New Idealized Test Cases for the Dynamical Cores of General Circulation Models

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Abstract

The talk surveys the scientific ideas behind a suite of new idealized test cases for the dynamical cores of atmospheric general circulation models. These new test cases have been explored for the 2025 Dynamical Core Model Intercomparison Project (DCMIP-2025) which will take place at NCAR in June 2025. A major theme of DCMIP is the impact of topography on the atmospheric flow fields. In particular, we explore the propagation and numerical treatment of topographic gravity waves in the presence of simple background conditions, like constant zonal flows and constant Brunt-Vaisala frequencies, as well as more complex background conditions with sheared zonal winds. The flow regimes span various Froude numbers and both hydrostatic and non-hydrostatic flow fields. Another element of DCMIP is the question whether machine learning emulators like GraphCast or FourCastNet can represent the evolution of idealized flow patterns, such as the evolution of idealized baroclinic waves. The test case concepts will be highlighted via three dynamical cores which are embedded in NCAR's Community Atmosphere Model. They are the Spectral Element (SE), FV3, and MPAS dynamical cores which will be used on a small planet to expose small-scale effects. The talk will demonstrate the impact of the numerical options and vertical resolutions on the flow fields.

Keywords: dynamical core test cases, machine learning emulators, topographic flows

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