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Critical rainfall and catchment scales to investigate urban hydrological response

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Interactions between rainfall and catchment scale are complex and there influence on hydrological response remains poorly understood. Particularly in urban areas, where catchments are generally small, with high variability in space, and where the high degree of imperviousness leads to a fast response in time. This work aimed to investigate the effects of rainfall and catchment scales and their interactions on urban hydrological response sensitivity.
A new approach to classify rainfall spatial and temporal variability was introduced, based on cluster identification and used to investigate the impact of rainfall aggregation in space and time on hydrological response in urban areas. Rainfall events obtained with 1 min temporal resolution and 100 m x 100 m spatial resolution, were aggregated in time and space to obtain different resolution combinations. The events were used as synthetical input for a semi-distributed high resolution hydrological models of Cranbrook (London, UK). Three dimensionless scaling factors were introduced to investigate the interactions between rainfall and catchment scale, rainfall input resolution and performance of the hydrological model.
Results showed that (1) cluster identification is a good way to classify the storm core dimension, (2) aggregation effects are stronger for rainfall than flow, with a coefficient of determination that reaches 0.25 for rainfall and 0.6 for flow (3) model resolution has limited influence on hydrological response sensitivity to rainfall input resolution compared to catchment and rainfall scales for this study case, (4) scaling factors allow to identify the required rainfall resolution to obtain a chosen level of accuracy in the calculation of hydrological response, with respect to a given combination of rainfall and catchment scale.