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External interannual ENSO forcing : which regions outside equatorial Pacific may influence the evolution of ENSO ?

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Low-frequency coupled ocean-atmosphere dynamics intrinsic to the Pacific Ocean are essential to El Niño development. Some recent studies (e.g Annamalai 2005, Izumo and al. 2010, Rodriguez-Fonseca 2009, Terray 2010, Vimont and al. 2003) however suggest that external interannual forcing may influence the evolution of El Niño. In the present study, we aim at identifying regions outside the Pacific Ocean, which can affect the evolution of ENSO. Our assumption is that zonal wind anomalies within the Pacific equatorial waveguide are a necessary condition to influence ENSO evolution. We thus aim at identifying teleconnections between SST anomalies outside of the equatorial Pacific, and Pacific equatorial zonal wind anomalies that are independent of ENSO. To that end, we first remove the ENSO signal from interannual wind and SST anomalies in several re-analyses by regression to all the principal components of an EOF analysis of Tropical Pacific Sea Surface Temperature which display significant correlations with Niño3.4 within 12 months of the ENSO peak. Results show that non-negligible (25% of interannual variance) ENSO-independent zonal winds anomalies remain in the western/central equatorial Pacific. We further show that SST anomalies in six regions (equatorial, northern and southern central Pacific; Tropical and southern Atlantic and southern Indian Ocean) display significant 0-3 months lead correlations to those ENSO-independent wind variations. These regions may hence influence ENSO evolution through remote influence on equatorial Pacific winds, as previously suggested by, e.g, Rodriguez-Fonseca (2009), Terray (2010), Vimont and al. (2003). While our statistical methodology did allow to isolate those regions, we still have to confirm from forced atmospheric and coupled simulations that:
- SST anomalies in those regions can indeed influence zonal winds over the tropical Pacific,
- the response of the Tropical Pacific coupled system to this external forcing can lead to an El Niño.