however rain water harvesting has been added as part of a foot note.
771	79396	3	26	26	26	27	Table 3 is drawn from a highly selective set of references some of which do not directly address climate change. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	If there are additional references please provide them, and comment accepted and table modfied.
772	57130	3	26	29	26	33	Adaptation Strategies for for mainstream in the middle reaches of Yellow River under Climate Change is highly discussed in paper "A Strategy to Deal with Water Crisis under Climate Change for mainstream in the middle reaches of Yellow River", we add this reference (Wang et al., 2011) to support adaptation. Wang, X.J. Zhang, J.Y.He, R.M. et al., 2011: A Strategy to Deal with Water Crisis under Climate Change for mainstream in the middle reaches of Yellow River, Mitigation and Adaptation Strategies for Global Change, 2011, 16（5）: 555-565； (Guoqing Wang, Nanjing Hydraulic Research Institute)	Accepted as references for table 3.3 as it adds relevant information at the regional level.
773	60976	3	26	29	26	40	"Adaptation measures, which involve a combination of… externalities in the pricing of exports." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Comment not clear.
774	81702	3	26	29	26	49	It would be preferable to provide much more nuance in the examples used here. (Katharine Mach, IPCC WGII TSU)	Accepted. Please note that due to space constraint the ammended text might not appear on the final version.
775	77150	3	26	35	26	35	results, i.e. (ITALY)	Accepted
776	77151	3	26	37	0	37	incerease (ITALY)	Accepted
777	77056	3	26	38	26	39	Wording requires improvement and clarification. Also, please define "virtual water." (Sean Fleming, Meteorological Service of Canada)	Accepted and deleted "virtual water"
778	79395	3	26	38	26	40	This appears to be a throw-away statement on the use of virtual water. How would its use prevent maladaptation? It is far from clear from the material here that it could possibly achieve this. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Text modified.
779	77152	3	26	44	0	44	"IWRM is an interantioanlly accepted approach": many references contraddict this (ITALY)	"approach" has been replaced with "concept".
780	60977	3	26	51	26	53	"adaptations are best archieved through mainstreaming… and treating them separately (Elasha, 2008)." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Accepted
781	56858	3	27	0	28	0	General comment - Section 3.6.3: It is worth mentioning the importance of identifying "critical thresholds" of a system, e.g. see "Weiß, M., and J. Alcamo (2011), A systematic approach to assessing the sensitivity and vulnerability of water availability to climate change in Europe, Water Resour. Res., 47, W02549." (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	This section is now merged with earlier sections
782	60982	3	27	1	28	0	It is worth mentioning the importance of identifying "critical thresholds" of a system, e.g. see "Weiß, M., and J. Alcamo (2011), A systematic approach to assessing the sensitivity and vulnerability of water availability to climate change in Europe, Water Resour. Res., 47, W02549." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This section is now merged with earlier sections
783	60978	3	27	5	27	8	"Integrating water resources management… priority in water management aspects." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Accepted
784	81703	3	27	11	0	0	Section 3.6.2. The title of this section should be considered, given that it assesses barriers to adaptation within the paragraph, which are distinct from limits to adaptation. (Katharine Mach, IPCC WGII TSU)	The title changed

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
785	79398	3	27	11	27	23	This section is very brief and, for instance, suggests that poor people settling in unsafe areas is a major barrier - but in fact the same is certainly true of the rich who tend to demand higher quality and more expensive services and who through their use of resource impose limits on poor people's adaptation. For instance, the impact of the floods in Pakistan were in part caused by the resistance from wealthy landowners to allow flooding of their land, leading directly to flooding and damage of land and assets used by the poor. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	No more space for additional text due to page limit
786	56474	3	27	15	0	0	Please add a comma as "communication, etc…" (Archis Ambulkar, Brinjac Engineering Inc.)	This sentence was revised.
787	60979	3	27	15	27	23	"Some of the barriers that are of… required for food and energy production." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Where is the comment?
788	56868	3	27	16	27	16	Cultural aspects are also important and should not be omitted, even if literature may be limited. The complexity and interlinkages between the technical, socio-economic and cultural issues need to be highlighted. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Due to lack of space, we shortened the section.
789	60980	3	27	16	27	16	Cultural aspects are also important and should not be omitted, even if literature may be limited. The complexity and interlinkages between the technical, socio-economic and cultural issues need to be highlighted. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Due to lack of space, we shortened the section.
790	77848	3	27	17	26	17	add something about saving water: saving water als means also energy becouse acquiring, transporting and prcessing the water needs huge energy costs. Therefore the improvement of managing demand for water is very important.Water as energy, is essential for human activity as well as for economic activity (POLAND)	Lack of space, the sentence has been deleted.
791	56475	3	27	22	0	0	Sentence needs revision as "customary; and (e)…." (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted
792	76603	3	27	22	27	22	change "sources" in "resources" (Claudio Cassardo, University of Torino)	Lack of space, the sentence has been deleted.
793	81704	3	27	26	0	0	Section 3.6.3. For this section, the chapter team should ensure that the focus throughout is on freshwater resources. For example, it would be helpful to clarify what type of freshwater impact is relevant for the example given on lines 33-35 on page 27. (Katharine Mach, IPCC WGII TSU)	Section has been moved and sentence rephrased
794	76604	3	27	26	27	26	in title: "uncertainty": of what? (Claudio Cassardo, University of Torino)	Section moved so title has now gone
795	70311	3	27	26	28	28	I suggest to add a description of the impact response surface approach that has been applied with hydrological and permafrost models (Fronzek et al. 2010, Applying probabilistic projections of climate change with impact models: a case study for sub-arctic palsa mires in Fennoscandia, doi:10.1007/s10584-009-9679-y; Fronzek et al. 2011, Evaluating sources of uncertainty in modelling the impact of probabilistic climate change on sub-arctic palsa mires, doi:10.5194/nhess-11-2981-2011; Weiss 2011, Future water availability in selected European catchments: a probabilistic assessment of seasonal flows under the IPCC A1B emission scenario using response surfaces doi:10.5194/nhess-11-2163-2011; Wetterhall et al. 2011, Using ensemble climate projections to assess probabilistic hydrological change in the Nordic region, doi:10.5194/nhess-11-2295-2011). In that approach, an impact model's sensitivity to changes in key climate variables (in these examples change in annual surface temperature and precipitation) is conducted and plotted as a surface showing an impact variable against temperature change on the one axis and precipitation change on the other. This can both be combined with probabilistic projections of climate change and to identify optimal adaption options in a bottom-up approach (Brown et al. 2011. A Decision-Analytic Approach to Managing Climate Risks: Application to the Upper Great Lakes, doi:10.1111/j.1752-1688.2011.00552.x). The same approach of constructing response surfaces has also been used by Prudhomme et al. (2010), which is mentioned on page 14, line 4, however, not in the context of uncertainty. (Stefan Fronzek, Finnish Environment Institute)	These are good examples, but the section has been shortened and moved so there is no longer space to include the references
796	57126	3	27	33	27	45	In the recent publication of "Quantifying Uncertainty in Catchment-scale Runoff Modeling under Climate Change (Case of the Huaihe River, China)", it argued that "As there are not enough probabilistic climate change scenarios or multiple runs, it is difficult to assess any likelihood of a particular projection. Ensemble analysis could be a resonable approach." As a study case to argue the idea of "produce liklihood distributions of impacts", the work could be refrenced in LINE 35, which could be changed as "...which use very large numbers of scenarios to produce..., but argued that which is large enough to form distribution(Liu et al,2012)". Liu, Y., Zhang, J., Wang, G., Liu, J., He, R., Wang, H., Liu, C. and Jin, J., 2012: Quantifying Uncertainty in Catchment-scale Runoff Modeling under Climate Change (Case of the Huaihe River, China), Quaternary International, 282:130-136. (Guoqing Wang, Nanjing Hydraulic Research Institute)	This extra example does not add anything to the text

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
797	70309	3	27	34	27	36	Two other examples of probabilistic hydrological impact assessments which could be mentioned here have been provided by Weiss (2011, doi:10.5194/nhess-11-2163-2011) and Wetterhall et al. (2011, doi:10.5194/nhess-11-2295-2011). An example for impacts on permafrost (also covered in this chapter) has been presented by Fronzek et al. (2011, doi:10.5194/nhess-11-2981-2011). (Stefan Fronzek, Finnish Environment Institute)	We have not included these additional references
798	70310	3	27	34	27	45	I suggest to add that probability distributions of impacts are usually conditional on a number of assumptions, e.g. the forcing scenario used to project future climate and specific assumptions made in the impact analysis. Ideally this should be (and I would argue most studies have done that) clearly communicated when presenting a probability distribution of an impact variable. Mentioning this would give a better context for the criticism of probabilistic approaches summarized in the latter part of this paragraph. (Stefan Fronzek, Finnish Environment Institute)	The text has been changed to reflect this.
