

Interactive comment on “Global hydrological droughts in the 21st century under a changing hydrological regime” by N. Wanders et al.

Anonymous Referee #1

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General comments:

In this paper a transient variable threshold approach is proposed to adapt analysis of dry spells to longer-term changes in projected low flow regimes. The approach is aimed to analyse drought duration and deficit characteristic in future climate with respect to a changed regime, defined by monthly flow quantiles Q80 (80% exceedance probability). Current studies of the research group (e.g. Van Huijgenvoort et al. 2014) used the conventional (intransient) variable threshold approach where the results reflect change of drought characteristics with respect to current regime (using monthly Q80 values calculated from 30 years of observations). The paper at hand is aimed to provide a different view, by analysing anomalies with respect to a possible future low flow regime, derived from GCM projections.

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While the paper is generally well written, it has a somewhat limited scope: It pursues a similar aim as previous studies (e.g. Van Huijgenvoort et al. 2014, Prudhomme et al. 2013), namely to assess the change of low flow and drought characteristics from global hydrological models (GHMs) forced with a set of GCMs and emission scenarios. While Van Huijgenvoort et al. 2014 used several GHMs, here only one GHM is used. This appears at a first sight as a weakness, unless the advantages of the applied GHM would be discussed more prominently in the paper, what I would certainly recommend.

There are two innovative aspects in this paper (which are in the current manuscript confounded and should be analysed and discussed more clearly). The first innovative aspect is that a rather novel PCR-GLOBWB model is used. Global models in general are afflicted with vast uncertainties and it would therefore interesting to compare the projections obtained here with other studies. However, this would require assessing the differences with respect to the same drought definition concept as in previous studies, i.e. the classical (intransient) threshold approach. This should yield into a discussion of similarity and differences, and the relative credibility of different models.

The second innovative aspect is the variable threshold approach. Here I am a bit in doubt about the interpretability of the dry spells characteristics with respect to a changed regime. While the classical approach is intended to assess future dry spells with respect to the current regime, the transient approach is intended to assess changes of anomalies with respect to a changed regime. So the future low flow regime may become more wet, but the anomalies could last longer or have a larger volume under an increased threshold. But I am not sure for what application this may be useful (e.g. fish will be happy to be in a wetter environment (higher low flows!), but the statistics will tell them to be unlucky because they are at same time in a longer dry spell because the threshold was set higher for its evaluation. Not sure if this makes sense. . .). There should be a careful interpretation of the physical scope of this intransient threshold approach that makes clear what water resources management tasks can be served by this statistics. And if the new statistics are useful, a direct com-

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parison on the results with the classical varying threshold method results is clearly indicated, so that one can learn about the differences of the two approaches.

To conclude, I think the paper has a greater potential as what it actually delivers in its present state. I would recommend that the scope of the paper is shaped according the two innovative aspects indicated above, to make it an interesting contribution to literature on projecting hydrological drought in future climate.

Minor comments:

P654, line 20: Give more specific information to what the R^2 value belongs to (I assume total discharges, daily flows, and whole regime?). What is the performance for low flows then?

657, line 4: "AID(t) is the total area in drought at a given time t," . . . is redundant; "at a given time (t)" may move to the sentence above. Section 3.1: Seems to me that you are mixing low flows and threshold. Decide if you wish to address change in low flows Q90, or just thresholds for the drought analysis, and be then consistent throughout the paper. References: Check reference style: Year of publication should appear at the end of each entry...

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