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## Assessing the atmosphere-surface exchange of gaseous elemental mercury using passive air samplers

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The specific properties of gaseous elemental mercury (GEM) allow it to undergo bidirectional exchange between the atmosphere and the Earth's surface. Determining the direction and the magnitude of GEM's atmosphere-surface flux is possible and has been accomplished using micrometeorological and chamber techniques, but (i) is complex and labor-intensive, and (ii) often only yields fluxes over relatively short time scales. A recently developed passive air sampler for GEM has the precision required for identifying and quantifying vertical concentration gradients above the Earth's surface. The feasibility and performance of this approach is currently being tested in a number of field studies aimed at the: (i) measurement of GEM concentration gradients above both mercury-contaminated and background forest soils, (ii) quantification of vertical concentration gradients on a tower through a temperate deciduous forest canopy, and (iii) measurement of mercury concentration gradients over stable and thawing permafrost to determine the effect of permafrost degradation on GEM evasion. Contrasting with earlier flux studies, these investigations cover long time periods (up to 1.5 years) and have coarse temporal resolution (monthly to seasonally). Significant gradients of GEM air concentrations, both increasing and decreasing with height above ground, were observed, implying that at a minimum, the method is able to identify the flux direction of GEM. Under the right circumstances, this method can also be used to estimate the approximate magnitude of the GEM air-surface exchange flux. The measured gradients also reveal the impact of factors such as temperature, solar irradiance, and snow cover on air-surface exchange. The method holds promise for establishing the direction and size of exchange fluxes at long time scales of months to a year, especially in study areas where access, effort and cost are prohibitive to longer duration studies with existing approaches.