

## TROPICAL INTERACTIONS BETWEEN THE TROPOSPHERIC BIENNIAL OSCILLATION AND ENSO

*Tim Li and C.-P. Chang*

Department of Meteorology, Naval Postgraduate School, Monterey, CA

A simple tropical atmosphere-ocean-land model is used to understand nonlinear interactions between the tropospheric biennial oscillation (TBO) that is most prominent in the Asian-Australian monsoon region and the El Niño-Southern Oscillation (ENSO).

When the interannual variation of the Asian-Australian monsoon is suppressed, the model has a dominant ENSO mode, with an oscillation period of 3-5 years. This interannual oscillation has the characteristics of the stationary SST mode proposed by Li (1997). It emphasizes two important processes of thermocline variations. The first process involves the zonal mean thermocline depth variation that is not in equilibrium with the wind variation. The second process involves the zonally asymmetric thermocline depth variation that is always in Sverdrup balance with the winds. When the seasonal cycle is included, the interannual mode becomes season-dependent and locks phase into the seasonal cycle.

In the absence of the zonal mean thermocline variations in the Pacific, a biennial oscillation mode develops as a result of the interactions between the monsoon and planetary-scale east-west circulation and dynamic and thermodynamic air-sea coupling.

In the presence of both the ENSO and TBO modes, the model presents rich characteristics of interannual spectrums, with both the TBO and ENSO oscillate irregularly. The TBO influences ENSO primarily through planetary-scale east-west circulation that is induced by anomalous monsoon heating. On the other hand, ENSO affects TBO through two processes: 1) the change of the western Pacific and Indian Ocean SST, and 2) the altering of large-scale atmospheric overturning. Both processes are induced by El Niño-associated convective heating in the central equatorial Pacific.

The proposed TBO-ENSO interaction theory provides a possible explanation for the quasi-biennial feature of the tropical ocean and atmosphere, and the intricate nature of the observed complex relationship between the Pacific warm events and the monsoon rainfall anomalies.

**Key words:** *Tropical Biennial Oscillation, Monsoon, El Niño*