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# Impact of multidecadal climate variability on policy-relevant low- flow estimates over France

Jean-Philippe Vidal, Laurie Caillouet, Alexandre Devers, and Eric Sauquet
Irstea, UR Riverly, Villeurbanne Cedex, France (jean-philippe.vidal@irstea.fr)

Low-flow statistics support the definition of legal thresholds used for estimating environmental flows, and for designing water structures or maximum abstraction levels. In France, the most used low-flow statistics is the annual monthly minimum flow with a 5-year return period (called QMNA5). Such low-flow statistics are moreover usually estimated from observations over the last few decades. Streamflow observations are indeed barely available before the end of the 1960s in France.

This works aims at demonstrating that such low-flow estimates are highly dependent on the period chosen for calculation, as a consequence of the large multidecadal climate – and thus hydrological – variability. The basis for this analysis is the SCOPE Hydro dataset, a 25-member ensemble daily streamflow reconstruction for more than 600 near-natural catchments in France covering the period 1871-2012 (Caillouet et al., 2017). The SCOPE Hydro dataset had been derived through a hydrometeorological reconstruction approach that combines a statistical downscaling of the Twentieth Century Reanalysis (Compo et al., 2011) and catchment-scale hydrological modelling. A complementary dataset is the Safran Hydro dataset, derived from the same hydrological models but using the Safran meteorological reanalysis from 1958 onwards (Vidal et al., 2010).

The QMNA5 low-flow statistics are here computed for all catchments over 7 consecutive 20-year periods, from (1) observations, (2) the Safran Hydro dataset, starting with 1971-1990, and (3) the SCOPE Hydro dataset, starting with 1871-1890. QMNA5 values are estimated by fitting a lognormal distribution, and in a probabilistic way to take account of sampling uncertainty. The performance of SCOPE Hydro is first assessed by its ability to reproduce low-flows statistics as derived from both observations and Safran hydro over the recent overlapping periods.

Results of the long-term analysis show a large multidecadal variability of QMNA5 estimates over the 7 periods covering the end of the 19th century and the whole 20th century. They notably show significantly higher values between the most recent period (1991-2010) and some earlier periods, notably 1871-1990 and 1911-1930. These results are consistent with the identification of extreme spatio-temporal low-flow events at the scale of France previously derived from the SCOPE Hydro dataset (Caillouet et al., 2017). They critically question current practices for estimating legal streamflow thresholds, which generally use a short and recent period for determining low-flow statistics and associated uncertainty.

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