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Influence of high resolution rainfall data on the hydrological response of urban flat catchments

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In the last decades, cities have become more and more urbanized and population density in urban areas is increased. At the same time, due to the climate changes, rainfall events present higher intensity and shorter duration than in the past. The increase of imperviousness degree, due to urbanization, combined with short and intense rainfall events, determinates a fast hydrological response of the urban catchment and in some cases it can lead to flooding. Urban runoff processes are sensitive to rainfall spatial and temporal variability and, for this reason, high resolution rainfall data are required as input for the hydrological model. A better knowledge of the hydrological response of system can help to prevent damages caused by flooding.
This study aims to evaluate the sensitivity of urban hydrological response to spatial and temporal rainfall variability in urban areas, focusing especially on understanding the hydrological behaviour in lowland areas. In flat systems, during intense rainfall events, the flow in the sewer network can be pressurized and it can change direction, depending on the setting of pumping stations and CSOs (combined sewer overflow). In many cases these systems are also looped and it means that the water can follow different paths, depending on the pipe filling process. For these reasons, hydrological response of flat and looped catchments is particularly complex and it can be difficult characterize and predict it.
A new dual polarimetric X-band weather radar, able to measure rainfall with temporal resolution of 1 min and spatial resolution of 100mX100m, was recently installed in the city of Rotterdam (NL). With this instrument, high resolution rainfall data were measured and used, in this work, as input for the hydrodynamic model. High detailed, semi-distributed hydrodynamic models of some districts of Rotterdam were used to investigate the hydrological response of flat catchments to high resolution rainfall data. In particular, the hydrological response of some subcatchments of the district of Kralingen was studied. Rainfall data were combined with level and discharge measurements at the pumping station that connects the sewer system with the waste water treatment plane. Using this data it was possible to study the water balance and to have a better idea of the amount of water that leave the system during a specific rainfall events.
Results show that the hydrological response of flat and looped catchments is sensitive to spatial and temporal rainfall variability and it can be strongly influenced by rainfall event characteristics, such as intensity, velocity and intermittency of the storm.