Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08630, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08630
EGU General Assembly 2008

Rainfall temporal downscaling and stochastic generation: scaling and non-scaling approaches

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Here we summarize some recent theoretical and experimental results concerning the temporal correlation structure of rainfall. A wide and recent literature has developed around downscaling techniques. These methods allow to estimate high resolution temporal series or precipitation fields on the basis of coarse resolution output obtained by numerical models. Nevertheless these methodologies concentrate on spatial downscaling, while relatively few attention is put on temporal downscaling of rainfall series, particularly hourly precipitation, that are of principal interest in the hydrological studies. Here we present a new method for downscaling rainfall in time using theoretically-based estimates of rainfall variability at the hourly scales from daily statistics. In particular, we review non-scaling scale relations which imply a non-power-law form of the second order moment. The method is validated on a wide data set representative of different rainfall regimes and produces unbiased estimates of rainfall variance at the hourly scale when a power-law-tailed autocorrelation is used for the rainfall process. We then demonstrate how the downscaling method together with a Bartlett-Lewis rainfall stochastic model may be used to generate hourly rainfall sequences which reproduce the observed small-scale variability uniquely from daily statistics. Finally, we compare the results obtained by the application of our new downscaling method and by a commonly used approach, which assumes a power-law structure of the statistical moments. We show that non-scaling procedures outperform those based on power-law expressions of the statistical moments in the estimation of rainfall variability at the hourly scale on the basis of daily observations.