EGU21-13034
https://doi.org/10.5194/egusphere-egu21-13034
EGU General Assembly 2021
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Process-based flood risk assessment for Germany

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Floods affect people worldwide and account for more than USD 100 billion losses on average every year. Hazard, Exposure and Vulnerability are the three components that influence flood risk. Flood Risk Management (FRM) decisions especially, with respect to new flood defense schemes and resilience initiatives are generally taken based on the assessment of impacts for hazard scenarios. Current large-scale studies are comprehensive in terms of sectors covered in impact assessment. However, these studies often deploy generalized data and methods on the model components resulting in coarse risk estimates with low spatial resolution.

In this study, we use process-based models with 100m resolution on the national scale within a systems approach to develop and simulate a 5000 year flood event catalogue for Germany. The events are then analyzed per economic sector, including residential, commercial and agriculture sectors. The risk chain includes continuous simulation of high-resolution hazard maps, obtained from coupled hydrology and hydraulic models; NUTS3-level exposure asset values further disaggregated to ATKIS land-use data and calibrated object-level vulnerability models that provide high-resolution quantification of economic damage. Spatial dependence of flood events is addressed by the continuous simulation approach. For each model component in the risk assessment (hazard, exposure and vulnerability), uncertainty in data and methods are integrated into the risk predictions. Based on these simulations, we present a sector-wise flood risk assessment for Germany along with the reliability of the risk estimates. This process-based, systemic flood risk assessment is valuable for policy making, adaptation planning and estimating insurance premiums.