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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Do climate-informed extreme value statistics improve the estimation of flood probabilities in Europe?" *by* Eva Steirou et al.

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This study presents a methodology to assess and quantify the impact of climatic covariates in the estimation of time-dependent flood probabilities. The method is tested on a wide sample of catchments in Europe. The paper is clearly and concisely written and the topic is of interest for the readers of this journal.
In my opinion, the study should be seen as an additional step in the efforts of the hydrological community towards a better understanding and quantification of flood risk and, as well underlined by the authors, the spatial consistency of the results indicates some degree of significance in the adopted model. However, further steps are required

before the suggested method can be effectively applied in practice.
Both the reviewers before me pointed out very interesting comments, many of which I happened to share. I come last so I'll try not to overlap.
In general, my main concern derives from the GEV approach that requires a number of hypotheses and, if not integrated within a regionalization framework, is prone to extremely large uncertainties. In addition to the references recommended by Elena Volpi, I may suggest the reading of Marani and Ignaccolo (2015), that provide a different perspective on extreme value analysis and the GEV approach (potentially for nonstationary extremes) that deserves attention.
To conclude, I think the paper definitely deserves publication, but some more discussion and comments on the adopted methods are required. Potentially, some additional analyses could be of help. Below my detailed comments.

- Is the use of climate-informed models contradicting the identical-distribution assumption behind the use of GEV? This perhaps needs to be discussed.
- The inclusion of climate information in the model raises the number of parameters to be estimated to 4. Is there a risk of overfitting?
- How the authors explain that the linear model applied to the scale parameters (rather than location) provides similar results? Shouldn't the two parameters be related one another since the location is related the mean and the scale to the variance of the annual maxima? Is it correct to change one of them and keep the other fixed?
- The GEV approach is highly sensitive to the shape parameter, which is prone to large estimation uncertainty when derived from short data records (50 years), particularly when using the maximum likelihood method. Why not using an L-moments estimation method? Could the inclusion of prior information on the GEV shape parameter improve the accuracy of the results? Perhaps this aspect

should be addressed in the study to check consistency in the significant indices (in the end shape and scale are then used as prior information in the estimation of the climate-informed model parameters).

- A linear model to relate climatic indices and GEV location parameter is chosen. Clearly, more complex models are not recommended due to the limited data sample and overfitting problems, but this represents a simplification of reality. How can this affect the results? This should be discussed.
- What do the authors recommend for situations in which more than one climatic index is significant?

Minor comments:
- Lines 24-28 in the abstract are not easy to read, I suggest to rephrase them;
- Introduction: the proposed method is of interest for (re-)insurance applications and for flood risk management. I think the design applications are not interested since year-by-year variability is not relevant - 169-172: please provide more details for readers not familiar with the technique;

References

Marani, M., Ignaccolo, M., 2015. A metastatistical approach to rainfall extremes. Adv. Water Resour. 79, 121–126. https://doi.org/10.1016/j.advwatres.2015.03.001 .

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