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Applicability of stochastically generated synthetic rainfall time series for urban drainage modelling

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For the planning and optimization of urban drainage systems, hydrological and detailed hydrodynamic rainfall runoff models are paramount. These models require long time series (> 20 years) as input which, however, are often not available. Either the measured time series are insufficiently long to provide statistically reliable results to meet the design requirements, or the location of the observational station is too distant from the catchment leading to unrepresentative rainfall characteristics.

The innovative alternative are synthetically generated time series with high temporal and spatial resolution.

The objective of the project SYNOPSE II is to provide nationwide synthetic continuous rainfall time series of any necessary length in a temporal resolution of 5 minutes on a grid of 1 km x 1 km for the design of urban drainage systems in Germany.

Two precipitation models are considered: a parametric stochastic model based on an alternating renewal approach and a non-parametric probabilistic approach. Both models generate point time series for 45 test locations with different climate and rainfall characteristics across Germany with a length of up to 300 years.

For the validation and proof of applicability of the synthetic rainfall time series in the context of urban drainage system design, two urban rainfall runoff models, a Hydrodynamic model for hydraulic performance and a Hydrologic lumped model for combined sewer overflow modelling are used.

The models were adjusted to the local rainfall characteristics of the 45 test locations.
The rainfall runoff results using the synthetic time series are validated individually (considering various performance and design criteria) against the results of two measured rainfall scenarios: (a) Reference scenario: observed rainfall time series; (b) Practice scenario: observed time series of neighboring stations to each test location. The latter is used to quantify the error employing non-catchment-specific rainfall data.

The preliminary results for the two fields of interest demonstrate that for the majority of the 45 test locations the results are in good agreement with the reference scenario and outperform the results of the practice scenario at a still greater number of test locations.