The article analyses the role of antecedent moisture conditions on the estimation of extreme floods on a basin in Switzerland. The authors use a rainfall generator and a hydrological model to generate long time series on which their study is based.

I found this is an interesting paper. I have only some minor comments detailed below.

Thank you very much! Please, find our replies to your comments below in blue and italic.

Detailed comments

General: Some parts of the article should be corrected by native English.

We will carefully re-read to spot and correct these parts.

Lines 33-35: Mathevet and Garçon (2010, https://doi.org/10.1080/02626667.2010.503934) also discussed this issue. Their analyses could be shortly commented.

Introduction: The following works may be interesting to cite in the context of this study :

The work by Cameron et al. (1999, https://doi.org/10.1016/S0022-1694(99)00057-8) may be worth citing here because it considered uncertainty in flood estimation using continuous hydrological modelling.

The work by Merz and Blöschl (2009, https://onlinelibrary.wiley.com/doi/10.1002/hyp.7168) on the controls of flood events

Thank you for pointing out these citations, we will carefully read and include if appropriate.

Lines 67-69: The authors could shortly discuss multi-model approaches in the context of flood estimation.

Yes, there are also multi-model approaches that attempt to represent the structural uncertainty of hydrological simulations and particularly for extremes this approach was followed by Thébault et al. (2024). When following this methodology, however, we also need to decide on how many models and which to choose (see, Gupta and Govindaraju, 2023). This is why often rather ensemble approaches are used. However, it would be particularly in the context of antecedent conditions very interesting to pursue such an approach and assess the differences coming from different hydrological models in a future research indeed!

Lines 94-99: I found the authors do not clearly show the originality of their work compared to the previous studies they cite in the introduction or others they discuss later in the article. The authors should more clearly state the novelty of their study. What are the gaps it intends to fill compared to previous works?

We examined processes and antecedent conditions at a finer temporal resolution than others (hourly instead of daily) and used much longer precipitation time series than has been done before, allowing for a much greater diversity of precipitation sequences prior to floods and hydrological initial conditions likely to occur in the catchment. This is expected to provide more robust results in terms of identifying process-based relationships. Furthermore, we have explicitly included hydrological routing and analyzed its effect, we have linked the return periods of events to the spatial contribution of sub-catchments and the processes within them. We will try to make these points more explicit.

Section 2.1: For the readers who do not know the Aare basin, I found a short physical description is missing.

We will add a short physical description of the Aare basin.

1: A horizontal scale and north are missing.

We will add these elements to the map.

Table 1: The Regime column is in French.

The regimes were actually introduced in French including all the nuances relevant for Swiss catchments, so we kept it this way and refer to Weingartner et al. (1992). For the rest and the grouping of catchments we used the three terms rain dominant, snow influenced, and glacier influenced.

Lines 112-115: For which typical catchment size are these comments relevant?

The small-scale flood processes are potentially occurring in parts of most of the catchments, but the larger the catchments are, the less relevant theses processes may be. For the large Aare basin, the largest events are not likely to be governed by these processes.

Lines 121-124: Sorry but it was unclear for me whether point simulations are produced by the GWEX generator and then averaged at the catchment scale to feed the hydrological model.

Yes, the GWEX generator first generates the weather at the meteorological stations, which are then used to calculate mean area precipitation and temperature series to the reference elevation mean catchment elevation. We will rewrite this carefully to make this clear.

Line 123: The disaggregation process was unclear for me.

We will rewrite to be clearer.

Line 133: Is there some bias in the spatial consistency of extreme events?

To our knowledge, there are no known inconsistencies concerning the generation of extreme events, despite in-depth evaluations (Viviroli et al., 2022).

Line 144: At the hourly time step, the 50-80% quantiles are not very high.

The quantiles around the median are not very high, that is correct. However, going to the higher percentiles they are higher than daily values because of the smoothing effect of aggregation. We did not pick the highest percentiles on purpose to not let the model calibration be too strongly influenced by values that are increasingly uncertain themselves.

Table 2: I did not understand why the snow correction factor (SFCF) can be below 1. Are there actually cases where measurements overestimate snow and should be corrected by SFCF below 1?

