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Sources, concentrations and fluxes of mercury wet deposition on the territory of Russian Arctic (a case study in Yamal-Nenets Autonomous Area)

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In some areas of the Russian Arctic pronounced manifestations of thermal degradation of the permafrost are observed, which can cause an increase in the mercury input into the atmosphere of the Arctic and its further distribution in terrestrial and aquatic ecosystems. Wet scavenging by precipitation events is one of the main ways of Hg removing from the atmosphere. Here we present a study of Hg in wet precipitation on the territory of the Yamal-Nenets Autonomous Area (YNAA) based on the data obtained at the Nadym monitoring stations. Seasonal and annual volume-weighted concentrations (VWC) and fluxes of Hg were determined to assess differences in cold and warm periods and factors influencing these changes. The maximum values in wet precipitation samples were found in the spring, most likely associated with the AMDE phenomenon that contributed from 9.8% to 16.7% in the total annual wet precipitation.

The average annual VWC in wet atmospheric precipitations in Nadym is comparable with the values obtained for other urbanized regions of the world; however, it is much higher than the values reported for remote Arctic places. On the other hand, the annual flux of mercury deposition in Nadym is comparable to remote areas of the Arctic zone but less than annual fluxes in continental-scale monitoring networks of other parts of the world.

There are several main possible sources of mercury in the YNAA: transboundary transport with air masses, regional atmospheric emissions of mercury from fires, and significant regional and local inputs from gas and oil combustion by power plants and factories. In addition, since air temperature and the thickness of the seasonally thawed layers were raised substantially in 2018, the increase of Hg flux in the warm period might also reflect regional input due to the re-emission of Hg from soils.

Keywords: mercury; Arctic; atmospheric wet precipitation; deposition fluxes; AMDE; permafrost thawing.