



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.

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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 $(\cdot)_*k$, not $(\cdot)_k$.
 - (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 $4 \times 4 \times 4 = 64$?
 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.