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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inversion of long-lived trace gas emissions using combined Eulerian and Lagrangian chemical transport models" *by* M. Rigby et al.

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We thank the reviewer for their constructive comments, which we respond to below. Reviewer comments are italicized, author responses follow each comment.

General comments: This paper presents a new way for coupling global Eulerian and regional Lagrangian inversion methodologies together for improving the estimates of regional emissions. Overall the paper is well written and worth publication. I would like to suggest that further discussions are added concerning the following points.

We thank the reviewer for this positive assessment of our work.

Specific comments:

1) Implications of the 5-day measurement averaging period The authors mention that measurement averaging periods of 1 to 30 days were tested as part of the uncertainty estimates of the inversion (p. 14703, ln. 16). Could the authors add further discussion on the results from these test runs, and describe how 5 days were chosen as the optimal averaging period? Also, I would like to suggest the addition of a brief description on the specific averaging scheme used in this study.

As mentioned in line 5 of page 14701 of the original submission, “since we would expect that model uncertainties might be correlated with a timescale similar to synoptic variability, measurements were averaged into 5-day periods". Simple block-averages were used.

Questions over the 5-day measurement averaging are raised when looking closely at the timeseries presented in Fig. 8 of the discussion paper (p. 14717). The Gosan time- series presented in this paper suggests that pollution peaks at this site occur in a time scale of weeks-months, and that SF6 concentrations at Gosan are always significantly higher than those of other NH stations. This is not an entirely realistic representation of what is observed at Gosan, where along with the many pollution events that span hours-days, relatively "clean" concentrations close to NH background levels are observed as well (compare with the SF6 timeseries shown in Figure 1 of Kim et al. (2010, Geophysical Research Letters, doi:10.1029/2010GL043263). It would seem that the modeling runs with a shorter averaging period may be more suitable in this regard.

Three-hourly average mole fractions were output by the models. Therefore, each 5-day average used in the inversion contains both the pollution events that the reviewer mentions and periods where background mole fractions were observed. The optimized

ACPD

11, C7818–C7822, 2011

mole fractions obtained when 1-day average observations were used is shown in the figure below. The short-timescale variability that the reviewer is referring to is indeed seen in this case. However, following the argument made above, we feel that multi-day averages are more appropriate in the inversion, since the uncertainties associated with each period are more likely to be un-correlated (a requirement of the methodology used).

2) Comparison of SF6 emissions derived for China and Korea This work finds that the EDGARv4 emissions for China and Korea (at least for the parts covered by the "local" regions) are significantly underestimated. Comparing this finding to previously published SF6 emissions in Vollmer et al. (2009, Geophysical Research Letters, doi:10.1029/2009GL038659), Kim et al. (2010) for China, and Li et al. (2011, Environmental Science and Technology, doi:10.1021/es104124k) for China and Korea may help substantiate the results derived in this study.

We thank the reviewer for highlighting these studies, which we have included in the revised manuscript, along with a brief discussion of the similarities and differences between the derived emissions.

On a related point, should the EDGARv4 emissions for 2005 be scaled in some way for making a fair comparison to the modeled emissions derived for 2007-2009?

It is certainly true that the time period of the inversion is different to that of the EDGAR estimates. However, we would argue that since the main focus of the paper is the presentation of a method for combining Eulerian and Lagrangian model sensitivities, the development of a more accurate prior estimate of 2007-2009 emissions would not add much value to the paper. We have already highlighted the difference in time period in the main text (e.g. line 25 of page 14703). However, we have also noted this difference in the Figure 7 caption in light of this comment.

ACPD
11, C7818–C7822, 2011

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 14689, 2011.

ACPD

11, C7818–C7822, 2011

Interactive Comment

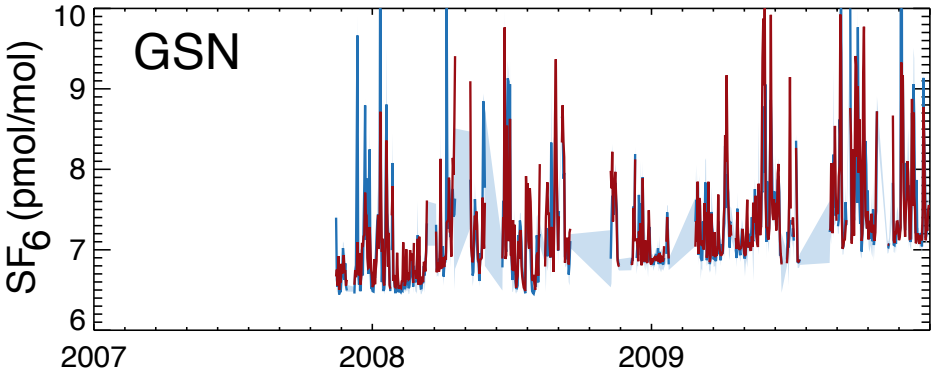

Fig. 1. Daily-average mole fractions at Gosan station (blue). Optimized mole fractions are shown in red.

ACPD
11, C7818–C7822, 2011