Geophysical Research Abstracts
Vol. 13, EGU2011-10521-2, 2011
EGU General Assembly 2011

Long-term measurements of Arctic aerosol number size distributions at Point Barrow

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The present work investigates the seasonal variability of particle number size distributions of the atmospheric aerosol at Point Barrow, the northernmost tip of Alaska. Aerosol particles are short-lived pollutants known to have an impact on regional Arctic climate directly and indirectly. They are contributing to the accelerated rates of warming relative to the annual mean global temperature increase.

In collaboration between the IFT and the NOAA, we took ground-based long-term measurements of aerosol particle number size distributions at the meteorological observatory Point Barrow over a 2-year period from September 2007 to August 2009. The data set was measured with a Scanning Mobility Particle Sizer (SMPS). We combined these measurement data with 72-h back trajectory calculations using HYSPLIT, a Lagrangian particle trajectory model. Utilizing the back trajectory cluster analysis, we tried to obtain information about aerosol source regions and seasonal variability.

The concentrations of the Aitken mode particles strongly depend on their source region. Maritime air masses reaching Point Barrow from northwestern directions indicate average particle concentrations of 1000 particles/cm^3. They are ten times higher than particle concentrations arriving from the northeastern directions. Additionally, the concentrations of accumulation mode particles of these two directions are highly variable with season. The highest air quality is observed in summer. There is a difference of one order of magnitude in concentrations between summer and the other seasons as a result of temperatures over freezing point and thus in ice-free ocean surface. Air masses from southern directions are influenced by the American continent. During warm seasons the continental surface is ice-free as well and more aerosol particles could be generated, leading to enhanced particle concentrations during spring and summer. In general, seasonal variability has been found to be over the submicron size range.