There were no cases where this parameter was calibrated to a value less than one. Note that in the bucket-type model, each parameter is used in a conceptual way, so the parameter is intended to correct for snow, but may actually interact with other parameters and indirectly account for other processes. We kept the parameter ranges generally wider for calibration, but checked their plausibility and distribution. As noted above, the model calibration never ended in values below one for this particular parameter.

Line 186: I was wondering whether the cross-correlation is not excessively influenced by a few extreme events. Should not the cross-correlation be calculated on transformed rainfall or streamflow (for example with square-root) to limit the influence of a few very large events?

We calculated the cross correlation as well using a rank correlation to give less weight to a few extreme values, but the results are very similar (see Figure 1 below). The main point of using the ACRT

instead of fixed windows is that we allow for catchment-specific analysis, which we believe is important and valuable in this context.

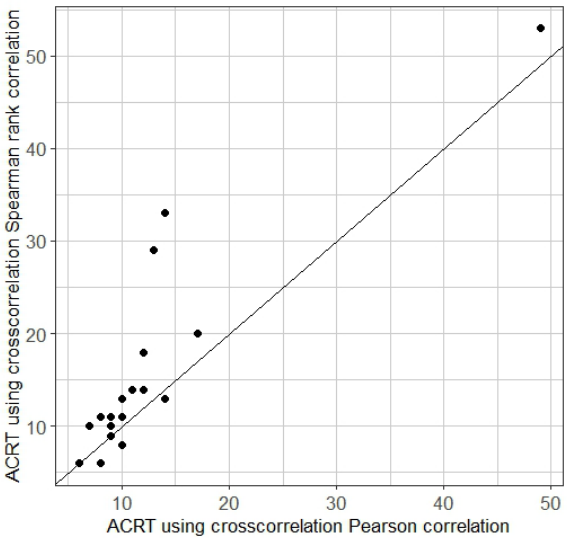

Figure 1 comparison between average catchment response time using cross-correlation with Pearson and Spearman rank correlation.

Lines 278-279: Is this really surprising or was it expected?

This finding is not really surprising, but it is nice that the separation of the AMF by their occurrence with the AMP or unrelated to the AMP shows this distinct pattern.

Section 4.2: I found that the authors could further discuss the implications of their work for classical approaches of extreme flood estimation methods. I think they could discuss how their results corroborate (or not) past findings from comparative studies of flood estimation methods. I was thinking for example about the Extraflo project (Lang et al., 2014, https://doi.org/10.1051/lhb/2014010) in which a large range of flood estimation methods were compared, in gauged and ungauged conditions, using statistical approaches or methods based on continuous or event-based hydrological modelling. Other studies also attempted to compare methods (e.g. Okoli et al., 2019, https://doi.org/10.2166/nh.2019.188, and references therein).

Thank you for these references, we will carefully read them and include if appropriate.

References

Gupta, A., & Govindaraju, R. S. (2023). Uncertainty quantification in watershed hydrology: Which method to use?. Journal of Hydrology, 616, 128749.

Thébault, C., Perrin, C., Andréassian, V., Thirel, G., Legrand, S., & Delaigue, O. (2024). Multi-model approach in a variable spatial framework for streamflow simulation. Hydrology and Earth System Sciences, 28(7), 1539-1566.

Viviroli, D., A.E. Sikorska-Senoner, G. Evin, M. Staudinger, M. Kauzlaric, J. Chardon, A.-C. Favre, B. Hingray, G. Nicolet, D. Raynaud, J. Seibert, R. Weingartner & C. Whealton (2022). Comprehensive space-time hydrometeorological simulations for estimating very rare floods at multiple sites in a large river basin. Natural Hazards and Earth System Sciences, 22(9), 2891–2920. doi:10.5194/nhess-22-2891-2022.

Weingartner, R., & Aschwanden, H. (1992). Abflussregimes als Grundlage zur Abschätzung von Mittelwerten des Abflusses. In Hydrologischer Atlas der Schweiz. (Vol. Tafel 5.2). Bern.