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The complexity of urban hydrology – capturing drivers and processes at the relevant spatial and temporal scales

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Mankind is altering the natural landscape and hence hydrological processes with increasing speed and magnitude, with urban areas reflecting one of the most prominent alteration. In the past, cities were developed to drain rainwater efficiently without considering long-term alteration on the water balance. The results were severe changes in water quality, quantity and even climate. In order to mitigate these influences, approaches for stormwater management, green infrastructure and low impact development target a reduction of the mostly negative impacts on hydrology and climate. These structures and approaches brought more “natural” hydrological processes back into urban areas, but they also complicate estimates of the overall water balance, runoff prediction and flooding potential and associated contamination by pollutants. In particular, the various partly sealed surfaces, green roofs and urban trees, the small scale lateral redistribution of water from sealed or partly sealed area to soils or specific bio-retention systems, and the small-scale variability of meteorological drivers and fluxes are major challenges in the development of adequate model representations of these landscapes. Data from several long-term observatories of urban catchments in Germany obtained with fix and mobile sensor networks allow a number of analyses of these competing influences, including for example approaches of paired catchment hydrology. Based on insights from experimental data a new model framework (Urban-RoGeR) for the simulation and prediction of the highly spatially and temporally variable drivers and fluxes of urban hydrology has been developed that adapts approaches from catchment and soil hydrology of natural landscapes to urban situations. The presentation will demonstrate the challenges of urban hydrology with several examples and show the potential for more process based modelling to predict the urban water balance as well as short-term flash flood events.