A Modeling Study of STE Near Tropical Cyclones Talas and Ita

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Abstract. The relationship among convection, inertial stability, dipoles of potential vorticity (PV), and stratosphere / troposphere exchange (STE) in the upper troposphere / lower stratosphere (UTLS) above typhoons Talas and Ita is investigated with the University of Wisconsin Nonhydrostatic Modeling System (UWNMS). Both were category 5 tropical cyclones that caused extensive damage in the high-tropopause environment of the western Pacific. Talas reached minimum central pressure south of Japan on September 2-3, 2011, while Ita formed over the Coral Sea and reached maximum strength off Australia on April 11, 2014. Turbulent kinetic energy, Richardson number, angular momentum, divergence, streamfunction, equivalent potential vorticity (EPV), absolute vorticity, and trajectories are used to diagnose STE and dynamical processes. Two primary modes of STE are found: 1) at the scale of the cyclone itself, inertially unstable-to-neutral anticyclonic outflow overrides surrounding stratospheric air in a "medusa" configuration, while 2) at the scale of embedded convective complexes, PV dipoles are generated with inertial instability and tropopause folding. In the absence of strong shear, vertical PV dipoles are produced in the UTLS near the tops of convection. The level between the dipole center is the level at which the flow turns from cyclonic to anticyclonic (and from inertially stable to inertially unstable). In the presence of strong shear, horizontal dipoles are produced with associated inertial instability features and gravity wave radiation, similar to recent findings in the warm upglide sector of midlatitude cyclones (Rowe and Hitchman, 2015).

Rowe, S. M., and M. H. Hitchman, 2015: On the role of inertial instability in stratosphere troposphere exchange near midlatitude cyclones, *J. Atmos. Sci.*, **72**, 2131-2151.