IPCC WGII
Fourth Assessment Report
Climate Change Impacts, Adaptation and Vulnerability

Government and Expert Review of Second Order Draft

Specific Comments

EXPERT REVIEW COMMENTS

Chapter 3

August 2006

(Includes late comments at the end)

Organization of the review comments file

Comments are organized as follows:

(a) First are the comments from the Co-Chairs and TSU. These:
  (i) track the development of the ZOD and FOD, and your responses to review comments on each of these drafts, and then
  (ii) present comments on the Second-Order Draft

(b) Second are the comments from the Expert Reviewers, organized in the same format as your FOD comments file.

Discussion of expert review comments and record keeping

IT IS RECOMMENDED THAT:

- AUTHORS BEGIN WORK ON THE COMMENTS IMMEDIATELY. SUBSTANTIVE COMMENTS NEED TO BE SEPARATED FROM NON-SUBSTANTIVE, AND THE TWO SHOULD BE TREATED DIFFERENTLY
- CONTACT IS MADE BETWEEN AUTHORS AND THEIR REVIEW EDITORS IN AUGUST

Substantive comments

- The chapter writing team should discuss all substantive expert review comments, by email and/or at Cape Town.
- Substantive comments require full and proper consideration. The *Principles Governing IPCC Work* state that:
  - genuine controversies should be reflected adequately in the text of the Report and
  - it is the role of the Review Editors to advise the lead authors on how to handle contentious/controversial issues
- You must record the outcome of these discussions in this document, under the column 'Notes of the Writing Team'.

Non-substantive comments

- For non-substantive comments, a very brief entry should be made in the column 'Notes of the Writing Team'. The following terms are acceptable:
  - Addressed
  - Not applicable
  - Text removed
  - A tick to denote a comment has been addressed (somewhere on the document this should be stated)

General

- The record should be kept in this document, ideally electronically.
- The document becomes part of the traceable account of the Working Group II Fourth Assessment. When completed to the satisfaction of the Review Editors, a copy should be returned to the TSU by the **8th December 2006**.

Chapter 3:

Comments from the Co-Chairs/TSU are laid out as follows: first we comment on whether the SOD addresses the comments we made on the ZOD; second we comment on whether the SOD addresses the comments we made on the FOD; our concluding comments on the Second-Order Draft are at the end

	Chapter 3 ZOD comments by Co-Chairs and TSU	Has this been addressed in the SOD?	Author response
3.Z1	This chapter is less complete than many others and thus quite difficult to comment on	Sections are complete	O.k.
3.Z2	Throughout, and especially from Section 3.4 on, large tracts are missing, to be completed. Essentially, the chapter after 3.4 is yet to be written. Thus, even though the text appears to be about the right length, it is perhaps less than 40% written, so will end up being far too long.	SOD complete	O.k.
3.Z3	Section 3.4 should be the key section of the chapter – it is recommended that it takes up around 50% of the total.	This section stil deserves to be expanded at the expense of other parts of the chapter which need reducing. 3.4 takes up 13 pages ~33% of total length	Expanded
3.Z4	Section numbering is somewhat non-compliant, with the TAR summary in 3.1 for example. A few sub-sections are short, weak and it's not always clear why they are present, e.g. 3.2.1.4. Others are too general, for example, 3.2.2.1, 3.4.1.5, 3.6.	Numbering OK	O.k.
3.Z5	It is not clear what the main emerging conclusions are regarding the new knowledge since the TAR, primarily because the core assessment has not been completed. If the authors are to achieve the right balance, and stay within their page length, they need to think hard about prioritization and key messages. There is no space for extraneous material. The next step is for the authors to undertake reading and assessment of the post-TAR literature. They need to identify the key messages they want to get across in AR4, work out an allocation of pages to the various sections in order to get these key messages across, and work to this plan	Core assessment complete. Chapter now at target length. Greater emphasis on what's new since TAR in certain sections (see 3.S3)	O.k.
3.Z6	The chapter is short on references and examples in many places, relying too heavily on only a few key references	References much more extensive. Number of pages in reference list has quadrupled	O.k.
3.Z7	Sections needing reduction to allow space for additional material elsewhere include Sections 3.1 and 3.	3.1 reduced from 5 to 2 pages in SOD 3.3 increased from 3.5 pages in ZOD to 4 pages in SOD	O.k.
3.Z8	Areas missing, or deserving considerable expansion, include: a) analysis of thresholds/key impacts,	3.2 mentions thresholds for salmon habitat degradation, systems thresholds.	Expansion achieved

	b) assessment of impacts on water demand, c) costs, d) multiple stresses, e) sustainability issues and key vulnerabilities	3.5 drought thresholds for water supply (Box 3.1) Impacts and vulnerabilities addressed in 3.4 Costs, demand, other stresses covered in 3.5	
3.Z9	We suggest that you summarise (and shorten text) by using tables to report the assumption of pop/income/tech under various SRES futures.	Not done. More time spent on uncertainties in section 3.3.1 than the climate and SRES assumptions	As agreed between authors
3.Z10	From page 20 onwards Section 3.4 needs more substance and more pages. Could not some of the key conclusions in TAR be re-assessed and updated e.g.: a) a new Table 4.1 in TAR updated to 2000-2005? b) new versions of Fig 4.1 in TAR showing new data on effects under i) stabilisation and ii) SRES futures? c) new table 4.8 from TAR showing new post-TAR regional studies	Section 3.4 has been increased a) no tabulated update/re-assessment of TAR findings b) No summary for stabilization. For SRES, figs 3.3 and 3.4 cover multiple models and multiple models and scenarios, respectively. c) not present in SOD	Revised
3.Z11	Section 6 on adaptation warrants expanding, especially with reference to the new literature	Still roughly the same length as in the ZOD but is now more concise and covers more info. Literature is recent too. Suggest that T3.4 be expanded. It states that it's not exhaustive but four examples each for supply and demand seems a little thin	Expanded
3.Z12	There are other gaps to be covered and related to other concurrent chapters (Chapter 17 to 20). They refer to water quality and the extreme hydrological events and their environmental and socio-economic implications (including human health related problems, cross-cuts with Chapter 8 and also the relations with the CCTs. In accordance with the above suggestions: i) the water management issue should be strengthened; ii) groundwater issues, including recharge and water quality under climate change needs addressing carefully; and iii) the concurrence / interlinkages with WG-I as well as WG-II´s chapters should be additional points under this section	These issues have been addressed in the SOD i) Management issues are addressed but could be strengthened with more illustrative examples ii) Groundwater covered iii) WG1 chapters referred to	Revised
3.Z13	Except for Arnell´s potential changes in runoff across the world (page 17, line 13 and following) there is no other reference to the Southern Hemisphere / South American sub-continent. However, there is research under the AIACC/GEF	Still short on S American examples but better on Australian – particularly Murray-Darling basin	There are some S. American entries

	and the National communication to UNFCCC´s projects which should be considered. Similarly, the chapter contains no information on expected / projected runoff changes due to snow/ice melt which would produce different runoff effects along the 'life span' of glaciers, particularly in the tropics		
3.Z14	Throughout, the emphasis should be on the new knowledge, laid on the basis of what was reported in the TAR	There is emphasis on new knowledge in the TAR in several sections	O.k.
3.Z15	Statements should be supported by reference to published material (much is not)	There are still sections with no, or very few, references	Revised
3.Z16	The new knowledge that should be reported probably includes new published assessments regarding; a) impacts under stabilisation scenarios; b) impacts under SRES futures; c) new regional studies, especially in developing countries, including results from the AIACC project. These are currently missing. Quite a lot of space is taken up with introductory material that seems not to be essential and could be summarised quite briefly. The main next step seems to require a thorough reading and assessment of the new literature so that the writing team can draw some emerging conclusions about the new knowledge.	SRES covered; stabilization mentioned only in passing Regional studies are present but mostly from Europe e.g., see section 3.4.3. Still need great balance with developing regions There is still a fair bit of space devoted to introductory material and WG1 material. These have highlighted in the excel spreadsheet.	Revised
3.Z17	Frankly, there is a lot to be done		A lot has been done. Is it the propoer lot_
	Chapter 3 FOD comments by Co-Chairs and TSU	**Has this been addressed in the SOD?**	**Author response**
3.F1	There are few Contributing Authors. These provide an opportunity to spread the author base	# of CAs has doubled to 12	O.k.
3.F2	Length:must be reduced from current 70 pages of A4 Word to 45 pp maximum, i.e. by at least a third. This reduction must be achieved in SoD	Now correct length	O.k.
3.F3	Authors must force themselves to consider what are a) the truly important and new knowledge, and b) what are their implications (eg for costs, socio-economic aspects, sustainable development); and condense their assessment to its essentials		O.k.
3.F4	English needs polishing throughout. Maybe identify a new contributing author for this task?	Still needs doing	As good as we can
3.F5	Section 3.4 now exists in first draft, which is good. But it needs considerable condensation; and the later sections eg on costs, adaptation, concusions/sustainability are not yet adequately assessed	Section 3.4 in the SOD is complete and has been condensed from 23 to around 12 pages See 3.Z11 and 3.Z8 for costs and adaptation	Improved
3.F6	The Conclusions are missing. The title of S 3.7 should be:" Conclusions: Implications for Sustainable Development"	Now included	O.k.

3.F7	The Excutive Summary and Conclusions omit mention of some key areas: a) what is new knowledge regarding impacts under different socio-economic pathways (eg SRES); and b) under differerent mitigation scenarios; and c) under different amounts of adaptation	Still missing from ES. Some mention of stabilization in Conclusions but minimal	Mentioned in the body of the text
3.F8	The current ES seems different from TAR only in respect of (new) observed effects. Is this the case: that there are no other significant new areas of knowledge?	The SOD ES has been altered with more info on projected changes	O.k.
3.F9	Omit italicised sections in SoD. (but I agree that they are useful in FoD)	Done	O.k.
3.F10	S 3.2 current sensitivity. This whole section is a thorough and valuable assessment. I suggest two things a) you should now liaise closely with ch1, and b) this section should be condensed to its essentials (maybe much reference material and summary conclusions could be in a table?) and reduced to HALF its current length. For example, in S 3.4.1 Table 3.2 is an excellent summary of new publications (but could this table also include one-line summaries of the main conclusions regarding effects on river flows?)	S3.2 has been drastically shortened from 17.5 → 3.5 pages in SOD. Current adaptation in this section should be expanded to include some specific examples	Included in 3.6
3.F11	S 3.4.1 is now a solid assessment of new knowledge on impacts. The maps are useful. But please think of ways of being more concise: a) one way is to report the conclusion and the source (eg "It is now evident that ….[ref]" rather than " so and so in a study of such and such a place found that...." Readers do not need to know the detail of the latter; and they can find it out in your ref, especially with the new regional database; and b) use tables to summarise conclusions, references, and places studied.	3.4.1 has been considerably shortened. Many of the maps have been removed. Tables to summarise conclusions, references etc have not been employed	A table is not space-effective. There is a summarizing paragraph.
3.F12	S 3.5 is very thin: suggest you bring sections on water availability and shortage to here; and bring demand here; and cover effects under different devt pathways here (i.e. SRES); and also assess the costs literature more thoroughly	3.5 strengthened and availability/shortage/demand have been included	Further strengthened.
3.F13	S 3.6 is also very thin, though it covers several pages. This all needs condensing too, I suggest, a maximum of 5 pages (that is reducing by half in length, while containing much more condensed information). Reduce the boxes substantially. Again: why not summarise adaptation practices/options in a table?	FOD = 12 pages for 3.6 this has now been considerably reduced to 5. Suggestions regarding reduction of boxes and summary of adaptation options have been implemented although the adaptation table 3.4 should be expanded	Further strengthened
3.F14	S 3.7 should be titled "Conclusions: Implications for sustainable development". It is completely missing any discussions of conclusions: especially: a) what is new info about effects under SRES; b) under mitigation ; and c) under differing	Still short on discussion of conclusions – just a generic statement regarding 1degC change since pre-industrial and projected water shortages for 2020 although summary map of selected impacts has	Improved

	adaptation? S 3.7 should include a matrix of available knowledge of projected effects under different assumptions about the future I recommend the authors consider following the example of ch 4 in creating an effective summary of findings, thus: a) a table summarising impacts by increments of T change (table 4.5) b) a summary map of projected impacts, worldwide (fig 4.9) c) a burning embers diagram for each FFF type to show key vulnerabilities (fig 4.10)	now been included	
3.F15	This is a copy of comments on the ZERO-ORDER DRAFT of Ch3 Water by Martin Parry in Jan 2006 [with added observation in square brackets regarding what response is made in FOD]: Reduce 3.1.1 currently 2 pages, to one short intro para. Omit Fig 1 since this can be stated in a sentence. [done] good Reduce this section 3.1.4 currently to (say) 2 sentences, omitting diagrams. These systems were understood and reported in the TAR: only a reminder is necessary here. This should leave you substantial space to expand section 4, which is needed [done] Table 1: Might this not be better in concluding section, drawing all eassessment together? By placing it here, and without references, makes it not clear if this table summarises your assessment of impacts, or of curent sensitivity, or hypothesises connections which wil later be examined. Each statement should be substantiated by ref to sources. [done] Section 3.2 omits to assess current adaptation [still thin, but not a priority] Table 3: How much of this was not reported already in TAR, and could better be summarised in a few lines? [well, it is still here; but I do not see what it says specifically about water; could apply to response in any sector] **(Martin Parry)** Though incomplete this FOD version of Chapter 3 is too much extensive (assigned 30 pages). Many of the examples included should be coordinated with the respectives chapters particulary regarding regional references. This action may	 Done Removed Table removed Includes adaptation but real-world examples would be useful Removed in SOD Chapter substantially shortened and now on target	O.k. – for all

	reduce extension. Although about 100 million people are already afected by natural insidious contamination, mainly with Arsenic and Fluoride; however, no reference is made of this hazard. Information is basic for decision making because of the many health problems and live losses resulting from the consumption of the underground water with high Ar or F concentrations (Ref. The Atlas of Water, R. Clarke and J. King, Earthscan, 2004). This is an important reference due to increasing underground water mining, definitely influence by the Earth ´s warming. In spite of the fact that wars have been initiated due to water shortages (Africa, Middle East, Latin America) no reference is made to this critical social and economic situation. Missing references. For instance in page 7 four reference brackets need to be completed. In all places where mentioned, the water issue shall be refered as a target and not as a goal of the Millennium Development Goals (it is target 10 in MDG 7) In spite of the fact that guidance notes suggest to consider the consecuences of water managment on WEHAB sectors, the potential effects are missing. **(Osvaldo Canziani)**	Fluoride and arsenic hazard now included in SOD. Clark and King ref included in SOD Not mentioned in SOD Some sections still short on references Done Impacts of water excess/deficit on energy, health, agriculture and biodiversity is included in the chapter	
	Chapter 3 SOD comments by Co-Chairs and TSU		**Author response**
3.S1	**LENGTH:**	Exactly 40 pages which is the target	By chance. Let us hope that the FGD, which is much better than SOD, remains at the target length
3.S2	**ARE PAO HEADINGS PRESENT?**	Yes	O.k.
3.S3	**HAVE MOST GENERAL COMMENTS OF ERs FROM ZOD AND FOD BEEN COVERED?** [square brackets and highlighted text gives indication of SOD response to ZOD and FOD reviews]	• Summarise more in tables and figures [some summary figures have been introduced eg F3.2 & 3.7] • Heavy reliance on papers by Oki [in the text Oki is cited as first author twice but the reference list still has 6 citations]	Improved

		• Not clear what advances have been made since TAR [in some sections the advances since TAR are clearly made eg 3.4.1] • References are incorrect [still problems with these] • Boxes not referred to in text [all boxes referred to in text] • ES statements cannot be found in text [all statements in ES can be found in SOD chapter] • English is poor [still needs work] • Fragmented style [now much more uniform]	
3.S4	**ARE REFERENCES BROADLY COMPLETE?**	References need careful checking by authors. In the first 3 pages of text there are several references not included in the ref list, or are incorrectly referenced with missing 2nd authors and dates which don't match between text and ref list. There are also two cases – Arnell (2004) and MEA (2004/5?) where two papers from the same year are cited yet not differentiated in the text.	Checked
3.S5	**IS THERE LINE-OF-SIGHT TEXT ➔ ES AND TEXT+ES ➔ TS+SPM?**	Yes. Need to check sourcing in ES but otherwise the info is there	Yes
3.S6	Needs English polishing		Done as much as we could
3.S7	References need to be carefully checked		Done
3.S8	Section 3.2.2 gives the impression at the start that it's going to cover vulnerability to current climate change/variability but concentrates more on non-climate related stress factors. Needs to be clearer what this section is covering as climate is only a small proportion.		Climate's included
3.S9	Section on uncertainty p11 – this is WG1 material and could be reduced by around 50% by starting at ln10 p12; and downscaling techniques p12-13 – also WG1.		Reduced
3.S10	Several sections with no, or very few, references e.g. 3.5 p26/ p8 ln41-49		Improved
3.S11	It would be good to have a summary table in section 3.1.1 with regional changes in climate precip and temp for all regions. Europe is just mentioned and it would be good to get an overall view of the future. This could replace most of the page currently covering uncertainties.		Done
3.S12	In general the chapter has come a long way but still needs work on the English and is too Eurocentric in parts. Work still needs to be done to plug gaps and remove repetition and WG1 material.		Have done our best
3.S13	***In summary our observations are***: This version is a major improvement on the FOD: But the following are needed: • SRES assumptions need to be represented, preferably tabulated • More detail on impacts related to stabilization and with increments of T change, also preferably		Bullets 1-2 difficult to implement, based on existing references. Otherwise, o.k.

	tabulated • More examples in the adaptation section are needed • Greater balance with developing countries • Remove WG1 material • References need checking carefully	
3.S14	**Further comments from Osvaldo Canziani** There is improvement with respect to FOD. However, SOD still shows the tendency to refer hydrology and water resources issues, progress, problems and requirements (but only research and management) for a few IPCC regions. This shortcoming is also affected by the lack of cross-references with the different Regional Chapters, as required. This comment brings the opportunity to mention that the title given to figure 3.2 does not cover the issues reported in its present title.. It would better read it as follows:" **Some current regional fresh water resources vulnerabilities"**. In fact the figure shows very little on management issues. Furthermore, this figure should include some comment to bring the reader ´s attention to the Regional Chapters dealing with these issues. Particularly in what concerns the regional key vulnerabilities in the water resources, hydrology and related sectors. Furthermore, SOD focus more on theoretical than on operational water management issues. Present and future. Important references on the control and management of water resources should be coordinated with the Regional Chapters ´ CLAs. Chapter 3 ´s authors should remember that this chapter, plus the sectorial and the regional ones will make the foundation of the IPCC Technical Paper on Water and the Panel ´s approved CCT on Water, involving te three IPCC WGs. Therefore, some of the missing information on actions to be taken by governments and decision making levels, such as the need to improve "water productivity" and enhance "irrigation efficiency", should be referred to. Finally, the reading of this chapter has shown that there are repetitions and a lack of appropriate drafting coordination between the different authors, who, in some cases, have develop statements presenting apparent contradictions with those appearing in other sections of the chapter. Such an action would enable to reduce the extension of the chapter, as necessary.	Remarks considered. We tried to react.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-3-1	A	0				why are so many citations given without the standard "et al." for multi-author publications? (Philip Mote, University of Washington)	Corrected
E-3-2	A	0				Throughout: The English needs to be improved and a good edit applied. Some words ought to be changed (such as "regretfully" p 8 l 14 since it is a value judgment) the whole chapter: Any model use should take into account how well models simulate the characteristics of precipitation in current climates; and none do very well. All have precipitation that is too frequent and with insufficient intensity. see e.g. Dai, A., and K. E. Trenberth, 2004: The diurnal cycle and its depiction in the Community Climate System Model. J. Climate, 17, 930-951) Any reasonable assessment must account for inadequacies in models, this chapter does not do that adequately. See the following for what can be said in spite of model deficiencies. Trenberth, K. E., A. Dai, R. M. Rasmussen and D. B. Parsons, 2003: The changing character of precipitation. Bull. Amer. Meteor. Soc., 84, 12051217. The whole chapter is weak with regard to evaporation and drying effects of climate change. Why is there almost no discussion of increased potential evapotranspiration that goes along with warming, increased drying and evaporation as a result, and increased risk of drought? This is dealt with a lot in chapter 3 of WG 1. See also for instance Dai, A., K. E. Trenberth and T. Qian, 2004: A global data set of Palmer Drought Severity Index for 1870-2002: Relationship with soil moisture and effects of surface warming. J. Hydrometeor., 5, 1117-1130. A number of references are given to WG I but usually to the SPM. This is inappropriate and the reference should be to the appropriate chapter of WG I. (Kevin Trenberth, NCAR)	Edited.
E-3-3	A	0				Throughout the chapter, integrated water resources management is invoked as a potential solution to problems identified – but insights into what integrated water resources management is are scant. If the authors are going to invoke this term in the chapter, then it would be helpful to include a brief but substantially overview of what the concept is and how it has been defined in the literature and practice. Perhaps a box could be used at an appropriate place? In general, the chapter is much improved relative to the first draft. However, it remains choppy in many places; for example, in numerous sections paragraphs of text did not flow particularly well, jumping from point-to-point in an almost random fashion (as if the section was a collection of notes from the literature that needed to be tied together coherently). In these sections, it was difficult to get a sense for the overall message in the section and subsection. Section 3.4.4 stands out	Improved

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						as being one that did NOT suffer from this problem. (Rob de Loë, University of Guelph)	
E-3-4	A	0				Thoroughly reading the whole chapter 3, I find out that I do not have too much to add or comment for improving. The structure of the chapter has been restructured a bit, the text gain in clarity though the number of pages has been reduced. (Constanta Boroneant, National Institute of Meteorology and Hydrology)	Thank you
E-3-5	A	0				This manuscript is greatly improved over the previous draft and seems well on its way toward completion! (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Thanks
E-3-6	A	0				This chapter is a marked improvement over the early draft I reviewed and the authors are to be congratulated. With respect to the information on various issues as presented in the different sections, I find them to be accurate and well supported with a substantial list of references. But, I wish to qualify my remark by saying that my above statement applies to facts and figures which are " non-climate" related. With respect to "climate-related" aspects, while statements based on globally observed and/or analyzed results related to hydrologic cycle are (by now) well substantiated (i.e., increases in global precipitation etc.), the regional implications are highly speculative. For all practical reasons, any grand conclusion and/or statements with respect to increases, decreases etc, of hydrologic fluxes in certain regions are hard to support. As indicated in the very last section, the uncertainties in regional model results are too large to be of any value to water resources management community. There are reports that show two or more regional models when applied to the same region, may show opposite trends. I wished this chapter would have started and ended with a MUCH stronger statement about the high degree of uncertainties in the output of climate models (regionally speaking) and why (at least in this assessment cycle), one should not put much faith on regional study conclusions. We need to do much more before we start making such information useful to the water resources management communities. (Soroosh Sorooshian, University of California, Irvine)	Thanks. We hope that FGD is much better than SOD.
E-3-7	A	0				There is a tendency of some co-authors to try to squeeze in too many details, often in the form of statements in parentheses. Some of this detail is unwarranted in this synthesis and I have made specific comments on several of these occurrences. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Changed, in many places

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-3-8	A	0				The whole chapter seems to be missing much information on research that has been done on the impacts of climate change on whole water resource systems (not just surface water - this seems to only include rivers), There is a tiny section on this under section 3.3.1 uncertainties - but this is very thin and does not really include much information on the new integrated studies that have been done since the TAR. Dennis Lettenmaier's group have published many studies on this sort of thing as have many UK groups. I really think that it would be worth having a section on "integrated water resources" in section 3.4. This seems a large omission and a real advance since the TAR. (Hayley Fowler, Newcastle University)	Several advances along these lines.
E-3-9	A	0				The use of descriptive confidence levels varies between sections. Some include many confidence level statements (e.g. 3.4.4) while others have none. This should be harmonised. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Uniformized
E-3-10	A	0				The major improvement I'd like to see in this chapter is a more clear specification of those regions where changes in the climatic drivers can be defined with greater confidence vs others, based on detailed references to the appropriate sections of the WGI report. Then, in turn, a greater consistency in assessing the level of confidence of projected impacts on the various aspects of the fresh water resources problem. As an example, I see in Fig 3.3 little consistencheny of results among the various models concerning runoff in Northeastern Brazil yet in Fig. 3.7 I see that this region is mentioned with emphasis regarding the changes in groundwater recharge, how can this be credible? This improved specification and level of consistency should then be reflected in the Executive Summary. (Annarita Mariotti, ENEA)	Further advances towards these remarks
E-3-11	A	0				The chapter suffers from one of the common problems in impacts studies: an overemphasis on the negatives, such that any positive changes are overlooked or underemphasized. For balance, some effort needs to be made to mention positives where they exist. (Philip Mote, University of Washington)	Some positive effects mentioned (increased water availability in some areas)
E-3-12	A	0				The chapter has vastly and positively developed over the previous draft stages. There are a couple of general issues that I think should be taken care of in the chapter: 1. Much of the more conceptual information provided is relying on very few sources, such as Petra Dölls work. 2. In many cases (such as under 3.2.2) anecdotal cases cited on global vulnerabilities are taken in the context of climate change without a more stringent	There are not many papers to compete with Petra's results. Improvements achieved in response to many of these comments.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						deduction/reasoning ehy a singular event should be part of climate change. It would be more helpful to show that the increase in frequency and intensity of certain hydrometeorological phenomena/extremes have a high probability to be linked to climate change or, if not climate change as a whole, increased climate variability. If not taken up in this chapter, creoss reference should be made to other chapters that take up the issues of and idfferentiation of climate variability, climate change, it4nsification of climate variability and trends in climate variability as part of climate change processes and likewise, finding some words on threshhold values observed in rapid climate changes in the past. In terms of vulnerabilities a few events could be singled out to demonstrate how in a warming climate these events would be more the norm than now or in the past. 3. The chapter does not provide a transition in incresed knowledge from the the TAR to the present assessment: What do we now know more than in the previous assessment? How did likelihoods of predicted changes change? Is it possible to introduce a table to demonstrate the increase in knowledeg and the decrease (to certain extents) in uncertainties of predictions? 4. In 3.8 the key uncertainties mentioned seem to be much larger than cemonstrated in the text, this leads to the impression of being contradictory. It needs to be worked out more clearly: Which issues have become more certain since the previous assessments and which issues remain to have major uncertainties. One needs to work around the issue that major uncertainties would mean that they are not policy relevant as there is no decision rule that could be justified under major uncertainties. For medium uncertainties one could mention a policy of no regret and flexibility. 5. Perhaps the most important criticism is that only negative aspects of climate change are highlighted globally which is simply not refelcting realities. There needs to be a more balanced approach to highlight "winning" and "losing" regions. Yes, it is understanbale that the "losing regions" dominate and certainly so with regard to socio-economic impacts considering that the the highest population increase is in the semi-arid areas, that also have highest negative impacts and least adaptation capacities. 6. One could also use one example to highlight positive and negative aspects: Use permafrost for example: Thawing of permafrost will lead to the possible expansion of wheat growing areas in Russia (positive) and likewise to extensive damages in infrastructre as well as increased release of greenhouse gases (negative). 7. In terms of making a difference between climate variability and change, one could argue that climate variability calsl for more robust design and decision	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						making systems while climate change calls for a range of policy-driven adaptation measures that will have a larger impact on social life and economies. 8. In calling for more robust desgin decisions nd adaptation measures, water managers will argue that the current design procedures (such as for dams and reservoirs) having a desing of a 1000 year flood would still be very much within any scale of projected climate change. It needs to be argues more in the line that probabilities of safe water supply are decreasing under system stress, that energy production is at risk with increasing drought problems etc (see examples cited for the dry summer 2005 in an article of the WALL STREET JOURNAL EUROPE, page A10, Tuesday 9 August 2005 (Wolfgang Grabs, WMO)	
E-3-13	A	0				The chapter has a lot of good material. As with any multi-author chapter, vigorous efforts are needed to bring coherence, and some sections are a real slog to read. Paragraphs that consist of several sentences describing local studies need some work to draw wider conclusions. Editing can fix much of this but considerable time will be required (Philip Mote, University of Washington)	More coherent now
E-3-14	A	0				REFERENCES: need careful checking by authors. In the first 3 pages of text there are several references not included in the ref list, or are incorrectly referenced with missing 2nd authors and dates which don't match between text and ref list. There are also two cases – Arnell (2004) and MEA (2004/5?) where two papers from the same year are cited yet not differentiated in the text. Oki cited only twice as first author in the text but there are 6 citations in the ref list (Clair Hanson, IPCC TSU)	References checked
E-3-15	A	0				Our comments include the following new sources of literature that we recommend for inclusion in the references' list: 1. Glaser, R., 2001, Klimageschichte Mitteleuropas – 1000 Jahre Wetter, Klima, Katastrophen. Primus-Verlag, 227 p 2. Ministry of Water Resources - Government of India (1998). India - Water Resources Management Sector Review, Groundwater Regulation and Management Report. Washington D.C., New Delhi, World Bank, Government of India 3. Moench, M. (2003). Groundwater and Poverty: Exploring the Connections. Intensive Use of Groundwater: Challenges and Opportunities. R. Llamas and E. Custodio. Lisse, A.A. Balkema: 441-156 4. Shah, T. (2005). "Water Poverty and Economic Development: Cross-country Analysis and Implication for Policy Reform." IWMI-TATA, Water Policy Research: Highlights 2.	Interesting references, but the chapter is about future predictions

