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# Incorporating channel geometric uncertainty into a regional scale flood inundation model

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Models that simulate the dynamics of river and floodplain water surface elevations over large regions have a wide range of applications including regional scale flood risk estimation and simulating wetland inundation dynamics, while potential emerging applications include estimating river discharge from level observations as part of a data assimilation system. The river routing schemes used by global land surface models are often relatively simple in that they are based on wave speed, kinematic and diffusive physics. However, as the research on large scale river modelling matures, approaches are being developed that resemble scaled-up versions of the hydrodynamic models traditionally applied to rivers at the reach scale. These developments are not surprising given that such models can be significantly more accurate than traditional routing schemes at simulating water surface elevation.

This presentation builds on the work of Neal et al. (2012) who adapted a reach scale dynamic flood inundation model for large scale application with the addition of a sub-grid parameterisation for channel flow. The scheme was shown to be numerically stable and scalable, with the aid of some simple test cases, before it was applied to an 800 km reach of the River Niger that includes the complex waterways and lakes of the Niger Inland Delta in Mali. However, the model was significantly less accurate at low to moderate flows than at high flow due, in part, to assuming that the channel geometry was rectangular. Furthermore, this made it difficult to calibrate channel parameters with water levels during typical flow conditions.

This presentation will describe an extension of this sub-grid model that allows the channel shape to be defined as an exponent of width, along with a regression based approach to approximate the wetted perimeter length for the new geometry. By treating the geometry in this way uncertainty in the channel shape can be considered as a model parameter, which for the first time enables channel conceptualisation to be considered within an ensemble flood risk prediction. With the aid of some synthetic test cases we demonstrate that this parameter, and thus the geometry, is identifiable from water level dynamics even in the presence of channel friction and depth uncertainty.

The new model was applied to a 60 km reach of the River Severn, for which the river channel parameters (friction, depth and shape) were estimated from water level dynamics at a number of gauging stations. To do this efficiently a Gauss-Marquardt-Levenberg based parameter optimisation approach was taken. Finally, the new and previous versions of the model were evaluated using observations from a large flood event from the summer of 2007, while river cross-section data were compared with the geometries obtained from model calibration.

Neal, J., G. Schumann, and P. Bates (2012), A sub-grid channel model for simulating river hydraulics and floodplain inundation over large and data sparse areas, Water Resour. Res., 48, W11506, doi:10.1029/2012WR012514.