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Application of a nesting approach for improved flood inundation simulation for estuaries and deltas in the framework of global flood modelling

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The world's deltas and estuaries are highly vulnerable to water-related disasters. In particular, mega deltas are of both societal and economic importance because of the large populations inhabiting them and the possible occurrence of multiple flood disasters concurrently. In order to estimate flood risk in mega delta regions, global flood models (GFMs) can be applied. Most of these are driven by 1D river flow equations, which means that they can be used to carry out hydrodynamic simulations including the entire catchment areas of deltas. However, modelling flood inundation processes in estuaries and deltas remains challenging, due to the complex water flow processes in such regions. This is particularly the case when fluvial and coastal flood processes interact, leading to compound flooding. The inclusion of 2D inundation processes can help to address this issue, however it is computationally too heavy to use 2D models for large-scale inundation simulations. A nested modelling, which means to use a local 2D model forced by a global model, is a potential for the solution here.

Hence, the objective of this study is to apply a nesting method to achieve improved flood inundation modelling in estuaries and deltas within a framework of GFMs. Here we employ the global river routing model CaMa-Flood (Yamazaki et al. 2011) and the 1D/2D hydrodynamic model Delft3D Flexible Mesh (Kernkamp et al. 2011). In the nested modelling framework, the Delft3D Flexible Mesh models is constructed, whose domain is set to include both the river mouth and coastal deltas, forced by upstream daily river discharge simulated by CaMa-Flood as a boundary condition. For model coupling, we utilize the GLOFRIM framework (Hoch et al. 2017), which was developed to facilitate spatially explicit and online coupling between different models.

In this presentation, we report the first results of this study, showing improved simulation results of flood hazard estimations for Bangladesh. Several different model configurations (i.e. CaMa-Flood simulations with and without Delft3D Flexible Mesh) were tested and their results were compared quantitatively against observations of river discharge and satellite-derived flood inundation extent.