Interactive comment on "Sensitivity of water scarcity events to ENSO driven climate variability at the global scale" *by* T. I. E. Veldkamp et al.

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We thank the reviewer for his/her thorough and fruitful comments. We have made our best efforts to implement the very useful recommendations throughout the manuscript (see Supplementary Information for a revised version). Below, we address each of major and minor comments point-by-point.

Major comments:

R1. While the study is generally interesting, parts of the manuscript are somewhat lengthy and may be shortened. In this respect, the whole paper should be checked for redundant text. The whole manuscript comprises too many figures, with an appendix that has even more figures than the main text. As all figures are referred and discussed

in the text, it is quite difficult to judge which figures are the important ones. Some of the appendix figures are likely dispensable, e.g. A2 or A3. I suggest determining which figures are essential for the study, and then remove those figures that are not important. Pease avoid showing all figures that you made during the study!

A1. We agree with reviewer #2 that shortening and removing the redundant text and figures could improve the manuscript. We have therefore condensed the results section, removed redundant text and figures, and made amendments to other sections as follows: (1) In the introduction and methods section we have removed repetitive parts and redundant text and referred more to existing literature. (2) We have completely revised the results section, putting more emphasis on the main/important results of our analysis and shortened text where possible. (3) Within the results section we now focus on the CTA indicator for water scarcity as the results found for the WCI are quite similar. If differences in results arise we mention it in the text. (4) We have removed redundant figures: 2 figures from the main body of text and 5 figures from the supplementary information. (5) We have added 4 tables to the results section that summarize the main results. (6) We have shortened both the discussion and conclusions section, removed repetitive text, and highlighted the most important results and policy implications.

R2. Sect. 3.1 discusses results of the study mixed with results from literature so that it remains unclear what is the new contribution to science by the authors in this section.

A2. Agree, within the revised manuscript we have split our contribution from the results presented by earlier research. A portion of this reference to earlier research has been transferred to the introduction and used as a general introduction (see also review comment 1 from reviewer #1) whilst other parts have been moved to the discussion section in order to place our results in the context of previous research.

R3. Sect. 3.3 comprises a lot of number crunching. I suggest putting all number in a summarizing table and discuss only those numbers explicitly in the text that are important. For all other numbers the new table should be sufficient. Further it seems

sufficient to concentrate on discussing one of the indices, e.g., CTA. If you then write about numbers and it may be sufficient to write the WCI number only in brackets if you think the information is necessary in the text. In addition, some of the percentages given refer to the total land area, some of them only to a specific land area (e.g. p. 5481 – line 2), which is sometimes confusing. Providing both percentage in the table would be helpful. In summary, I suggest some revisions to be conducted before the paper may be accepted for publication.

A3. Thank you for pointing this out. Indeed, the main messages/results of our research are somewhat obscured by the large amount of numbers presented throughout the results section. To accommodate for this, we have added four tables to the result section that summarize per section the main results. Moreover, we have completely revised the results section, putting more emphasis on the key messages, deleting quite some numbers from the text and referring to the tables instead, and removing redundant text. We focus only on the CTA indicator for water scarcity in the revised results section as the results for the WCI are quite similar. In case of differences in results between the two indicators we mention it in the text.

Technical comments:

R4. p. 5466 – line 6 . . . climate change. However, . . .

A4. Amended.

R5. p. 5467 – line 16 I assume that the term "blue water" is not familiar to everyone so that it needs to be properly defined.

A5. Agree, in the revised manuscript we explain the term blue water in the introduction as 'the water available in rivers, lakes and aquifers' whilst we put more emphasis on the differences between the blue, green and other types of water resources, and their corresponding water scarcity interpretations in section 2.4.

R6. p. 5475 – line 6-14 Very long sentence that makes it difficult to follow. I suggest

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separating into several sentences to improve readability.

A6. Amended.

R7. p. 5478 – line 5-7 It is written: " . . .whereas it might be more appropriate for consumptive water use to assess its correlation either using monthly time-scales or yearly maxima." Can't this be checked?

A7. If the research was entitled to the sensitivity of consumptive (irrigation) water use to ENSO driven climate variability only, we could have done so indeed. However, estimating the correlation between consumptive (irrigation) water use and ENSO driven variability at a monthly time-scale or using monthly maxima requires an extensive analysis on potential time lags between the observed ENSO conditions and the variability in consumptive irrigation water demand, amongst other because of issues related to the soil moisture memory and differences in crop growth rates, rates of evapotranspiration, and water demands, (see also Comment 11, Reviewer #1). Since we used consumptive water demands mainly as input for our water scarcity metrics, we were especially interested in the yearly totals whilst a detailed analysis on yearly maxima or monthly values was out of the scope of this research.

