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A multi-model cross-scale study to quantify sources of uncertainty in hydrological climate change impact assessment

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Climate change impacts on hydrology are normally investigated applying a chain of climate and impact models under different scenario conditions. While the goal is generally to investigate the relevance of changes in climate for the water cycle, water resources or hydrological extremes, it is often the case that variations in other components of the model chain obscure the effect of climate scenario variation. The result is that there is no clear hydrological impact signal in many regions, especially when the climate change signal is small. This latter finding is very important when discussing the limits of future temperature increase. In our study, we use ANOVA (ANalyses Of VAriance) to allocate and quantify the main sources of uncertainty in the entire model and scenario chain and to determine the significance of different sources of uncertainty. To this end, we use a set of five climate models in nine large scale river basins under different scenario conditions. The climate scenario data are the driver for a set of four global and nine regional hydrological impact models. The impact variable we consider in our analysis is daily river discharge at the basin outlet, as an indicator for overall water availability and flow regime including seasonality, high flows and low flows. We further analyze scaling effects by separately looking at discharge generated by global and regional hydrological models. Finally, we compare our results against the outcome of other recently published studies.