including future uncertainties. It will be helpful for the reader if you divide the results chapter in one section about the baseline assessment and another section about the modelling of future conditions. A possible satisfier is what are satisfiers? AHEAD value, which is calculated on the basis of the 16 elements from table 1, and what are “fuzzified AHEAD conditions” – Do you mean limiting factors? Sentence dropped. Sentence dropped. We have removed this sentence, as the background paper is available shortly and should give all relevant information to understand the development of AHEAD. - The analysis of data sets takes continuous values from 0 (: : :) to 1. - For example, a value of 0.6 belongs to the linguistic category of intermediate (0.6-0.4). We have rephrased this to: “Fuzzified data sets take continuous values from 0 (conditions are inadequate) and 1 (conditions are adequate).” - Possible satisfiers. - “possible satisfiers” – What are satisfiers? We have added a paragraph to Section 2.1 which briefly discusses the relationship between adequacy, ranging from very high (1-0.8), high (0.8-0.6), intermediate (0.6-0.4), low (0.4-0.2) to very low (0.2-0)". - Class borders are not clear. For example, a value of 0.6 belongs to the linguistic category of intermediate (0.6-0.4). We have adjusted the abstract with the intention of defining single elements for the present analysis, further supports this set: "" - If the additional literature is not applicable for the definition of elements, how can it support the set of defined elements? - AHEAD index is a novel measure that integrates aspects from various sectors, a detailed analysis of current livelihood conditions in the world would be an interesting topic for an article even without the consideration of future developments and related uncertainties. Indeed, the numbers seem to be mixed up. We have extended this paragraph to include a more explicit definition, also including the suggestions in comment #12, #13 and #33 (Figure 2), giving more details of the procedure. Yes, thank you. Changed accordingly. - Do you mean limiting factors? We have extended the results section here, including more details on the distribution of impacts across the 15 elements that are included in the AHEAD index. So, the survey is no comparison of impacts across sectors. So, the specific origin of each single element remains unclear. You can solve that easily by adding the underlying approaches in a new column in table 1 (next to the column Elements’). We have rephrased this sentence in the introductory part (Yet, such a framework can provide an important means to assess the consequences of climate change for human welfare and societal systems, allowing to relate impacts of climate change to other development aspects and needs and to compare of impacts across sectors; also) and have added a more specific sentence in the objectives part to clarify the scope of the present paper ("For a first implementation of the approach, we focus on the example of water scarcity which has been identified as a major challenge of the future (Gray et al. 2013)."; "After an initial implementation of the approach on a global scale, we show how climate as well as population change may affect overall fulfillment of AHEAD, focussing on changes in water availability)."

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Page 419, lines 1-2: “Calculations using the full range of ISM-MIP modelling results (...).” – I assume that these calculations refer to the future simulations. It would be helpful to the reader if you mention this explicitly.

Page 419, lines 6-7: “Generally, the distribution of countries between classes is rather even.” – The reader can only believe that, because you do not document the modelling results for the future scenarios.

Page 419, line 9: “GCMs and IMs.” – Do you refer to global climate models and impact models? This is not clear, because you do not explain these abbreviations.

Page 420, line 3: “water security.” – What exactly do you refer to with this term (also subsequently in the text)? Various definitions of water security exist in the literature, and they can be quite comprehensive. So, you should briefly define water security. Does water security refer to a fuzzy value of 0 for the ‘water’ variable/element?

Page 420, line 6: “seemingly smaller results” – Please drop the word “seemingly”, because the results ranges are indeed smaller, even though they do not lead to different fuzzy values.

Page 420, lines 19-20: “We use the value range across all models and scenarios for the classification, but differentiate between the four time slices 2000, 2030, 2060 and 2090.” – If you have classified the uncertainties for four time periods, why do you only show results for 2000 and 2090?

Page 420, lines 22-23: Where changes occur between baseline and 2090 calculations, these are hatched in the respective colour. – (1) It is difficult to recognize the hatched colors in the small printed Illustration. (2) As the 2090 projection includes different climate scenarios in the various models, I would have expected that uncertainties are higher than in the baseline assessment. Surprisingly, only five countries differ in their uncertainty classification, and these countries apparently move to “better” classes (I assume that the colors of the thin lines represent the future class).

Page 421, lines 12-15: “(...) our approach to combine water resource security, nonetheless other effects may negatively affect the adequacy of human livelihoods.” – The studied impacts result also from changes in water availability, population forecasts. Actually, in a range of countries and is essential additional to resource availability, hence the MIN operator. We have added the following paragraph to the discussion of the limitations of the paper:

New paragraph: “It is also important to note that uncertainty ranges outside the thresholds relevant to AHEAD remain important for other water-related decisions, e.g. urban water flow management. While such changes may not directly affect water security, nonetheless other effects may negatively affect the adequacy of human livelihood conditions.”

