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Role of sea ice and hemispheric circulation mode on sulphur oxidised compounds (Methanesulfonate and Sulfate) in the Artic aerosol

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The recent decline in sea ice cover in the Arctic Ocean is expected to affect the regional radiation budget and to influence the ocean–atmosphere exchange of dimethylsulfide (DMS), thus the amount of biogenic aerosols formed from its atmospheric oxidation, such as methanesulfonate (MS-) and non-sea salt sulphate (nssSO42-). This study examines the temporal evolution of atmospheric MS- and nssSO42-, as measured in atmospheric aerosols, at Ny-Ålesund, (78.9°N, 11.9°E, Svalbard islands) and Thule (76.5°N, 68.8°W, Greenland) during three years (2010-12).
Aerosol sampling was carried out using a PM10 sampler with Teflon filters, and a 12-stage impactor (SDI, Small Deposit-area Impactor) with polycarbonate filters. Analyses were performed by ion chromatography, for ion composition, and ICP-SFMS, for selected metals; both techniques are sufficiently sensitive, accurate, and reproducible to be applied to very low atmospheric load of aerosol particles, typical of remote polar regions.
The evolution of MS- and nssSO4 concentrations was analysed as a function of speciation (as acidic species or ammonium salt), size distribution, and airmass pathways. This study reveals that nssSO4 is meanly associated with long range transport from anthropic sources, and presents a relative maximum in spring. Conversely, MS- arises from natural local sources and shows a peak in mid-summer. A large interannual variability is observed in MS- concentration with values in spring-summer 2010 in both the stations higher than in the other summers. In the previous winter a larger sea ice extent and larger sea ice melting surface in the following spring were observed. Arrigo et al. (2008) have observed a 22% increase in the annual primary productivity, that has been attributed to a longer phytoplankton growing season connected with the progressive decline in sea ice coverage in the Arctic over the past decade. Modeling results (Gabric et al., 2005) suggest that an increase in DMS production would result from the retreat of the ice cover and would be accompanied by an increase in primary production. In order to better understand the links among MS- concentrations in the aerosol, biogenic activity, and sea ice extent, and to evaluate the effect of transport processes from the surrounding oceanic areas, the atmospheric MS- measured at Thule and Ny-Ålesund were compared with sea ice extent north of 70°N, general circulation mode patterns (East Atlantic-Western Russia Oscillation), and meteo-synoptic conditions during days with the highest MS- concentrations.

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