Effect of Model Error on the Predictability of Hurricane Intensity

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While forecasts of hurricane track have continuously improved over the last couple of decades, predictions of hurricane intensity remain a challenging problem. To better understand the effect of model error on the uncertainty and predictability of hurricane intensity, this study investigates scale-dependent error growth in high-resolution WRF ensembles of Hurricane Earl (2010). The ensembles were generated with two different ensemble techniques: Ensemble A is a physical parameterization ensemble, where each member uses a different physical parameterization scheme, representing the uncertainty due to parameterized physical processes. Ensemble B uses a stochastic kinetic energy backscatter scheme (SKEBS), which mimics the effects of subgridscale turbulence on the resolvable flow. The ensembles feature triply nested vortex-following domains with 12, 4, and 1.33 km grid spacing. Hurricane intensity predictability is determined by computing the error magnitude associated with each component of the Fourier-decomposed hurricane wind fields at forecast times up to seven days. It is found that in both ensembles, forecast errors on small scales (~ 30 km) grow rapidly and saturate within 6-12 h. The storm-scale circulation (i.e., the mean hurricane vortex and wavenumber-1 asymmetry) in Ensemble B is resistant to upscale error propagation and remains predictable for at least 7 days. In contrast, the different parameterizations in Ensemble A introduce unique biases in each member, which manifest as hurricanes with vastly different sizes/intensities (substantial storm scale errors). This indicates that parameterized physical processes are a major source of forecast uncertainty, and limit the skill with which hurricane intensity can be predicted.