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Partitioning the impacts of spatial rainfall variability and climate variability in urban drainage flow modelling

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The performance of urban drainage systems is typically examined using hydrological and hydrodynamic models where rainfall is uniformly distributed and derived from a single rain gauge, or spatially distributed and obtained from a weather radar system. When models are fed with a single realization, the response of the urban drainage system to the spatiotemporal variability of rainfall remains unexplored. High resolution stochastic rainfall generators allow studying the response and sensitivity of urban drainage networks to these spatial and climatological rainfall variabilities. The goal in this study was to understand how climate variability and spatial rainfall variability affect the response of a calibrated hydrodynamic urban drainage model. A stochastic high resolution rainfall generator (STREAP) was used to simulate many realizations of rainfall, accounting for both climate variability and spatial rainfall variability. The generated rainfall was then used as input into a calibrated hydrodynamic model (EPA SWMM) to simulate surface runoff and channel flow for a small urban catchment. The variability of peak flows at three different locations in the urban drainage network in response to rainfall of different return periods was evaluated and partitioned among it sources. We found that the main contribution to the total flow variability originates from the natural climate variability. In addition, the contribution of spatial rainfall variability to the total flow variability was found to increase with longer return periods.