A dynamical core for global atmospheric model using summation-by-parts finite-differences method

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Abstract

We present the development of a novel dynamical core for a next-generation global atmospheric model to
be used in numerical weather prediction (NWP) and climate simulations. This dynamical core is designed
on a gnomonic equiangular cubed-sphere grid, allowing for static resolution refinement. To obtain high-
order accurate and energy consistent spatial discretization, we employ Summation-By-Parts (SBP) finite
difference methods. Given the broad range of potential applications (NWP and climate), our dynamical
core is designed to be highly flexible. It supports both hydrostatic and non-hydrostatic formulations of the
governing dynamical equations and incorporates various time-integration strategies, including explicit,
HEVI, IMEX and semi-Lagrangian methods. Additionally one can switch between different orders of
accuracy for spatial discretization. We provide results of the dynamical core testing using idealized cases
from the DCMIP project, including cases with simplified physics. Furthermore, we evaluate the
computational and parallel efficiency of the dynamical core, discussing the current challenges and
advancements in implementation utilizing GPU architecture.

Keywords: dynamical core, summation, by, parts finite, differences, cubed, sphere

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