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Oceanic Dynamics Associated with ENSO in Affecting the SST variation in the Philippine Sea

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Negative Sea Surface Temperature (SST) anomalies in the Philippine Sea during the El Niño have been noted as an important element for maintaining the anomalous Philippines Sea anticyclone (PSAC) which prolongs the El Niño influence in the East Asia (Wang et al., 2000, 2003; Hsu et al., 2001). It is found that the correlation between the interannual variations of net heat flux and SST tendency is weak in the tropical western Pacific (Chou et al., 2004), and that the Philippine Sea generally receives positive surface heat flux during El Niño (Klein et al., 1999). The role of oceanic dynamics in affecting the SSTs in this portion of the Pacific has been noted but not yet being fully investigated. The study is a first try to identify the kinds of oceanic dynamical process associated with ENSO in affecting the SST variation in the Philippine Sea.

Fifty-five years of model results from the OFES (OGCM for the Earth Simulator) are deployed, with focus on the 1997/98 El Niño simulations. The OFES is a flux driven MOM3 with horizontal grid spacing of 0.1° and 54 vertical levels with various grid width. Analysis of ocean heat content (0/200 m) derived from the OFES data (1950-2004) shows that, in the Philippine Sea, there are substantial interannual variations in areas with large meridional gradients of mean thermocline depth (3°-7°N and 8°-12°N) as well as in the shallow thermocline region associated with the mean upwelling, the NECC Trough (6°-9°N). In the 1997/98 El Niño episode, we find that thermocline was first elevated at the NECC Trough, which are geostrophically associated with the North Equatorial Counter Current (NECC) and North Equatorial Current (NEC), then by the non-local upwelling Rossby waves originated from the mid-basin along 3°N and 11°N. As a result, the thermocline was diffuse and its topography became widely flat; the sub-thermocline cold water was brought to 20 m depth as early as in May of 1997, and was able to affect the SST when strong westerly winds provided energetic mixing in July-August of 1997.

The result indicates that the dynamical process of the thermocline upwelling in the Philippine Sea region involves a) the local effect related to the strength and latitude changes of NEC and NECC and b) non-local waves. The dynamical process of the thermocline upwelling is less well represented in mixed layer model; thereby it provides an explanation for the weak SST anomaly in Lau and Nath's (2003) simulation.