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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.

Anonymous Referee #1

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General Comments

This manuscript details a statistical method to estimate ambient air gaseous oxidized mercury (GOM) and particulate bound mercury (PBM) concentrations from mercury (Hg) wet deposition measurements. The benefits could potentially lead to information on atmospheric Hg concentrations in areas where Hg wet deposition is monitored but ambient air Hg concentrations are not. I agree with the authors that this is an important goal, due to the much lower cost of establishing wet deposition monitoring sites; however, the paper falls quite short of accomplishing this goal. The presentation in the paper appears to be an exercise in statistical data-mining, and I do not believe this

paper is up to the standards for publication in such a highly read journal as ACP.

The paper does nothing to advance the science; in particular, there is no mechanistic discussion for why these relationships should work, or how the relationships are applicable to the mercury biogeochemical cycling field as a whole. Specifically Figures 5 and 8 illustrate my point. Even using a set of "super" sites that have measurements of both Hg wet deposition and ambient air Hg speciation, there is no consistent relationship between modeled and measured GOM + PBM concentrations, even for this extensively studied area. This inability to reproduce data for "ideal" sites, in my opinion, makes the technique useless for application in areas where ambient air concentration measurements of GOM and PBM are not made. Without this applicability, the paper loses relevance to the scientific community. Further without a mechanistic discussion for why or how these relationships should work it is impossible to extrapolate the relationships to areas outside of the Ohio, Maryland, New York, New Jersey, New Hampshire, and Vermont sites mentioned here. Despite a relatively broad spatial spread in sites, the site characteristics are quite similar when compared to other sites even in the U.S. portion of the MDN, including the "plains" in the mid-west, the arid western desert, coastal areas, the hot and humid southeast, and any of the sites in Alaska. There will also be dilution effects on weekly samples, that the authors indicate is non-trivial and a "subject of future study", which make it nearly impossible to capture the true variability of GOM + PBM in the atmosphere with this technique.

As the actual chemical constituents of GOM and PBM are unknown, it remains to be determined whether different areas may actually have different types of GOM; therefore, the statistical relationship would vary greatly from region to region. Another important issue not addressed (in the absence of a mechanistic discussion) is the influence of different types of precipitation on this relationship, as the scavenging ability (and thus the relationship between gaseous and liquid concentrations) will differ based on rain, snow, sleet, ice, etc.

Based on these very significant factors I cannot support publication of this manuscript

in Atmospheric Chemistry and Physics.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 12771, 2013.