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						5. Tsur, Y. (1990). "The Stabilization Role of Groundwater When Surface Water Supplies Are Uncertain: The Implications for Groundwater Development." Water Resources Research 26(5): 811-818. 6. Tsur, Y. (1993). The Economics of Conjunctive Ground and Surface Water Irrigation Systems: Basic Principles and Empirical Evidence from Southern California, Department of Agricultural and Applied Economics, University of Minnesota. 7. Pielke, Jr. R.A, Downton, M.W., 2000, Precipitation and damaging floods: Trends in the United States, 1932-97, Journal of Climate, 13(20), 3625-3637 8. The Fluid Mosaic: Water governance in the context of variability, uncertainty and change. A synthesis paper' by Marcus Moench, Ajaya Dixit, S. Janakarajan, M.S. Rathore and Srinivas Mudrakartha (2003) 9. Guidelines for reducing flood losses, (UN 2004) (http://www.unisdr.org/eng/library/isdr-publication/flood-guidelines/isdr-publication-floods.htm) 10. Frank Thomalla, Tom Downing, Erika Spanger-Siegfried, Guoyi Han, Johan Rockström, 2006, 'Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation', Disasters, 30(1), 39-48). 11. Schipper, L., Pelling, M., 2006, 'Disaster risk, climate change and international development: scope for, and challenges to, integration', Disasters, 30(1), 19-38 12. F. Sperling and F. Szekely (2005). 'Disaster Risk Management in a Changing Climate'. Discussion Paper prepared for the World Conference on Disaster Reduction on behalf of the Vulnerability and Adaptation Resource Group (VARG). Reprint with Addendum on Conference outcomes. Washington, D.C.) available at www.unisdr.org (Silvia Llosa, ISDR System)	
E-3-16	A	0				Many parts of the world currently have critical water shortages, independent of climate change. Increasing population and wealth will exacerbate these problems, whether or not climate changes. These problems are not limited to the developing world, they exist in the U.S. Southwest, much of Australia, and other places in the developed world. The chapter acknowledges these problems, but needs to do a better job of explaining the relative roles of climate change and other factors in creating water shortages. (Lenny Bernstein, L.S. Bernstein & Associate, L.L.C.)	See 3.5.1
E-3-17	A	0				It is suggested that the authors familiarize themselves with Milly et al. (2005, Nature, Global pattern of trends...), which is not cited in this chapter, but which seems relevant.	Done

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						(Christopher Milly, U.S. Geological Survey)	
E-3-18	A	0				In general, the Second Order Draft presents significant improvements concerning structure, contents and conclusions compared to the FOD, even if some review comments are not incorporated. (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Now, we improved SOD
E-3-19	A	0				I note that Section 3.4.2, "Soil Water and Evapotranspiration" that was in the First Order Draft has been removed from this Second Order Draft. In the First Order Draft, the authors stated that most previous studies have assumed that increasing CO2 will have no direct effects on evaporation or that reduced stomatal conductance will be offset by increased crop growth. I commented that such an assumption is not wise. It is true that the very first free-air CO2 experiments did not show significant effects of CO2 on evapotranspiration (e.g. Dugas, W.A., M.L. Heuer, D.J. Hunsaker, B.A. Kimball, K.F. Lewin, J. Nagy, and M. Johnson. 1994. Sap flow measurements of transpiration from cotton grown under ambient and enriched CO2 concentrations. Agricultural and Forest Meteorology 70:231-245; Hunsaker, D.J., G.R. Hendrey, B.A. Kimball, K.F. Lewin, J.R. Mauney, and J. Nagy. 1994. Cotton evapotranspiration under field conditions with CO2 enrichment and variable soil moisture regimes. Agricultural and Forest Meteorology 70:247-258; Kimball, B.A., R.L. LaMorte, R.S. Seay, P.J. Pinter Jr., R. Rokey, D.J. Hunsaker, W.A. Dugas, M.L. Heuer, J.R. Mauney, and G.R. Hendrey. 1994. Effects of free-air CO2 enrichment on energy balance and evapotranspiration of cotton. Agricultural and Forest Meteorology 70:259-278.). However, these first experiments were conducted on cotton, a woody C3 species with a large CO2 growth response (about 40% for a 200 ppm increase in CO2; Mauney, J.R., B.A. Kimball, P.J. Pinter Jr., R.L. LaMorte, K.F. Lewin, J. Nagy, and G.R. Hendrey. 1994. Growth and yield of cotton in response to a free-air carbon dioxide enrichment (FACE) environment. Agricultural and Forest Meteorology 70:49-67.). In contrast, more recent FACE experiments with sorghum, a C4 grass, had an insignificant CO2 growth response (Ottman, M.J., B.A. Kimball, P.J. Pinter Jr., G.W. Wall, R.L. Vanderlip, S.W. Leavitt, R.L. LaMorte, A.D. Matthias, and T.J. Brooks. 2001. Elevated CO2 increases sorghum biomass under drought conditions. New Phytologist 150(2):261-273.), while at the same time it had a significant reduction in evapotranspiration (about 13% for a 200 ppm increase in CO2; Conley, M.M., B.A. Kimball, T.J. Brooks, P.J. Pinter Jr., D.J. Hunsaker, G.W. Wall, N.R. Adam, R.L. LaMorte, A.D. Matthias, T.L. Thompson, S.W. Leavitt, M.J. Ottman, A.B. Cousins, and J.M. Triggs. 2001. CO2 enrichment increases water use efficiency in sorghum. New Phytologist 151(2): 407-412; 183.	The chapter is on projections, and based on the post-2001 references

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						Triggs, J.M., B.A. Kimball, P.J. Pinter Jr., G.W. Wall, M.M. Conley, T.J. Brooks, R.L. LaMorte, N.R. Adam, M.J. Ottman, A.D. Matthias, S.W. Leavitt, and R.S. Cerveny. 2004. Free-air carbon dioxide enrichment effects on energy balance and evapotranspiration of sorghum. Agricultural and Forest Meteorology 124:6E-3-79). Wheat was intermediate between cotton and sorghum (Hunsaker, D.J., B.A. Kimball, P.J. Pinter Jr., R.L. LaMorte, and G.W. Wall. 1996. Carbon dioxide enrichment and irrigation effects on wheat evapotranspiration and water use efficiency. Transactions of the ASAE 39(4):1345-1355; Hunsaker, D.J., B.A. Kimball, P.J. Pinter Jr., G.W. Wall, R.L. LaMorte, F.J. Adamsen, S.W. Leavitt, T.W. Thompson, and T.J. Brooks. 2000. CO2 enrichment and soil nitrogen effects on wheat evapotranspiration and water use efficiency. Agricultural and Forest Meteorology (104)2:85-100; Kimball, B.A., R.L. LaMorte, P.J. Pinter Jr., G.W. Wall, D.J. Hunsaker, F.J. Adamsen, S.W. Leavitt, T.L. Thompson, A.D. Matthias, and T.J. Brooks. 1999. Free-air CO2 enrichment (FACE) and soil nitrogen effects on energy balance and evapotranspiration of wheat. Water Resources Research 35(4): 1179-1190.). Thus, it appears likely that significant proportion of Earth's vegetation (half of the Midwest is covered by corn, a C4 plant much like sorghum, southern prairie grasses, many plants in Australia) will likely have reductions in ET due to the elevated CO2. In the First Order Draft, the authors went on to cite modeling studies which suggested that elevated CO2 will have significant effects in some regions depending on scenarios, which is appropriate. However, in spite of the FACE data in the literature and these modeling studies, the authors seem to discount the direct CO2 effects, and the last sentence states uncertainty. While of course there is uncertainty associated with these effects, on the other hand there is far less uncertainty associated with the data on direct CO2 effects on ET of vegetation than there is on the indirect effects of elevated CO2 on future precipitation patterns, which forms the basis for the bulk of the climate change-hydrology studies. On page 8 of the Second Order Draft, the authors appropriately cite the recent paper of Gedney et al (2006), which attributes a 3% rise in global river flows over the 20th century to reductions in ET due to the increases in atmospheric CO2 concentration that occurred over the century. This result is consistent with the above-mentioned FACE data. However, it seems logical to me that a discussion of the effects of elevated CO2 on ET should be reinstated along with a discussion of the consequences for stream flows. (Bruce Kimball, USDA, Agricultural Research Service)	
E-3-20	A	0				I found this version of the chapter to be much better written than the previous draft. There has obviously been a great deal of effort put into revising the previous draft	Homogeneization effort undertaken

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						and all involved are to be congratulated. I did, however, find that the chapter is still in need of further revision and editing to create greater consistency in the presentation of the material. It still reads very much like a document that has been written by many people, each with their own style and focus. Perhaps this will always be the case for a document of this nature. (Donald Burn, University of Waterloo)	
E-3-21	A	0				I also found that there has been considerable change in the content of the chapter, with many sections on which I previously had comments no longer being in the chapter. There does seem to have been a change in focus with less attention to impacts on the hydrological cycle and more of a focus on water management issues. This is not meant to be a criticism, but merely an observation. (Donald Burn, University of Waterloo)	Further major changes made
E-3-22	A	0				General Comments: This chapter has been improved quite a lot since the last version. However, it needs more explanation almost everywhere on the impact of climate change scenarios (A2 & B2) on water resources. For example, there is a need to explain to the reader why Co2 would lead to increase or decrease in river flows or groundwater recharge or LAI, etc. what is the mechanism and relationship. The chapter in most of it gave the outcome of the climate change on certain parameter of the water balance without explaining why and how. The reader will be interested to know why and how Co2 will lead to such changes. There are paragraphs where the number of references more than the text. It looks quite stuffed with references at places. Please revise. Some of my previous comments were taken on board and some were not. It might be worthwhile to revisit them. (Ragab Ragab, Centre for Ecology and Hydrology)	Largely improved
E-3-23	A	0				General comments: [1] Given the importance of soil moisture for plant growth and, therefore, agriculture, forests, biological productivity, etc, there should be a a wider discussion about past empirical trends in soil moisture than is contained in this chapter. Reference to the results of Robock et al. (2000, 2005), for example, which are based on empirical data, would be appropriate. Notably, their rsults indicate that these trends do not track general expectations in a warming world. (2) Equally astonishing is the fact that there is almost no discussion as to whether -- and to what extent -- changes in climate related variables seen in recent decades are within the bounds of natural variability. [References: (1) Robock, A., Mu, M., Vinnikov, K., Trofimova, I.V. and Adamenko, T.I. 2005. Forty-five years of observed soil moisture in the Ukraine: No summer desiccation (yet). Geophysical Research	The chapter deals primarily with future projections

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						Letters 32: 10.1029/2004GL021914. (2) Robock, A., Vinnikov, K.Y., Srinivasan, G., Entin, J.K., Hollinger, S.E., Speranskaya, N.A., Liu, S. and Namkhai, A. 2000. The global soil moisture data bank. Bulletin of the American Meteorological Society 81: 1281-1299.] (Indur Goklany, US Department of the Interior)	
E-3-24	A	0				General comments on Chapter 3: I understand that editing will be done BUT the writing style is very poor, very stilted.The text is very repetitious in describing climate change. Statements are too often qualified by "may be the case", "it is possible that". Stronger assertions are warranted in many places. The ordering of paragraphs within sections seems nearly random. Paragraphs frequently contain two or more topics without transition. Contrary to the intent of the assessments, a great deal of space is devoted to methodology rather than findings (i.e. what do we know). (Charles Howe, Institute of Behavioral Science)	Largely improved
E-3-25	A	0				GENERAL COMMENT: The SOD is very different from the FOD. There has been needed abbreviation, but many important aspects have been omitted as well. Though the intended coverage includes snow, ice, and water vapour ("Guidance Notes for Expert Reviewers") the SOD is essentially limited to the liquid form of water. In turn, this limitation places the geographical focus of the chapter on the warmer parts of the globe, and ignores vulnerabilities and climate impacts associated with cold regions hydrology . (Spyros Beltaos, National Water Research Institute)	The length has been reduced with new material added, so much material had to go.
E-3-26	A	0				Compared with the previous draft, there has been a significant increase in the number of examples and case studies reported which emanate from the USA. In terms of the numbers of reported illustrative cases which can be drawn on I am sure that the USA provides a significant proportion. However, at times, this chapter read like a report for the USEPA (no bad thing in itself) rather than a eclectic review of a global problem. If so many cases from the USA are to be used, some comment on why they are so predominant might be warranted. There are a number of references cited in the text that do not appear in the list at the end of the Chapter. I feel that the quality of composition throughout this Chapter has suffered from the need to reduce the page count. Paragraphs are sometimes disjointed and assumed knowledge often a burden to understanding. I have tried to highlight some of the major instances but a thorough proof read by an intended recipient of the report prior to final publication would be a useful investment. (Paul Jeffrey, Cranfield University)	Improved

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E-3-27	A	0				Boutkan & Stikker 2004 not listed but cited in p. 39. Burkett et al., 2002 cited in p. 8, is it Burnett instead? Fassio et al., 2005 cited on p. 39 but not listed here. Faver et al., cited P. 7, but Fayer et al., listed ? Guo et al. 2004, cited but not listed. There are two pieces of work under Holman et al. 2005; lettering a and b required in citations p. 42. Ochada et al., 2004 cited on p. 39 but not listed here. There are two pieces of work under Oki et al. 2003; lettering a and b required in text citations. Schmidt and Dikau 2004 cited but no in list. Shiklomanov 2003 cited but not listed. Vassolo 2005 cited in text (ex. p. 6) but not listed here. WDR 2003, 2004 not listed bu cited. Wilby and Harris, please verify year p. 2005 or 2006 (see p. 42 and 64). Yarze (p. 65) or Yarza (p. 7) Zacharias et al. 2003 not listed but referred to (see p. 39). In summary, the reference list contains numerous mistakes that would be tedious to completely inventory here. The authors should correct the mistakes listed above review carefully the citations in text along the reference list as many errors exist in the years of articles, the spelling of names, etc. (Martine M. Savard, Geological Survey of Canada)	References checked
E-3-28	A	0				1. I found Chapter 3 difficult to read. As a reason I identified the rather awkward and winding way the authors make to reach their target "Freshwater Resources and their Management" in the view of "Climate Change Impacts, Adaptation and Vulnerability". I understand that the main focus is on projections, observations are dealt with in Chapter 1 of WG2. The problem could be overcome by two mayor changes: (i) Non-climate drivers should only be presented in a way to allow for better allocation of the climate drivers. In the present version they are too prominent, almost as they were in the main objective of the report. Wide parts read as a draft for the World Water Assessment Report and not for a Climate Change one. (ii) Too many efforts are made and too much space is given on the presentation and discussion on climate projections, i.e. future global and regional temperature and precipitation scenarios. They are thoroughly presented and discussed in the respective Chapters of WG1: "The Physical Basis of Climate Change". In WG2 Ch3 only a brief summary should be given with reference to the WG1 chapters 8 –	Changes went in the direction of this comment

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						11. This summary should only focus on the needs for WG2 Ch3. (Georg Kaser, Geo and Atmospheric Sciences)	
E-3-29	A	3	1	42		Following are citations not provided within individual comments. Most of these can be obtained at http://members.cox.net/igoklany/ Goklany, IM. 2003. Relative Contributions of Global Warming to Various Climate Sensitive Risks, and Their Implications for Adaptation and Mitigation. Energy & Environment 14: 797-822. Goklany, IM. 2005c. Is a Richer-but-warmer World Better than Poorer-but-cooler Worlds? 25th Annual North American Conference of the US Association for Energy Economics/International Association of Energy Economics, September 21-23, 2005. Goklany, IM. 2005a. A Climate Policy for the Short and Medium Term: Stabilization or Adaptation? Energy & Environment 16: 667-680. Goklany, IM. 2006a. Integrated Strategies to Reduce Vulnerability and Advance Adaptation, Mitigation, and Sustainable Development. Mitigation and Adaptation Response Strategies for Global Change, forthcoming. Goklany, IM. 2006b. Death and Death Rates Due to Extreme Weather Events: Global and U.S. Trends, 1900-2004, Climate Change and Disaster Losses Workshop, 25-26 May 2006, Hohenkammer, Germany. (Indur Goklany, US Department of the Interior)	Page limit! We were sticking to water
E-3-30	A	3	1			The organisation of the statements from high to low confidence is not evident since nearliy all statements cited in the "Executive summary" are of the category "high confidence". My proposal is to file the statements in a more deterministic way e.g. increase in temperature causes impact in - sea level rise... - decreased snow storage - changed variability and timing of precipitation etc (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	ES substantially revised
E-3-31	A	3	1		33	P 3 l 33: states that "simulation of precipitation by climate models remains largely uncertain". This is s strange choice of words. In fact it remains poor, or unrealistic, or not very good. Now that may create uncertainty about credibility of change projections. But why not say that? In particular, precipitation has many characteristics: type, frequency, intensity, duration, and amount, as well as its distribution in space and time; and so forth. It would be helpful to elaborate and note that models do not simulate frequency and intensity well and errors exist in some major features (like the ITCZ which spuriously migrates across the equator). There ought to be a statement in the exec summary about the state of art in	Uncertainty bits revised

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						simulating precipitation by itself. (Kevin Trenberth, NCAR)	
E-3-32	A	3	1			Comment on Executive Summary. This comment reiterates some that were made earlier on the FOD. The summary has a few significant gaps: [1] Given the importance of soil moisture for plant growth and, therefore, agriculture, forests, biological prodcutivity, etc, there should be a couple of sentences in the Executive Summary dealing with this matter. (2) Similarly the Summary should also indicate whether -- and to what extent --changes seen in recent decades are within the bounds of natural variability. (Indur Goklany, US Department of the Interior)	Disagree. Prioritization forced by page limit
E-3-33	A	3	3	3	5	These introductory remarks should be re drafted to provide a more appropriate approach to Chapter 3 objectives. Suggestions are following: a) The fresh water problems (meterological, hydrological, social, economic and else) are basically of a local and sub-regional nature and their causes and effects are influenced by climate change. Therefore, it would clearer to say: Since fresh water issues are particular to local, national and sub-regional scales, relevant information and specific key vulnerabilities to climate change are found in the regional chapters (9 to 16) b) For AR4 one of the specific requirements for chapter 3 is to improve and expand the information available in previous IPCC assessments with regard to water management. In fact, the magnitude of the problem to be faced from now on, calls for the best possible information on integrated water management. Therefore, this introduction to the chapter ´s aim should also mention this very important requirement. c) Finally we should amend the reference to the Chapter 1 incumbencies, in line 4 it should read “water related observed changes and responses, in natural and managed systems”., which is completely different meaning than “water-related observation data”. On this very critical problem (lack of observation data) more comments are given below. (Osvaldo Canziani, IPCC WGII Co-chair)	Substantial rewording
E-3-34	A	3	3	3	3	The first part of the sentence should be changed to: ‘Since water resources are of regional scope…’ (Martine M. Savard, Geological Survey of Canada)	Changed
E-3-35	A	3	3	3	5	The ES should not start with mentioning what other chapters did, but with a strong sentence on the scope of Chapetr 3 (Georg Kaser, Geo and Atmospheric Sciences)	Revised
E-3-36	A	3	3			Executive summary: what is the rationale for the order of appearance of bullets? If	(Fuzzy) order dictated by importance and

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						there is one it should be noted; otherwise we suggest ordering according to references to sections. (,)	logic of structure (if possible, smooth transitions)
E-3-37	A	3	4	3	5	the sentence 'This chapter … issues' does not seem necessary and could be deleted. (Silvia Llosa, ISDR System)	Done
E-3-38	A	3	8	3	8	Cancel the first mention to vulnerabilities so to read: current and future impacts and vulnerabilities, adaptation and sustainable use of freshwater, as affected by climate change, are summarized below. (Osvaldo Canziani, IPCC WGII Co-chair)	Reworded
E-3-39	A	3	9	3	10	The statement in these lines would be superfluous. (Osvaldo Canziani, IPCC WGII Co-chair)	O.k.
E-3-40	A	3	9	3	10	Last sentence, "The statements are organized …" This statement seems uneccessary as all but only 2 of the 9 bullets have "high" confidence levels. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-41	A	3	10			Whilst I welcome the pragmatic approach taken to the reporting of relative confidence levels adopted here, without some point of reference for at least one of the statements, the reader has no basis on which to form an opinion about the signficiance of each statement. Could not either the first or last statement be associated with a more definite (though not necessarily numeric) confidence indicator ? Perhaps a similar classification to that provided for Table 2.5 in Ch2 ?? (Paul Jeffrey, Cranfield University)	Revised
E-3-42	A	3	12	3	17	An example of change in precipitation variability may be given, according to the examples for sea level rise and snowmelt. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	This is WG1 remit
E-3-43	A	3	12	4	14	It should be made clear before the bullet point list that the numbers contained in parentheses (I assume) refer to subsequent section headings (Paul Jeffrey, Cranfield University)	Now it is clear
E-3-44	A	3	12	4	14	Bullets: these illustrate the apparent indecisiveness of assertions in the report: line 12 speaks of "the most certain impact of climate change" without saying what that is. Line 30 leaves one wondering if anything is relly known about the impacts of climate change (Charles Howe, Institute of Behavioral Science)	Substantially revised
E-3-45	A	3	13	3	13	"high confidence, 3.3.1..", one could mention that these are sections of this chapter. (Annarita Mariotti, ENEA)	Self-explanatory
E-3-46	A	3	13	4	14	It is not clear the meaning of the numbers reflecting high, medium or low confidence (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Explained centrally in the report

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E-3-47	A	3	15			"will be affected by reduction…". This is a very strong claim. Is it "reduction" at the global scale? Are there regions that may experience increases? (Soroosh Sorooshian, University of California, Irvine)	Changed
E-3-48	A	3	16	3	17	Change "confidence. Thus, … decrease." to "confidence, resulting in a decrease of freshwater availability in coastal areas." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Changed
E-3-49	A	3	16	3	16	After the dot add: More than a quarter of people worldwide relay on groundwater for drinking. Before closing the following sentence, replace groundwater by coastal aquifers and add estuaries, so to read: salinization of aquifers and estuaries (Osvaldo Canziani, IPCC WGII Co-chair)	We do not know the source of this estimate. Reworded.
E-3-50	A	3	17			Append to the last sentence the following just prior to the period (full stop): "unless adaptation measures are successfully implemented." We note that water storage is a time-honored adaptation technique. Other adaptations that can help alleviate the problem include: (a) desalination plants, particularly if technological change can reduce its economic and energy costs, (b) demand side management (e.g., water pricing), (c) development of salt tolerant crops, and so forth. (Indur Goklany, US Department of the Interior)	Revised
E-3-51	A	3	19	3	24	The piecemeal description of some regional changes overlooks the global synthesis by Milly et al. (2005, Nature, Global pattern of trends...), who identified a global pattern of regional increases and decreases in runoff, streamflow, and water availability that was much more consistent with modeled forced climate change than with natural variability. (Christopher Milly, U.S. Geological Survey)	Milly's results are in
E-3-52	A	3	19	3	28	In both bullets currently on these lines, there should be an indication as to (1) the time period over which these changes have been observed, and (2) whether these changes are within the bounds of natural variability. (Indur Goklany, US Department of the Interior)	Revised
E-3-53	A	3	19			Insert another bullet following the previous one, that would read as follows: "Some modeling studies project that through the 2080s at least, climate change might reduce the population that would otherwise be at risk for water stress. Moreover, these studies indicate that non-climate-change related factors are likely to be more significant in determinng the population at risk (PAR) of water shortage than is climate change itself (see Arnell 1999, 2004). This suggests that in the short-to-medium term reducing current vulnerabilities to climate and climate variability may be the most effective methd of reducing the PAR for water stress " For detailed rationale, see Table 3.2 of this chapter, which shows this statement is valid for the 2050s; Arnell (1999, 2004) show it for the 2080s; see, also Goklany (2003, 2005a),	Revised

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						and my comment for page 38 line 36 below. (Indur Goklany, US Department of the Interior)	
E-3-54	A	3	19			Insert a new bullet on line 19 which would repeat what's on page 11, lines 41-44. This is an important finding, albeit that it's not necessarily new. (Indur Goklany, US Department of the Interior)	LAs decided otherwise
E-3-55	A	3	21	3	21	The statement that 'climate-related increase of winter runoff has been detected' seems is over-simple. (Paul Jeffrey, Cranfield University)	Changed
E-3-56	A	3	21	3	22	After the coma, following the word regions, add: generalized glaciers retreat and changes in volume and timing of, etc (Osvaldo Canziani, IPCC WGII Co-chair)	Mentioned in 3.4
E-3-57	A	3	22	3	22	Whether or not the observed precipitation change is due to climate change, I'd question whether it's appropriate to attribute investments in irrigation and water management to these changes. For example, economic considerations relating to markets for crops, along with major changes in water allocation institutions, play a key role. (Rob de Loë, University of Guelph)	Changed wording
E-3-58	A	3	22			"In some regions…..water Supply decreases." Are there also regions with the oppostie experience? If so, one may wish to state that so no false impressions are given that it is always decreases. (Soroosh Sorooshian, University of California, Irvine)	See 3.5.1
E-3-59	A	3	23	3	24	Change " … has caused … management." to "… forced large financial investmens in water supply management." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Revised
E-3-60	A	3	26	3	26	Change "There has been evidence of global ..." to "There is evidence of a global ..." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Revised
E-3-61	A	3	27	3	27	Reference to "3.1.1". There is no section 3.1.1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-62	A	3	28	3	28	Reference to "3.4.4". Should this be 3.4.3? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-63	A	3	28	3	28	Assuming that what follows has the same confidence level, before the confidence level reference add the following: “These changes would affect the aquifers´ recharge and modify the groundwater quality.” (Osvaldo Canziani, IPCC WGII Co-chair)	Another change made
E-3-64	A	3	30	3	37	The main thrust of this bullet, that projected changes in river flows, remain uncertain, is not an accurate summary of the situation, in my opinion. The demonstration by Milly et al. (2005, Nature, Global pattern of trends...), that	Milly’s results and figure reported

