

Atmospheric mercury speciation and air-sea mercury flux in the marine boundary layer during the SHIPPO cruise in 2012

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Different species of atmospheric mercury (gaseous elemental mercury, GEM; reactive gaseous mercury, RGM; and particle bound mercury, PBM) and relevant trace gases in the marine boundary layer have been measured in situ onboard the Korean icebreaker R/V Araon during the SHIPPO (SHIPborne Pole-to-Pole Observations) campaign. The campaign started from Incheon on July 14, 2012, lasted for two weeks, though yet continuing over the Arctic Ocean thereafter. The concentration of GEM during the cruise from Busan to Nome, Alaska, ranged between 1.1 and 2.9 with mean of $\sim 1.5 \text{ ng/m}^3$. The ranges of RGM and PBM, on the contrary, were 0 – 41 pg/m^3 and 0 - 11 pg/m^3 with an average of $\sim 1.7 \text{ pg/m}^3$ and $\sim 1.6 \text{ pg/m}^3$, respectively. Fairly constant level of RGM is an indicative of minor photochemical production though some diurnal variation of GEM have been revealed during the campaign. The concentration of all the three different species tended to decrease as she sailed far from the coast likely due to having less influence by the mercury loaded continental air. The concentration of GEM gradually increased when the air mass coming from the East Asian continent and Japanese Islands. A highly dynamic mercury flux varying between ~ 10 and $\sim 200 \text{ ng m}^{-2}\text{day}^{-1}$ calculated based on the concentration gradient of total gaseous mercury between the surface water and the overlying atmosphere and wind speed shows that along the entire cruise track the ocean acted as a potential source of elemental mercury to the atmosphere.