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Analysis of tropical cyclone warm core structure by using the Advanced Microwave Sounding Unit (AMSU) data

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A warm core, defined as the central area of a tropical cyclone (TC) warmer than the surrounding area, is a characteristic feature for TC identification and is physically related to the minimum sea level pressure (MSLP). Intensification of the warm core is related to the decrease of MSLP due to the latent heat release caused by convections in the TC. In addition, adiabatic heating by air subsidence inside the eye contributes to the intensification of the warm core. To capture the characteristics of TC warm core, this study uses the 55-GHz band brightness temperature (TB) data of the Advanced Microwave Sounding Unit-A (AMSU-A) for TCs in the Western North Pacific basin.

Investigations on the warm core intensity defined as the maximum TB anomaly showed that the correlation coefficient between the warm core intensity and the best track MSLP of the Japan Meteorological Agency was +0.91 for TCs in 2008. Further, MSLPs were estimated from the warm core intensity for TCs in 2009 - 2011 by the estimation equation derived from AMSU-A data and the best track MSLP for TCs in 2008. The validation of the MSLP estimates showed that the accuracy to the best track MSLP is 8.55 - 11.66 hPa in root mean square error and -0.48 - +2.67 hPa in bias.

We also focused on the evolution of a warm core height and intensity using temperature profiles analyzed from AMSU-A TB data and the Cooperative Institute for Research in the Atmosphere (CIRA) algorithm (Demuth et al. 2004). In addition to the intensification of warm core with the decrease of MSLP, this study revealed that the warm core height depended on the TC life stage. For example, the height of warm core for Typhoon Talas (2011) shifted upward from the developing stage to the mature stage, and downward from the mature stage to the decay stage. We will discuss the influences of environment (sea surface temperature, vertical wind shear, and so forth) on this warm core structure change.

Reference:
Demuth, J. L., M. DeMaria, J. A. Knaff, and T. H. Vonder Haar, 2004: Evaluation of Advanced Microwave Sounding Unit tropical-cyclone intensity and size estimation algorithms. J. Appl. Meteor., 43, 282-296.

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