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Data assimilation of global hydrological model discharge to constrain a distributed hydrological model

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Daily climate projections have been recently created using several global climate models under different scenario emissions for their specific use as inputs for global hydrological models (Lange et Büchner., 2021). Despite the interest of these data, their coarse resolution prevent them to be used for hydrological models at the catchment scale and even more at the reach-scale.

This work therefore proposes a novel approach to make use of both global climate and global hydrology information and derive catchement-scale hydrological time series through a distributed hydrological model and a specifically designed data assimilation method. The final objective is to produce future streamflow series over 6 catchment case studies in Europe as part the DRYvER project (Datry et al., 2021). To that end, coarse climate forcings are downscaled through a spatial analogue procedure on precipitation, temperature, and potential evapotranspiration to derive ensemble time series of meteorological forcings. This ensemble then serves as an input to the distributed hydrological JAMS-J2K model (Krause et al., 2006). Finally, the hydrological distributed model JAMS-J2K is constrained by global hydrological time series available at the catchment outlet using a Particle Filter data assimilation procedure (van Leeuwen, 2009).

This setup is first applied to DRYvER catchments during the historical period 1995-2015, securing independent observations over the catchments to evaluate the impact of data assimilation. These experiments put forward the improvement of high-resolution hydrological simulations resulting from the assimilation of discharge from a global hydrological model, with respect to a simulation only driven by coarse meterological time series. Furthermore, by construction, the method allows deriving daily high-resolution hydrological time series coherent with global hydrological time series, paving the way for reach-scale hydrological projections under climate change scenarios.

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