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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global atmospheric model for mercury including oxidation by bromine atoms" *by* C. D. Holmes et al.

Anonymous Referee #2

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This manuscript is focused to evaluate the role of bromine chemistry in the global mercury cycle and how it influences the atmospheric mercury transport and removal processes, and ultimately how modeled concentrations of Hg(0), Hg(II) and Hg(p) compare with observations. Major known bromine chemical reactions with Hg have been introduced in GEOSS-Chem model and comparison of results obtained by adopting (Hg+Br) and (Hg+OH/O3) mechanisms have been provided. One of the goal is to define which of these mechanisms is more likely to occur. The authors conclude that the bromine oxidation pathway results to produce a better agreement with the observations, though significant uncertainty still remain. In summary the paper is well written and quite innovative from technical point of view. The approach used and the Br chemistry adopted is well known in the literature, results are well discussed though not always the authors give credit to previous published work on the subject, especially

that related to mercury emissions from anthropogenic and natural sources as pointed out below.

Mercury emissions from anthropogenic and natural sources used in this work are primarily based on Selin et al.(2008) in which Hg emissions were increased to match observations. In this MS has been used 300 Mg yr-1 as global Hg emission from biomass burning based on a Hg/CO ratio of 100 nmol mol-1. I am quite surprised that the authors have not considered the work published by Friedly et al. 2009 (Environ. Sci. Technol. 43, 3507–3513) which provides a very interesting assessment of mercury emissions from biomass burning by season and by region. In Friedly et al. 2009, mercury emissions from biomass burning is estimated to be 675 +/- 240 Mg/year as an average for the period of 1997-2006, and a discussion of inter-annual variability by region/forest type region is also provided. One of the outcome of Friedli et al. (2009) was that during the (1997-2006) period, the largest mercury emissions are from tropical and boreal Asia, followed by Africa and South America. It is important to keep in mind that one of the outcome was that these emissions do not coincide with the largest carbon biomass burning emissions, which originate from Africa, because frequently burning grasslands in Africa and Australia, and agricultural waste burning globally, contribute relatively little to the mercury budget. I believe the authors should consider the estimate provided in Friedli et al. 2009, otherwise should discuss why they do not agree with the estimates provided in this earlier work.

As general comment, I noticed that the reference Selin et al. (2008) is used as overarching reference instead of referring to the original work from which the estimate has been derived from - i.e. for the mercury emissions from artisanal gold and mercury mining, I would suggest to use the original reference which is the work by Telmer et al. and Veiga et al. (e.g., Chapter 6 in "Mercury fate and transport in the global atmosphere, edited by Pirrone and Mason, published by Springer in 2009). Telmer et al. estimated mercury emissions from ASGM of 400 Mg yr-1 to which 50Mg yr-1 has to be added from mercury mining that brings the total amount to 450 Mg yr-1.

There are few references that need to be updated, reported now as ACPD, that have been published already in ACP.

Overall, I suggest to accept the MS for publication as soon as the above criticisms have been addressed in appropriate manner.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 19845, 2010.