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Influence of building resolution on surface water inundation outputs

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Surface water (pluvial) flooding occurs when intense precipitation events overwhelm the drainage capacity of an area and excess water is unable to infiltrate into the ground or drain via natural or artificial drainage channels. In the UK, over 3 million properties are at risk from surface water flooding alone, accounting for approximately one third of all UK flood risk. This risk is predicted to increase due to future climatic changes resulting in an increasing magnitude and frequency of intense precipitation events.

Numerical modelling is a well-established method of investigating surface water flood risk, allowing the researcher to gain an understanding of the depth, extent and severity of actual or hypothetical flood scenarios. Although numerical models allow the simulation of surface water inundation in a particular region, the model parameters (e.g. roughness, hydraulic conductivity) and resolution of topographic data have been shown to exert a profound influence on the inundation outputs which often leads to an over- or under-estimation of flood depths and extent without the use of external validation data to calibrate model outputs. Although previous research has demonstrated that model outputs are highly sensitive to Digital Elevation Model (DEM) mesh resolution, with flood inundation over large and complex topographies often requiring mesh resolutions coarser than the structural features (e.g. buildings) present within the study catchment, the specific influence of building resolution on surface flowpaths and connectivity during a surface water flood event has not been investigated.

In this study, a LiDAR-derived DEM and OS MasterMap buildings layer of the Loughborough University campus, UK, were rasterized into separate 1m, 5m and 10m resolution layers. These layers were combined to create a series of Digital Surface Models (DSM) with varying, mismatching building and DEM resolutions (e.g. 1m DEM resolution, 10m building resolution, etc.) to understand the influence that building treatment and grid cell resolution has upon surface water inundation outputs. FloodMap, a simplified 2D raster-based diffusion wave model that requires minimal pre-processing and data requirements was used to simulate a short-duration, intense rainfall event that occurred over Loughborough University on the 28th June 2012 using precipitation data obtained from the University weather station. Preliminary results demonstrate that altering building resolution and maintaining a constant topographic cell size has a profound influence on surface water inundation outputs. Furthermore, the impact of building resolution on flood depth (m) is shown to become exacerbated by factors such as building alignment, rotation and offset from the DEM grid, as well as building geometry and size.