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Interactive comment on "Inverse modelling for mercury over Europe" *by* Y. Roustan and M. Bocquet

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We would like to thank the referees for their reviews.

This article presents the second part of a more general work based on the use of an adjoint method. We haven't fully developped the presentation of this method since it has been made in [1]. Unfortunately, this paper is not available yet, but it should be online very soon. We will improve the autonomy and the accessibility of this part of the text.

An URL will be provided in the text to made available the description of models. (http://www.enpc.fr/cerea/fich/article/YR_gloream_2005.pdf).

We agree that elemental mercury does not contribute significantly to wet deposition.

This seems to us not so clear for the dry deposition. Nevertheless we agree that this work does not address the issue of boundary conditions for oxidized species in gaseous and particulate phase, which remains a crucial topic. We will detail these points in our text.

1- The southern and the top boundary conditions are not chosen as variables to invert because the sensitivity of the modeled measurements to these forcing fields are too weak (a statement that we have quantified in [1]). Therefore those parameters cannot be reliably inverted (with the observations at our disposal presently). This explanation will be reported in the text.

2- The mass balance in Table 1 is established for elemental mercury. With this chemistry module the chemical conversion and the wet deposition are merged. The elemental mercury in aqueous phase is regarded as negligible in comparison to oxidized mercury. Direct scavenging of elemental mercury is not taken into account and as you mention it probably negligible. The only oxidation path represented is the reaction with ozone in aqueous phase. Neither the elemental mercury, nor ozone are really soluble which explains the weak chemical conversion/scavenging. Moreover, the relatively coarse spatial and temporal resolution of the precipitation fields used do not support an effective scavenging.

3- All the simulations are performed with 2001 meteorological and emissions data. Only the boundary conditions are modified. We will make this point clearer.

4- We use the term “climatic boundary conditions” to distinguish between uniform and non-uniform boundary conditions. Uniform ones are described in paragraph 2.3. Non-uniform ones are build from annual mean concentration fields resulting from simulations performed by the MSC-E/HM model for 2001 and 2002. Boundary conditions for our domain are simply obtained by interpolating these concentration fields. The terms “uniform” and “non-uniform” refer to the spatial dimension, in both case the boundary conditions are constant in time

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5- We agree with the reviewer that the method presented here is applied to averaged fields. We use averaged measurements to improve an averaged description of the boundary conditions. We have shown that monthly averaged measurements manage to represent the impact of the monthly variability of the northern boundary conditions, which is clearly impossible with annually averaged measurements. We hope that a finer temporal descriptions of the measurements (which are available) could be used to improve more precisely the description of the boundary conditions, but this remains to be checked and such an approach requires more consequent computational resources (since one adjoint simulation is needed for each spatially and temporally located measurement). Moreover, one of our motivation is impact studies for which we believe that annual and monthly time scale are relevant.

6- The assimilated (or inverted) parameter in our work is λ^*, the coefficient applied to the boundary conditions after the assimilation of observations. We will modify the text to make this explicit.

7- Unfortunately, to our knowledge there are no other data available in our domain for the year 2001. The site of Spitsbergen, Zeppelin (NO42) is beyond its northern border. Several sites in Germany provide observations for mercury concentrations but in precipitation (DE01, DE09).

8- We agree with the reviewer. We will change our text in order to be more exhaustive.

References

[1] Roustan, Y. and Bocquet, M.: Sensitivity analysis for mercury over Europe, J. Geophys. Res., in press, 2006.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 795, 2006.