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The Exact Distribution of Associated Extremes in Hydrology

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Editorial

The study of hydrological extremes has a long history in research that has been used to the design and administration of water delivery and flood-control projects. Gumbel 2019 American Geophysical Union, nearly half a century after the initial pioneering empirical investigations. All intellectual property rights are reserved. (1958) developed a framework that connected the theoretical properties of extreme value probability to the empirical base of hydrological frequency curves. Extreme value theory (EVT) applied to hydrological assessments has been a hot topic in the literature since then.

1. They should resemble samples of random variables that are independently and identically distributed (i.i.d.). Then, from a stationary distribution, extreme occurrences emerge that are unrelated to one another.

2. They should be in vast numbers. The properties of the parent distribution from which the extreme values are drawn, as well as the degree of precision we need, are used to determine how large they should be.

Most of these assumptions, which are prevalent in traditional statistical analysis, are rarely realised in hydrological applications, particularly when studying extremes.

Traditional hydrological extremes analysis is based on statistical samples that are created by selecting values from the complete data series that can be considered as realisations of independent extremes, such as annual maxima or peaks exceeding a specific high threshold. As a result, many observations are eliminated, and the already short size of conventional hydrological records has a considerable impact on the estimates' trustworthiness. The fact that observed hydrological extremes tend to cluster in time strengthens the case for using the POT sampling method rather than block maxima techniques, which tend to disguise dependence. This sort of clustering reflects reliance (at least) on the nearby excesses of a threshold, invalidating the basic in classical POT analysis; the assumption of independence is made. As a result, the norm in case studies, the approach is to set a (rather subjective) high threshold and then filter the results. Clusters of exceedances in order to obtain a set of observations that can be declared mutually exclusive independent.

Such a delustering procedure entails using empirical rules to define clusters (for example, setting a run length that represents a minimum timespan between consecutive clusters, implying that a cluster ends when the separation between two consecutive threshold exceedances is greater than the fixed run length) and then selecting only the maximum excess within each cluster, resulting in a wasteful recursive procedure. We hope to resolve these issues in this work by examining the actual distribution of connected extremes. As a result, we can set significantly lower thresholds than in typical POT studies and avoid delustering procedures whose efficiency is put into question if process features are not taken into consideration. The proposed technique sheds fresh light on probabilistic approaches developed for extreme value analysis while taking the clustering dynamics of the 2019 American Geophysical Union into account. All intellectual property rights are reserved. It is consistent with the overall notion of permitting maximum information utilisation. In summary, asymptotes or limiting extreme value distributions have been widely employed in hydrological applications, although precise distributions are rarely employed in stochastic hydrology because their evaluation needs knowledge of the parent distribution. However, due to the small size of common hydrological records (e.g., a few tens of years) and the impact of correlations on the information content of observed extremes, empirical evidence cannot be provided with enough precision to predict limiting extreme value distributions. As a result, we feel that modelling attempts to reach analytical answers for extremes caused by linked systems should be given additional study attention.

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