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# Accumulation risk assessment for the flooding hazard

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One of the main consequences of the demographic and economic development and of markets and trades globalization is represented by risks cumulus. In most cases, the cumulus of risks intuitively arises from the geographic concentration of a number of vulnerable elements in a single place. For natural events, risks cumulus can be associated, in addition to intensity, also to event's extension. In this case, the magnitude can be such that large areas, that may include many regions or even large portions of different countries, are stroked by single, catastrophic, events.

Among natural risks, the impact of the flooding hazard cannot be understated. To cope with, a variety of mitigation actions can be put in place: from the improvement of monitoring and alert systems to the development of hydraulic structures, throughout land use restrictions, civil protection, financial and insurance plans. All of those viable options present social and economic impacts, either positive or negative, whose proper estimate should rely on the assumption of appropriate - present and future - flood risk scenarios. It is therefore necessary to identify proper statistical methodologies, able to describe the multivariate aspects of the involved physical processes and their spatial dependence.

In hydrology and meteorology, but also in finance and insurance practice, it has early been recognized that classical statistical theory distributions (e.g., the normal and gamma families) are of restricted use for modeling multivariate spatial data. Recent research efforts have been therefore directed towards developing statistical models capable of describing the forms of asymmetry manifest in data sets. This, in particular, for the quite frequent case of phenomena whose empirical outcome behaves in a non-normal fashion, but still maintains some broad similarity with the multivariate normal distribution. Fruitful approaches were recognized in the use of flexible models, which include the normal distribution as a special or limiting case (e.g., the skew-normal or skew-t distributions).

The present contribution constitutes an attempt to provide a better estimation of the joint probability distribution able to describe flood events in a multi-site multi-basin fashion. This goal will be pursued through the multivariate skew-t distribution, which allows to analytically define the joint probability distribution. Performances of the skew-t distribution will be discussed with reference to the Tanaro River in Northwestern Italy. To enhance the characteristics of the correlation structure, both nested and non-nested gauging stations will be selected, with significantly different contributing areas.