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How robust are flood hazard and risk projections?

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Major river and flash flood events have accumulated in Central and Eastern Europe over the last decade reminding the public as well as the insurance sector that climate related risks are likely to become even more damaging and prevalent as climate patterns change. However, information about current and especially future hydro-climatic extremes is often not available, and the complexity of the task and the associated uncertainty, considering different climate scenarios and models, aggravates the adaptation of any flood risk management.
In our study, we quantify and discuss the different climate-related sources of uncertainty when projecting flood risk and hazard, and we show that robust trends and projections can be found. We do this by applying the Future Danube Model (FDM), which provides spatially consistent information on extreme hydro-climatic events throughout the entire Danube catchment. The model suite consists of five individual and exchangeable modules: a weather and climate module, a hydrological module, a risk module, an adaptation module, and a web-based visualization module. The weather and climate module was used to produce synthetic daily weather time series of 10,000 years that statistically represent current (reference period) and future climate conditions (two climate change scenarios in two periods in the 21st century). The weather time series were fed into the hydrological module to simulate river discharges in more than 13,000 river reaches in the entire Danube catchment. The output of the hydrological module is used by the risk module which translates hydrological extremes into financial losses. 2D hydro-dynamic simulations are performed to derive inundation depth, return period and flow velocity maps as flood intensity metrics which are input to the flood loss model component.
The results show that more and more intense hydrological extremes are likely to occur under climate scenario conditions, despite the inherent uncertainty in climate projections, e.g. higher order floods occur more frequently. We further support our findings by analyzing current trends in hydro-climatic pattern.