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Role of the ocean dynamics in ENSO-tropical Atlantic teleconnection under warmer climate

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El Niño-Southern Oscillation (ENSO) is the leading air-sea coupled mode of inter-annual variability in the tropical Pacific with worldwide climate impacts. Recent studies have reported that the Global Warming (GW), induced by GHG external forcing, could affect the ENSO phenomena in a long-term future climate (i.e. the frequency, intensity, spatial pattern) and consequently the ENSO teleconnections and impacts. In addition, the role of the internal climate variability seems to be crucial to amplify or attenuate the GW effect in the near-term horizon.

In the present study, we use a pacemaker protocol in a perfect model framework by using the coupled model CNRM-CM5 to investigate the influence of the mean background state (pre-industrial vs RCP85) on the ENSO teleconnection over the tropical Atlantic (TA). Two pacemaker experiments have been performed by restoring the SSTs anomalies, issued from a pre-industrial control simulation, over the eastern Tropical Pacific. Both experiments, consisting of an ensemble of 30 members each, only differ in the prescribed GHG forcing: Pre-industrial versus RCP85.

In a warmer climate, the mean Walker circulation is debilitated in the tropical band, causing anomalous subsidence over the eastern equatorial Atlantic during winter-spring. Additionally, the Atlantic Subtropical Highs are weakened and the ocean surface-subsurface connection is enhanced in the tropical Atlantic basin. Under the RCP85 scenario, the ENSO-TA teleconnection is reinforced, activating the ocean wave activity. In particular, the El Niño event originates a negative NAO-like pattern and in turn an anomalous reduction of the north-eastern trades in TA. This wind pattern at the surface is able to excite an oceanic downwelling Rossby wave north of equator that is reflected in the western boundary and propagates as an equatorial downwelling Kelvin wave from boreal spring to summer. The latter ENSO-TA teleconnection mechanism is much more prominent in a warmer climate, suggesting the importance of the background state in modulating the atmospheric ENSO signal and TA mean conditions, key elements for the effectiveness of the ENSO impact.