

Review HESS-egusphere-2025-3073

Climatology and trends of observed daily and hourly extreme precipitation in the French Alps

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Recommendation: acceptable after minor revisions.

Major Comments

To my regret, the authors have preferred to estimate yearly return levels from annual maxima, rather than derive them from the seasonal distributions, despite agreeing with my considerations on “purely theoretical grounds”. They argue that it is uncertain how well the derived return levels perform (presumably in terms of closeness to the empirical estimators), use the relative influence of different weather patterns to infer that the seasonal maxima come from the same distribution, invoke error propagation and high computational costs, and present trials in which the difference in return levels (stationary) and trends (non-stationary) between the two methods are essentially not very large.

I do not agree with the authors’ presentation of the numerical derivation of the yearly return levels as an “alternative method”. On the contrary, it is the theoretically robust method, and in their particular case, perhaps because they opted to work with a relatively low return period of 20 years, the results happen to be similar.

Unless the authors can show that the hypothesis that the seasonal maxima of different seasons come from the same distribution cannot be rejected (which seems unlikely given the difference in dominant precipitation processes between winter and summer), the yearly maxima cannot be assumed to follow a GEV. The readers should explicitly be made aware of this. In my view, the methods section should present the theoretically robust method, and the author’s reason to depart from it, given that they in fact have the means to derive these yearly return levels from the seasonal distributions. Possible consequences for the interpretation of the results should be discussed in the discussion section.

To accept this paper for publication, I insist on the following:

- In section 3.2.1
 - o explain that if the monthly (seasonal) maxima are not from the same distribution, the seasonal (yearly) maxima cannot be assumed to follow a GEV distribution. This should be mentioned explicitly. It must be clear to the readers that the authors must justify their assumption that the seasonal (yearly) maxima follow a GEV.

- explain that if the seasonal (yearly) maxima do not follow a GEV, the seasonal (yearly) return levels should be derived numerically from the monthly (seasonal) distributions rather than fitting a GEV to the seasonal (yearly) maxima.
 - Indicate that this method was not pursued, and the authors' reasons for this choice.
 - Indicate that the possible consequences for the interpretation of the results will be examined in the discussion.
- In section 5.1.3 the following points, at least, need to be explained and/or discussed.
- Deriving yearly return levels from the seasonal distributions is theoretically correct and is the more robust approach.
 - Not deriving the return levels for the stationary analysis is probably of minor importance, as the uncertainties are large. On the other hand, it can be critical for the long-term trends. Indeed, not only do these rely on the exact value of the return level without taking into account its uncertainty, but the position of the return value on the timeline is relevant. In addition, the significance of the trends can be affected.
 - According to Extreme Value Theory, the maxima must be taken over a large enough number of iid values to justify the use of the GEV approximation. Therefore, confidence may be greater in assuming that the seasonal maxima (based on approximately 90 values) follow a GEV than the monthly maxima (based on approximately 30 values). This supports the authors' choice to estimate seasonal return levels from seasonal maxima, rather than deriving them from monthly GEV distributions.
 - While the month-to-month distribution of weather types does not negate the assumption that precipitation measurements in months of the same season, characterized by similar physical processes, follow the same distribution, the same cannot convincingly be argued for different seasons in which precipitation processes are known to be different. Thus, it is doubtful that, for instance, winter and summer hourly or daily precipitation are iid.
 - The results are similar when estimating yearly return levels from yearly maxima and when deriving them from the seasonal distributions for a return period of 20 years. The readers should be made aware that this similarity may no longer hold for higher return periods or a change in analysis period.

Minor Comments

A few of the changes to the manuscript seem to have been hastily added, as they disrupt the logical thread of the text, or deprive it from its support in the literature (see lines 340 and 422).