

# **“Lagrangian advection scheme with shape matrix (LASM) v0.2: interparcel mixing, physics-dynamics coupling and 3-D extension**

by  
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## **1 General comments**

The paper describes some interesting updates of the Lagrangian LASM transport scheme, which was introduced in Dong et al. (2014). It is (correctly) argued that interparcel mixing must be introduced in fully Lagrangian models. The main update of the scheme as compared to the original LASM is a modification of the inter-parcel mixing.

One issue is the cost of the scheme as compared to more traditional schemes and in particular the cost of identifying the computational grid (or procedure) needed to perform the interparcel mixing. It is stated that this will parallelize. But how can this parallelize on modern computers? A more in depth discussion of these issues would be nice.

Another issue is the fact that LASM has very little diffusivity. The authors should somehow state that the diffusivity may be lower than what happens in nature (via turbulent mixing).

The English in the manuscript has improved significantly. There are however, still a few grammatical issues. I have listed some in the specific comments below.

## **2 Specific comments**

- p5, l8: replace "has" with "have"
- p5, l19: replace "topics" with "topic".
- p7, l18: replace "cost" with "costly".
- p7, l19: replace "parallelize" with "parallelizing".
- p8, l1-2: The sentence "After rescaling, the parcel volume is reset, so the deformation matrix and skeleton points are." could be reformulated to something

like "After rescaling, the parcel volume, the deformation matrix, and the skeleton points are all reset."

- p8, l4-5: "This mass fixer seems to be artificially, but it is noteworthy that the total mass is conserved exactly on the parcels during the simulation ...". It is unclear what is meant here. First of all the word "artificially" should be replaced by "artificial". Then: the fixer is introduced because the remapping from parcels to the Eulerian grid is not inherently mass conserving. So the fixer not only seems to be artificial but actually **is** artificial, which is not a serious issue since the memory is maintained in the Lagrangian space anyway.
- p9, l17: "By defining in this way, ..., are independent on ..." should be reformulated into "Defined in this way, ..., independent of ..."
- p10. More info about  $C_m$  is needed. Why is  $C_m$  not simply proportional to the typical values of  $\gamma$  for the involved parcels.
- p13, l10: Insert "a" before "sphere".
- P16, l12: the sentence "that may cause instability" could be deleted because, at least for semi-Lagrangian schemes, this is not relevant. They are inherently stable.
- p16, l18-19: "Except the scheme itself, the physics-dynamics coupling also affect the results, such as the tendency evaluation type". I do not understand what you mean here. You have no such coupling since LASM is not used to update the dynamics. Why not delete the sentence.
- p17 and the reference list: "Shamarock" is wrongly spelled. It should be "Ska-marock"
- p17 - bottom: It is obvious from Fig. 9 that LASM is far less diffusive than WRF. However, it is not at all clear to me which of two is most realistic. To evaluate the realism of LASM it would have been great to