Geophysical Research Abstracts
Vol. 20, EGU2018-15101, 2018
EGU General Assembly 2018

Intensification of Strongly Tilted Tropical Vortices Through Asymmetric Diabatic Heating

Tom Dörffel (1), Ariane Papke (1), Rupert Klein (1), and Piotr Smolarkiewicz (2)

(1) FU Berlin, Mathematik, Mathematik und Informatik, Berlin, Germany (tom.doerffel@fu-berlin.de), (2) European Centre for Medium-Range Weather Forecast, Reading, United Kingdom

Although much effort was made to understand the dynamical behavior of the dynamics of tropical cyclones key mechanism of rapid intensification are not fully captured, yet.

Our investigations concern intensification mechanisms of tilted atmospheric vortices with Rossby number of order 1 and higher as they are observed by Huntley and Diercks (1981) and Dunkerton et al. (2009), among other. Along the lines of Päschke et al. (2012), we study the influence of strong vortex centerline displacements of the order of the radius of maximum wind, *i.e.*, $\sim [100]km$, and the alignment of asymmetric diabatic heat release relative to the tilt direction. Examination of the governing equations for dry-air inviscid flows with diabatic sources by multiscale asymptotic analysis leads to an effective evolution equation for the circumferential velocity depending only on tilt and heating pattern. This model gives rise to a possible connection between moisture-induced asymmetric latent heat release and rapid intensification of a tilted tropical cyclone which is in agreement with observations. Furthermore, this theory is compatible with Lorenz' concept of APE revealing the mechanism of transferring heat into kinetic energy.

We present an outline of the theory for the asymmetrically-driven diabatic amplification from tropical storm to hurricanes strength. Three-dimensional simulation of unheated as well as externally heated dry-air atmospheric flows corroborate the theoretical predictions. We pay attention to the intrinsic eigenmode structure of the governing asymptotic equations. Concluding remarks will highlight the track of future investigations, especially those of moisture-driven thermodynamical effects. See also the companion talk given by R. Klein who will highlight recent developments of incorporating moist thermodynamics and boundary layer dynamics into the discussed asymptotic theory.