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Modeling the ability of source control measures to reduce inundation in a community-scale urban drainage system

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Abstract: Urban inundation is a serious challenge that increasingly confronts the residents of many cities, as well as policymakers, in the context of rapid urbanization and climate change worldwide. In recent years, source control measures (SCMs) such as green roofs, permeable pavements, rain gardens, and vegetative swales have been implemented to address flood inundation in urban settings, and proven to be cost-effective and sustainable. In order to investigate the ability of SCMs on reducing inundation in a community-scale urban drainage system, a dynamic rainfall-runoff model of a community-scale urban drainage system was developed based on SWMM. SCMs implementing scenarios were modelled under seven design rainstorm events with return period ranging from 1 to 100 years, and inundation risks of the drainage system were evaluated before and after the proposed implementation of SCMs, with a risk-evaluation method based on SWMM and analytic hierarchy process (AHP). Results showed that, SCMs implementation resulting in significantly reduction of hydrological indexes that related to inundation risks, range of reduction rates of average flow, peak flow, and total flooded volume of the drainage system were 28.1%∼72.1%, 19.0%∼69.2%, and33.9%∼56.0% , respectively, under seven rainfall events with return periods ranging from 1 to 100 years. Corresponding, the inundation risks of the drainage system were significantly reduced after SCMs implementation, the risk values falling below 0.2 when the rainfall return period was less than 10 years. Model simulation results confirmed the effectiveness of SCMs on mitigating inundation, and quantified the potential of SCMs on reducing inundation risks in the urban drainage system, which provided scientific references for implementing SCMs for inundation control of the study area.