Seasonal variation in pathways of atmosphere-land exchange of mercury in a northern hardwood forest

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Northern forest ecosystems can be sensitive to atmospheric mercury deposition. In this study we integrated data collected at the Huntington Wildlife Forest in the Adirondack region of New York to examine seasonal variation in pathways of mercury exchange between the atmosphere and the forest ecosystem. The data included concentrations of atmospheric mercury, wet mercury deposition (Mercury Deposition Network), throughfall mercury, foliar accumulation of mercury, litterfall mercury deposition, soil mercury evasion, soil solution mercury fluxes as well as estimates of mercury deposition predicted from the atmospheric transport model CMAQ. In this analysis we examined mercury transfers at a monthly time step over the annual cycle using average data over recent years (2004-2011). Depletion of gaseous elemental mercury during the growing season generally agreed with foliar mercury accumulation and litter mercury deposition. This pathway was the largest annual influx of mercury as dry mercury deposition (14.3 $\mu g/m^2$-yr) exceeded wet mercury deposition (6.7 $\mu g/m^2$-yr). Soil evasion was the greatest mercury loss pathway (6.4 $\mu g/m^2$-yr), exceeding vertical and lateral drainage from soil (2.8 $\mu g/m^2$-yr). Field measurements of mercury fluxes generally did not agree well with CMAQ simulations of mercury deposition. The upland hardwood forest was a net sink for mercury inputs. Our analysis showed marked seasonal variation in the transfers of mercury largely mediated by annual canopy development of the forest ecosystem.

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