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Geoscientific
Model Development
Discussions

Interactive comment on "A mass conserving and multi-tracer efficient transport scheme in the online integrated Enviro-HIRLAM model" *by* B. Sørensen et al.

Anonymous Referee #1

Received and published: 17 January 2013

General comment:
In this paper, the authors present a new transport scheme which is mass conserving, shape preserving, and multi-tracer efficient in the context of the online coupled chemical-weather prediction model Enviro-HIRLAM. The properties of the new transport scheme are illustrated by comparing with other shape preserving filters using forecasts without or with chemistry.

I recommend that the manuscript be accepted after minor revisions. Adjustments to the layout of the paper are desirable.

Specific comments:

1. p.3740, line 1, Point 5: Why don't you use another variable to represent the mixing ratio? ψ is used for volume density and mixing ratio.

2. In Sub-Section 4.4, the shape preserving filters are compared using a 1D advection with a constant wind. However, a constant wind is not useful to observe the impact of the modified interpolation weights of LMCSL since there is no divergence. Why not use also a 1D advection using a steady divergent wind $u(x)$?

3. In Section 3, the first Sub-Section (without any numbering) covers the 3D version of LMCSL and enumerates points 1 to 7. Points 5-6 are about shape preservation. The second Sub-Section (with number 3.1) covers again shape preservation but without mentioning ILMC that is used as default value in the new transport scheme. I suggest to rewrite Section 3 to better describe the new transport scheme. Maybe the name LMCSL-3D is not adequate since it does not incorporate the shape preserving filter.

4. Beginning of Section 4: Those two paragraphs describe why we need shape preserving filters. However no link is done to introduce the filters covered in Sub-Sections 4.1 to 4.4.

5. Sub-Section 4.1:

   (a) I suggest to move lines 3-4 (p.3743) describing the subscripts k and l before starting the enumeration of the points 1 to 5.

   (b) p.3742, line 9: The Lagrangian departure point should be represented by $(.)_* k$, not $(.)_k$.

   (c) Eq.(10)-(11): L_r is never defined in the text.

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(d) In Footnote 2, I would interchange *positive* and *negative*. For example, if we have an overshoot, we move this extra mass to surrounding cells. So we calculate $\Delta\psi_k^+$ (i.e. *positive*) to increase the value at surrounding cells while at the same time respecting their respective upper limit.

(e) Since one of the preoccupation of this paper is efficient, how do we parallelize the ILMC filter? It is possible that two closed overshoots k_1 and k_2 want to increase the same surrounding cell. So they have to do it not both at the same time. So OPENMP could not be used readily.

6. Sub-Section 4.2 and Fig.2: I suggest to replace k,l_i by ${}_*k$, ${}_*l_i$ so that k, l_i will always refer to gridpoints and ${}_*k$, ${}_*l_i$ to their departure locations.

7. Beginning of Sub-Section 4.3: The definition of Global filters should be revised. We should define there the terms 'Global-PD and 'Global-M' that are used later in the text.

8. p.3745, line 3: Mention that Fig.3 and Table 1 will be described below.

9. Sections 5.1, 5.2 and 5.6: Confirm if LMCSL-3D is always combined with the default ILMC filter in those experiments.

10. Fig.3: I suggest to add a companion figure with the errors. The curves are close together. The errors may enlight some details.

Typos:

1. Eq.(1): The two $+$ signs should be replaced two $-$ signs, as done in Eq.(2). Also, in the last term of the right-hand side, the upperscript $n+1$ should apply to ψ and the divergence, as done in Eq.(2).

2. We should see χ_l and not χ in Eq.5 and in point 3 (p.3739, line 20)

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3. p.3740, line 12: Why 72 grid cell values? It is not 4x4x4 = 64?
4. Replace in the text ‘cells one’ by ‘cells with radius=1’
5. Eq.(15): I presume that $i - 60$ should be instead $i - 72$ where 72 is the mid-point between 60 and 84.
6. p.3741, line 7: Correct ‘difussive’
7. p.3745, line 20: Correct ‘function the has’
8. p.3748, line 10: Correct ‘shown in Fig.5 The’
9. p.3749, line 20: Correct ‘seen that the for’
10. p.3749, line 24: Correct ‘can bee seen’
11. p.3749, line 25: Correct ‘in the the’
12. p.3751, line 5: Correct ‘schemes shows’
13. p.3751, line 11: Correct ‘without out’
14. p.3753, line 25: Correct ‘the the’
15. p.3755, line 15: Correct ‘Model on the Sphereodel on the Sphere’
16. Legend Table 1: Replace ‘for the step and cosine hill,’ by ‘for the step and cosine hill functions,’
17. Legend Fig.7: ‘Bottom row’ is missing.

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