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Using the advanced delta change approach and a distributed model for a rapid assessment of reach-scale streamflow projections in intermittent rivers

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Global bias-adjusted daily climate projections have been recently set up as part of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) phase 3 based on CMIP6 projections (Lange et Büchner., 2021). This dataset is aimed at being used as input to global hydrological models, and their coarse resolution however prevents them to be used for catchment-scale and reach-scale applications.

This work proposes to downscale these global climate projections through a pragmatic delta change approach and to derive catchment-scale streamflow time series through a fully-distributed hydrological model. The final objective is to produce future daily streamflow series over a high-resolution hydrographic network of 6 European catchment case studies for the DRYvER project (Datry et al., 2021). The advanced delta change approach (van Pelt et al., 2012) is selected here as it allows to create differential change factor according to distribution quantiles. The method is applied on precipitation, temperature, and potential evapotranspiration serving as input to the distributed JAMS-J2K model (Krause et al., 2006).

This setup is first applied to the Ain catchment case study (France) that includes the intermittent Albarine river, considering a control period (1985-2014) and two future periods (2021-2050 and 2071-2100). These experiments are conducted using one run from 5 different global climate models and 2 emission/socio-economic scenarios (SSP1-RCP2.6 and SSP5-RCP8.5) from the CMIP6 experiments. This methodology allows to grasp the range of future changes in daily streamflow over the entire catchment. The comparison between the control period and the two future periods is used to describe possible changes over seasonal discharge and low flow characteristics.

This approach is a preliminary step providing first and rapid insights into plausible futures for European intermittent rivers in terms of hydrology, biodiversity, ecosystem functioning and services, and adaptive management. Future steps will refine such futures using an innovative downscaling approach combining global and catchment-scale transient projections way to better grasp the joint influence of climate change and climate variability on reach-scale intermittence.

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