General comments and recommendation

The manuscript by Meresa et al. presents an interesting illustration of the uncertainties present and arising in modelling flood frequency and flood magnitude under different climate change projections for four catchments in Ireland. While it thoroughly covers a wide range of sources of uncertainty along the modelling chain and their interactions by applying an ANOVA, besides the reduced number of catchments analysed, a main drawback of the setup of the study is the lack of a better representation of the uncertainty stemming from the hydrological modelling. The many different preprocessing methods evaluated and also the multiple extreme value distributions are a strength of this study –which is otherwise not applying nor showing something new-, however the robustness of the finding that hydrological model parameter uncertainty is the least important component is very weak. Furthermore I am surprised the authors (apparently?) didn't expect the results to be different across catchments, as this is the case in some of the studies cited, and not only.

The manuscript is well structured, the methods are generally described in a comprehensible way or supported by relevant sources and/or equations. Even though the discussion provides good points; some important considerations should have been stated already before in the text. While the authors are quite keen on describing findings for each catchment, they don't really try to explain and justify some of the differences observed, what is an important shortcoming.

The manuscript generally features high-quality and interesting figures. However the authors might think about possibly reducing the number of figures (are they all relevant, or could be part of the supplement?), and also improving the readability by changing of some colors used.

I found some inconsistencies in the equations and an error in a figure. I am reporting all those I found in the technical corrections.

Because of these considerations, I think the manuscript requires further work before it can be recommended for publication.

Please find my specific and technical comments here following.

Specific comments

- Introduction:
  - This is HESS and not NHESS, but still I think using the term flood risk might be misleading for some readers. I think using flood frequency and flood magnitude would be more appropriate. Avoid also to speak about extremes, as the return periods you are looking at here are those usually considered in many countries as the limiting design floods for inhabitated areas.
  - In general there might be more literature out there to cite, but in particular here I miss Addor et al.2014, who did a similar evaluation for several Swiss river catchments, and have actually some common findings.

- Modelling and numerical experiments:
  - I am not sure numerical experiments is the correct name for what you did.
  - In your paper you make very strong statements about the uncertainty related to the hydrological model parameters, but this might be related to the hydrological model used itself – what you also say later in the discussion- however you might already state this here. I would also expect you to actually better justify your choice: why using a single conceptual hydrological model with only 4 parameters? Why completely leaving out a more physically based model (where the assumption of stationary parameters might be relaxed) ?

- P4-L103: in Table 1 with elevation do you mean *mean* elevation? What is exactly 95% of precipitation value?
- Why do you use only one goodness-of-fit measure –in principle-for selecting the behavioural parameters? Or how do you exactly take PCI into account? This is not clear to me according to your text.
- P8-L230: I think here there is a mistake, GEV has three parameters, whereas Log-Normal and Log-Logistic 2?(again pay attention to the consistency of lower/upper cases and the separating dash between text and Equations)
- Equation 17: you might write $(x-\mu)/\sigma$ instead of z (for the sake of consistency with the other equations).
- P8-L235 k is the shape parameter and not the location parameter, and please define σ and μ too (GEV's scale and location parameters respectively).

- Results:
  - P10 Wouldn't make more sense to have Fig.4 shown and commented before Fig. 3?
  - P10 Fig.6 is a figure you might consider to put in the Supplement
  - P10-L290-295: you could spend a few more words on the deficiency of the model in modelling late summer-autumn, and also explain how the NSE values shown in Fig.7 have been calculated (with daily or monthly data?) It would be also important to spend some few more words also on the performance of the model in the different catchments.
  - Fig.7: you are showing the 95% interval, but this is not in line with your text P10-L293, or I am missing something?
  - P11 first paragraph: I am not sure how "useful" this is. If you want to keep it (and Fig. 8 too), I would suggest you elaborate more on the trend and patterns you are mentioning, on the visible temporary effects, and rather give flow increases as percentages rather than absolute values.
  - P11-L3095-306 isn't there a clear increase with all downscaling methods? Well, RAW data too..
  - P11-L317: you are not showing the reference (i.e. observations) in Fig. 10, so what do you mean by saying ..*the smallest changes in flood quantiles..?*
  - P11-L318: I think here it should be LogN and not LogL?
  - Is the y-axes in Fig.11 correct for the Slaney catchments downscaled using EQM? There is a massive difference as compared to the application of the other downscaling methods, and you don't really mention it in the text…
  - P11-L327: aren't the smallest changes for Slaney using BSM ?
  - P11-L327: aren't the smallest changes for Newport using CF and BSM ?
  - P12-L332-333: why is that? Is this not contradicting results shown in Fig. 5?
  - Figure 13: First of all, some colors are too similar (e.g. BC and BC*DM look almost the same to me), second, it is not so easy to compare the different return periods by eye, as the circles have different diameters, what can be deceptive (e.g. the percentage seems to increase with the return period). It might be helpful to add the actual percentages and write somewhere the return period too. If possible removing the white outline of the percentages might also improve the figure.

- Discussion:
  - P 13-L391: Both Bastola et al. a&b?
  - P14-L399-400: Across all catchments the uncertainty in *future hydrological model parameters* .. is wrong. Please correct resp. reformulate this sentence.

- P15-L453: you might want to add a comment on the influence resp. limitation of assuming flood processes to remain stationary within the 30-year windows on your extreme value distribution fits, and if applying instationary fitting would have been a better option.
- I think authors really need to be harder on themselves for limiting the study to a single specific hydrological model, and elaborate more on what they would expect to be different by applying different model structures.

- Conclusion:
  - An important source of uncertainty in any hydrological setup are the discharge data themselves, which are implicitly assumed to be true resp. correct. There is an interesting study by Westerberg et al.2020 on this topic, it might be added as a source we should start considering too when performing sensitivity and uncertainty propagation studies, as an outlook for future work?

Technical corrections

- P5-L138: for the sake of consistency add (EQM)
- P7 Equation 10: remove the square
- P7 Equation 13: check the consistency of lower and upper cases
- P8-L213: remove a bracket in the middle in (Equation(14)
- P8: Equation 14 vs. text=> check the consistency NQi,p vs. NQin,p
- P8 Equation 17 remove ^ in the equation
- Fig. 9: the SSPs have wrong numbers, SSP2 should be SSP3 and ssp3 should be SSP5

References

Addor, N., O. Rössler, N. Köplin, M. Huss, R. Weingartner, and J. Seibert (2014), Robust changes and sources of uncertainty in the projected hydrological regimes of Swiss catchments, Water Resour. Res., 50, 7541–7562, doi:10.1002/ 2014WR015549

Westerberg, I.K., A.E. Sikorska-Senoner, D. Viviroli, D., M. Vis, and J. Seibert (2020), Hydrological model calibration with uncertain discharge data, Hydr. Sci. J.,https://doi.org/10.1080/02626667.2020.1735638