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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Quantifying the Impacts of Compound Extremes on Agriculture and Irrigation Water Demand" *by* Iman Haqiqi et al.

**Anonymous Referee #2**

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Overall:

The paper is about a well-designed study aiming to elaborate individual and compound extreme event impacts on corn yields in the USA using statistical approach. The significance of extreme events on yield anomalies were studied using various indicators of soil moisture (representing water stress) as well. The outcomes of the paper can be insightful for further studies of predicting crop yield anomalies and assessing impacts of extreme weather conditions to crop yields. Consequently, the paper is worth for publishing with some revisions.

My major comments on the paper are:

1- The paper needs to be re-structured/re-written. First, it is too lengthy including text-



book information (e.g. Figure 1b, and Figure 2) which are not necessary for the reader (peer knowledge). Second, its structure is chaotic: the introduction chapter includes results and discussions points etc; it is like a short summary of the whole paper; the discussion section includes equations, methods, results and data sources. The authors claim to include results/conclusions which are too diverse and out of scope of the analysis (e.g. irrigation, farm soil management, marginal value, decision making as specified in the abstract). The framework of analysis do not support to make conclusions about these topics. The authors should revise their goals and associated conclusions accordingly. The paper is about compound vs individual extreme events on crop yield and comparison of different soil moisture indicators. Other conclusions not taken from this analysis can be excluded. Furthermore, the empirical concerns are relevant however too lengthy for readers. It can be reduced and can be removed to SI.

2- The authors claim that "marginal value of water" will be calculated and utilized in the paper. There is nothing about it in the method and result section (only shown in the discussion section – a short paragraph without any substantial info). I think having this goal of economic analysis is not relevant and beyond the scope the. It is better to exclude this part of the analysis so that the paper is coherent and consistent with its framework.

3- Discussion sections were boldly written (e.g. like for climate change discussion and farmer management). I recommend drawing conclusions only if it is supported by the data and analysis.

For more-detailed comments:

1) Abstract

- which crops were addressed in the article? Please specify. It is important to mention corn here. - "the value of water experiences a four-fold increase on hot days": not clear, what do the authors refer to by "value of water"? Is this volume? Value of water is generally associated with significance, importance, true cost etc. - This paper also

improves our understanding of the conditional marginal value (or damage)". Which way? And what is conditional marginal value? It is important to provide necessary descriptions in the text as well.

2) Introduction

- The first paragraph was written like a conclusion section (after line 26). It includes a short summary, reminding "an abstract". This part needs revision or can be completely excluded (or moved to discussion/conclusion sections). - Ln 33: there can be other factors affecting crop yield significantly such as soil, management, nutrients etc. - Ln 37-38: "Other metrics of extreme water conditions", please specify. - Ln 38-39: "Current statistical studies had limited success in statistically capturing the yield response to soil moisture metrics", please explain why. - Ln 43: "the impact of climate change on soil moisture". The paper is about individual extreme response of yield vs compound. It is not clear why the authors refer to CC studies. - Ln 46: "conditional marginal impact". Please explain what this means. - Ln 50: please explain "wet-heat stress" - Ln 55-60: this part is an outcome of the study. Please remove it to another section (e.g. discussion). - What are exactly marginal and conditional marginal impacts? It is better if definitions are given for readers. - Ln 64-79: this part is related to discussion/conclusion. I recommend deleting these parts or move to the other relevant sections. - Ln 77/78: the authors claim that they will show how the results can be used to economically quantify the marginal value of water, in the form of soil moisture, for corn production in the US under different hydroclimatic conditions. I couldn't see this in the rest of the paper. Please clarify.

