How good are 'broad-scale' models of urban flooding?

July 2014

The city of Newcastle-upon-Tyne in North East England flooded on 28 June 2012 during intense summer storms, known locally as the "Toon Monsoon"

Newcastle University collected evidence about the depth of flood water in the city and this unique data set allows us to test models for surface water flooding

Photos: Newcastle City Council. Photo interpretation: R Bertsch

Testing JFlow and CitiCat

The Environment Agency's national flood map for surface water is based on a 2D hydrodynamic model, **JFlow**, run on a 2x2m resolution terrain model (DTM) with special adjustments for buildings.

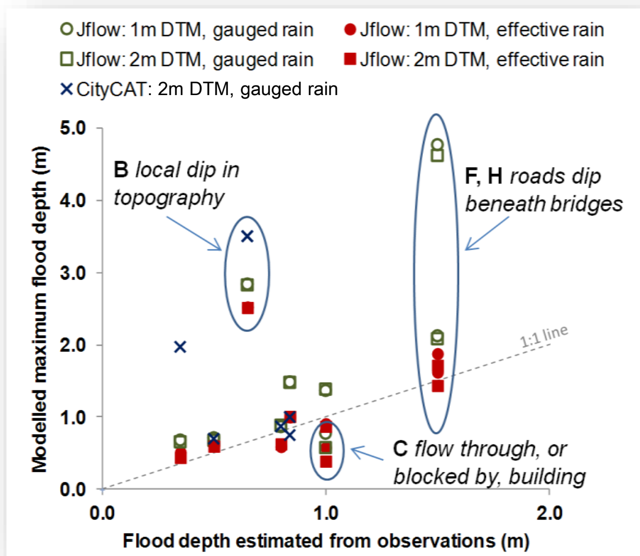
The modelling included a reduction to the amount of rainfall to mimic the net effects of drainage systems and soil infiltration ('effective' rain).

We tested the same assumptions, and also looked at the effect of using a finer 1x1m DTM and the actual (gauged) rainfall.

We compared the results with Newcastle University's model **CityCAT**, in which buildings are represented as voids in the simulation.

The effective rainfall adjustment helps to prevent the model from simulating too much flooding in local dips in the terrain such as underneath bridges.

Relatively large discrepancies can be explained by local topography and uncertainties in the observations (which are approximate and might not have captured maximum flood depth).



The results show that assumptions developed for national surface water flood modelling work well for this urban flood event.

The research described here is based on a study completed by Robert Bertsch for his MSc in Hydroinformatics at Newcastle University. Robert's work was supported by his supervisor Dr Vedrana Kutija and JBA Consulting's Newcastle office. JBA Trust project W13-4277.

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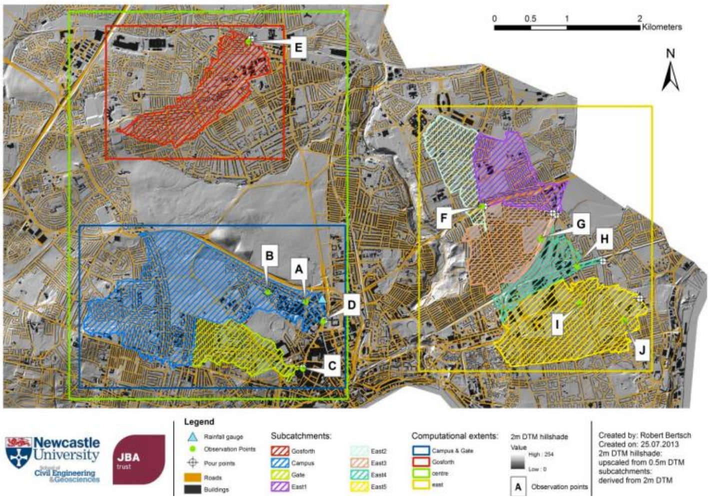
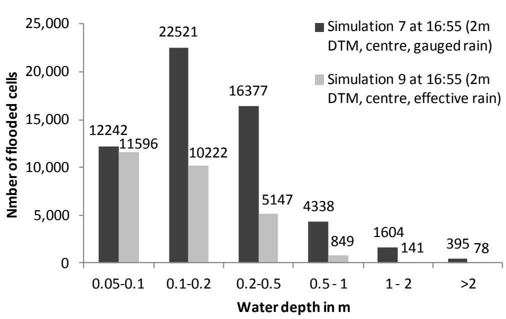
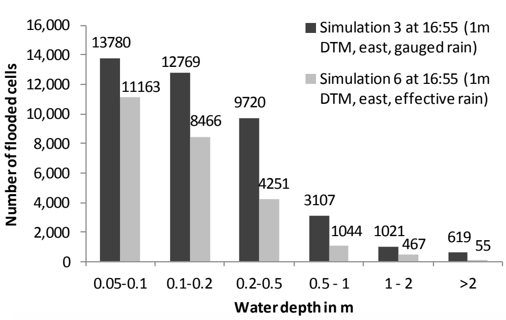


