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Does rainfall intermittency help explain the sensitivity of urban hydrological response?

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Rainfall variability in space and time, combined with catchment characteristics, plays an important role for runoff generation and hydrological response, particularly in small urban catchments, which are generally characterized by high spatial variability and fast response time. One possible way to investigate rainfall variability over such catchments is to rely on high-resolution rainfall measurements, derived from weather radar observations. In this work, the impact that rainfall variability and resolution in space and time have on the sensitivity of urban hydrological response is investigated. Rainfall space-time variability is characterized in terms of storm core dimension and rainfall event intermittency, with the latter quantified in terms of burstiness and memory of interamount times, as presented in a previous study proposed by M. A. Schleiss in 2015. For this purpose, twenty-eight rainfall events were selected from a 15-year (2001 – 2015) radar rainfall data set, derived from the National Weather Service (NWS) Next Generation Radar network (NEXRAD). Radar measurements were obtained at high resolution (15 min, 1 km^2) and successively aggregated in space (to 3 km^2 and 6 km^2) and time (to 30 min and 60 min) to investigate the sensitivity of the hydrological response to different combinations of spatial and temporal rainfall resolutions. This spatial and temporal aggregation changes the intermittency properties of the data. Observed and aggregated rainfall events were used as input for the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model simulations for the urbanized catchment of Little Sugar (111 km^2), located in the Charlotte metropolitan area (North Carolina, USA). Two smaller subcatchments were included in the analysis to investigate the effects of rainfall intermittency at different catchment scales. Simulated flow was compared with 1-min streamflow observations at the catchment outlet. Three dimensionless scale factors, presented in previous studies, were implemented to investigate the interactions between rainfall and catchment scale. The latter were used to support the identification of the minimum required rainfall resolution according to the level of model accuracy that is requested. First results highlight the importance of taking intermittency into account when modeling response times and show a complicated link between rainfall intermittency and sensitivity of hydrological response.