



Fully nested 3-copula in multivariate flood frequency analysis

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In hydrological studies, the univariate flood frequency analysis is widely used. In fact, in order to define the relationship hydrographs - return period, only flood peak or flood volume is statistically analyzed. However, the three main characteristics of flood event (peak, volume and duration) are often required. To fully understand these variables and for a their appropriate use, a multivariate statistical approach is necessary. The main aim is to define the trivariate probability density and cumulative distribution functions. When the joint distribution is known it is possible to define the bivariate distribution of volume and duration, conditioned to the peak. Consequently volume-duration couples, statistically linked to peak values, will be available. This paper proposes to build trivariate joint distribution of flood event variables using the so-called fully nested or asymmetric Archimedean 3-copula functions. Properties of this copula class and extensive simulations are described in order to highlight differences with the well-known symmetric Archimedean copulas. Asymmetric distributions are applied to observed flood data. Finally, results are compared with those obtained using distributions built with symmetric copula and standard Gumbel logistic model. This study confirms that using marginal distributions of same family for all analysed variables is a too strict condition in multivariate analysis, and for particular dependence structures it is useful to model the analyzed quantities by a flexible asymmetric model.