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A 140-year ensemble streamflow reconstruction of over 662 catchments in France

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The knowledge of historical French weather has recently been improved through the development of the FYRE (French Hydrometeorological REanalysis) Climate reanalysis, a high-resolution ensemble daily reanalysis of precipitation and temperature covering the period 1871-2012 (Devers et al., 2018). This new dataset originates from an offline data assimilation scheme merging the ensemble SCOPE Climate reconstruction dataset (a statistical downscaling of the Twentieth Century Reanalysis, Caillouet et al., 2018,) and historical daily observations of precipitation and temperature.

The FYRE Climate dataset has been used as an input for hydrological modeling over a large sample of 662 near-natural French catchments using the GR6J lumped conceptual model, in order to build a 140-year ensemble large-scale streamflow reconstruction over France. Several sources of uncertainties have been taken into account : (1) the climate uncertainty by using forcings from all 25 ensemble members provided by FYRE Climate, (2) the streamflow measurement error by perturbing observations used during the calibration, and (3) the hydrological model error based on the relative discrepancies between observed and simulated streamflow.

The streamflow reconstructions are compared to the SCOPE Hydro dataset (Caillouet et al., 2017) and the Safran Hydro dataset, obtained using forcings respectively from SCOPE Climate and the reference deterministic Safran reanalysis (covering the 1958-2016 period, Vidal et al., 2010). The streamflow reconstruction using FYRE Climate and taking into account the three sources of uncertainty show a higher daily correlation and a lower root mean square error than the SCOPE Hydro reconstruction. The streamflow reconstructions also reach a performance similar to the Safran Hydro dataset, and additionally (1) span the entire twentieth century, and (2) provide information about the hydrometerological reconstructions uncertainty. Overall the results show the added value of the new reconstruction in terms of temporal extent, quality, and uncertainty estimation, therefore allowing to better understand the variability of past hydrology over France.

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