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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Do small and large floods have the same drivers of change? A regional attribution analysis in Europe" *by* Miriam Bertola et al.

Anonymous Referee #2

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The manuscript addresses an important and popular topic in statistical hydrology: how and why are floods changing? General: The paper is well written and rooted in the literature. Flood attribution in this study is limited to three drivers, and the focus is on which physical process is relatively more important (as compared with other studies which have attempted to attribute floods to many different processes, e.g. Schlef et al 2019). I think the paper presents an interesting analysis, though I think its main conclusions and results are not well interpreted for the general scientific community, limiting the applicability and generalizability of the work. I give specific details in this review. The manuscript's results do not convince me of the conclusions - maybe it is in the presentation - but I am not really convinced that the conclusions about the

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observed flood changes are valid. Without sufficient validation of the approach, its unclear if the method performed as expected. For example, in choosing out a case from the dataset, can we validate that in fact within a region, extreme precip increased and floods increased for a q2 or q100 return period (not from spatial difference / relative contribution plots, but from actual time series and data within that region?

Introduction: While I agree in general that focusing on the mean/median can mask changes in the various return periods of a flow distribution, the mean is also traditionally an indicator of changes within the distribution and thus is an important piece of the story on how nonstationarity may be impacting a particular basin. Also after reading the paper, I am not certainly convinced that extreme precipitation is well aligned with the 100-yr event and would like to see more on the bounds of the 2 and 100 yr return periods. Speaking of return periods: in the spirit of helping to change the conversation from return periods to a more meaningful statistic, like reliability, I would recommend reframing the need to examine changes in floods from 'return period based' to something more robust. At the very least, return period must be well defined at the start of this paper: When the authors refer to return period in the manuscript, I think they mean "average return period" (e.g. Read and Vogel, 2015). Additional issues with the use of return period here: Please describe how the formulation of 2.1 holds true when p = 1/T is no longer valid..). Can the Gumbel parameters be inferred from the 2- and 100-yr floods if the distribution is changing? I do not follow why the method for extreme precipitation was used. I am assuming there is a reason that this was made more complicated than pairing the flood data with the rainfall data in a more straightforward way. In using the average occurrence day, is there a chance that the actual highest precip/flood days are left out of the analysis (for example if they do not occur within the average window)?

Lines 270-272: With regard to elasticities specifically, why was a decadal % used to identify drivers? In the results generally, the interpretations of the individual elements are limited. For example, 273 "Extreme precipitation contributes positively to flood

changes in northwestern and central Europe, and negatively in southern and eastern Europe". Also 276-77: "The contributions of snowmelt to changes in q2 and q100 are predominantly negative and marked in Eastern Europe, with small differences towards smaller contributions in absolute values with return period". Its a bit of work for the reader to translate this, using Fig 5. Put this in terms that are clearly translatable. This issue persists throughout the results, and clarification could especially be helpful in regard to the elasticities discussion. Translate elasticity into the meaningful metric that it is (e.g. in lines 286-88, an elasticity of zero indicates XXX).

Again, in 4.2, the results are restated, but are not communicated in a way that is useful for an audience. Take it a step further to explain how the sign/magnitude of the changes/relative contributions are meaningful in the context of the problem this manuscript is addressing. The Conclusions (4.4) really offer no further insight for the reader than the results. Suggest revising this to focus on implications.

Minor Comments: Fig 8: why use a hypothetical catchment instead of select from those available within the study region? lines 345, 348 spell out numbers below ten.

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