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Stochastic simulation of daily rainfall fields conditioned on both regional and local Information

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Hydrology at the basin scale needs precipitation at very high resolution, both in space and time, as an input variable for the study of such processes as local-scale spatially-distributed runoff generation, groundwater recharge, etc. Several methods have been developed to represent rainfall at varying space-time scales and in a physically realistic way. For example, GCMs, RCMs, LAMs and reanalysis or forecast systems use physical representations of precipitation generation processes, although in all these cases the smaller-scale (sub-grid resolution) generation processes are parameterized. The main strength of these models is their ability to simulate the patterns of atmospheric circulation (ACP) having direct impact on the rainfall generation mechanism. However, from a hydrological point of view, they do not currently simulate precipitation with sufficient accuracy and spatial resolution. The precipitation estimates are often severely biased, and the predictive (i.e. forecast) time-scales are very short.

In this talk we present a stochastic method for generating daily spatially distributed rainfall field simulations. The method takes advantage of several sources of information to generate random spatially correlated rainfall fields using a geostatistical framework. The conditioning information includes: (1) Historical rainfall measurements at available gage locations, (2) knowledge of dominant synoptic-scale ACP's provided by reanalysis or forecast systems (e.g., NCEP, ERA40), and (3) local topography. The primary assumption is that the availability of moisture is determined by the synoptic-scale ACPs in each season, and that the local generating mechanism (the probability distribution function and spatial correlation structure of precipitation for each ACP type in each season) is invariant and determined by local factors such as topography.

A case study for the Upper Guadiana basin (Spain) shows that the method accurately reproduces various spatio-temporal characteristics of precipitation that are important for hydrological analyses.