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Spring- and summer-time atmospheric ozone fluxes above the polar snowpack of Summit, Greenland

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Atmospheric ozone deposition to polar snow was studied at Summit, Greenland. Vertical profiles of ozone, from a 10-m tower and within 1 m deep in the snowpack, were obtained during July 2003, March-August 2004 and March-April 2005. Meteorological measurements of air and snow temperatures, wind speed and wind direction, and incoming and reflected solar radiation were also recorded.

Ozone flux measurements over snow-covered surfaces are particularly challenging because environmental conditions are often characterized by small fluxes, low nighttime convective mixing, shallow boundary layer heights and highly stable atmosphere mixing regimes. Consequently, the flux analysis requires appropriate data evaluation and filtering, and adjustments of gradient data. Two experimental approaches, namely the tower flux-gradient and the eddy correlation methods, were used and compared. Atmospheric stability, expressed by the Richardson number, friction velocity and sensible heat fluxes are preliminary entities that were used to filter data for subsequent calculation of ozone fluxes.

This analysis provides continuous record of spring- and summer-time ozone fluxes above a permanent Arctic snowpack. Interestingly, for most of the spring-time days, ozone fluxes varied between -0.03 to +0.03 μg m^{-2} s^{-1} without any significant diurnal variation. In contrast, for most of the summer-time days, ozone fluxes showed a diurnal pattern, with maximum downward fluxes during hours around solar noon. These summer-time atmospheric ozone fluxes reflect the diurnal variation of ozone in firn air. These results suggest that ozone deposition to Arctic snow could follow the seasonal cycle of solar radiation.