



Predictability of Tropical Cyclone Intensity

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Although significant progress has been made in predicting the tracks of tropical cyclones (TC), forecasts of TC intensity have barely improved at all. In particular, predictions of rapid intensification remain a grand challenge with wide-ranging socioeconomic consequences. Unfortunately, the reasons for the lack of improvement are not very well understood, provoking fundamental questions about the predictability of TC intensity.

To explore the intrinsic predictability limit of TC intensity, we conducted a comprehensive analysis of forecast error growth in a set of convection-permitting WRF ensembles. The ensembles, which feature Hurricane Earl of 2010, were generated with a stochastic kinetic-energy backscatter (SKEBS) scheme. The analysis shows that error growth in the TC surface wind field is highly-scale-dependent. Errors grow rapidly at the convective scale, limiting the predictability of convective features in the TC circulation to 6-12 h. Errors grow much slower at scales that represent TC rainbands, which are predictable for a few days. The storm-scale circulation (i.e., the mean TC vortex and the wavenumber-1 asymmetry) is even more resistant to upscale error growth and, at least in the case of Earl, remains predictable for 7 days. This indicates that long-term intensity predictions in Earl-like storms are theoretically possible.

A defining characteristic of the Earl ensembles is an extreme amount of forecast uncertainty during Earl's rapid intensification period, prompting questions about what processes control the onset of rapid intensification. We will show that both environmental and vortex-internal parameters influence rapid intensification and its predictability. The environment, which has longer predictability, controls the general tendency for rapid intensification to occur. On the other hand, internal processes (such as interactions between convection and the mean vortex) play an important role in determining the onset of rapid intensification. This implies that the exact timing of rapid intensification has low intrinsic predictability. Probabilistic forecasting methods may therefore be best suited to tackle the rapid intensification prediction problem.

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Refreshments 3:15 PM
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