MJO Signals in Latent Heating: Results from TRMM Retrievals

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Popular Summary

The Madden-Julian Oscillation (MJO) is the dominant intraseasonal signal in the global tropical atmosphere. Almost all numerical climate models have difficulty to simulate realistic MJO. Four TRMM datasets of latent heating were diagnosed for signals in the MJO. In all four datasets, vertical structures of latent heating are dominated by two components, one deep with its peak above the melting level and one shallow with its peak below. Profiles of the two components are nearly ubiquitous in longitude, allowing a separation of the vertical and zonal/temporal variations when the latitudinal dependence is not considered. All four datasets exhibit robust MJO spectral signals in the deep component as eastward propagating spectral peaks centered at period of 50 days and zonal wavenumber 1, well distinguished from lower- and higher-frequency power and much stronger than the corresponding westward power.

The shallow component shows similar but slightly less robust MJO spectral peaks. MJO signals were further extracted from a combination of band-pass (30 – 90 day) filtered deep and shallow components. Largest amplitudes of both deep and shallow components of the MJO are confined to the Indian and western Pacific Oceans. There is a local minimum in the deep components over the Maritime Continent. The shallow components of the MJO differ substantially among the four TRMM datasets in their detailed zonal distributions in the eastern hemisphere. In composites of the heating evolution through the life cycle of the MJO, the shallow components lead the deep ones in some datasets and at certain longitudes.

In many respects, the four TRMM datasets agree well in their deep components, but not in their shallow components and the phase relations between the deep and shallow components. These results indicate that caution must be exercised in applications of these latent heating data.