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Does seasonality impact the distribution of rainfall extremes?

P. Allamano, F. Laio, and P. Claps
Politecnico di Torino, DITIC, Torino, Italy (paola.allamano@polito.it)

Rainfall often exhibits marked periodic variability on annual time scales. As a consequence, also the corresponding extreme values will likely be dependent on the non-homogeneity of their occurrences. Accounting for the seasonal character of hydroclimatic extremes in determining their design values is a somewhat obscure problem for engineers. We devise a simple stochastic model in which rainfall extremes are produced by a non-homogeneous extreme value generation process; the design values are estimated (in closed analytical form) both in a peak over threshold framework and by using the standard annual maxima approach. In this completely controlled world of seasonal hydrological extremes, a statistical measure of the error associated to the adoption of a homogeneous model is introduced. The sensitivity of this measure to the typology and strength of seasonality is investigated. We find that seasonality induces a downward bias in design value estimators. The magnitude of the bias may be large when the peak over threshold approach is adopted, while the return period distortion is limited when the annual maxima are considered. An application to daily rainfall data from a 30000 Km^2 region in North-Western Italy is presented.