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A new randomised Poisson cluster model for rainfall in time

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The analysis and simulation of rainfall time series on fine time scales require the use of special types of stochastic models. This necessity is justified by the intermittent character of rainfall at these time scales. Among the successful model types are point process models. The purpose of the present study is to examine the behaviour of a new randomized Poisson cluster model for rainfall in time. The new model is free to develop a negative or positive correlation between storm intensity and duration. Two historical time series are used as case studies. The first one is from Denver airport (1949-1976), and the second is the National Technical University of Athens (NTUA) station data (1994-2003).

The complexity of the mathematical model, the introduction of non-analytical relations and the presence of many local optima require the use of a direct search ("global") optimization method. A novel optimization algorithm is developed, while a decomposition approach results in the introduction of several simplifications to the optimization procedure. Additionally, qualitative, semi empirical criteria are developed, to roughly estimate in advance the model efficiency. In the Denver case, the new model achieves a 54% improvement in preserving historical rainfall statistics, in comparison with those of the Random Bartlett-Lewis Model (RBLM). The simulation results (statistics of synthetic series) confirm this conclusion. In the case of the Athens data, the new model also yields a better approximation of the historical statistics (in comparison to the RBLM). However, in simulation mode, it did not provide any improvement due to an unacceptable ratio of negative parameter values. As a result, RBLM is preferable to the new model in the Athens case.