An Observational Study on the Rapid Intensification of Typhoon Chanthu (2021) near the Complex Terrain of Taiwan

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Abstract

Intensification of Typhoon Chanthu (2021) along the eastern coast of Taiwan was accompanied by pronounced asymmetry in eyewall convection dominated by wavenumber-1 features, as observed by a dense radar network in Taiwan. This study integrates data from multiple radars to analyze the temporal evolution of the inner core structure and kinematic features. The maximum wind speed at 3 km altitude, retrieved from radar observations, exhibited a rapid increase of approximately 18 m s^{-1} within an 11-hour period during the intensification stage, followed by a significant decrease of approximately 19 m s^{-1} within 8 hours during the weakening stage, indicative of rapid intensification (RI) and rapid weakening (RW), respectively. Therefore, Chanthu underwent both RI and RW within the 24-hour analyzed period, posing challenges for intensity forecasts. During the intensifying stages, the region of maximum eyewall convection asymmetry underwent a sudden cyclonic rotation from the eastern to the northern semicircle immediately after the initiation of terrain-induced boundary inflow from the south of the typhoon, as observed by surface station data. This abrupt rotation of eyewall asymmetry exhibited better agreement with radar-derived vertical wind shear (VWS) than that derived from global reanalysis data. Further examination of the radar-derived VWS indicated that the VWS profile pattern provided a more favorable environment for typhoon intensification. In summary, Chanthu's RI was influenced by the three factors: 1) terrain-induced boundary inflow from the south of the typhoon, observed by surface station data, 2) low-level flow pointing toward the upshear-left direction, and 3) weak upper-level VWS.

Key word: Rapid intensification; Rapid weakening; Vortex Rossby waves; Ground-based velocity track display (GBVTD); Vertical wind shear; terrain-induced flow