Geophysical Research Abstracts
Vol. 19, EGU2017-14494-2, 2017
EGU General Assembly 2017

Comparing rainfall variability, model complexity and hydrological response at the intra-event scale

Elena Cristiano (1), Marie-claire ten Veldhuis (1), Susana Ochoa-Rodriguez (2), and Nick van de Giesen (1)

(1) Department of Water Management, Delft University of Technology, Delft, The Netherlands (e.cristiano@tudelft.nl), (2) RPS Water, Derby, United Kingdom

The high variability in space and time of rainfall is one of the main aspects that influence hydrological response and generation of pluvial flooding. This phenomenon has a bigger impact in urban areas, where response is usually faster and flow peaks are typically higher, due to the high degree of imperviousness. Previous researchers have investigated sensitivity of urban hydrodynamic models to rainfall space-time resolution as well as interactions with model structure and resolution. They showed that finding a proper match between rainfall resolution and model complexity is important and that sensitivity increases for smaller urban catchment scales. Results also showed high variability in hydrological response sensitivity, the origins of which remain poorly understood. In this work, we investigate the interaction between rainfall input variability and model structure and scale at high resolution, i.e. 1-15 minutes in time and 100m to 3 km in space. Apart from studying summary statistics such as relative peak flow errors and coefficient of determination, we look into characteristics of response hydrographs to find explanations for response variability in relation to catchment properties as well storm event characteristics (e.g. storm scale and movement, single-peak versus multi-peak events). The aim is to identify general relations between storm temporal and spatial scale and catchment scale in explaining variability of hydrological response.

Analyses are conducted for the Cranbrook catchment (London, UK), using 3 hydrodynamic models set up in InfoWorks ICM: a low resolution semi-distributed (SD1) model, a high resolution semi-distributed (SD2) model and a fully distributed (FD) model. These models represent the spatial variability of the land in different ways: semi-distributed models divide the surface in subcatchments, each of them modelled in a lumped way (51 subcatchment for the S model and 4409 subcatchments for the SD model), while the fully distributed represents the surface with a dense 2D mesh, based on a high resolution Digital Elevation Map. Nine storm events measured by a dual polarimetric X-Band weather radar, located in Cabauw (CAESAR weather station, NL) were used, with original resolution of 100mx100m in space and 1min in time.

Results show that the FD model presents a slightly higher sensitivity to spatial rainfall variability than the SD1 and SD2 model. Model resolution, however, seems to have a small impact on the sensitivity of model outcomes compared to rainfall variability: intensity and intermittency, as well as spatial range and velocity, have a higher influence than model configuration.