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Review of “Streamflow indices to identify catchment drivers of hydrograph” by Mathai and Mjumdar

Wouter Knoben (Referee)

Referee comment on "Use of streamflow indices to identify the catchment drivers of hydrograph" by Jeenu Mathai and Pradeep Mujumdar, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-307-RC1>, 2021

Dear authors,

Please find my review below and in the attached annotated pdf.

Kind regards,

Wouter Knoben

Manuscript summary

This study attempts to investigate the relationship between statistical descriptors of catchment properties (e.g mean elevation, mean aridity, forest fraction, etc) and statistical properties of the rising limbs and recessions of streamflow hydrographs. The study uses 671 catchments from the CAMELS dataset and a subset of 15 of the CAMELS' attributes. The study uses six streamflow indices/signatures; three of which describe properties of rising limbs and three of which describe properties of recessions. The signatures are the rising and falling limb density, and four parameters that are found by respectively fitting a Weibull function to the rising limbs of each catchment and two exponential regressions to the falling limbs of each catchment. Values for these six signatures are correlated with values of the 15 catchment attributes and these correlations are summarized. Part of the analysis is performed with the catchments grouped into 10 clusters defined in other work and part of the analysis is performed without this division into clusters.

Summary of comments

I have provided a summary of my thoughts about this manuscript here. I have also uploaded an annotated PDF with additional comments. Some overlap exists between the summary here and the individual comments in the annotated PDF.

Novelty

The introduction is currently missing an overview of what is already known about drivers of rising limbs and recessions. Currently no knowledge gap is defined and this makes it somewhat difficult to assess the novelty of this paper. A literature review and definition of knowledge gap should be added to the paper.

In my opinion, the paper currently does not provide what the title indicates, namely a way to identify the catchment drivers of hydrograph[s]. Instead, the paper merely shows that certain catchment attributes in the CAMELS data correlate with certain streamflow signatures. The fact that these attributes and signatures show correlations is not particularly instructive for hydrologic understanding unless it can be explained why these correlations exist. This connection is currently not discussed in the paper, apart from a single mention on line 250. Multiple papers already exist that investigate the relationship between CAMELS attributes and a variety of other things (model performance, streamflow signatures, catchment similarity, etc), and unless hypotheses about the catchment processes that explain the correlations seen in this paper are added and tested, the main novelty of this paper seems to be that we now know that the CAMELS attributes correlate with four previously unseen streamflow signatures. In my opinion this is not enough to warrant publication.

Methods

The paper does a good job of explaining what was done but it is somewhat incomplete in explaining why various choices are made and how certain methods are implemented. For example:

- Why are these six signatures chosen? Why not other ones?
- Why is only a subset of the CAMELS catchment attributes used and why specifically were those 15 attributes selected? How much independent information is contained in these 15 attributes?
- Why are the catchments divided into clusters for part of the analysis and why these clusters specifically?
- How are the number of rising limbs and number of falling limbs determined?
- How are the Weibull and exponential regressions fitted to rising and falling limbs respectively?
- How accurate are these fits for each catchment and what does this mean for the resulting correlations with catchment attributes?
- Which correlations are shown in Tables 3 and 4?
- Why are some correlations missing in these tables?

Clarification of why and how the methods are used is needed to allow for better understanding of the paper and reproducibility by others.

Manuscript flow

The manuscript is well-written but may benefit from some restructuring. For example, section 3 ("Contributions of this study") could be moved to be part of the introduction.

As far as I can tell, Section 6.1 relies quite heavily on descriptions of clusters in Jehn et al. (2020). To fully understand the results shown in 6.1 the reader currently needs to flip back and forth between the current manuscript and searching through Jehn et al. (2020). I suggest to make this easier for the reader by showing/reproducing the relevant data that supports these catchment/cluster descriptions in the current manuscript or in the Supporting Information if space is an issue.

Please also note the supplement to this comment:

<https://hess.copernicus.org/preprints/hess-2021-307/hess-2021-307-RC1-supplement.pdf>