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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Method development estimating ambient mercury concentration from monitored mercury wet deposition" *by* S. M. Chen et al.

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We greatly appreciate the comments and criticisms provide by both reviewers which helped us to improve the paper significantly. Because both reviewers provided similar comments, we chose to address all the comments together to avoid duplication.

We completely agree with the criticisms provided by the two reviewers. The major ones can be summarized as (1) improving statistical results by incorporating more factors into the statistical model; (2) improving statistical results using larger dataset; (3) testing/verifying the results using other sites; and (4) trying to interpret the results

from science point of view.

We admit that the method is far from complete. That is why we initially submitted the paper as a short technical paper instead of as a full research paper. We hoped this initial experiment to motivate the scientific community to improve the method or develop better methods.

The motivation of this study came from a recent mercury transport model evaluation study (Zhang et al., 2012, Environmental pollution) in which the modelled surface concentrations for oxidized mercury were found to be 2-10 times higher than the monitored concentrations at multiple locations. Thus, if using modelled dry deposition or using modelled surface concentration to estimate dry deposition, the results would be biased high significantly. Considering that mercury collected in precipitation are mainly from oxidized mercury (GOM and PBM), it might be possible to generate some statistical relationships between the ambient concentration and the wet deposition. Because of the many factors (including in-cloud scavenging) affecting the wet deposition, it is not realistic to expect a very accurate relationship. Our minimum goal was to develop a method that might generate reasonable RGM and PBM concentrations from wet deposition over a relatively long period (e.g., monthly or longer periods). Then the estimated monthly RGM and PBM concentration can be used to constrain dry deposition estimates and to evaluate mercury transport model output. We think the method presented here can serve this purpose. To improve the paper, we have done many additional analyses in the revised paper as explained below.

Regarding concerns on the deviation of model estimates demonstrated in both Figure 5 and 8: the research goal is to develop a statistical model to establish a relationship between mercury wet deposition data and ambient mercury concentration. There are a number of steps involved toward the final task. First of all, we need to find the dry and wet mercury distribution density functions (which also introduced precipitation as an input variable). This study developed and demonstrated both well fitted density functions. The second step is to establish the relationship between ambient concentration

with wet deposition and precipitation based on the Equation (4) and (5). The origin of the equations is derived in Amos et al. (2012). There were a number of assumptions applied to simplify the relationship. In the revised version, we taken a closer look at the assumptions and improved the state of statistical model.

Regarding data sample size and geographic coverage limitation: Although there is a large number of mercury wet depositions monitoring sampling data, there are only a few mercury air concentration monitoring stations in North America. The fact of unbalanced wet and dry monitoring stations was the driver to initialize this study. Our first focus region is NE seaboard and eastern Canada, which contain more wet and dry monitoring stations than other areas. We recognize this research and approach may be limited to a region and the model parameters might be changed in the other regions. We prefer to develop a statistical model to be suitable to the study area in the first place, and then expend the concept to other regions. However, we'd like to point out that precipitation-weighted wet deposition (concentration in precipitation) may have less dependence on the region than dry deposition because the former mainly depends on precipitation and the later depends on surface characteristics and many other meteorological variables. In the revised paper, we have included more monitoring data and longer periods of sample time up availability.

We agree that it is necessary to perform model validation. We have added one year (2010) of model validation results and analysis in the revised paper.

We have also improved presentation by adding information on the number of datasets, the time periods of the datasets, sample size and data characteristics, and selection of model data for statistical modeling. We improved the labels of figures and tables. And we have added discussion on model performance, how can it be applied elsewhere, and future improvements.

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