

Science for Environment Policy

Rivers could be a pathway for mercury found in the Arctic Ocean

A new modelling study has indicated that rivers could be the main pathway of mercury entering the Arctic Ocean. More research is needed to support this claim, but climate change could be increasing the release of mercury into rivers through thawing permafrost and increased wildfires.

Human activities, such as mining and industry, have increased levels of mercury in the environment which can be transported and eventually deposited at locations far from the source of emission. This is likely to be the case for remote regions, such as the Arctic, and concentrations of mercury in Arctic marine mammals are amongst the highest in the world. Greater knowledge of how mercury reaches these areas could help mitigate further contamination.

Measurements of mercury in the surface air at high Arctic coastal sites show a strong seasonal variation, with the lowest levels recorded in Spring and the highest in Summer. The reasons for the summer maximum are not well understood, and the study explored possible reasons.

The researchers simulated the seasonal cycle of atmospheric mercury using the GEOS-Chem¹ global mercury model in three Arctic sites in Canada, Russia and Norway. The model has previously been shown to correspond well with real observational data. It simulates important mechanisms in the mercury cycle, such as the movement of mercury within the different layers of the ocean and the evaporation of mercury from the ocean surface into the atmosphere.

Although the model could accurately simulate the observed minimum of atmospheric mercury in Spring, it could not simulate the Summer maximum. The researchers investigated possible factors that the model had not considered, such as the possible re-emission of mercury previously deposited on the ice and snow. However, when these factors were included in the model it still did not simulate the Summer maximum.

The researchers propose that this 'missing pathway' could be the large rivers that feed into the Arctic Ocean. Three of the world's ten largest rivers are located in the Eurasian Arctic and, as they are known sources of organic carbon in the Arctic, it is likely they also transport mercury stored in Northern soils and peatlands. The freshwater from the rivers remains at the surface of the Arctic Ocean, making the mercury available for evaporation into the atmosphere.

Previous estimates of the flow of mercury from rivers into the Arctic Ocean range from 5 to 39 tons a year, but are based on limited data from the 1990s that were collected in autumn (a time when river flow and mercury amounts are at their lowest). The model was used to estimate mercury contributions from rivers into the Arctic Ocean. The results suggested that rivers contribute 80 tons of mercury a year, whilst coastal erosion (and release of mercury from coastal sediments) provides 15 tons of mercury a year. In combination, these two figures are double the estimate of mercury deposited into the ocean directly from the atmosphere and from melted runoff (45 tons of mercury a year), indicating that this could be a highly significant pathway of mercury transportation to the Arctic.

However, more data are urgently needed to quantify the contribution of mercury from rivers and coastal erosion, particularly as climate change may well be a significant driver of these two sources, through the release of mercury from melting permafrost, increased wildfires and increased coastal erosion.



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1. See: <http://acmg.seas.harvard.edu/g eos/>