Geosci. Model Dev. Discuss., 6, C1813–C1815, 2013
www.geosci-model-dev-discuss.net/6/C1813/2013/


Geoscientific Model Development Discussions
Open Access

# *Interactive comment on* "A standard test case suite for two-dimensional linear transport on the sphere: results from a collection of state-of-the-art schemes" *by* P. H. Lauritzen et al.

**F. Xiao (Referee)**

xiao@es.titech.ac.jp

Received and published: 9 December 2013

This paper reports the inter-comparison results of some advection schemes used in different GCMs. The comparisons were conducted by using a set of benchmark tests to evaluate the accuracy of the participating schemes. It will of course provide useful information about the performance of each individual scheme, and enrich our knowledge about the current level of the advection schemes in GCMs. The paper can be accepted in its current form after corrections of typos and careless writings (there are quite a bit in the text). Meanwhile, I have some reservations, which I think might be more appropriate to be raised in the interactive discussion stage, but I still hope an



adequate response and possible reflections in the revised version to this peer review.

1) I wonder why this kind of experiments could not start with a Cartesian grid. I believe all developers should have begun with a Cartesian-grid version, and be ready to do so if a case suite in Cartesian grid is provided. This will largely remove the unnecessary factors, like the influence of different grids, and make the comparison more focused on the pure "numerical property" of the advection transport schemes.

2) The performance of an advection scheme can be assessed more rigorously by looking into the algorithms used in both spatial reconstruction and time marching. For example, the Taylor expansion and Fourier analysis provide well established tools to see the truncation order (convergence rate) and the numerical errors of linear schemes (without limiting). In principle, this kind of more rigorous analysis should be able to foretell the conclusion drawn from numerical inter-comparison. Inter-comparison can be more meaningful for complex models, but less interesting for purified solvers since we can see their performance from theoretical analysis even without "shed a light on " by the numerical experiments.

3) The schemes tested in this paper might not be the state-of-the-art. For example, the limiting projection cited is of old-fashion TVD style, which has at most second order. More advanced reconstructions, such as WENO (include the refined WENO-M and WENO-Z), are overlooked. Instead of "state-of-the-art", "currently-in-use" might be more appropriate.

4) Without the computational cost as another account, it is hard for the readers to get a fair judge among the schemes. Usually, higher order schemes are more computationally expensive than low order schemes. In practice, there is always a tradeoff between accuracy and efficiency. The balance is a key point, which is worthy of more attention in the whole story. As the authors mentioned, the elapse time inevitably depends on the computing platform used, as well as the coding style. As the next follow-up, if it is possible for the organizer to provide a platform and measure the elapse time of all

participating schemes in their Cartesian form.

5) As commented above, an “apple to apple” comparison among pure advection schemes can be made relatively easier by examining both spatial reconstruction and time updating algorithm. Rather than this, what we see here is how a scheme performs under the circumstance of a certain “culture” which heavily depends on the background of the developers. It is easy to say which advection scheme is more accurate, but it is not that easy to say which culture is better than others.

---

Interactive comment on Geosci. Model Dev. Discuss., 6, 4983, 2013.