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How model selection can determine flood risk estimates – a case study in the Ganges basin using the GLOFRIM framework

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Fluvial flood events are a major threat to people and infrastructure. To compute flood risk estimates, modelling cascades are often applied. Therein, flood hazard is driven by hydrologic or river routing and floodplain flow processes. As such, model selection within such a cascade can determine how well some of these processes can be simulated. Depending on the selection made, obtained flood maps can vary and, in turn, can have major implications for the analysis of how many people, buildings, economic values and so forth is at risk. Understanding the role of model selection in the flood risk modelling process is thus of great importance.

By means of GLOFRIM 2.0, we coupled the global hydrologic model PCR-GLOBWB with the hydrodynamic models CaMa-Flood and LISFLOOD-FP for the delta region of the Ganges-Brahmaputra basin. Applying the model-coupling framework GLOFRIM facilitates forcing various models with identical boundary conditions and thus transparent and objective inter-comparison of flood models.

While replacing the kinematic wave approximation of the hydrologic model with the local inertia equation of hydrodynamic models does not yield better discharge estimates in the Ganges basin, flood maps obtained with LISFLOOD-FP improved representation of observed flood extent. Compared to downscaled products of PCR-GLOBWB and CaMa-Flood, the critical success index increases by around 50 %.

Combining the obtained flood maps with actual exposure maps gives then a first-order estimate how the selection for one specific model set-ups translates into varying flood risk estimates. The research thus shows how those model selections, deliberately made or not, are an important driver of simulated flood risk. As such, it is detrimental that the various specifics of a model are known to facilitate the optimal model selection for objective-specific modelling requirements.