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# Information entropy concepts for collective flooding hazard model selection

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To properly describe the flood hazard component represents a serious challenge, also when compared to the quantification of vulnerability and exposure, i.e. the other elements determining the risk. This is especially true in case of catastrophal insurance, where the cost of the economic capital that must be reserved against potential catastrophes can be significant, even compared to the expected loss. This is particularly the case for international reinsurers underwriting the less frequently affected, but potentially very costly, upper layers of catastrophe eXcess Of Loss (XOL) reinsurance.
In the present contribution, the multivariate skew-t distribution and the copula function are employed to describe the joint probability distribution able to describe the simultaneous flood hazard in a high dimensionality framework: eighteen nested and non-nested gauging stations within the Upper Mississippi River basin. To properly describe the Mississippi river floods – an extraordinary concentration of risks subject to frequent flood episodes – represents a challenge for the technical and scientific community in terms of risk scenarios assessment.
From the statistic viewpoint, one could emphasize that, while copulas have been widely used in the modelling of hydrological processes, the use of the skew-t distribution in hydrology has been only recently proposed (Ghizzoni et al., 2010, Adv. Water Resour., 33, 1243–1255). Once a flood event is defined, and the extreme time series derived, both methods are applied to reproduce the multivariate statistics of the time series, as well as the characteristics of the marginal distributions. Advantages and drawbacks of both methods are analyzed and results compared in terms of the capability of simulated time series in reproducing the observed one. Unfortunately, describing multivariate joint distributions of flood events, no quantitative goodness of fit test is available to help in selecting the best model. In this work the principle of minimum cross-entropy (Shannon, 1948, Bell System Tech. J., 27, 379-423 and 623-656; Kullback, 1959, On Information theory and statistics, Wiley, NY, 399 pp) is used to compare model's results. Even though the principle of minimum cross-entropy is not a quantitative goodness-of-fit test, one can assume that, at least, it represents a first effort for the identification of the best joint behavior model. Results confirm the ability of both the copula and the skew-t approaches in providing a consistent description of the flooding processes and its correlation structure, as described by the available flood discharge measurements.