A vegetation control on seasonal variations in global atmospheric mercury concentrations

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Anthropogenic mercury emissions are transported through the atmosphere as gaseous elemental mercury (Hg(0)) before they are deposited to Earth's surface. Strong seasonality in atmospheric Hg(0) concentrations in the Northern Hemisphere has been explained by two factors: anthropogenic Hg(0) emissions are thought to peak in winter due to higher energy consumption, and atmospheric oxidation rates of Hg(0) are faster in summer. Oxidation-driven Hg(0) seasonality should be equally pronounced in the Southern Hemisphere, which is inconsistent with observations of constant year-round Hg(0) levels. Here, we assess the role of Hg(0) uptake by vegetation as an alternative mechanism for driving Hg(0) seasonality. We find that at terrestrial sites in the Northern Hemisphere, Hg(0) co-varies with CO2, which is known to exhibit a minimum in summer when CO2 is assimilated by vegetation. The amplitude of seasonal oscillations in the atmospheric Hg(0) concentration increases with latitude and is larger at inland terrestrial sites than coastal sites. Using satellite data, we find that the photosynthetic activity of vegetation correlates with Hg(0) levels at individual sites and across continents. We suggest that terrestrial vegetation acts as a global Hg(0) pump, which can contribute to seasonal variations of atmospheric Hg(0), and that decreasing Hg(0) levels in the Northern Hemisphere over the past 20 years can be partly attributed to increased terrestrial net primary production.

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