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Comment on hess-2021-321

Anonymous Referee #3

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-RC3, 2021

This is a well written paper by a strong team of researchers. My main comment is on their Section 2.3 - The authors are limiting their investigation by using a single GCM and scenario for projecting into the future. RCMs are essentially interpolators although with good physical realism. They work off lower and lateral boundaries that are simulated by the GCM. These lower and lateral boundaries have considerable biases unfortunately, and I often feel the use of RCMs without accounting for these biases as doing disservice to the use the simulation may have. We know that RCMs are well grounded to the topography, and hence one needs to question whether the RCM simulations with biased boundary conditions are essentially simulating the effect of the topography or the true change warming is about to unfold.

There are two ways of correcting this limitation and unfortunately, both require a bit of work on the part of the authors. The first of these is to remove systematic biases in the lateral and lower boundaries that form the inputs into the RCMs. By this I am not referring to the post-processing bias correction the authors have perfomed here, but the bias in the boundary conditions before the RCM is run. This, however, requires new RCM runs which is a significant effort in terms of computing and time. The authors may want to go through the papers below that illustrate how useful this can be:
Rocheta, E., Evans, J. P. & Sharma, A. Correcting lateral boundary biases in regional climate modelling: the effect of the relaxation zone. Climate Dynamics 55, 2511-2521, doi:10.1007/s00382-020-05393-1 (2020).
Kim, Y., Evans, J. P., Sharma, A. & Rocheta, E., Geophysical Research Letters, Spatial, temporal, and multivariate bias in regional climate model simulations. 48, e2020GL092058 (2021).

The other way of addressing this limitation is to use multiple GCMs as the basis for boundary variables that feed into the RCM. While this does not address the biased boundary inputs the RCMs is subject to, it atleast produces an envelope of the uncertainty that results from the use of a single (biased) GCM. This is the approach most researchers use in climate change assessment, often coupled with a post-processing step involving

bias correction. I realise the authors may be limited in their access to RCM simulations from other GCMs, but, if so, need to atleast discuss the implications this may have on their overall findings.

The only other comment I have is regarding the use of the distributional bias correction adopted. Given the importance of antecedent conditions (which the authos have noted), not considering bias in persistence attributes can misrepresent the relationship between pre-storm wetness and storm extremes. This is evident even in urban catchments where one would usually not expect antecedent conditions to matter. It may be worthwhile for the authors to assess this dependence in their bias corrected precipitations and observations, incase there is a bias present. This may be especially important in those catchments where they are seeing a decrease in flood magnitudes.