

Seasonal and diurnal variations of Hg⁰ over New England

H. Mao, R. W. Talbot, J. M. Sigler, B. C. Sive, and J. D. Hegarty

Abstract

Factors influencing diurnal to interannual variability in Hg⁰ over New England were investigated using multi-year measurements conducted by the AIRMAP program at the Thompson Farm (TF) coastal site, an inland elevated site at Pac Monadnock (PM), and one summer of measurements on Appledore Island (AI) in the Gulf of Maine. Mixing ratios of Hg⁰ at TF showed distinct seasonality with maxima in March and minima in October. In comparison, Hg⁰ at AI tracked the trend at TF but with higher minima, while at PM the diurnal and annual cycles were dampened. In winter, Hg⁰ was correlated most strongly with CO and NO_y, indicative of anthropogenic emissions as their primary source. Our analysis indicates that Hg⁰ had a regional background level of ~160 fmol/mol, a summertime dry deposition velocity of ~0.20 cm s⁻¹, and a ~16 day lifetime in the coastal boundary layer. The influence of oceanic emissions on ambient Hg⁰ levels was identified using the Hg⁰-CHBr₃ correlation at both TF and AI. Moreover, the lower Hg⁰ levels and steeper decreasing warm season trend at TF (0.5–0.6 fmol/mol d⁻¹) compared to PM (0.2–0.3 fmol/mol d⁻¹) likely reflected the impact of marine halogen chemistry. Large interannual variability in warm season Hg⁰ levels in 2004 versus 2005/2006 may be due to the role of precipitation patterns in influencing surface evasion of Hg⁰. In contrast, changes in wintertime maximum levels of Hg⁰ were small compared to drastic reductions in CO, CO₂, NO_y, and SO₂ from 2004/2005 to 2006/2007. These trends could be explained by a homogeneous surface distribution of Hg⁰ over the North American continent in winter and/or rapid removal of mercury released from anthropogenic sources. We caution that during warmer winters, the Hg⁰-CO slope possibly reflects the ratio of Hg⁰ loss relative to changes in CO more than their emission ratio.

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