Map of the flood depth observation points (above)

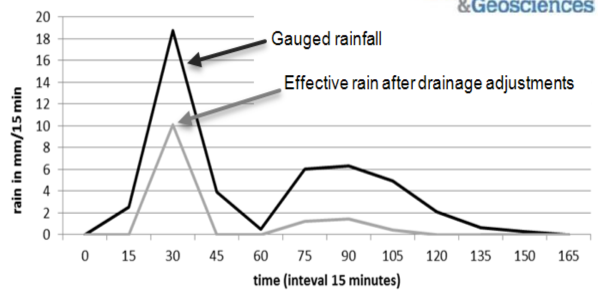
The effective rainfall adjustment is seen to reduce flooding most obviously in locations where converging flow pathways cause water to accumulate, compared with areas that convey water away.

This was seen for both 1m and 2m resolution models (shown below)





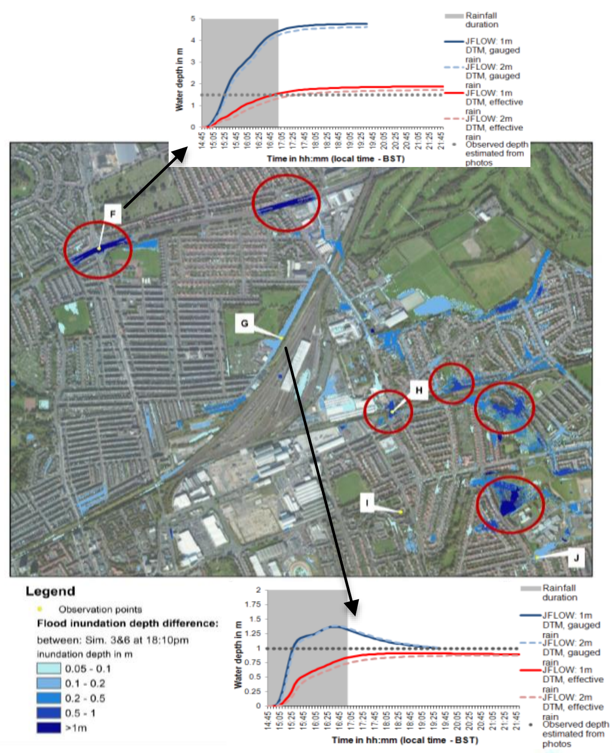
In this study, the effective rainfall adjustment was found to be more important than the choice between 1m and 2m DTM resolution



The storm of 28 June, 2012 showing effective rainfall adjustment (above)

The map (below) shows several examples where roads dip beneath bridges.

At point F the water ponds beneath a road bridge. At point G there is an open flow route to convey the water.



Background image (satellite): ESRI online imagery library (implemented within ArcMap)