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Detailed Responses to Reviewer 3's Comments

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First, we would like to thank the three reviewers for their thorough review and relevant comments and suggestions. Based on their feedback and recommendations, we notably adjusted the structure of the paper and added numerous clarifications. The modifications in the revised version of the manuscript are highlighted in blue. Below are detailed responses to all of Reviewer 3's comments.

Interesting paper. However, I feel it may become more of use with additional investigations of refinements needed to the method that has been proposed. See my comments below.

1. l125: Is $EP_{\max}$ defined for a calendar day for nearby regions or defined as the maximum at that point location? Equation 1 referred to $PW_{\max}$ which is the atmospheric moisture. $EP_{\max}$ is I suspect the same but should be consistent or else defined. If non-seasonal, please refer to WMO guidelines for seasonal variations in PMP.

   Precipitable water should be written as $PW_{\max}$ and not $EP_{\max}$ throughout the paper; this has now been corrected. To answer your question, $PW_{\max}$ is defined as the maximum at that specific location. This has been clarified in the revised version, and we have also referred to the WMO guidelines regarding seasonal variations. Thank you for the suggestion.

2. l140 - interesting. However, the sampled r_i are non-iid, which complicates their use in defining the Beta distribution I think. Plus, there is an assumption that the sampled r_i has an upper limit of 1. Given this limiting value will dictate/influence the PMP estimate, the uncertainty associated with this assumption is important to characterize.

   It is true that the sampled r_i are not iid. Typically, for precipitation in the considered location, autocorrelation exists in daily non-zero precipitation series, but it is very weak and short-range. We believe that the impact of this very small dependence is quite limited compared to the overall sampling uncertainty, which already results in very large uncertainty in the parameter estimates. For example, the autocorrelation estimate for the non-zero precipitation series recorded in Montréal is 0.0092 for a lag of one day, and 0.0095 for the St-Hubert station. These values have been added to Table 1 to demonstrate that dependence is weak for the data considered. However, in regions where autocorrelation is stronger, it should be accounted for.

In this paper, the analysis is restricted to summer precipitation (from May to October inclusive) to minimize the effects of seasonality. While some seasonality may still exist, it appears negligible compared to the natural variability of precipitation and precipitable water as shown in Figure 1. We have added these figures to the revised version of the manuscript.

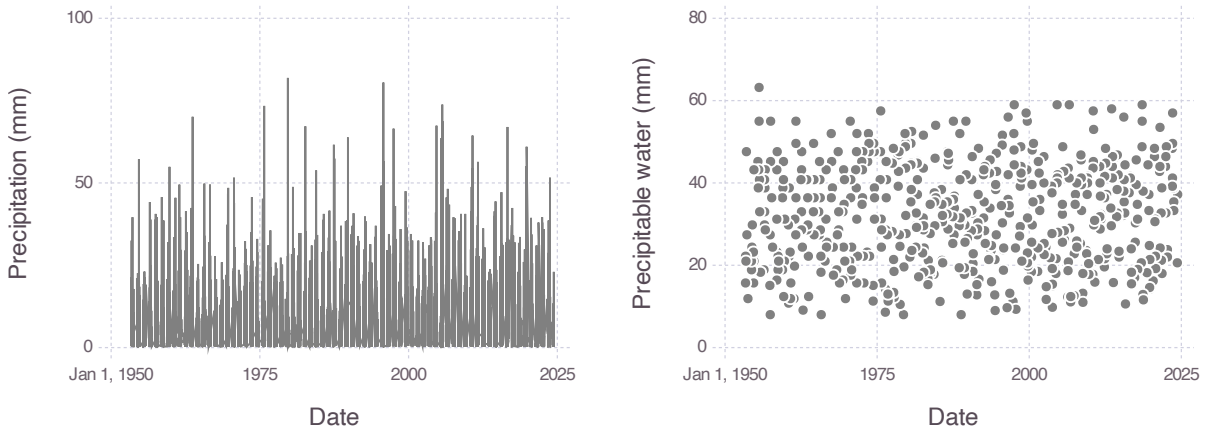
3. Also, how can stationarity be assumed given there is a clear temporal trend in precipitable water time series. Would violation of the stationarity assumption distort the beta distribution parameters?

   Yes, non-stationarity in precipitable water and/or in precipitation would distort the Pearson Type I distribution. For the considered observed data, there is no evidence of a trend in either the precipitable water and precipitation, as shown in Figure 1. This is due to the natural variability of these variables.

   Non-stationarity might be present in long series of simulated data from a climate model. In such cases, Eq. (6) should be extended to account for non-stationarity by allowing either or both the PMP and the ratio to evolve over time. In the context of the Pearson Type I distribution, this involves allowing the upper bound and the shape parameters to vary with time. This discussion has been added to the revised version of the manuscript.

4. l375 - The authors recommendation makes sense. In addition to the issues they have mentioned, I also feel that the lack of independence (unless they parameters are being fitted using iid data above a threshold) and the presence of a trend are limiting factors. I wonder if using a nonstationary model and regional data can help overcome these limitations.

   Thank you. We agree that a regional model could potentially help in the estimation of the PMP. Such an approach would involve modelling the spatial dependence between precipitation at multiple sites. In future work, we plan instead to focus on spatial modelling of extreme precipitation within the framework of extreme value theory.



(a) precipitation

(b) precipitable water

Figure 1: Time series of (a) daily precipitation and (b) precipitable water for the top 10% of storms recorded at the Montréal station.