Secondary particle formation in Arctic Russia

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The Arctic and northern boreal regions of Eurasia are experiencing rapid environmental changes due to pressures by human activities. The Arctic environment is highly sensitive to changes in aerosol concentrations or composition, largely due to the high surface reflectance for the most part of the year. Secondary particle formation from atmospheric vapours is a mechanism, potentially affecting the aerosol particles, and the climate effects which follow, in these remote regions (e.g. Asmi et al., 2011). Direct measurements, especially in the Russian side of the Arctic, are though still lacking.

Tiksi meteorological observatory in northern Siberia (71°36´N; 128°53´E) on the shore of the Laptev Sea has been operating since 1930s. Recently, it was upgraded and joint in the network of the International Arctic Systems for Observing the Atmosphere (IASOA, www.IASOA.org), in the framework of the International Polar Year (IPY) Activity (#196) project. The project is run in collaboration between NOAA with the support of the NSF, Roshydromet (AARI and MGO units), government of the Republic of Sakha (Yakutia) and the FMI. FMI activities in Tiksi were initiated in summer 2010 and include aerosol size distribution measurements starting at 7 nm size. These are measured with a twin-DMPS system and here the data are used to pinpoint secondary particle formation events, as well as to tie them with meteorological and air mass properties.

In Figure 1, average concentration of nucleation mode (here: 7-25 nm) particles in each month is presented. It appears that the rise of sunlight in the month of March strongly assist secondary particle formation. With a snow covered ground in early spring, it is likely that the nucleating and condensing vapours are transported from longer distances. Another smaller peak in particle formation occurs in summer when local vegetation contributes as a source of vapours.

Analysis of air mass origin during the observed events supports the conclusions. During early spring, nucleation mode particles are increasingly seen in high Arctic air masses, while during summer, the small particles appear also in continental Siberian airflows.

A climate impact of the secondary particles is also studied. The preliminary results show that the particle growth rates are much higher in summer in comparison to other seasons, thereby allowing them to affect the climate more often. This is connected with vegetation sources of biogenic organic vapours, as seen with clear correlations with air mass origin and temperature (Fig. 2).

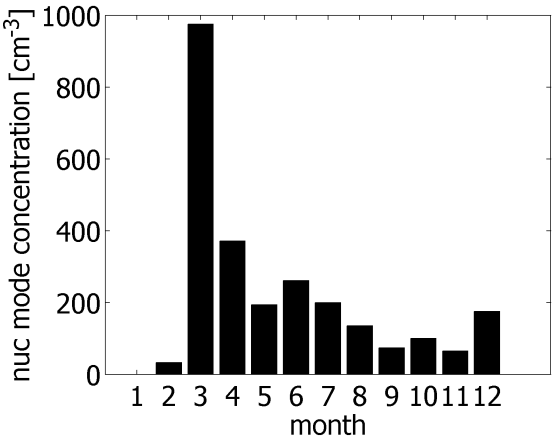

Figure 1. Average concentration of nucleation mode (7-25 nm) particles per each month.

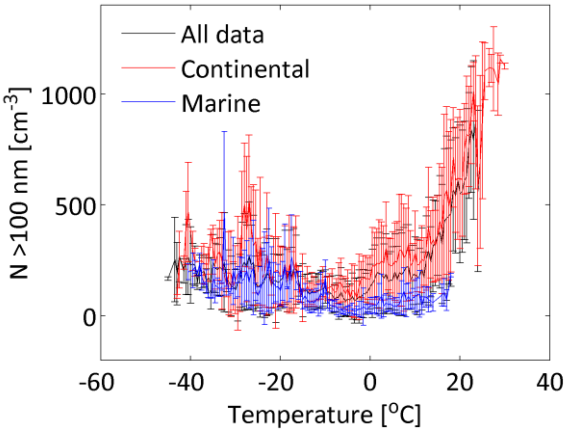

Figure 2. Accumulation mode (>100 nm) concentration as a function of temperature (black), and in continental (red) and marine (blue) air masses separately.

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