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Merging airborne and terrestrial LiDAR data to determine geometric controls on flood propagation in urban areas

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The recent development of mobile terrestrial LiDAR scanning systems generating very high resolution DEMs (5 – 10 cm) of urban areas has led to initial investigations into the utility of such a data source for hydraulic flood modelling purposes. These preliminary investigations have highlighted the added value of a street-level derived product for delineating the complex flow paths that exist in urban environments by explicitly representing road camber and curb heights. In addition, terrestrial LiDAR derived DEMs have proven advantageous for a wide range of different numerical models of varying complexity for simulating flow propagation. Finally, the improvement in vertical error and horizontal grid resolution provided by the mobile LiDAR data over similar airborne products is significant when considering the propagation of shallow flows along street networks.

However, mobile terrestrial LiDAR data are costly to collect and by their very nature are limited to line of sight, creating substantial data voids. Furthermore, a significant degree of segmentation and processing is required to successfully remove artefacts (e.g. cars) and ensure that hydraulically-relevant features (e.g. curbs) are captured sufficiently well. Alternatively, airborne LiDAR provides a wider spatial coverage, albeit at coarser resolution, that may be able to fill in the gaps in the terrestrial product. Therefore, it is necessary to investigate methods for appropriately fusing the more readily available airborne LiDAR data with the terrestrial LiDAR data in order to derive an optimal product for urban flood modelling, in terms of resolution, accuracy and computational cost.

The Greenfields site in Glasgow, UK has formed the basis of a number of benchmarking tests for two dimensional urban flood inundation model codes. Therefore, this site provides an ideal test bed for further developing and analysing the utility of terrestrial LiDAR data and further benchmarking varying complexity urban flood models. In this study, the inertial and dynamic (Roe solver) variants of the LISFLOOD-FP numerical model are used to evaluate various fusing methodologies and DEM resolutions. The model results highlight the importance of the geometric controls of urban areas (road camber and curb heights) on flood propagation and the need to appropriately combine the best available data sets for DEM generation.