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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multi-model study of mercury dispersion in the atmosphere: Vertical distribution of mercury species" *by* Johannes Bieser et al.

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Answers to Reviewer #3:

We want to thank reviewer #3 for his comments. We implemented all suggestions into the revised manuscript.

Q: Only the CCLM-CMAQ model considered the natural emission inventory. I would like to ask the authors to discuss the influence without the natural emission for these model simulation when compared to CCLM-CMAQ, and observed vertical atmospheric Hg profiles in more details.

A: All models used natural emissions of Hg. However, there was an error in Table 1.

We corrected this and Table 1 now includes the natural emission totals as used by the all models.

Q: Line 513 " Figure 1 depicts idealized seasonal vertical profiles for the northern mid-latitudes." Please specify the sources.

A: The depicted profiles are based on aircraft observations from CARIBIC, ETMEP, NOMADDS, and Tullahoma flights. Data gaps in altitudes in which no observations are available were estimated (we added this information to the figure caption)

Q: Line 539-541 "This is in line with many previous model studies which found that models tend to underestimate current TM concentrations in Europe" , can be caused by the inventory or modeling setup ? Please give more detailed discussion for this.

A: We now discuss this in more detail. "Based on a model run from 1996 to 2008 Muntean et al. (2014) hypothesized that this was due to an overestimation of emission reductions in the last decade. Moreover, a change in the speciation of mercury emissions due to new cleaning technologies of modern coal fired power plants can have an impact on the lifetime of regional primary anthropogenic emissions."

Q: Line 657-660 "Apart from GEM no individual mercury compound has been identified so far. The speciation of mercury is thus operationally defined as GEM, GOM, and PBM (Gustin et al., 2015)." In my opinion, this sentence should be removed into introduction section.

A: We moved this to the introduction: "However, apart from GEM no individual mercury compound has been identified so far and the atmospheric oxidized mercury is an unknown mixture of mercury bound to Br, Cl, OH, O, and NO2 compounds (Horowitz et al, 2017). The speciation of mercury is thus operationally defined as GEM, GOM, and PBM (Gustin et al., 2015). In the following we will address the sum of all oxidized mercury species as OM (oxidized mercury)."

Hannah M. Horowitz, H.M., Jacob, D.J., Zhang, Y., Dibble, T.S., Slemr, F., Amos, H.M.,

Schmidt, J.A., Corbitt, E.S., Marais, E.A., Sunderland, E.M., 2017. A new mechanism for atmospheric mercury redox chemistry: Implications for the global mercury budget. Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016- 1165, 2017

Q: Line 680 “Five of the seven models”, please specify these five models.

A: We now name the models: (GLEMOS, GEOS-Chem, GEM-MACH-Hg, CMAQ-Hem, CCLM-CMAQ)

Q: Line 690-695, please discussed the uncertainties of the GOM and PBM measured by Tekran and site the paper from Gustine’s group recently before comparing the observation and simulated results.

A: We added a pragraph at the end of section 3.2: “As discussed in Section 2.4, current GOM measurement techniques which are based on the sorption of GOM on KCl coated denuders have been shown to be susceptible to environmental interferences. Mainly, ozone and humidity have shown to lead to an underestimation of ambient GOM concentrations (Lyman et al., 2010; Jaffe et al., 2014; Gustin et al., 2015). Thus, we focus the following model evaluation on the relative distribution of OM in the atmosphere rather than absolute values.”

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