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Impact of multi-decadal scale changes in large-scale circulation in the North Atlantic sector on Mediterranean winter extreme hydroclimate.

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The Mediterranean region, located in the transition zone between the dry subtropical and wet European climate, is very sensitive to changes in the global mean climate state. Those changes, either radiatively forced or caused by intrinsic climate variability, may have a large impact on the presently observed and future hydroclimate in the region. Observations are usually insufficiently long to investigate and attribute decadal-scale hydroclimate changes. On the other hand, models still struggle to correctly reproduce the main mechanisms controlling Mediterranean hydroclimate and have resolutions that are too coarse to realistically simulate extreme hydroclimatic phenomena.

In this study we employ two simulations: GFDL CM2.1 and CM2.5. GFDL CM2.5 has higher spatial and temporal resolution, and has been shown to provide a reliable representation of large-scale circulation and its impact on the Mediterranean hydroclimate. This representation is consistent with observations, to the extent that observations are available.

Multi-channel singular spectrum analysis (MSSA) was applied to isolate spatio-temporal patterns of two components, which dominate the coupled ocean-atmosphere multidecadal variability over the Northern Atlantic and a large part of Europe. These components resemble the observed North Atlantic Oscillation and Eastern Atlantic Pattern (Hurrel 1999, Hurrel 2003). Both modulate the winter mean state atmospheric flow over the North Atlantic and European regions in their own unique way, which impacts precipitation over North Africa, the Mediterranean Sea and southern Europe on decadal time scales.

These results provide a necessary foundation for the second part of the study, where we quantify the influence of anthropogenic forcing on large-scale atmospheric circulation and associated Mediterranean hydroclimate.