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Robustness of conceptual rainfall-runoff models to high-resolution climate projections in northern Tunisia

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Robust hydrological models with temporal transposable parameters are needed to evaluate the impact of climate change on water resources at the catchment scale. This study thus aims to assess the transferability of three conceptual rainfall-runoff models (GR4j, HBV and IHACRES) under contrasted climate conditions in view of hydrological scenarios based on high-resolution climate projections in Northern Tunisia. For this purpose we developed an original General Split Simple Test (GSST) based on an oriented bootstrap allowing for more contrasted sub-periods to be sampled. When applied to five catchments in northern Tunisia, the enhanced GSST provided clearer limits of models' transferability under changing precipitation (P) and temperature (T) conditions in comparison to other techniques. The transferability limits call for selecting a past sub-period as close as possible to future climate to identify calibration parameters that can be used for hydrological projections. These limits of transferability were then confronted to the climate projections from nine high-resolution Eurocordex and Medcordex Regional Climate Models (RCMs) over the studied catchments. The RCMs precipitation and temperature simulations over the historical 1970–2000 period were first assessed in order to select the more realistic ones for future projections. Given the insufficient realism of mean seasonal and annual precipitation from the RCMs, a delta-change monthly correction was used to perturb the observed climate series according to climate simulations under two Radiative Concentration Pathway (RCP) scenarios (RCP4.5 and RCP8.5) for two horizons (medium 2040–2070 and long-term 2070–2100 horizons).The effects of the selected past calibration period on the hydrological projections were analysed. We found that models calibrated on the whole observed period lead to underestimate the climate change impacts on runoff by 5 to 20% in comparison to their calibration on sub-periods with mean annual P and T closer to future climate conditions.