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Coupled modelling of flood inundation over a topographically complex urban floodplain

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This study describes the coupling of a 2D diffusion-based flood inundation model to a 1D river flow model. The coupled model (FlowMap) was applied to simulate the 2000 flood event occurred on the River Ouse which runs through the city centre of York, UK. The 1D river model solves the full one-dimensional St. Venant equations for unsteady flow using the Preissmann Scheme. Two coupling approaches were investigated: (i) a loosely coupled approach where a 1-D river flow model was used to provide boundary condition to the 2D model at the river-floodplain interface prior to the initialisation of the 2D model; and (ii) a tightly coupled approach where the 1D river flow is solved simultaneously with the 2D floodplain flow model by treating the flux exchange at the river-floodplain boundary explicitly through mass control at each time step. These two approaches were tested on a 10 km long river reach across the city centre of York. The 1D component of the model was calibrated against the recorded stage hydrograph upstream of the river and inundation extents were validated against the aerial imagery obtained during the flood event. The accuracy statistics shows that the tightly coupled model performs better than the loosely coupled model in terms of the prediction of inundation extents. This study demonstrated the complex interaction between river flow and floodplain flow in terms of the momentum and mass transfer at their common boundary and its effect upon flood inundation. This study focused upon mass transfer and shows that floodplain flow routing might change the way water flows back to the river and hence affects channel flow which in turn affects flood inundation. In relation to prediction of inundation extent, this study showed that, in diffusion-types of flood models, if the flow exchange between river and floodplain is not represented correctly, it is likely that flood inundation extent will not be modelled correctly. This study emphasized the importance of boundary conditions for flood in-

undation predictions and the need for improved approaches to channel and floodplain flow coupling, particullary in terms of momentum representation.