799	60981	3	27	36	27	45	"The use of multiple scenarios… less literal interpretation of scenario results." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Do not understand comment
800	77153	3	27	38	27	38	creoss reference to be completed (ITALY)	Cross reference removed
801	81705	3	27	38	27	38	A cross-reference should be supplied here, noting that there's not a single chapter that could be described as the scenario chapter. (Katharine Mach, IPCC WGII TSU)	Cross reference removed
802	77154	3	27	42	0	42	omit "and others" (ITALY)	OK
803	77155	3	27	45	0	45	"less literal interpretation of scenario results": unclear (ITALY)	Sentence rephrased
804	77156	3	27	47	0	53	the concept of methods and models are mixed and therefore the overall meaing of the paragraph is unclear. (ITALY)	paragraph has been rephrased
805	71825	3	27	47	27	52	The authors may be citing editorial opinions about this issue rather than studies showing results that expand understanding on this issue. There may be editorial viewpoints included in the citations list of this statement. Authors should review the narrative in their citations. For citations that offer editorial views and no analysis related to this issue, it would be best to instead reference the citations that supported the editorial view (i.e., Do Lins and Cohn 2011 or Stakhiv 2011 do original analysis to support this view? If not, then do they cite other studies that showed results leading to this view? if yes, then cite those studies rather than Lins and Cohn 2011 or Stakhiv 2011.) (UNITED STATES OF AMERICA)	Referencing has been changed
806	58686	3	27	47	28	2	I welcome the new paragraph which is in accord to what I had suggested. I think its addition is a step toward more balanced presentation of the literature. A minor point: Lins and Cohn (2011) appears twice in the paragraph but I think this is an error. Its first appearence should be deleted (it is out of context), while the second is fine. (Demetris Koutsoyiannis, National Technical University of Athens)	References changed
807	76876	3	27	47	28	2	A relevant study may be Raff et al., 2009 (doi:10.5194/hess-13-2119-2009) who discuss the benefits of using climate projections compared to using only flow observations (what they call the expanding retrospective). A key question in this respect is if changes in (especially) the probability of extreme events can be identified *before* they become apparent in the flow record, because by then it is obviously too late. (Rutger Dankers, Met Office Hadley Centre)	Interesting reference, but we have not added it for space reasons
808	56859	3	28	0	29	0	General comment - Section 3.6.5: It is worth highlighting that costs would depend on local, regional, national circumstances, e.g. institutional and socio-economic structures. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	We revised the section.
809	60985	3	28	1	29	0	It is worth highlighting that costs would depend on local, regional, national circumstances, e.g. institutional and socio-economic structures. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Not necessary to make this obvious point
810	60986	3	28	1	29	0	Discussion non-monentary and intangible costs are missing, e.g. stress on communities due to forced migration. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Due to lack of space, we can not add.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
811	58687	3	28	3	28	3	I reiterate my earlier comment on the discussion of the IPCC AR4 report (chapter on Freshwater), which is very relevant to uncertainty, the subject of this section. I suggest to refer to it by adding the following paragraph: “Uncertainty was the central issue of an extended discussion (Koutsoyiannis et al., 2009; Kundzewicz et al., 2009) as a follow up of a summary of the corresponding Freshwater Chapter of the IPCC AR4 (Kundzewicz et al., 2008). Koutsoyiannis et al. (2009) imply that the climate system and particularly its components related to freshwater are fundamentally unpredictable, and that hydrologists and water managers should give more emphasis on understanding and modeling the uncertainty per se, rather than relying on hopeless deterministic projections. On the other hand, Kundzewicz et al. (2009) argue that scenarios of the future which present plausible futures of climate are necessary for supporting present-day decisions with respect to mitigation of and adaptation to climate change in the water sector.” References to be added Koutsoyiannis, D., A. Montanari, H. F. Lins, and T.A. Cohn, Climate, hydrology and freshwater: towards an interactive incorporation of hydrological experience into climate research—DISCUSSION of “The implications of projected climate change for freshwater resources and their management”, Hydrological Sciences Journal, 54 (2), 394–405, 2009. Kundzewicz, Z. W., L. J. Mata, N. W. Arnell, P. Döll, B. Jimenez, K. Miller, T. Oki, Z. Şen and I. Shiklomanov, The implications of projected climate change for freshwater resources and their management, Hydrological Sciences Journal, 53(1), 3–10, 2008. Kundzewicz, Z. W., L. J. Mata, N. W. Arnell, P. Döll, B. Jimenez, K. Miller, T. Oki and Z. Şen, Water and climate projections—Reply to discussion “Climate, hydrology and freshwater: towards an interactive incorporation of hydrological experience into climate research”, Hydrological Sciences Journal, 54(2), 406-415, 2009. (Demetris Koutsoyiannis, National Technical University of Athens)	We feel that the rephrased discussion covers these points, particularly given the space constraints
812	60983	3	28	4	28	28	"Addressing the effects of uncertainty through its… wide range of potential disruptions." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Do not understand this as a comment
813	77477	3	28	4	28	28	Suggestions for additions from Willems et al., 2012: o The large uncertainties that currently exist should not be an argument for delaying climate change impact investigations or adaptation actions. Instead, uncertainties should be accounted for and flexible and sustainable solutions aimed at. An adaptive approach has to be established that both provides inherent flexibility and reversibility and also avoids closing off options. This is different from the traditional engineering approach, which is rather static and is often based on design rules set by engineering communities without much public debate. o This adaptive approach involves active learning, hence recognizing that flexibility is required as understanding increases. o And from Willems & Arnbjerg-Nielsen, 2013: In the presence of climate change induced uncertainty, urban water systems also need to be more resilient and multi-sourced. An adaptive approach has to be established that both provides inherent flexibility and reversibility and also avoids closing off options. This is different from the traditional engineering approach, which is rather static and is often based on design rules set by engineering communities without much public debate and an ever increasing optimization towards achieving the design criteria. Adaptive approaches mainly originate from the ecological sector where high uncertainties in the knowledge of processes and responses are inherent, even beyond the climate change context. In ecology, traditional engineering design approaches are often not applicable because of scientific uncertainties. This also involves challenging modifications to the roles of the water scientist, the water manager and the water engineer, but also of the property owner and user, the insurer, the city and green area planner, the socio-economist and the politician. Adaptive approaches also involves active learning, hence recognizing that flexibility is required as understanding increases and that solutions must be identified that are good for all stakeholders rather than being the optimal solution for just one stakeholder. The higher awareness of future changes hence can be seen as a driver to rethink the concepts of urban drainage. Climate change impacts on precipitation clearly show that a business-as-usual approach is not feasible in many regions of the world. The issues raised here point out that it is in many situations necessary to re-evaluate the entire concept of urban drainage rather than “just” upgrading the technical solutions we have implemented over the last 150 years. It is necessary to establish and maintain hygienic barriers and to build cities that interact with water in a healthy, environmentally friendly, and cost-efficient way. This will in general include the use of sewer systems, but in the future the sewer systems will be part of a greater and more complex infrastructure governing the collection, storage, use, and reuse of water in cities to meet many different objectives that the citizens will all benefit from. Ref: • Willems, P., Arnbjerg-Nielsen, K. (2013), ‘Climate change as a driver for urban drainage paradigm change’, Water21, February 2013, 23-24 (Patrick Willems, KU Leuven)	This is too policy prescriptive for the IPCC
814	77157	3	28	6	28	7	creoss reference to be completed (ITALY)	Done
815	81706	3	28	6	28	7	The mentioned cross-references must be supplied. (Katharine Mach, IPCC WGII TSU)	Done

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
816	60828	3	28	7	28	7	Insert reference Mathison et al. (2012): Camilla Mathison, Andy Wiltshire, Pankaj Kumar, A P Dimri, Jeff Ridley, Daniela Jacob, Pete Falloon, Prof Yasunari, Christian Siderius, Markus Stoffel (2012) Regional Projections of South Asian Climate for Adaptation studies. Science of the Total Environment (accepted) http://dx.doi.org/10.1016/j.scitotenv.2012.04.066 (Peter Falloon, Met Office Hadley Centre)	This is just another example; we have not included it
817	56476	3	28	7	28	9	The sentence "An example… infrastructure" needs to be rephrased for correct language. (Archis Ambulkar, Brinjac Engineering Inc.)	Sentence rephrased
818	56477	3	28	10	28	12	The sentence "This combined… disruptions" needs to be rephrased for correct language. Also, it should be "This combined low-regret option" or "These combined low-regret options" (Archis Ambulkar, Brinjac Engineering Inc.)	Rephrased
819	56478	3	28	19	28	20	There are too many "the" included, please revised the sentence. (Archis Ambulkar, Brinjac Engineering Inc.)	Rephrased
820	71826	3	28	31	28	48	Authors should add "inter-disciplinary training" to the section on capacity building. (UNITED STATES OF AMERICA)	added
821	79399	3	28	31	28	48	This paragraph has a limited view as it only deals with community-based approaches to adaptation and whilst this is important, on larger basins adaptation will also (or primarily) involve other processes where major decisions on infrastructure management and development will be required - there may be local consultation in such decisions but it is unlikely to involve full participatory processes (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Accepted, sentence has been revised
822	80116	3	28	31	28	48	Adaptation measures to climate change should also consider improvements to the management of water resources. In Chile this it is focused through the creation and strengthening of water user organizations, which allows organizations to manage water resources in the most efficient way. Within the areas of management of water user organizations, are; the allocation of the resource among irrigators, maintenance and improvement of its infrastructure and the ensuring of water quality for irrigation, among other function. (CHILE)	Agreed, revised
823	85120	3	28	33	28	34	Please clarify what is meant by increasing vulnerability to climate change--do you mean increasing risks from climate change? (Michael Mastrandrea, IPCC WGII TSU)	Sentence has been revised
824	60984	3	28	33	28	48	"Strengthening the professional capacity… water supply and flood risk" (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Accepted
825	56479	3	28	37	0	0	The sentence to be revised as "Thus, for implementing…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted, sentence has been revised
826	56480	3	28	40	0	0	The sentence to be revised as "so that they will understand…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted, sentence has been revised
827	60640	3	28	42	0	0	Capacity building may be hampered by the increased intensity, frequency, and duration of extreme events, as climate change becomes more extensive, and where adaptation measures based on traditional knowledge or extrapolation of historical trends could be largely ineffective. [15.3.2.2] (George Backus, Sandia National Laboratories)	Agreed
828	81707	3	28	44	28	44	Following from my overall comment on the chapter's use of calibrated uncertainty language, the chapter team could consider whether it would be preferable to present a level of confidence here, instead of the likelihood term. (Katharine Mach, IPCC WGII TSU)	Accepted
829	57463	3	28	47	28	48	In further some time especially in developing countries, social and political intervention also limit the implementation of adaptation measures. (So Kazama, Tohoku University)	Accepted, sentence has been revised
830	65850	3	28	49	0	0	Case of water- Brazil has several thousands of initiatives to help poor communities to adapt to climate change, while providing means for dealing with floods, droughts, heat waves, garbage reuse/recycling. They are being implemented by cooperatives, small towns, neighborhood associations; they use traditional knowledge. The main supporting organization is Fundacao Banco do Brasil published the book "Water and Climate Change". Launched during the UN´s Rio+20 conference, the book shows 34 examples of how communities face and try to adapt to climate change and water; cisterns, water pits, tree plantation, agro intercropping for cattle and vegetables production, collection and reuse of city solid wasstes, composting, small dams for saving water for cattle and gardening. (book by Milton N Silva et al, published by Centro de Documentacao Eloy Ferreira da Silva and Fundacao Banco do Brasil, Belo Horizonte, 2012). Copy was sent via email. (Milton Nogueira da Silva, Climate Change Forum of Minas Gerais, Brazil)	Accepted, but too specific
831	81708	3	28	51	0	0	Section 3.6.5. This section should cross-reference chapter 17 and ensure coordinated assessment. (Katharine Mach, IPCC WGII TSU)	Added to text
832	60987	3	29	4	29	5	"At the local, national, and river basin… do exist in developing countries." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Some reference are added

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
833	81709	3	29	5	29	6	The timeframe for this estimate should be specified. (Katharine Mach, IPCC WGII TSU)	Addressed in text
834	59860	3	29	10	29	13	Clarify if this refers to adaptation costs in sub-Saharan Africa specifically, or global costs. (AUSTRALIA)	Addressed in text
835	81710	3	29	10	29	13	It would be helpful to specify if this also pertains to sub-Saharan Africa. (Katharine Mach, IPCC WGII TSU)	Addressed in text
836	85034	3	29	10	29	13	Are these costs global or specific to Sub-Saharan Africa? Are they the source of the 50-70% mentioned in the executive summary? Please clarify. (Michael Mastrandrea, IPCC WGII TSU)	Addressed in text
837	66096	3	29	15	29	15	Either the word "needed" may be deleted or sentence need to be rephrased (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Revised in text
838	81711	3	29	17	29	22	Where "up to 2030" is mentioned, it could be helpful to clarify the full relevant timeframe--2010-2030? (Katharine Mach, IPCC WGII TSU)	Revised in text
839	81712	3	29	28	0	0	Section 3.6.6. This section does not fully focus on case studies. It could be best to integrate this material into earlier subsections. (Katharine Mach, IPCC WGII TSU)	Now integrated with a previous section
840	60988	3	29	38	29	48	"the incorporation of climate change into water resources… climate change over the next few decades." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Do not understand this as a comment?