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						climate models retrospectively predicted much of the global pattern of 20th century trends on the basis of climate forcing, has substantially increased the credibility of projected regional changes from climate models. This is a major achievement by the modeling community since TAR. (Christopher Milly, U.S. Geological Survey)	
E-3-65	A	3	30	3	37	For water managers, the clear message in this paragraph is that it's too soon to start changing behavior. I don't believe that that's the message this chapter should be sending. Numerous adaptations of appropriate even in the face of the real uncertainty that exists. (Rob de Loë, University of Guelph)	See 3.6
E-3-66	A	3	34	3	36	No examples need to be given since "river flow and groundwater" are already mentioned at the begining of the sentence (Georg Kaser, Geo and Atmospheric Sciences)	Substantial change
E-3-67	A	3	34	3	34	Change "water availability" to "projected water availability". Change "(river flow..." to "(e.g. river flow...". (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Substantial changes
E-3-68	A	3	34	3	36	Change "… for adaptation procedures " to "… for developing adaptation procedures." and remove "which … groundwater." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Revised
E-3-69	A	3	36	3	36	Please add availability or flow … in river discharge or groundwater availability. (Martine M. Savard, Geological Survey of Canada)	Substantial change
E-3-70	A	3	39	3	39	What kind of extreme events are referred to? (Georg Kaser, Geo and Atmospheric Sciences)	Water-related; self-explanatory
E-3-71	A	3	39	3	43	How far into the future? (Soroosh Sorooshian, University of California, Irvine)	Reworded
E-3-72	A	3	41	3	41	Please add water… on other water pollutants will… (Martine M. Savard, Geological Survey of Canada)	Reworded
E-3-73	A	3	42	3	42	Reference to "3.4.5". Should this be 3.4.4? And possibly 3.4.5 as well? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Reworded
E-3-74	A	3	43	3	47	it is economic activity that is the problem, and actually economic growth is not always achieved, therefore replace 'growth' by 'activity'. (Silvia Llosa, ISDR System)	Reworded
E-3-75	A	3	44	3	49	The bullet is formulated in an awkward way. E.g. in the first sentence write: "Climate change has a multiple impact on ..." or ".. is one of several ..." depending on what is intended to say (Georg Kaser, Geo and Atmospheric Sciences)	Revised
E-3-76	A	3	44	3	47	Suggested re-write for the sentence "In … resources." to "In many areas,	Another change made

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						anthropogenic pressures such as population, economic growth, land use and urbanization are major factors behind adverse changes in freshwater resources, in addition to climate change (especially in water-scarce regions)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-77	A	3	44	3	44	Reference to "3.1.1". There is no section 3.1.1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Revised
E-3-78	A	3	51	4	4	The bullet needs clearer formulation (Georg Kaser, Geo and Atmospheric Sciences)	Reworded
E-3-79	A	3				Executive Summary. This section can be shortened, for instance the 1st and 2nd bullets contain repetitions. The results which need to be emphasized with each bullet could be more clearly focused on. (Annarita Mariotti, ENEA)	Improved
E-3-80	A	4	1	4	10	P 4 lines 10-14. I would have low or no confidence in this statement. I do not believe the published work: it is likely wrong. The Gedney et al result makes conclusions as a residual but the budgets are not that accurate and are at odds with other studies. In particular, monthly mean data are used and no account is taken of changes in frequency or intensity of precipitation. Since intensity appears to be increasing that should affect runoff. (Kevin Trenberth, NCAR)	Paragraph deleted
E-3-81	A	4	1	4	6	P 4 l 6: Why will water demand grow due to climate change? This is not helpful. It needs to state something like, Owing to increased evaporation, water demand will grow… In fact nowhere in the exec summary is there a statement about potential evapotranspiration (which increases with warming), or evaporation (which likely increases), or the consequences of these things for drought or water availability. (Kevin Trenberth, NCAR)	See 3.4.1
E-3-82	A	4	1	4	1	omit 'longer' because: Time series of hydrological variables show variability on different time scales, from intra-annual to inter-annual or longer time scales. Research on climate change and weather phenomena (e.g. Glaser, R., 2001, Klimageschichte Mitteleuropas – 1000 Jahre Wetter, Klima, Katastrophen. Primus-Verlag, 227 p) increasingly concludes that climate has always changed throughout the Earth's history. Therefore, the assumption of stationarity (e.g. designing flood defence measure with a life-time of 80 years on the basis of observations of the past 30 or 50 years) may never have been valid. A similar statement is made on page 33, line 46, chapter 3. (Silvia Llosa, ISDR System)	Reworded
E-3-83	A	4	1	4	1	Change "not" to "no" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Reworded

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E-3-84	A	4	6	4	8	This bullet could be linked to figures of population without access to safe drinking water and sanitation. This bullet could also state that in addition climate change affects the achievement of the MDG target of reducing by half the number of people without sustainable access to safe drinking water. (Silvia Llosa, ISDR System)	
E-3-85	A	4	6	4	7	Modify this bullet to read as follows: "Globally, water demand will grow primarily due to population growth and, possibly, greater affluence, and secondarily due to climate change." See, e.g., Arnell (2004). (Indur Goklany, US Department of the Interior)	Bullet removed
E-3-86	A	4	6	4	9	"…groundwater recharge….will decrease very strongly". Due to what? Climate change or other factors? Be more clear. If due to climate change then how can one substantiate this claim? Highly speculative at this stage. (Soroosh Sorooshian, University of California, Irvine)	Bullet removed
E-3-87	A	4	6	6	8	Section 3.4.3 indicates that groundwater recharge may or may not increase and, moreover, the estimates are model dependent and not robust. Accordingly, we would strike the portion of this bullet addressing groundwater or fashion a more even-handed statement. (Indur Goklany, US Department of the Interior)	Bullet removed
E-3-88	A	4	7	4	7	Change "very strongly" to "considerably". (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Bullet removed
E-3-89	A	4	7	4	8	'very strongly' versus 'medium confidence'. Suggestion: ….will decrease. (medium confidence) (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Bullet removed
E-3-90	A	4	8	4	8	Reference to "3.4.3". Should this be 3.4.2? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Bullet removed
E-3-91	A	4	10	4	14	There is little doubt that direct CO2 effects (physiological and structural, which presumably more or less cancel each other out) will have effects on runoff, but their net effects is probably so small in size (and uncertain to quantify) that this issue doesn't merit consideration in the Executive Summary. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Bullet removed
E-3-92	A	4	10	4	14	The Gedney et al. result is based on a questionable runoff reconstruction and has conclusions that fly in the face of much of the literature on the subject, which is not surprising, as it ignores the physical feedback of boundary-layer drying and heating and the biological feedback of increased plant growth. To elevate this study to a bullet in the executive summary seems ill-advised. (Christopher Milly, U.S. Geological Survey)	Bullet removed
E-3-93	A	4	11	4	11	Replace " a larger variability in runoff" instead of saying " a greater increases or	Bullet removed

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						smaller decreases in runoff" (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-94	A	4	11	4	11	Change "a greater increase or smaller decreases" to "both greater increases and smaller decreases" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Bullet removed
E-3-95	A	5	1	5	19	P 5 l 19: "boundary conditions" is jargon. Change to something like: local land surface properties influence the atmospheric circulation more than large-scale effects. (Kevin Trenberth, NCAR)	LAs decided to keep as is
E-3-96	A	5	1	6	26	The "Introduction" seems somewhat disjointed and vague. According to "Guidance Notes for Expert Reviewers" this section should discuss scope, key issues, summary of TAR conclusions, specific methods. However, the key issue of climate change seems to be lost among a plethora of other findings and issues (e.g. Fig. 3.1; Nile basin example), whose impacts/significance are already well known. A major concern relates to climate change effects on hydrologic extremes, but it is not mentioned. Moreover, there is no discussion of Chapter scope (e.g. focus on liquid form of water and exclusion of cold regions hydrology; focus on literature after 2000). (Spyros Beltaos, National Water Research Institute)	Accepted and revised.
E-3-97	A	5	3	5	5	The Millennium Development Goals include access to adequate sanitation as well, Please add. Also, you might add a citation for the "human right to water" comment -- UN General Comment 15, issued November 2002. (Peter Gleick, Pacific Institute)	**[will be done]**
E-3-98	A	5	3	5	4	Suggested re-write of "virtually in any human activity." to "to sustain humanity." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Disagree. The meaning will change if accepted.
E-3-99	A	5	5	5	5	It is Millennium Development Goals (MDGs), no Targets. (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-100	A	5	8	5	9	"clomate change exerts considerable……". If we are talking about the natural climate then in a way, you are stating the obvious. Except the use of the term "considerable", rises a flag. How can you be sure and what evidence to support it? (Soroosh Sorooshian, University of California, Irvine)	Disagree. Either natural or anthropogenic climate changes have the impact. It is hard to find reference saying the impact is marginal.
E-3-101	A	5	17	5	18	In the second phrase, starting on line 16, make a change to provide a direct geophysical sense to the man-made actions, so to read: "on surface and sub-surface water cycles, having effects on the local and meso-scale atmospheric circulation and influencing the local and regional climate conditions. The disastrous precipitation events registered in Haiti, in 2004 and in NW Argentina, in the summer of 2006 so demonstrate.	Accepted

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						(Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-102	A	5	17	5	17	Between “on” and “atmosphere” add "local and regional" and also write "affecting" instead of "and". Then the phrase should read "effects on local and regional atmospheric circulation, affecting regional climate". (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-103	A	5	22	5	23	I have suggested in a separate comment that Figure 3.1 could be removed as it does little to add to the discussion. If the figure is removed, the first sentence of this paragraph could be changed to "Population growth, economic activities and a consumptive life style impact on the hydrological cycle, water use and water stress (Oki 2005)." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Disagree. The figure illustrates the connections and shows climate change is one of the multiple stresser on the freshwater resources.
E-3-104	A	5	30	5	49	The figure misleads from the scope of "Climate change Impacts, Adaptation and Vulnerability". Climate should be on top. (Georg Kaser, Geo and Atmospheric Sciences)	Changed figure
E-3-105	A	5	31	5	49	Figure 3.1 This figure does not seem to add much to the text and train of thoughts. Cutting it would reduce the length of the paper which is exceeding the recommended length by 2 pages (Martine M. Savard, Geological Survey of Canada)	Disagree.
E-3-106	A	5	46	5	46	As already mentioned in the comments to FOD, the figure is missing the consumptive use of natural ecosystems. As in any reference on an author work, the reference of the adjustment shall be mentioned, as done in many previous similar cases. (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-107	A	5				Figure 3.1. All of these components of course impact on hydrology, but this figure doesn't really help me understand how the pathways influence the hydrological cycle. I suggest leaving it out, find a better one, or perhaps have a table listing these factors. For one, it is implied from the text that it is just "increases" in many of these factors that lead to "increases" in water withdrawals and "increases" in water stress. An indication of "increases" appears nowhere in the figure. For another, the interaction along many of these "pathways" goes both ways, yet there is only one link that indicates bi-direction. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Disagree. The change could be both side, increase and decrease. Both ways are accepted.
E-3-108	A	6	1	6	2	The sentence is superfluous, all is sayd by the publication year (IPCC 2001) (Georg Kaser, Geo and Atmospheric Sciences)	DA. It is important to remind TAR adopted publication upto 2000.
E-3-109	A	6	1	6	34	P 6 l 34: seems incomplete: presumably these descriptors apply to precipitation not the water cycle? (Kevin Trenberth, NCAR)	DA. Water cycle.

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E-3-110	A	6	16	6	16	change "due to higher water efficiency and higher pricing" to "due to improved water-use efficiency and some changes in economic structures away from water-intensive industries" (Peter Gleick, Pacific Institute)	DA. It is the original TAR sentence.
E-3-111	A	6	24	6	26	How does this relate to the TAR? Can one make any short/simple statements here regarding if any of the preceding TAR statements have been negated, or are they all confirmed and enhanced, etc.? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-112	A	6	29	6	29	There is a remarkable lack of reference to critical cases, like that affecting the extensive NE Brazil (4 million km2), the heavily populated and important productive regions in Central Chile and Central Western Argentina, Peru, etc.. A clear reference to the IPCC regions ´s chapters will obviate duplicated information and provide a better link between this chapter and the regional ones would obviate this type of shortcomings (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-113	A	6	29	9	48	This section is particularly hard to read, and the text seems to bear little resemblance to the promise of the title. Most of the paragraphs do not even mention climate, climate variations, or sensitivity; the section seems to be focused on the social context for water management rather than sensitivity to climate variations. Furthermore, the section misses some opportunities to link with Chapter 3 of WGI, to set the stage for links later on future climate. I recommend a vigorous rewrite. (Philip Mote, University of Washington)	Accepted
E-3-114	A	6	29	10	32	The entire Chapter 3.2. is too descriptive and misses to assess quantities. Give at least orders of magnitude about impacts attributed to climate and non-climate drivers (Georg Kaser, Geo and Atmospheric Sciences)	Accepted
E-3-115	A	6	29	10	31	Section 3.2 lacks clear structure. Observed climatic variations and vulnerabilities are discussed in random order, and are interspersed with management issues (sec 3.2.1), then back to vulnerabities, this time on global scale (sec 3.2.2). According to "Guidance Notes for Expert Reviewers" this section should be organized along the following lines: sensitivity/vulnerability to weather and climate and to other stresses; recent findings on trends – presumably after the TAR; current adaptation, which may involve not only water resources management, but also lifestyle modifications of affected populations. (Spyros Beltaos, National Water Research Institute)	Accepted
E-3-	A	6	29	10	32	Mention of key vulnerabilities associated with cold regions hydrology would have	Accepted

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116						given section 3.2 a “global” flavour. (Spyros Beltaos, National Water Research Institute)	
E-3-117	A	6	31	8	49	However, in the Section 3.2.1 Climatic variations and water resources management, would gain in clarity if references on the linkage between low frequency climatic phenomena such as ENSO and NAO and ground water resources, is added. Reading the notes and comments of the writing team to my suggestions for such references on observation studies I realized that no one of the suggested reference was included neither in Chapter 3 nor in Chapter 1 where indeed, they would have fit better. (Constanta Boroneant, National Institute of Meteorology and Hydrology)	**More WG I stuff**
-118	A	6	34	6	35	Unclear whether the term 'water resources management' referes to a process or the institutional arrangements required to manipulate the process. (Paul Jeffrey, Cranfield University)	Accepted
E-3-119	A	6	35	6	36	“unprecedented” must be qualified (i.e. in last 10000 years). (Spyros Beltaos, National Water Research Institute)	Deleted
E-3-120	A	6	35		36	don't need to talk about future projections here as this is the current sensitivity/vulnerability section (Clair Hanson, IPCC TSU)	Deleted
E-3-121	A	6	38	6	38	Remove "partaking" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Why?
E-3-122	A	6	38	6	39	As in related comments, I don't think Fig. 3.1 is very illustrative and suggest removing the text " (as illustrated in Figure 3.1)". (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	DA
E-3-123	A	6	39	6	39	It would be better to read "may also exert", instead of "have also been exerting" (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-124	A	6	44	6	44	Please check references Shiklomanov 2003; Vassolo 2005, not listed (Martine M. Savard, Geological Survey of Canada)	Accepted
E-3-125	A	6	46	6	47	Please check references Shiklomanov 2003; Vassolo 2005, not listed (Martine M. Savard, Geological Survey of Canada)	Accepted
E-3-126	A	6	48	6	49	The statement that 'human water use during the last decades was overwhelmingly driven by non-climatic factors' is too general to be of much use in developing an argument for a more sensitive approach to water management - it might be more appropriate to emphase that increases in demand for water have not been informed by an appreciation of the limits to water availability. (Paul Jeffrey, Cranfield University)	Accepted
E-3-127	A	6	48	6	48	"lost" is not precise. The irrigation water either evaporates, is bound in biomass, or goes into the groundwater	Accepted

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						(Georg Kaser, Geo and Atmospheric Sciences)	
E-3-128	A	6	50	6	51	supplement: as well as social changes as e.g. the increase of single households and an improved lifestyle. (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Accepted
E-3-129	A	6	51	6	51	Change "growth … particular." to "growth and expanded water supply systems." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-130	A	6	51	6	51	"water supply" should be "water supply systems" (Georg Kaser, Geo and Atmospheric Sciences)	Accepted
E-3-131	A	7	2	7	10	it should be mentioned here that future climate change is likely to exacerbate the stress imposed by other factors, such as population growth and increased demands (Spyros Beltaos, National Water Research Institute)	DA. See 3.4
E-3-132	A	7	5	7	6	The poor information available to authors regarding the impact of population growth in other countries, like Peru, Central Chile, NE Brazil, and no doubt, other developing regions, emphasizes even more the already mentioned need to cross-refer with the Regional Chapters, (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-133	A	7	7	7	8	There are two possible Oki et al. 2003 and Arnell 2004 in the references list at the end of the document. Designation by letters a and b should be added to the reference list and to the citations in text. (Martine M. Savard, Geological Survey of Canada)	**Tidied up**
E-3-134	A	7	12	7	17	this seems to be too general; any specific examples/references? (Spyros Beltaos, National Water Research Institute)	**Revised**
E-3-135	A	7	12			Para unclear. (Charles Howe, Institute of Behavioral Science)	**Changed**
E-3-136	A	7	13	7	14	It is not clear what the sentence intents to say. Reformulate or remove the sentence. (Georg Kaser, Geo and Atmospheric Sciences)	**Reworded**
E-3-137	A	7	17	7	17	Schmidt and Dikau 2004 and WDR 2003 and 2004 are not in the reference list. (Martine M. Savard, Geological Survey of Canada)	**Ordered**
E-3-138	A	7	17	7	7	("Schmidt and Dickau 2004") is missing in "References" (Uwe Gruenewald, Brandenburg University of Technology Cottbus)	Same above
E-3-139	A	7	17			the paper of Schmidt and Dichau is missing in chpt. References (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Same above
E-3-140	A	7	19	7	29	The anecdotal and cursory approach embodied in these lines does not do justice to the issue of climate change. First, the fact that the number of floods for which international or inter-regional assistance has increased is unremarkable given that today the world is more globalized, richer, more able to provide assistance to	Accepted

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						distant parts, and more compelled to do so because TV cameras/media coverage are more ubiquitous, and a host of other reasons. Nor would it be any more remarkable if the affected populations were to increase. The real issues that should be addressed are the following: (a) Are the phenomena listed here part of a long term trend, (b) is the magnitude of disaster as measured by the number of people affected increasing because of climate change or because of socio-economic factors such as the general increase in population and the possibility that a greater fraction of this larger population is living in more marginal areas, and (c) to the extent larger areas are being flooded, is it due to climate change or changes in land use and land cover? Whether or not one has answers to these issues, these matters should be addressed in the text, and lack of information about trends and acauses should be noted.. (Indur Goklany, US Department of the Interior)	
E-3-141	A	7	19	7	21	Give the sentence more assessment character. It reads like a review sentence. (Georg Kaser, Geo and Atmospheric Sciences)	DA. IPCC Assessment report is an anthology of reviews.
E-3-142	A	7	20	7	20	Change "earlier" to "the preceding" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-143	A	7	21	7	29	Nothing is said about climate change impact (Georg Kaser, Geo and Atmospheric Sciences)	DA. Here is about the current vulnerabilities.
E-3-144	A	7	21	7	23	It is not clear in this sentence whether there is a climatic influence to the increased incidence of major floods (in addition to socio-economic factors), and what its relative weight might be. (Spyros Beltaos, National Water Research Institute)	Not enough reference to judge.
E-3-145	A	7	21			Add the following new material following the period (full stop) on line 21: "Data from EM-DAT, the International Disaster Database maintained by the Office of Foreign Disaster Aid and Center for Research on the Epidemiology of Disasters at the Université Catholique de Louvain, Brussels, Belgium, for the period 1900 to 2004 indicates that, worldwide, 38% of all fatalities from extreme weather events were due to floods. Comparing average annual mortality (AAM) for 1900-1989 against the AAM for 1990-2004 indicates that deaths due to floods declined by 89.5%. Over the same period, mortality rates -- a better measure for the impact of floods because it automatically accounts for the increase in risk due to population growth -- declined by 95% (Goklany 2006b)." With this insertion, start a new para with the following sentence ["Part of the observed ..."] (Indur Goklany, US Department of the Interior)	DA. Out of scope of this chapter.
E-3-146	A	7	23	7	24	Here again, reference to the Regional Chapters is recommended (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted

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E-3-147	A	7	25	7	25	Schmidt and Dikau 2004 and WDR 2003 and 2004 are not in the reference list. (Martine M. Savard, Geological Survey of Canada)	**Ordered**
E-3-148	A	7	25			Citation in references is WRD not WDR (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	**O.k.**
E-3-149	A	7	36	7	42	This view on climate change effects upon lakes is extremely selective, as there are hundreds of related studies. I expect these to be presented in detail in the Ecosystems Chapter, so a link to that chapter may be sufficient here. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	**O.k.**
E-3-150	A	7	36		38	"Temperature change in Fraser river" says nothing without a time scale, trend or base (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	**Reworded**
E-3-151	A	7	39			due to precipitation CHANGE or variability ? Is the change really evident ? (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	**Changed**
E-3-152	A	7	40	7	42	The critical issue of natural polluted underground water resources with Arsenic and Fluor, which is also influenced by climate change and the increasing demand for fresh water, should be referred and cross-cut with the Regional Chapters (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-153	A	7	44	7	50	This message is a relatively well known fact. I am not certain if it is intended to highlight a connection to climate and if so, based on what evidence? (Soroosh Sorooshian, University of California, Irvine)	This is a remind about the possible relation between presence of viruses and extreme events.
E-3-154	A	7	44	7	44	Several diseases' should be re-worded as 'Numerous diseases' (Paul Jeffrey, Cranfield University)	Accepted
E-3-155	A	7	44		45	…consuming crops IRRIGATED by POLLUTED water' (Clair Hanson, IPCC TSU)	Accepted
E-3-156	A	7	45	7	45	"..polluted by irrigated water", I guess the authors meant to say "..irrigated with polluted water". (Annarita Mariotti, ENEA)	Accepted
E-3-157	A	7	46	7	47	Check spelling and reference listing of Yarza and Chasse 1999 and Faver et al. 2002, probably Yarze and Fayer instead? (Martine M. Savard, Geological Survey of Canada)	**Checked**
E-3-158	A	7	49	7	50	The last part of the phrase should be improved. It could be read "although it is clear that lower water availability reduces dilution of contaminants, leading to higher pollutant concentration (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-159	A	8	1	8	2	The statement that coastal regions are water scarce has to be placed in some sort of context - in what sense are they water scarce ? (Paul Jeffrey, Cranfield University)	Accepted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-3-160	A	8	1	8	2	Seems to be a parenthesis missing here (Paul Jeffrey, Cranfield University)	Accepted
E-3-161	A	8	1	8	32	P 8 l 29-32: This result should not be accepted uncritically: it is likely wrong. The Gedney et al result makes conclusions as a residual but the budgets are not that accurate and are at odds with other studies. In particular, monthly mean data are used and no account is taken of changes in frequency or intensity of precipitation. Since intensity appears to be increasing that should affect runoff. (Kevin Trenberth, NCAR)	Agree. But we need references to say their results could be due to the change in the rainfall intensity.
E-3-162	A	8	1	8	24	P 8 l 24: “direct”: what does that refer to? (Kevin Trenberth, NCAR)	Accepted
E-3-163	A	8	2	8	2	Change "renewable water supply" to "global renewable water supply" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-164	A	8	2	8	2	Change "), but" to ", and" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-165	A	8	6	8	7	The fact that "… in the Mary River in Australia saline intrusion advances by more than 0.5 km/yr" does not say anything about the causes (e.g., sea level rise, decreased river flow, or both) (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	**Piece deleted**
E-3-166	A	8	6	8	6	Geographically-wise, in addition to mention the impact of sea-water intrusion in rivers, reference to estuaries is pertinent. Therefore, the phrase should read" Salinization also affects estuaries and rivers. Again, the cross-reference with the regional chapters would show that millions of urbanites living in the River Plate Estuary, in Argentina and Uruguay are already becoming affected by seawater intrusion. (Osvaldo Canziani, IPCC WGII Co-chair)	Piece deleted
E-3-167	A	8	7	8	7	are the 0.5 km/yr a single event or are the an average over a certain time period? Which time period? Is this ongoing? (Georg Kaser, Geo and Atmospheric Sciences)	**[Piece deleted**
E-3-168	A	8	8	8	8	Check spelling and reference listing of Burkett et al., 2002, probably Burnett instead? (Martine M. Savard, Geological Survey of Canada)	**O.k.**
E-3-169	A	8	10	8	20	This paragraph is totally incomplete because it does not refer to the critical situation of more than 200 million people affected by the insidious natural contamination by Arsenic; Fluor and Lead. The failure of the project to open millions of wells in India and Bangladesh, resulting in the water supply of heavily contaminated water, shall be mentioned. Cross reference with Chapter 8 - Human Health is fundamental and the same applies to the Regional Chapters . The Atlas of Water	Accepted

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						.Clarke R & J. King- Earthscan, 2004) provides factual information on this issue. Further the analyses made in the recent published WHO book on "Climate Change and Health" mention the problems involved in mining natural polluted water. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-170	A	8	10		11	repetition of microbial. Can 'especially the microbial aspects' be removed? (Clair Hanson, IPCC TSU)	Accepted
E-3-171	A	8	11	8	11	Replace "microbial point of view" for "microbial load point of view" (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Deleted
E-3-172	A	8	11	8	11	Remove ", mainly from the microbial poit of view" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-173	A	8	14		16	can you give some examples of pathogens which affect developing countries? (Clair Hanson, IPCC TSU)	**Given]**
E-3-174	A	8	18	8	19	Please correct as follows: … to a drop of water quality in water networks (Martine M. Savard, Geological Survey of Canada)	Accepted
E-3-175	A	8	18	8	19	Change ", lead … networks." to "leads to a reduction of water quality." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-176	A	8	22	8	27	This paragraph is only loosely linked to the remainder of the text; I suggest deleting the (repetitive) first sentence on general climate effects; and it needs to be stated in which region the change in erosion was observed! (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Moved
E-3-177	A	8	22	8	27	This is important physical context for water concerns, but is out of place in the current text. I recommend keeping it but weaving it in better. (Philip Mote, University of Washington)	Moved
E-3-178	A	8	22	8	27	The information in this paragraph is good,; however, it is quite incomplete. As already mentioned when reviewing FOD, the oceans warming, due to GHG effect is one important factor in the exacerbation of the hydrological processes. The amount of about 13.2 x 1022 Joules of heat energy put into the oceans and seas (Barnett et al, Science, 13 April 2001) has enhanced evaporation and, hence, the incorporation of large amounts of energy in the atmosphere exacerbating extreme events. A study with the sponsorship of the EPA / USA, on the Impact of Climate Change on the Change on the Argentina ´s Pampas (Hydrometeorological part - CanzianiO, J.C. Gimenez, 2202), provides information. (Osvaldo Canziani, IPCC WGII Co-chair)	Out of the scope of this chapter
E-3-179	A	8	22	8	22	The first sentence of the new paragraph does not indicate a driver for the observed pheneomenon - what is promoting an increase in the water holding capacity of the upper atmosphere ? (Paul Jeffrey, Cranfield University)	"Warmer atmosphere" as stated

