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Comparison of Scenario-neutral Approaches to Estimate Future Flood Characteristics

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An novel approach to estimate climate change impacts on hydrological variables has gained increasing attention in the last decade: Oftentimes referred to as “decision scaling”, “scenario-neutral” or “bottom-up” approach, it comprises the use of impact models to assess the sensitivity of a given response variable (e.g. peak discharge) and catchment to a pre-defined range of changes of selected climatic variables. The scenario-neutral approach requires the definition of a selection of variables to alter and the generation of plausible meteorological time series that capture expected future conditions. Different methods have been proposed to achieve the latter, and it remains unclear if and to which extent they result in comparable flood projections.

In the present study, we compare three of these methods to generate temperature and precipitation time series covering a major fraction of approaches currently found in literature. Apart from considering change in mean temperature and precipitation, the existing methods address different aspects of the meteorological time series, e.g. their seasonality, their wet spell frequency and length or their statistical dispersion. We explore the effects of these methods on projected flood peak magnitudes and volumes using a distributed hydrological model for a pre-alpine example catchment.

The results reveal how the sensitivity of flood characteristics to change in mean precipitation and temperature is affected by additional assumptions made by different methods. We explain these patterns in the hydrological response by relating them to the properties of the generated meteorological time series and quantify the uncertainty that can arise by focusing on selected characteristic of hydro-meteorological change when projecting future flood occurrences.