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Investigating the control of climatic oscillations over global terrestrial evaporation using a simple supervised learning method

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Intra-annual and multi-decadal variations in the Earth's climate are to a large extent driven by periodic oscillations in the coupled state of atmosphere and ocean. These oscillations alter not only the climate in nearby regions, but also have an important impact on the local climate in remote areas, a phenomenon that is often referred to as 'teleconnection'. Because changes in local climate immediately impact terrestrial ecosystems through a series of complex processes and feedbacks, ocean–atmospheric teleconnections are expected to influence land evaporation – i.e. the return flux of water from land to atmosphere. In this presentation, the effects of these intra-annual and multi-decadal climate oscillations on global terrestrial evaporation are analysed. To this end, we use satellite observations of different essential climate variables in combination with a simple supervised learning method, the lasso regression. A total of sixteen Climate Oscillation Indices (COIs) – which are routinely used to diagnose the major ocean-atmospheric oscillations – are selected. Multi-decadal data of terrestrial evaporation are retrieved from the Global Land Evaporation Amsterdam Model (GLEAM, www.gleam.eu).

Using the lasso regression, it is shown that more than 30% of the inter-annual variations in terrestrial evaporation can be explained by ocean-atmospheric oscillations. In addition, the impact in different regions across the globe can typically be attributed to a small subset of the sixteen COIs. For instance, the dynamics in terrestrial evaporation over Australia are substantially impacted by both the El Niño Southern Oscillation (here diagnosed using the Southern Oscillation Index, SOI) and the Indian Ocean Dipole Oscillation (here diagnosed using the Indian Dipole Mode Index, DMI). Subsequently, using the same learning method but regressing terrestrial evaporation to its local climatic drivers (air temperature, precipitation, radiation), allows us to discern through which climatic variables these remote ocean–atmospheric oscillations are acting upon the regional dynamics in land evaporation. The results of our study allow for a better understanding of the link between ocean-atmosphere dynamics and terrestrial bio-geochemical cycles, and may help improve the prediction of future changes in the global water cycle.