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E-3-180	A	8	22	8	24	Suggest to give the quantitative definition of intensification of water cycle and intensification of hydrological cycle (Chunzhen Liu, Water Resources Information Center of MWR)	**Wording changed**
E-3-181	A	8	22	8	22	Change "The … is" to "With warmer temperatures, the water-holding capacity of the atmosphere increases and is ..." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-182	A	8	25	8	27	The figures provided here which link rainfall with runoff and erosion need to be reported with units or at least some description of what types of processes are involved (Paul Jeffrey, Cranfield University)	**No figures given]**
E-3-183	A	8	25	8	27	"Each 1% change in average annual precipitation induce 2% change in runoff and a 1.7% change in erosion (Pruski and Nearing 2002a)" 1) 2002a is missing 2) see for instance: Schmidt J., M.v.Werner, Michael, A. (1999) Application of the EROSION 3 D model to the CATSOP Watershed, The Netherlands. Catena 37 (1999) 449-456 "Table 4 simulated and measured runoff and sediment yield refering to the CATSOP catchment - siumulated/measured Runoff [%] 91.8 to 107.1; Sediment [%] 110.1 to 3869.7"!! or: Toy T.J., G.R. Forster, K.G. Renard (2002) Soil Erosion: Processes, Prediction, Measurement, and Control. John Wiley and Sons, Inc. page 146: "Erosion models typically fit measured average annual soil loss with an uncertainty of about +-25% for moderate erosion rates of a about 3 to 30 tons/acre (6 to 60 metric tons/ha) per year and increases to +- 50% for values greater than about 50 tons/acre (100 metric tons/ha) per year and to errors as larger as 1000% for small loss values of less than 0.1 ton/acre (0.2 metric tons/ha) per year ..." Did you prove several model quantifications too? (Uwe Gruenewald, Brandenburg University of Technology Cottbus)	Deleted
E-3-184	A	8	26	8	27	These results are not general but of a regional study. This should be emphasized in the text! (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Deleted
E-3-185	A	8	27	8	27	The reference Pruski and Nearing 2002a needs to be defined. (Annarita Mariotti, ENEA)	Deleted
E-3-186	A	8	28	8	29	Please clarify text as it is difficult to understand even for an expert in the fields of water and plant sciences; particularly the section 'CO2 forcing by plants enhancing river flows by 5% with a 2% offset by climate change.' (Martine M. Savard, Geological Survey of Canada)	Accepted
E-3-	A	8	29	8	32	This sentence is difficult to understand, if plant cover rally has this influence, how	Accepted

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187						was it differentiated from other, potentially much larger influence factors? (Wolfgang Grabs, WMO)	
E-3-188	A	8	29	8	32	This paragraph sounds too definite to me. Suggested re-write to "Increasing concentrations of greenhouse gases may also affect the physiological processes of plants and in turn the water cycle. Gedney et al. (2006) attributed an observed 3% rise in global river flow over the 20th century to CO2 induced reductions in plant transpiration. This would imply an annual decrease in the global land-atmosphere moisture flux of approximately 60,000 tonnes of water per second." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-189	A	8	29	8	30	"Gedney et al (2006) attributed an observed 3% rise in global river flow over the 20th century to CO2...". This statement means that increase of global runoff over the 20th century was caused by plant's physiological controls rather than increase in rainfall amount. Does it contradict the presentation in the page 8 line 2E-3-24 and page 18 line 4E-3-44 "... an ongoing intensification of water cycle (Huntington 2006)" (Chunzhen Liu, Water Resources Information Center of MWR)	**Reworded and re-shuffled**
E-3-190	A	8	32			I recommend to use m3 in stead of "tons" water (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Deleted
E-3-191	A	8	32			Append to the end of the last sentence in this para, the following: "due to incresaes in plant water use efficiency." (Indur Goklany, US Department of the Interior)	Accepted
E-3-192	A	8	34	8	35	The extent to which different stakeholder groups are involved in water management varies greatly across the globe. It is simply incorrect to suggest that 'all levels of government, as well as the private sector and individual stakeholders are regularly engaged in water management' (Paul Jeffrey, Cranfield University)	**Deleted]**
E-3-193	A	8	41	8	43	Very good point (Soroosh Sorooshian, University of California, Irvine)	Thank you.
E-3-194	A	8	41	8	49	This paragraph is far too general, I do not see how it addresses current adaptation (Spyros Beltaos, National Water Research Institute)	Disagree. It is one of the most important messages we have to deliver policy makers.
E-3-195	A	8	41	8	49	This paragraph about adaptation may be more suited to section 3.6. It seems out of place here. (Philip Mote, University of Washington)	It is related to current vulnerabilities.
E-3-196	A	8	41		49	no references (Clair Hanson, IPCC TSU)	**How about Oki and Kanae (2006)??**
E-3-197	A	8	46	8	46	change "structure" to "structures" (Peter Gleick, Pacific Institute)	Accepted

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E-3-198	A	8	47			In practical work, the criteria for the design of warter resources systens are usualley focussed on extreme values (droughts, floods). (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	A. We mean the "change" in mean state but the "change" in extreme event.
E-3-199	A	8	49	8	49	add a reference to this paragraph: AWWA 1997. American Water Works Association. "Climate change and water resources." Journal of the American Water Works Association, Vol. 89, Issue 11, pp. 107-110. (Peter Gleick, Pacific Institute)	**Pre-TAR reference**
E-3-200	A	8	49			Also, suggest also add to adaptation strategies; early warning systems, better use of short and long forecasting, and other non structural measures besides just demand management, which is not relevant to, e.g., flooding . (Paul Kirshen, Tufts University)	Accepted
E-3-201	A	9	1	9	1	To avoid misunderstanding, please change the section title to: "3.2.2 Global overview of current regional vulnerabilities". (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Accepted
E-3-202	A	9	1	9	48	The text in this section is not about "global perspectives" but a patchwork of local perspectives. Figure 3.2 provides an unexploited opportunity to bring a more global perspective. I recommend discussing the big picture first - what are the common issues in all the orange areas on the map? What are other challenges? Then work on weaving together the local narratives into a clear message. (Philip Mote, University of Washington)	Accepted
E-3-203	A	9	1	9	4	P 9 l 4: makes no sense? (Kevin Trenberth, NCAR)	A. Revised.
E-3-204	A	9	3	9	4	The first sentence is incomplete. (Spyros Beltaos, National Water Research Institute)	A. Revised.
E-3-205	A	9	3	9	4	Sentence incomplete. Maybe "and … water-related" should be "and prone to water-related adversities." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-206	A	9	3	9	4	On which basis are these examples introduced here and not others – any specific criteria for their selection? Were they selected because they are well documented? Of large scale? As mentioned by the authors theses examples stand for some regions and constitute a non exhaustive list of known examples documented in the literature. (Martine M. Savard, Geological Survey of Canada)	Removed
E-3-207	A	9	3	9	4	"In some regions on the global fresh water resources are particularly vulnerable to current climatic variation and prone to cause water-related". The water-related issues in the introduced examples are mainly caused by different kinds of human activities, such as high withdrawal, ground water overexploitation, pollution et al.	Accepted

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						rather than current climatic variations. Suggest to give some explanation. (Chunzhen Liu, Water Resources Information Center of MWR)	
E-3-208	A	9	3		4	doesn't make sense (Clair Hanson, IPCC TSU)	A. Revised.
E-3-209	A	9	4	9	4	The phrase is not complete. It should read "….and prone to cause water-related impacts". (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Accepted
E-3-210	A	9	4	9	4	Prone to cause water-related' … what ?? (Paul Jeffrey, Cranfield University)	Accepted
E-3-211	A	9	4			Half sentence missing "..and prone to casue water related."..? (Wolfgang Grabs, WMO)	Accepted
E-3-212	A	9	6	9	18	While correct, what is the connection to climate. I assume it is only given as an informational piece. (Soroosh Sorooshian, University of California, Irvine)	Accepted
E-3-213	A	9	6	9	44	The anecdotal approach employed here does not shed much light on climate change, particularly when these examples do not stretch back any further than 1970 (for the Sahel, for example). Are the changes noted here part of a much longer term trend? Are they due to climate change or other factors? Are they within the bounds of long term natural variability? These are the questions that should be explored here. To help get away from this short-term, anecdotal approach, for runoff, we would recommend using studies such as Cluis and Laberger (2001), Svensson et al (2005), Lindstrom and Bergstrrom (2004), and Kundzewicz et al (2004). Kundzewicz et al. (2004), for instance, undertook a study of world-wide hydrological time series of maximum annual river flow obtained from the Global Runoff Data Centre (GRDC) in Koblenz, Germany. Their analysis of 195 long time series of annual maximum flows drawn from this database does not support the hypothesis of general growth of flood flows. They note that "Even if 27 cases of strong, statistically significant increase have been identified by Mann-Kendall's test, there are 31 decreases as well, and most (137) time series do not show any significant changes. Some regional patterns have been observed. However, a caution is needed, that in case of strong natural variability, a weak trend, even if it exists, cannot be detected by statistical testing." With respect to drought, for the U.S., appropriate sources would be Cook et al. (2004) and McCabe et al. (2004) becvause they cpover large areas for longer periods of time. Cook et al. note, for instance, that, "The western United States is experiencing a severe multiyear drought that is unprecedented in some hydroclimatic records. Using gridded drought reconstructions that cover most of the western United States over the past	Re-structured into logical sub-sections

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						1200 years, we show that this drought pales in comparison to an earlier period of elevated aridity and epic drought in AD 900 to 1300, an interval broadly consistent with the Medieval Warm Period..." (1) Cluis, D. and Laberge, C. 2001. Climate change and trend detection in selected rivers within the Asia-Pacific region. Water International 26: 411-424. (2) Svensson, C., Kundzewicz, Z.W. and Maurer, T. 2005. Trend detection in river flow series: 2. Flood and low-flow index series. Hydrological Sciences Journal 50: 811-824. (3) Lindstrom, G. and Bergstrom, S. 2004. Runoff trends in Sweden 1807-2002. Hydrological Sciences Journal 49: 69-83. (4) Kundzewicz, Z.W., et al. 2004. Detection of change in world-wide hydrological time series of maximum annual flow. GRDC Report Series, Report 32. (4) McCabe, G.J. M. A. Palecki, J. L. Betancourt, Proc. Natl. Acad. Sci. U.S.A. 101, 4136 (2004). (5) Cook, E.R., Woodhouse, C., Eakin, C.M., Meko, D.M. and Stahle, D.W., "Long-term aridity changes in the western United States," Sciencexpress.org / 7 October 2004. (Indur Goklany, US Department of the Interior)	
E-3-214	A	9	6	9	36	In this description, when not indicated, the authors should cite the country in which the examples occur in order to ease reading (Martine M. Savard, Geological Survey of Canada)	DA. They are typical and famous examples and easily identified their nations.
E-3-215	A	9	6	9	36	have the described vulnerabilities been caused by climatic variations ? If not, are they likely to be exacerbated by climate change ? (Spyros Beltaos, National Water Research Institute)	Accepted.
E-3-216	A	9	6	9	6	Change ", and the sea" to ". The Sea" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-217	A	9	6		10	the first two examples plus the Colorado River example in lines 14-16 aren't climate related (Clair Hanson, IPCC TSU)	A, but we think it is relevant to show the current vulnerability here because Climate Change is likely to exacerbate the vulnerabilities.
E-3-218	A	9	6			Are these examples also presented in the corresponding regional chapters? (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	**Some are**
E-3-219	A	9	7	9	7	"Former size..", the time of reference could be included. (Annarita Mariotti, ENEA)	Accepted
E-3-220	A	9	9	9	12	It is not clear how much of the observed variation in river runoff can be attributed to irrigation. (Georg Kaser, Geo and Atmospheric Sciences)	A but no quantification.
E-3-221	A	9	9	9	9	Change "Similarly, the … due" to "Similarly, the flow volume in the Yellow River was reduced due" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted

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E-3-222	A	9	10	9	11	Change "In … 700 km." to "In 1997, a year with low precipitation, the river ran dry fo more than 200 day over a distance of 700 km." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-223	A	9	11	9	11	Remove "Fortunately, " (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-224	A	9	12	9	12	Change ", which" to "that" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-225	A	9	13	9	13	Remove "to meet" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-226	A	9	14	9	18	the last two sentences in this paragraph are seriously in error. The Colorado is not highly saline when it reaches Mexico -- there are legal salinity limits now in place that are met. Further, Mexico is guaranteed a certain amount of water from the Colorado by the 1944 Treaty, and it receives all the water guaranteed by the treaty, which it uses completely. Finally, it is incorrect to say that the US built a desalination plant to ensure Mexico gets its water. This plant -- the Yuma Desalter -- was built but is NOT operating, and has never operated. Mexico gets its water due to other management actions. Please replace these two sentences with something like "Due to high withdrawals by both the United States and Mexico, very little water now reaches the river's delta, affecting both the ecology of the region and the economic health of local populations dependent on fisheries." (Peter Gleick, Pacific Institute)	Accepted
E-3-227	A	9	14	9	14	Remove "necessary" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-228	A	9	14	9	14	Change "wetlands" to "wetlands to be met." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-229	A	9	16	9	16	Change "resource" to "water resource" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-230	A	9	20	9	24	Regarding the comment on Lake Victoria, being this a chapter involving the effects of climate change and not only those of man-made pollution and eutrophication, the paragraph shall also mention the adverse effect of the water warming on ecosystems. Then, the change of the habitat conditions for some fish species (i.e. tilapia), should be mentioned. Therefore, the phrase should read as follows: "In addition to the adverse warming effects, in the case of Lake Victoria, etc". Logically, cross reference to Chapter 4 is necessary, (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-231	A	9	20	9	39	contains multilple unrelated topics. (Charles Howe, Institute of Behavioral Science)	DA. It is an global overview of current regional vulnerabilities.

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E-3-232	A	9	26	9	30	This observation is interesting but apparently not related to climate change. I assume that this is but one example from the Health Chapter, and the links between that Chapter and Chapter 3 should be made more clear (i.e. either presenting more examples or just referring to the other Chapter). (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Accepted
E-3-233	A	9	26	9	30	Here again, information on fluorosis shall refer to the critical situation in other regions - Latina America (Mexico and Argentina) etc. Cross-reference to Regional Chapters is required. (Osvaldo Canziani, IPCC WGII Co-chair)	Accepted
E-3-234	A	9	32	9	36	It should be noted that data from EM-DAT, the International Disaster Database maintained by the Office of Foreign Disaster Aid and Center for Research on the Epidemiology of Disasters at the Université Catholique de Louvain, Brussels, Belgium, indicates that aggregate mortality and mortality rates due to extreme weather events are generally lower today than they used to be in earlier decades. Globally, mortality and mortality rates have declined by 95 percent or more since the 1920s. The largest improvements came from declines in mortality due to droughts and floods, which apparently were responsible for 95 percent of all deaths caused by extreme events during the 20th century. (Goklany (2006b). (Indur Goklany, US Department of the Interior)	**Page limits problem**
E-3-235	A	9	34	9	34	"In such areas ..." Which areas do you mean? Bangladesh or Elbe river basin? Or is there any specific common character of both that is referred to? (Georg Kaser, Geo and Atmospheric Sciences)	Accepted
E-3-236	A	9	38	9	39	This is a very speculative statement as far as the climate connection is concerned. The few examples given are interested, but they are at such small scale. Isn't there a danger the unfamiliar readers may generalize this to a much larger scale? (Soroosh Sorooshian, University of California, Irvine)	Accepted
E-3-237	A	9	38	9	41	Results concerning Sahel need to be updated to include the recent come back to more average precipitation. (Annarita Mariotti, ENEA)	**Careful, the come back is questionable. Deleted anyway**
E-3-238	A	9	38	9	38	Change "Climatic changes have ..." to "Climatic variation has ..." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-239	A	9	38	9	44	A very good paragraph - the chapter needs more like it. Clear topic sentence and some local illustrations. (Philip Mote, University of Washington)	Thank you.
E-3-240	A	9	39	9	42	However, that, based on NDVI from 1982-2003, Herrman et al. (2005), note that contrary to assertions of wide spread desertification of the Sahel, large areas of the Sahel are greener now than they were. This seems to be conrary to the current	**Reworded**

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						ststement on these lines. Refernce: Herrman, S.F., et al., Recent trends in vegetation dynamics in the African Sahel and their relationship to climate," Global Environmental Change 15: 394-404 (2005). (Indur Goklany, US Department of the Interior)	
E-3-241	A	9	40	9	40	Change ", and … drought" to ", causing serious and long-lasting dreought" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-242	A	9	41	9	41	Change "The sea level" to "Sea level" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Accepted
E-3-243	A	9	42	9	42	the reference to “chapters 6 and 16” is too vague, and makes it difficult for the reader to pinpoint the source of the preceding statement. (Spyros Beltaos, National Water Research Institute)	**Changed**
E-3-244	A	9	42			Please add the following citation: Burns, WCG. 2002. "Pacific Island developing country water resources and climate change." In P.H. Gleick (editor) The World's Water 2002-2003. Island Press, Washington DC, pp. 11E-3-131. (Peter Gleick, Pacific Institute)	Accepted
E-3-245	A	9	46	9	48	Suggested re-write of 2nd sentence in the paragraph to "Examples of water scarcity correspond well to areas identified with high water stress." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	**Revised**
E-3-246	A	9	46	9	48	It is not clear what the paragraph intents to say (Georg Kaser, Geo and Atmospheric Sciences)	**Reworded**
E-3-247	A	9				Section 3.2.2: I don't see the need to have this section given that a range of vulnerabilities have already been illustrated in 3.2.1 and some cases are repeats (i.e see what concerns Bangladesh). New material can be integrated in the previous section. (Annarita Mariotti, ENEA)	Accepted
E-3-248	A	9				S3.2.2: please make it clear what you're discussing in this section. The introductory sentence that the section is climate related but the majority discusses non-climate issues (Clair Hanson, IPCC TSU)	Accepted
E-3-249	A	10	1	10	31	Re-title Fig. 3.2 so that it reads: "Current Vulnerabilities for Freshwater Resources from All Causes" (Indur Goklany, US Department of the Interior)	Accepted
E-3-250	A	10	1	10	40	P 10 l 39-40 why is evaporation omitted here? (Kevin Trenberth, NCAR)	Evaporation mentioned in 3.4
E-3-251	A	10	1	10	30	P 10 l 30 Fig 3.2. The oval in the Pacific might be better located if it in fact included some island states. (Kevin Trenberth, NCAR)	**Revised**

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E-3-252	A	10	1	10	28	Figure 3.2. The map in the background raises questions. The reference Doll (2005) is published in German in a German journal. Suggestion: use a neutral background map or a global water stress indicator map that is pubished in a peer reviewed journal available for the entire scientific community (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	**Remains as was**
E-3-253	A	10	1	10	31	Figure 3.2 If this figure is to be published in black and white, the tones of gray are very difficult to distinguish and they perhaps should be changed to patterns. If in colors, fine. (Martine M. Savard, Geological Survey of Canada)	It will be in colour.
E-3-254	A	10	1			Fig.3.2 Suggest to add inland river basins in arid and semi-arid region in Northwest China in fig.3.2 where the withdrawal-to-availability ratio is over 1(~1.27) producing the degradation of ecological environment (Liu Chunzhen 2005: The primary analysis of hydrological cycle and its ecological function of inland river basins in China. Arid meteorology.Vol.23.N0.3 12-15.(in Chinese).and The vulnerability of climate change impact on the Western China http://essi.nju.edu.cn/AIACC/website/index.htm as well. (Chunzhen Liu, Water Resources Information Center of MWR)	One for China is likely to balance in the figure.
E-3-255	A	10	29			p. 10, Fig 3.2 contains same error re desalting plant and provision of "drinkable water" to Mexico. (Charles Howe, Institute of Behavioral Science)	**Revised**
E-3-256	A	10	30		31	Figure 3.2 reflects water problems which differ signifantly in their importance and spatial scale. The damages to riparian ecosystems by flood protection in the Elbe river can not be compared with the dry-out of the Aral- Sea. The map should focus on continental or transnational water problems only. (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	**Examples only]**
E-3-257	A	10	31	10	31	it would be appropriate here to emphasize that the vulnerabilities depicted in Fig. 3.2 are only a few examples from a much larger set. (Spyros Beltaos, National Water Research Institute)	Accepted
E-3-258	A	10	36	11	2	Good introductory paragraphs. Section 3.2 needs one. Maybe the 3.3 LAs can help. (Philip Mote, University of Washington)	Improved
E-3-259	A	10	37	10	37	"the AR4 WG2 report", replace with "this report". (Annarita Mariotti, ENEA)	Done
E-3-260	A	10	39	10	40	Remove "(principally, precipitation, temperature, and sea level rise)" as these are specified in text below. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-	A	10	41	10	41	Reference to desalinization techniques, which were implemented in many regions	Desalination mentioned elsewher in Ch. 3

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261						years ago and the new developments (case of Singapore) as well as the fog the fog-droplets catching, in some regions (i.e. Peru and Chile, in this last case through - Camanchaca ´s mining, should be mentioned. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-262	A	10	42	10	43	"... but also to compare the relative importance of climate-related changes to changes due to other drivers". There is lack of this kind of content in text of section 3.3 (Chunzhen Liu, Water Resources Information Center of MWR)	It is o.k. now
E-3-263	A	10	46			"Section 3.3.1" This section is of fundamental importance and needs to be improved since it sets the stage for what can be inferred regarding the impacts (necessarily not much more than what can be said for the climatic drivers). In my view it should give less details on the various sources of uncertainty for precipitation, temperature and sea level rise (the model, the tecniques to descrease uncertainty etc) which are the focus of the WGI report . Instead it should focus and state more clearly what can be concluded from the WGI report in terms of the expected changes for the major climatic drivers and their confidence, adding issues regarding the coupling with freashwater impact models. In particular, it should give the confidence of the various results (changes in the mean and in the extremes of each variable) with regional detail. All these results should make references to specific sections of the WGI report, as is already partly done, so that addition detail can be easily sought by the reader, instead less direct references to papers in needed here. (Annarita Mariotti, ENEA)	Revised, reflecting this advice
E-3-264	A	10	48	13	9	The text on assumptions regarding future trends should note that impacts studies often ignore adaptations (see, e.g., Arnell 1999, 2004). This becomes increasingly important in the future not only because water stress could increase with time (because of higher and wealthier populations), but also because adaptive capacity should be higher, if economic and technological deevlopment follows paths specified in the SRES scenarios (see Goklany 2005c, 2006a). Accordoingly, projected impacts frequently have a tendency to overestimate negative impacts and underestimate benefits from climate change. (Indur Goklany, US Department of the Interior)	Strongly changed
E-3-265	A	10	49	10	49	Wouldn't it be more correct to change "evaporation" to "evapotranspiration"? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Evaporative demand now
E-3-266	A	10	51	11	2	Remove last sentence in the paragraph "Another … report)". This statement seems unnecessary as you have already mentioned in general terms "evaporation" (evapotranspiration?, there is a separate comment on this) in the preceding	Revised

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						sentence. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-267	A	10	51	11	2	"Another important climate variable is the evaporative..". Evaporation has already been mentioned, that's where the dependence on the various physical parameters could be added, however in this context relevance is low. (Annarita Mariotti, ENEA)	O.k.
E-3-268	A	11	1	11	49	P 11 l 49: there is no reason to believe that any of the model versions simulate precipitation well when the fundamental physics is flawed. (Kevin Trenberth, NCAR)	Wording used in IPCC WG I followed
E-3-269	A	11	1	11	7	P 11 l 4-7. This statement 1 4 is not justified. Global precipitation change is uncertain. It increases in greenhouse gas runs but can decrease when aerosols are included, especially over land. Much improved references and justification is required for these statements. Some of what is stated here are model results but the utility of those is questionable. (Kevin Trenberth, NCAR)	Re-worded after WG I SPM
E-3-270	A	11	1	11	36	P 11 l 36: "could": needs to be stronger: "certainly will" (Kevin Trenberth, NCAR)	Done
E-3-271	A	11	1	11	35	P 11 l 35-35. Why is there no statement here about how poorly climate models simulate characteristics of precipitation (see e.g. Dai, A., and K. E. Trenberth, 2004: The diurnal cycle and its depiction in the Community Climate System Model. J. Climate, 17, 930-951) (Kevin Trenberth, NCAR)	Uncertainty in precipitation extensively addressed
E-3-272	A	11	1	11	24	P 11 l 24: Why is there nothing on evaporation here in this section? (Kevin Trenberth, NCAR)	Addressed in 3.3.1 and 3.4.1
E-3-273	A	11	1	11	23	P 11 l 22-23: How is 5 to 13 cm sea level rise credible when it has increased since 1993 at 3 mm/year: 37 mm in the past 13 years? See chapter 5 WG 1. Simple extrapolation of current rates gives 15 cm by 2050. Similarly the values for 2100 are absurd. Are they based on only expansion of the ocean (no glacier melt, perhaps?) (Kevin Trenberth, NCAR)	O.k., addressed, following WG I formulation
E-3-274	A	11	1	11	1	It would be opportune to discriminate between atmospheric and soil humidity. Both are important meteorological variables closely link to the evaporation and infiltration, and also recognized as variables defining flood conditions, particularly in plains / flatlands. (Osvaldo Canziani, IPCC WGII Co-chair)	O.k. addressed
E-3-275	A	11	4	11	15	Rewrite this paragraph for clarity: projections of future precipitation changes have strong variations in space, in time, and among models; distilling meaningful, likely-	Re-written

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						to-occur projections is challenging. Giorgi and Mearns (2004) offer a useful method for doing so, Reliability Ensemble Averaging. (Philip Mote, University of Washington)	
E-3-276	A	11	4	13	9	This section provides much information on climate change itself as covered by WG I. I see the need to reflect potential climate (precipitation) changes and their uncertainties owing to their importance for water resources assessment, but nonetheless this section should be shortened, especially since fig. 3.3 on p. 16 already shows some range of runoff responses under different climate projections. Also, the uncertainty from climate models as propagated to hydrological models is discussed on p. 15, first paragraph, which is redundant. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Revised accordingly
E-3-277	A	11	4			I would say 'Globally, precipitation is expected to increase. (Soroosh Sorooshian, University of California, Irvine)	O.k. addressed
E-3-278	A	11	6	11	6	Change "declines" to "decreases" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-279	A	11	7	11	7	The definition of magnitude in sciences recommends to replace ”increments” in the place of “magnitudes” (Osvaldo Canziani, IPCC WGII Co-chair)	Done
E-3-280	A	11	8			"tropic" should be "tropics" (Philip Mote, University of Washington)	Done
E-3-281	A	11	10	11	13	Change "In Europe … periods" to "Precipitation patterns are expected to show more intense events, separated by longer dry (or low precipitation) periods, even in regions where the mean annual precipitation decreases (Christensen & Christensen 2003, Kundzewucz eta l. 2006)." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-282	A	11	13			"mid…latitude" should be "middle and high latitudes" (Philip Mote, University of Washington)	Re-worded
E-3-283	A	11	17	11	18	Change "until" to "by", 2 occurrences. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-284	A	11	17	11	17	Between global and temperature add surface, so to read global surface temperature. (Osvaldo Canziani, IPCC WGII Co-chair)	Done
E-3-285	A	11	17	11	18	and elsewhere… "until" implies that the action ended at that point. A better word would be "to", which would make even more sense if preceded by "from pre-industrial time". (Philip Mote, University of Washington)	Re-worded
E-3-286	A	11	21	11	21	specify what are “very northern latitudes” (Spyros Beltaos, National Water Research Institute)	Re-worded (Arctic)

