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Discussions

Interactive comment on "Global-scale drought risk assessment for agricultural systems" *by* Isabel Meza et al.

Anonymous Referee #1

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The authors present a relevant and interesting manuscript, where they have studied and mapped composite drought risk at the global scale. For assessing agricultural drought risk, they have separated drought hazard/exposure in irrigated and rainfed cropping systems, and combined these hazard indicators with socio-ecological vulnerability. Finally, they have compared the obtained drought risk metric, with reported drought hazard events from EM-Dat. In general, I like and agree with the approach described in the study. My notes about the study are written below.

1. I very much agree with looking into drought hazard for irrigated and rainfed cropping systems separately. However, the way these hazard indicators are combined, is potentially misleading. The hazard indicators are combined in a way that equalizes the weight of drought hazards in irrigated and rainfed cropping systems. However, as

irrigated systems are, in general, more resilient to drought (irrigated systems can mitigate drought impacts by irrigation while rainfed systems cannot), equalizing the hazard associated with rainfed and irrigated systems, does not seem sensible. Further, if I understand correctly, based on the analyses, drought is more frequent in irrigated cropping systems compared to rainfed systems, which is not something that would be initially expected (Page 7, Lines 193-194). To make the methods comparable across rainfed and irrigated cropping systems, the authors could potentially define droughts for rainfed systems as for irrigated systems, but without the option to compensate the demand deficit by irrigation.

2. The vulnerability assessment includes a high number of indicators. Although, the authors have excluded variables that have >0.9 correlation, many of the indicators are still most likely highly correlated. Considering the method used for calculating the vulnerability metric, this would lead to some phenomena being unproportionally weighted in the composite vulnerability index. Further, with this many variables, it is also more difficult to pinpoint and isolate potential socio-economic entry-points for reducing drought vulnerability. Hence, it might be worthwhile to analyze how the variables correlate and identify the most relevant indicators using e.g. PCA.

3. Fig. 6: The comparison between the drought risk indicator developed here and the drought hazards observed in EM-DAT is a relevant and nice addition to the study. However, visually it does not seem that the amount of observed drought hazards correlate with the risk indicator presented. I would recommend showing a scatter plot about this relationship (especially, since the authors refer to this section as a validation of the proposed drought risk indicator), at least for those areas where data exist for both sources, so that the reader can assess their agreement more easily.

4. The authors have assessed the risk of drought by combining the associated hazard, exposure and vulnerability components. However, the difference between hazard and exposure is currently not clearly stated and defined in the manuscript. For example, what are the drought exposure and hazard components used for deriving the results in

Figs 2 and 3. Further, it would be good to explicitly explain the exposure component in the text (exposure of what?), since also some of the vulnerability indicators could be viewed as being related to drought exposure (e.g. % of GDP from agriculture etc., rural population).

5. The GCWM was forced with monthly data, which were transformed into pseudo daily climate. As products that readily have daily records exist (e.g. AgMerra, ISI-MIP forcing), why they chose to use monthly forcing data?

6. Minor comment for structure: would be good to be consistent between methods and results in which order you present the results (method: rainfed, irrigated; results: irrigated, rainfed)

7. It would be worthwhile to cross-refer to Fig. 1 in describing the methods, as it would make the methods easier to understand. This would also bind Fig. 1 better to the rest of text, as now it is a bit isolated from it.

8. I would recommend tabulating also the other data than vulnerability indicators used for the study, so that the reader can get an understanding of the data more quickly and easily.

9. Page 5 Rows 116-117: The definition of the MIRCA-areas is a bit unclear.

10. Figures 2 and 3: The range for color scales of the figures should be the same, at least for the hazard and vulnerability figures. Currently, it is very difficult to assess the contribution of each component on the total risk factor, and it seems that the hazard component has a way stronger influence on the drought risk compared to vulnerability (the mapped patterns are essentially the same for hazard/exposure and risk).

11. Why hazard/exposure for rainfed is computed at national/sub-national level? Further, why these are aggregated to national level in analyses of for agricultural systems? These aggregations make it hard to compare the different results. It is of course ok to finally aggregate the results to country scale, but would be good show also the non-

aggregated results for all the results.

12. Fig. 5: Would be good to have the y and x axes in same scale, not to give misleading impression of the results. And/Or you could show 1:1 line, and with that it would be easier to see in which countries risk irrigated agriculture is higher/lower than in rainfed agriculture

13. Page 7, Lines 170-173: Why is IH transformed logarithmically?