R8. p. 5478 – line 20-24 Sentence is difficult to read. Please rewrite!

A8. Amended, moreover we have added a table in the revised manuscript to summarize all the numbers presented (section 3.2, table 3).

R9. p. 5479 – line 13 It is written: " . . . we did not find any FPUs with (in)significant correlations for water availability, . . . I don't understand. Does this mean that you don't find any correlation at all? If so then write it directly.

A9. We meant here that for all FPUs for which water resources availability can be significantly correlated with ENSO driven climate variability we also found a significant correlation in water shortage conditions with ENSO driven variability. We have clarified this in the revised manuscript (section 3.2).

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R10. p. 5480 – line 25-26 It is written: "... we found correlations ......for one-third (33.1%) of the land area susceptible to water stress events (blue dots)." Does mean 33% of the total land area, or 33% of the susceptible land area? Please clarify in the text!

A10. We meant here 33% of the susceptible land area, thus 7.6% (33.1% * 23.1%) of the total land area. We agree that this was not clear in the original manuscript. Moreover, we think that the numbers presented in this specific paragraph obscured the key messages in this section. We have therefore decided to omit this paragraph in the revised manuscript.

R11. p. 5481 – line 10-11 What is a factor difference? A factor is multiplicative, a difference is additive. I don't understand.

A11. We meant here that the share of population (41.1%) affected by water scarcity events is a factor 2.9 higher than the share of land area (13.9%) affected by water scarcity events. We agree with the reviewer that this was not clear in the original manuscript. Therefore, we have amended this throughout the results section, whilst we summarized our main results in accompanying tables.

R12. p. 5481 – line 13-18 This sentence is difficult to read and seems to only duplicate the caption of figure 6. Please avoid duplicating figure captions in the main text!

A12. Amended.

R13. p. 5483 – line 22 ... that all individual GHMs ...

A13. Amended.

R14. p. 5484 – line 1 ... areas sensitive to ...

A14. Amended.

R15. p. 5484 – line 14 Due to clustering effects ....

A15. Amended.

R16. p. 5485 – line 27 It is written: " .... of ENSO lacks (...). Here, some words seem to be missing after '... lacks'.

A16. Amended.

R17. p. 5486 – line 4 ... value remain stationary ....

A17. Amended.

R18. p. 5486 – line 16 ... modulate the ENSO ...

A18. Amended.

R19. p. 5487 – line 5 ... presented here, are ...

A19. Amended.

R20. p. 5488 – line 3-5 Sentences "...water resources availability and consumptive water use to ENSO driven climate variability." And "We found that both water resources availability and water scarcity conditions can be significantly correlated with ENSO driven climate variability..." are redundant. Please merge appropriately.

A20. Amended.

R21. p. 5499 – Figure 1 Panel titles are too small. Also, it would make more sense to show FPUs in Fig. 1 as FPUs are used in Fig.2.

A21. Agree, in the revised manuscript we now show FPUs in Fig. 1. Moreover, we have changed the font size of the panel titles.

R22. p. 5507 – Figure 9 The black colour is difficult to separate from the grey one (Water Gap/Ensemble mean ENSO). It seems that the middle panels are the only panels that include the red and the orange line, but actually I cannot distinguish both lines. If they are the same one of those lines may be obsolete

A22. We agree with the fact that the black colour is difficult to separate from the grey ones. In the revised version we have therefore changed its colour to yellow. We understand that this figure requires some more explanation. The colours black (in the revised manuscript yellow), orange, and red are each only used twice in the different sub-figures representing the ensemble-mean values whilst the grey lines (dotted, dashed, and continuous) represent the individual GHMs in every sub-figure. Sub-figures I and IV show, the modelling spread in population 'sensitive to ENSO driven variability' (grey lines) relative to the ensemble-mean result for this topic (black line, now yellow). Sub-figures II and V show, the modelling spread in population 'affected by water scarcity' (grey lines) relative to the ensemble-mean result for this topic (orange line). Sub-figures III and VI show, finally, the modelling spread in population 'affected by water scarcity & sensitive to ENSO driven variability' (grey lines) relative to the ensemble-mean result for this topic (red line). In order to make this clear we revised the caption for this figure.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/12/C3260/2015/hessd-12-C3260-2015-supplement.zip

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