841	79400	3	30	4	30	9	In the fourth group, note that the paper published by Howard et al 2010 noted above (which also appears in greater length on the WHO website) address issues around adaptation in the wider water and sanitation service delivery sector (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have not included these additional references
842	60989	3	30	7	30	16	Please qualify this statement witrh examples "institutional structures have the potential… is a significant barrier." (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Sentence rephrased
843	79401	3	30	11	30	21	This paragraph should also refer to the work done by the World Bank on climate change and utilities (Danilenko et al 2010) (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	We have not included these additional references
844	56869	3	30	24	30	24	Some text is needed to explicitly highlight that freshwater systems should not be considered in isolation. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Disagree, due to space constratins and because this is evident from the text in 3.7.1 and 3.7.2 .
845	60990	3	30	24	30	24	Some text is needed to explicitly highlight that freshwater systems should not be considered in isolation. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Disagree, due to space constratins and because this is evident from the text in 3.7.1 and 3.7.2 .
846	76605	3	30	24	30	24	linkages or links? (Claudio Cassardo, University of Torino)	We decided on Linkage
847	62948	3	30	26	0	0	This section is too short and does not justify a section and a title. (Benoit Laignel, University of Rouen)	Accepted, but still necessary
848	56870	3	30	26	30	26	A similar section on "Impacts of adaptation in freshwater systems on other sectors" is missing but necessary - e.g. irrigation requirements may cause conflicts with say, recreational / tourism activities. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Agreed, we thought about it, but due to space constraints did not include it
849	60991	3	30	26	30	26	A similar section on "Impacts of adaptation in freshwater systems on other sectors" is missing but necessary - e.g. irrigation requirements may cause conflicts with say, recreational / tourism activities. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Agreed, we thought about it, but due to space constraints did not include it
850	58649	3	30	28	30	35	I suggest the revision of this para should be as follows: Adaptation in other sector such as agriculture, forestry and industry may have impacts on the freshwater system and have to be considered while planning adaptation measures in the water sector. For example, improving agriculture land management practices and sustainable management of forests can also lead to reduction in erosion and sedimentation of river channels as well as improvement of water quality. Some adaptation measures in other sectors may cause negative impacts in the water sector, e.g. increased irrigation upstream may limit water availability downstream (World Bank, 2007). Furthermore, a project designed for other purposes may also deliver increased climate change resilience as a co-benefit, even without a specifically identified adaptation component (World Bank, 2007, Falloon and Betts, 2010). (chunfeng wang, State Forestry Administration, China)	Accepted, we integrated some of their findings

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
851	59266	3	30	28	30	35	Reference should be made to the adaptation of changes of irrigation methods and crop cultivation. They could result in significant smaller water demands without changes in crop production. (Athanasios Loukas, Civil Engineering Department, University of Thessaly, Greece) (GREECE)	Accepted, but too specific
852	81713	3	30	28	30	35	More citations should be provided for these statements, if possible. (Katharine Mach, IPCC WGII TSU)	We included two more references
853	58650	3	30	46	31	2	Concerning the impacts on runoff by afforestation cannot be simply considered to result in large-scale and long-term reduction of average runoff. The impacts of afforestation on runoff have close relationship with the climate (mainly precipitation), soil type, site condition, site preparation, tree species planted etc. immediately after afforestation, runoff can be reduced, but runoff underground can be increased, such as the study taken by WANG Jin-Xin-；Huang-Bao-Long-；Luo-Wei-Xiang. Influence of Land Preparation for Afforestation on Runoff Producing and Transport from Slopes with Young Planted Trees System[J] , 2004,V2(3): 36-40）. This para cites the literature of (Trabucco et al, 2008), which comes to conclusions just based on several case studies. The conclusions in the literature are suitable for dry region, but not suitable for wet region. Therefore, revision suggested is as follows： Afforestation of areas suitable according to the Clean Development Mechanism-Afforestation /reforestation provision of the Kyoto Protocol（7.5million Km2） would lead to high and large-scale decrease of long-term average runoff in dry region (Trabucco et al, 2008). (chunfeng wang, State Forestry Administration, China)	Groundwater recharge ("runoff underground"?) can be increased by afforestation but not total runoff will generally reduce average streamflow in both humid and dry conditions (van Dijk and Keenan, 2007). Reference was added.
854	60627	3	30	52	30	52	Replace "societ al" by societal (Maria Manuela Portela, Instituto Superior Tecnico (IST))	We cannot find the word.
855	77057	3	30	53	30	53	For the presumably somewhat general readership of this document, it would be wise to provide some kind of working definition here for the term "true cost," which is used a little vaguely here. (Sean Fleming, Meteorological Service of Canada)	Revised.
856	81714	3	30	54	30	54	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
857	60628	3	31	3	31	3	Remove the word "dealing" (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Comment seems to be misplaced.
858	68174	3	31	4	31	5	This sentence implies that all hydropower has negative impacts on a freshwater system, but this is too broad a statement to be included. It should be changed to read that hydropower CAN have negative impacts. (International Hydropower Association (IHA))	It is widely accepted that hydropower development has negative impacts, and no examples of positive impacts have been reported.
859	81715	3	31	14	31	14	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
860	56481	3	31	15	0	0	Change to "an already high…" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted
861	76606	3	31	15	31	15	change "a already" in "an already" (Claudio Cassardo, University of Torino)	Accepted
862	68175	3	31	19	31	20	Again, the text implies that all impacts are negative, and that all hydropower brings negative impacts This should be changed to read that hydropower "CAN negatively affect freshwater ecosystems" (unless the supporting research has tested all hydropower installations worldwide). (International Hydropower Association (IHA))	It is widely accepted that hydropower development has negative impacts, and no examples of positive impacts have been reported.
863	79402	3	31	19	31	25	This section appears to assume all hydropower requires storage and does not take into account the more limited impact of the run of the river projects and therefore over-states the adverse impact. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	It is widely accepted that hydropower development has negative impacts, and no examples of positive impacts have been reported.
864	59861	3	31	22	31	25	This statement needs to explan why or how the global warming potential can be higher than coal. (AUSTRALIA)	Revised, refering to methane emissions.
865	68176	3	31	22	31	25	Again, the science referenced in this section is questionable. Many of the research programmes working in the area of GHG and freshwater reservoirs wouldn't support these conclusions. The statements made here even contradict IPCC's own work conducted in the same time frame. (International Hydropower Association (IHA))	Statement was modified to express more clearly that this is not a general behaviour of reservoirs.
866	81716	3	31	27	31	27	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
867	62713	3	31	27	31	29	CO2 is injected into deep saline aquifer at depth below about 900 m (typically about 1000-2000 m) in CCS operation. CCS is little relationships to freshwater accessed. The description just say the impacts if CO2 leaked and achieved freshwater. The possibility will be very low. The description is partial and therefore should be deleted. (Keigo Akimoto, Research Institute of Innovative Technology for the Earth (RITE))	But Little and Jackson assess leakage into overlying freshwater aquifers.
