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Comment on hess-2021-321

Anonymous Referee #1

Referee comment on "A large-sample investigation into uncertain climate change impacts on high flows across Great Britain" by Rosanna A. Lane et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-321-RC1, 2021

Lane et al. present an analysis of high flow metrics for 346 catchments in a future climate, considering 30 different parameter fields and 12 different RCMs. Although there is really nothing substantially wrong with the approach, especially when the goal is to support policy making, I think scientifically there are some missed opportunities which makes that the scientific gain of this study is currently limited.

Several choices are not properly substantiated. All RCMs are based on one single GCM. Why only one, and why this one? It reads as if this is not necessarily the GCM that performs best in the region of GB. DECIPHeR gives nice opportunities to test multiple model structures, why only one, and why only Topmodel? Only RCP8.5 is considered, why only this one and what would that imply for the results? Why were different datasets used for P and PET for the bias correction? Both datasets seem to have both variables. Why was snow not included as process in the hydrological model? I was surprised that T was not required as input for the hydrological model (indeed, to simulate snow processes), to only find at the end of the discussion that snow was not accounted for - with a reference to eastern Scotland where the snow fraction can be up to 0.17. There might be valid reasons for each of these choices, but they can be better explained.

At several places, it is mentioned that caution should be taken when interpreting the results (related to snow, see later point, and to potential groundwater flow). Not even widely discussed are the catchments with reservoirs/regulated flow (they are only mentioned as being excluded for the analysis of the evaluation of the model chain, but how many of the 346 are (heavily) regulated? are they spatially clustered? and how can we somehow validate the simulation of these catchments if the regulation is not included in the model structure?). Taken into account these three factors (snow, groundwater, regulation) that require caution in the interpretation, it becomes a bit difficult to determine which numbers have meaning, and which don't. Given that uncertainty estimation is one aspect of this study, it are precisely these kind of aspects that might need more attention.

Besides that many choices are not well substantiated, I think there are some missed

opportunities in analyzing and presenting the effect of uncertainty (in this case, introduced by RCMs and parameters). For instance in Figure 7, one could expect that the parameters have influence on the non-linear relation between precip and Q1, while it is precisely the median of the parameter sets that is displayed here (same for the runoff coefficient). Therefore, after reading the manuscript, I still don't have the feeling I fully comprehend the uncertainty in the projections and their implications for the results.

In spite of what is written in the introduction ("Many studies have attempted to quantify the impact of these uncertainties by using multiple GCMs/RCMs, bias correction techniques, hydrological model structures and/or hydrological model parameter sets and propagating these uncertainties through the modelling chain. However, these studies are often focused on small catchment samples as the large numbers of simulations needed are computationally demanding"), there are studies that sample several steps of the modelling chain for a large sample of catchments (see references below, sorry to refer to my own work), and which might be useful in the discussion to put the results into perspective (how do these results compare to accounting for different GCMs and different hydrological model structures?).

*Melsen et al. "Mapping disagreement in hydrologic projections", HESS 2018
*Chegwidden et al., "How Do Modeling Decisions Affect the Spread Among Hydrologic Climate Change Projections? Exploring a Large Ensemble of Simulations Across a Diversity of Hydroclimates", Earths Future 2019,
*Queen et al., "Ubiquitous increases in flood magnitude in the Columbia River basin under climate change", HESS, 2021

Last minor thing: In the discussion (l. 430) the selection of a metric is referred to as a source of uncertainty. I'm not sure I entirely agree with that. Different metrics will lead to different results, simply because they evaluate different things. That is, in my opinion, not uncertainty but simply the result of a (hopefuly deliberate) choice. It does show, however, that it can be useful to evaluate multiple metrics.

l. 244; average flow is not necessarily equal to median flow.

If this review sounds a bit harsh, it is because I know the authors can do better. Most of the material is already there, therefore I am confident that the authors will be able to improve the manuscript such that it will add more to the scientific literature.

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