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Contraction of the radius of maximum symmetric rotational kinetic energy during the intensification of Tropical Cyclone Khanun (2017)

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Tropical cyclone (TC) Khanun in 2017 was simulated in this study by the Weather Research and Forecasting (WRF) model. The observation-validated simulation data were used to examine dominant dynamic processes resulting in the contraction of the radius of maximum kinetic energy of symmetric rotational flow. The contraction rate was quantified by calculating the radial derivatives of symmetric rotational kinetic energy budget. The radius of maximum symmetric rotational energy was contracted rapidly before rapid intensification (RI) and moved inward slowly, then barely moved, and moved inward slowly again during RI.

The conversion from kinetic energy of asymmetric rotational flow to symmetric rotational flow induced by advection of asymmetric rotational tangential wind by asymmetric divergent radial wind at dominant azimuthal wavenumber-1 asymmetry and convergence of inward flux of symmetric rotational flow led to the rapid contraction before RI. During RI, symmetric rotational energy grew in the lower troposphere significantly, and upward flux convergence was equally important as inward flux convergence of symmetric rotational flow, which caused the first slow contraction. The conversion from kinetic energy of symmetric divergent wind to symmetric rotational flow associated with co-locations of maximum symmetric rotational energy and maximum symmetric inward radial flow produced stationary maximum symmetric rotational energy. Finally, horizontal and vertical flux convergence of symmetric rotational flow, and the conversion from environmental kinetic energy to symmetric rotational kinetic energy through the interaction between symmetric rotational flow and symmetric radial environmental flow generated the second slow contraction.