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Seasonal onset of the Madden-Julian Oscillation and its relation to the southeastern Indian Ocean cooling

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The relation among sea surface temperature (SST) cooling in the southeastern Indian Ocean (SEIO), oceanic Rossby waves, and the seasonal onset of the Madden-Julian Oscillation (MJO) is examined for the period 1993-2012. A westward propagation of the annual downwelling Rossby waves occurs in the southern Indian Ocean for most of the years. However, its amplitude and phase speed vary every year. Positive SST anomalies migrate concurrently with the Rossby waves but are followed by a wide-spread cold pool in the SEIO from boreal summer to fall. Whereas the cold pool tends to persist for a longer period until November during positive Indian Ocean Dipole (IOD) and/or El Nino years, it occurs irrespective of the IOD. Convection related to the MJO events during boreal winter propagates from the Indian Ocean to the Pacific only after the cold pool is terminated. A correlation analysis indicates that the SST cold pool is confined to the Southern Hemisphere, but its influence on convection reaches north of the equator via excitation of the local circulations over the eastern Indian Ocean and the tropical western Pacific. The resulting southerly surface-wind anomalies may advect dry air south of the equator to the north and suppress atmospheric convection around the equator. Thus, the SEIO cold pool tends to prevent intraseasonal convection from propagating eastward to the Pacific. Briefly analyzing the process of the cold pool formation shows that SST variability in the SEIO during boreal summer to fall correlates well with zonal advection and surface heat flux. In turn, zonal advection is connected to the strength of westward currents associated with the Rossby waves. Clarifying the SEIO upper-ocean processes can contribute in predicting the seasonal onset of an MJO sequence.

Keywords: Madedn-Julian Oscillation, oceanic Rossby wave, the southeasern Indian Ocean