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How to a priori select ordinary distributions in flood frequency analysis when applying the Metastatistical Extreme Value approach

Sumra Mushtaq, Arianna Miniussi, Ralf Merz, and Stefano Basso
Helmholtz Centre for Environmental Research - UFZ, Department of Catchment Hydrology, Germany
(stefano.basso@ufz.de)

Standard flood frequency analyses hinge on unrealistic asymptotic assumptions, use a small portion of the data available (annual maxima or a few values above a high threshold only), and are ill-suited for short time series. Lately, the Metastatistical Extreme Value Distribution (MEVD) has gained momentum in the study of extremes, as it relaxes the assumptions on which traditional methods are based and makes a more effective use of the information at hand. Moreover, it is more flexible in the choice of the distribution of the ordinary events (i.e., events belonging to the bulk of the distribution, in contrast to annual maxima), hence giving room for selecting the statistical method that better describes the data.

In this work, we leverage the flexibility of the MEVD and develop an approach to a priori select the distribution of ordinary peaks according to the ratio between their empirical 99th and 90th percentiles, and apply it to daily mean streamflow time series from 183 gauges in Germany. Based on the value of this ratio, we choose either the Generalized Gamma or the Log-Normal distributions to describe ordinary peaks that show lighter or heavier tails respectively. This distinction allows us to improve the estimation of the magnitude of floods with high return periods in 117 basins of a 64 % on average and to reduce under-/over-estimation issues, when compared to a MEVD application in which the ordinary distribution is chosen regardless the tail features of the underlying data.