3) Empirical concerns

- This section is mostly about discussion of the method and assumptions taken for the study. It can be presented as supplementary information, rather than in the main text. That can help reader to focus on the results of the paper and its wider implications. In its current form, it is too lengthy. - Equation 1: please describe what exactly each letter



in the equation refers to? For example please refer last variable in the equation as error and describe g(h) function? - Ln 126: "measure the value of water". Not clear what the authors refer to as "value of water". Please clarify. - Figure 1: this is nothing new, a known information– like a textbook. Excluding this figure does not change anything about the paper. I recommend not to include it. - Ln 134: "Many researchers have acknowledged the need for soil moisture data to predict the response of crop yields to variations in water availability." Please provide references to those researchers. - Ln 171: please provide references to those studies.

4) Method - This section is too long. Please shorten it and provide detailed information in SI. - Equation 2: please define each variable and function used in the equation. - Ln 230: "some indicators", please clarify which indicators. - Please provide numbers to the equations. - Ln 277: g(Ws), please define the parameter - Ln 290-295: this is a result of the analysis, not related to data/method or assumptions. - Figure 4,5 and 6 are outcomes of the model/analysis. They can be presented in the result section.

5) Results - Ln 363/364: "We will discuss the implications of these results in Sect. 5." The authors use lots of cross references between the sections as seen in here. This is not necessary, since discussion section means discussion of the results by definition. Please through the entire text and remove unnecessary cross-section references. - Table 2: note section is repetition of the previous sections, thus it is not necessary. - Ln 404: "This indicates that water is up to four times more valuable in hot weather." The authors can consider revising the sentence and be more explicit, "value of water" may mean several things. - Model (2-a) and Model (2-b) were mentioned here for the first time. Please describe the differences between these models in method/data section.

6) Discussion

- Ln 410/411: this is related to differences between model 1 & 2, right? Please clarify which model outcome supports (or all?) the statement. - Performance: does this mean best correlation between indicators of extreme events yield anomalies? Please

clarify. - First paragraph: what about model 1-c ? - Model 2 a-b were not defined in the previous parts of the paper. Please check consistency. - Ln 416-421: These are newly introduced topics. None of these research goals (including why to have them), methods and results were mentioned in the previous sections of the paper (e.g. new interaction model, why do you have that and this was never mentioned in the paper). It is like Appendix is another paper with its own results, methods and goals. Please revise the paper accordingly. - Ln 424-428: Is this an outcome supported by the results? If so, please indicate how. It is more like a general knowledge. - Ln 429-430: Please provide supporting data/result from the analysis. - Ln 433: what are the other metrics suggested in the literature? - Ln 434-438: Is this a conclusion related to compound vs individual extreme weather event analysis? Can we say the same if we use other metrics of water stress than soil moisture? - Ln 465-469: I question that the authors' research is critical for climate change studies. First, their analysis was based on historical data and says nothing about counterfactual analysis. This is not the first time impacts of a compound event was researched and like other studies this paper shows stronger impact of a compound event. It does not bring anything to climate change impact studies. - Ln 472: please clarify benefit of this collaboration. In which way it helps to solve the challenge. - Ln 479-ln 483: this recommendation is not related to the sub-section heading. The authors stated a discussion point which is out of scope of their analysis and not supported with the overall goal of the paper. Recommendations can be given to farmers etc; however their model/research is not aimed for decision -support guidance. Please remove this section of revise it. - Section 5.4: This section includes literature, method, data and equation related to an estimation. This is not a discussion section. Please previse it accordingly. This additional analysis doesn't bring anything to the value of the paper. I would recommend excluding this analysis from the paper in order to keep its coherence and consistency. - Ln 501: "We find that the average damage from excess heat has been up to four times more severe when combined with water stress" what is the damage, yield losses? - Line 517-525: the CC knowledge and analysis were not included in previous parts (method, data, results) section



of the paper. Please include info about this analysis in adequate sections. - Line 525-535: There is almost no economic analysis thus the paper does not contribute to CC economics. No policy analysis or research were provided either; also paper does not say/bring anything to regional resilience of agroecosystems, global food security, and as well as future climate impacts. These two paragraphs have to be re-written. These claims are bold and cannot be taken from the research as described in the paper.

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