

Interactive comment on “A Lagrangian Advection scheme with Shape Matrix (LASM) for solving advection problems” by L. Dong et al.

Anonymous Referee #1

Received and published: 22 September 2014

In this paper, the authors have developed a new Lagrangian advection scheme on the sphere. The key idea of this work is (1) finite parcels with the shape of ellipse for 2-D cases are used to discretize the tracers; (2) and the deformation matrix is employed to control the shape and the size of each parcel. Moreover, (3) a interparcel mixing strategy is also adopted when a parcel is highly deformed and the determinant of the associated deformation matrix is negative. Extensive numerical examples were tested to show the efficacy of the method and the numerical results are convincing. I recommend the paper for publication with some questions.

1 The numerical results indicate that the proposed LASM scheme is first order accurate (Fig. 8). The authors stated on page 4847 line 14 that the dominated error is from trajectory calculation. However, the trajectory equation (3) is solved by a 4th order

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Runge-Kutta method which is sufficiently accurate for many cases. Therefore, it seems that the error from trajectory calculation should not dominate the total numerical error. The first order accuracy of LASM should be further discussed.

2 In Fig. 11, three diagnostics are reported in order to assess the capacity of LASM in preserving the pre-existing nonlinear correlation among tracers. It is observed that l_u is non-zero. In fact, it is a very small number and far less than 1. Further note that for many first order schemes such as the first order CSLAM and the first order upwind scheme, l_u is zero. The authors could give an explanation why this is not the case for LASM.

Some minor comments:

1 On page 4836 line 16, In despite of -> in spite of or despite.

2 On page 4842 line 13, are same -> are the same

3 On page 4844 line 21, when search -> when searching

4 On page 4845 line 17, he -> the

5 On page 4847 line 4, subjected -> subject

Interactive comment on Geosci. Model Dev. Discuss., 7, 4829, 2014.

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