Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-347-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global deposition of speciated atmospheric mercury to terrestrial surfaces: an overview" *by* Lei Zhang et al.

Anonymous Referee #2

Received and published: 6 June 2019

This manuscript presents a review of speciated atmospheric mercury (Hg) deposition to the terrestrial surfaces on a globe scale. The topic is relevant to the Atmospheric Chemistry and Physics. However, the scientific contribution could be enhanced by a more inclusive review and a more depth discussion that highlight the advancement, challenges, and directions for future research. The presentation could be improved as well. My specific comments and suggestions are listed below.

Major concerns

1. A method section is missing. The authors may want to provide a Methodology section to cover the following items, how the literature search/review was conducted, what is the scope of the literature search, what are the primary source of publications (e.g. peer reviewed journal articles, government reports), restrictions if any (e.g. by

year of publication, or by language).

2. The scope of the review needs more justification. The title reads, "Global deposition of speciated atmospheric mercury to terrestrial surfaces: an overview". The rational of excluding the water surfaces (Figures 1, 6, 7 do include water through) and snow/ice over land should be presented.

3. The scientific contribution could be enhanced significantly. The manuscript as written is a somewhat descriptive presentation of estimation methods (sections 2 and 3) and Hg deposition values (sections 4 and 5). Consequently, there is a lack of new insights and findings. The authors are encouraged to conduct a rigorous research leading to more depth discussion that highlights the advancement, challenges, and directions for future research. Some potential topics are listed below (also see sample papers and a sample weblink at the end) 1) Comparison of co-located measurements with different techniques 2) Comparison of Hg deposition estimates by different models 3) Model-measurement comparison 4) Observed/predicted changes in Hg deposition due to changes in quantity of Hg emissions in local, regional or globe scale 5) Observed/predicted changes in Hg deposition due to changes in profiles (e.g. the percentage of each Hg species in total emission) of Hg emissions in local, regional or globe scale 6) Contributions to observed/simulated Hg dry deposition from different sources or regions 7) The major sources of uncertainty in Hg deposition estimates and how to reduce those uncertainties 8) What is the knowledge or data gap (relevant to Hg deposition) that hinders our understand of the global Hg cycle, or the development and evaluation of emission control measures?

4. The "Bidirectional air-surface exchange model for GEM" is presented. However, dry deposition of GEM is estimated in many field studies and model simulations, including most GEM dry deposition data presented in the manuscript. Thus, the authors may want to include dry deposition models of GEM.

5. Please provide facts to support your statements, e.g. "For PBM dry deposition, a

size-segregated resistance model is more and more widely applied" (L312)

Presentation

1. Most materials presented in sections 2 and 3 can be found in previous review/research papers, because those techniques have been around for a while. The authors could provide a summary table and direct the interested readers to those review/research papers, instead of a lengthy description of each method. Another option is to provide a comparative review of those methods and to include strength, weakness, recent advancements if any, and application issues.

2. Section 4.3 (Forest deposition or Deposition over forests) could be better placed in section 5 (Global Hg deposition on different terrestrial surfaces).

3. If the authors decided to keep the equations, please 1) provide unit of each variable, 2) provide the source of each equation, 3) clarify the expansion factor in equations (8) and (9). Is it an expansion from a measurement in a small area to a forest? 4) explain how to calculate two resistances with equation (16).

4. Please state the mechanism of Hg deposition via cloud/fog at high elevation sites (L258).

5. L456, the authors many want to distinguish the net emission fluxes from "natural GEM emission sources".

6. Figure 6, "precipitation levels" or "annual precipitation"?

7. The papers from which data were obtained to generate each figure could be tabulated and presented as Supplement Information.

Editorial suggestions

The use of English language is largely satisfactory. However, there is much room of improvement. Some examples are listed below.

1. There are quite a few awkward sentences and word choices, e.g. "Ci is the total Hg concentration in precipitation water" (L193), "Usually, GOM and PBM contribute equivalently to Hg wet deposition (Cheng et al., 2015)." (L206), add "GEM dry deposition is equivalent to GOM and PBM dry deposition, even significantly higher than in forests" (L535), "consequently exhibit significantly high litterfall Hg deposition fluxes." (L560), "Water surfaces could affect Hg wet deposition through fog scavenging." (L580), "The contribution GEM dry deposition has been underestimated previously." (L596), "Cloud, fog or even dew Hg deposition needs careful investigation" (L599), please rephrase.

2. There are some contradicting or confusing statements, e.g. "Based on available measurements of PBM size distributions and fine/coarse PBM mass ratios, Zhang et al. (2016b) assumed 30% of the total PBM mass to be coarse particles in order to estimate total PBM dry deposition flux based on the theory that PBM has the same proportion in both fine and course particles." (L318)

3. Avoid the use of first person, i.e. "we".

Sample model-model and model-measurement comparison papers:

Holmes, H. A., E. R. Pardyjak, K. D. Perry, and M. L. Abbott, 2011. Gaseous dry deposition of atmospheric mercury: A comparison of two surface resistance models for deposition to semiarid vegetation, J. Geophys. Res., 116, D14306, doi:10.1029/2010JD015182.

Wright, L.P. and L. Zhang, 2015. An approach estimating bidirectional air-surface exchange for gaseous elemental mercury at AMNet sites. J. Adv. Model. Earth Syst., 7, 35–49. (L1088)

Ye, Z., Mao, H., Driscoll, C.T., Wang, Y., Zhang, Y., Jaeglé, L. (2018) Evaluation of CMAQ Coupled With a State-of-the-Art Mercury Chemical Mechanism (CMAQ-newHg-Br). Journal of Advances in Modeling Earth Systems 10, 668–690. 588. https://doi.org/10.1002/2017MS001161

Sample weblink to find more papers:

https://www.researchgate.net/profile/Shuxiao_Wang

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