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Seasonal relationship between intraseasonal atmospheric variability and ENSO

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The large part of the synoptic variability in the Tropics is organized by convectively coupled large-scale equatorial waves, which includes the Kelvin, equatorial Rossby, mixed Rossby-gravity, eastern inertio-gravity and western inertio gravity waves and the so-called Madden and Julian Oscillation (MJO). Such disturbances are characterized by the time scales from several days up to season and contribute to a large extent to the tropical intraseasonal variability (ITV). Whereas many ENSO studies have focused on the MJO as a forcing mechanism for the change in ENSO amplitude, the role of higher-frequency waves on ENSO remains unclear. Here we investigate the seasonal relationship between the various components of the ITV and ENSO from the NCEP/NCAR Reanalysis and coupled model simulations. Double space-time Fourier analysis was applied to OLR and zonal wind at 850 hPa in order to separate the different component of the ITV in the tropical troposphere, which is used to defined indices of wave activity and document the spatial pattern of the waves. From the Reanalyses, we find that, like for the MJO, a strong seasonal dependence is between ENSO and the Kelvin and Rossby waves, with the latter having similar ITV-ENSO seasonal dependence than the MJO. Interestingly the ITV-ENSO relationship has also a marked decadal variability which reflects the ENSO low frequency modulation and character. In particular, the ITV patterns, as well as their phase-locking to El Niño differs significantly between the two different kinds of El Niño, namely the Cold Tongue El Niño and the Warm Pool (Modoki) El Niño. From a composite analysis, it is shown that, whereas for the Cold Tongue El Niño, ITV is characterized by western Pacific MJO activity in spring-early summer (central Pacific activity of equatorial Rossby waves in July) before its development, during Modoki El Niño, the wave activity enhancement occurs later in the year, in boreal fall and persists during the El Niño peak. The location of the wave variability peaks also exhibits dependence to the type of El Niño. Despite the current limited skill of coupled models to simulate the MJO, we investigate to which extend such characteristics of the ITV-ENSO seasonal dependence can be simulated by an intermediated tropical Pacific coupled model and a full CGCM.