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Highlights from the 2016 Dynamical Core Model Intercomparison Project (DCMIP-2016)

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The 2016 Dynamical Core Model Intercomparison Project (DCMIP-2016) shed light on the newest modeling techniques for global weather and climate and models with particular focus on the newest non-hydrostatic atmospheric dynamical cores, their physics-dynamics coupling, and variable-resolution aspects. As part of a two-week summer school held in June 2016 at the National Center for Atmospheric Research (NCAR), a main objective of DCMIP-2016 was to establish an open-access database via the Earth System Grid Federation (ESGF) that hosts DCMIP-2016 simulations for community use from over 12 international modeling groups. In addition, DCMIP-2016 established new atmospheric model test cases of intermediate complexity that incorporated simplified physical parameterizations.

The paper presents the results of the three DCMIP-2016 test cases which assess the evolution of an idealized moist baroclinic wave, a tropical cyclone and a supercell. All flow scenarios start from analytically-prescribed moist reference states in gradient-wind and hydrostatic balance which are overlaid by localized perturbations. The simple moisture feedbacks are represented by a warm-rain Kessler-type parameterization without any cloud stage. The tropical cyclone test case also utilizes surface fluxes and turbulent mixing in the boundary layer. The paper highlights the characteristics of the DCMIP-2016 dynamical cores and reveals the impact of the moisture processes on the flow fields over 5-15-day forecast periods. In addition, the coupling between the dynamics, physics and the tracer advection schemes is assessed via a "Terminator" tracer test. The work demonstrates how idealized test cases are part of a model hierarchy that helps distinguish between causes and effects in atmospheric models and their physics-dynamics interplay. This characterizes and informs the design of atmospheric dynamical cores.