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Hydro-meteorological changes in European catchments: scale-dependency of the forced climate response and natural variability

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As a consequence of global warming the hydrological behavior of river catchments is expected to change. However, the multi-decadal natural variability may be large compared to the forced climate response, making it difficult to detect changes in hydro-meteorological variables due to anthropogenic greenhouse gas and aerosol emissions from observational records. As was shown previously for the local scale (12km) in Western Europe, the natural variability in precipitation (extremes) is especially large, masking or amplifying the forced response until far in the 21st century (Aalbers et al. 2017). Here we examine whether spatial aggregation of precipitation over a series of European catchments (among others the Rhine, Meuse, Loire, Seine, Po, Elbe, Thames) yields a more robust climate change signal. Moreover, we examine to what extent the signal-to-noise ratio in precipitation is reflected in more comprehensive hydro-meteorological variables, namely evaporation, soil moisture and runoff.

We base our analysis on a large ensemble of climate model simulations for the period 1951-2100, forced with historical emissions until 2005 and the RCP8.5 emission scenario from 2006 onwards. All simulations have been performed with the same global (EC-EARTH) and regional ($RACMO_2$) climate model, but were started from slightly different initial conditions, thus sampling the natural variability of the climate system. As such we can examine the relative role of multi-decadal natural climate variability on trends in hydro-meteorological variables.

Aalbers, E.E., Lenderink, G., van Meijgaard, E. and van den Hurk, B.J.J.M. Local-scale changes in mean and heavy precipitation in Western Europe, climate change or internal variability. Clim Dyn (2017). https://doi.org/10.1007/s00382-017-3901-9