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E-3-287	A	11	22	11	22	Add the qualificative "mean" so to read correctly "Global mean sea level rise" . (Osvaldo Canziani, IPCC WGII Co-chair)	Done
E-3-288	A	11	27	11	27	In addition to the model uncertainties, it is necessary, as indicated in other parts of this chapter the scale ´s problem, Climate and hydrological models are, at present, worked in unmatched, different scales (i.e basin scale versus sub-continental scale) (Osvaldo Canziani, IPCC WGII Co-chair)	Scale mismatch addressed in 3.3.1 par. 2 and in a 6-line bullet in 3.8
E-3-289	A	11	41	11	44	These lines should be part of the Executive Summary. (Indur Goklany, US Department of the Interior)	Uncertainty statement has indeed penetrated into ES
E-3-290	A	11	45	11	47	Suggest removing the sentence "Parameter … (Muuphy et al. 2004).", unnecessary detail. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-291	A	11	50	11	50	I think it would be more correct to change "probability" to "conditional probability" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-292	A	12	1	12	8	P 12 l 6-8: Just because models are flawed for this task does not mean nothing can be said when one considers expected changes in potential evapotranspiration and extremes. Use of WG 1 chapter 10 alone is inadequate for this purpose. (Kevin Trenberth, NCAR)	O.k. addressed. Re-worded
E-3-293	A	12	1	12	32	P 12 l 31-32: Why is there no discussion of changes in evaporation and drought? (Kevin Trenberth, NCAR)	Drought tackled in 3.4.3
E-3-294	A	12	1	12	23	P 12 l 19-23: Any model use should take into account how well models simulate the characteristics of precipitation in current climates and none do well. All have precipitation that is too frequent and with insufficient intensity. Any reasonable assessment must account for inadequacies in models, this does not do that. See the following for what can be said in spite of model deficiencies. Trenberth, K. E., A. Dai, R. M. Rasmussen and D. B. Parsons, 2003: The changing character of precipitation. Bull. Amer. Meteor. Soc., 84, 1205-1217. (Kevin Trenberth, NCAR)	Substantially re-worded, in the direction of this comment
E-3-295	A	12	10			"climate change impact" is a string of noun modifiers. "impacts of climate change" better. (Philip Mote, University of Washington)	This string is in broad use
E-3-296	A	12	12	12	12	"Döll et al. 2003" was a poster presentation! Do not use unreviewed literature! Proof other references too! (Uwe Gruenewald, Brandenburg University of Technology Cottbus)	It was published. Included in the list of refs.
E-3-297	A	12	25	12	28	This paragraph on "detection" seems out of place and can probably be removed completely. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Removed
E-3-	A	12	35	12	36	The term "scaling" in some recent literature has been used to refer to methods of	Wording changed to "adjusted"

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298						bias-correcting variables from RCMs to be able to use the RCM outputs more "directly". Here, you are referring to the "non-direct" method based on a "delta approach" or "delta change approach". Would it be possible to modify your statements and change "scaled" to "perturbed" and "scaling" to "perturbation" in the interest of maintaining clarity with upcoming methods"? If I am not mistaken, I think Arnell used "perturbed" in some of his publications, or am I thinking of another author? Perhaps there is yet another term that could be used instead of scaling (e.g. "modified")? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-299	A	12	40	12	43	Another method that has been used is to use the outputs from regional climate models and bias-correct the control climate to match observations. You then bias correct the future climate using the same bias-correction as the control. You can then use the results from climate models directly in rainfall-runoff models. This has been shown to reproduce real river flow statistics well in northern England (Fowler and Kilsby, in press in Climatic Change - Fowler, H.J. and Kilsby, C.G. Using regional climate model data to simulate historical and future river flows in northwest England. Climatic Change, in press. Additionally, if the method is used across a whole region then the implications for water resources can be assessed (Fowler, H.J., Kilsby, C.G. and Stunell, J. Modelling the impacts of projected future climate change on water resources in northwest England. Hydrology and Earth System Sciences, in press.) (Hayley Fowler, Newcastle University)	Fowler et al. included in references. Cannot elaborate here due to page limit.
E-3-300	A	12	41	12	44	The two sentences in these lines are not quite representative of the real facts. Changes in inter-annual or daily variability of climate variables are taken into account, very particularly in agrometeorological studies, closely linked to the impacts of the hydrometeorological variables in crop production. However, it has to be agreed that "other geophysical and geological variables (i.e terrain ´s slope, geomorphology and their edaphological structures are poorly considered to foresee floods and droughts and, in particular regarding irrigation requirements. Also, there are few studies on the water use efficiency for different crops. (Osvaldo Canziani, IPCC WGII Co-chair)	Wording modified (weakened)
E-3-301	A	12	41	12	43	I do not agree that changes to daily variability are not commonly taken into account. I think that this is one of the biggest changes in hydrological impact studies since the TAR. I have published 3 papers myself using methods that change variability and examining climate change impacts on hydrology and water resources (Fowler et al., 2003, WRR, and see references detailed above) Addiitonally, just within the UK i can think of many other studies. I would say that	Wording modified (weakened)

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						it is now commonplace to not only change the mean but the variability and even the sequencing etc of rainfall in impact studies. (Hayley Fowler, Newcastle University)	
E-3-302	A	12	46	13	9	Reading this important paragraph one comes to the conclusion that still there is little information for decision making. It presents a good scientific approach; however, is missing a reference on the value of under- ground water resources to supplement water requirements in rain-fed crops and surface water resources for irrigation. Such a reference, with the necessary clarification that competitive use of both surface and underground water resources may present the limitations that would result when both sources of water have the same origin; as it is the case for streams, lakes, reservoir and underground water resources fed from ice /snowmelt, in the arid, semiarid foothills of mountain regions.(Case of Central Chile and Central Western Argentina) (Osvaldo Canziani, IPCC WGII Co-chair)	Good comment but page limit is binding and critical
E-3-303	A	12	48	12	48	Please clarify by providing the scale of the hydrological processes (variable but commonly 10's of km) so that the reader can make comparisons with CGM scale. (Martine M. Savard, Geological Survey of Canada)	Hydrological scale explained elsewhere
E-3-304	A	13	6			"allow to incorporate …in": idiomatic English would read something like "allow the modeler to incorporate…" or "allow daily variability to be incorporated" (although now that I read it that way it's not clear what it's being incorporated *in* - sentence needs clarifying (Philip Mote, University of Washington)	Reworded by a CA from the UK
E-3-305	A	13	9			At the end of this column a reference on cpt. 3.8 would be helpful, otherwise a recommandation on the best methodology is needed. (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Difficult issue. Demands many words. Page limit!
E-3-306	A	13	14	13	21	Another excellent paragraph, providing an overview of the section; succeeding paragraphs elaborate on the points mentioned here. Such "road maps" are badly needed elsewhere in the chapter. (Philip Mote, University of Washington)	Thanks. Wording changed to suit other referees
E-3-307	A	13	18	13	21	The statement in the last sentence of the paragraph could be reinforced by adding that the development of IWRM plans by 2005 is a target set by the WSSD and included in the Johannesburg Plan of Implementation. (Silvia Llosa, ISDR System)	Yes, but we have page limit
E-3-308	A	13	19	13	19	what exactly is "the paradigm of Integrated Water Resources management" ? (Spyros Beltaos, National Water Research Institute)	See glossary
E-3-309	A	13	19	13	21	The authors state that it can be expected that the paradigm of integrated water resources management will be increasingly followed all around the world. This is a	Wording softened

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						hopeful claim, but doesn't stand on its own without evidence for additional support. (Rob de Loë, University of Guelph)	
E-3-310	A	13	24	13	24	After "land cover" add "land use practices" (Osvaldo Canziani, IPCC WGII Co-chair)	Done
E-3-311	A	13	28	13	38	This paragraph is missing the reference to a recent publication by Thayer Suudder, entitled "The Future of Large Dams" Earthscan, 2005. This books analyses the WCD Final Report Dams and Development: A New Framework for Decision Making. The book deals with social, environmental and political costs of large dams, bringing issues of interest to developing countries ´decision makers. (Osvaldo Canziani, IPCC WGII Co-chair)	Reference to Scudder included
E-3-312	A	13	29			can omit "already" - it's redundant (Philip Mote, University of Washington)	Done
E-3-313	A	13	32			Add citation after "Howard": Gleick, P.H. 2000. "The removal of dams: A new dimension to an old debate." in P.H. Gleick, 2000. The World's Water 2000-2001. Island Press, Washington, D.C. pp. 11E-3-136. (Peter Gleick, Pacific Institute)	We have this reference now
E-3-314	A	13	35	13	35	A useful addition to the two references provided here would be: Hochstrat, R., Wintgens, T., Melin, T., and Jeffrey, P. (2006) Assessing the European wastewater reclamation and reuse potential — a scenario analysis. Desalination 188. 1-8 (Paul Jeffrey, Cranfield University)	LAs decided otherwise
E-3-315	A	13	36	13	38	Costs of energy continue to rise, so it is inconsistent to (Bruce Kimball, USDA, Agricultural Research Service)	Reworded
E-3-316	A	13	36			the costs of desalination "may" continue to decline; not "will." Recent evidence suggests costs are rising again as energy and construction material costs have risen. See Cooley, H., P.H. Gleick, G.Wolff. 2006. "Desalination: With a grain of salt." Pacific Institute, Oakland, California, at http://www.pacinst.org/reports/desalination/index.htm. (Peter Gleick, Pacific Institute)	Changed. Reference is there now
E-3-317	A	13	37			"of not only coastal towns" awkward - how about "of towns even some distance from available water" or "from the coast" (Philip Mote, University of Washington)	Changed
E-3-318	A	13	38			Should read: "However, there are unresolved concerns about the environmental impacts of impingement and entrainment of marine organisms, the safe disposal of highly concentrated brines that can also contain other chemicals used in the desalination process, and the sensitivity of costs to energy use." (Peter Gleick, Pacific Institute)	Changed
E-3-	A	13	40	13	49	This paragraph brings the need to inform on the recent studies on the problems	Reworded

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319						stemming from the consumption of tap water. The chemical reactions among the different substances used to clean and purify water, to make it more sure are the cause of potential diseases, like bladders ´cancer (New Scientist, August 2005,page 48) Cross reference with Chapter 8 is necessary. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-320	A	13	48	13	48	should be "increases" (Bruce Kimball, USDA, Agricultural Research Service)	Revised
E-3-321	A	14	2	14	5	Is it safe to assume that every reader knows that "N" stands for nitrogen? (Philip Mote, University of Washington)	Revised
E-3-322	A	14	6	14	6	It is suggested to insert "would" between system and decrease, to read "in the freshwater system would decrease". (Osvaldo Canziani, IPCC WGII Co-chair)	Revised
E-3-323	A	14	7	14	8	The real fact is that food production in many countries has already created hazards deriving from the use, normally excessive, of agrochemical. Therefore, in view of the increasing commercial requirements for food, this use will be incremented. Therefore, in line 8, the phrase should read: "emission, which critically affect water quality in developing countries are very likely to increase" (Osvaldo Canziani, IPCC WGII Co-chair)	Careful wording
E-3-324	A	14	10			omit the colon after "are" - it's ungrammatical (Philip Mote, University of Washington)	Done
E-3-325	A	14	15			add a sentence after "…dominant." "Data from a wide range of industrialized countries now show declining per-capita water use through improvements in efficiency and changes in economic structures. The U.S., for example, now uses less water in total than was used in 1970, and far less on a per-capita basis (Gleick 2003)." Add the citation Gleick, P.H. 2003. "Water Use." Annual Review of Environment and Resources. Vol. 28, pp. 275-314. (Peter Gleick, Pacific Institute)	Done
E-3-326	A	14	17	14	17	Should 100m3/yr become 1000m3/yr? (Annarita Mariotti, ENEA)	Is correct
E-3-327	A	14	23	14	32	This paragraph reserves a re-drafting. For instance, its first line repeats developing countries with no sense. The rest would require a better reading, particularly for decision making levels. (Osvaldo Canziani, IPCC WGII Co-chair)	Re-drafted
E-3-328	A	14	25	14	25	Unless the cropping intensity refers to an index, it should have units. (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Done
E-3-329	A	14	25			what is "cropping intensity" and what significance do those numbers have? (Philip Mote, University of Washington)	Explained

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E-3-330	A	14	35	14	27	Subsection 3.4.1: There is nothing in this subsection about ice cover, one of the aspects identified for coverage under "Surface water" in the "Guidance Notes for Expert Reviewers". (Spyros Beltaos, National Water Research Institute)	Added
E-3-331	A	14	35	25	51	Section 3.4 is the core of chapter 3, but it seems to have missed some important ingredients. The "Guidance Notes for Expert Reviewers" identify five specific topics for discussion, i.e. water cycle, surface water, groundwater, water demand/use, and extreme events. Water cycle and water demand/use are not covered. (Spyros Beltaos, National Water Research Institute)	All elements are covered in the chapter
E-3-332	A	14	35			Section 3.4: almost exclusively addresses impacts and not vulnerabilities despite its title. (Silvia Llosa, ISDR System)	Some vulnerabilities
E-3-333	A	14	37	15	30	This section should highlight Milly et al. (2005, Nature, Global pattern of trends...), who showed AR4 ensemble model projections of runoff change, having demonstrated retrospectively the skill of the ensemble. (Christopher Milly, U.S. Geological Survey)	Included
E-3-334	A	14	37			Confidence categories are missing in section 3.4.1. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	And elsewhere (except ES)
E-3-335	A	14	41	14	43	Why there is no mention of influence of physiological controls on evapotranspiration and runoff (see 29-32 page 8). (Chunzhen Liu, Water Resources Information Center of MWR)	Is elsewhere in the chapter
E-3-336	A	14	41	14	41	What has already been said about the important energy accumulation because of the terrestrial atmosphere greenhouse effects, suggest that the reference to " energy availability" be informative of both the solar and the terrestrial energy availability (Osvaldo Canziani, IPCC WGII Co-chair)	No action (many words needed)
E-3-337	A	14	41	14	42	the changes also potentially affect melting of ice (Georg Kaser, Geo and Atmospheric Sciences)	Later in 4.3.1
E-3-338	A	14	45	15	14	very good, value-adding, summary of work done since the TAR. (Spyros Beltaos, National Water Research Institute)	Thank you
E-3-339	A	14	46	14	46	It is felt that the authors have missed the recent developments stemming from the AIACC projects and the vulnerability and impact studies requested under the UNFCCC Article 12 (National GHG inventories). They are not gray literature, but many of them are valuable research studies. Again, cross reference with Regional Chapters is opportune (Osvaldo Canziani, IPCC WGII Co-chair)	Some references from regional chapters introduced
E-3-	A	14	46	14	46	"international literature" should be "scientific journals" and "grey literature"	Done

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340						"internal reports" (Georg Kaser, Geo and Atmospheric Sciences)	
E-3-341	A	14	51	15	1	The study P.C.D. Milly, K.A. Dunne and A.V. Vecchia, Global pattern of trends in streamflow and water availability in a changing climate, Nature 438, 347-350, 2005, should be cited here. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Done
E-3-342	A	15	3		14	can be deleted as it doesn't discuss impacts (Clair Hanson, IPCC TSU)	Reduced and re-worded
E-3-343	A	15	5	15	7	The following 2 recent articles would fit in well with those listed here for use with RCMs. They were sent to the TSU for WGII In March (in pdf format). The revised final versions are now available and they will soon be in press, expected to be in print by Dec 2006. Graham, L.P., Hagemann, S., Jaun, S. and Beniston, M., 2006. On interpreting hydrological change from regional climate models. Climatic Change, (accepted). Graham, L.P., Andréasson, J. and Carlsson, B., 2006. Assessing climate change impacts on hydrology from an ensemble of regional climate models, model scales and linking methods - a case study on the Lule River Basin. Climatic Change, (accepted). (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-344	A	15	6	15	6	Change "Andreasson et al. 2003" to "Andreasson et al. 2004" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-345	A	15	6	15	6	Andreasson et al, 2003 should read Andréasson et al. 2004 (Sten Bergström, Swedish Meteorological and Hydrological Institute)	Done
E-3-346	A	15	6			reference Fowler and Kilsby 2005 is missing from reference list (Hayley Fowler, Newcastle University)	Fowler et al., 2006
E-3-347	A	15	11	15	13	This is contradictory to what is said earlier in the chapter when talking about uncertainty when you clearly state that Kay et al (2006) show that the structural uncertainty provided by the GCM is the largest source of uncertainty, larger than either the uncertainty from emissions scenario or hydrological model used. This is certainly what has come out of publications resulting from the PRUDENCE project and from our own recent work. (Hayley Fowler, Newcastle University)	Re-worded
E-3-348	A	15	16	15	22	Regional details should be further discussed. In particular, pointing regions where greater consistency among model results is found. In this respect, an additional figure or panel showing some measure of uncertainty (or confidence) would be useful as a reference for future discussion.	Addressed in new text

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Annarita Mariotti, ENEA)	
E-3-349	A	15	16	15	22	Needs to explain why A2 and B2 scenarios gave diferent results for annual river runoff. (Ragab Ragab, Centre for Ecology and Hydrology)	Wording changed
E-3-350	A	15	16	15	22	Can this model runs be updated by using climate scenarios from AR4? (Georg Kaser, Geo and Atmospheric Sciences)	No, this is aganst the rules
E-3-351	A	15	16	15	22	A single decade is not a good way to get robust results for runoff change. Multimodel, 30-year means improve the signal-to-noise ratio. (Philip Mote, University of Washington)	Text substantially changed
E-3-352	A	15	18	15	18	Please clarify by providing the range of latitudes referred to (above 30°). (Martine M. Savard, Geological Survey of Canada)	More specific wording used
E-3-353	A	15	22	15	22	should be "is there" (Bruce Kimball, USDA, Agricultural Research Service)	Wording changed
E-3-354	A	15	23			Insert a new paragraph on line 23, noting that some perojections indicate that climate change might reduce the global population at risk of water stress. Specifically, this para should go as follows: "By the 2080s, climate change may reduce the population suffering from water stress, although that is by no means certain. Moreover, non-climate-change related factors are likely to be more significant in determinng the population at risk (PAR) of water shortage than is climate change (Arnell 1999, 2004). This can also be seen in current Table 3.2 of the this chapter. This suggests that in the short-to-medium term reducing current vulnerabilities to climate and climate variability may be the most effective method of reducing the PAR for water stress (Goklany (2005a)." Finally, this finding should be echoed in the Executive Summary because of its potential significance to policy makers. See my comment for p38 line 36 for additional details.. (Indur Goklany, US Department of the Interior)	Page limit! Issue addressed now in 3.5.1
E-3-355	A	15	24			it's not readily apparent that Figure 3.3 shows that climate change is large relative to natural variabilitiy or that the assertion is believable. Point out that each map has little gray in it, meaning that in most areas runoff change exceeds variability as measured by one standard deviation, but also point out that there are areas where models agree about the sign and magnitude of change but agreement is poor in many areas. More important, though, how was the "standard deviation" calculated and over what time period? is it really a measure of natural interdecadal variability as asserted? (Philip Mote, University of Washington)	Wording changed
E-3-356	A	15	26	15	26	It would be interesting to know what does it mean the phrase between brackets, particularly to understand which could be the significance of statistical evaluations	Wording changed

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						with projected values of a difficult variable to model. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-357	A	15	32	15	43	Too many references in this paragraph. Makes it difficult to read. (Ragab Ragab, Centre for Ecology and Hydrology)	Section shortened but references found important
E-3-358	A	15	32	15	43	Once again, cross-reference with the Regional Chapters is necessary Changes in the river flow seasonality has also been detected and studied in other IPCC regions (Osvaldo Canziani, IPCC WGII Co-chair)	Many regional examples given. Regional chapters used references from this list
E-3-359	A	15	34	15	35	The reference "Andreasson et al. 2004" does not concern the Alps and should be removed from this citation. However, the newer reference listed below reports on results from both the Alps and the Baltic Sea region and supports the statements on snow and seasonality. As documented in a separate comment, this reference was sent to the TSU for WGII in March 2006. {*Note from the TSU – Phil's papers were circulated to chapters 3 and 12 in March 2006.*} Graham, L.P., Hagemann, S., Jaun, S. and Beniston, M., 2006. On interpreting hydrological change from regional climate models. Climatic Change, (accepted). (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-360	A	15	34	15	34	Delete Andreasson et al. 2004. This reference is not relevant for the Alps. (Sten Bergström, Swedish Meteorological and Hydrological Institute)	Done
E-3-361	A	15	36			this effect was first modeled and reported for the western North America by Gleick, P.H. 1987b. "Regional hydrologic consequences of increases in atmospheric carbon dioxide and other trace gases." Climatic Change. Vol. 10, No. 2, pp. 137 161. Please add at line 36. (Peter Gleick, Pacific Institute)	We assess references published since the TAR
E-3-362	A	15	40	15	41	Both of the the following 2 recent articles would fit in well with those listed here for seasonality/snow effects for Scandinavia and the Baltic region. As documented in a separate comment, they were sent to the TSU for WGII in March 2006. Graham, L.P., Hagemann, S., Jaun, S. and Beniston, M., 2006. On interpreting hydrological change from regional climate models. Climatic Change, (accepted). Graham, L.P., Andréasson, J. and Carlsson, B., 2006. Assessing climate change impacts on hydrology from an ensemble of regional climate models, model scales and linking methods - a case study on the Lule River Basin. Climatic Change, (accepted). (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Both references now in the list
E-3-363	A	15	40	15	40	Andreassan et al. should read Andréasson et al. (Sten Bergström, Swedish Meteorological and Hydrological Institute)	Done
E-3-	A	15	41	15	41	Bergstrom should be Bergström	Done

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364						(Sten Bergström, Swedish Meteorological and Hydrological Institute)	
E-3-365	A	15	42	15	43	Please rephrase, the text is not clear; particularly in the following part: … and in many studies brings forward the flow season by at least a month. (Martine M. Savard, Geological Survey of Canada)	Re-phrased
E-3-366	A	15	43			at least a month by when? (Philip Mote, University of Washington)	Re-phrased
E-3-367	A	15	45	15	51	Sarha Raper and Roger Braithwaithe have published several papers on future global glacier ablation scenarios that may fit into this paragraph (Georg Kaser, Geo and Atmospheric Sciences)	There is a para on this
E-3-368	A	15	45	15	51	A paragraph on climate change related runoff scenarios for glacier runoff intwo different climate regimes was prepared for WG1 Ch4.5 but was considered more appropriate for WG2 Ch3. The paragraph including Figures and references was provided to WG2 Ch3 CLA Z. W. Kundzewicz (Georg Kaser, Geo and Atmospheric Sciences)	LAs wrote the final text in Cape Town
E-3-369	A	15	46	15	47	The Andes that Mark and Seltzer (2003) refer to have no (thermal) summer but a climate regime, that provides glacier runoff all year round. See respective parts in WG1 ch 4.5 (Georg Kaser, Geo and Atmospheric Sciences)	Needs to be addressed
E-3-370	A	15	47	15	49	It should be noted that in the Karakoram Himalaya (Hindu Kush) there has been a recent cooling of summer temperature (Fowler and Archer in press in J Climate - Fowler, H.J. and Archer, D.R. Conflicting signals of climatic change in the Upper Indus Basin. Journal of Climate, in press.) and an observed expansion of glaciers (Ken Hewitt 2005). Recent trends suggest that global warming may induce winter warming and higher winter precipitation (Archer and Fowler 2004) and therefore increased accumulation of snow on glaciers, but reduce summer melting through a cooling effect. Indeed, summer flows have reduced significantly in recent years and this can be explained by a simple regression with summer temperature - the 1degC cooling of mean temperature since 1961 is predicted to cause a 14% reduction in flow (Fowler and Archer in press JC) - the observed figure is higher (details in paper) (Hayley Fowler, Newcastle University)	Comment refers to observations (Chap. 1) not projections
E-3-371	A	15	47			"Higher", not "warmer" temperatures. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Done
E-3-372	A	15	51			in how many river basins is glacial melt a significant contribution to flow? (Philip Mote, University of Washington)	General statement
E-3-373	A	16	1	16	41	Figure 3.3 If this figure is to be published in black and white, the tones of gray are very difficult to distinguish and they perhaps should be changed to patterns. If in	Hopefully colours

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						colors, fine. (Martine M. Savard, Geological Survey of Canada)	
E-3-374	A	16	40			Figure 3.3 is based on old model outputs. Suggest using results from AR4 model, such as those of Milly et al. (2005, Nature, Global patterns of trends…) (Christopher Milly, U.S. Geological Survey)	Milly's fig. is 3.4 now.
E-3-375	A	16	46			Fowler and Kilsby, Climatic Change in press (Hayley Fowler, Newcastle University)	LAs have not acted on this
E-3-376	A	16				Figure 3.3. The quality needs to be improved. It is particularly hard to distinguish between the 2 red colors. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Impaortant technical details to be finalized in the editing phase.
E-3-377	A	17	1	17	20	P17 l 20 Betts submitted is not available and should not be used in IPCC. This material can not be examined. What 128 GCM simulations? (Kevin Trenberth, NCAR)	We follow the rules
E-3-378	A	17	1	17	27	P 17 l 27 ditto for Betts et al. (Kevin Trenberth, NCAR)	Ditto
E-3-379	A	17	2	17	2	Recent results by Elguindi and Giorgi [2006] show that for the Caspian Sea evaporation will also play a very relevant role. (Annarita Mariotti, ENEA)	Reference included
E-3-380	A	17	4	17	6	but is this a robust result or is it a result of the peculiar time evolution of a specific model's water balance in that location? If it's only one scenario, and no more plausible than, say, rising to the 2050s and then falling, why even mention it? (Philip Mote, University of Washington)	Nothing better could be found
E-3-381	A	17	8	17	8	What is meant by "feasible" land-use changes? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-382	A	17	15	17	27	This section is somewhat speculative. The effects of CO2 on river runoff requires more references to published and not submitted material. (Sten Bergström, Swedish Meteorological and Hydrological Institute)	Submitted is o.k.
E-3-383	A	17	15	17	16	Please rephrase "Accounting for effects of land cover change and direct effects of CO2 enrichment ..." (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Revised
E-3-384	A	17	15	17	27	needs to explain clearly the impact (or the mechanism) of CO2 on runoff volume (Ragab Ragab, Centre for Ecology and Hydrology)	Explained
E-3-385	A	17	17	17	18	Change "GCM (and not catchment) scale)." to "GCM scale." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	LAs decided to keep as is
E-3-386	A	17	18	17	27	The paper on which this paragraph is based is not yet published (Betts, submitted), so it is not possible to judge the relevance of the statement that "global mean runoff under a doubled CO2 scenario was approximately 50% greater". One needs to	Submitted is enough

