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A 300 years environmental and climate archive for western Spitsbergen from Holtedahlfonna ice core

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An ice core extracted from Holtedahlfonna ice cap, the most extensive in western Spitsbergen, was analyzed for major ions and spans the period 1700-2005. The leading EOF component is correlated with an indicator of summer melt (log ([Na+]/[Mg2+])) from 1850 and shows that almost 50% of the variance can be attributed to seasonal melting since the beginning of the industrial revolution. Percolation or diffusion disturbs the annual stratigraphy allowing paleoclimate interpretation of the chemical record only at decadal resolution. The Holtedahlfonna δ18O value is less negative than that in the more easterly Lomonosovfonna ice core suggesting that moist air masses originate from a closer source most likely the Greenland Sea. During the Little Ice Age lower methansulfonic acid (MSA) concentration and MSA non-sea salt sulfate fraction is consistent with the Greenland Sea as the main source for biogenic ions in the ice core. Ammonium concentrations rise from 1880, which may result from the warming of the Greenland Sea or from zonal differences in atmospheric pollution transport over Svalbard. During winter neutralized aerosols are trapped within the tropospheric inversion layer which is usually weaker over open seas than over sea ice placing Holtedahlfonna within the inversion more frequently than Lomonosovfonna.