868	81717	3	31	32	31	32	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
869	65825	3	31	38	31	47	The meaning of this paragraph is difficult to understand. The ratio of the electricity consumption for the water management relative to the total electricity consumption is naturally different among countries depending on the population, industrial structure, and etc. It might be a good idea to describe the electricity consumption for the water supply (treatment, or irrigation) and its intensity (i.e., the electricity required to one unit of the supply), from the view point of the capacity of climate change mitigation. (Ayami HAYASHI, Research Institute of Innovative Technology for the Earth (RITE))	Revised.
870	60992	3	31	38	32	5	Section 3.7.2.2 can also pinpoint and discuss the climate change mitigation dimension of several new technologies relating to water supply enhancement, and particularly desalination, which is a highly energy intensive process. See for example the general discussion in McEnvoy and Wilder, 2012, Discourse and desalination: Potential impacts of proposed climate change adaptation interventions in the Arizona–Sonora border region, Global Environmental Change, 22, 2, pp.353-363. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Added.
871	76607	3	31	40	31	41	it is really necessary to specify that the year considered is the Japanese fiscal year? (Claudio Cassardo, University of Torino)	No, revised.
872	81718	3	31	41	31	47	It would be preferable to specify the relevant time frame for these statistics. (Katharine Mach, IPCC WGII TSU)	Added.
873	77058	3	31	46	31	46	I assume the emissions in question here are China's GHG emissions...? (Sean Fleming, Meteorological Service of Canada)	Yes, revised.
874	81719	3	31	50	31	50	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Revised.
875	77059	3	31	52	31	52	"...will also benefit water quality..." Yes, and also protect aquatic habitat - an important point, given that habitat loss is on par with climate change as a worldwide ecological threat (though of course the two are related, with deforestation helping to drive global climate change, and habitat loss likely occuring in turn as a result of climate change). (Sean Fleming, Meteorological Service of Canada)	Added.
876	60994	3	32	1	32	0	More studies are also needed from not only the science, but also the adaptation perspective, especially those in practical terms. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, but outside of scope here.
877	65826	3	32	1	32	3	For the description, "global CH4 emissions from rice fields could be decrease by 4.1 Tg/a (15%)," the time point under the evaluation should be mentioned. (Ayami HAYASHI, Research Institute of Innovative Technology for the Earth (RITE))	Added.
878	62949	3	32	6	0	0	This section is particularly interesting and original and summarized well the questions about the relationships between climate change on hydrology and water resources changes. (Benoit Laignel, University of Rouen)	Thank you very much. We're honored.
879	56871	3	32	6	32	6	More studies are also needed from not only the science, but also the adaptation perspective, especially those in practical terms. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Thank you very much, we tried to describe adaptation in terms of ground water in this section, and also tried to describe practical adaptation in 3.6.4.
880	71827	3	32	6	32	54	Clarify what is meant here. Do authors mean to suggest the climate science community should develop single models that integrate natural hydrology with water management activities? There are many examples of loosely coupled model systems where one component does hydrology and the other water management. Also, there is software that marries the two (e.g., Stockholm Environment Institute's WEAP). (UNITED STATES OF AMERICA)	No. WEAP is a nice system integrating water demand and supply for policy making in a river basin, but still various modeling systems coupling natural hydrological systems with water management on a global scale, we believe. In the future, such a model will be coupled with climate models (or people will call it Earth System Model).
881	77060	3	32	6	32	54	Good start, but a few points could be made here. (i) Suggest broadening the discussion on lines 17-19 to address LULC change more generally, including anthropogenic changes, glacier recession, etc. (ii) Provide some kind of convincing backup to the assertion about the "...typical engineering criterion of a 1% probability of annual exceedance." (iii) Lines 45-51 seem to imply that increased reliance on groundwater is a potential solution, which it almost certainly isn't in most places... the language could be refined just a little. (iv) An additional knowledge gap, which has a pretty high profile within the statistical hydrology and statistical hydroclimatology communities, is that we need a better understanding of the physical sources of long-term persistence in hydroclimate datasets and its implications to assessing the water resource impacts of anthropogenic global climate change. (v) Perhaps the most pressing knowledge gap at present is how climate change will affect hydrologic extreme events - work is being done on this, but it is a particularly difficult aspect of the question. (Sean Fleming, Meteorological Service of Canada)	i) ??. ii) This text has been removed. iii) ??. iv) ?? <I suggest not saying anything about long-term persistence, because we do not say anything about it in the body of the chapter.> v) The importance of further study of hydrologic extreme events is emphasized in the final sentence of paragraph 4 of the section.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
882	79403	3	32	6	32	54	There is a clear research need to understand how water and service delivery, particularly in developing countries and this should be flagged. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)	Yes, and we have sentences "Relevant socio-economic data, such as rates of surface water and groundwater withdrawal by each sector, and information on already-implemented adaptations for stabilizing water supply, such as long-range diversions, are limited even in developed countries. In consequence, assessment capability is limited in general, and especially so in developing countries."
883	77849	3	32	17	32	19	add after line 19: Digital models might be used for quantitative and quality simulations of water state as well as for transport of substances that pollute surface and groundwater. Current knowledge, which allow to analyse mechanisms ruling systems of ground and surface water, should still be advanced in order to allow correct implementation of policy (POLAND)	Thank you very much. We let the final sentence as "More studies are needed, especially in developing countries, on the impacts of climate change on water quality, and of vulnerability to and ways of adapting to those impacts." and emhpasize the relevance of water quality issue.
884	71828	3	32	18	32	18	Authors should povide a citation for this statement. It links with other discussions in the chapter. (UNITED STATES OF AMERICA)	Yes, but we missed to refere any related section of the chapter. Referring to Box CC-VW should have been appropriate.
885	60829	3	32	19	32	19	Link this sentence to box CC-VW? (Peter Falloon, Met Office Hadley Centre)	YES.
886	60993	3	32	21	32	25	Studies on non-monetary, indirect, social, environmental costs are missing but important. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Yes, we expect "synthesis of case studies" described in the two paragraphs after this part will provide some non-monetary costs. Also ecosystem services on freshwater resources are described in Chapter 4, Terrestrial and inland water systems.
887	57856	3	32	27	0	0	Riverdischarges have been projected with the 20-km mesh AGCM and their uncertainties have been quantified with the 60-km mesh AGCM. Therefore, this mismatch is not cotinuing but disappearing. The regional future climate chages in AR5 WG I have been projected with the 60-km mesh AGCM. Please see Chapter 21 in the WG I. References are listed below: * Kwak, Y., K. Takeuchi, K. Fukami, and J. Magome 2012: A new approach to flood risk assessment in Asia-Pacific region based on MRI-AGCM outputs. Hydrological Research Letters 6, 70–75.doi: 10.3178/HRL.6.70 * Kure, S., and T. Tebakari 2012: Hydrological impact of regional climate change in the Chao Phraya RiverBasin, Thailand. Hydrological Research Letters 6, 53–58. DOI: 10.3178/HRL.6.53 * T. Nakaegawa, C. Wachana, and KAKUSHIN Team-3 Modeling Group. First impact assessment of hydrological cycle in the Tana River basin, Kenya, under a changing climate in the late 21st Century. Hydrological Research Letters., Vol. 6, pp.29-34, (2012) . (continued) (Toshiyuki Nakaegawa, Meteorological Research Institute)	Reduction of the mismatch is now acknowledged.
888	57857	3	32	27	0	0	* Champathong, A. D. Komori, M. Kiguchi, T. Sukkhapunnapan, T. Nakaegawa, and T. Oki. 2013: Future projection of mean river discharge climatology forthe Chao Phraya River basin. Hydrological Research Letters. Vol.7, in press. * J. Fábrega, T. Nakaegawa, R. Pinzón, K. Nakayama, O. Arakawa, SOUSEI Theme-C modeling group. 2013: Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters. Vo.7., in press. * Akio Kitoh, Akiyo Yatagai and Pinhas Alpert: “First super-high-resolution model projection that the ancient “Fertile Crescent” will disappear in this century”, Hydrological Research Letters, Vol. 2, pp.1-4, (2008) . * Nakaegawa, T., A. Kitoh, M. Hosaka. 2013: Discharge of major global rivers in the late 21st century climate projected with the high horizontal resolution MRI-AGCMs -overview-. Hydrological Processes. 27. DOI: 10.1002/hyp.9831 * Kitoh, A., S. Kusunoki, and T. Nakaegawa, 2011: Climate change projections over South America in the late 21st century with the 20 and 60 km mesh Meteorological Research Institute atmospheric general circulation model (MRI-AGCM). Journal of Geophysical Research, 116, D06105. (Toshiyuki Nakaegawa, Meteorological Research Institute)	See response to #887.
889	77158	3	32	27	32	27	the use of the term "scale" is unclear. does it mean resolution? anyhow 200 for climate and 20 for catchment seem bizarre (ITALY)	The "scale" of climate models has been clarified. The numbers we use seem reasonable to us.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
890	68187	3	32	27	32	28	After the end of this sentence includes: Even though recently Fabrega et al., 2013 and Nakaegawa et al., 2013 have employed a methodology to measure consitency between 20 km high resolution model and various projections at 60 km scale ensemble simulation. The corresponding references are: T. Nakaegawa, A Kitoh, M. Hosaka. 2013: Discharge of major global rivers in the late 21st centrury climate projected with the high horizontal resolution MRI-AGCMs-overview. Hydrological Processes. 27 DOI:10.1002/hyp. 9831. ------ J. Fábrega, T. Nakaegawa, R. Pinzón, K. Nakayama, O. Arakawa, SOUSEI Theme-C modling group. 2013: Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters Vol. 7, in press (José Fábrega, Universidad Tecnológica de Panamá)	There seems to be no strong case for adopting this suggestion. Our assessment is factually accurate, and in response to comment 887 we have added an acknowledgement that high-resolution simulations are improving.