Page 421, line 24-25: “(...) in 67 countries the model spread is outside the thresholds for AHEAD fulfilment.” – (1) Please explain what AHEAD fulfilment is. Do you mean an overall AHEAD value of 0.8-1 [class ‘very good’], or do you refer to AHEAD values if exactly those that were the whole sentence means that at all models, the respective country does not achieve a “very good” AHEAD value in a certain period (or even more than 1)?

Page 422, lines 26-27: “(...) water security is below all minimum requirements in all RCPs-IM-GCM combinations.” – Do “minimum requirements” refer to fuzzy values below 1 for the ‘water’ variable/element, which indicates that adequate conditions exist with regard to annual internal renewable water resources or ‘access to improved water source’ are not achieved (i.e., at least one of both indicators has a fuzzy value below 1)?

Page 422, lines 7-8: “(...) the AHEAD approach provides a means to view climate impacts in a water context.” – The studied impacts result also from changes in population size, because the projections of water resources per capita are based on climate and on population forecasts. Actually, in a range of countries the effects from population changes can be stronger than from climate changes.

Page 422, lines 12-15: “(...) our approach to combine water resource availability with the access to an improved water resource provides an important way forward to account for the fact that water shortages to some extent can be mitigated by good water infrastructure.” – This is not reflected in the AHEAD index: As both indicators are aggregated through a MIN operation (cf. page 421, line 27), water shortages are not compensated by good technical infrastructure.

Page 422, line 11-12: “The use of global data and globally applicable thresholds in a fuzzy logic algorithm adds other types of uncertainties and short-comings.” – You should briefly discuss how the temporal scale influences the results of the analyses. The very variable of your survey, water availability/person can vary considerably within a country. Moreover, countries with low population densities and low water availability for agricultural use can have serious consequences for the population and is definitely relevant. You should address this issue in the discussion section.

Page 422, line 24: “(...) the use of global data and globally applicable thresholds in a fuzzy logic algorithm adds other types of uncertainties and short-comings.” – You should briefly discuss how the temporal scale influences the results of the analyses. The very variable of your survey, water availability/person can vary considerably within a country. Moreover, countries with low population densities and low water availability for agricultural use can have serious consequences for the population and is definitely relevant. You should address this issue in the discussion section.

Page 423, lines 2-3: “(...) changes do not differ significantly between the timescales, so we chose to illustrate the results of 2 time periods only in order to reduce the amount of figures and information.” – Indeed, since we focus mainly on this latest timeslice we have adjusted the manuscript and now focus on 2090 changes only. We hope that the reviewers agree with this adjustment.

Page 423, lines 22-23: Where changes occur between baseline and 2090 calculations, these are hatched in the respective colour. – (1) It is difficult to recognize the hatched colors in the small printed Illustration. (2) As the 2090 projection includes different climate scenarios in the various models, I would have expected that uncertainties are higher than in the baseline assessment. Surprisingly, only five countries differ in their uncertainty classification, and these countries apparently move to “better” classes (I assume that the colors of the thin lines represent the future class).

Page 423, line 24-25: “(...) in 67 countries the model spread is outside the thresholds for AHEAD fulfilment.” – (1) Please explain what AHEAD fulfilment is. Do you mean an overall AHEAD value of 0.8-1 [class ‘very good’], or do you refer to AHEAD values if exactly those that were the whole sentence means that at all models, the respective country does not achieve a “very good” AHEAD value in a certain period (or even more than 1)?

Page 424, lines 26-27: “(...) water security is below all minimum requirements in all RCPs-IM-GCM combinations.” – Do “minimum requirements” refer to fuzzy values below 1 for the ‘water’ variable/element, which indicates that adequate conditions exist with regard to annual internal renewable water resources or ‘access to improved water source’ are not achieved (i.e., at least one of both indicators has a fuzzy value below 1)?

Page 425, line 2: “(...) the AHEAD approach provides a means to view climate impacts in a water context.” – The studied impacts result also from changes in population size, because the projections of water resources per capita are based on climate and on population forecasts. Actually, in a range of countries the effects from population changes can be stronger than from climate changes.

Page 425, line 3: “(...) the use of global data and globally applicable thresholds in a fuzzy logic algorithm adds other types of uncertainties and short-comings.” – You should briefly discuss how the temporal scale influences the results of the analyses. The very variable of your survey, water availability/person can vary considerably within a country. Moreover, countries with low population densities and low water availability for agricultural use can have serious consequences for the population and is definitely relevant. You should address this issue in the discussion section.

