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Performance Analysis of high-order remap-type advection scheme on icosahedral-hexagonal grid

Rashmi Mittal (1), Sarvesh Dubey (2), Vaibhav Saxena (3), and Yann Meurdesoif (4)

(1) IBM Research India, New Delhi, India (rashmitt@in.ibm.com), (2) Indian Institute of Technology Delhi, New Delhi, India(sarvesh0inf@gmail.com), (3) IBM Research India, New Delhi, India (vaibhavsaxena@in.ibm..com), (4) Le Laboratoire des Sciences du Climat et l'Environnement, IPSL, France (yann.meurdesoif@cea.fr)

A comparative performance analysis on computational cost of second order advection schemes FF-CSLAM (Flux form conservative semi-Lagrangian multi-tracer transport scheme) and it's two simplifications on Icosahedral grid has been presented. Tracer transport is one of the main building blocks in atmospheric models and hence their performance greatly determines the overall performance of the model. FF-CSLAM falls in the category of arbitrary Lagrangian Eulerian (ALE) scheme. It exploits the finite volume formulation and therefore it is inherently conservative. Flux-area through edges are approximated with great circle arcs in an upwind fashion. Bi-quadratic sub-grid scale reconstructions using weighted least-squares method is employed to approximate trace field. Area integrals on the overlapped region of flux-area and static Eulerian meshes are evaluated via line-integrals. A brief description of implementation of FF-CSLAM on icosahedral -hexagonal meshes along with and its numerical accuracy in terms of standard test cases will be presented.

A comparative analysis of the computational overhead is necessary to assess the suitability of FF-CSLAM for massively parallel and multi-threading computer architectures in comparison to other advection schemes implemented on icosahedral grids. The main focus of this work is to present the implementation of the shared memory parallelization and to describe the memory access pattern of the numerical scheme.

FF-CSLAM is a remap-type advection scheme, thus extra calculation are done in comparison to the other advection schemes. The additional computations are associated with the search required to find the overlap area between the area swept through the edge and the underlining grid. But the experiments shows that the associated computational overhead is minimal for multi-tracer transport. It will be shown that for the Courant Number less than one, FF-CSLAM, the computations are not expensive. Since the grid cells are arranged in rectangular array just like cubed-sphere or lat-lon grids, the schemes computational performance is similar to that of the similar schemes on geodesic grids.