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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global estimates of CO sources with high resolution by adjoint inversion of multiple satellite datasets (MOPITT, AIRS, SCIAMACHY, TES)" *by* M. Kopacz et al.

Anonymous Referee #2

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Review: "Global estimates of CO sources with high resolution by adjoint inversion of multiple satellite datasets (MOPITT, AIRS, SCIAMACHY, TES)", ACPD, 9, 19967-20018,2009, Monika Kopacz et al.

This is an interesting piece of work worthy of publication. As the authors rightly mention we as an atmospheric science community have a long way to go until we fully understand all the aspects which regulate CO distributions in the atmosphere. There are two main finding in this work, one of them is the fact that the seasonal cycle of CO emissions in northern mid-latitudes (e.g. Europe, United States) is not captured well in the a priori. According to the authors an explanation for that discrepancy could be that CO

from wood burning and so called "cold starts" (cars) are not well treated in the a priori emissions inventories. The second main finding of the research concludes that GFED emissions from the Global Fire Emissions Database underestimate the magnitude of CO coming from biomass burning emissions in the tropics. In this work the total global annual CO emissions of about 1570 Tg CO are at the upper range of previous emissions estimates. For their seasonal inversions analysis, the authors use the adjoint GEOS-Chem as forward model constraint by satellite data of CO columns from MOPITT, AIRS, and SCIAMACHY in a joint inversion for the full year of May 2004 to April 2005. The results have been validated by comparing it to TES satellite , NOAA/GMD surface flux and airborne MOZAIC observations, respectively.

Specific minor comments:

2.4. SCIAMACHY

25: You cite the paper of de Laat et al. (2007) which introduces a method of how to average by weighting an ensemble of CO column observations. It is not clear whether you also used the negative SCIAMACHY CO columns (as you probably should).

4. The inverse model

It is not clear if you are using daily 2x2.5 grid-box averages of columns of MOPITT, AIRS and SCIAMACHY observations. Am I right if I assume the number of observations in Fig. 6 correspond to 305484 (MOPITT), 923234 (AIRS), and 25773 (SCIAMACHY) , respectively? If it is easy to make new plots you could plot the number of observations (or indicate it in the legend of Figure 6) because the number of TES, MOZAIC, and NOAA/GMD observations, respectively, is not mentioned in the paper.

6.2. Seasonal and regional results

25: The explanation that residential heating and on-road vehicle emissions (cold starts) needs one or more sentence of elaboration if possible because this finding is a central part of the paper. It would be interesting to read a typical estimate what the individual

contribution of residential heating versus cold starts might be even if this estimate is only cited from the literature. Or do they always go hand in hand (if temperatures are low people for example in Europe will heat and 'cold start' their cars).

I am not criticising but wondering why the a posteriori adjustment of emissions follows the a priori pattern in the adjoint inversion. To give you an example (I have randomly picked out a region for closer inspection). In Europe for example (Fig. 6 of your work) the a posteriori emissions in winter are being adjusted by as much as a factor of 1.6 in the grid-box covering southern Germany, Switzerland, northern Italy and western parts of Austria. At the same time eastern parts of Austria which cover the adjacent grid-box are not increased (about only 1.1) by as much in absolute terms (Tg CO) as to give a similar a posteriori emissions estimates, even though winters in eastern parts of Austria are as cold as in Switzerland or western alpine parts of Austria. After careful inspection of Figure 1 the a priori in eastern parts of Austria is also lower; maybe the ratio of the two grid boxes of a posteriori emissions follow the ratio of a priori emissions. On the other hand I am intrigued by you results because eastern parts of Austria share a strong contribution from urban gas heating as opposed to western Austria which is dominated still by wood burning and this would support your findings at least for that region in Europe. I have no actual figures for Switzerland or Germany though.

8. Conclusion

You do not mention 'cold starts' in the conclusion . I think you should as you did in the main text mention it as one possible explanation on top of wood burning and coal burning in Asia.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 19967, 2009.