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A View to Spatially and Temporally Coherent Extremes from Aggregate Loss Prospective

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Flood is the most frequent and one of the costliest perils and, as such, the realistic and statistically consistent simulation of its driving force, the extreme precipitation field, is of particular importance. In the context of collective flood risk assessment and the corresponding aggregate economic losses, it is even more important to preserve the coherence of simulated rainfall extremes. This is because the aggregate losses are determined by the interplay between the spatial-temporal clustering of extreme rainfall intensities, the physiography and the population density.
The stochastic simulation of a rainfall field at large scale is particularly challenging task on its own. The reason for this is that the size of a typical low pressure system extents up to several thousand kilometers, while the typical coverage of area affected by rainfall within the storm system is usually of the order of several hundred kilometers. Consequently, the correlation length of covariance functions obtained through rainfall data analysis is also in the order of several hundred kilometers (typically without detecting a long negative correlation range, especially as the number of data used for the analysis increases). The random fields resulting from the use of such correlation functions may overestimate by far the coverage of areas with extreme precipitation whenever the scale of simulation exceeds twice the correlation length. On the top of this, there is a clear evidence that the coherence of rainfall fields depends on the local rainfall intensity, which introduces non-Gaussian (or non-linear) dependence especially at short space-time scales.
In this talk, a new recursive simulation of rainfall with intensity dependent covariance will be reported, which overcomes the problem of non-Gaussian dependence. However, even with the type of correlation and local rainfall distributions preserved through a spatial copula approach, the spatial coverage of extreme rainfall is still overestimated, when compared with observations and NWP model simulations. To show this discrepancy, a new measure is introduced, specifically designed to quantify the performance of large-scale rainfall simulations.