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Fluxes of nitrates between snow surfaces and the atmosphere in the European high Arctic

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Abstract. Measurements of atmospheric and snow mixing ratios of nitrates and nitrites and their fluxes above the snow surface were made during two intensive campaigns during spring time 2001 at Ny-Ålesund, Svalbard as part of the EU project "`The NItrogen Cycle and Effects on the oxidation of atmospheric trace species at high latitudes" (NICE).

At this coastal site close to the unseasonably unfrozen fjord, of the measured nitrogen species, only HNO_3 showed a significant flux on to the snow surface; a mean deposition of -8.7 nmol h^{-1} m^{-2} was observed in late April / early May 2001. These fluxes may be due to the reaction of HNO_3 with sea salt, and especially NaCl, or may be simply uptake of HNO_3 by ice, which is alkaline because of the sea salt in our marine environment. During snowfall periods dry deposition of HNO_3 may contribute up to 10% of the N budget in the snow; however, the main source for N is wet deposition in falling snow.

The surface snow at Ny-Ålesund showed very complex stratigraphy; the NO_3^- mixing ratio in snow varied between 65 and 520 ng g^{-1}, the total NO_3^- content of the snowpack was on the order of 2700 ng cm^{-2}. In comparison the atmospheric boundary layer column showed a NO_3^- content of only 8 ng cm^{-2}. The limited exchange, however, between the snow and the atmosphere was attributed to low mobility of NO_3^- in the observed snow.

Contrary to other Arctic sites (i.e. Alert, Nunavut or Summit, Greenland) deposition of sea salt and crustal aerosols in this marine environment made the surface snow alkaline; snow NO_3^- was associated with heavier cations and was not readily available for physical exchange or photochemical reactions.

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