Enhancement of Madden-Julian Oscillation realization by low-frequency zonal SST gradient

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An environment favorable for development of the Madden-Julian Oscillation (MJO) is investigated by classifying MJO-like atmospheric patterns into MJO and regionally confined convective events (RCC). Comparison of MJO and RCC events show that even with preceding major event of convective suppression, convective events do not develop into an MJO when it is not accompanied by large scale buildup of moist static energy (MSE). The difference in the MSE accumulation between MJO and RCC is related to the contrasting low-frequency basic state sea surface temperature (SST) pattern, in which MJO and RCC are associated with prevalence of anomalously warm and cold low-frequency SST over western to central Pacific respectively. Distinct difference in the SST anomaly field between MJO and RCC identified in the low-frequency range is missing in the intraseasonal frequency range of 20-60 days. During the MJO low-frequency SST pattern is characterized by positive zonal SST gradient from the Indian Ocean to the central Pacific. This low-frequency SST pattern contributes to the sufficient build-up of MSE across Indian Ocean to the Western Pacific by providing long-standing condition that induces large-scale low-level convergence. The results of this study propose the potential importance of the low-frequency SST pattern with positive zonal SST gradient in enhancing convective activities on longer than intraseasonal time scale and realizing a complete lifecycle of the MJO.

Keywords: Madden-Julian Oscillation , Air-Sea interaction

