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Mercury Surface-Atmosphere Flux and Speciation Measurements in Barrow, Alaska, USA during the BROMEX campaign

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Atmospheric Mercury Depletion Events (AMDEs) during which gaseous elemental mercury is oxidized to gaseous oxidized mercury and then readily deposits to underlying snow and ice surfaces are an important concern for polar mercury loads. There are many unknown factors surrounding the causes and controls of AMDEs in the polar atmosphere, including the fate of the mercury once deposited, the degree to which AMDEs relate to bromine chemistry, and how sea ice dynamics and changes thereof may affect future Hg cycling.

We show an experimental set-up and provide results from a portion of a new study, the Bromine, Ozone, and Mercury Experiment (BROMEX) in Barrow, Alaska, located 515 km north of the Arctic Circle along the coast of the Arctic Ocean. Our instrumentation is designed to characterize AMDEs and quantify atmospheric mercury and ozone emissions and depositions over seasonal sea ice near open ice leads. These areas, that are known to cause intensive halogen chemistry, are expected to increase as the expanse of perennial sea ice decreases.

Our unique, portable, cold-weather tested experimental set-up, called the Out On The Ice (OOTI) system, allows for the quantification of atmospheric speciated mercury concentrations, along with gaseous elemental mercury and ozone surface fluxes. These fluxes are measured with a micrometeorological surface-flux tower over the seasonal sea ice. The systems are housed in well-insulated aluminum boxes that can be deployed and retrieved readily with snow machines. A second, equivalent set of instruments is deployed near the coast at an inland location. This second site allows us to quantify the atmospheric chemical gradients from the seasonal sea ice site close to the open ice lead to the coast. Auxiliary measurements of mercury and halogen concentrations in surface snow, ice, and diamond dust along a transect from the sea ice site to the inland site and daily samplings at each site are also included. This unique campaign will be provide us an unprecedented, comprehensive look at AMDEs from out on the sea-ice to the coast along with respective patterns of depositions and emissions of mercury in polar ecosystems.