Comparison of different synthetic 5-min rainfall time series on the results of rainfall runoff simulations in urban drainage modelling

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The design of urban drainage systems with numerical simulation models requires long, continuous rainfall time series with high temporal resolution. However, suitable observed time series are rare. As a result, usual design concepts often use uncertain or unsuitable rainfall data, which renders them uneconomic or unsustainable. An expedient alternative to observed data is the use of long, synthetic rainfall time series as input for the simulation models. Within the project SYNOPSE, several different methods to generate synthetic rainfall data as input for urban drainage modelling are advanced, tested, and compared.

Synthetic rainfall time series of three different precipitation model approaches, - one parametric stochastic model (alternating renewal approach), one non-parametric stochastic model (resampling approach), one down-scaling approach from a regional climate model-, are provided for three catchments with different sewer system characteristics in different climate regions in Germany:
- Hamburg (northern Germany): maritime climate, mean annual rainfall: 770 mm; combined sewer system length: 1.729 km (City center of Hamburg), storm water sewer system length (Hamburg Harburg): 168 km
- Brunswick (Lower Saxony, northern Germany): transitional climate from maritime to continental, mean annual rainfall: 618 mm; sewer system length: 278 km, connected impervious area: 379 ha, height difference: 27 m
- Friburg in Brisgau (southern Germany): Central European transitional climate, mean annual rainfall: 908 mm; sewer system length: 794 km, connected impervious area: 1 546 ha, height difference 284 m
Hydrodynamic models are set up for each catchment to simulate rainfall runoff processes in the sewer systems. Long term event time series are extracted from the
- three different synthetic rainfall time series (comprising up to 600 years continuous rainfall) provided for each catchment and
- observed gauge rainfall (reference rainfall)
according national hydraulic design standards. The synthetic and reference long term event time series are used as rainfall input for the hydrodynamic sewer models.

For comparison of the synthetic rainfall time series against the reference rainfall and against each other the number of
- surcharged manholes,
- surcharges per manhole,
- and the average surcharge volume per manhole
are applied as hydraulic performance criteria.

The results are discussed and assessed to answer the following questions:
- Are the synthetic rainfall approaches suitable to generate high resolution rainfall series and do they produce, - in combination with numerical rainfall runoff models - valid results for design of urban drainage systems?
- What are the bounds of uncertainty in the runoff results depending on the synthetic rainfall model and on the climate region?

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