Influence of the Complex Land-Sea Distribution on the Propagating MJO in the Maritime Continent

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Abstract

The Maritime Continent acts as a semi-continental barrier to the eastward propagating Madden-Julian Oscillation (MJO) with its discrete small islands and oceanic areas. Although exact mechanism(s) due to the complicated land-sea contrast and narrow-distributed topography are not fully understood, observations in previous studies have shown clear relationship between the evolution of MJO and the existence of the Maritime Continent. Mean cloud top pressure of the International Satellite Cloud Climatology Project (ISCCP) D1 product is applied to demonstrate different stages which deep convection (wet phases) or lower cloud anomalies dominate (dry phases) in specific locations during the entire MJO cycle. No matter what the phases are, obvious land-sea contrast could be seen for both kinds of cloud systems.

Analyses of the Tropical Rainfall Measurement Mission (TRMM) 3B42 product, version 6 also show similar phenomena, and provide detailed information of the spatially discontinuous but sequentially developed cloud systems near the mountainous islands such as Sumatra, Borneo and Sulawesi, as well as Papua New Guinea at the eastern edge of the Maritime Continent. Compared with dynamical fields from the ERA40 dataset, these results suggest that deep upward motion favorable for convection development occur in the regions of westerly anomalies, and easterly anomalies only those close to zero m/s contours, which implies the importance of the zonal confluence to MJO propagation. Clear separation of zonal wind patterns by complex topography similar to those of clouds and surface rain could also be observed. Vertical profiles also show that easterly anomalies at the east side of islands next to the MJO convection center may be lifted either by low-level convergence or the topography itself, where farther easterly anomalies are accompanied with wave-like motion which may be caused by complicated interaction between subsidence of MJO circulation and the mountains. During later phases which westerly anomalies dominate the domain, downdrafts at leeward sides of topography and large-scale subsidence both suppress generation of deep convection, therefore lower cloud systems evolve instead.