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Natural Hazards and Earth System Sciences
Discussions

# *Interactive comment on* "The impact of hydrological model structure on the simulation of extreme runoff events" *by* Gijs van Kempen et al.

**Anonymous Referee #1**

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In this study the FUSE framework to unserstand model structural error is used to investigate the effects of model structure on extreme events in different climate zones. The authors do not use real catchments to investigate the model structural effects but a synthetic approach with a given range of parameter sets (the same for each all climate zones). The topic of investigating structural errors is very relevant and the application in different climatic regions is interesting. The manuscript is written clearly and follows a logical structure, even though not quite the classic one.

While I generally like the methodological approach I am not fully convinced in every aspect , which the authors might explain in more detail.

Main points: - The parameter ranges are taken from the original FUSE paper and applied in different climate zones. I am not convinced that the parameter space is fully



(or sufficiently) sampled using theses ranges. For very different regions than the ones where the models were intended and developed for the ranges might be quite different and a stop in increase of change using the Kolmogorov-Sirnoff test might not indicate that the space as sufficiently sampled, but could also be that there is a region of the parameter space that is not considered at all by the study set up.

- I am also not fully convinced that the very same parameter range should be applied for the catchments that can be found in different zones, hence I cannot understand why in the synthetic test these ranges should be the same and not a plausible range known from or tested in real catchments from these zones.

- How much do the additional snow routine parameters potentially influence the plausible parameter ranges of the other parameters? I would argue that that could change quite a bit and again would expect some kind of evaluation for instance by using real catchments from the respective regions.

- How much could using the same parameters in the snow routine effect the results? The very same degree-day was used despite the different climate zones. for snow influenced catchments the snow routine is crucial and varying for instance the degree-day will have large differences in the simulations. Please discuss.

- One of the objectives of the study is to link extreme event via their return periods to their sensitivity to model structure if the extreme events are simulated. The authors use daily data and daily simulation, however, often very large events occur at shorter time scales. How could the apporach be extended to these or would that shift the return periods very much? I assume that might be particularly relevant for arid zones.

- the extreme events were selected by using the minimum and maximum, for many studies on extreme values (particularly low flows) a moving average is used to avoid effects of oscillations etc. in these ranges. Maybe that would also solve some of the problems with the hard-coded threshold?

- extreme values are looked at only in terms of timing and maximum/minimum simulated streamflow. Other parts of the events might be interesing as well (event volume, deficit, duration etc.), while I see that that is not the focus of this study, I would appreciate a couple of words on these and how easy or difficult the proposed method could be extended to these characteristics.

Minor comments:

- the terms "drought" and "low flow" are not clearly distinguished. While one (drought) can lead to the other, low flow is a seasonal characteristic of the flow regime. Maybe use instead of simply drought the term "hydrological drought" but since the study is really about low flows, why not fully leave out the term drought?

- form: the results part is slightly mixed with discussion parts (referring to other studies). Then a synthesis follows and then, when the reader would expect conclusions, a new discussion part starts. While it is interesting in a way, I would propose to change the order. A reader that is looking only at specific parts can easily find them without having to go through the full paper. The discusson bits in the result part could together with the synthesis become the first part of a discussion before going into the discussion about limitations of the study setup.

Line by line comments:

L2 Add "different" after "several"

L11 compared to?

L18 I would urge to better distinguish drought and low flow (effects on crop production are rather linked to meteorological drought)

L28 remove "a" before "statistical"

L29 does not need t be the GEV but a distribution that is suitable, please mention

L35 could refer also to the tails paper by Klemeš here (Klemeš, 2000)



L97 change the word "procedure"

L164 please add the ranges in a table since they are relevant for the study

L184 what does "mainly determined" mean here? A slight difference might be very important if coming from the model structure when using the same meteorological forcing

L211 will describe -> describes

L219 are -> is; what does "significantly sensitive" mean?

L227 Or none is adequate for this zone?

L245 indicates -> indicate

L288 that show deviant behaviour -> that deviate

L350 but there might be other formulations that were not tested, where that could show up

L357 there is no one hand...

L359 for shorter events also snow melt can become important

References

Klemeš, V., 2000. Tall tales about tails of hydrological distributions. I. Journal of Hydrologic Engineering, 5(3), pp.227-231.

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