Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09185, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09185
EGU General Assembly 2008

Modelling of daily rainfall for flood risk assessment using a mixed distribution

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Stochastic weather generators are often used in the construction of long time series of rainfall that can be used in conjunction with rainfall-runoff models for risk assessment in the planning of water resources and flood mitigating facilities. The basic requirements of the weather generators used for such purposes are that they be able to reproduce the statistical properties of the historical rainfall series at each site and the spatial covariance structure between sites. Although a single type of distribution has frequently been implemented to model the amount of daily precipitation with seasonally varying parameters, it can sometimes be inadequate to capture some of the statistical properties of the daily rainfall that have relevance to the purpose the model is sought for. In the present work, we demonstrate applicability of a stochastic model for the generation of daily time series of rainfall at multiple locations in which the amount of daily rainfall is modelled by a mixture of two different probability distribution functions. A two stage modelling procedure is implemented. In the first stage, a multivariate autoregressive model is used to model the local probability of occurrence of rainfall and the amount while keeping the inter-site covariance structure using a truncated and power transformed normal distribution. In the second stage, the amount simulated using the power transformed normal distribution is further transformed so that it can be regarded as coming from a mixture of Gamma and Gumbel distribution. Application was made on 122 stations within the Unstrut catchment in Eastern Germany. Results show that the model can fairly well reproduces the monthly mean rainfall and the corresponding variability as well as the extreme value distribution of the annual maximum daily rainfall.