

Response to comments of Reviewer 2

March 9, 2022

Thank you very much for your positive comments about our work. You can find below our response to your comments.

General comments: The manuscript gives a nice overview of state-of-the-art methods for regionalization of precipitation, with a clear aim of comparing and evaluating these methods. Comparison strategy and evaluation criteria seem adequate and the different methods' strengths and drawbacks are well presented. The manuscript would however benefit from a clearer structure (especially of Chapter 3) and a more concise language (see below).

Response: We are glad to hear that the reviewer find our manuscript interesting. We clarify below some of the points raised by the reviewer and will make the corrections in the revised manuscript.

1 Specific Comments

- *Chapter 1 Introduction: It could be stated more clearly what potential practical uses and benefits of such methods are, besides "modeling the whole range of positive precipitation"*

Response: We will clarify more on this in the revised manuscript. We will point out that modelling the whole range of precipitation has various practical applications. For instance in flood risk assessments, where stochastic precipitation generators are used to simulate long series of positive precipitations, extremes included, e.g. in [3]. The simulated precipitation is then used as input to conceptual hydrological models for simulation of long series of river discharge. Other practical applications are in the evaluation of numerical weather simulations or investigation of climatology of rainfall events as outlined by [1]

- *Chapter 2: Could you please comment on the histogram in Figure 1; why the large number of stations in Switzerland in 1900-09 for instance?*

Response: The histogram in Figure 1 of the manuscript summarizes the data available for this study. It simply shows the number of gauges installed (or at least with records starting) in each decade. The large number of stations in Switzerland in 1900-09 simply reflects the fact that a lot of stations (more than 150) were installed within that decade. The same is highlighted on the map of the same figure, orange to dark red colored stations (> 100 years) are mostly located in Switzerland.

- *Chapter 3: It is unclear what the difference is between "methods of regionalization" and "regional models". I would prefer moving Table 1, and maybe the whole chapter 3.5 to the beginning, as an introduction to the models, and then describe details in the sub-chapters. Also consider adding a column to Table 1, naming the section where the model is described. You could also mark clearly in the text whenever one of the 5 models is described/introduced, since only number 5 has its own sub-chapter. I believe repetition, for instance in the summary at the end of chapter 3.2 and chapter 3.3, is a bit confusing. Could you rather base your description on the steps of the summary?*

Response: We agree with the reviewer that the difference between the two is not necessarily very clear.

To clarify, "methods of regionalization" as used in our work refers to the three different approaches to regionalization i.e. i) Regional frequency analysis based on the upper tail behaviour, ii) Region of influence approach (ROI), and iii) Spatial method using generalized additive model (GAM) forms.

The "regional models" are the four models developed based on the the three outlined methods of regionalization as applied to the Extended Generalized Pareto Distribution (EGPD) of [4].

One model each based on the first and the last method of regionalization, and two models based on the ROI method. The fifth model is the EGPD without regionalization.

We will also review and revise the chapter to make the presentation of the approaches more clear and concise.

- *Chapter 5: The first five paragraphs (lines 337 - 356) describe the method and should be moved to a previous chapter. Would you please comment on the seasonal differences in Figure 3 (chapter 5.2).*

Response: We agree that this paragraph describe the method and we will move it accordingly in the revised manuscript.

The seasonal differences in Figure 3 of the manuscript is evident from the marked seasonality as well as the spatial variability of daily precipitation in Switzerland. We recall that the identification of the regions for each station is based on the homogeneity of the scaled extremes. The occurrence of these extremes and their quantity, which affects the test of homogeneity ([2]) depend on the season, and hence the observed seasonal differences.

2 Technical corrections

- *There are several examples of unclear language and wordy sentences. I have listed the most obvious ones below, but I recommend a full language review.*

Response: We thank you for noticing these and we will do a full language review of the manuscript to identify and correct/rephrase them as well as others.

References

- [1] Juliette Blanchet et al. “Mapping rainfall hazard based on rain gauge data: an objective cross-validation framework for model selection”. en. In: *Hydrology and Earth System Sciences* 23.2 (Feb. 2019), pp. 829–849. ISSN: 1607-7938. DOI: [10.5194/hess-23-829-2019](https://doi.org/10.5194/hess-23-829-2019). URL: <https://hess.copernicus.org/articles/23/829/2019/> (visited on 04/19/2021).
- [2] G. Evin et al. “A regional model for extreme rainfall based on weather patterns subsampling”. en. In: *Journal of Hydrology* 541 (Oct. 2016), pp. 1185–1198. ISSN: 00221694. DOI: [10.1016/j.jhydrol.2016.08.024](https://doi.org/10.1016/j.jhydrol.2016.08.024). URL: <https://linkinghub.elsevier.com/retrieve/pii/S0022169416305145> (visited on 08/25/2021).
- [3] Guillaume Evin, Anne-Catherine Favre, and Benoit Hingray. “Stochastic generation of multi-site daily precipitation focusing on extreme events”. en. In: *Hydrol. Earth Syst. Sci.* (2018), p. 18.
- [4] Philippe Naveau et al. “Modeling jointly low, moderate, and heavy rainfall intensities without a threshold selection”. en. In: *Water Resources Research* 52.4 (Apr. 2016), pp. 2753–2769. ISSN: 00431397. DOI: [10.1002/2015WR018552](https://doi.org/10.1002/2015WR018552). URL: <http://doi.wiley.com/10.1002/2015WR018552> (visited on 08/25/2021).