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Modeling rainfall distribution using a thresholded transformed latent Gaussian process

L.S. Tøfte (1), H. Rue (2)

(1) Sintef Energy Research, Trondheim, Norway (lenat@sintef.no), (2) Norwegian University of Science and Technology, Trondheim, Norway

There is a great need for spatio-temporal modelling of precipitation as input data to hydrological models. Traditional methods for precipitation interpolation has an unsatisfactory way of recreating areas with no rainfall. The development and increasingly use of area distributed models and energy balanced equations, requires a more correct calculation of both the amount and distribution of precipitation.

This study demonstrates a method for modeling rainfall using a thresholded transformed latent Gaussian process, used as input for regional calibration of a distributed, hydrological model. Observed rainfall at the gauging stations is transformed to a latent Gaussian variable by the use of a monotonic function. Then stochastic simulation is used to generate realisations of rainfall for each time step in the distributed hydrological model. In the case of rainfall at every gauging station, the transformed rainfall is sampled for each other location conditioned on the observed transformed rainfall. If some or all the gauging stations has no rainfall, a two step algorithm is used. The transformed rainfall variable is sampled at those gauging stations with no rainfall conditioned on those gauging stations with rainfall, until the transformed variables indicate no rainfall. Then the transformed rainfall for each other location conditioned on the observed transformed rainfall is sampled.

The modeled precipitation is used both as input data for regional calibration of a distributed hydrological model, and as the basis of calculating catchment precipitation in a lumped model. Preliminary hydrological simulations show improved results for particularly ungauged basins, and for catchments that have appeared to be difficult to calibrate.