ENSO modulations by 14.7 day- and 18.6 yr- Lunar cycles

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ENSO forecasts are sensitive to the combination of sudden weather changes with the slow recharge of the equatorial heat content from the Indian and Pacific subtropics. While the occurrence of weather regimes can be implemented in ENSO models from the daily monitoring of TRMM rain and and QuikSCAT winds, it is a challenge for coupled models to reproduce the anti-symmetry of the equatorial recharge from the North and South systematically observed in sea level and in meridional displacements of intertropical convergence zones. Climate models favor the growth of symmetric modes (SST) and underestimate the meridional changes of the circulation (recharge). Using various independent satellite data sets, we find vigorous biweekly reversals of cross-equatorial currents and winds. In the 3 tropical oceans, the Tropical Instability Waves (TIW) extracted from altimetry match the dispersion diagram of a well-organized train of Mixed-Rossby-Gravity Waves with their highest frequency at 14.7 days.

By accumulation in time, biweekly TIWs significantly contribute to interhemispheric exchanges of water properties at lower frequencies, with local and remote impacts on the atmosphere. TIWs favor normal and cold conditions in the Pacific rather than warm events. Data sets are then analyzed as a function of the biweekly equatorial crossing of the (Earth-Moon) mass center and its alignment with the Sun and Earth's center. Since 1993, the strength of TIW activity simulated by satellite data assimilation is found consistent with the minimum Lunar inclination in 1997 and maximum in 2006. Indeed historical climate records since 1850 indicate that adding the 18.6 yr Lunar inclination cycle to the 11-yr solar activity cycle is helpful to explain the decadal modulations of ENSO indices: both the irregular peaks of Sun Spot Numbers and the Lunar standstill extrema seem to contribute to the occurrence of cold or warm events. So in addition to sudden occurrences of weather bursts and to decadal adjustments of Indian and Pacific ocean recharge which both condition the growth or collapse of climate events, implementing the quasi-biweekly and -binovennial Lunar triggering of TIWs in coupled models is a source of interhemispheric climate changes which may help reduce the misfits between simulations and observations.