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A method for improved channel representation in continental scale flood models. An example from the conterminous United States

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Continental scale flood inundation models have undergone rapid development in the past five years. In data rich locations, such as the conterminous United States, accurate DEM data and high-performance computing resources allow floodplain flows to be resolved in great detail at high resolution (30 m or less). However, all fluvial flooding is governed by the conveyance capacity of the river network and thus accurately representing the expected conveyance within the inundation model is critical for simulation accuracy.

In continental scale models, the geometry of the river channel is typically estimated from an expected conveyance capacity using Manning's equation or hydraulic geometry, due to the difficulty of obtaining complete channel bathymetry data over wide areas. However, as these methods all fail to account for backwater effects during simulation the models are susceptible to over prediction of water level, especially during small floods or flows close to bank full discharge. As a result, risk estimates from low return period events can be dramatically overestimated in relation to flood loss data.

We present results from a version of the Fathom US flood model where a 1D steady state solver and optimisation technique has been employed to estimate an appropriate channel bed bathymetry for bank full conveyance, allowing for more control over inundation inception. Employing our method reduces losses due to small flood flows and greatly improves the representation of flood defence standards where known. Although defence standards still need to be estimated, our method allows for an accurate representation of the assumed standard within the continental scale model, which was not the case with earlier model structures.