Vertical Distribution of Gaseous Elemental Mercury Over the Pacific Northwest in the Spring of 2006

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ABSTRACT
In the spring of 2006, we measured the vertical distribution (up to 6km) of Gaseous Elemental Mercury (GEM), CO, ozone, and aerosol scatter over the Pacific Northwest. Flights dates were selected when the modeled CO values suggested long-range transport of Asian emissions to the Northwest. We observed a nearly constant vertical profile of GEM (~1.4 ng/m3) above the boundary layer along with several well correlated enhancements of GEM and CO above the mean profile. A composite of the enhancement values of the three largest events had a GEM-CO correlation slope of (0.0063 ng/m3/ppbv CO) which agreed with previous observations of the Asian industrial plume. Kinematic back trajectories support eastern Asia as the source region for the observed GEM-CO enhancement. Local anthropogenic emissions were observed to have a statistically insignificant GEM-CO correlation. Several episodes of GEM depletion at higher altitudes were observed which had a similar signature to reactive gaseous mercury (RGM) enhancement events observed at Mt. Bachelor. This implies we observed > 100 pg/m3 RGM. The concentrations of GEM were generally lower below 700 mb than above. This suggests a rapid loss of GEM either in-situ with anthropogenic pollution, or prior to mixing.

Background
The control of the oxidation of mercury above the boundary layer remains one of the most salient areas of uncertainty in its global cycle. Also, long-range transport (LRT) is the most important input source for most remote regions and makes a significant contribution to local deposition in most other regions. Therefore, understanding the free-tropospheric chemistry is crucial for understanding and predicting local deposition.

Experimental
We used a Beechcraft Duchess (ceiling 20k ft) to conduct 8 flights in Western Washington between Apr 12 and May 9. We measured:
- ozone (DAShi-3B)
- aerosol scatter (3-A)
- gaseous elemental mercury (Tekran 2537A)
- CO
- temperature, RH, GPS

This aircraft work continues our mercury work which has had several important findings: Jaffe et al. (2005) describe observations of Asian outflow to Okinawa, JP and LRT to Mt. Bachelor (MOB) and a showed the GEM-CO ratio (Above) was a good marker of the Asian industrial plume. These findings were later confirmed by Weiss-Penzias et al. (2006). Swartzendruber et al. (2006) describe observations of mercury speciation in the free-troposphere at MOB and report strong interconversion of species (Left) that could not be explained by currently modeled chemistry.

Conclusions
- Asian Long-Range Transport (ALRT) was clearly identified with GEM-CO ratio (0.0063 ng/m3/ppbv CO) in good agreement with previous studies.
- Local anthropogenic signature was distinctly different than ALRT with an insignificantly small GEM enhancement and insignificant GEM-CO correlation.

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