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Geoscientific
Model Development
Discussions

Interactive comment on "Semi-Lagrangian methods in air pollution models" *by* A. B. Hansen et al.

A. B. Hansen et al.

abu@dmu.dk

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Answer to Referee 2

Thank you for your review. Below the comments are answered one by one.

Referee: This manuscript compared several Semi-Lagrangian schemes in air pollution models and presented detailed test results based on simplified cases with rotating cones and slotted cylinder cases. Such tests provided valuable information in choosing the advection schemes for the chemical transport models. However, some of the technical details and result presentations could be shortened. It would be more beneficial if the authors could provide more focused discussion and insight or explanation on the model performances.

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Authors: We agree with the reviewer that the present work contains many results and technical details. However, we think that it would be cumbersome if not impossible to support the conclusions without documentation, i.e. including the plots and tables.

Referee: P2366, 2.2: The limitation of the operator splitting has to be mentioned.

Authors: To be added after the end of section 2.2: Diagnosing c_i from ρ_i and ρ can be problematic and lead to the so-called wind-mass inconsistency (see Jöckel et al. (2001)) unless the same numerical scheme is used to forecast both ρ_i and ρ. In the present study we have a non-divergent flow, implying that this problem is not at play.

Jöckel, P., Von Kuhlmann, R., Lawrence, M.G., Steil, B., Brenninkmeijer, C.A.M., Crutzen, P.J., Rasch, P.J., Eaton, B. (2001). On a fundamental problem in implementing flux-form advection schemes for tracer transport in 3-dimensional general circulation and chemistry transport models. Q. J. R. Meteorol. Soc. 127, 1035–1052.

Referee: P2367, section 2.2.1: It is strange that "Numerical treatment of the advection in DEHM" is a subsection of 2.2 "Mixing ratio versus volume density.

Authors: We agree and the the section 2.2.1 is now changed to section 2.3

Referee: P2368, line 25: Can you spell out POPs?

Authors: Persistent Organic Pollutants, is added to the text

Referee: P2370, line 1: Please rewrite "which 58 species is used". "58 species" is inconsistent with what is given on page 2368 (line 24).

Authors: Both numbers are correct. To the section General description of DEHM the following will be added: 58 photo-chemical species, 9 primary emitted particles, 14 persistent organic pollutants, and 7 mercury species.

This sentence will be added to section 2.3.2. In the study only the photochemical part of the model, excluding primary emitted particles, POPs and mercury.

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Referee: P2371, line 11, “Section 3.3 “ to the end of the paragraph should be deleted. The first paragraph on page 2376 is almost identical to this.

Authors: We have corrected this according to the suggestion from the reviewer.

Referee: P2400, line 1: “the highest Courant number”: the “lowest”?

Authors: We have changed the text to: The highest Courant number less than 1, resolution 3_1,. . .

Referee: P2400, line 18: What does “the second” mean here? The second best performing?

Authors: It means: The second group of filtered semi-Lagrangian. We have changed the text in the paper.

Referee: P2403, line 6-12: This paragraph is very confusing.

Authors: The paragraph has been partially rewritten.

Referee: P2367, equations (1) and (2): There should be a “.” in the first term of RHS.

Authors: $\cdot$ will be added to the two equations.

Referee: P2376, line 24: (Eq. 6.4 of Durran) -> (Eq. 6.4, Durran, 1999)

Authors: Has been corrected.

Referee: P2389, line 9: In Sect. 3 describes . . . -> Sects 3 describes . . .

Authors: “In” is removed

Referee: P2395, line 9: “more wrong” -> “worse”

Authors: Corrected

Referee: P2399, line 24:”The semi-Lagrangian schemes the LMCSL” -> “Among the semi-Lagrangian schemes the LMCSL”

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Authors: Section rewritten to: The semi-Lagrangian schemes perform better with filter and fine spatial resolution with big time step. Among the semi-Lagrangian schemes the LMCSL scheme with filter performs best. . .

Referee: P2400, line 22: Please rewrite “Almost exactly as the non-filtered distribution” to be a complete sentence.

Authors: The sentence has been changed to: Almost exactly the same is the case for the distribution of non-filtered schemes.

Referee: P2401, line 22: Remove “third”.

Author: We have changed the text to: . . .third according to the l_2 error, . . .

Referee: P2401, line 5: over all -> overall.

Authors: Corrected

Interactive comment on Geosci. Model Dev. Discuss., 3, 2361, 2010.