ArcticDEM; DSM to DTM conversion and associated hydrodynamic flood modelling

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ArcticDEM is a new, freely available assembly of 2 metre resolution, repeat digital surface models (DSMs) covering the entire landmass north of 60[U+F0B0]N and some Sothern regions (e.g. Alaska). The models were created from high resolution optical satellite imagery using stereo auto-correlation techniques. ArcticDEM has good potential for flood modelling because of its resolution which is far higher than other large scale DEMs available in the Arctic, for example the TanDEM-X (90 metre) or MERIT (90 metre) DEMs. Additionally, vertical accuracy is a key factor in the effectiveness of a DEM for flood modelling, ArcticDEM has a relatively high internal accuracy of 0.2 metres whilst TanDEM-X and MERIT DEM have vertical accuracies of 2 metres over limited land pixels. However, ArcticDEM is a DSM as it models the highest surface elevation, whether that be bare earth or surface features such as buildings and vegetation. Using a DSM in a hydrodynamic flood model results in the floodplain being over elevated and thus incorrect simulations of floods are predicted. Therefore, this study aims to remove surface features on ArcticDEM and produce a series of digital terrain models (DTMs). Methods used to produce these DTMs included Progressive Morphological Filtering and subtracting outputs from a canopy height model created from ArcticDEM elevations. These DTMs were then used in hydrodynamic flood models of a previously studied 50km reach of the Ounasjoki River, Finland, where there is significant building and vegetation coverage on the floodplain. Two different flood events in 2005 and 2014 were simulated and validated against synthetic aperture radar (SAR) images of the areal flood extent. Additionally, the floods simulated with the ArcticDEM DTMs were compared to those completed with LiDAR, MERIT and TanDEM-X DEMs. The methodology used in this study provides a framework on how to use ArcticDEM for hydrodynamic flood modelling on floodplains where substantial vegetation and buildings are present.