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

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ABSTRACT

Upper-tropospheric reconnaissance flights were carried out using a civil jet with a dropsonde system for three intense typhoons: Lan in 2017 (Yamada et al. 2021; Tsujino et al. 2021; Ito et al. 2018), Trami in 2018 (Hirano et al. 2021), and Mindulle in 2021. 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 calculated and was plotted as a function of the sea-level pressure, which shows 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 and Lan, 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. These results suggest that to clarify a cause of the fluctuation of warm-core strength will contribute to an improvement of typhoon intensity estimation using a satellite microwave sounder.

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