ATS/CIRA Special Seminar

Rosimar Rios-Berrios

Visiting ATS from the University at Albany, SUNY

Tropical Cyclone Intensification under Moderate Vertical Wind Shear

Hosted by Michael Bell

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ATS room 101
Discussion will begin at 3:00 p.m.
Refreshments will be served at 2:30 p.m. in the weather lab

Deep-layer (200−850 hPa) vertical wind shear is generally an inhibiting factor for tropical cyclone intensification. This negative relationship stems from a number of processes, including: vertical misalignment of the vortex, increased stability, ventilation of the upper-tropospheric warm core, and dry air entrainment. Despite these processes, many tropical cyclones can intensify under moderate vertical wind shear—the range of shear magnitudes that are neither too weak nor too strong (5–10 m s^{-1}). Multiple studies have proposed potential explanations for tropical cyclones intensification amid moderate shear (e.g., vortex re-alignment, downshear reformation); however, the majority of those studies have considered either case studies or simplified idealized numerical experiments. These limitations prevent understanding why some tropical cyclones intensify while most tropical cyclones weaken in sheared environments.

A potential hypothesis to explain intensification under moderate vertical wind shear is that other factors—associated with both the tropical cyclone and its environment—can help offset the effects of wind shear and aid intensification. This hypothesis was tested with three different approaches: (1) two case studies, (2) a climatological analysis, and (3) idealized numerical simulations. These approaches consistently show that the three-dimensional distribution of thermodynamic quantities is key for intensity changes in sheared environments. Tropical cyclones are likely to intensify under moderate shear when surface latent heat fluxes and middle tropospheric moisture are uniformly distributed around the low-level center of circulation. Such conditions, when coupled with storm-relative kinematics, can limit the amount of dry air intrusions and favor symmetric rainfall around sheared tropical cyclones. Altogether, these findings suggest that three-dimensional observations of thermodynamic fields are important for understanding and predicting tropical cyclone intensity.

Link to colloquium videos and announcement page: http://www.atmos.colostate.edu/dept/colloquia.php