

## Hygroscopic properties of summertime central Arctic sub-micrometer aerosol particles and prediction of their CCN activity

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The central Arctic Ocean is a region that is particularly sensitive to changes in climate due to various feedback mechanisms that exist there. During the Arctic summer, aerosol particles influence the radiative balance primarily by acting as cloud condensation nuclei (CCN). Therefore, knowledge of the sources and physical/chemical properties of these particles are essential for an adequate assessment of future climate changes in the Arctic region.

In the summer 2001 Arctic Ocean Expedition (AOE-2001), the Swedish icebreaker *Oden* was used as a measurement platform in the central Arctic, mostly north of latitude 85°N in July-August 2001 (Leck *et al.*, 2004; Tjernström, 2005). Measurements of the hygroscopic and cloud-nucleating properties of the aerosol and the size distribution were conducted on *Oden* using an H-TDMA (Hygroscopic Tandem Differential Mobility Analyzer), a CCN counter and a DMPS (Differential Mobility Particle Sizer). A summary of the aerosol particle size distributions are given in Heintzenberg *et al.* (2006). Continuous and uninterrupted measurements in the pristine Arctic environment were greatly facilitated by mooring the icebreaker to an ice floe and drifting with the trans-polar current. The ice drift started on 1 August 2001 near 89.0° N, 1.8° E and ended on 22 August at 88.2° N, 9.4° W.

The H-TDMA often showed an external mixture during the ice drift period for particles with dry diameters between 20-165 nm. More-hygroscopic particles were nearly always present (83-92% frequency) with hygroscopic growth factors (dry to  $RH=90\%$ ) between 1.49-1.61 and increasing with dry size. Less-hygroscopic particles were less frequent (23-42%) with growth factors between 1.11-1.01 and decreasing with dry size. Since periods of pollution from the icebreaker were carefully excluded, the appearance of near-hydrophobic particles in the Aitken and accumulation mode size ranges indicate a surface source of aerosol particles within the pack ice region.

Concentrations of CCN were predicted based on the DMPS and H-TDMA data (Rissler *et al.*, 2004), and compared with parallel measurements at supersaturations of 0.3 and 0.8% (Bigg & Leck, 2001).

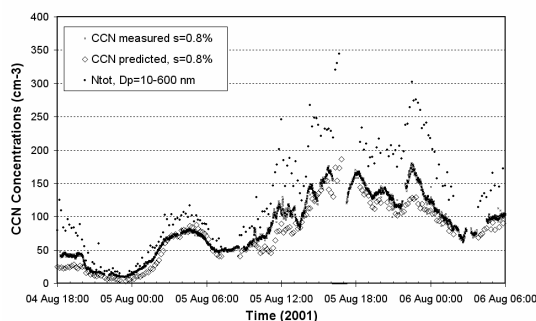


Figure 1. Comparison between predicted and measured CCN concentrations at  $s=0.8\%$  for a time period during the ice drift.

Figure 1 shows a 36-hour time series of predicted and measured CCN concentrations at 0.8% supersaturation. Agreement was in general good despite very low particle number concentrations, with ratios of predicted/measured CCN concentrations in general between 0.7-1.3 at both supersaturations. Time periods during which the CCN prediction failed may be indicative of the existence of poorly water-soluble compounds or surface tension depression at the point of activation. Particles with these properties might be linked to biogenic activity in the Arctic Ocean or the surface microlayer of the open leads during summer (Leck & Bigg, 2005).

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