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On the generation of stochastic simulations of rainfall in space and time for hydrological applications

Alan Seed
Australian Bureau of Meteorology, Melbourne, Australia

Stochastic simulations of rainfall in space and time are required for modelling the impact of the spatial and temporal distribution of rainfall on the hydrological response of a catchment. Rainfall forecasts have significant uncertainty at the space and time scales of most catchments, and therefore large ensembles of rainfall forecasts are required as forcing for ensemble hydrological prediction systems.
The statistical properties of rainfall are strongly dependent on scale in both space and time, and this signature characteristic has important implications for hydrology. The Short Term Ensemble Prediction System (STEPS) uses a multiplicative cascade to model the spatial distribution of rainfall and a hierarchical second order auto-regressive model (AR2) to simulate the temporal evolution of rainfall in Lagrangian coordinates.
STEPS was developed to generate large ensembles of rainfall forecasts that are conditioned on observed and rainfall forecasts from Numerical Weather Prediction (NWP) models. The conceptual framework has also been used to generate ensembles of design storms, down-scaled climate model and low-resolution NWP rainfall fields, and blended radar, satellite, and NWP rainfall fields.
This paper will present the basic theoretical frame work for STEPS and provide examples of the various applications.