A Monsoon-Warm Ocean Interaction Scenario for the Tropospheric Biennial Oscillation (TBO)

Tim Li
IPRC and Department of Meteorology, University of Hawaii

ABSTRACT

The observed structure and seasonal evolution characteristics of the Tropospheric Biennial Oscillation (TBO) in the warm ocean areas of the Indo-Pacific region are explored using a season-sequence EOF analysis approach. The major convective activity centers associated with the TBO appear in the southeast Indian Ocean (SEIO) and western North Pacific (WNP), accompanied with anticyclonic (or cyclonic) circulation patterns with a first-baroclinic-mode structure. The convection and circulation anomalies have distinctive life cycles in the SEIO and WNP – the former have a peak phase in northern fall and the latter persist from northern winter to subsequent summer.

The mechanisms of the TBO in this region are investigated with a hybrid coupled GCM. Numerical results show that air-sea interaction in the warm ocean alone can support TBO variability that has many observed characteristics. Key processes involved in the TBO include the WNP monsoon variability and associated cross-equatorial flows, convective activity over Southeast Asia/maritime continent and associated anomalous Walker circulation, and ocean dynamic responses to anomalous wind stress curl in the western Pacific. The coupled model experiment demonstrates that the essential element of the TBO in this region arises from the monsoon-warm ocean interaction.

A possible connection between the TBO and ENSO variability is further studied in another model that excludes the delayed oscillator dynamics. The key to cause the biennial variability of ENSO arises from teleconnections between the tropical Pacific and Indian Oceans, with three "atmospheric bridges": 1) north-south teleconnection that connects the WNP monsoon and southeast Indian Ocean, 2) east-west teleconnection that connects the Indian Ocean and eastern Pacific, and 3) El Nino-WNP monsoon teleconnection.