Exploring the linkage between urban flood risk and spatial characteristics in small urbanized catchments of Beijing, China

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In the context of global urbanization, urban flood risk in many cities has become a seriously environmental issue, threatening health of public residents and environments. A number of hydrological studies have linked urban flooding issues closely to the spectrum of spatial patterns of urbanization, but relatively little attention has been given to small-scaled catchments within the realm of urban systems. This study aims to explore the hydrological effects of small-scaled urbanized catchments assigned with various landscape patterns. Twelve typical residential catchments in Beijing were selected as the study areas. Total impervious area (TIA), directly connected impervious area (DCIA), and a drainage index were used as the catchment spatial metrics. Three scenarios were designed as different spatial arrangement of catchment imperviousness. Runoff variables including total and peak runoff depth (Q_t and Q_p) were simulated by using SWMM model. The relationship between catchment spatial patterns and runoff variables were determined, and the results demonstrated that, spatial patterns have inherent influences on flood risks in small urbanized catchments. Specifically, (1) Imperviousness acts as effective indicators in affecting both Q_t and Q_p; (2) Increasing the size of drainage area dominated by each drainage inlet will benefit the catchment peak flow mitigation; (3) Different spatial concentrations of impervious surfaces have inherent influences on Q_p. These findings may provide insights into the role of urban spatial patterns in driving rainfall-runoff processes in small urbanized catchments, which is essential for urban planning and flood management.

Keywords: SWMM, Urban flood risk, Spatial pattern, Imperviousness, Rainfall-runoff

