Thermodynamic Aspects of Tropical Cyclone Formation

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Abstract

The thermodynamic aspects of tropical cyclone (TC) formation near the center of the wave pouch, a region of approximately closed Lagrangian circulation within the wave critical layer, are examined through analysis of a high-resolution numerical simulation, dropsonde data from a recent field campaign and the ERA-Interim reanalysis data. The high-resolution numerical model simulation shows that the meso-β area near the pouch center is characterized by high saturation fraction, small difference in equivalent potential temperature (θ_e) between the surface and the middle troposphere, and a short incubation time scale. Updrafts tend to be more vigorous in this region, presumably due to reduced dry air entrainment, while downdrafts are not suppressed.

The analysis of dropsonde data shows that the mid-level θ_e increases significantly near the pouch center one to two days prior to genesis but changes little away from the pouch center. This may indicate convective organization and the impending TC genesis. The significant differences of the thermodynamic conditions between the inner pouch and outer pouch regions are also revealed in the analysis of more than 150 named storms using the ERA-Interim reanalysis. It suggests that the thermodynamic conditions near the pouch center are critically important for TC formation but the critical information of TC genesis near the pouch center may be masked out if an average is taken over a large spatial scale.