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A long-term, continuous simulation approach for large-scale flood risk assessments

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The Regional Flood Model (RFM) is a process based model cascade developed for flood risk assessments of large-scale basins. RFM consists of four model parts: the rainfall-runoff model SWIM, a 1D channel routing model, a 2D hinterland inundation model and the flood loss estimation model for residential buildings FLEMOps+r. The model cascade was recently undertaken a proof-of-concept study at the Elbe catchment (Germany) to demonstrate that flood risk assessments, based on a continuous simulation approach, including rainfall-runoff, hydrodynamic and damage estimation models, are feasible for large catchments. The results of this study indicated that uncertainties are significant, especially for hydrodynamic simulations. This was basically a consequence of low data quality and disregarding dike breaches. Therefore, RFM was applied with a refined hydraulic model setup for the Elbe tributary Mulde. The study area Mulde catchment comprises about 6,000 km2 and 380 river-km. The inclusion of more reliable information on overbank cross-sections and dikes considerably improved the results. For the application of RFM for flood risk assessments, long-term climate input data is needed to drive the model chain. This model input was provided by a multi-site, multi-variate weather generator that produces sets of synthetic meteorological data reproducing the current climate statistics. The data set comprises 100 realizations of 100 years of meteorological data. With the proposed continuous simulation approach of RFM, we simulated a virtual period of 10,000 years covering the entire flood risk chain including hydrological, 1D/2D hydrodynamic and flood damage estimation models. This provided a record of around 2.000 inundation events affecting the study area with spatially detailed information on inundation depths and damage to residential buildings on a resolution of 100 m. This serves as basis for a spatially consistent, flood risk assessment for the Mulde catchment presented in this study.