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Sensitivity analysis of hydraulic model to morphological changes and changes in flood inundation extent

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Recent research into modelling floodplain inundation processes is primarily concentrated on the simulation of inundation flow without considering the influences of channel morphology and sediment delivery from upstream. River channels are often represented by simplified geometry and implicitly assumed to remain unchanged. However, during and after flood episodes the river bed elevation can change quickly and in some cases drastically. Despite this, the effect of channel geometry and topographic complexity on model results has been largely unexplored. To address this issue, the impact of channel cross-section geometry, and channel long-profile variability on flood inundation extent are examined using a simplified 1D-2D hydraulic model (LISFLOOD-FP) of the Cockermouth floods of November 2009 within an uncertainty analysis framework. The Cockermouth region provides a useful test site for such study because of the availability of channel and floodplain data, the collection of post-event water and wrack marks and the presence of pre-and post-event morphological surveyed data. More importantly, in some areas the river has undergone significant course change and additionally the deposition of stones and debris on the floodplain. The use of relatively simple formulations of critical velocities in the initiation of motion formula enables the construction of a series of hypothetical bedform scenarios among cross-sections. These scenarios can be used as input to LISFLOOD-FP. Slope gradient, Manning roughness coefficients, grain size characteristic, and critical shear stress will be considered in a Monte Carlo simulation framework. The November 2009 Cockermouth flood is simulated and the results are analysed to quantify the accuracy associated with each bedform scenario and to assess how different channel long-profiles affects the performance of LISFLOOD-FP. The study will further analyse and quantify the variability and uncertainty of flood inundation extent resulting from discharge boundary conditions upstream. We shall assess the relative importance of these factors and identify what dominates the uncertainties in flood inundation extent.