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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Patterns of mercury dispersion from local and regional emission sources, rural Central Wisconsin, USA" *by* A. Kolker et al.

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Response to interactive comments on Discussion paper by Kolker et al., Atmos. Chem. Phys. Discuss., 10, 1823-1846, 2010

Comment 1, by Anonymous Referee #2, posted 5 March, 2010

Referee #2 asks a series of relevant questions that we summarize as follows: 1) Can you better explain why the greatest peak RGM occurs at the farthest site?; 2) Can you say something about the behavior of RGM on days other than Sept. 23? 3) What is mercury speciation like at each of the emission sources; 4) What is the effect of wind speed on Hg delivery? 5) what methods could be used to reduce emissions of mercury

to the environment and the study area, especially for RGM and Hgo.

Question 1: We don't know for sure why the greatest peak RGM occurs at the 100 km site and therefore, we have offered several possible explanations. One possibility is RGM is being generated in the plume during transport. Another possible explanation is that RGM is carried over the immediate vicinity of the emission source and the closest monitoring site. This is based on our general knowledge of the design parameters of emission stacks. Another possibility, that the 100 km site is influenced by emissions from the chlor-alkali facility or regional urban emissions, seems the most plausible overall.

Question 2: We go into some detail about Sept. 23, 2007, because it appears to contradict our assumptions going into the study. RGM plumes on other days were found to be both similar to Sept. 23 in that they show greatest peak heights at the 100 km site (3, 4 October) and in other cases, they are consistent with a source to the south (e.g. 20 October), with a regular decrease in RGM peak height at each of the sites from south to north. We could show this by modifying Fig. 3 to include results for both September and October, but in doing so we would lose a little detail.

Question 3: We do not have direct Hg speciation data any of the primary point sources in the study. However, previous investigations of chlor-alkali sources indicate that their primarily emit elemental Hg. The portion of oxidized vs. elemental Hg released from coal fired power plants is highly variable and dependent on coal composition (especially S and halogen content), the presence/absence of specific emission control units, and general operating conditions of the plant (Kolker et al., 2006). As such, it's difficult to assess what the speciation of the Hg from the regional coal-fired power plants was at the time of the investigation.

Reference: Kolker, A., Senior, C.L., and Quick, J.C., 2006, Mercury in coal and the impact of coal quality on mercury emissions from combustion systems: Applied Geochemistry, v. 21, p. 1821-1836.

Question 4: It's not entirely clear what is meant by Hg delivery; concentration or travel time? Increased wind speed is often associated within increased turbulence, which increases dispersion. Increased dispersion has the effect of decreasing average concentration (as a result of increased mixing) and will tend to smooth out the front edge of a plume so that portions of the plume will arrive much faster and will impact a site for a longer period, although the maximum concentration will be much lower than in an environment with low dispersion.

Question 5: Operational changes to each emission source that should reduce the input of mercury to the study area are as follows: 1) The chlor-alkali plant has undergone conversion to a mercury-free membrane technology which should eliminate use of mercury in this process; 2) the 465 MW power station has added a new unit that doubles its overall capacity. The new unit has a state-of-the art sorbent injection system to limit Hg emissions and similar modifications are planned for the original capacity; 3) the 1114 MW utility has put in place or planned upgrades to its emissions controls.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 1823, 2010.