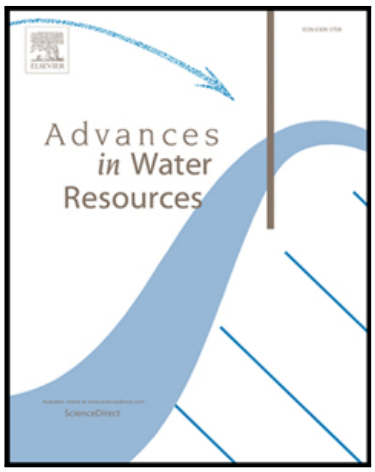

Dependence structure of urban precipitation extremes

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Dependence structure of urban precipitation extremes

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Abstract

Addressing spatial variation of extreme precipitation in urban areas is important for urban hydrologic designs. Climatology of urban areas is, in general, different from that of its surroundings and the spatial variation of extreme precipitation within the city exhibits shorter spatial range, especially for short duration events. This work aims at understanding the dependence structure of extreme precipitation within an urban area and its surrounding non-urban areas at various durations. The spatial dependence of precipitation is analysed with three different measures for examining dependence, considering observations from pairs of stations. Further, the spatial precipitation extremes are modelled with the max-stable process to include the dependence structure of spatial extremes. The City of Berlin, Germany, with surrounding non-urban area is considered to demonstrate the methodology. For this case study, the hourly precipitation shows weaker dependence within the city even at small distances, whereas the daily precipitation shows a high degree of dependence. This dependence structure of the daily precipitation gets masked as more and more surrounding non-urban areas are included in the analysis. Further, the extreme precipitation at different durations are modelled considering max-stable process. Different geographical and climatological covariates are considered in the modelling of location and scale parameters of the Generalized Extreme Value distribution. The geographical covariates are seen to be predominant within the city and the climatological covariates prevail when non-urban areas are added. These results suggest the importance of quantification of dependence structure of spatial precipitation at the sub-daily timescales, as well as the need to more precisely model spatial extremes within the urban areas.

Key words: Urban precipitation extremes, Dependence structure, Max-stable process, Extremal coefficient, Bayesian model averaging.