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# Dynamical ocean-atmospheric drivers of floods and droughts

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The present study contributes to a better depiction and understanding of the "facial expression" of the Earth in terms of dynamical ocean-atmospheric processes associated to both floods and droughts. For this purpose, the study focuses on nonlinear dynamical and statistical analysis of ocean-atmospheric mechanisms contributing to hydrological extremes, broadening the analytical hydro-meteorological perspective of floods and hydrological droughts to driving mechanisms and feedbacks at the global scale.

In doing so, the analysis of the climate-related causality of hydrological extremes is not limited to the synoptic situation in the region where the events take place. Rather, it goes further in the train of causality, peering into dynamical interactions between planetary-scale ocean and atmospheric processes that drive weather regimes and influence the antecedent and event conditions associated to hydrological extremes.

In order to illustrate the approach, dynamical ocean-atmospheric drivers are investigated for a selection of floods and droughts. Despite occurring in different regions with different timings, common underlying mechanisms are identified for both kinds of hydrological extremes. For instance, several analysed events are seen to have resulted from a large-scale atmospheric situation consisting on standing planetary waves encircling the northern hemisphere. These correspond to wider vortices locked in phase, resulting in wider and more persistent synoptic weather patterns, i.e. with larger spatial and temporal coherence. A standing train of anticyclones and depressions thus encircled the mid and upper latitudes of the northern hemisphere.

The stationary regime of planetary waves occurs when the mean eastward zonal flow decreases up to a point in which it no longer exceeds the westward phase propagation of the Rossby waves produced by the latitude-varying Coriolis effect. The ocean-atmospheric causes for this behaviour and consequences on hydrological extremes are investigated and the findings supported with spatiotemporal geostatistical analysis and nonlinear geophysical models.

Overall, the study provides a three-fold contribution to the research on hydrological extremes: Firstly, it improves their physical attribution by better understanding the dynamical reasons behind the meteorological drivers. Secondly, it brings out fundamental early warning signs for potential hydrological extremes, by bringing out global ocean-atmospheric features that manifest themselves much earlier than the regional weather patterns. Thirdly, it provides tools for addressing and understanding hydrological regime changes at wider spatiotemporal scales, by providing links to planetary-scale dynamical processes that play a crucial role in multi-decadal global climate variability.