



Stochastic simulation of simultaneous precipitation time series in high temporal resolution for multiple locations

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Hydraulic modelling of urban catchments with large area requires in-depth knowledge of the spatial variability of precipitation. Additionally precipitation data needs to be available in very high temporal resolution, since urban sewage systems usually react very fast on thunderstorms. Generally precipitation data of such quality is not available. Therefore synthetic time series are needed for the design of these sewage systems.

Here a stochastic simulator for time series of precipitation is presented, which generates these time series synthetically for ungauged areas at multiple locations simultaneously. This simulator consists of a generation scheme for simultaneous time series in hourly resolution and a disaggregation scheme to produce synchronous time series in five minutes resolution from the hourly series. A database containing all statistical properties necessary for simulation supplements the system. Statistical properties are regionalised on a grid for the project region of 35 000 km², covering the state of Baden-Wuerttemberg in Southwest-Germany, and include properties like parameters of the gamma distribution, autocorrelation and scaling parameters.

The spatial relationship of the simultaneous time series for the different stations is considered by three different parameters reflecting different phenomena. Cross correlation considers the overall relationship between time series at multiple stations. Simultaneous occurrence of extreme events is considered by an areal reduction factor. Movement and direction of rain fields are taken from radar data and considered as temporal lag of precipitation in the time series at the different locations.

Both schemes use a non-parametric approach based on simulated annealing. Generation starts with the independent simulation of hourly values of precipitation from the gamma distribution for each simultaneous time series. In initial steps each time series is optimized individually by randomly exchanging hourly values within a year's time series. The influence of this exchange is measured with an objective function, which sums the deviation of the time series' statistical properties and the local properties taken from the database. After individual initialisation all time series are optimized simultaneously. Therefore one time series is chosen randomly and two hourly values are exchanged. The results of this exchange are summed up and evaluated in the objective function for the individual and spatial statistical properties. Repeating this procedure several times results in simultaneous time series in hourly resolution. Afterwards these time series are disaggregated to five minutes values following a similar approach. The presentation will include an introduction to the simulation scheme with focus on the generator. Comparisons of the resulting time series with measured time series will demonstrate the successful implementation of the simulator.