Page 425, line 7: “(...) changes do not differ significantly between the timescales, so we chose to illustrate the results of 2 time periods only in order to reduce the amount of figures and information.” – Indeed, since we focus mainly on this latest timeslice we have adjusted the manuscript and now focus on 2090 changes only. We hope that the reviewers agree with this adjustment.

Page 425, line 22: “(...) the AHEAD approach provides a means to view climate impacts in a water context.” – The studied impacts result also from changes in population size, because the projections of water resources per capita are based on climate and on population forecasts. Actually, in a range of countries the effects from population changes can be stronger than from climate changes.

Page 425, line 24-25: “(...) in 67 countries the model spread is outside the thresholds for AHEAD fulfilment.” – (1) Please explain what AHEAD fulfilment is. Do you mean an overall AHEAD value of 0.8-1 [class ‘very good’], or do you refer to AHEAD values if exactly those that were the whole sentence means that at all models, the respective country does not achieve a “very good” AHEAD value in a certain period (or even more than 1)?

Page 426, line 6: “(...) you do not explain these abbreviations.”

Page 428, table A2: (1) There is no reference to this table in the manuscript (applies also to figure A2). We have made sure these are all referenced – the extended results section also refers to these Tables in more detail now.

Page 428, table A3: We have specified the abbreviation where the terms are first mentioned (Section 2.4). See comment #3 (general comments) on data documentation.

Page 429, table A1: (1) We have updated the table accordingly. (2) As indicated in footnote 1, page 416, the element ‘shelter’ cannot be adequately represented with data and is therefore not included in the present analysis. We have specified this again in the caption of the table.

Page 430, figure 1: (1) We have updated the table accordingly. (2) As indicated in footnote 1, page 416, the element ‘shelter’ cannot be adequately represented with data and is therefore not included in the present analysis. We have specified this again in the caption of the table.
Page 437, figure 2: This figure is important for the analyses, but it needs clarification, because explanations in the manuscript are scarce. (1) 1st column: What is 'AHEAD spread'? Is it the difference between the maximum and minimum overall AHEAD value across all models and scenarios within a single period? (2) According to the manuscript (page 417), the AHEAD spread in the upper box can also be exactly 0.2, and the AHEAD spread in the lower box can also be exactly 0.5. (3) 2nd column: What does 'AHEAD' refer to? Given the spread of AHEAD values (column 1), how do you arrive at a single AHEAD value for each country? Is it its AHEAD value from the baseline assessment, which represents the mean from all model calculations for that period? (4) 3rd column: Why is class B characterized by 'AHEAD low to medium'? Its AHEAD value is between 0.2 and 0.8 (column 2), so it should rather be 'low to high', because values from 0.6 to 0.8 are classified as high (page 418, figure 3). (5) 3rd column: Why is the uncertainty range relevant for class C3, but not for classes A and B? In all three cases, the AHEAD spread (which is below 0.2) may make a country pass a class threshold and move to another class.

We have extended the explanation of Figure 2 in text according to these suggestions. Point (3): we differentiate the different spreads 0 - <0.2, 0.2 - < 0.5 and >0.5. Even though class boundaries may be passed for classes A and B, at the most this can be one class. The direction of the results therefore remains the same, making uncertainty less important in these cases.

Page 439, figure 4: The bars are very small in the printed version.

We have revised the figure for better readability. We suggest to also rotate the figure, so the bars become larger (depending on final format of publication).

Page 440, figure 5: (1) Changes between the baseline results and those for 2090 occur for five countries, not four countries as is written below the figure. (2) Obviously, uncertainties do matter less for the 2090 period than for the baseline assessment: Ethiopia and Mongolia move from C.3 to C.2, Hungary from B to A, Syria from D.2 to D.1, and Yemen from D.2 to C.3 (assuming that thin lines depict the 2090 results). How is it possible that the inclusion of five different climate scenarios for 2090 does not lead to significantly higher relevance of uncertainty as compared to the baseline assessment? You should address this in the results or the discussion section (see comment 23).

We have adjusted the figure for better readability and have extended the results section (see comment #23). Briefly, the reduction of uncertainty is due to reductions in water availability, which leads to very high limitations (water availability = 0) under all scenarios in additional countries.

Page 426, lines 15-18: Reference de Crombrugghe et al. (2009) - Apparently, you did not take the data directly from this report, but from the database that is described therein. So, you should add the web database in the reference list and refer to it in table 1.

Reference added

Technical comments
All technical comments have been changed in the manuscript.