891	71829	3	32	27	32	36	The increasing interest in using integrated hydrologic (and climate) models for climate research may be a relevant point to conside adding here. (UNITED STATES OF AMERICA)	Better integration of models from the physical-science and impact/adaptation domains is certainly desirable, and is the subject of much research activity, but we think that in the space available we have identified the most serious of the gaps related to modelling.
892	71830	3	32	31	32	33	Clarify the sentence starting with "Climate extremes". Do authors mean extremes expressed by climate model simulations or in observations? What types of extremes? (UNITED STATES OF AMERICA)	This text has been removed.
893	77159	3	32	38	0	43	The paragraph is unclear and text needs to be checked (ITALY)	The comment offers no guidance about what is unclear.
894	56861	3	33	0	33	0	General comment - FAQ 3.2: Where is the discussion on drought?!?! (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	The text in this question was changed to address drought projections
895	56860	3	33	0	34	0	General comment - FAQ : A question such as "What needs to be taken into consideration when planning for freshwater resources under future climate?" is needed. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Good idea.
896	60998	3	33	1	33	0	Where is the discussion on drought?!?! (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The text in this question was changed to address drought projections
897	60997	3	33	1	34	0	A question such as "What needs to be taken into consideration when planning for freshwater resources under future climates?" is needed. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Good idea.
898	71831	3	33	2	34	16	Section Frequently Asked Questions: There should be a FAQ on drought, particularly since there is one on floods. (UNITED STATES OF AMERICA)	The text in this question was changed to address drought projections
899	71077	3	33	4	0	10	The answer to this FAQ is quite technical. Suggest increasing policy relevance and explaining more technical terms (e.g., evapotranspiration) a little more where possible. It would also be helpful if the sources of uncertainty could be explained. (CANADA)	After much discussion we decided to assume an understanding of the water cycle and its component flows in our readers. To strengthen the emphasis on policy, we have moved the third sentence to become the first sentence.
900	57956	3	33	6	33	6	“Increase in land evapotranspiration may become limited by the water availability” see see Fig.10 in kumar et al. 2013(d). Reference: Kumar S., P. A. Dirmeyer, V. Merwade, T. DelSole, J. M. Adams, and D. Niyogi, 2013(d): Land Use/Cover Change Impacts in CMIP5 Climate Simulations –A New Methodology and 21st Century Challenges. Journal of Geophysical Research (Atmospheres), doi:10.1002/jgrd.50463, in press. (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	Sentence now begins "Globally, evapotranspiration …".
901	81720	3	33	6	33	6	Casual usage of "very likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	"Very likely" has been deleted.
902	60629	3	33	7	33	7	Specify the meaning of the acronym RBMP (River Basin Management Plan?) (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Where is RBMP?
903	81721	3	33	8	33	8	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	"likely" has been deleted.
904	56482	3	33	9	0	0	Change to "to decreases" from "ot decreases" (Archis Ambulkar, Brinjac Engineering Inc.)	Accepted
905	65360	3	33	9	33	9	"ot => to" : Typo (REPUBLIC OF KOREA)	Accepted
906	76608	3	33	9	33	9	change "ot" in "to" (Claudio Cassardo, University of Torino)	Accepted
907	77160	3	33	9	33	9	to (ITALY)	Accepted
908	60996	3	33	12	0	0	FAQ 3.2: The question should address extreme events and not only floods, as drought and its impacts on water resources are of similar, critical importance. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	There is another question regarding drought impacts

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
909	66043	3	33	12	33	27	FAQ3.2 Major consistency along the chapter is necessary (Maria-Carmen Llasat, University of Barcelona)	It has been checked for consistency
910	71078	3	33	17	0	0	Suggest changing to "limited AREAL extent" (CANADA)	Changed
911	71079	3	33	18	0	19	Suggest adding also that there will be less precipitation stored in snowpack and hence less snow-melt driven flooding during snow melt in spring; however, there may be more winter flooding due to winter rain events or rain on snow events. (CANADA)	The question is now shorter and this part was removed
912	77061	3	33	18	33	19	"The magnitude of spring snowmelt floods..." Fine, but it should be noted here that whether a given snowpack produces a flood may depend less on the size of the snowpack and more on the intensity and duration of springtime hot spells - tying back to questions of how climate change may affect meteorological extreme events. (Sean Fleming, Meteorological Service of Canada)	The question is now shorter and this part was removed
913	81722	3	33	18	38	18	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Katharine Mach, IPCC WGII TSU)	Changed
914	77062	3	33	19	19	22	The author may wish to note that a couple of studies have suggested that flood hazards may also increase along the Pacific coast of Canada, though admittedly both these studies are not very recent (Whitfield et al., 2003, Canadian Water Resources Journal, 28(4), 633-656; Weston et al., 2003, Canadian Water Resources Journal, 28(4), 657-672). (Sean Fleming, Meteorological Service of Canada)	The question has been focussed on model outcomes.
915	76609	3	33	20	33	20	"East Africa, Central and Western Africa": why you do not say simply Africa? Also page 19 line 39 (Claudio Cassardo, University of Torino)	Some areas of Northern and Southern Africa had a very high variability and models are unable to deal with.
916	71832	3	33	29	33	41	FAQ 3.3: Suggest authors replace "It depends" with "There are complex linkages and interactions that must be considered together." Add to the sentence which begins "Impacts on freshwater stressorsÉ" the term "population growth". (UNITED STATES OF AMERICA)	Suggestions were not followed. The proposed first sentence does not fit to the train of thought followed in the FAQ, and addition of population growth is inappropriate as the indirect effects of it a captured by land use change, water withdrawals, water pollution, ... listed.
917	77063	3	33	35	33	35	Yes, deforestation, and probably also urbanization (conversion from either natural or agricultural uses) (Sean Fleming, Meteorological Service of Canada)	urbanization added.
918	81723	3	33	40	33	41	Should the dependence of this outcome on the level of climate change be clarified? (Katharine Mach, IPCC WGII TSU)	added "unless strong climate mitigation efforts will successful"
919	81724	3	33	43	33	43	The wording of this question should be revised to ensure that the formulation is not prescriptive. (Katharine Mach, IPCC WGII TSU)	Done.
920	80117	3	33	43	33	52	Proper water management incorporates natural resource management, social measures and infrastructure development, which should be done comprehensively. Within the national irrigation strategy are integrated multiple tools in order to increase food security and adapt to climate change impacts without neglecting other sectors. Among the tools used are the promotion of management to improve organizational capacity of water users to manage water resources, especially in times of scarcity; also develop and conduct headworks; has been invested in the development of telemetry projects and infiltration of groundwater, among others in order to have a varied range adaptive measures. (CHILE)	Thank you very much. This FAQ (FAQ 3.3 in the final governmental draft) intends to introduce non-conventional management practices.
921	71080	3	33	44	0	45	This sentence could be read as prescriptive. Suggest reframing in terms of current knowledge of water management practices. (CANADA)	Done.
922	77064	3	33	47	33	47	In addition to "maintaining vegetation cover," may also wish to explicitly and specifically include "maintaining or restoring riparian vegetation," which is particularly important from freshwater ecology and fisheries perspectives. (Sean Fleming, Meteorological Service of Canada)	Thank you very much. We added "Restoring and protecting freshwater habitats, and managing natural floodplains" in the FAQ (3.3 in the FGD).
923	60995	3	33	49	33	52	In discussing how water management should be adapted in the future, large scale infrastructure such as dams and irrigation systems are noted to be maladaptive measures. This statement is not supported by any text nor references in the main text of the chapter and seems somewhat suggestive. We propose to elaborate on this in section 3.7.2.2. This discussion may then also indicate some of the reasons that such infrastructure fails to deliver including suboptimal operation and/or poor maintainance (see e.g. Labadie, 2004). Labadie, J. (2004). ”Optimal Operation of Multireservoir Systems: State-of-the-Art Review.” J. Water Resour. Plann. Manage., 130(2), 93–111. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	This statement is supported in section 3.6.1. The source is from Campbell et al. 2009.
924	71081	3	34	1	0	9	This FAQ seems like it is intended to also provide some perspective on whether there are opportunities or benefits associated with climate change and water resources, but never actually goes in that direction. Is there more of a story to tell here? (CANADA)	FAQ 3.5 has been rewritten, but the answer is deliberately crafted so as to convey a mixed message.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
925	76610	3	34	3	34	3	"same places", I suggest to add "and times" (Claudio Cassardo, University of Torino)	The targeted text has been removed.
926	81219	3	34	4	0	0	FAQ 3-1 Authors may wish to provide some details like time splices of when, where and by how much. At present the answer is too general and doesn't really provide any specific take away points. (Monalisa Chatterjee, IPCC WGII TSU)	NB P33, not P34. We prefer to avoid offering details about time and space, because inevitably some readers would object to the choices we would have to make.
927	76611	3	34	4	34	4	"but in … detectable": the 'consecutio temporum' is strange: I suggest to change in "but in some regions they will become statistically detectable some decades later" (Claudio Cassardo, University of Torino)	The targeted text has been removed.
928	77065	3	34	5	34	7	Glacial meltwater contributions are already declining in many parts of the world. Some key references are as follows: (i) Baraer M, Mark BG, McKenzie JM, Condom T, Bury J, Huh K-I, Portocarrero C, Gómez J, Rathay S. (2012), Glacier recession and water resources in Peru's Cordillera Blanca, Journal of Glaciology, 58:134-150; (ii) Stahl, K., Moore, R.D., 2006. Influence of watershed glacial coverage on summer streamflow in British Columbia, Canada. Water Resources Research, 42, doi:10.1029/2006WR005022; (iii) Stahl K, Moore RD, Shea JM, Hutchinson DG, Cannon A. 2008. Coupled modelling of glacier and streamflow response to future climate scenarios. Water Resources Research, 44, doi:10.1029/2007/WR005956; (iv) Moore, R.D., Fleming, S.W., Menounos, B., Wheate, R., Fountain, A., Stahl, K., Holm, K., Jakob, M., 2009. Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality. Hydrologic Processes 23: 42–61; (v) Jost, G, and others (2012), Hydrology and Earth System Science, 16, 849–860. (Sean Fleming, Meteorological Service of Canada)	Baraer et al. 2012 is cited in Table 3-1, and we do not have room for the other suggested references. The sentence now begins "In many regions where …". The trouble with "already declining" is that it requires a statement about the date of the maximum.
