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Use of global model results to understand airborne oxidized mercury observations at five sites

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In this study it was compiled atmospheric mercury (Hg) measurements using the Tekran[®] analytical system from 1 high elevation tropical site, 2 high elevation mid-latitude sites, and 2 mid-elevation, mid-latitude sites (1400-3200 m elevation) in Asia and the U.S. over multiple seasons and years, and compared these data with the global model GEOS-Chem. Mercury data from both the observations and the model over equivalent time periods on the same time resolution were separated into gaseous elemental Hg (GEM) and “reactive Hg” (RM) which is a combination of the gaseous oxidized (GOM) and particulate bound (<2.5 μm) (PBM) fractions. The oxidation scheme used by the GEOS-Chem model was varied between the standard run with Br oxidation and an alternative run with OH-O₃ oxidation. The standard model generally overestimated the concentrations of both RM and GEM by about a factor of 3 and 15%, respectively. However, the bias notwithstanding, the standard model did a reasonable job at reproducing interspecies correlations between RM, GEM, O₃, and WV. For example, during the summer RM was negatively correlated with GEM and WV and positively correlated with O₃ across most sites both in the model and the observations. Three of the sites showed significant ($p < 0.05$) correlations for all species comparisons (RM:GEM, RM:O₃, RM:WV) in the observations and the standard model. This confirms that RM can be formed in dry upper altitude air from the photo-oxidation of GEM. Modeling results using the OH-O₃ oxidation scheme were similar to the results from the Br-oxidation scheme, but in some cases agreed more closely with the observations. In particular, high RM concentrations observed at the DRI site in Nevada in the summer of 2007 were more closely matched by the OH-O₃ vs. Br-oxidation schemes. Both models produced RM/GEM monthly mean ratios that were 2.8 higher than RM/GEM monthly mean ratios in the observations, which assuming the models are correct, this factor is in line with that previously suggested as the GOM capture inefficiency of the method. Finally, because the OH-O₃ oxidation scheme model produced a different pattern of RM/GEM monthly mean ratios relative to the Br-oxidation scheme, it is speculated that there could have been different forms of RM present at the mountain top sites relative to the desert sites.

Biography

Peter Weiss-Penzias completed his PhD at the University of Washington in 1995. He completed his post-doctoral studies at the University of Washington, Bothell in 2005 and he is currently an Associate Researcher and a Lecturer at the University of California, Santa Cruz. He has 12 first author papers and 26 papers overall. He is currently the lead PI on an NSF-funded research project to quantify mercury in coastal marine fog.

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