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Robust multiscale prediction of Po River discharge using a twofold AR-NN approach

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The Mediterranean area is among the regions most exposed to hydroclimatic changes, with a *likely* increase of frequency and duration of droughts in the last decades and potentially substantial future drying according to climate projections. However, significant decadal variability is often superposed or even dominates these long-term hydrological trend as observed, for instance, in North Italian precipitation and river discharge records. The capability to accurately predict such decadal changes is, therefore, of utmost environmental and social importance.

In order to forecast short and noisy hydroclimatic time series, we apply a twofold statistical approach that we improved with respect to previous works [1]. Our prediction strategy consists in the application of two independent methods that use autoregressive models and feed-forward neural networks. Since all prediction methods work better on clean signals, the predictions are not performed directly on the series, but rather on each significant variability components extracted with Singular Spectrum Analysis (SSA).

In this contribution, we will illustrate the multiscale prediction approach and its application to the case of decadal prediction of annual-average Po River discharges (Italy). The discharge record is available for the last 209 years and allows to work with both interannual and decadal time-scale components. Fifteen-year forecasts obtained with both methods robustly indicate a prominent dry period in the second half of the 2020s.

We will discuss advantages and limitations of the proposed statistical approach in the light of the current capabilities of decadal climate prediction systems based on numerical climate models, toward an integrated dynamical and statistical approach for the interannual-to-decadal prediction of hydroclimate variability in medium-size river basins.

[1] Alessio et. al., Natural variability and anthropogenic effects in a Central Mediterranean core, Clim. of the Past, 8, 831-839, 2012.