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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: A new method for the Lagrangian tracking of pollution plumes from source to receptor using gridded model output" *by* R. C. Owen and R. E. Honrath

Anonymous Referee #1

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The paper by Owen and Honrath describes a method to combine forward and backward Langrangian particle dispersion model output to specifically retrieve the ensemble of pathways that link surface emissions at a given location and time with an observation at a given location and time. This represents an attempt to simplify the interpretation of more complex model output usually provided by LPDM runs. I recommend the paper to be published after some minor revisions described below.

General comments

It is unclear why both, forward and backward LPDM runs are required to retrieve the pathway taken by emissions from a certain source area and time that arrive at a spe-

cific receptor at a particular time. One could simply use for example the backward simulation and select those particles that link a specific source volume to the receptor volume, before the output is gridded and the information is lost. Equivalently could select the forward run. The reasons for using backward and forward model output are at least not made very clear in the paper.

In principle, the information on the source-receptor pathway retrieved from forward runs should be identical to the information retrieved from backward runs. The product of forward and backward plume, called PMR (partial mixing ratio) by the authors, gives the same answer, if forward and backward simulations agree. If they do not agree, only the common parts of the forward and backward calculated pathway are used for the PMR (paths that do not exist in the forward run give a weight of zero in the PRM, similarly for the backward run). However, there should be no significant disagreement, where significant is meant in the statistical meaning, given that both runs are stochastic. Any significant disagreement of forward and backward paths points to non-reversibility, which is intimately linked to fulfilling the well-mixedness criterion (see Thomson 1987, also Lin et al., 2003) and thus should be addressed by modifying the model so that it is well mixed. In case of such disagreement, neither forward nor backward runs might be correct, and also the folded retroplume itself might not be correct.

I recommend to add a few words on why the authors use the combination of forward and backward runs rather than selecting the appropriate particles within either the forward or the backward run. I suggest a careful analysis of such cases of disagreement between forward and backward runs, and a statement about how significant those differences are. Since the paper is quite long, one could think about dropping section 5 as it is not primarily related to the main topic of the paper.

Specific comments

Page 18858, line 4: "... where two forward positive particles stray below the core transport region (panel b). The absence of positive particles from both model directions

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indicates that this region is not part of the source-to-receptor transport pathway": At least 2 of the 670 forward particles that make it from source to receptor took this path. Statistically not a high probability, but from the forward run one would expect that 0.3% of the paths lead through this area.

Page 18858, line 24: It should be stated clearly what the authors mean by "expected UMR".

Page 18869, 2nd paragraph: "First, the positive particles were not colocated with the areas with the maximum PMR, indicating minor differences.": Together with Figure 7, these minor differences in the transport between the forward and backward model simulations seem to suggest that the largest effect results from those "minor differences". As argued above, in this case neither of the simulations might be correct, including the folded retroplume.

Page 18871, line 6: "CO that will be dropped from the forward model before it can be transported to the receptor.": This is somewhat unclear. Why would this be dropped in the forward model?

References

Thomson, D. J., Criteria for the selection of stochastic models of particle trajectories in turbulent flows, J. Fluid Mech., 180, 529-556, 1987.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18843, 2008.