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Climate change impacts on hydro-meteorological extremes - are there robust signals?

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Major river and flash floods and other hydro-meteorological extremes have accumulated worldwide over the last decade reminding the public as well as the private sector that climate related risks are likely to become even more damaging and prevalent as climate patterns change. However, information about current and 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 natural hazards related risk management. While not all low probability weather and flood events will lead to high impacts, others may accumulate by the interaction of several hydro-meteorological events. This will lead to a change of the level of risk, for example, to critical infrastructure.

The methodology and model suite presented here was developed to estimate different perils such as heavy precipitation, heat waves, floods, and droughts under recent and future climate conditions. The focus is on extreme events, related damages and possible adaptation measures. The weather and climate module uses observed and regional climate model data to produce, using a probabilistic approach, long-term daily weather time series as they are representative under current and future climate conditions. They serve as input to the hydrological module, which translates the weather input under current and future conditions into runoff components, which are routed over the river network using a hydraulic model to assess the changes in future flood volumes and levels. A risk module translates the hydrological extremes into financial losses and a web-based Geographic Information System visualizes the simulation results.

Using the example of the Danube basin, we quantify and discuss the different climate-related sources of uncertainty when projecting flood hazard and risk, and we show that robust trends and projections can be found. We also demonstrate how these results can be applied in adaptation strategies in the public and private sectors, for example when looking at critical infrastructure