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Circumpolar transport and air-surface exchange of atmospheric mercury at Ny-Ålesund (79° N), Svalbard, spring 2002

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Abstract. Mercury in different environmental compartments has been measured at Ny-Ålesund (78°54' N, 11°53' E) during an intensive campaign, 17 April to 14 May 2002. Time-resolved speciated determination of mercury in the atmosphere and snow was conducted at the Norwegian research station at the Zeppelin mountain, 474 m above the sea level, and at the Italian research facility Dirigibile Italia, 12 m above the sea level.

Total Gaseous Mercury (TGM) was present in the range <0.1 to 2.2 ng m^{-3} during the campaign. Three mercury depletion events, identified as periods with decreased TGM concentrations, were observed. At the lower altitude, TGM concentrations following such events were found to exhibit both higher magnitude and larger variability in comparison to results from the Zeppelin station. Oxidised mercury species in air and fall-out with snow as well as mercury attached to particles were also measured and their concentrations were found to be anti-correlated with TGM in air. concentrations of total Hg in snow (Hg-tot) showed a large ($\sim 15\times$) increase in response to Gaseous Elemental Mercury Depletion Events (GEMDEs, range $1.5\text{--}76.5 \text{ ng L}^{-1}$). Solid evidence for photo-stimulated emissions of $\text{Hg}^0(\text{g})$ from the snow pack in conjunction to depletion events were obtained from gradient measurements as well as from flux chamber measurements. Steep diurnal concentration variations of $\text{Hg}^0(\text{aq})$ in surface seawater were also found to concur with changing solar radiation.

The concentration of $\text{Hg}^0(\text{aq})$ in seawater was found to be in the range $12.2\text{--}70.4 \text{ pg L}^{-1}$, which corresponds to supersaturation. Hence, the seawater surface constituted a source emitting elemental mercury. The concentrations of RGM (reactive gaseous mercury), Hg-p (particulate mercury), and BrO column densities (detected by DOAS) were very low except for a few individual samples during the major Hg^0 depletion event. BrO vertical column densities obtained by the remote satellite ESR-2 and trajectory analysis indicate that the air masses exhibiting low Hg^0

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concentrations originated from areas with high BrO densities.

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