

## ***Interactive comment on “Simulation of atmospheric mercury depletion events (AMDEs) during polar springtime using the MECCA box model” by Z.-Q. Xie et al.***

**Z.-Q. Xie et al.**

Received and published: 4 October 2008

We would like to thank the reviewer 1 for his/her comments that have helped us to prepare this final version. The suggestions have been taken into account. Below is a point by point answer to the reviewer 1 comments.

Specific Comments: 1. The authors selected the kinetics of Pal and Ariya (Phys. Chem. Chem. Phys., 6, 572-579, 2004) for the oxidation of mercury by ozone in the gas phase (line 25, p. 13201). This kinetics is not used in global and regional models of atmospheric mercury because it oxidizes Hg(0) too quickly and leads to Hg(0) concentrations that are too low compared to observations (Seigneur et al., 2006; Selin et al., 2007). Although it is unlikely that the kinetics of this reaction has a significant effect

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on the main conclusions, the authors need to reconcile their work with those earlier results.

We have addressed this problem in Section 2.1. The reaction  $\text{Hg} + \text{O}_3$  is not important in our study (see black line in our Fig. 7).

2. The statement that the oxidation of  $\text{Hg}(0)$  is faster in the aqueous phase than in the gas phase is incorrect (lines 17-18, p. 13202).

The reviewer is correct in pointing out that the low solubility of  $\text{Hg}$  makes the overall oxidation in the aqueous phase slow. We have corrected the statement as follows: The chemical lifetime of  $\text{Hg}$  against oxidation is much less in the aqueous phase than in the gas phase; in Section 2.2.

3. The work by Gardfeldt and Johnson (J. Phys. Chem., 107, 4478-4482) on the reduction of  $\text{Hg}(\text{II})$  by  $\text{HO}_2$  in the aqueous phase should be mentioned and its implications should be discussed.

The work by Gardfeldt and Johnson suggested that the reduction of  $\text{Hg}(\text{II})$  by  $\text{HO}_2$  in the aqueous phase may be not important. We updated this point accordingly in Section 2.2.

4. Skov et al. (2004) derived empirical estimates of the first-order oxidation of  $\text{Hg}(0)$  during depletion events at Station Nord (using the depletion of ozone as a means to estimate the  $\text{Br}$  concentrations) and obtained values in the range of  $0.8 \times 10^{-12}$  to  $1.2 \times 10^{-12}$  molec $^{-1}$  cm $^3$  s $^{-1}$  for the effective rate of the  $\text{Hg}(0) + \text{Br}$  reaction.

This value is quite different from our result. The reason is that Skov underestimated the concentration of  $\text{Br}$  atoms, which is only 1-3 ppt, while in our study during  $\text{Br}$ -Explosion, the level of  $\text{Br}$  is high up to 20 ppt.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 13197, 2008.

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