929	71082	3	34	11	0	16	This FAQ does not link sufficient to the chapter topic (water resources). Suggest that the concepts of "portfolio" and "no regrets adaptation" need to be better linked to the water resources discussion. (CANADA)	FAQ 3.6 has been deleted.
930	81220	3	34	12	0	0	FAQ 3-2 Chapter FAQs should highlight findings that come out of the specific chapter assessment and not from other assessements. The flow of the answer would appeal more to a wider audience if it begins with what is emerging as consistent findings (e.g. flood hazards) and then move into challenges with uncertainty. The flood hazard and flood damage tension is good to highlight here, but the importance of increased exposure and vulnerability is subtly given, it may be better to make it more clear. Authors may wish to consider these changes in their revisions. (Monalisa Chatterjee, IPCC WGII TSU)	The text in this question was changed to address this comment
931	60630	3	34	18	34	18	Specify the meaning of the acronym EACC (Maria Manuela Portela, Instituto Superior Tecnico (IST))	We cannot find the word.
932	81221	3	34	29	0	0	FAQ 3-3 The FAQ is very useful. The language could be alittle more direct and forceful. It may be useful to summarize the factors that will play a role in the first sentence with 'it depends'. (Monalisa Chatterjee, IPCC WGII TSU)	I added a "very" to be more forceful.
933	77161	3	34	30	34	41	The paragraph seems to be inconsistent with what stated above, in particular for what concerrns impacts in 2050s (ITALY)	The first paragraph notes that most models do not account for flow regimes, and in the second, the results of one specific model that relates number of fish specific with mean annual flow.
934	81222	3	34	43	0	0	FAQ 3-4 The answer reads more like a list. Perhaps another sentence on how managing resources, social measures and infrastructure development can interface positively will be useful. The reference to maladaptive actions is useful but a little abrupt. Perhaps a connecting sentence will be useful. (Monalisa Chatterjee, IPCC WGII TSU)	The FAQ was revised a lot.
935	81223	3	35	1	0	0	FAQ 3-5 The message is very general, unless the chapter has specific findings on this and can provide details, perhaps the question can be dropped. Alternatively, authors may wish to change the FAQ and make 'meltwater dividend' the catch phrase and exclusive focus on that if there is strong literature on it. (Monalisa Chatterjee, IPCC WGII TSU)	The message is intended to be very general, and to explain that items of good news are often balanced by corresponding items of bad news.
936	81224	3	35	11	0	0	FAQ 3-6 Although the content of this FAQ will be useful to the wider audience, the subject doesn't seem to fit with the scope of chapter 3. Authors can perhaps check and suggest to other chapters where it would fit more naturally. (Monalisa Chatterjee, IPCC WGII TSU)	FAQ 3.6 has been deleted.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
937	77066	3	35	21	35	27	Kudos for addressing the topic here. However, I think there are some significant issues with the passage as written, at least with respect to glacial rivers. I suggest the author re-reads in detail the Jacobsen et al. paper already cited here, and additionally consults the following papers for a better picture of the subject: (i) Milner AM and others (2009), Hydroecological response of river systems to shrinking glaciers. Hydrological Processes, 23: 62-77; (ii) Dorava JM, and Milner AM (2000), Role of lake regulation on glacier-fed rivers in enhancing salmon productivity: the Cook Inlet watershed, south central Alaska, USA. Hydrological Processes, 14: 3149–3159; (iii) Fleming SW (2005), Comparative analysis of glacial and nival streamflow regimes with implications for lotic habitat quantity and fish species richness. River Research and Applications, 21:363-379; (iv) Ward JV (1994), Ecology of alpine streams. Freshwater Biology, 32:277–294; (v) Moore RD and others (2009), Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality. Hydrological Processes, 23:42-61. (Sean Fleming, Meteorological Service of Canada)	There is not sufficient space to provide more detailed explanation here - see 3.4.4 for more information on the hydrological impacts. The focus of this box is on consequences of these changes to freshwater ecosystems and this issue is also considered further in 4.3.3.3.
938	76877	3	36	35	40	18	A relevant study is: Davie, J. C. S., et al. (2013).: Comparing projections of future changes in runoff and water resources from hydrological and ecosystem models in ISI-MIP, Earth Syst. Dynam. Discuss., 4, 279-315, doi:10.5194/esdd-4-279-2013, 2013. (Rutger Dankers, Met Office Hadley Centre)	Study indeed relevant, now considered.
939	77162	3	36	43	36	43	iWUE requires a definition of what is meant bi intrinsic (ITALY)	Definition provided.
940	60830	3	37	34	37	34	After Cao et al 2009, insert "or a decrease in runoff, depending on the strength of the competing factors of enhanced plant growth and reduced stomatal conductance (Davie et al. 2013)". This study from the ISI-Mip project found that in models including CO2 effects, elevated CO2 could act to either increase or decrease runoff, which is the major finding relevant here. The sentence will likely need reworking as it is already long. The Davie et al. reference is already in the chapter reference list. (Peter Falloon, Met Office Hadley Centre)	Citation added, sentence restructured and moved further below.
941	70804	3	38	0	0	0	Figure VW-1 „Top bottom, with without“ seem interchanged to me (Sarka D. Blazkova, T.G. Masaryk Water Research Institute)	Labelling is correct (top with, bottom without CO2 effect).
942	77163	3	38	7	38	7	coverage, as (ITALY)	Accepted
943	77164	3	38	9	0	9	17% in (ITALY)	Accepted
944	60631	3	39	15	22	18	There are several paragraphs that are authentic miscellaneous of ideas some of them without any interconnection - e.g., pg. 39, lines 15 to 22 "hydropower generation leads to fragmentation of river channels and to alteration of river flow regimes that negatively affect freshwater ecosystems, in particular biodiversity and abundance of riverine organisms (Döll, 2009; Poff and Zimmerman, 2010). In particular, hydropower operation often leads to fast sub-daily discharge changes that are detrimental to the downstream river ecosystem (Bruno et al., 2009; Zimmerman et al., 2010). If, in tropical regions, the ratio of hydropower generation to surface area of the related reservoir is less the 1 MW/km2, the global warming potential (CO2-eq. emissions from the reservoir per MWh produced) can be higher than in the case of coal use for energy production (Gunkel, 2009). Densification of urban areas to reduce traffic emissions may conflict with provisioning additional open space for inundation in case of floods (Hamin and Gurran, 2009)". (Maria Manuela Portela, Instituto Superior Tecnico (IST))	True, but difficult to avoid given space constraints.
945	60632	3	40	18	40	18	Remove the word "so" (Maria Manuela Portela, Instituto Superior Tecnico (IST))	We cannot find the word.
946	60633	3	40	18	40	19	Review the last paragraph (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Where is the paragraph?
947	60634	3	40	30	40	31	The paragraph "Climatic extremes of concern in water management generally recur more frequently than the typical engineering criterion of a 1% probability of annual exceedance" as nothing to do with the content under discussion. (Maria Manuela Portela, Instituto Superior Tecnico (IST))	Revised (deleted).
948	77067	3	41	2	41	2	Really? It would be interesting to cite here just which countries spend nearly half their total energy use just on pumping groundwater...? (Sean Fleming, Meteorological Service of Canada)	has been removed, was an error.
949	56801	3	44	15	44	17	Just a comment that the debate “spawned by the Stern (2007) Review” which is mainly a Western debate was spawned only because Stern proposes a low discount rate is as old as Ramsey who invented the intertemporal optimization approach and in the end argued against the use of discount rates in this approach. (Manuel F. Montes, South Centre)	This comment is not for Ch3?
950	56802	3	47	13	47	16	The example that China’s high growth rate could justify a high discount rate as much as 15 per cent in the example is an application of a microeconomic idea (discounting) applicable to projects to a macroeconomic observation (China’s high national growth rate). Economists often hide the analytical gulf between microeconomic and macroeconomics analysis for the benefit (or to the detriment) of non-specialists. If China’s national growth rate could suddenly collapse because of the unsustainable financial growth, then an argument can be made for a much lower discount rate. (Manuel F. Montes, South Centre)	This comment is not for Ch3?

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
951	64236	3	51	37	51	37	In accordance with comment above (ch. 3, p. 15, l. 4) the following reference should be added: Jóhannesson, T., G. Aðalgeirsdóttir, A. Ahlstrøm, L. M. Andreassen, S. Beldring, H. Björnsson, P. Crochet, B. Einarsson, H. Elvehøy, S. Guðmundsson, R. Hock, H. Machguth, K. Melvold, F. Pálsson, V. Radić, O. Sigurðsson and Th. Thorsteinsson. 2012. Hydropower, snow and ice. In: Thorsteinsson, Th., and H. Björnsson, eds. Climate Change and Energy Systems. Impacts, Risks and Adaptation in the Nordic and Baltic Countries. Nordic Council of Ministers, TemaNord 2011:502, 91–111. (ICELAND)	They are the references of #473.
952	62650	3	64	0	0	0	Please revise ref.7 in the table 3-1. In the seventh row of table 3-1, there is “Disappearance of Chacaltaya Glacier. Bolivia (2009), but ref.7 is from Rosenzweig et al 2007. (Liu Chunzhen, Ministry of Water Resources)	The reference is correct.
