Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

ACG05-16 Room:201B Time:May 25 14:30-14:45

Cooling Processes in the Southeastern Tropical Indian Ocean during the Initiation Period of the 2006 IOD

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Subsurface temperature variability in the southeastern tropical Indian Ocean associated with the 2006 Indian Ocean Dipole (IOD) event and a possible mechanism responsible for cooling of the upper-ocean during a generation period of the IOD are investigated using satellite data, atmospheric reanalysis data, and results from a high-resolution ocean general circulation model (OFES). We conducted a heat budget analysis, focusing on the evolution for the 2006 IOD event, which was the largest positive IOD during the 2000s and the first event of the three consecutive positive IODs in 2006/07/08.

OFES reproduced the 2006 IOD event realistically in terms of time evolution of the subsurface temperature in the eastern tropical Indian Ocean. During May to July 2006, prior to the emergence of the surface IOD signals, several equatorial upwelling Kelvin waves are excited in the central Indian Ocean by zonal wind stress anomalies. These Kelvin waves penetrate into the coastal regions along the Sumatra and Java Islands, and generate subsurface negative temperature anomalies through a vertical advection term in the heat budget analysis. It turns out that the vertical advection term is dominated by a term associated with an advection of mean vertical temperature gradient by an anomalous vertical velocity. These subsurface cooling processes associated with the intraseasonal Kelvin waves seem to be important for the onset of the sea surface temperature anomaly off the coast of Sumatra and Java Islands in 2006.

Keywords: Indian Ocean Dipole, Upper ocean heat budget