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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A global scale evaluation of extreme events in the *eartH2Observe* project" *by* Toby R. Marthews et al.

Anonymous Referee #1

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General comments The manuscript presents an analysis of a unique dataset that was produced from the eartH2Observe project. This dataset involves the simulation of several hydrologic variables from a number of state-of-art land surface/hydrologic models and using as forcing several satellite and reanalysis dataset. The scale of analysis is global and the focus is on the tails (i.e. low/high extremes) of evapotranspiration and surface runoff. Overall the work is very interesting and the dataset analyzed is very unique. Additionally, the fact that the analysis is performed at global scale provides important information on the regional variability of findings. The manuscript is generally well written but there are certain parts (especially in the description of methodology) that require additional clarification and discussion. I provide some specific comments below that hopefully will help the authors to improve their manuscript.

Specific comments

1. I believe that the title should be revised to better reflect the context of the paper. One of the main elements of you analysis is "uncertainty in identification of extreme events" but this is not reflected in the current title.

2. Abstract L17-19: I agree but given the focus of your analysis (i.e. identification of extremes) you should be more specific on what your results will allow to comment. For example, models can be quite robust in representing the main body of the distribution of hydrologic variables, which is actually very important for water resources applications. So I suggest to specifically refer again to representation of extremes.

3. P3L3: For a multiregional evaluation of satellite precipitation over complex terrain, you may want to consider also Derin, Yagmur, et al. "Multiregional satellite precipitation products evaluation over complex terrain." Journal of Hydrometeorology 17.6 (2016): 1817-1836.

4. Information in Section 2.1 needs to further clarified. What do you mean by "base distribution"? Is this the reference for your EE/yr at each cell? Why you average the five runs and you don't consider each model independently? Do you repeat the same procedure for each product and then compare? Please clarify.

5. It would be very useful to provide a graphical example to demonstrate the different uncertainty components that you describe in equations 1-3.

6. L24-28 are confusing. First, it is not clear why you consider εx,j >1 as an indicator of model amplification of uncertainty? Do you mean αx,j instead? Also if you want to identify the relative contribution of the different sources of uncertainty, why don't you take the ratio of α/β ?

7. P6L6: "global average", why do you consider global average? It is not advisable since the average masks regional variability. Also "ET highs (58.1% vs 41.9%)", it is not clear what these numbers correspond to.

8. P6L10 “αx,j<-1”, I believe you mean log(αx,j).

9. P6L19-23. Interesting findings, some additional comments are welcome here. For example, why “the magnitude of the increase reduced in wetter environments”?

10. P6L25: “The global mean value. . ..is a measure of variability”. How can a mean value tell you anything about variability? Please clarify/revise.

11. P6L25-30: In general, this part of the text is quite difficult to “digest”. Please improve clarity.

12. P6L31: What do you mean by “internal model uncertainty”?

13. P7L3-4: “. . .are more sensitive to precipitation extremes in wet environments”. Be careful here, you should state “. . .more sensitive to precipitation uncertainty”.

14. P7L15-16: I believe that there is a confusion here between model uncertainty and uncertainty propagation. This is a very important aspect and the authors should clarify it in their discussion. For example, even with zero model uncertainty, transformation of precipitation uncertainty to runoff uncertainty could potentially amplify as a result of the nonlinear transformation of rainfall-to-runoff.

15. The same point as in 14(above) should be considered in the discussion of section 4.2 (e.g. L26-27).

16. P9L10: “. . .to improve prediction of water cycle quantities”. Ok I agree but the analysis presented has not done anything on the quantitative aspect. Perhaps revise to “improve prediction of water cycle extremes”?

17. Section 4.3. (L15-22). The text here is relevant to work that is evaluating uncertainty and compares against observations. However, this is not the scope of your work. You isolate (correctly) the forcing and model uncertainty by considering as reference a model/forcing combination.

18. Fig2: What is (a) and what is (b). Also, some of the explanation on the calculation

of results could be added to text in manuscript as well.

19. Fig3. Similar comment on the explanation.

20. Figure 4. I find this map very useful. It would be nice to provide for the other cases analyzed.

21. Figure 7: “erros bars show SE”. Do you mean standard error? And how the error is defined. Perhaps you refer to standard deviation instead?

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