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R-tools for estimating exceedance probabilities of Envelope Curves of hydrological extremes

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Envelope curves of flood flows are classical hydrological tools that graphically summarize the current bound on our experience of extreme floods in a region. Castellarin et al. [2005] introduced Probabilistic Regional Envelope Curves (PRECs) and formulated an empirical estimator of the recurrence interval T associated with the curves themselves. PRECs can be used to estimate the T-year flood (design-flood) for any basin in a given region as a function of the catchment area alone. We present a collection of R-functions that can be used for (1) constructing the empirical envelope curve of flood flows for a given hydrological region and (2) estimating the curve's T on the basis of a mathematical representation of the cross-correlation structure of observed flood sequences. The R functions, which we tested on synthetic regional datasets of annual sequences characterized by different degrees of cross-correlation generated through Monte Carlo resampling, implement the algorithm proposed in Castellarin [2007], providing the user with straightforward means for predicting the exceedance probability $1/T$ associated with a regional envelope curve, and therefore the T-year flood in any ungauged basin in the region for large and very large T values. Furthermore, the algorithm can be easily coupled with other regional flood frequency analysis procedures to effectively improve the accuracy of flood quantile estimates at high T values [Guse et al., 2010], or extended to rainfall extremes for predicting extreme point-rainfall depths associated with a given duration and recurrence interval in any ungauged site within a region [Viglione et al., 2012].

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