Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-622-RC2, 2019


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 #2**

Received and published: 27 March 2019

Review of Marthews et al. "A global scale evaluation of extreme events in the earth2observe project"

The authors use model simulations from the earth2observe project to study the sources of uncertainty in simulated runoff and evapotranspiration (ET). Model simulations from this project are well chosen for this purpose as they are performed with (i) different precipitation forcing datasets and (ii) different land surface and hydrological models. Analysing these simulations, the authors compared the relative importance of the precipitation forcing uncertainty with that of the model uncertainty for resulting runoff and ET extremes.



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Discussion paper

Recommendation: I think the paper should be rejected.

While the research question is interesting and relevant, and the model simulations are well suited for the purpose of this study, the applied methodology is too complex and hard to understand such that I am not sure about the robustness of the resulting conclusions.

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General comments:

(1) As mentioned above I do not understand (the purpose of) the methodology applied in this study, even after carefully reading it many times.

While the focus on extremes is not explained or motivated, I also do not see why/how 10% of a 14-year time series can already be considered extreme. Also, there is no indication to what extent the final conclusions depend in this arbitrary choice. Further, the definition of 'uncertainty' in extremes is only explained in the caption of Figure 2, and I wonder why such great complexity is needed after all. Why not simply analysing the very highest/lowest monthly precipitation, runoff and ET sums at each grid cell, across models and forcing datasets?

Moreover, it remains unclear if absolute values or anomalies (i.e. with removed seasonal cycle) are used. In the case of absolute values, high ET extremes will necessarily occur in summer and while this is not always the case for extreme precipitation, this would lead to a (unwanted) de-coupling of the variables with this analysis design.

Concerning the low extremes, I am not sure how much sense this makes for precipitation. Lets say in a dry grid cell precipitation is zero in most of the analyzed months, does it make sense then to determine such months as low precipitation extremes?

(2) I do not agree with referring to MSWEP as a 'gold standard', and with statements like 'the best global evapotranspiration products (Martens et al. 2017)' or 'simulation results from the earth2observe project [...] driven by the best available published pre-

cipitation observations'. While these products are certainly state-of-the-art, I doubt that they will be 'the best' (based on what measure?) in all regions and at all times. As for the reference precipitation used in this study, it could be a more fair alternative to use the ensemble mean across the considered precipitation products.

(3) I think the linearity assumption made in Figures 4-6 is not justified, such that the linear regressions are no suitable way to analyze these point clouds. Further, displaying the point cloud envelopes is misleading, as these envelopes is likely dominated by outliers/extremes, and do not necessarily reflect actual relationships. Instead, why not use a 2D density plot here, and climate-regime-based moving average lines to summarize the results?

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Specific comments:

- section 3.1, line 13, and caption of Figure 3, and elsewhere: the authors sometimes refer to 'increases' while also decreases are found in some regions

- epsilon is used twice, in section 2.1, line 21, and then in section 2.2, line 10

- section 2.1, line 22: '20 mm annual precipitation' - does this refer to multi-year means, or to individual years

- section 2.1, line 23: abbreviation SD not defined

- section 2.1, line 25: replace 'runs' with 'simulations'

- section 2.2, line 2: 'simulator' is not defined

- section 2.2, line 18: I think here you mix up i with j (?)

- results section, and figure captions: instead of using X as subscript and then referring to ET or runoff, you could replace the X with Q or ET

- Figure 2: numbers on color bar are very small

- Figure 3, caption: you mention a 'run' here, but these are just precipitation products and no model simulations

- Figures 4-7: legends missing

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