Flood scenarios: an introduction to financial and insurance perspectives

To cope with the flooding hazard, 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: a quantitative event description in terms of i) the flood hazard, with its probability of occurrence, extension, intensity, and duration, ii) the value of the exposed elements and iii) their vulnerability. It is therefore necessary to identify proper methodologies, able to describe the chief aspects of the involved physical processes and their spatial dependence.

Multisite flooding hazard assessment in the Upper Mississippi River

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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 limited 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). In this context, copula as well can be viewed as alternative and flexible tools for dealing with multivariate simulations*.*

The present contribution constitutes an attempt to provide an 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 and the copula function. Performances of both methods will be discussed with reference to the Upper Mississippi River. To enhance the characteristics of the correlation structure, both nested and non-nested gauging stations will be selected, with significantly different contributing areas. Such conditions represent a challenge for both the skew-t and the copula approach. In perspective, the ability of such approaches in explaining the multivariate aspects of the relevant processes is needed to specify flood hazard scenarios in terms of their intensity, extension and frequency. When this is associated to the knowledge of location, value and vulnerability of exposed elements, comprehensive flood risk scenarios can be produced, and risk cumuli quantified, for given portfolios, composed of wherever located risks.