Effects of diurnal cycle of solar radiation on the upper Indian Ocean thermal structure during the MJO events

Presenter: Weiqing Han

Authors:

Li Yuanlong & W. Han (whan@colorado.edu, U. of Colorado)

T. Shinoda (Naval Research Laboratory), C. Wang (AOML/NOAA), R.-C. Lien (U. of Washington), J. Moum (Oregon State University) and J.-W. Wang (CIRES/NOAA)

In the western Pacific warm pool, diurnal cycle of solar radiation was suggested to increase intraseasonal SST. Over the Indian Ocean, the effect of diurnal cycle on intraseasonal SST variability is not well understood, and the diurnal warming effect – if occurs during the pre-onset and onset stages of the MJO - could play a role in affecting the MJO initiation, since maintaining warm SSTs during these stages is crucial for the development of atmospheric convection associated with the MJO.

The overall goal of this study is to quantify the effects of diurnal cycle on the upper Indian Ocean thermal structure during different stages of the MJO events, examine the spatial structures and seasonal dependence of the diurnal cycle effects, and investigate the associated physical processes. To isolate the impact of diurnal cycle, two parallel experiments were performed using the HYbrid Coordinate Ocean Model (HYCOM) for the Indo-Pacific basin (30ºE-290ºE, 40ºS-40ºN) with 1/4ºx1/4º horizontal resolution and 35 vertical layers. The Control Run (CTR) is forced by the daily CCMP winds, CERES shortwave radiation plus an idealized diurnal cycle, CERES longwave radiation, TRMM precipitation and ERAI 2-m air temperature and specific humidity from 2006-2011. In the Bay of Bengal, monthly river discharge data are from Papa et al. (2011) and Dai et al. (2009) are used to force HYCOM. The Experiment Run (EXP) is the same as the CTR, except that the idealized diurnal cycle is removed from the shortwave radiation field. Our preliminary analyses show that HYCOM CTR reasonably simulates the upper Indian Ocean background state, diurnal and intraseasonal variability, and compare reasonably well with the satellite and in situ observations from RAMA, ARGO and DYNAMO field campaign in the fall of 2011. The difference between the two experiments (CTR - EXP) indicates that diurnal cycle generally deepens the mixed layer, with large amplitudes occurring in the Bay of Bengal, southeast Arabian Sea and eastern equatorial Indian Ocean. The SST difference between the CTR and EXP solutions exhibits significant amplitudes at specific locations. The amplitudes, however, significantly reduce when regional mean is performed. Further analyses will be performed to reveal the role of the diurnal cycle in affecting the SST during different stages of the MJO events during the DYNAMO period of 2011, and to understand the causes.