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						know what the absolute effect is, ie. whether the simulated change in runoff and the reduction imposed by stomatal effects are significant at all, and what are the regional patterns. Generally, this paragraph is focused too much on a single study, while there have been a number of other studies that dealt with CO2 effects on water balances / runoff. These studies came to the conclusion that net CO2 effects are relatively minor (significant only in specific regions, and non uniform in direction of change); to provide a more balanced view, such studies should not be neglected here (e.g. ; Kergoat, L., Lafont, S., Douville, H., Berthelot, B., Dedieu, G., Planton, S. & Royer, J.-F. 2002, Impact of doubled CO2 on global-scale leaf area index and evapotranspiration: conflicting stomatal conductance and LAI responses, J. Geophys. Res. 107, 4808–4838; Leipprand & Gerten 2006, Global effects of doubled atmospheric CO2 content on evapotranspiration, soil moisture and runoff under potential natural vegetation, Hydrol. Sci. J. 51, 171-185; and local-scale studies). (Dieter Gerten, Potsdam Institute for Climate Impact Research)	
E-3-387	A	17	30	17	49	Regarding this paragraph there would be a few things to clarify. First, we are already withdrawing water from underground aquifers at a faster rate than it can be replenished; however, the scarcity of measurements of the underground water levels and the lack of isotopic studies to determine the recharge time as well as the effective characterization of aquifers, does not permit the appropriate underground water management. It is now the opportunity to promote such type of measurements, including that of underground water quality, so to obviate the brutal failure of underground water projects, as it has happened in India and Bangladesh. Therefore, it is not merely the lack of research, in many areas, particularly in developing regions, it is the lack of basic information. In this regard, the two first sentences need redrafting to bring to the attention of decision makers the need to improve the hydrometeorological data base. (Osvaldo Canziani, IPCC WGII Co-chair)	Addressed
E-3-388	A	17	30	18	38	In addition to the comment above, on repetitions, the polishing of this paragraph should include some comments on underground water management, in spite of the fact that they could be expanded later. It is crucial that decision making begin to understand that underground water sources are also finite and that good management, including the analyses of underground water quality, is a must.. A cross reference with Chapter 13, regarding the joint management of the Guaraní aquifer, between Argentina, Brazil, Paraguay and Uruguay, could be useful. A reference on aquifers´ with ice/snowmelt feeding would be important due account taken of glaciers retreat, the increasing snowfalls in some regions and the fact that	Addressed

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						there is uncertain the time horizon for their disappearance. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-389	A	17	30			Section 3.4.2 on groundwater focuses on climate impacts and has no mention of potential implications for management. The reasons for this are recognized given the paucity of studies on management implications for groundwater as a consequence of climate change. Three points are, however, important to make: First, in a number of regions groundwater currently plays an important role buffering variability in supplies from surface sources. This ability to control variability through the use of groundwater may have, for example, played a key role in India's progress toward poverty alleviation and food security. See for example: World Bank and Ministry of Water Resources - Government of India (1998). India - Water Resources Management Sector Review, Groundwater Regulation and Management Report. Washington D.C., New Delhi, World Bank, Government of India; Moench, M. (2003). Groundwater and Poverty: Exploring the Connections. Intensive Use of Groundwater: Challenges and Opportunities. R. Llamas and E. Custodio. Lisse, A.A. Balkema: 441-156; Shah, T. (2005). "Water Poverty and Economic Development: Cross-country Analysis and Implication for Policy Reform." IWMI-TATA, Water Policy Research: Highlights 2.) The extensive work by Shah and others at IWMI on groundwater, although not directly related to climate change, would be good to review for this since it does contain a number of implications for climate change. Second, because of its role as a reliable source, groundwater has a high insurance value in comparison to surface water. Estimates suggest that this greatly increases the overall value per cubic meter of water from ground versus surface sources. See for example (Tsur, Y. (1990). "The Stabilization Role of Groundwater When Surface Water Supplies Are Uncertain: The Implications for Groundwater Development." Water Resources Research 26(5): 811-818. Tsur, Y. (1993). The Economics of Conjunctive Ground and Surface Water Irrigation Systems: Basic Principles and Empirical Evidence from Southern California, Department of Agricultural and Applied Economics, University of Minnesota. If climatic change results in increases in variability, the importance of this role is likely to increase. Third, regions where groundwater extraction is lowering water tables rapidly are among the most likely to experience major impacts if climate change increases the occurrence of drought as some research suggests. Locations such as China, parts of Mexico, India and the Western U.S. may be particularly vulnerable to this. This would, for example, compound the impact of stream flow decreases shown in fig 3.7 for the Western U.S.	Addressed

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						(Silvia Llosa, ISDR System)	
E-3-390	A	17	32	17	32	Replace use by using. (Martine M. Savard, Geological Survey of Canada)	Addressed
E-3-391	A	17	32	18	38	Section 3.4.2. I find this section somewhat rambling and repetitive. It can be condensed as some general statements made in paragraph 1 are repeated with more detail in paragraph 2. I suggest minnor revisions to reduce overlap here, but I leave most of the details to the authors. My guidelines would be: paragraph 1 - general intro/process description paragraph 2 - specific study results paragraph 3 - global results (which it basically is already) (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Overlaps are avoided. Largely changed
E-3-392	A	17	32			why is it likely that millions of people will be increasingly using groundwater in warmer future? What is the evidence for this claim? (Rob de Loë, University of Guelph)	Addressed
E-3-393	A	17	34	17	35	Remove "including … connected" as this can be implicitly implied as a part of a general definition of groundwater and more specific details are given in the following discussion. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Addressed
E-3-394	A	17	37	17	38	Under lines37 and 38, it is necessary to add, between brackets,: edaphological conditions . (Osvaldo Canziani, IPCC WGII Co-chair)	Added
E-3-395	A	17	51			The next paragraph needs an introductory sentence stressing that groundwater changes are very site-specific and have only been investigated in some areas. (or however you want to introduce the list of local studies) (Philip Mote, University of Washington)	Addressed
E-3-396	A	18	1	18	48	P 18 l 48. It correctly states “risk of both floods and droughts”. It should add “Whether these risks are realized or not depends on many other factors.” The next paragraph introduces some of those. (Kevin Trenberth, NCAR)	Not applicable to groundwater section
E-3-397	A	18	1	18	43	P 18 l 43: Need to define what is meant by “intensification of the hydrological cycle”. Usually it refers to increased flows: increased evaporation and precipitation. But this is NOT guaranteed when aerosols are introduced. Instead, what changes are the characteristics of precipitation: increased intensity associated with increased water vapour in the atmosphere, and increased potential evapotranspiration. (Kevin Trenberth, NCAR)	Not applicable to groundwater section
E-3-	A	18	1	18	41	P 18 l 41: to p 22 l 10. Section 3.4.3 is much improved but should reference	Not applicable to groundwater section

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398						chapters in WG I. (Kevin Trenberth, NCAR)	
E-3-399	A	18	1	18	3	P 18 l 3: “will reduce by” can not be stated so positively. (Kevin Trenberth, NCAR)	Addressed
E-3-400	A	18	5	18	5	Remove "and hydropower generation". You are discussing groundwater and this has very little connection to hydropower, which is primarily a surface water appication. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Removed
E-3-401	A	18	19	18	21	It is not clear if "the thickness of the freshwater lens was computed to decrease from 25 to 10 m……" is due solely to sea-water level rise OR the combined effect of sea-water level rise and the decreased groundwater recharge. (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Added "combined effect of sea-water level rise and the decreased groundwater recgarge
E-3-402	A	18	21			this seems physically implausible… at least provide an explanation. (Philip Mote, University of Washington)	This is the result from model scenarios
E-3-403	A	18	23	18	38	This text is based on an interesting model simulation (see also Figure 3.4). Unfortunately the material has not (yet) been published in a peer reviewed journal available for the entire scientific community (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	It can be considered as gray literature
E-3-404	A	18	23	18	38	perhaps this paragraph would better serve the flow of the discussion if moved up ahead of the previous paragraph. Then it can provide the global-scale view before diving into local studies. (Philip Mote, University of Washington)	Moved up head
E-3-405	A	18	23	19	27	where the model-predicted changes are so small (9% and 2% for runoff and recharge, respectively), can one draw credible conclusions as to climate change impacts ? (Spyros Beltaos, National Water Research Institute)	Yes to a certain extend
E-3-406	A	18	23		38	only one reference in this section (Clair Hanson, IPCC TSU)	Yes
E-3-407	A	18	31	18	32	Remove ", which … 10 mm" as this is unecessary detail. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Removed and the word "threshold" is included
E-3-408	A	18	41	22	9	Section 3.4.3. This section refers repeatedly to SPM WGI. Is this referring to the 3rd assessment, 2001? If so, aren't there updated references that could be used instead (e.g. the current WGI assessment)? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Major revisions made
E-3-409	A	18	41	22	9	Glacier Outburst related Floods (GLOFs) should be mentioned as a climate change impact. Ref. : Ames, A., 1998. A documentation of glacier tongue variations and lake development in the Cordillera Blanca, Peru. Zeitschrift für Gletscherkunde und	It is about future projections rather than past records, based on post-TAR literature.

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						Glazialgeologie, 34(1): 1-26. Mool, P.K., Bajracharya, S.R. and Joshi, S.P., 2001a. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods Monitoring and Early Warning Systems in the Hindukush- Himalayan Region- Nepal, ICIMOD, Kathmandu. Mool, P.K., Wangda, D. and Bajracharya, S.R., 2001b. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods: Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region - Bhutan. ICIMOD, Kathmandu, 227 pp. Nakawo, M., Raymond, C.F. and Fountain, A., 2000. Debris-covered glaciers. IAHS Red Book, Publ. 264, 288 pp. Yamada, T., 1998. Glacier lake and its outburst flood in the Nepal Himalaya, Japanese Society of Snow and Ice, Tokyo. (Georg Kaser, Geo and Atmospheric Sciences)	
E-3-410	A	18	41			Section 3.4.3 is focused too much on Europe, and the effects on soil moisture (and resulting agricultural droughts as opposed to hydrological droughts) should be stressed more, including studies such as Manabe, S., Milly, P. C. D. & Wetherald, R. 2004, Simulated long-term changes in river discharge and soil moisture due to global warming, Hydrol. Sci. J. 49, 625–642; Nemani, R., White, M., Thornton, P., Nishida, K., Reddy, S., Jenkins, J. and Running, S. 2002, Recent trends in hydrologic balance have enhanced the terrestrial carbon sink in the United States, Geophys. Res. Lett. 29, doi:10.1029/2002GL014867; Gerten, D., Lucht, W., Schaphoff, S., Cramer, W., Hickler, T., Wagner, W. 2005, Hydrologic resilience of the terrestrial biosphere, Geophys. Res. Lett. 32, L21408, doi: 10.1029/2005GL024247). (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Some non-European results mentioned
E-3-411	A	18	43	22	9	Section 3.4.3: this section is very heavily oriented towards Europe and, to a lesser degree, Asia. It contains very little about the Americas. Moreover, there is nothing about floods caused by ice jams, which are often more severe than open-water floods in many rivers of Canada, the US, Northern Europe, Russia, and China. Low winter flows caused by freezeup and ice cover formation can also be an extreme occurrence with adverse effects on water quality and aquatic life. (Spyros Beltaos, National Water Research Institute)	Some non-European results mentioned
E-3-412	A	18	46	18	46	Change "water cycle" to "future water cycle" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Ongoing, so not only future
E-3-413	A	18	47	18	47	Change "The warmer climate" to "A warmer climate" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-	A	18	50	18	50	Change "Yet there are" to "There are also"	Re-phrased

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414						(L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-415	A	18	51	18	51	Change "conditions" to "pre-existing conditions" or "antecedent conditions" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-416	A	18	51	18	51	Change "and timing" to "timing" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-417	A	18		18		Finally, it should be noted that there is repetition of same statements, as shown in page 18. (Osvaldo Canziani, IPCC WGII Co-chair)	Pruned
E-3-418	A	19	1	19	1	The brackets are missing two geophysical variables of importance: the local geomorphology and the edaphology of its soils. (Osvaldo Canziani, IPCC WGII Co-chair)	Re-worded
E-3-419	A	19	1	19	48	P 19 l 42-48: the correct reference for this is chapter 3 of WG I. (Trenberth et al 2007). (Kevin Trenberth, NCAR)	Material shifted to 3.3.1
E-3-420	A	19	2	19	2	Change "encroaching" to "encroachment" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-421	A	19	2	19	2	add sentence concerning the response during floods. After damage potential, add 'The response of flood afftected people and disaster risk management significantly influences flood damages.' (Silvia Llosa, ISDR System)	This is a true general statement, but out of sscope in 3.4.3 Therse issues are discussed in 3.5.2 and 3.6.
E-3-422	A	19	5	19	6	it's not clear to me what purpose this unattributed quote serves here. I recommend deleting it. (Philip Mote, University of Washington)	Deleted
E-3-423	A	19	5	19	5	Change ". The 21st" to ", and the 21st" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-424	A	19	6	19	6	Who has labelled this as the "age of water scarcity"? Give a reference. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-425	A	19	42	19	47	this paragraph is about what has already occurred, not about future changes. Perhaps it is better placed in section 3.4.2. (Spyros Beltaos, National Water Research Institute)	Parts shifted to 3.3.1
E-3-426	A	19	42		43	This very important statement should be discussed in greater detail: Who has observed this and where ? Are the changes statistical significant ? (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Parts shifted to 3.3.1
E-3-427	A	19	45	19	45	Since the curves shown in the already mentioned paper by Barnett T, D, W.Pierce and R. Schnur, (Science, April 2001), show little latitudinal difference in the amount of heat accumulated in the oceans, it would be better to cancel the information between comas. Instead of saying " especially in low latitudes" include	Parts shifted to 3.3.1

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						some reference on the remarkable energy amount accumulated in the world oceans, in the last 50 years (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-428	A	19	49	20	40	this material is not directly related to floods and droughts. It would have been more appropriately placed in a sub-section dealing with the water cycle, and where additional factors such as evapotranspiration, soil moisture, snow cover, glaciers, would have also been discussed. (Spyros Beltaos, National Water Research Institute)	Reduced, and parts shifted to 3.3.1
E-3-429	A	19	49	20	2	it is preferable to use plain language in place of such statements as "… increase of proportion of heavy precipitation events is likely over many areas of the globe [high confidence, SPM WG1]" or coupling "likely" with "moderate confidence", as is done in the next sentence. (Spyros Beltaos, National Water Research Institute)	O.k. addressed
E-3-430	A	20	4	20	14	This paragraph appears out of context and would be better placed in section 3.3.1. (Annarita Mariotti, ENEA)	Reduced, and parts shifted to 3.3.
E-3-431	A	20	4	20	14	I see conflicting statements here. The statement in sentence 5 "… larger increase in frequency than in magnitude" does not appear to "match" that of sentence 2 "Extremes of daily precipitation … will increase." My interpretation of "extremes will increase" is that the "magnitudes" of the extremes will increase. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Reduced, and parts shifted to 3.3.
E-3-432	A	20	4	20	19	As shown in Chapter 13, the study of extreme events in the Pampas mentions the increasing intense storms, both in intensity and frequency, though the annual mean precipitation shows, in average, small increases, below the order of 10 %. Therefore, cross reference is suggested. (Osvaldo Canziani, IPCC WGII Co-chair)	Agreement between LAs – shift most of intense precip stuff to 3.3.1.
E-3-433	A	20	16	20	19	This simply repeats statements made on page 11, lines 10-11. Recommend deletion. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-434	A	20	21	20	30	Combine these 2 paragraphs into 1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Shrunk
E-3-435	A	20	21	20	21	Change "growing" to "rising" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-436	A	20	27	20	40	This paragraph is largely a repetition of what is written in section 3.4.1. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Re-worded
E-3-437	A	20	27		30	be consistent: 'fall' or 'autumn' (Clair Hanson, IPCC TSU)	Linguistinc (?)
E-3-438	A	20	32	20	40	Repetition of information on snow and glaciers given in section 3.4.1 (page 15, lines 45-51). Harmonize.	Attempt to harminize was made.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-439	A	20	42	22	4	These 5 paragraphs simply list a lot of different studies. This could be consolidated and condensed. Make a better summary of the important points to help the reader interpret their significance. For instance, how relevant is it to compare a study with "quadrupled" CO2 (page 21, line 50) to others with doubled CO2 (isn't quadrupling an extreme case)? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-440	A	20	43			The statement of Lehner is not published yet, I suggest to focus on reviewed papers only ! How certain are such statements with regard to the statements given at page 11 lines 32 to 45 or page 41 lines 23 to 26 ? (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	WG rules followed
E-3-441	A	20	49	20	50	This finding is different from most of the other cited studies. It would be interesting to briefly explain how they came to this result and how this relates to the uncertainty associated with quantitative projections of changes in river flows. (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Page limit
E-3-442	A	20	49	20	50	Kay et al 2005 does not match with the reference list (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Corrected
E-3-443	A	20	49	20	49	"…indicate a decrease in peak floods by 2080s…" does this refer to magnitude or frequency or both ? (Spyros Beltaos, National Water Research Institute)	Re-worded
E-3-444	A	21	34			reference is incomplete (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	O.k. addressed
E-3-445	A	21	38			change "both" to "either" and omit "still" (redundant) (Philip Mote, University of Washington)	Lingustic editor's job
E-3-446	A	21	39			reference is given (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Addressed
E-3-447	A	21	41	21	41	"..analyzed the modelled differences", the quantity which has been analyzed could be specified (Annarita Mariotti, ENEA)	Wording is o.k.
E-3-448	A	21	42			what has been calculated around the time of 2xCO2 (Clair Hanson, IPCC TSU)	Lingistic editor's job
E-3-449	A	22	1	22	20	P 22 l 14-20. Suggest combining first two paragraphs here and starting second with "For instance, …" (Kevin Trenberth, NCAR)	Re-worded
E-3-450	A	22	1	22	10	P 22 l 10. This section does not discuss possible mitigation of flooding by improving drainage, water management etc. Similarly droughts may be mitigated by irrigation and water storage.	See 3.5.2 and 3.6

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Kevin Trenberth, NCAR)	
E-3-451	A	22	3	22	4	what were the findings of the mentioned studies ? (Spyros Beltaos, National Water Research Institute)	Flagged issue. Page limit.
E-3-452	A	22	3	22	4	There are only a few words on method of joint probability of extremes and lack of its projected results. (Chunzhen Liu, Water Resources Information Center of MWR)	Flagged issue. Page limit.
E-3-453	A	22	3		4	tell us more about the future change in joint probabilities (Clair Hanson, IPCC TSU)	Flagged issue. Page limit.
E-3-454	A	22	3			either discuss results or omit (Philip Mote, University of Washington)	Flagged issue. Page limit.
E-3-455	A	22	6		9	give examples of countries with low adaptive capacity (Clair Hanson, IPCC TSU)	Discussed in 3.6
E-3-456	A	22	12	24	28	These pages and lines refer to Water Quality, a very important issue due account taken of the critical issue the humanity is already facing, i.e. more people less water. A first comment is the tendency to repeat statements (i.e line 24 to 28 and lines 44 onwards, on page 22) (Osvaldo Canziani, IPCC WGII Co-chair)	Pruned
E-3-457	A	22	12			Water quality concerns receive good treatment in section 3.4 4. The summary at the end of the section is particularly useful; many other sections would benefit from a similar kind of summary that points to specific implications for water managers. (Rob de Loë, University of Guelph)	Thanks
E-3-458	A	22	12			Section 3.4.4. The material could be presented more effectively describing in order the impacts of changes in rainfall and temperature. In addition, a greater effort should be set on drawing conclusions for specific regions based on the more robust of expected climatic changes. As a side remark, I'm surprised not much emphasis is given to the effect of sea level rise (infiltration of saline water in coastal regions) while this is mentioned in the first bullet of the Executive Summary. (Annarita Mariotti, ENEA)	Major revision
E-3-459	A	22	14	22	20	Combine these 2 paragraphs into 1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Major changed made, number of paragraphs reduced
E-3-460	A	22	14	24	28	This section is hard to read. Both the structure and the language need further attention. (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Major changes
E-3-461	A	22	18	22	18	change "have been" to "have also been" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Major changes
E-3-462	A	22	18		20	can be incorporated into the paragraph on lines 30-42 (Clair Hanson, IPCC TSU)	O.k.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-3-463	A	22	22	22	24	Lofgren et al (2002) do not mention bottom sediment re-suspension as a potential result of a drop in water level. Is this a conclusion reached by the author of section 3.4.4 ? If so, it needs to be clarified. (Spyros Beltaos, National Water Research Institute)	Carfefully re-worded
E-3-464	A	22	22	22	22	Change "of the water … may" to "of water levels in rivers and lakes, bottom sediments may" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Changed
E-3-465	A	22	34			change "P" to phosphorous (Philip Mote, University of Washington)	Done
E-3-466	A	22	35	22	35	….algal growth may increase…. (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	O.k.
E-3-467	A	22	41	22	41	Now, regarding the modification of water treatment plants, mentioned In line 41, page 22, an important reference should be added. It is the one resulting from the current potabilization techniques. The problem is not only bacteria. The use of different chemical substances for water "purification", leave in the water the traces of "desincfection by-products (DBPs). Over 500 DBPs have been identified. The epidemiological studies have found links between long-term consumption of water with high levels of DBPs and the risk of aggressive forms of cancer, such as the bladder carcinoma. DBPs have also been linked to spontaneous abortions and birth defects. (New Scientist, 3 December 2005, page 48). This issue shall be interlinked with Chapter 8. (Osvaldo Canziani, IPCC WGII Co-chair)	This is about future projections
E-3-468	A	23	1	23	4	P 23 l 4 Darling not arling (Kevin Trenberth, NCAR)	Yes
E-3-469	A	23	4	23	4	Murray Darling (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Yes
E-3-470	A	23	4			missing D (Philip Mote, University of Washington)	Yes
E-3-471	A	23	4			D missing from Darling (Clair Hanson, IPCC TSU)	Yes
E-3-472	A	23	11		12	cause for salinization is larger precipitation minus evaporation ? This means flushing not accumulation ! (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	More careful wording used
E-3-473	A	23	12			What means higher evapotranspiration ? (compared with ?) (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Reworded
E-3-474	A	23	15	23	15	Add a reference by Ragab, 2005: use of non-conventional water resources. The reference is:RAGAB, R. (Editor), 2005. Advances in integrated management of	Reference in the list

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						fresh and saline water for sustainable crop production: Modelling and practical solutions. International Journal of Agricultural Water Management (Special Issue), volume 78- Issues 1-2, pages 1-164. Elsevier, Amsterdam. The Netherlands. (Ragab Ragab, Centre for Ecology and Hydrology)	
E-3-475	A	23	17	23	17	Remove ", which is projected for a changing climate, " (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	More careful wording
E-3-476	A	23	18	23	21	The phrase is confusing. I would rewrite it as follows: "Also some studies point out that in regions suffering from droughts, the greater incidence of diarrheic and other water-related diseases (Environment Canada 2004, Patz, 2001) will mirror the deterioration of water quality". (Eduardo Usunoff, Instituto de Hidrología de Llanuras)	Rephrased
E-3-477	A	23	18	23	21	Is this due to insufficient wastewater treatment, or some other phenomenon? (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-478	A	23	21			"endless cycle" is careless wording - revise ("further exacerbating water quality") or something like that (Philip Mote, University of Washington)	Revised
E-3-479	A	23	50	23	50	The sentence that starts with "The exploitation of lower…" is unclear. (Spyros Beltaos, National Water Research Institute)	Revised
E-3-480	A	24	1	24	1	The recent publication of the already mentioned Atlas of Water (Earthscan, UK, 2004) and the valuable information it contains on the many aspects of the water resources, including a good reference on the natural polluted underground water by Arsenic, Fluoride, Lead, etc, suggest the convenience to include it between the same brackets that the UN 2003 report). Further, the whole paragraph would be enriched with the latest references on insiduous underground water pollution, for instance that of. New Scientist, August 2003,article "Arsenic ´s fatal legacy grows ,and the one on the State of World Water 2001 World Water 2001, published by the World Water Forum of Journalists, with the sponsorship of the Ministry of Environment and Forest, of Bangladesh and the UNDP Bangladesh, and the UNDP, Dhaka, 2001. In view of the social and economic importance of this issue - Arsenic pollution affects more than 200 million people over all the world, including the USA (with about 13 million people affected), this issue should be cross referred in Regional Chapters and with Chapter 8, as already mentioned. (Osvaldo Canziani, IPCC WGII Co-chair)	Future projections here
E-3-481	A	24	7	24	28	Suggest to shorter this well known content related to socio-economic development. (Chunzhen Liu, Water Resources Information Center of MWR)	Re-phrased
E-3-	A	24	10	24	11	DFID (2004) is not in the reference list. For projected changes in climate it is better	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
482						to refer to findings/literature mentioned in FAR. (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	
E-3-483	A	24	16	24	18	Is "lack of information" really such a singular issue? I would have thought that lack of financing and economics would also play quite a large role. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-phrased
E-3-484	A	24	17	24	17	In this paragraph, the reference on "lack of information" must explicitely mention the flagrant lack of basic hydrometeorological data (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-485	A	24	31	25	51	Similar problems of quantification with other modelling aspects! (Uwe Gruenewald, Brandenburg University of Technology Cottbus)	Yes. But no action made.
E-3-486	A	24	33	24	37	Move last sentence of paragraph to become the first sentence of the paragraph, "While … rainfall." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-487	A	24	35			can omit "be on the" with no loss of meaning (Philip Mote, University of Washington)	Re-worded
E-3-488	A	24	49		51	The results of Michael et al are based on a strong simplyfication of the complexity of such assessments. The references in the next three paragraphs at page 25 consider the complexities much better. (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	CA has addressed this issue
E-3-489	A	24	50	25	1	Remove last part of sentence from "and climate input data ...", as this is not important (and the enke references are not given). (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Re-worded
E-3-490	A	25	17			"While…" is a sentence fragment. (Philip Mote, University of Washington)	Corrected
E-3-491	A	25	36	25	36	Change "scenarios" to "land use scenarios" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-492	A	26	1	26	50	P 26 l 35 to 50: many statements here say “will be …” that is not justified. (Kevin Trenberth, NCAR)	Will be edited
E-3-493	A	26	1	26	21	P 26 l 21: “will lead to” increased risk of “floods and droughts”. Whether the actual floods and droughts occur depend on mitigation and social aspects. (Kevin Trenberth, NCAR)	Will be edited to accommodate aspects of flood mitigation
E-3-494	A	26	3	33	34	Section 3.5 is far too long, relative to the total length of Chapter 3. Potential abbreviations include: (a) reduction of general discussions to essential points (e.g. page 26, lines E-3-34 can be reduced to a single paragraph stating that it is difficult to assess monetary costs and there are no global assessments of monetary costs of climate change impacts); and (b) tabulation of the main findings, in place of lengthy discussions of individual studies (eg. page 29 line 13 - page 32 line 39)	Impacts and costs are main elements of this chapter. Editing will be done to further reduce the length where possible.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Spyros Beltaos, National Water Research Institute)	
E-3-495	A	26	5	26	9	This paragraph should also mention the relative benefits arising from climate change, i.e. changes in precipitation distribution may bring into food production some rain-fed areas which have had negative water balances. As an example, the flooding of 8 million hectares in the depressed Pampas, was so to say, compensated with the expansion of the agricultural frontier to the semiarid-arid lands of the west of the Province of Buenos Aires. Also new food producing activities, like fish cropping by means of aquaculture, were developed. Again, cross reference, inthi case with Chapter 13, is recommended. (Osvaldo Canziani, IPCC WGII Co-chair)	Will consider editing to add examples of possible benefits.
E-3-496	A	26	7	26	7	Add 'environmental' after 'societal' (Silvia Llosa, ISDR System)	o.k. editorial
E-3-497	A	26	8	26	9	Change "There … damages)." to " Costs should include considerations for both damages and adaptation." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Will be edited
E-3-498	A	26	11			this para understates our abilities to compute economic impacts of change, especially for the U.S. (Charles Howe, Institute of Behavioral Science)	Will be edited
E-3-499	A	26	13	26	13	Change "global assessments" to "known global assessments (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Editorial o.k
E-3-500	A	26	14	26	14	Replace related to by regarding. (Martine M. Savard, Geological Survey of Canada)	Editorial, o.k.
E-3-501	A	26	14	26	17	"At the national scale.." this doesn't really add any information to what as been previously said at the global scale. (Annarita Mariotti, ENEA)	This sentence will be changed.
E-3-502	A	26	19	26	34	This paragraph does not cover the hydrological conditions in large flatlands. Reference to Regional Chapters, in particular Chapter 13 cover this shortcoming. (Osvaldo Canziani, IPCC WGII Co-chair)	We will include this example, in one more sentence.
E-3-503	A	26	21	26	22	The phrase referring to water infrastructure, use patterns, etc, is incorrect for a report aiming at a worldwide value. In many developing countries, and even in some developed ones, it is incorrect to say that infrastructure, use patterns and institutions have evolved to fit current conditions. The main goal of this chapter is to bring information to decision making to assume the urgent need for integrated water management procedures which, as far as the reality show, are far to be fully implemented in many parts of the world. (Osvaldo Canziani, IPCC WGII Co-chair)	Will be edited
E-3-	A	26	22			Add a citation for this: U.S. Global Change Research Program. 2000. Water: The	Citation will be edited

