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Multivariate Extreme Value models in hydrology: a copula approach

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Multivariate Extreme Value models are a fundamental tool in hydrology in order to assess potentially dangerous events. For instance, the analysis of the 2003 severe drought event, or of the 1994 catastrophic food event, occurred over the Po river basin (Northern Italy) cannot be addressed completely by considering only the data collected at a single river section, e.g. at Pontelagoscuro gauge station close to the outlet.
As frequently stressed in hydrologic literature, the statistical analysis of multivariate extremes is difficult, essentially due to (1) the complexity of the phenomena, (2) the reduced sample size of the actual multivariate datasets, and (3) the availability of suitable multivariate probability distributions.
The target of this work is twofold. On the one hand we outline how, exploiting recent theoretical developments in the theory of Copulas, new models can be easily constructed: in particular, we show how a suitable number of parameters, having a physical meaning, can be introduced, a feature not shared by traditional Extreme Value models. On the other hand, we suggest several strategies in order to estimate the parameters of interest according to different criteria: these may use either a nearest neighbour or a nearest cluster approach, or exploit the pair-wise relationships between the available gauge stations. An application to food data is also illustrated and discussed.