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Seasonal and diurnal variations of Hg° over New England

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Abstract. Factors influencing diurnal to interannual variability in Hg° over New England were investigated using multi-year measurements conducted by AIRMAP at the Thompson Farm (TF) coastal site, an inland elevated site at Pac Monadnock (PM), and two month measurements on Appledore Island (AI) in the Gulf of Maine. Mixing ratios of Hg° at TF showed distinct seasonality with maxima in March and minima in October. Hg° at AI tracked the trend at TF but with higher minima, while at PM the diurnal and annual cycles were dampened. In winter, Hg° was correlated most strongly with CO and NO_y, indicative of anthropogenic emissions as their primary source. Our analysis indicates that Hg° had a regional background level of ~160 fmol/mol in winter, a dry deposition velocity of ~0.20 cm s^{-1} with a ~16 day lifetime in the coastal boundary layer in summer. The influence of oceanic emissions on ambient Hg° levels was identified using the Hg°-$CHBr_3$ correlation at both TF and AI. Moreover, the lower Hg° 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 Hg° levels in 2004 versus 2005/2006 may be due to the role of precipitation patterns in influencing surface evasion of Hg°. In contrast, changes in wintertime maximum levels of Hg° were small compared to drastic reductions in CO, CO_2, NO_y, and SO_2 from 2004/2005 to 2006/2007. These trends could be explained by a homogeneous distribution of Hg° over North American in winter due to its long lifetime and/or rapid removal of reactive mercury from anthropogenic sources. We caution that during warmer winters, the Hg°-CO slope possibly reflects Hg° loss relative to changes in CO more than their emission ratio.

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