

Radar-derived Thermodynamics in Tropical Cyclones

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Deep convection and stratiform precipitation are integral parts of a tropical cyclone (TC), but our understanding of how these different modes of convection contribute to intensity change is still limited. The forcing and mode of convection depends on a dynamic and thermodynamic environment that changes throughout the TC's life-cycle. Increasing rotation and a symmetric warm-core development during intensification is followed by extratropical transition to an asymmetric cold-core system. While Doppler radar can provide kinematic and precipitation structures, direct observation of three-dimensional changes in the warm-core, local buoyancy, and pressure gradients remains difficult. An indirect approach can retrieve temperature and pressure perturbations from Doppler radar-derived winds, but traditional techniques are not optimal for application in a large, rapidly rotating storm with a system-scale warm or cold core.

A modified thermodynamic retrieval will be presented that uses radar-derived winds to solve for temperature and pressure perturbations relative to a system-scale vortex assumed to be in thermal wind balance. In situ kinematic and thermodynamic data from aircraft are incorporated into the retrieval to improve the results. The new formulation is believed to provide better insight into the nature of convection and the thermodynamic structure of TCs. Details of this novel retrieval methodology will be presented along with results using data from the RAINEX and T-PARC field campaigns. The results illustrate the changing characteristics of TC convection and thermodynamics at different stages of the life-cycle, from genesis to rapid intensification and eventual extratropical transition.