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Uncertainty assessment of the EURO-CORDEX climate change products on streamflow across Germany

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The coordinated regional downscaling experiment (EURO-CORDEX) provides currently the most advanced downscaled climate change scenarios for the European continent. It is well known that climate projections differ for different global circulation models (GCMs) and that it is necessary to apply an ensemble of GCMs to obtain more robust climate change impact assessments. Besides that, first assessments show, that the CORDEX datasets perform different for different ecoregions. Also, various bias correction methods exist which all have their advantages and disadvantages. The main objective of this study is the uncertainty assessment of climate change projections and bias correction methods on streamflow and streamflow indicators in three different catchments across Germany.

From the downscaled EURO-CORDEX 11km-grid size dataset, we ran all possible combinations of two representative concentration pathways (RCP 4.5 and 8.5) of 16 GCMs under five bias correction methods for precipitation and temperature, including no bias correction. This resulted in 192 climate time series up to the year 2100. These scenarios have been applied on well-calibrated daily time step SWAT-models of three mesoscale catchments in Germany (Treene, Kling-Gupta-Efficiency (KGE)=0.94; Kinzig, KGE=0.93; Ammer, KGE=0.61). The catchments are representative for three ecoregions, the northern German lowlands, the central German lower mountains and the Alpine region.

Performance of the bias-correction methods and type of GCM has been evaluated by comparing hydrologic simulations of monthly streamflow using the hindcasted, bias-corrected and uncorrected climate data versus station-based climate data. The climate change impact on future simulated streamflow, depending on the choice of climate model, RCP 4.5 and 8.5 and bias correction method has been assessed for three different future time periods, averaged over 10yr-periods for 2030, 2050 and 2100. For these time periods, indicators of hydrologic alteration (IHA) have been calculated.

Our results show which climate model and which bias correction method performs best in the respective region. More importantly, it shows the uncertainty range and main trend of future projections. The provided information of how streamflow indicators will most likely develop, is an important basis for further impact studies.