

Unequal anthropogenic enrichment of mercury in Earth's northern and southern hemispheres

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Northern hemisphere (NH) perturbation of the natural mercury (Hg) cycle has been extensively studied from peat, ice and sediment cores, and by Hg emission driven box models. Radiocarbon-dated peat and sediment archives in the NH document median 5 (n=14) and 6 (n=5) fold increases in Hg accumulation rates (HgAR) from pre-mining (<1550 AD) to pre-industrial (1760 – 1880 AD) periods, and subsequent 4 (n=19) and 3 (n=68) fold increases from pre-industrial to 20th century peak HgAR. All-time (since 1550 AD) median NH increases in HgAR range from 16 to 26 and exceed common appreciation of the extent of global NH Hg pollution. Due to the scarcity of archives, historical atmospheric Hg deposition is poorly understood in the southern hemisphere (SH). In particular, the extent to which Hg deposition has increased over natural levels remains unclear. Here, we reconstruct millennial atmospheric Hg deposition to five peat bogs on a South Atlantic to South Indian Ocean transect (Tierra del Fuego, Falkland Islands, South Georgia Island, Amsterdam Island). Results indicate that: 1. Natural SH HgARs average $4 \pm 4 \mu\text{g m}^{-2} \text{yr}^{-1}$ (1σ , n=4, <1550 AD century); 2. Unlike the NH, there is only a small, 2-fold increase in HgAR due to pre-industrial anthropogenic activities (1760 – 1880 AD); 3. There is a median 3-fold increase in HgAR during the industrial period (20th century). Our observations suggest that the increase in all-time HgAR in SH peat bogs of 6 is far lower than the all-time increase in HgAR of 26 in NH bogs. Possible explanations for the dramatically different enrichment factors between hemispheres are enhanced anthropogenic Hg emissions and discharge in the NH and limited atmospheric or oceanic exchange of Hg between the NH and SH.