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A 3-D Finite-Volume Non-hydrostatic Icosahedral Model (NIM)

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The Nonhydrostatic Icosahedral Model (NIM) formulates the latest numerical innovation of the three-dimensional finite-volume control volume on the quasi-uniform icosahedral grid suitable for ultra-high resolution simulations. NIM's modeling goal is to improve numerical accuracy for weather and climate simulations as well as to utilize the state-of-art computing architecture such as massive parallel CPUs and GPUs to deliver routine high-resolution forecasts in timely manner. NIM dynamic corel innovations include:
* A local coordinate system remapped spherical surface to plane for numerical accuracy (Lee and MacDonald, 2009),
* Grid points in a table-driven horizontal loop that allow any horizontal point sequence (A.E. MacDonald, et al., 2010),
* Flux-Corrected Transport formulated on finite-volume operators to maintain conservative positive definite transport (J.-L, Lee, ET. Al., 2010),
*Icosahedral grid optimization (Wang and Lee, 2011),
* All differentials evaluated as three-dimensional finite-volume integrals around the control volume.
The three-dimensional finite-volume solver in NIM is designed to improve pressure gradient calculation and orographic precipitation over complex terrain. NIM dynamical core has been successfully verified with various non-hydrostatic benchmark test cases such as internal gravity wave, and mountain waves in Dynamical Cores Model Inter-comparisons Projects (DCMIP). Physical parameterizations suitable for NWP are incorporated into NIM dynamical core and successfully tested with multimonth aqua-planet simulations. Recently, NIM has started real data simulations using GFS initial conditions. Results from the idealized tests as well as real-data simulations will be shown in the conference.