Impact of Cloud-Radiative Interaction on Tropical Cyclone Structures and Intensity

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Hypothesis: Cloud-top radiative cooling tends to destabilize the cloud layer (if occurring in the PBL), and cause descending motion leading to dissipation of cirrus clouds (if occurring aloft), which may result in the diurnal changes of TC intensity and structures.

Scope of work:

a) Two cases will be selected for simulations using the HWRF with full physics and high horizontal and vertical resolutions, including the cloud-radiative interaction scheme: a mature storm [e.g., Hurricane Edouard (2014)], and a TC during its genesis stage.

b) Sensitivity simulations of the two cases will be performed by turning off the cloud-radiative interaction scheme.

- The modeled intensity and structures as well as cloud patterns and depths will be verified against field experiment and all the other available observations.
- Diagnostic analyses of clouds and vertical motion at the low-level cloud top (likely in the PBL) and cirrus clouds (i.e., likely above the upper-level outflow) will be performed to see if and how (vertical) dynamical instability and different cloud structures develop between the control and sensitivity runs.
- Whether or not the HWRF could reproduce the above features, we will attempt to provide a understanding of the processes associated with the model simulations. Any mismatch between the modeled and observed cloud-radiative features will be addressed. Some could be addressed by testing different cloud-radiative interaction schemes.