Geophysical Research Abstracts
Vol. 15, EGU2013-8714, 2013
EGU General Assembly 2013

Aerosol data over the last 3000 years in seasonal resolution from the Greenland NEEM ice core

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During the field season in summer 2009, the first 600 m (corresponding to 3 kyr b2k (3000 years before A.D. 2000) on the GICC05 timescale) of the Greenland NEEM ice core have been analysed for a variety of aerosol constituents using Continuous Flow Analysis (CFA). Here, the records of electric conductivity, sodium (Na^+), calcium (Ca^{2+}), particle numbers of insoluble dust, ammonium (NH_4^+), nitrate (NO_3^-) and hydrogen peroxide (H_2O_2) are presented with an average effective resolution of 1-2 cm, depending on the component. Since the annual layer thickness λ amounts to 15cm at minimum sub-annual signals are resolved in all components over the Holocene period. We achieved to extend the aerosol record over the early Holocene period except for a large gap over the brittle zone from 5-9 kyr b2k.

Seasonal variations and extreme events are preserved in great detail and all components. H_2O_2 is a reliable proxy for the strength of photochemical processes in the lower atmosphere and thus shows its minima and maxima at the summer and winter solstice, respectively. Dust-derived species (insoluble dust, Ca^{2+}) show peak concentrations in early spring and minima in mid-summer. The marine-derived Na^+peaks in mid-winter and is lowest during early summer. The mean annual variability in concentrations is about 20 ppbw for both Ca^{2+}andNa^+. Moreover, it is of the same order of magnitude in NH_4^+, butconsiderably larger in NO_3^- (100 ppbw), both representing continental biogenic sources peaking in spring and showing minima in autumn. The interpretation itsclimatic signal is restricted by NO_3^- undergoing post-depositional redistribution processes.

Not only is the analysis of impurities in sub-annual resolution crucial for the accurate dating of the ice core, but also for establishing a detailed chronology of the occurrence of extreme events such as volcanic eruptions and wildfires. Furthermore, possible changes in the seasonal variability of aerosol concentrations can be investigated. First results are presented here.