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Towards a 1km resolution global flood risk model

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Recent advances in computationally efficient numerical algorithms and new High Performance Computing architectures now make high (1-2km) resolution global hydrodynamic models a realistic proposition. However in many areas of the world the data sets and tools necessary to undertake such modelling do not currently exist. In particular, five major problems need to be resolved: (1) the best globally available terrain data (SRTM) was generated from X-band interferometric radar data which does not penetrate vegetation canopies and which has significant problems in determining ground elevations in urban areas; (2) a global river bathymetry data set does not currently exist; (3) most river channels globally are less than the smallest currently resolvable grid scale (1km) and therefore require a sub-grid treatment; (4) a means to estimate the magnitude of the T year flood at any point along the global river network does not currently exist; and (5) a large proportion of flood losses are generated by off-floodplain surface water flows which are not well represented in current hydrodynamic modelling systems. In this paper we propose solutions to each of these five issues as part of a concerted effort to develop a 1km (or better) resolution global flood hazard model. We describe the new numerical algorithms, computer architectures and computational resources used, and demonstrate solutions to the five previously intractable problems identified above. We conduct a validation study of the modelling against satellite imagery of major flooding on the Mississippi-Missouri confluence plain in the central USA before outlining a proof-of-concept regional study for SE Asia as a step towards a global scale model. For SE Asia we simulate flood hazard for ten different flood return periods over the entire Thailand, Cambodia, Vietnam, Malaysia and Laos region at 1km resolution and show that the modelling produces coherent, consistent and sensible simulations of extent and water depth.