Evolution of Clouds and their Large Scale Environment during the Madden Julian Oscillation

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Abstract:

The interactive evolution of clouds and the large-scale environment is a long-standing issue frequently speculated in hypotheses of the Madden Julian Oscillation (MJO). In this study we observationally investigate their evolution from a bottom-up perspective of the atmosphere. We used data from Ka-band Atmospheric Radiation Measurement (ARM) Zenith Radars (KAZR) and atmospheric soundings from Gan Island collected during the Dynamics of the MJO (DYNAMO) field campaign and from one long-term (approximately 6 years) observational site in the Tropical Western Pacific (TWP) and estimates of precipitation from the tropical rainfall measurement mission (TRMM). We classified clouds according to the height of their base and observed precipitation into four groups: boundary layer and convective non-precipitating, convective precipitating, alto, and high clouds. A relatively dry low and mid troposphere, as well as shallow non-precipitating and scattered thin alto and high clouds characterize the pre-onset stage of the MJO. The low and mid troposphere progressively becomes moister and the convective and alto cloud tops become deeper towards the onset stage. The maximum in relative humidity occurs before the maxima in occurrence and depth of convective clouds. Alto and high clouds become thicker and more frequent after the onset stage. Finally, the occurrence and depth of the four types of clouds diminishes and the low and mid troposphere become drier towards the next inactive phase of the MJO.