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Towards the simulation of tropical cyclones in high-resolution GCMs: Assessing uncertainty

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Using General Circulation Models (GCMs) for tropical cyclone studies is difficult due to the relatively small size of the storms, the intense convection and a host of large-scale small-scale interactions. These are mostly unresolved at typical GCM resolutions of about 50-100 km, and still challenged at high resolutions between 12-30 km. Nevertheless, high-resolution GCMs are becoming a tool of choice to evaluate tropical cyclones in current and future climate conditions. Therefore, the physical and dynamical components of a GCM need to be carefully evaluated to assess their reliability for tropical cyclone studies. An idealized tropical cyclone test case for high-resolution GCMs is implemented in aqua-planet mode with constant sea surface temperatures. The initial conditions are based on an initial vortex seed that is in gradient-wind and hydrostatic balance and intensifies over a 10-day period. The impact of small variations in the initial conditions and model physical constants on the evolution of the tropical cyclone are assessed. In particular, we investigate the role of these uncertainties within NCAR's hydrostatic Community Atmosphere Model CAM 5. In addition, we utilize two different dynamical cores available in CAM 5. These are the default Finite-Volume (FV) and the next generation High-Order Method Modeling Environment (HOMME) models. Therefore, the investigation also sheds light on the role of structural differences within GCMs in tropical cyclone simulations.