Idealized tropical cyclone experiments of varying complexity: a tool for model development

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With increasing computer power comes the capability of routinely running atmospheric general circulation models (AGCMs) at high horizontal resolutions (i.e., grid spacing less than 0.5 degrees). Moving to such resolutions requires understanding, and likely improving, the performance of many components of these AGCMs, such as parameterizations of sub-grid scale physics and the interaction of physics and dynamics. The ability of high-resolution AGCMs to simulate tropical cyclones is of particular interest.

The first part of this study involves dynamical core model intercomparisons. This analysis is focused on the evolution of a single, idealized tropical storm and the uncertainties triggered by the choice of model dynamical core formulation in various global models. The second portion of this research takes an initial look at longer-term idealized simulations. In particular, the National Center for Atmospheric Research's Community Atmosphere Model 5 (CAM5) is configured in radiative-convection equilibrium (RCE) to better understand tropical climate and extremes. The RCE setup consists of an ocean-covered earth with diurnally varying, spatially uniform insolation. Configurations with no rotation effects and spatially uniform rotation effects are investigated; the latter permitting the formation of tropical cyclones. CAM5 is run with the spectral element dynamics package at two horizontal resolutions: a standard resolution of approximately 1 degree grid spacing and a high-resolution of approximately 0.25 degree grid spacing. The various model configurations provide useful insights into the simulation of tropical cyclones at high-resolution. The two AGCM setups demonstrate to be unique testbeds for model development.