HyARC Seminar #151

Date: August 24 (Fri) 10:30-

Room: HyARC big lecture room (3F)

Title: A New Paradigm for Concentric Eyewall Formation in Tropical Cyclones

Speaker: Prof. Chun-Chieh Wu (National Taiwan University, Taiwan)

Abstract:

Based on a dataset assimilated with data from T-PARC (THORPEX - Pacific Asian Regional Campaign), this study investigates the secondary eyewall formation (SEF) in Typhoon Sinlaku (2008). The identified precursors to SEF suggest a possible application of a newly proposed spin-up paradigm to the SEF problem. A new model is presented for SEF from an axisymmetric view, containing precursor characteristics, the associated evolution of the boundary layer flow and a dynamical interpretation.

The findings point to a sequence of vortex structure changes that occur in the outer-core region of a mature tropical cyclone and which culminate in SEF provided favorable environmental conditions. This diagnosis features suggest that the combined growth in storm size and the unbalanced response of the boundary layer flow serves as an important controlling mechanism for initiating and sustaining an approximate ring of deep convection in a narrow supergradient-wind zone in the vortex's outer-core region. The results also imply that the boundary layer scheme and its coupling to the interior flow need to be adequately represented in numerical models to improve the understanding of SEF, including the timing and preferred radial intervals.

Budget calculations suggest that the formation of the secondary tangential wind maximum in the boundary layer is achieved mainly via the strong radial influx of mean absolute vorticity that more than offsets the loss of tangential momentum due to surface friction. The radial influx of asymmetric absolute vorticity is found subdominant to the mean influx terms.

To further assess this new SEF model, a diagnosis of the Sawyer-Eliassen balance equation is carried out to understand the balanced/unbalanced responses of the secondary circulation to heat and momentum forcings in different radial regions. This sequence of studies aims to provide new physical insights into SEF, as well as to improve the design of additional idealized experiments.

References:

Huang, Y.-H., M. T. Montgomery, and C.-C. Wu*, 2012: Concentric eyewall formation in Typhoon Sinlaku (2008) - Part II: Axisymmetric dynamical processes. J. Atmos. Sci., 69, 662-674.

Wu*, C.-C., Y.-H. Huang, and G.-Y. Lien, 2012: Concentric eyewall formation in Typhoon Sinlaku (2008) - Part I: Assimilation of T-PARC data based on the Ensemble Kalman Filter (EnKF). Mon. Wea. Rev., 140, 506-527.

(given in English)