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
504						Potential Consequences of Climate Variability and Change. National Water Assessment Group, U.S. Global Change Research Program. U.S. Geological Survey and Pacific Institute. Washington D.C. (Peter Gleick, Pacific Institute)	
E-3-505	A	26	26	26	26	Start a new paragraph here from the sentence "Hydrological changes …" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Editorial, o.k.
E-3-506	A	26	37	33	34	Reference is made to the full sub-paragraph 3.5.1 "How will climate change affect the balance of water demand and water availability". Although there are comments for some segments of this sub-paragraph, it is clear that it misses the concept of water productivity and water use efficiency, key elements for the best possible management of such a scarce basic resource. In fact, the first challenge is to raise the efficiency of irrigation, very particularly since agriculture accounts for 70 % of the world water use. Further, decision makers should start to understand that flooding cropping yards does not improve yields. The need to speak about water productivity is important, particularly when we realize that surface water irrigation efficiency ranges between 25 and 40 % in India, México, Pakistan and Phillipines while goes between 50 and 60 % in Israel and Japan. As known, the irrigation efficiency depends not only from de mode and condition of irrigation systems but also from the mean water balance conditions - temperatures, humidity and soil types- and would call, as already done in certain countries, on the more water economy way to satisfy the plants water requirements, in their different stages of development. Information on this management conditions is, for the many reasons we know, badly necessary in developing regions for decision making.(Ref. Boosting water productivity, by Postel S. and A.Vickers,WorldWatch State of the World 2004; FAO: Crops and Drops, Drops, 2002; Unlocking the Water Potential of Agriculture, FAO 2003; Water Use, Gleic P., The World ´s Water200-2001, Island Press 2000. (Osvaldo Canziani, IPCC WGII Co-chair)	The concept of water productivity will be added to the text and water productivity will be introduced as new entry in the glossary. References will be added.
E-3-507	A	26	41		43	First of all water is socially valueable for agriculture, not for domestic use (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Wording will be clarified.
E-3-508	A	26	45	26	45	Replace "would", instead of " or will " (Osvaldo Canziani, IPCC WGII Co-chair)	o.k. editorial
E-3-509	A	26	45	26	45	"or will" eliminate "or" (Annarita Mariotti, ENEA)	o.k. editorial
E-3-510	A	26	45			remove 'or' (Clair Hanson, IPCC TSU)	o/k. editorial
E-3-	A	27	4	27	4	Remove sentence "In addition … variable."	o.k. editorial

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
511						(L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-512	A	27	5	27	5	Change "can have" to "can also have" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-513	A	27	14	28	33	Given that the time horizon of many of these studies is toward the end of this century, the discussion should note whether and to what extent the studies considered adaptations to water demand, e.g., through development of crops requiring lower water demand or changes in agricultural techniques (e.g., no-till farming, precision agriculture), and demand side management (e.g., water pricing, development of tradable water rights). These adaptations should become more available and affordable with the passage of time if populations grow wealthier, as per the SRES scenarios, and with secular technological change (see Goklany 2005a, 2006a). The discussion should also note that because adaptations are often overlooked, the net negative impacts of climate change over a specific time frame may be exaggerated. (Indur Goklany, US Department of the Interior)	This point is important and will be mentioned in the revised text, and also should be mentioned in section 3.8. Will search for papers and cite if appropriate.
E-3-514	A	27	19	27	20	Change "(those … resource)" to "(demands that are actually met)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-515	A	27	24			Updated literature is needed to support the claim that voluntary water transfers are becoming increasingly common in the western United States; the sources cited are from 1998 and 1997. Later, on page 35, the point is made again, but more recent sources are used. (Rob de Loë, University of Guelph)	Wording will be clarified and newer citations will be added.
E-3-516	A	27	29	27	31	Remove the first sentence "Irrigation … 2003)." as this is already stated in section 3.2 (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Will be edited across section 3.2.
E-3-517	A	27	29		31	repetition of information in ln42-47 p6 S3.2.1 (Clair Hanson, IPCC TSU)	Will be edited
E-3-518	A	27	31	27	40	Combine these 2 paragraphs into 1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Will be edited
E-3-519	A	27	33			"values" should be "value" (Philip Mote, University of Washington)	Will be edited
E-3-520	A	27	34	27	34	Add, at the end of the sentence: "as well as by the effectiveness of the irrigation methods". (Osvaldo Canziani, IPCC WGII Co-chair)	Will be edited
E-3-521	A	27	37			"remained" should be "remains" to be grammatically corrects (Philip Mote, University of Washington)	Will be edited
E-3-	A	27	38	27	39	Please provide reference related to increased carbon dioxide concentrations, WUE	References will be added.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
522						and the ratio of water input per unit of crop yield increases. (Martine M. Savard, Geological Survey of Canada)	
E-3-523	A	27	38			"Due to" should be "because of" ("due to" is equivalent to "caused by" and should not start a sentence) (Philip Mote, University of Washington)	Will be edited
E-3-524	A	27	39	27	39	should be "ratio of crop yield per unit of water input increases" (Bruce Kimball, USDA, Agricultural Research Service)	Will be edited
E-3-525	A	27	40	27	40	Start a new paragraph here from the sentence "There are no global …" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Will be edited
E-3-526	A	27	41			"which" should be "that" because it precedes a restrictive clause (Philip Mote, University of Washington)	Will be edited
E-3-527	A	27	42	27	43	if such studies are available, it would be interesting to add information on whether genetically modified plants modify demand for irrigation water and how they react to CO2 increases (Silvia Llosa, ISDR System)	Too much detail for this place. Refer to agriculture chapter for possible discussion of role of genetically modified crops.
E-3-528	A	27	44	27	44	Doll (2003) not in reference list (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Will be clarified with author
E-3-529	A	27	44			Döll 2003 is a poster presented on a national meeting. It can not be given as a reference (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Will be clarified with author
E-3-530	A	27	46	27	51	In view of modelling uncertainties, do the low percentages simply mean that net irrigation requirements are most likely to remain the same ? (Spyros Beltaos, National Water Research Institute)	Discussion of uncertainties will be added at this place.
E-3-531	A	27	48			What on earth is global net irrigation? (Philip Mote, University of Washington)	Will be edited & reworded
E-3-532	A	27	51	27	51	Start a new paragraph here from the sentence "On the national scale …" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Will be edited
E-3-533	A	27	51			not necessary to state that B2 has lower emissions than A2 (Clair Hanson, IPCC TSU)	o.k. editorial
E-3-534	A	28	6			it's not generally true that variability of precipitation has detectably increased. (Philip Mote, University of Washington)	The study refered to is a prospective study and does not deal with past precipitation. The increasing variability of precipitation mentioned here refers to modeling results.
E-3-535	A	28	10	28	12	this sentence is hard to follow and should be rewritten. (Philip Mote, University of Washington)	Will be edited
E-3-536	A	28	14	28	14	Insert "management" between future and changes, so to read: future management changes.	Will be edited

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-537	A	28	17	28	20	What factors restrict a further increase in irrigation area? (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Examples of factors will be added
E-3-538	A	28	23	28	23	Replace "would be" by "is" (Osvaldo Canziani, IPCC WGII Co-chair)	o.k.
E-3-539	A	28	26	28	27	To remark tye differences between the sentence above and this one, add “however” before the increase. In line 27 replace “would” instead of “will” (Osvaldo Canziani, IPCC WGII Co-chair)	o.k. editorial
E-3-540	A	28	26	28	31	are these three examples enough to support the general statement about "most areas"? How big is 11 liters compared with the average daily demand? (Philip Mote, University of Washington)	Will be edited to improve consistency between general statement and examples.
E-3-541	A	28	34	39	10	This section shall include a reference on the potential effects of acidic depositions, including the acidification arising from the increasing CO2 concentration in the atmosphere. Increasing wildfires and provoked fires exacerbate this CO2 content (Osvaldo Canziani, IPCC WGII Co-chair)	Too much detail for this section. Possibly dealt with in the chapter on agriculture.
E-3-542	A	28	34			Why is water availability for aquatic ecosystems discussed in this section addressing economic impacts of climate change? (Rob de Loë, University of Guelph)	Because humans value it and we discuss both monetarized and non-monetarized impacts.
E-3-543	A	28	38	28	41	are there no positive aspects of reducing ice-jam flooding? (Philip Mote, University of Washington)	We will check the study referenced and others and edit as appropriate.
E-3-544	A	28	42	28	43	Move "in the 2080s (SRES A2 scenario)" to end of line 43 so that it reads "exist over 94% of the time in the 2080s (SRES A2 scenario)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-545	A	28	45	28	45	Change "USA," to "USA by 2050," (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-546	A	28	46	28	46	Remove ", until 2050, " (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-547	A	28	46			"until" implies that the action ended at that point. A better word would be "by" (Philip Mote, University of Washington)	o.k. editorial
E-3-548	A	29	3	29	6	are Juric (2005) and Justic (2005) the same reference ? (Spyros Beltaos, National Water Research Institute)	o.k. editorial
E-3-549	A	29	7			"will" implies a high level of confidence or even certainty… is that appropriate in this case for both the hydrologic change and the biological response? (Philip Mote, University of Washington)	Will change to “is predicted to decrease”
E-3-550	A	29	13	29	34	"climate-change induced changes" awkward. Rewrite. (Philip Mote, University of Washington)	o.k. editorial
E-3-	A	29	14	29	15	It is not only hydropower generation and transport, but also commercial and sport	Text will be expanded

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551						fishing activities, having a large social and economic importance in many countries. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-552	A	29	16	29	17	Change ", until the 2070s (IS92a emissions)," to "(IS92a emissions)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-553	A	29	16	29	19	"until" implies that the action ended at that point. A better word would be "by" (Philip Mote, University of Washington)	o.k. editorial
E-3-554	A	29	19	29	19	Change "until the 2070s" to "by the 2070s" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-555	A	29	22	29	22	Remove "(depending on the climate model)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-556	A	29	24	29	32	Water available for withdrawal does not just come from surface sources – as implied in this paragraph (Rob de Loë, University of Guelph)	Will be edited and expanded.
E-3-557	A	29	27		30	Rather trivial statement. (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Phrase removed to make less trivial.
E-3-558	A	29	36			Add a citation for this: U.S. Global Change Research Program. 2000. Water: The Potential Consequences of Climate Variability and Change. National Water Assessment Group, U.S. Global Change Research Program. U.S. Geological Survey and Pacific Institute. Wa (Peter Gleick, Pacific Institute)	References will be added.
E-3-559	A	29	45	29	49	Change "demand to … future, the impact" to "stress is low (e.g. Yangtze) and high where it is currently high (e.g. Yellow River) (Kirshen 2005). Impacts in the highly stressed basins are less reliably assessed due to the uncertain changes of runoff. Furthermore, the impact" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-560	A	29	48	29	51	The authors make a very important point in this sentence: climate change impacts will exacerbate existing stresses on water. However, the point is made only about water supply, when I think it really is appointed applies to almost all of the anticipated impacts discussed in the chapter. I think this message is important enough to warrant the authors finding ways to emphasize it throughout the chapter. (It does appear elsewhere, but a powerful statement in the chapter introduction would help to make the case better.) (Rob de Loë, University of Guelph)	Executive summary has addressed this, and will look elsewhere in chapter to include this point.
E-3-561	A	29	50	29	50	Change "because of" to "due to" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-562	A	30				F3.6: shouldn't the horizontal line be higher up the y-axis. It looks as though it's around 10.1m m3/a not 10.5 as stated in text	Source will be checked for correct number – 10.1 or 10.5.

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						(Clair Hanson, IPCC TSU)	
E-3-563	A	31	1	31	3	Table 3.1 should it be part of Box 3.1? (Ragab Ragab, Centre for Ecology and Hydrology)	Optons will be explored to change formatting to include table in box.
E-3-564	A	31	1	31	3	Please clarify for the reader what is meant by 'no balancing' and 'with balancing'. (Martine M. Savard, Geological Survey of Canada)	We will check with author for clarification
E-3-565	A	31	9			"adds to the" -> "further", and explain the difference between runoff and streamflow. (Philip Mote, University of Washington)	Will be edited
E-3-566	A	31	22	31	22	Change "is around" to "is currently around" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-567	A	31	34	31	35	Remove "(low … availability)" unecessary detail (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-568	A	32	2	32	5	Change "In global … studies." to "Global estimates of the number of people living in areas with high water stress differ significantly among studies (Alcamo 2005; Alcamo 2003; Arnell 2004; Vörösmarty 2000)." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-569	A	32	11	32	13	it's indefensible to report such uncertain projections (probably not valid to within a factor of 5) to three or even four significant figures. Recommend rewriting the sentence without any specific numbers. (Philip Mote, University of Washington)	Section will be rewritten including the table 3.2
E-3-570	A	32	15	32	17	Change "If the global … stress" to "Using this global indicator, climate change would appear to reduce water stress." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-571	A	32	20			ah! A positive aspect of climate change! It deserves some mention in the executive summary. (Philip Mote, University of Washington)	Executive summary has been modified.
E-3-572	A	32	23	32	26	It is not clear what causes the differences in the different columns of table 3.2 (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Section rewritten and table changed.
E-3-573	A	32	30	32	31	Assuming that the comment made above, on the need to speak about "water productivity"", is developed in TOD, it would be opportune to add, between brackets the term "water productivity" (Osvaldo Canziani, IPCC WGII Co-chair)	Term will be included in the text and glossary
E-3-574	A	32	31	32	31	Change "even increases" to "increases" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-575	A	32	36	32	37	Remove "(on 5E-3-83% … stress)" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-	A	32	37	32	38	Remove "(on 87-90% … precipitation"	o.k. editorial

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576						(L. Phil Graham, Swedish Meteorological and Hydrological Institute)	
E-3-577	A	33	1	33	28	P 33 l 9-28. Surely there are major assumptions here? For instance no account is taken of improvements to weather forecasts that give extra time to mitigate floods in the short term or drainage projects designed to permanently mitigate flooding (adaptation). The assumptions need to be stated clearly and the studies qualified by these. (Kevin Trenberth, NCAR)	We will explore different aspects of flood mitigation in this paragraph.
E-3-578	A	33	1	33	7	Following the idea that AR4 and very particularly this Chapter 3 shall bring decision levels to assume their basic and fundamental responsibility to provide for improving data and information, it is suggested to amend the text. The idea is to say, after droughts", the following: "in many areas the scarcity of concurrent geophysical data and socio-economic information does not permit to distinguish, etc; instead of saying "it is not possible to distinguish". (Osvaldo Canziani, IPCC WGII Co-chair)	Issue of decreasing availability and quality of hydrologic data will be included here as well as in 3.8.
E-3-579	A	33	6	33	7	this sentence can be omitted by adding the words "number and" in line 3, between the words "the" and "costs". (Spyros Beltaos, National Water Research Institute)	o.k. editorial
E-3-580	A	33	6	33	7	Remove "Globally … Re 2005)." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-581	A	33	9	33	18	the cited results are very interesting, but there is too much detail, which tends to obscure the effects of climate change relative to the effects of other factors. (Spyros Beltaos, National Water Research Institute)	The point is that the effects of climate depend on those other factors. Revise opening sentence to make that point.
E-3-582	A	33	13	33	14	this sentence is hard to follow and should be rewritten. (Philip Mote, University of Washington)	Will be edited.
E-3-583	A	33	14	33	15	The following example could be added after increased exposure: 'The analysis of precipitation and flood damage data suggests that climate plays an important, but by no means, determining role in the growth of flood damages in the United States in 1932-97 (Pielke, Jr. R.A, Downton, M.W., 2000, Precipitation and damaging floods: Trends in the United States, 1932-97, Journal of Climate, 13(20), 3625-3637). (Silvia Llosa, ISDR System)	Example and reference will be added.
E-3-584	A	33	16			"where" should be "were" (Philip Mote, University of Washington)	o.k. editorial
E-3-585	A	33	17		20	percentage of population affected by floods increases, but number of people living in the flood plain decreases ? What is the message of this statement ? Is it of general interest ? (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	Sentence will be rewritten to clarify

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E-3-586	A	33	20	33	20	Start a new paragraph with the sentence "For the 2ºC temperature …" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-587	A	33	23			"a A1-type" use "an" (Philip Mote, University of Washington)	o.k. editorial
E-3-588	A	33	24	33	25	Change "to even … (Hall 2005)." to "to 15 billion GBP by the 2050s and 21 billion GBP by the 2080s (Hall 2005)." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-589	A	33	25	33	28	Is this sentence needed? "The effect … (Evans et al. 2004)." It seems like unecessary detail to me. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-590	A	33	30	33	34	With such a high degree of uncertainty in model results for regional applications, how valuable such results are? (Soroosh Sorooshian, University of California, Irvine)	More examples of studies will be added and the uncertainty will be emphasized.
E-3-591	A	33	30	33	34	this study shows flood damage increase by a factor of 4 to 10; this is much higher than indicated by the findings cited in the previous paragraph and the discrepancy merits some discussion. (Spyros Beltaos, National Water Research Institute)	Two different geographical locations are discussed, with different exposure. This will be clarified.
E-3-592	A	33	31	33	31	What is a "T-year flood" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	We will look at source and incorporate a specific number.
E-3-593	A	33	35			Regarding flood damages, we can report the following if you are interested: In a study of climate change impacts in the metro Boston area in the northeastern USA, over the period 2000 to 2100 using changes in the increase in the amount of precipatation in extreme events from the Canadian Climate center and the IS92a scenario, the number of properties damaged and the overall cost of flood damage both doubled relative to what might be expected with no climate change. The most severe incremental impacts will occur in the fast growing western suburbs. The likely economic magnitude of these damages is sufficiently high to justify large expenditures on adaptation strategies such as universal flood proofing in all flood plains. The most extensive adaptation strategy – as incorporated in the "green" scenario – greatly reduces the incremental flood damage due to climate change. In fact, damages under the green strategy with climate change are substantially lower than might be expected in the absence of climate change but with no adaptation strategies. It was also found that the flooding will make road transportation delays become a significant nuisance that will become noticeably and increasingly worst over the next century. (Kirshen, P., Ruth, M., Anderson, W., and Lakshmanan, T.R., Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area, Final Report to US EPA	Results and reference will be added.

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						ORD, EPA Grant Number: R.827450-01, 2004; Kirshen, P., Ruth, M., and Anderson, W., Climate's Long-term Impacts on Urban Infrastructures and Services: The Case of Metro Boston, Chapter 7 of Ruth, M., Donaghy, K., and Kirshen, P.H., (eds.) Climate Change and Variability: Local Impacts and Responses, Edward Elgar Publishers, Cheltenham, England, 2006; Kirshen, P., Ruth. M., and Anderson, W., Responding to Climate Change in Metropolitan Boston: The Role of Adaptation, New England Journal of Public Policy, Spring/Summer 2005; (Paul Kirshen, Tufts University)	
E-3-594	A	33	46	33	45	I am not convinced that the term 'era of global change' is either accurate or useful - might be toned down ! (Paul Jeffrey, Cranfield University)	Wording will be changed
E-3-595	A	33	46	33	47	Change "not valid any longer" to "no longer valid" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-596	A	33	48	33	49	Change "under-designed … costly." to "under-designed, resulting in either poor performance or excessive costs." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	o.k. editorial
E-3-597	A	33		37		Whilst the material presented on the limits to adaptation is both concise and relevant, it is limited in the sense that it seems to be informed largely by current knowledge on adaptation to climate change. There is a much wider literature on adaptive capacity and water management which, although inspired by challenges other than climate change, has much of pertinence to contribute. See; Galaz, V.2005. Social-ecological resilience and social conflict: Institutions and strategic adaptation in Swedish water management. Ambio 34 (7), pp. 567-572 and Giansante, C., Aguilar, M., Babiano, L., Garrido, A., Gómez, A., Iglesias, E., Lise, W., (...), Pedregal, B. .2002. Institutional adaptation to changing risk of water scarcity in the Lower Guadalquivir Basin. Natural Resources Journal 42 (3), pp. 521-564 (Paul Jeffrey, Cranfield University)	Paragraph will be upgraded and new references added.
E-3-598	A	34	9			the definition of IWRM seems to be more of a shopping list of what an IWRM plan contains and not what it is; which is an integrated approach to water resources problem solving that involves all relevant disciplines initially in the process and considers all inter-relations between problems and solutions. (my definition - there are probably better out there) (Paul Kirshen, Tufts University)	o.k. will edit
E-3-599	A	34	15		16	retain '(Kabat and van Schaik, 2003)' in the final sentence but delete the rest so k&vS, 2003 refers to the currently penultimate sentence	o.k. will edit.

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						(Clair Hanson, IPCC TSU)	
E-3-600	A	34	16	34	16	At the end of this paragraph, it could be noted that climate related risks are still hardly considered in water sector development and management plans (see www.waterandclimate.org) (Silvia Llosa, ISDR System)	Will be edited.
E-3-601	A	34	27	34	28	Give the name of the countries these basins are located (Soroosh Sorooshian, University of California, Irvine)	Will do
E-3-602	A	34				table, line next to "global" - why is Grand Canyon NP in the global line?? (Philip Mote, University of Washington)	Will check with the author
E-3-603	A	35	4	35	10	some literature is more critical about IWRM. 'The Fluid Mosaic: Water governance in the context of variability, uncertainty and change: A synthesis paper' by Marcus Moench, Ajaya Dixit, S. Janakarajan, M.S. Rathore and Srinivas Mudrakartha (2003), explains: 'more than comprehensive integration of relevant factors into water management approaches and decision-making, which is often unnecessary as a response to many water management needs, the key is to think systematically and define the boundaries of analysis or management at scales where hydrologic, social, economic and institutional conditions enable effective action in response to specific needs'. How integration can be achieved is far from clear. Water management has to be placed firmly in the context of deeper questions of governance and human organization. (Silvia Llosa, ISDR System)	Will upgrade text to include more discussion on relation between IWRM and climate change
E-3-604	A	35	6			their knowledge might be getting out ahead of what the instrumental records can support. (Philip Mote, University of Washington)	Wording will be changed.
E-3-605	A	35	18	36	20	This is a good start in identifying adaptation options, but the section should be developed in better. For example, more systematic consideration of meditation options relating to the sectors of water uses would be appropriate. (Rob de Loë, University of Guelph)	Section improved
·E-3-606	A	35	18	36	19	There is no doubt that the effectiveness of adaptation options is founded in the availability of basic information – geophysical, social, economic, environmental and even cultural – as well as on the community habits and behavior. Since AR4, as it has been pointed out when the Panel decided to have its Fourth Assessment,, shall be a tool for sustainable development, emphasis should be put also in the recipients ´ responsibility, either governments or private institutions, to assume their roles, as suppliers of basic data. In the case of hydrometeological events, the need for observations and monitoring is a local/regional responsibility. The same is applicable to the first and simplest adaptation effort, that is the	

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						implementation of the required hydrometeorological watching and alert systems, and the emission of early warnings to safeguard the communities and their goods. Although in line 17, on page 36, some reference is made, the importance of such an adaptation action, particularly when climate projections show the exacerbation of extreme events (both in intensity and frequency) calls for some stronger presentation. Decision makers must know that saving life and goods justify efforts to improve the associated hydrometeorological facilities an services. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-607	A	35	18			Section 3.6.2 could provide a paragraph on options to counteract an increasing risk of droughts similar to the ones on floods. This section refers to dams: Increasing water storage (dams) has been noted in a number of publications as key for adapting to climate change. The World Bank, has for example, noted the low levels of storage in Africa as a key factor constraining development and is currently arguing for major investments to increase storage (see presentations at the recent World Water Forum IV). Climate change is being cited as part of the justification for this. If increases in storage are seen as essential for adapting to climate change, aquifer storage and recovery could play a significant role in some areas. Groundwater banking is already being applied as a technique for buffering water supply variability and low season flows in locations such as the Central Valley of California. See: http://cee.engr.ucdavis.edu/faculty/lund/papers/Zhu2005.pdf for a recent AWRA journal publication on climate change for comments on this. See also http://www.energy.ca.gov/2005publications/CEC-500-2005-195/CEC-500-2005-195-SF.PDF More broadly, not related to groundwater specifically, there are major tradoffs in water management approaches related to assumptions regarding the likely impacts of climate change. These tradoffs are mentioned on p. 36, lines 12-19 but could be strengthened. There is an increasing focus on risk management in the water sector (see Risk Management chapter in baseline documents prepared for the IV Water Forum). This section could also provide examples of innovative water management practices being used in developing countries to assist farmers cope with unusual climate variability, such as the 'five percent technology', a technique for harvesting rainwater and excess runoff (Shrinivas Badiger, 2006) (for full reference see http://www.i-s-e-t.org/ 'Adaptation to climate variability and change'). The same publication contains other examples in particular of community-based actions to respond to droughts, floods and climate variability that detail numerous adaptation practices for possible inclusion in this section.	Page limit critical

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Silvia Llosa, ISDR System)	
E-3-608	A	35	23	35	24	Table 3.4, The sulpply side in column 1 bottom line:neeed to add "and rainfall harvesting" and in second column under the demand side: Add: use more efficient irrigation systems, use of non-conventional water resources (i.e. Treated waste water, saline water, brackish water, etc.) (Ragab Ragab, Centre for Ecology and Hydrology)	Table extended
E-3-609	A	35	23			supplement to Table 3.4: demand side: "water-saving technology" could be another option and "reduction of irrigation water demand by use of improved water-saving technology, e.g. trickle irrigation" (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	Table extended
E-3-610	A	35	33			"which" should be "that" because it precedes a restrictive clause (Philip Mote, University of Washington)	Re-phrased
E-3-611	A	35	34	35	34	Within the thematic of providing fresh water for human consumption, and even for some irrigation purposes, there are many experiences accumulated along centuries in arid lands. Seawater distillation using solar radiation energy was and is still applied. Also capturing fog droplets in some regions, like in the west coast of South America, in particular in Peru and Chile, solves the human needs and some agriculture ´s water requirements. Another solution, which, in the long term, is not energy consuming, is the transfer of water between basins. In pre-Colombian times, the indigenous populations transferred water from the Pacific to the Atlantic basin. Nowadays, engineering development enables the transference of fresh water from the Lake Marcopomacocha on the Atlantic Basin, to the City of Lima water supply system, on the Pacific Basin. Information on the pre-Colombian, indigenous development in the area of water resources is available in the book " Macchu Picchu: A Civil Engineering Marvel, by Wright K and A. Valencia, ASCE Press, 2000. Therefore, in the Table 3.4, it will be opportune to add reference on water basin transference between basins, on te Supply side, logically, reporting also the pre-Inca civilizations experience in this field. The above mentioned book also includes information on the development of water reservoirs, elementary water filtration techniques and irrigation channels design, in the High Andes, in Peru. The case study in Chapter 13 refers these matters. (Osvaldo Canziani, IPCC WGII Co-chair)	Interesting, but this is history. Page limit critical
E-3-612	A	35		36		In addition to supply and demand side management, there is a growing movement to better link land use planning with water resources management. Much of the 'joined up governance' alluded to elsewhere in this Chapter has such an outcome at its core. Relevant literature goes back to Ball Jr., Richiard L. 1976 Land Use Planning: An Important Tool for Controlling Water Demands. Water Sewage	Integrated water resources managament mentioned several times

