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Impacts of ocean-atmospheric oscillations on Mediterranean hydrology

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The Mediterranean basin is a region that is expected to be strongly impacted by climate change. Therefore it is important to analyse the water cycle over this region and the climate variability, which is expected to be controlled by oceanic-atmospheric oscillation patterns. However, the connection between Mediterranean hydrology and ocean-atmospheric oscillations is still poorly understood, because of uncertainties in the observations and the co-varying behaviour of multiple oscillations. Therefore, it is necessary to improve our understanding of these connections to provide better predictions about the evolution of the Mediterranean climate and hydrology.

Here, we present a supervised learning approach to disentangle the impact of seventeen ocean-atmospheric oscillations on hydrological variables such as precipitation, evaporation and changes in terrestrial water storage. This supervised learning approach is based on least absolute shrinkage and selection operator (LASSO) models. Our methodology allows us to account for cross-correlations in the predictors, which are in our case the climate oscillation indices. The hydrological variables are provided by the WACMOS-MED dataset, which is available for the Mediterranean area and optimised by constraining on the closure of the water budget. However, the impact of ocean-atmospheric oscillations on Mediterranean hydrology is not necessarily instantaneous. To take this into account, time lags ranging between zero and five months were introduced in every predictor. Besides using the entire available timespan at once, we also perform the analysis for the four seasons.

Our results show the impact of ocean-atmospheric oscillations on the different components of the hydrological cycle in the Mediterranean region. Particularly, we reveal a strong signal of the East Atlantic Oscillation, the North Atlantic Oscillation and the East Atlantic West Russia pattern on precipitation during the winter months. Especially Western Europe seems to be affected by those oscillations. The signal of the East Atlantic Oscillation is almost only positive, the East Atlantic West Russia pattern influences the region solely negatively and the North Atlantic Oscillation has both, a positive impact in the north and a negative influence in the south of Western Europe.

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