論文の内容の要旨

論文題目

On the Dynamics of Warm Core Structures of Tropical Cyclones

（熱帯低気圧の暖気核に関する力学的研究）

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The present study aims to improve the understanding for the intensities and structures of tropical cyclones via two approaches related to the warm core structures.

At the first part, on the basis of numerical results of a three-dimensional model diagnosed using balance dynamics, a mechanism by which the upper-level warm core of TCs forms is proposed. The numerical results reveal that an upper-level warm core develops when TCs intensify just prior to reaching the mature stage. Potential temperature budget analysis reveals that for the tendency of potential temperature, the azimuthal-mean component of advection is dominant at the upper level of the eye at the mature stage. Sawyer-Eliassen diagnosis shows that tendencies due to forced flow by diabatic heating and diffusion of tangential wind are dominant in the eye and are negatively correlated to each other. The distributions of the diabatic heating in the simulated TC are not peculiar. Therefore, it is unlikely that the heating distribution itself is the primary cause of the flow from the lower stratosphere. The analyses of forced circulations of idealized vortices show that the upper-level subsidence is enhanced in the eye when the vortex is sufficiently tall to penetrate thestatically stable stratosphere. This result is deduced because the stronger inertial stability extends

the response to the heating of the lower stratosphere and causes upper-level adiabatic warming. Therefore, the upper-level warm core emerges if angular momentum is transported into the lower stratosphere due to processes such as convective bursts. These analyses suggests that TCs can be even stronger than that expected by theories in which the TC vortex is confined in the troposphere.

At the second part, the warm core structures in the TCs simulated in a one-year simulation using the nonhydrostatic GCM with 7-km horizontal grid spacing were investigated. The statistical analyses revealed the strong correlation between intensifies and heights of warm core maxima of TCs which reach a certain level of intensity, although the heights of warm core maxima diverged for weaker TCs. By comparing the heights of the warm core maxima with those 24 hours before the corresponding sampling time, it was determined that the heights of warm core maxima tended to be higher (lower) than those 24 hours before the correspond sampling times for the developing (decaying) TCs. By comparing actual temperature anomalies with those calculated according to the thermal wind balance equation and simplifying the calculation gradually, it was revealed that warm core structures can be captured from only the inner core tangential wind field and the ambient temperature profile. Therefore, there is a possibility that the warm core structures can be estimated the combination of thermal wind balance equation and the slope of satellite brightness temperature reflectivity surfaces under assumptions for tangential wind fields such as the rigid body rotation.

The results which suggested the possibilities that the lower stratospheric can behave as additional energy sources for tropical cyclones through the dynamical processes occurring near the tropopause and that the warm core structures which are closely related to the intensities can be estimated from satellite observations can contribute the improvement for the understanding of TC intensities.