

Is the TC Storm-Scale Circulation and the Large-Scale Flow in Quasi-Equilibrium?

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ABSTRACT

The TC vortex and structure (including size, eyewall, and rainbands) is usually not well resolved by the model initial conditions provided by global models. For a better forecast of TC intensity change, structure, and track, improved TC intensity and structure at the model initial time in high-resolution mesoscale models is crucial. To spin up a TC from the large-scale fields given by global models, it normally takes 12-36 1-h cycles using the TC initialization techniques developed by Nguyen and Chen (2011; 2014), depending on the storm intensity. In other words, the adjustment time scale is comparable to the time scale of the large-scale changes and the initial TC structure and the large-scale fields (including SST) may not be in quasi-equilibrium. Thus, if the initial storm structure is not well represented or an initial bogus vortex that is not well adjusted to the large-scale flow is inserted, the initial 12-36 hour model forecast may be inaccurate due to the adjustment process.

Nguyen and Chen (2011; 2014) (NC2014) developed a new TC initialization method (NC2014) to generate a high-resolution initial TC structure using the advanced research version of the Weather Research and Forecasting (WRF-ARW) model without the need to inserting an artificial TC vortex. Under the hypothesis that the initial TC structure, intensity, and size is closely related to the storm environment given by the GFS global model, they are able to reproduce the initial vortex structure and intensity that are close to observations and best track data by spinning up the TC using the high-resolution WRF-ARW model under given large-scale conditions. Results show that the new initialization scheme significantly improves TC track and intensity simulations, especially intensity. The key to the success of the NC2014 scheme is that the initial TC structure and intensity in the model are well adapted to the model employed and also well adjusted to the environment it is embedded in with an initial intensity and structure close to the best track data estimated by operational centers and satellite observations.