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Uncertainty analysis of channel capacity assumptions in large scale hydraulic modelling

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Flood modelling on national or even global scales is of great interest to re/insurers, governments and other agencies. Channel bathymetry data is not available over large areas which is a major limitation to this scale of modelling. It requires expensive channel surveying and the majority of remotely sensed data cannot see through water. Furthermore, channels represented as 1D models, or as an explicit feature in the model domain is computationally demanding, and so it is often necessary to find ways to reduce computational costs. A more efficient methodology is to make assumptions concerning the capacity of the channel, and then to remove this volume from inflow hydrographs.

Previous research have shown that natural channels generally conform to carry flow for a 1-in-2 year return period (QMED). This assumption is widely used in large scale modelling studies across the world. However, channels flowing through high-risk areas, such as urban environments, are often modified to increase their capacity and thus reduce flood risk. Simulated flood outlines are potentially very sensitive to assumptions made regarding these capacities. For example, under the 1-in-2 year assumption, the flooding associated with smaller events might be overestimated, with too much flow being modelled as out of bank. There are requirements to; i) quantify the impact of uncertainty in assumed channel capacity on simulated flooded areas, and ii) to develop more optimal capacity assumptions, depending on specific reach characteristics, so that the effects of channel modification can be better represented in future studies.

This work will demonstrate findings from a preliminary uncertainty analysis that seeks to address the former requirement. A set of benchmark tests, using 2D hydraulic models, were undertaken where different estimated return period flows in contrasting catchments are modelled with varying channel capacity parameters. The depth and extent for each benchmark model output were then compared to determine the impact of channel capacity. Results will be evaluated against an expectation that the depth and extent of smaller return periods are more sensitive to the channel capacity assumption than larger return periods. This is because at low return periods flows, a greater percentage of flow is held within the channel. Since larger return periods are expected to be less sensitive to the channel capacity assumption as it is allowed to increase beyond QMED, the difference between the smallest and largest return periods will increase disproportionately. The results here will demonstrate the significance of the in channel capacity assumption.