Comparison of model performance between global- and regional-scale river models in simulating compound flooding in coastal deltas in the world’s continental rivers

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Compound flooding, the co-occurrence of river and coastal flooding, is a major threat for delta regions and is rapidly gaining both social and academic attention. Global river models are widely used these days for various purposes such as flood forecast, flood risk assessment, and earth system sciences, and they can be used for flood risk assessment in delta regions as well. CaMa-Flood is a state-of-the-art global hydrodynamic model replicating river routing and floodplain inundation dynamics, and recently it has been applied to conduct compound flooding simulation by coupling a global tide and surge reanalysis data for the first time. However, because the model solves 1 dimensional momentum equations, complex water flow processes in river-coast interface may not be fully expressed.

The objective of this study is to enhance our understanding on issues in modelling compound flooding in the framework of global river models. To achieve this, we compare the difference in model performance between a global- and a regional-scale river model for the simulation of flood inundation in delta regions. We selected CaMa-Flood as a global model and LISFLOOD-FP as a regional model respectively. The reason for the choice of these models is that both the momentum equation and the sub-grid approximation of floodplain inundation dynamics are the same in the models, which enables us to compare the model performance in terms of dimensions, i.e., 1 dimensional flow equation for CaMa-Flood, and 2 dimension for LISFLOOD-FP. We proposed a method to construct LISFLOOD-FP model based on the topography and river channel bathymetry taken in CaMa-Flood to make the input topographical data as similar as possible. Simulation results suggest that while the overall flood extent was similar for both models, the spatial pattern of floodplain inundation depth differed because of the unit-catchment shape, i.e., the spatial unit of calculation taken in the CaMa-Flood model.

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