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Current state of Arctic mercury cycling: Sources, pathways and levels (Ashu Dastoor and over 15 co-authors)

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Findings of a recent review of abiotic Hg in the Arctic (Arctic Monitoring and Assessment Programme, 2021) will be summarized in this presentation. An up-to-date understanding of the emissions, transport and deposition pathways, source apportionment, inter-compartmental fluxes and mass budgets of total Hg in Arctic environments is developed based on observations and multi-model modeling. Total Hg levels in Arctic air (~300 Mg), permafrost soils (~600 Gg, 0-3 m), seasonal snowpacks (~40 Mg), glaciers (~2,400 Mg), sea ice (~10 Mg), and ocean waters (~1,900 Mg) are revised. Hg fluxes for terrestrial systems (anthropogenic, soils/vegetation and wildfire emissions and deposition) and the Arctic Ocean (deposition/evasion, river export, coastal erosion, ocean inflow/outflow, sea ice export, and sediment burial) are constrained. Terrestrial Hg fluxes north of 60^0N suggest an approximate balance of Hg in soils, but the observed dominant Hg(0) deposition to terrestrial systems (vegetation/soils uptake) is underestimated in models, and wildfire emissions remain highly uncertain. A net Hg input of >50 Mg/y to the Arctic Ocean waters is implied, which is explained using uncertainties in fluxes, and recent GEOTRACES cruises observations. Hg fluxes are found relatively better constrained for river export, and oceanic inflow/outflow. Direct link between terrestrial Hg deposition and river Hg export is not yet fully possible, but model ensemble deposition to pan-Arctic watersheds north of 60^0N is consistent with annual river Hg exports, and suggests that majority of river Hg is derived from seasonal snowpacks and surface soils during spring freshet. Permafrost thaw is an important Hg source to downstream ecosystems, but current observations are insufficient to estimate the overall impact. The sediment-bound Hg in glacier-fed streams is notably higher than the Hg levels in glacial-ice meltwater, resulting from the mobilization of soil Hg. Contemporary global anthropogenic Hg emissions are responsible for 30-40% of Arctic Hg deposition in winter/spring, and 25-30% in summer, of which industrial sources contribute to half and, remaining comes from artisanal and small-scale gold mining (28%), power generation (17%), and intentional use and product waste (7%). Recommendations are derived to improve the assessment of concurrent impacts of Minamata Convention and climate change on Arctic mercury cycling.