953	66089	3	64	0	0	0	Table 3.1, Reference # 7: “Ascent of freezing isotherms at 50 meters per decade". It would be more appropriate to mention the period in which this change has been observed (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Time span of observations added.
954	66090	3	64	0	0	0	Table 3.1, Reference # 12: It is suggested that either "Increase temperature and precipitation" is enough as attribute or 1 or 2 examples of confounding factors may please be added by saying such as ……. (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	No examples were provided as the paper is unclear on which should be the 1 or 2 to be preferably mentioned
955	71833	3	64	0	0	0	Table 3-1 Caption: "Selected examples, mainly from Section 3.2, of the observation, detection and attribution of impacts of climate on freshwater resources." Delete 'change' since the following sentence points out "Observed hydrological changes are attributed here to their climatic drivers, which are not all known to be anthropogenic; In the cast of #15, the change in hurricane frequency have been shown to be in response to the Atlantic Multidecadal Oscillations. The statement in AR5 WG1 is "Consistent with SREX, there is low confidence in attribution of changes in tropical cyclone activity to human influence due to insufficient observational evidence and low level of agreement between studies." (UNITED STATES OF AMERICA)	No. The comment seems to assume that climate change must be anthropogenic, which is definitely not in agreement with IPCC usage. The second sentence of the caption has been reworded to clarify.
956	71834	3	64	0	0	0	Table 3-1: The figure complement to the table is hard to read and not useful. It would be better to (1) eliminate the figure, and (2) switch the table to landscape with columns added to indicate "degree of confidence in detection" and "degree of confidence in detection and attribution". (UNITED STATES OF AMERICA)	We do not agree that the figure is not useful, although it is true that it calls on the reader for study.
957	71835	3	64	0	0	0	Table 3-1: Decreases in groundwater recharge are related to precipitation and air temperature, but cannot be attributed to (anthropogenic or other) climate change with any confidence based on the studies cited. Refs 10 (Aguilera and Murillo, 2009) and 11 (Jeelani, 2008) show historical trends and use conceptual/empirical models to fit these trends. They did not incorporate CO2 effects on transpiration, and the hydrology models were very simplistic. Thus the "Degree of Confidence in Attribution" should be "Very Low." (UNITED STATES OF AMERICA)	It is clearly explined in the figure caption that attribution is to climate drivers only, and not to anthropogenic climate change.
958	71836	3	64	0	0	0	Table 3-1: The figure embedded in the table is not only hard to read but somewhat misleading since it shows only "Selected examples" and none of the selected examples are for the vast major of possible but not selected examples that have either a 'very low' or 'low' 'degree of confidence in detection'. Suggest either deleting the embedded figure or shade the left 2/5s of the figure ('very low' or 'low') a different color to remind the reader that the vast majority of possible examples are not plotted. (UNITED STATES OF AMERICA)	The examples are selected from the literature on hydrological change. There is no evidence of selection bias in this literature. That is, there is no "vast majority" of studies in which change has been searched for and not found.
959	80368	3	64	0	0	0	Table 3.1: Includes material on D&A - please check and ensure consistency with WGI Ch10 and WGII Ch18 of AR5. Table has been expanded to now also include graphic on D&A degree of confidence; What is the basis for this figure, expert elicitation? Please clarify. (Gian-Kasper Plattner, IPCC WGI TSU)	In WG2 chapter 3 we have maintained close contact with WG2 chapter 18 throughout AR5, and have checked carefully for consistency with WG1 chapter 10. The basis of the assignments of confidence is the calculations or expert judgements of the study authors, where given explicitly; or the judgement of the chapter-3 authors, where the source does not make an explicit assignment.
960	81359	3	64	0	0	0	Table 3-1: It would be easier for the reader to follow all information in a single table instead of having some of the information as a chart and some in a table format. The table could include new columns: 1) degree of confidence in detection; 2) Degree of confidence in DnA; and possibly 3) Location; and 4) Year observed which can be separated from the Observed Change column for better organization of the table. (Yuka Estrada, IPCC WGII TSU)	A purely tabular presentation is an obvious alternative, but we prefer to mix tabular and graphical styles of presentation.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
961	81725	3	64	0	0	0	Table 3-1. The combination of figure and table is effective. Several further adjustments to the table could be considered. 1st, it would be helpful to add an initial column to the table that specifies which of the 5 symbol categories the example falls under. 2nd, within the attribution column in the table, a brief annotation could be used within the column for clarity and ease of reading, specifying the type of attribution, for example: "[ACC]" or "[end to end]." 3rd, given that only one reference is relevant to each line of the table, the references could simply be provided within the final column. Finally, a few specific points for the examples: it would be best to specify the timeframe for the reduced runoff for the Yellow River. Then, could it be clarified what is meant by "fraction of risk of flooding"? For examples where only states are given, it could be clearest to also specify the relevant country. (Katharine Mach, IPCC WGII TSU)	These constructive suggestions are valuable and we will try to implement them. However it will be difficult to accommodate physically the extra information (especially suggestion 3) in a table that is already dense with information and likely to fill the entire width of a published page.
962	57122	3	64	0	64	0	Data series used in the references “Piao et al (2010)” is short, and attribution of runoff change in this reference was also cited from another old reference. Therefore, we add three more references to Table 3-1 to renew conclusions for China, which are listed as follows: “Wang and Yan et al (2013), Wang and Zhang, et al (2012), Bao et al (2012)”. Some changes in Table 3-1 are : (1) to change “Reduced runoff (Yellow River, China)” in Table 3-1 to “Reduced runoff (Kuye River in the Yellow River basin, Hai River, China)”; (2) to change “increased temperature, only 35% of reduction attributable to human withdrawals” to “mostly contributable to human activities including land use change, human consumption, etc, such as the Yellow River and Hai River, climate change contributes to 25%~45% of runoff reduction” References (1) Wangm G. Q. Yan, X. L. Yan. Zhang, J.Y. et al., 2013: Detecting evolution trends in the recorded runoffs from the major rivers in China from 1950~2010. Journal of Water and Climate Change. 2013. (accepted,will be published in 2013) (2) Wang, G. Q. Zhang, J.Y.Pagano, T. C. et al. 2013: Identifying contributions of climate change and human activity to changes in runoff using epoch detection and hydrologic simulation. Journal of Hydrologic Engineering. 2012. doi:10.1061/(ASCE)HE.1943-5584.0000559 (accepted,will be published in 2013) (3) Bao, Z.X. Zhang, J.Y. et al., 2013: Attribution for decreasing streamflow of the Haihe River basin, northern China: Climate variability or human activities?". Journal of Hydrology. http://dx.doi.org/10.1016/j.jhydrol.2012.06.054 (Guoqing Wang, Nanjing Hydraulic Research Institute)	Piao et al. 2010 rely on a time series that is 50 years long, citing a 2004 study in support. The references suggested here are very interesting, and are statistically stronger than Piao et al., but they are at a smaller spatial scale and for our purposes are compromised by the probable very strong differences in human activity between the catchments that are studied in detail.
963	62015	3	65	0	0	0	Table 3-2. An additional reference may be included in this table: - Type of hydrological change or impact: Spatio-temporal drought event characteristics - Description of indicator: Mean duration, affected area and total magnitude of drought events over France - Hydrological change or impact in different emissions scenarios or different degrees of global warming: reduced increase in all severity characteristics under the B1 scenario compared to A2 and A1B - Reference: Vidal, J.-P., Martin, E., Kitova, N., Najac, J., and Soubeyroux, J.-M. (2012) Evolution of spatio-temporal drought characteristics: validation, projections and effect of adaptation scenarios. Hydrology and Earth System Sciences, 16(8), 2935-2955. doi: 10.5194/hess-16-2935-2012 (Jean-Philippe Vidal, Irstea)	included in Table 3-2
964	62651	3	65	0	0	0	Please add projected decade in the 1st, 3th, 4th, 10th and 15th row in the second column of table 3-2 and add description of indicator in the 8th row. (Liu Chunzhen, Ministry of Water Resources)	Not possible and meaningful as studies do not relate changes to decades e.g. because ensemble mean changes as a function of ensemble mean global mean temperature rise are reported.
965	66091	3	65	0	0	0	Table 3.2, Reference Schewe at al.: Under description of indicators requires to be rephrased for the sake of clarity (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Revised.
966	76612	3	65	2	65	2	second row, 1st column: change "Decreace" in "Decrease" (Claudio Cassardo, University of Torino)	Accepted and revised
967	57858	3	66	0	0	0	GCM20 should be MRI-AGCM3.2S. Please confirm it 3.1 or 3.2 since Fukubayashi has not yet been published. (Toshiyuki Nakaegawa, Meteorological Research Institute)	Entry removed as publication was not accepted by August 31 2013.
968	66092	3	66	0	0	0	Table 3.2, Reference Van Vliet at al.: In column 2, delete word "with" as it is used twice (GHAZANFAR ALI, GLOBAL CHANGE IMPACT STUDIES CENTRE (GCISC))	Accepted and revised
969	81726	3	66	0	0	0	Table 3-3. The qualifying categories used for this table (CC, M and M+A) would benefit from clarification. It is not fully clear what is meant by particularly relevant to climate change. Additionally, it is not clear how assisting mitigation and adaptation is different from also assisting mitigation. For all examples within the table, footnotes for the relevant citations given at the end of the table should be specified throughout. (Katharine Mach, IPCC WGII TSU)	Table was modified and explantion added.
970	59862	3	66	0	66	0	Table 3-3 - This table seems incomplete. Some cells are empty. If these cells are supposed to be empty, it may be better to put NA in these boxes. (AUSTRALIA)	Accepted.
