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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multi-species inversion of CH_4, CO and H_2 emissions from surface measurements" *by* I. Pison et al.

I. Pison et al.

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We thank the reviewer for his/her most helpful comments. We addressed them all. Our response appears inserted within his/her text: the comments of the reviewer are in black and answers in bold. We wish to apologize for the inconvenience caused by many typos. The text and tables have now been checked for them several times.

General comments

1. The multi-species inversion approach is not new. It has been used before by e.g., Mïller and Stavrakou (2005) and Elbern et al. (2007). These references (and maybe

more) should be cited.
References: J.-F. Müller and T. Stavrakou (2005), Inversion of CO and NOx emissions using the adjoint of the IMAGES model, Atmos. Chem. Phys, 5, 1157-1186. H. Elbern, A. Strunk, H. Schmidt, and O. Talagrand (2007), Emission rate and chemical state estimation by 4-dimensional variational inversion, Atmos. Chem. Phys., 7, 37493769. Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20687, 2008.

We will add the new references in the introduction: "[. . .] whereas they are linked through chemical reactions and transport. At the mesoscale in the framework of air quality, Elbern et al. (2007) have studied the feasibility of the inversion of emissions of sulphur dioxide and ozone precursors. At a global scale, Stavrakou and Müller (2006) have inverted CO emissions taking into account their relation to the non-methanic volatil organic compounds (NMVOCs) through OH. In this work, we describe an inversion system that optimizes the four main reactive species of the methane oxidation chain [. . .]". Our approach is somehow original because instead of developing the complex and computationally expansive adjoint of a full chemistry model, we chose to start from a simplified chemistry model (with only the CH_4 oxidation chain) so as to be able to handle long inversions and large systems.

2. The multi-species inversion is compared with CO and CH4 mono-species inversions, but differences are found to be small. The paper would be considerably strengthened if the authors could provide a case for which the multi-species inversion does a (demonstrable) better job than a corresponding single-species inversion. The reader should be convinced that it is useful to do multi-species inversions.

Our results do not invalidate the previous mono-species studies: in the case described here, they are significantly different from the results obtained with mono-species inversions but not radically different. Now that we have shown that the multi-species approach is valid, we plan to use HCHO satellites retrievals from OMI to constrain the HCHO part of our system for example.

ACPD

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Interactive Comment

3. There appear to be inconsistencies in the reported trace-gas budgets (see specific comments). These should be clarified and repaired.
See answers to specific comments. Many errors were typos on our part, we apologize for this inconvenience. They will be corrected in the final version

4. The evaluation of the analysis results with independent observations is not very convincing (see specific comments).
See answers to specific comments. The main purpose of this paper was to expose our methodology. Our study provides a first attempt at evaluating the inverted fluxes. Our formulation may have not been clear enough on this point and will be reformulated in the final version of the abstract ("[...] with methyl chloroform. The methodology is exposed and a first attempt at evaluating the inverted fluxes is made. Inversions of [...] ") and of the introduction ("[...] within the inverse system. After having exposed the methodology, we study the year 2004 and make a first attempt at evaluating the inverted fluxes is described. All the prior [...]"). A more detailed study will follow, based on an extended period of analysis.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20687, 2008.