Geophysical Research Abstracts
Vol. 14, EGU2012-2692, 2012
EGU General Assembly 2012

Improving the extreme value behaviour of Bartlett-Lewis rectangular pulse models

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The use of rainfall time series for various applications is widespread. However, in many cases historical rainfall records lack in length or quality for certain practical purposes, resulting in a reliance on rainfall models to supply simulated rainfall time series, e.g. in the design of hydraulic structures. One way to obtain such simulations is by means of stochastic point process rainfall models, such as the Bartlett-Lewis type of model.

It is widely acknowledged that the calibration of such models suffers from the presence of multiple local minima which local search algorithms usually fail to avoid. To meet this shortcoming, four relatively new global optimization methods are presented and tested for their abilities to calibrate the Modified Bartlett-Lewis Model (MBL). The list of tested methods consists of: the Simplex method, Simplex-Simulated Annealing (SIMPSA), Particle Swarm Optimization (PSO) and Shuffled Complex Evolution (SCE-UA). The parameters of these algorithms are first optimized to ensure optimal performance, after which they are used for calibration of the MBL model. Furthermore, the issue of subjectivity in the choice of weights in the objective function is addressed. Several alternative weighing methods are compared to determine whether or not they influence the simulation results.

The optimization method and objective function which exhibit the best performance are withheld for further research with respect to the extreme value behaviour. The Bartlett-Lewis model is improved through: (1) the introduction of the third order moment in the objective function during fitting, (2) the use of a Gamma distribution, rather than an exponential one, for sampling cell intensity, and (3) the utilisation of a truncated probability distribution for the sampling of cell durations.

The presented research results in practical guidelines for the calibration of the Bartlett-Lewis models. Furthermore, the question whether or not the presented measures actually improve extreme value behaviour will be addressed.