971	67849	3	66	0	66	0	Table 3-2: In the third column of last row, GCM20 should be either MRI-AGCM3.1S or MRI-AGCM3.2S. Please confirm it according to Fukubayashi et al. (2013). (JAPAN)	Entry removed as publication was not accepted by August 31 2013.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
972	56862	3	66	0	67	0	General comment - Table 3-3: This table is very important for decision makers and needs reviewing, paying particular attention to presentation and communication issues, duplicates, clarity etc. E.g. under "Reduce impact of natural disasters", " Develop contingency plans" and "Actively seek and secure water from a diveristy of sources..." seem to be the same item. Besides contingency plans, disaster and emergency response and recovery is missing (e.g. water restrictions, emergency funds) (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Table modified.
973	60999	3	66	1	67	0	Table 3-3 needs substantial revision and lacks clarity due to overlaps and misinterpretation-representation of different concepts. There are repetitions (e.g. ln 16-17 on the need to change cropping patterns, ln. 19 and ln 15 on wastewater reuse). Furthermore, measures aimed at water demand management and at more efficient water use are not only linked to a reduction of the impact of natural disasters, but also form an integral part of Integrated Water Resources Management. They also form part of "soft approaches". It would be better if the table was re-designed to towards a sectoral approach (agriculture, industry, municipal services), including infrastucture, natural disasters and institutional measures (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Table modified.
974	61000	3	66	1	67	0	This table is very important for decision makers and needs reviewing, paying particular attention to presentation and communication issues, duplicates, clarity for non-technical personnel etc. E.g. under "Reduce impact of natural disasters", " Develop contingency plans" and "Actively seek and secure water from a diveristy of sources..." seem to be the same item. Besides contingency plans, disaster and emergency response and recovery is missing (e.g. water restrictions, emergency funds). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Table modified.
975	56803	3	67	13	67	13	Is the Garnaut reference a peer-reviewed one? (Manuel F. Montes, South Centre)	I did not find this reference in the text.
976	62652	3	68	0	0	0	The Fig.3.1 is too complex, confused and unclearly. It is better to categorize and combine some relevant elements into common terms, such as water management and non-climatic driver into “Governance” etc. The Fig.1 of SPM is a good example. I’d like to suggest revise Fig.3.1 per Fig. 1. (Liu Chunzhen, Ministry of Water Resources)	We revised the figure a lot.
977	63111	3	68	0	0	0	Fig. 3-1: Looking at that figure I had the strong feeling that I need to consult my optician because I couldn't read most of the contents of the boxes without difficulties.....This figure has a really poor resolution. (Sabine Wurzler, LANUV NRW)	We revised the figure a lot.
978	81360	3	68	0	0	0	Figure 3-1: Please provide the legend for this figure. One might get the impression that the different color arrows have some significance. Is this the case, or are they simply for contrast? If it is the latter, then a better way of distributing color should be used that is not suggestive, or simply use one color for the arrows. (Yuka Estrada, IPCC WGII TSU)	We revised the figure a lot.
979	81727	3	68	0	0	0	Figure 3-1. This table would be much more effective if the number of boxes and arrows were reduced, focusing on the essence of the relationships assessed within the chapter. Right now, the reader cannot help but feel tangled in a network of tube-like arrows without seeing the overall point quickly and clearly. The text in all of the yellow square boxes would benefit from revision and clear organization. (Katharine Mach, IPCC WGII TSU)	We revised the figure a lot.
980	61001	3	68	1	0	0	Figure 3-1: A legend for the colour scheme for the arrows is missing. An option could be the colour scheme to represent different components of the presented framework (e.g. driver, status, adaptation, mitigation). (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We revised the figure a lot.
981	61002	3	68	1	0	0	Figure 3-1: The proposed framework is complex and one could argue that several links are missing - for example structural measures lead to changes in exposure but also to vulneability. Also abbrevations such as SLC are not explained. I presume this is Sea Level Change - which in other parts of the reports is abbreviated to SLR; Overall Fig 3-1, in its current form, is too complicated and it should become clearer what it should explain. (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	We revised the figure a lot.
982	56440	3	69	0	0	0	Figure 3-2 might need to add a legend that explains or describes various conditions considered for the graphs included in the figure. (Archis Ambulkar, Brinjac Engineering Inc.)	Figure 3-2 has been removed.
983	62653	3	69	0	0	0	Could you please give more detailed assessment on the research results shown in Fig. 3.2, such as its confidence level and scientific meaning. (Liu Chunzhen, Ministry of Water Resources)	Figure 3-2 has been removed.
984	63113	3	69	0	0	0	Fig. 3-2: The labels of the ordninate are missing. (Sabine Wurzler, LANUV NRW)	Figure 3-2 has been removed.
985	68077	3	70	0	0	0	“Taiwan” in Figure 3-3 should be changed to “Taiwan, China”. (CHINA)	No. We do not wish to refer to politically unsettled questions.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
986	71837	3	70	0	0	0	Figure 3-3: The table describes observed impacts. Given that, the caption should read "Observations" of the impacts rather than "Observations and Projections" of the impacts. (UNITED STATES OF AMERICA)	Accepted.
987	77165	3	70	0	0	0	Figure 3-3 still "under production" (ITALY)	OK.
988	81361	3	70	0	0	0	Figure 3-3: The map shows “renewable freshwater resource” which does not seem to be referred to anywhere in the text. Would it be possible to have a map showing “water quality” so that the map will be more closely in line with the section of the chapter? (Yuka Estrada, IPCC WGII TSU)	There is no such map.
989	81728	3	70	0	0	0	Figure 3-3. The caption indicates that projections are also provided within the graphic, but I am having a hard time figuring out which if any of the examples are projections. Also, for the examples stating "2-6 years" and "near 11 years" it would be preferable to specify the year range if possible. (Katharine Mach, IPCC WGII TSU)	"Projections " was deleted.
990	61003	3	70	1	0	0	Figure 3-3: This figure presents a global view based on very local case studies. It would be important to include a statement to this in the caption to avoid interpreting conclusions found in studies to wide regions (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Good point, mentioned on the text.
991	80369	3	71	0	0	0	Figure 3.4: This is entirely a WGI figure – rather than using the Hawkins and Sutton study here, we suggest that you refer to Ch9/11/12 of WGI AR5 to refer to the assessment of different sources of (physical science) uncertainties in projections. (Gian-Kasper Plattner, IPCC WGI TSU)	Figure 3-4 has been removed.
992	57957	3	72	0	0	0	Figure 3-5 is not clear to me. Particularly several overlapping vertical boxes. Please explore some innovative way to represent this figure. (Sanjiv Kumar, Center for Ocean-Land-Atmosphere Studies)	The purpose of the boxes is now explained in the second sentence of the caption.
993	70696	3	72	0	0	0	Fig. 3-2. This is novel figure but I'm not sure what the take home message is other than there are more references on water quality than groundwater or extremes. More description/discussion of this figure in the text would make it more meaningful. (Cate Macinnis-Ng, University of Auckland)	Figure 3-2 has been removed.
994	61004	3	72	1	0	0	Figure 3-5: Grey boxes difficult to distinguish. Consider different colour schemes, as in the original paper (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The colours in the original paper served to distinguish different methods of measurement, and would be needlessly technical for this assessment. See also response to #992.
995	71838	3	73	0	0	0	Figure 3.6: The legend is missing from this figure. (UNITED STATES OF AMERICA)	Legend changed
996	71839	3	73	0	0	0	Figure 3-6: A clear explanation of the figure in needed. One could assume that changes under the HadCM3 model 4C increases are shown in the red line but it is unclear why the HadCM3 model 2C increases are outside of the range. (UNITED STATES OF AMERICA)	Legend changed
997	81729	3	73	0	0	0	Figure 3-6. It would be helpful to specify what range is shown--5-95%? Then, it would be helpful to specify the colors corresponding to 2 and 4°C. (Katharine Mach, IPCC WGII TSU)	Legend changed
998	56872	3	73	0	73	0	A legend seems to be missing/necessary. (Rita Yu, Climatic Research Unit & Tyndall Centre for Climate Change Research, University of East Anglia)	Legend changed
999	61005	3	73	1	0	0	Figure 3-6: Include in the caption a colour legend for the two lines (corresponding to the 2oC and 4oC increase) (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	Legend changed
1000	68078	3	74	0	0	0	Figure 3-7 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	It is no problem.
1001	81362	3	74	0	79	0	Figures 3-7, 3-8, VW-1: 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)	Robinson projection provided for Fig. VW-1.
1002	70700	3	76	0	0	0	Fig. 3-7. What do the different colours (arrows and other shapes) signify? (Cate Macinnis-Ng, University of Auckland)	Where are arrows and other shapes?
1003	76613	3	76	1	77	1	figures in my opinion are too small, thus regional particulars are hardly distinguishable (Claudio Cassardo, University of Torino)	No enlargement possible due to space constraints; readers can zoom in pdf-version.
1004	61006	3	78	1	0	0	Figure RG-2. Could be useful to add lines indicating current glacial cover in each region (European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)	The data for Ecuador and Europe refer to different catchments while Alaska refers to time series for on catchment. This is now explained in the caption.
1005	76614	3	78	1	78	1	which variable is plotted in the y-axis? What means "Accumulated regional species loss"? Does it mean the absolute number of species lost? (Claudio Cassardo, University of Torino)	Accumulated regional species loss in each region represents the number of species at each site that were found at higher, but not at lower, percentages of GCC. These counts were then accumulated.

#	ID	Ch	From Page	From Line	To Page	To Line	Comment	Response
1006	68079	3	79	0	0	0	Figure VW-1 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)	National borders removed.
1007	76615	3	79	1	79	1	not clear to me the difference between top and bottom figure. Above the graph it is written: with/without CO2. But in the caption they are referenced as only CC/also other things plus CC ("additionally"). So from the captions I understand that also bottom figure contains CO2 effect? Am I wrong? Could you explain it better? (Claudio Cassardo, University of Torino)	Captions were interchanged, now labelled appropriately.