High-resolution, multi-decadal tropical cyclone simulations using a variable-resolution general circulation model

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This project explores a variable-resolution general circulation model approach that allows for high spatial resolutions in low-latitude ocean basins where tropical cyclogenesis occurs. A statically-nested, variable-resolution option has recently been introduced into the National Center for Atmospheric Research (NCAR) Community Atmosphere Model's (CAM) Spectral Element (SE) dynamical core. We have coupled a variable-resolution CAM-SE mesh with high resolution (approximately 25 kilometer grid spacing) over the Atlantic Ocean basin to land, ocean, and ice components within the Community Earth System Model (CESM).

We present preliminary results of a 20 years climate simulation using Atmospheric Model Intercomparison Project (AMIP) protocols, which force the model with historical sea surface temperatures. We compare modeled tropical cyclone statistics to both observations and other high-resolution simulations. Specific focus is paid to intensity profiles, track densities, and storm pressure-wind relationships as well as interannual variability in cyclone count in the Atlantic Ocean. Changes in the dynamical structure of simulated storms between different grid scales within the model run are also explored. We examine the modeled synoptic environment through the use of indices such as the Genesis Potential Index. Potential improvements in simulating regional and global energy budgets when using a variable-resolution global setup instead of a high-resolution limited area model are considered. We also discuss the performance of the CAM5 physical parameterization package in multiple resolution simulations and the computational advantages of using scalable variable-resolution setups in long-term climate studies.