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High-resolution stochastic generation of extreme rainfall intensity for urban drainage modelling applications

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Urban drainage response is highly dependent on the spatial and temporal structure of rainfall. Therefore, measuring and simulating rainfall at a high spatial and temporal resolution is a fundamental step to fully assess urban drainage system reliability and related uncertainties. This is even more relevant when considering extreme rainfall events. However, the current space-time rainfall models have limitations in capturing extreme rainfall intensity statistics for short durations. Here, we use the STREAP (Space-Time Realizations of Areal Precipitation) model, which is a novel stochastic rainfall generator for simulating high-resolution rainfall fields that preserve the spatio-temporal structure of rainfall and its statistical characteristics. The model enables a generation of rain fields at 10^2 m and minute scales in a fast and computer-efficient way matching the requirements for hydrological analysis of urban drainage systems. The STREAP model was applied successfully in the past to generate high-resolution extreme rainfall intensities over a small domain. A sub-catchment in the city of Luzern (Switzerland) was chosen as a case study to: (i) evaluate the ability of STREAP to disaggregate extreme rainfall intensities for urban drainage applications; (ii) assessing the role of stochastic climate variability of rainfall in flow response and (iii) evaluate the degree of non-linearity between extreme rainfall intensity and system response (i.e. flow) for a small urban catchment. The channel flow at the catchment outlet is simulated by means of a calibrated hydrodynamic sewer model.