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						Works 123 (7), pp. 74-77 with a more recent articulation by Mitchell, B. 2005 Integrated water resource management, institutional arrangements, and land-use planning. Environment and Planning A 37 (8), pp. 1335-1352 (Paul Jeffrey, Cranfield University)	
E-3-613	A	35				T3.4: can you provide more adaptation options as the table is a little short (Clair Hanson, IPCC TSU)	Extended
E-3-614	A	36	7	36	9	"acre-feet" and "acre" should be converted to metric units (Spyros Beltaos, National Water Research Institute)	No US units now
E-3-615	A	36	7			"acre-feet" is no SI standard. (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	No US units nos
E-3-616	A	36	12	36	19	Consider adding a reference to 'Guidelines for reducing flood losses' published by the UN, which presents a range of options for reducing losses from floods. The following sentence is proposed for inclusion at the end of the paragraph: 'More and more, a paradigm shift from post-event response to investing in an integrated and holistic approach to flood disaster management taking climate change into account is being proposed (UN 2004)' for complete reference see http://unbisnet.un.org:8080/ipac20/ipac.jsp?menu=search&aspect=power&npp=50&ipp=20&spp=20&profile=bib&ri=&index=BIB&term=740229#focus (Silvia Llosa, ISDR System)	Page limit critical
E-3-617	A	36	16	36	19	Suggest to add the utilization of flood water resources facing an increasing risk of floods and water shortage in future (liu Chunzhen and liu zhiyu 2006: Discussion on Utilization of Flood Water Resources in China. Hydrology in press in September this year. (Chunzhen Liu, Water Resources Information Center of MWR)	This is well known + page limit
E-3-618	A	36	19	36	19	the following statement could be added: 'There is a significant link between disaster risk reduction and adaptation to climate change. Improving the capacity of communities and governments to cope with current climate-related events is expected to improve their capacity to deal with future climatic changes (Frank Thomalla, Tom Downing, Erika Spanger-Siegfried, Guoyi Han, Johan Rockström, 2006, 'Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation', Disasters, 30(1), 39-48). Actions taken today to reduce vulnerability to existing shocks and extreme events will provide a buffer against uncertain consequences of climate change (Schipper, L., Pelling, M., 2006, 'Disaster risk, climate change and international development: scope for, and challenges to, integration', Disasters, 30(1), 19-38). To this end, more anticipatory, prevention-oriented disaster risk management approaches (instead of mainly reacting to disasters) have to be adopted. Such approaches must	We are aware of these references but do not feel that thez have made large impact

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						support 'no-regrets' measures and flexible solutions that can be adjusted to further changes in risk and vulnerabilities. It is important to understand which policies tend to initiate long-term developments which are difficult to reverse.' (F. Sperling and F. Szekely (2005). 'Disaster Risk Management in a Changing Climate'. Discussion Paper prepared for the World Conference on Disaster Reduction on behalf of the Vulnerability and Adaptation Resource Group (VARG). Reprint with Addendum on Conference outcomes. Washington, D.C.) available at www.unisdr.org) (Silvia Llosa, ISDR System)	
E-3-619	A	36	20			Kirshen et al (2004, 2006) found that because there were interactions among the impacts of climate changes on urban water uses and problems in metro Boston in the northeastern USA (e.g. flooding can endanger water supplies and public health by flooding water treatment plants and wastewater treatment plants), there are also interactions among adaptation actions that must be considered and that in most cases, an effective adaptation action in one sector also lessens climate change impacts in another sector.The interactions of adaptations with other sectors are most widespread in the case of management of future river flooding. Adaptations include increased use of flood proofing, retreat from flood plains, and increased recharge rates. Retreat from flood plains will be beneficial to transport in the sense that fewer travel trips will begin and end in flooded areas, so the impact of floods on system performance will be less. If land use restrictions lead to denser development, there will also be a benefit in terms of less residential energy use, which may in part offset the need for more air conditioning. Retreat from flood plains (and coastal areas) will also have the environmental benefits of less displacement of natural flora and fauna in these ecologically rich areas. These same areas may also serve as greenways, which benefit mitigation efforts. Increased recharge rates, which actually serve to reduce the extent of flooding, have very widespread benefits in terms of improved water supply and water quality. (Kirshen, P., Ruth, M., and Anderson, W., Climate's Long-term Impacts on Urban Infrastructures and Services: The Case of Metro Boston, Chapter 7 of Ruth, M., Donaghy, K., and Kirshen, P.H., (eds.) Climate Change and Variability: Local Impacts and Responses, Edward Elgar Publishers, Cheltenham, England, 2006; Kirshen, P., Ruth, M., Anderson, W., and Lakshmanan, T.R., Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area, Final Report to US EPA ORD, EPA Grant Number: R.827450-01, 2004) (Paul Kirshen, Tufts University)	Reference to Kirshen included
E-3-	A	36	37	36	43	Effective water governance should be added to the list of factors that influence	Remodelled

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620						adaptive capacity of water management, including freedom of information, the right to organize, explicit or implicit mechanisms to balance power in society, and enabling financial mechanisms (source: 'The fluid mosaic: Water governance in the context of variability, uncertainty and change. A synthesis paper'. 2003 by Marcus Moench, Ajaya Dixit, S. Janakarajan, M.S. Rathore and Srinivas Mudrakartha) (Silvia Llosa, ISDR System)	
E-3-621	A	36	45	37	4	useful information but does it apply to "Limits"? I suggest deletion. (Spyros Beltaos, National Water Research Institute)	Deleted
E-3-622	A	37	10			could safely omit "In a related study" (Philip Mote, University of Washington)	Deleted
E-3-623	A	37	14	38	18	Sections 3.4.1 and 3.4.2, These sections should discuss the potential problems related to increased nitrate concentrations in water during the various seasons due to CC. Indeed, with CC, bacterial nitrification in agricultural regions will be enhanced during winter because low temperature tend to decrease the rate of nitrification in temperate regions. There is therefore a potential for an increased vulnerability of temperate-region SW and aquifers as it is expected that the warming during winter will increase runoff and aquifer recharge during that same season. Can the literature review cover this aspect as well? (Martine M. Savard, Geological Survey of Canada)	Marked in 3.4.4
E-3-624	A	37	16			But other studies must be cited here. For example, Yao and Georgakakos published an article in the Journal of Hydrology in 2001 that evaluated operational changes in the Folsom Lake, American river system under conditions of climate change, that showed how such changes can greatly reduce climate risks in existing systems. Please add this info and citation: Yao, H., and A.P. Georgakakos, 2001: Assessment of Folsom Lake response to historical and potential future climate scenarios, 2, Reservoir management. Journal of Hydrology, 249, 176-196. (Peter Gleick, Pacific Institute)	Reference in the list now
E-3-625	A	37	26	37	37	Since increasing population is bringing greater stress, affecting water supply, it is clear that appropriate water management actions are necessary and urgent. Therefore, it is suggested that the phrase be reshaped saying, for instance, " In addition to the recognized urgency to implement water management practices, it shall be noted that climate change is already adding two major conceptual challenges to water management practices. First, etc. Regarding line 32, it may be convenient to say " the future is foreseen as highly uncertain" (Osvaldo Canziani, IPCC WGII Co-chair)	Slight change
E-3-626	A	37	32			but we can place bounds on this uncertainty. For instance, the planet will continue warming.	Yes, but this is not very practical

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						(Philip Mote, University of Washington)	
E-3-627	A	37	39	38	2	uncertainty has been established earlier in Chapter 3, so this paragraph is only reinforcing what is already known. I suggest deletion. (Spyros Beltaos, National Water Research Institute)	We believe that it is important here. See comment below.
E-3-628	A	37	39			good paragraph. (Philip Mote, University of Washington)	Thank you. See comment above.
E-3-629	A	37	40			"between" should be "among" if there are more than two. (Philip Mote, University of Washington)	Done
E-3-630	A	38	4			supplement: or in Southern Germany (Stae Baden-Württemberg), in which a surplus of up to 15 % on the design flood values is laid down due to results of a transboundary research project about the influence of climate chang e on water resources (KLIWA 2005, LfU 2005). (Morgenschweis Gerd, Ruhrverband (Ruhr River Ass.))	We tried to dig out these references but in vain.
E-3-631	A	38	21	38	30	add: use of treated waste water, drought tolerant plants, use of saline and brackish water (Ragab Ragab, Centre for Ecology and Hydrology)	Prioritization made
E-3-632	A	38	22			"which" should be "that" because it precedes a restrictive clause (Philip Mote, University of Washington)	Done
E-3-633	A	38	30	38	30	The following statement could be added: 'The planning of disaster risk reduction measures should take full account of the additional uncertainty brought about by climate change. This implies a combination of structural flood defences and non-structural measures, such as raising people's awareness to floods, supporting private precautionary measures, and setting up evacuation plans.' (Silvia Llosa, ISDR System)	Many words. Page limit
E-3-634	A	38	33	38	33	Change "Conclusions: Implications for sustainable development" to "Implications for sustainable development", otherwise the reader expects more overall conclusions here. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	We follow the agreed pattern
E-3-635	A	38	33	41	18	This subsection does not resemble "Conclusions" but reads like a "Discussion", by bringing up considerable new material. I suggest that the content of this subsection should focus exclusively on implications of material that has been presented in preceding subsections. (Spyros Beltaos, National Water Research Institute)	Agreed template is binding
E-3-636	A	38	33			The conclusion raises important concerns, but still seems a bit shallow. Additionally, it's a bit confusing to have a section follow the conclusion (3.7 is the conclusion, but then 3.8 appears and addresses new issues).	We agree. But this was a deal

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Rob de Loë, University of Guelph)	
E-3-637	A	38	35	39	6	Suggested re-write "Global warming is expected to substantially impact on freshwater resources. For example, if a temperature rise of 1ºC (since pre-industrial times) occurs by the 2020s, the additional number of people exposed to water shortage is estimated to be in the range 400-800 million (Parry et al. 2001; Martinez-Villalbe and Pinol 2002). Such impacts to freshwater resources may in turn affect sustainable development and put at risk reduction of poverty, which is one of the seven Millennium Development Goals (MDGs). All of the MDGs are related directly or indirectly to water management and climate change, as presented in Table 3.4 (UNDP 2006). Even with optimal water management, it would not be possible to avoid negative impacts. Figure 3.7 shows some key cases around the world where freshwater related climate change impacts are a threat to sustainable development." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Millions at risk are in 3.5.1. Accepted
E-3-638	A	38	36	38	38	These lines claim that "for the 2020s, the additional number of people in water shortage is estimated to be in the range of 400-800 million people," and it provides as references, Parry et al. (2001) and Martinez-Villabe and Pinol (2002). Since the citation to the latter is not furnished, we couldn't check out what that paper had to say, but we can speak to Parry et al. (2001). The source of the "information" on water shortage in that paper is Arnell et al. (2002), which in turn derives from Arnell (1999). But, in fact, a close look at Arnell (1999) does not support this statement. Equally important, it shows that key results have been overlooked. Such an examination shows the following: First, using HadCM2, depending on which model run is used, the population for which water stress is increased in the 2020s may well be smaller than the population for which water stress is reduced. In fact this is the case for 3 of the 4 runs of the HadCM2 model, but not for 1 of the 4 or the ensemble average (although, it's not clear why not for the ensemble average) [See, e.g., Table 7 or Table 10 in Arnell (1999)]. Second, using the HadCM3 model, the population for which water stress is decreased exceeds the population for which it is increased. It is incorrect, and misleading, to only report the population with increased stress but not the population with lowered stress (see Goklany 2003, 2005a). [Incidentally, we were unable to reproduce the 400-800 million increase in the number of people with greater stress based on the information provided in Arnell (1999).] Third, the net changes (whether up or down) are small compared to the population under water stress in the absence of any climate change (which, by the way, is over 5 billion for the 2020s). This means that other factors are more important than climate change in determining water	Millions at risk in 3.5.1

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						shortage. This is a key result that should not be swept under the rug, because it conveys important information to policy makers who have to ultimately decide on what trade-offs have to be made in pursuing one policy to reduce water shortage, and not another. Finally, per Arnell (1999) and Arnell (2004), the same qualitative results also hold for the 2050s and the 2080s, namely, climate change may or may not increase the global population at risk (PAR) of water stress and the total PAR due to climate change is smaller than the PAR due to other non-climate-change related factors (see Goklany 2003, 2005a, 2005c). [Notably, neither Arnell (1999) or Arnell (2004) consider any adaptations, thereby, tending to overestimate net negative impacts.] Accordingly the sentence on lines 36-38 should be replaced by the following: "By the 2080s, climate change may reduce the global population suffering from water stress, although that is by no means certain. Moreover, non-climate-change related factors are likely to be more significant in determinng the population at risk (PAR) of water shortage than is climate change (Arnell 1999, 2004). This can also be seen in current Table 3.2 of the this chapter. This suggests that in the short-to-medium term reducing current vulnerabilities to climate and climate variability may be the most effective method of reducing the PAR for water stress (Goklany (2005a)." Finally, this finding should be echoed in the Executive Summary because of its potential significance to policy makers. [Reference: Arnell, N.W., 1999. Climate change and water resources. Global Environmental Change 9, S31-49.] (Indur Goklany, US Department of the Interior)	
E-3-639	A	38	38	38	40	At the end of this paragraph, it could be noted that strategies for achieving the MDGs do not account for climate variability and change (www.waterandclimate.org) (Silvia Llosa, ISDR System)	
E-3-640	A	38	42	39	1	Table is missing some information in three cells. (Ragab Ragab, Centre for Ecology and Hydrology)	No direct/indirect relation
E-3-641	A	39	8	39	18	Combine these 2 paragraphs into 1. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Two paragraphs remain, but reworded
E-3-642	A	39	10	39	14	References are not given. Please also cite Falkenmark, M., Rockström, J. 2004: "Balancing water for humans and nature", Earthscan Publications 2004, which is an essential publication on land and water management as related to water scarcity. In this context, the widespread use of "green water" in rainfed agriculture and the large, and necessary, potential for improving efficiency of green water use needs to be mentioned here. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	

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E-3-643	A	39	10	39	10	Ref. "Franks et al. 2004" is missing from reference list (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-644	A	39	14	39	14	Ref. "Carter et al. 2005" is missing from reference list (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-645	A	39	16	39	18	I find the following statement "Since 2000 … Fassio et al. 2005)." misleading and suggest removing it altogether. Tools to aid sustainable management go much further back than the year 2000, regardless of whether you call them "decision-support tools" or not. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	O.k.
E-3-646	A	39	17	39	17	None of the cited references appear in the list provided at the end of the chapter. (Martine M. Savard, Geological Survey of Canada)	O.k.
E-3-647	A	39	18	39	18	Change "studies" to "studies on sustainability" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-648	A	39	20	39	20	Add “health” after “energy”. (Osvaldo Canziani, IPCC WGII Co-chair)	Done
E-3-649	A	39	21			Please briefly explain the "carbon footprint of the water sector". (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Re-worded
E-3-650	A	39	22	39	23	Boutkan & Stikker (2004) not in reference list (Marcel de Wit, Ministry of Transport, Public Works and Watermanagement)	Deleted
E-3-651	A	39	25			"energy emissions" presumably means "energy-related greenhouse gas emissions" - (Philip Mote, University of Washington)	Done
E-3-652	A	40	28	40	28	The group of future climate change impacts on freshwater presented here is not not exhaustive, therefore the title should read: Illustrative map of some future… (Martine M. Savard, Geological Survey of Canada)	Done
E-3-653	A	40				Figure is mainly based on a paper submitted but not published yet. How this figure suits to the statements given at page 11 lines 32 to 45 ? (Andreas Schumann, Ruhr- University Bochum, Institute for Hydrology)	O.k.
E-3-654	A	41	1	41	51	References Adger et al 2005 not listed (see p. 41). There are two pieces of work under Arnell 2003; lettering a and b required in text citations.There are two pieces of work under Arnell 2004; lettering a and b required in text citations. (Martine M. Savard, Geological Survey of Canada)	References ordered
E-3-655	A	41	10	41	10	Change "which" to "that". Change "cut" to" may reduce" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-656	A	41	10			insert 'gas' after 'greenhouse' (Clair Hanson, IPCC TSU)	Done
E-3-657	A	41	10			"which" should be "that" because it precedes a restrictive clause. The sentence is confusing and needs to be rewritten - the point seems to be that reductions in	Done

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						emissions will not avert further change (refer to WG I). (Philip Mote, University of Washington)	
E-3-658	A	41	11	41	11	Change "The impact … future" to "The extent of impacts from climate change on future" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Remains as was
E-3-659	A	41	11	41	11	Change "do not eliminate impacts" to "cannot eliminate them" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Re-worded
E-3-660	A	41	12	41	13	Change "depends on … dependant." to "depends also on the future state of the world, as the number of people exposed is scenario dependant." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Page limit critical
E-3-661	A	41	13	41	14	Change "stabilization … number." to "stabilization of emissions at 550 ppmv reduces the number." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-662	A	41	13			be very careful about this statement. If you read WGI carefully, it's pretty clear that 550 ppmv is very unlikely to result in a total delta-T of 2C since pre-industrial times. Also, a reduction of 30-50% compared with what scenario? (Philip Mote, University of Washington)	More careful wordins used
E-3-663	A	41	16	41	16	Change "Finally, it is important to mention that climate" to "Finally, as climate" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-664	A	41	16			As other sections of this chapter and earlier studies show, climate change is not "the most important" driver of change, at least not in many regions; please state more clearly that this may apply for the supply side, but that the demand side is in many cases at least as important. (Dieter Gerten, Potsdam Institute for Climate Impact Research)	Deleted
E-3-665	A	41	18	41	18	Change "water … development." to "water supplies, it can have considerable impact on sustainable development." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted
E-3-666	A	41	21	42	30	The following are the comments devoted to point 3.8 "Key Uncertainties and Research Priorities". First of all, although the lack of basic information has been mentioned more than once, in these SOD ´s comments as it was mentioned when reviewing FOD, reading this chapter and knowing the real problems on the lack of basic information, it looks like if science can be made without data. As known, data limitations – geophysical, biological, social, economic, etc - are the most negative factors to proceed with adaptation and any sustainable development action.. Since IPCC is an intergovernmental body and the climate change is a global issue, it looks rather strange to observe the authors reluctance to put in black nd white and clearly state this critical shortcoming. A very recent article, in Science,	See last para in 3.8

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						Vol 312, 23 June 2006 puts the emphasis in the lack of data to check model ´s results regarding the Andean glaciers ´rapid retreat. This is, no doubt a critical issue for all the countries along the Andes which water needs are still solved by snow/ice melt. Regarding some other comment, in line 26, of page 41, information on other geophysical variables of importance in water management, particularly in extreme event situations, call for a relable information on the geomorphological and edaphic characteristics of any type of environment.. In this respect, it is understood that management and adaptation should include the consideration of the hydrographic nature of different basins – arrheic, endorrheic or else – water infiltration, aquifer recharge, runoff and other environmental variables. Regarding line 28, it would be quite opportune to mention the critical lack of underground water data. This shortcoming explains the failure of important international projects through which millions of wells were drilled in Asia with the disastrous consequences of the human use of naturally poisoned water (AR, F). Furthermore, since the fresh water pH defines the viability of ecosystems´ development, the issue of acid precipitation and deposition, and, nowadays, the necessity to assess the acidification of surface waters due to tye increasing concentration of carbon dioxide in the atmosphere, already acidifying sea water, should be considered. Observations and research are needed in this area of water resources. Finally, the introduction of the "water productivity" concept, as it was done, during the "green revolution" with the so called "food productivity", call for the attention of water managers, for improving water use efficiency. (Osvaldo Canziani, IPCC WGII Co-chair)	
E-3-667	A	41	21	42	31	Perhaps the best section in the report, stating how uncertain the conclusions of many reported studies related to impact on water resources are. (Soroosh Sorooshian, University of California, Irvine)	Thank you. I hope that now it is improved.
E-3-668	A	41	21	42	31	Discussion of "model uncertainties" is missing! See above examples of "erosion - [%]" (Uwe Gruenewald, Brandenburg University of Technology Cottbus)	Prioritization!
E-3-669	A	41	21			Section 3.8 does not address the research needs linked to adaptation options and practices. Proposed research priorities to respond to the second bullet of page 35, line 39 include 'a) Detailed investigation of the social and institutional responses to uncertainty, variability and the specific problems emerging at different geographical locations. How to design water management that can adapt to hydrological variability, lack of data and scientific knowledge, socio-economic, demographic, technical, institutional and environmental change, and dynamics of human organizations and politics. Adaptive frameworks or processes are needed to	Many words demanded

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						reflect uncertainties and changing contexts and constraints and unforeseen problems. b) The degree to which specific uses and management interventions affect water resource systems, c) methodologies to work on the continuum from present climatic risks to climate change futures that will help bridge climate change and climate risk management. (Silvia Llosa, ISDR System)	
E-3-670	A	41	27	41	27	Change ", which" to "that" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Mistakenly omitted
E-3-671	A	41	27			"which" should be "that" (and the comma deleted) because it precedes a restrictive clause (Philip Mote, University of Washington)	Mistakenly omitted
E-3-672	A	41	28	41	28	Change "difficult to … way," to "difficult to reliably assess" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	An Englishman told us that “to reliably assess” is not good style
E-3-673	A	41	29	41	30	Change "Research … needed." to "Methods for adapting in the face of these uncertainties are needed." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	No action
E-3-674	A	41	30	41	31	Change "concrete … known" to "certain projections, it is known" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Editorial?
E-3-675	A	41	39			I agree wholeheartedly with the suggestion that research is needed to fill pragmatic information needs of water managers who are responsible for adaptation. However, I believe that the authors of this chapter could have made some progress on this issue in the chapter. There were numerous opportunities throughout to make appropriate connections to the information needs of water managers. (Rob de Loë, University of Guelph)	Conections would take precious room
E-3-676	A	41	41	41	41	Change "depends on" to "depends partly on" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Left as is
E-3-677	A	41	42	41	43	Remove ", addressing … freshwater resources" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	No action
E-3-678	A	41	49	41	49	Change "climatic … catchment" to "climate models and hydrological catchment (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Clear as is
E-3-679	A	41	51	41	51	Change "of adequately validated, regional" to "of validated regional" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	LAs left as it was
E-3-680	A	41				Section 3.4.3: In this whole section references to specific WGI report section are needed instead of just SPM. (Annarita Mariotti, ENEA)	Pruned
E-3-681	A	42	4	42	31	The research issues identified in the list of bullets on this page are appropriate and important. However, the list would have much more impact than if each one of	Difficult, in view of page limit

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						these bullets had been better supported in the body of the chapter. For example, on line 18 the point is made that research into human dimension indicators of climate change impacts is in its infancy and that more work is needed. What are these indicators and why are they important? I found little obvious support for this claim in the body of the chapter. In contrast, there's more support the costing of climate change impacts on medication options is essential but an underdeveloped area. (Rob de Loë, University of Guelph)	
E-3-682	A	42	4	42	5	Change "Among … following:" to "Regarding research issues related to the climate-water interface, specific developments needed are listed below:" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Editorial (?)
E-3-683	A	42	10	42	12	Suggested re-write that includes an important addition. "● Impacts of change in climate variability need to be integrated into impact modeling efforts. In particular, better transfer of changes in extremes is needed between climate models and impacts models." "● Improvements in coupling climate models with land-use changes including vegetation change and anthropogenic activities such as irrigation are necessary." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Many words (page limit)
E-3-684	A	42	10			the second sentence does not seem to have anything to do with changes in climate variability. (Philip Mote, University of Washington)	Should be integrated
E-3-685	A	42	16	42	16	Change "costing of" to "the economics of" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Changed
E-3-686	A	42	17	42	17	Change "extreme" to "high" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Changed
E-3-687	A	42	18	42	18	The term "human-dimension indicators" is not defined, either here or anywhere else in the text. Some explanatin is needed. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	LAs did not change
E-3-688	A	42	19	42	19	Change "a vigorous growth is necessary." to "should be expanded." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Editorial (?)
E-3-689	A	42	22	42	23	I feel that the attribution of changes is a very important research area that deserves greater prominence than what is currently given. It is essential that we are able to be more definitive in our statements regarding the origins of changes that are detected in time series of hydrological variables. This is particularly important where land use or other changes are also affecting the water availability. (Donald Burn, University of Waterloo)	Slightly extended bullet
E-3-690	A	42	25	42	25	References are only given here and on line 30. I suggest removing both citations. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleten from line 25 but retained in 30

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E-3-691	A	42	27	42	27	Change "with" to "to" (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Done
E-3-692	A	42	29	42	31	Change "across … sectors?" to "across multiple water-dependent sectors, which should be investigated." (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	LAs decided to keep as was (many words)
E-3-693	A	42	30	42	30	References are only given here and on line 25. I suggest removing both citations. (L. Phil Graham, Swedish Meteorological and Hydrological Institute)	Deleted from line 25 but retained here.
E-3-694	A	42	31			Suggest to add the research on interaction between climate change and human activities (Chunzhen Liu, Water Resources Information Center of MWR)	No. Page limit
E-3-695	A	47	1	47	25	P 47 l 25 Quian should be Qian. (Kevin Trenberth, NCAR)	

LATE COMMENTS

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3-1	LATE	3	22			...have led to _seasonal_ water supply... (Herbert Lang, ETH)	Changed
3-2	LATE	5				Fig.3.1 : the information content of this figure is rather poor and does not help the reader in extent of the written text, therefore better delete it (Herbert Lang, ETH)	DA but revised.
3-3	LATE	8	29		32	these results need an additional comment concerning their reliability (Herbert Lang, ETH)	Reworded.
3-4	LATE	8	34		39	these 2 sentences seem indeed superfluous in this context (Herbert Lang, ETH)	DA but moved to another part in the text.
3-5	LATE	11	27			...(e.g.2020s), climate_model uncertainties_ and _resulting_hydrological model uncertainties … (Herbert Lang, ETH)	Changed

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
3-6	LATE	18	10			Following the sentence ending with "... is thin." I would recommend to add an additional sentence on groundwater sensitivity : _ In higher latitudes the sensitivity of groundwater and runoff to increasing temperature increases because of increasing vegetation and leaf area index connected with improved grow conditions and increased evapotranspiration. (Herbert Lang, ETH)	Addressed
3-7	LATE	18	23			Remark on the use of global hydrological models GHMs : While GHMs may be useful as part components of GCMs they seem not to be very appropriate for the assessment of hydrological components in single river basins. Various established river basin models do much better serve this purpose. Appropriate downscaling of GHMs to hydrological bason scales may in some cases prove as useful. (Herbert Lang, ETH)	Important. But we have page limit