Generalisation of Topographical Resolutions for Two-Dimensional Urban Flood Modelling

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Abstract

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Advances in urban flood modelling have been made through the use of 2D hydraulic numerical models in the last decade. These advances offer the potential to predict the local pattern and timing of flood depth and velocity, enabling informed flood risk zoning and improved emergency planning. Researchers have shown that with the availability of high resolution DEMs derived from airborne lidar, these models can theoretically be routinely parameterized to represent considerable topographic complexity, even in urban areas where the potential exists to represent flows at the scale of individual buildings. However, computational constraints on the use of fine resolution DTM for 2D urban flood modeling require model dicritizations at scale well below those achievable with lidar and thus unable to make optimal use of this emerging data stream

In this paper we will present and discuss an approach that tries to capture small scale urban features which are presented in fine resolution data as we try to move from sub-grid scale to coarse resolution for 2D urban flood modelling. The approach we used involves mathematical reformulation of the 2D numerical model to account for the change in storage and lateral fluxes when we use model discritsation which are coarser than the available fine resolution DTM. This modeling approach enables highly efficient model applications at

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coarse spatial resolutions while retaining information about the complex geometry of the built environment.

This approach is evaluated using numerical experiments in a real-life case study by building urban flood models using different model discritisations (from fine to coarse) and the results are compared both from this approach and the conventional approach in terms of spatial pattern of inundation, flood wave propagation and model run -times.

The reformulation of the 2D numerical model to account for the changes in storage and lateral fluxes presented best accuracies in retaining the important urban features of the original model (fine resolution) when coarsening the grid cells. Based on the overall experimental work it can be concluded that the use of this approach enables coarse resolution 2D urban flood modelling which captured small scale urban features with reasonable accuracy and substantial model simulation reduction time.

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