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Long range atmospheric transport of aerosols: First arctic measurements

A. Bacak (1) and J. Sloan ()

(1) CANDAC (canadian network of detecting atmospheric changes) university of waterloo Waterloo Canada (abacak@uwaterloo.ca), (2) WCAS (waterloo centre of atmospheric sciences) university of waterloo Waterloo Canada (sloanj@UWaterloo.CA)

Atmospheric aerosols have a direct effect on climate by scattering and/or absorbing solar radiation, thereby modifying the radiative balance of the atmosphere. Aerosols also can act as cloud condensation nuclei, which alter cloud properties and precipitation rates, thereby indirectly influencing the climate. Aerosol surfaces also are a medium for heterogeneous reactions, modifying the chemical composition of both the gas and aerosol phases in the atmosphere. Aerosol surfaces may carry numerous different compounds (e.g. organic or inorganic, hydrophobic or hydrophilic), which naturally affect their chemical and physical properties. Since aerosol lifetimes in the free troposphere are on the order of a few days to a week, they are transported over long distances in the Earths atmosphere. To study this transport, we have installed a quadruple aerosol mass spectrometer (Q - AMS) (Aerodyne Research Inc.) in the Polar Environment Atmospheric Research Laboratory (PEARL) in August 2006. PEARL is located in the Arctic on Ellesmere Island (80°N 86°W) at an elevation of 610 m. above sea level. It provides a unique location for observing transport to the sensitive Arctic ecosystem, because it is far from anthropogenic sources of contamination and it is in the free troposphere most of the time.

In this presentation, we will report the analysis of aerosol mass concentrations, size, and chemical compositions covering the time period from August, 2006 to January, 2008. Our measurements show that sulphate dominates the aerosol composition most of the time, with a maximum concentration of 0.655 µg/m3 and minimum concentration of 0.030 µg/m3. The second most abundant species was organic aerosols, with concentrations in the range from 0.440 µg/m3 to 0.050 µg/m3. Although the sulphate dominates in general, plots of concentration time series show a seasonal change in the relative concentrations of sulphate and organic species. Relatively lower concentrations of nitrate and ammonium species were detected during the period of our observations. Occasional episodes of concentrations up to 0.050 µg/m3 nitrate and 0.080 µg/m3 ammonium were detected; otherwise these were below our detection limit. (The Q - AMS detection limit at PEARL was determined to be 0.009 µg/m3, which is three standard deviations from the noise.) In addition to the above results, we will briefly report the ionic components and discuss possible aerosol transportation routes determined with the semi-Lagrangian trajectory model, FLEXPART.