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Canada's Global mercury passive sampling network study

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The atmosphere forms the key pathway for the global distribution of mercury (Hg). Monitoring its spatial and temporal variation within the atmosphere is key to evaluating regulatory measures, such as the Minamata Convention on Mercury, that look to reduce the environmental and health impacts of Hg exposure, and to understand its behavior in response to climate perturbations. Our global understanding currently relies on regional and multi-regional measurement programs, with many areas of the world still having little to no monitoring. Using established infrastructure, Canada has created a network of networks to increase global coverage of mercury monitoring using the Tekran MerPAS®, which enables monitoring in areas without access to established technologies and at minimal cost. This study, initiated in 2019, has 99 sites operating across 35 countries. The MerPAS® works by diffusive uptake of mercury onto sulphur-impregnated carbon housed within a mesh tube all within a protective container. Concentrations are determined based on measurement of the accumulated mercury normalized by time exposed and the sampling rate. Global Hg concentrations show significant spatial and temporal variability, global average mercury concentration of 1.49ng m^{-3} (SD 0.92ng m^{-3}). Concentrations peak in Q2 (April to June, 1.57ng m^{-3}) and minima during Q3 (July to September, 1.38ng m^{-3}). Temporal variability has found that extreme low temperatures may cause decreases in the sampling rates to unknown values due to a slowing of molecular diffusion through the diffusive barrier, causing an over-estimation of Hg concentrations. Comparison of passive Hg concentrations with active Hg measurements at sites that experience average negative temperatures found a 23% difference from active measurements, compared to 9% when average temperatures were above zero. Understanding temperature effects on the passive air samplers is of particular importance for arctic regions where temperatures often reach extremes, measurements are often sparse, and communities are often disproportionately at risk for mercury exposure. The strong global picture of atmospheric mercury concentrations developed by this global program provides valuable information on atmospheric Hg patterns and helps to inform the progress of regulatory actions.