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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stochastic fields method for sub-grid scale emission heterogeneity in mesoscale atmospheric dispersion models" *by* M. Cassiani et al.

Anonymous Referee #3

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Chemistry transport models have to deal with simplified descriptions. The neglect of small-scale emission fluctuations (e.g. caused by highways, localized industry) is one of these simplifications. This paper investigates ways to account for this sub-grid-scale variability. The specific solution proposed is to do an ensemble simulation in which different concentration fields are created. Each concentration field has a different emission, and as such the ensemble of fields represents the concentration fluctuations that are expected from sub-grid-scale emission variability.

The paper is well written, and the theory is well introduced. However, to be appreciated by a wider audience, some additions are recommended, which are listed below.

- The effects of the stochastic forcing and the T_{mix} term remain unexplored. Obviously, leaving out of modifying these terms will change the results and it would be interesting to investigate the effect of these terms on the comparison with the LES results. The effect of the stochastic term influences the vertical transport (how?), which currently seems a bit too fast in the RANS-SFM model (figure 2)

- The cells E and F are not influenced by the emissions in cell C. Please explain to the reader why. The situation appears symmetric, but the wind backs towards the surface I assume

- The emission distribution in the LES simulation is chosen rather arbitrary (figure 1). Why not a random distribution or a distribution that would represent line or point sources, surrounded by non-emitting areas? This would make the simulations more representative for a real-world example. Moreover, the edge effects now strongly influence the transport of tracers to the cells A and B. This is partly caused by a shrinking source area in the LES

- The discussion of the applicability could be extended. In the conclusions, it is mentioned that about 50 realizations are required for one tracer. If more chemical reactive tracers would be included with either correlated or un-correlated emission structures, what would be the computational burden? What about emission variability in adjacent grid cells? Would that require 50x50 tracers?

- Instead of focusing on the third order moments, it would be instructive to show plots with typical concentration fluctuations in both the LES (averaged) and the RANS-SFM

Some small textual points: 15216, line 6: and the results compared. Change to: and the results are compared. 15217, line 19: emissions heterogeneity. Change to: emission heterogeneity. 15219, line 13: scalars. Change to: scalar 15220, line 19: Change

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'scalar' in 'scalars'. 15226, line 3: Namely the atmospheric flow. . ...sentence unclear (Namely?) 15228, line 3: reaction source terms. Why not sink terms? 15230, line 29: at this point, the reference to Galmarini et al. (2008) starts to bother me. Maybe introduce G2008 or remove some of the recurring references to this paper. 15233, line 6: negative value, change to negative values. 15234, line 14: change 'issue' in 'issues' 15236, line 21: change 'word' in 'world' 15236, line 26: scalars instead of scalar. 15237, line 3: 'reactions' instead of 'reaction' 15237, line 8: 'concentration values' 15237, line 9: What are gridded populations?

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 15215, 2009.