Cyclone Prediction Across Scales with Global Storm Resolving Models

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For the last several decades, meteorologists have relied on global numerical weather prediction models to study and predict high-impact cyclones such as hurricanes and winter storms. However, due to limited resolution, those models could neither provide a holistic view of the multiscale aspects of cyclones, nor could they capture the mesoscale processes that give rise to their extreme nature (e.g., the eyewall convection in hurricanes, details of the warm conveyor belt in extratropical cyclones). The goal of this report is to demonstrate that global storm-resolving models, that is, models with grid spacings of 5 km or finer, are formidable tools to overcome these shortcomings and advance cyclone prediction and research. To this end, a global storm-resolving version of NCAR’s Model for Prediction of Scales (MPAS) was used to produce several real-case simulations. The simulations, run without cumulus parameterization, reveal hitherto unseen details in global-model-generated cyclones. A model evaluation indicates that the global storm-resolving MPAS improves the prediction of hurricane genesis, track, and intensity compared to lower-resolution versions of the same model. Despite some biases such as storms being too large, the results suggest that global storm resolving models have the potential to transform the way we predict violent cyclones and their meteorological hazards.