The warm-core structure of typhoons as observed through the T-PARCII aircraft reconnaissance and upper-air soundings

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Upper-tropospheric reconnaissance flights were carried out for three intense typhoons (Lan in 2017, Trami in 2018, and Mindulle in 2021) using a civil jet with a dropsonde system. In all flights, we succeeded to fly into the eye and to deploy dropsondes near the circulation center. In addition, the eye of two tropical cyclones (Ampil and Trami in 2018) were observed using radiosondes launched from stations in the Ryukyu islands. These in-situ observations provide opportunities to examine the vertical structure of the warm core in a very fine resolution (10~15 meters) between the Earth surface and the upper troposphere (~13 km MSL). They also provide opportunities to clarify a relationship between the warmth of the circulation center and the typhoon intensity in a direct way, which will be helpful for improving intensity estimation using a satellite-based microwave temperature sounder. In this work, we examined the warm-core structure of these typhoons and the relationship between the warm core and the typhoon intensity. In each sounding, the temperature anomaly of the warm core was defined as the difference in temperatures between the eye and the surrounding region (radius of 550-600 km). The mean temperature anomaly between 900 and 250 hPa was plotted as a function of the sea-level pressure (as shown figure). There is a robust strong positive relationship between strength of the warm core and typhoon intensity, as should be expected for a balanced vortex. However, comparing some observations of Mindulle (plotted as M) and Lan (L), the temperature anomalies are almost the same (8-10 K) even though the sea-level pressures differ by about 10 hPa. This suggests not only hydrostatic equilibrium, but also other factors involved in the determination of the minimum sea-level pressure of a typhoon.

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