UNIVERSITY of HAWAI'I MĀNOA

Department of Atmospheric Sciences Seminar Announcement

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SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

The Role of Boundary Layer Dynamics in Tropical Cyclone Intensification

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Date:	**Wednesday, April 5, 2017**
Refreshments:	**3:00pm at MSB courtyard** **Free Cookies, Coffee & Tea Provided** **(Please Bring Your Own Cup)**
Seminar Time:	**3:30pm**
Location:	**Marine Sciences Building, MSB 100**

Abstract:

The planetary boundary layer (PBL) dynamics are quite important to the tropical cyclone (TC) intensification because the intensification process is closely tied with the warm, moist, and energetic rich air in the PBL from the ocean. The energy input to the TC system from the ocean can determine the final intensity of a tropical cyclone as inferred from the maximum potential intensity (MPI) theory. Previous studies suggest that the secondary circulation of the TC plays an important role in TC intensification, which can be substantially enhanced by surface friction and the related unbalanced dynamics. It is still under debate regarding whether surface friction has a net positive or negative effect on TC intensification. In this study, we assume that the radial gradient wind distribution above the PBL of the storm can determine the location and magnitude of the boundary layer inflow, and thus the moisture convergence, upward motion, and diabatic heating in the eyewall. The PBL-driven diabatic heating may result in the TC intensification and also changes of the radial gradient wind distribution above the PBL, the latter in turn can further affect the intensification rate of the storm by modifying the inertial stability in the inner core. To isolate the effects of PBL dynamics, three different models with different complexities are utilized to conduct a series of sensitivity experiments in our study. Results show that the storm with less strength, stronger intensity, smaller radius of maximum wind (RMW), and larger drag coefficient may induce stronger and more inward penetrative inflow together with larger radial convergence and stronger vertical velocity slightly inside the RMW in the simply boundary layer model. Results from the interactive boundary layer model and a shallow water model above suggest that the storm with less strength, stronger intensity, smaller RMW, and larger drag coefficient can contract its gradient wind distribution at a higher rate with larger upward motion inside the RMW, as in the simple boundary layer model, and thus displaying a more rapid intensification. Results from the full-physics tropical cyclone model version 4 (TCM4) demonstrate that the initial vortex structure is key to the intensification rate through its modification of the strength and inward penetration of boundary layer inflow and the radial location of diabatic heating by boundary layer dynamics. Experiments with different drag coefficients indicate that larger drag coefficient (surface friction) may shorten the initial spinup and thus earlier onset of rapid intensification but has little effect on the overall intensification rate, suggesting that surface friction and its related unbalanced dynamics might not be considered as a special mechanism to explain rapid intensification of TCs. Results from this study are anticipated to provide better insight into the dynamical and thermodynamic roles of PBL process, including surface friction, in the intensification of a TC.