# Multi-seasonal ultrafine aerosol particle number concentration measurements at the Gruvebadet observatory

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## Introduction

Study of the nature, properties and seasonal variability of aerosols in the Arctic region is essential to define not only sources and transport processes, but also to estimate the induced change in the Earth radiative budget via direct (scattering and absorption of solar radiation) and indirect effects (change in cloud properties and precipitation), considering the peculiar characteristics of this polar region (high albedo values and low sun elevation angle), which exert a complex feedback mechanism resulting in a major temperature increase (the so-called ‘‘Arctic amplification’’ (Pithan and Mauritsen 2014 ).

## Data and methods

More than 86000 size distribution of ultrafine aerosol particles have been collected at the Gruvebadet observatory located in Ny-Alesund (Svalbard Islands, 78 550 N, 11 560 E). Aerosol particle size distribution (APSD) were measured in 54 channels in the size range from 10 to 470 nm, using a SMPS TSI 3034 (Hogrefe et al., 2006), usually from the beginning of spring to the beginning of fall during four (non-consecutive) years (2010, 2011, 2013 and 2014); object of this study is to investigate the various seasonal modal in terms of Nuclei, Aitken and Accumulation regions.

## Aerosol Analysis and Conclusions

Measurements of aerosol number concentration taken at the Gruvebadet observatory clearly show the seasonal cycle linked to the transport phenomena of the Arctic Haze (e.g. Law and Stohl, 2007), with accumulation mode dominating during April and May, and the Aitken mode dominating during the summer months (figure 1). The Accumulation mode median particle concentration drops during this period, practically halving from April to August, while the Aitken number modal concentration increases. Median Nuclei concentration is quite stable, with a slight increase towards the summer months, presumably due to NPF events (figure 2).

The median total number concentration it did not present a well-defined seasonal behavior, where the overall median aerosol concentration for the whole period taken into account was 214 particles $cm^{-3}$ , oscillating between the median maximum in July with a concentration of 257 particles $cm^{-3}$ and a median minimum in April with 197 particles $cm^{-3}$. On the opposite, interquartiles range show a well defined seasonal properties.

All the data set was subsequently fitted as sum of lognormal curves (Hussein et al., 2005),

$$APSD = \sum N_k / (2 \pi \sigma_k)^{(1/2)} \exp(-1/2 (\log D_k - \log D)/\sigma_k)^2) \quad (1)$$

with k varying from 1 to 3, in order to describe the complete dataset as a function of maximus 9 parameters, i.e. the geometrical mean diameters $D_k$, the modal concentration $N_k$ and the modal variance $\sigma_k$ (figure 3).

The median ASD analyzed present maximum frequency in the Aitken region between 25 nm and 45 nm, while in the Accumulation region the range is between 100 and 200 nm. A quick comparison with similar data sets collected in the not so far Zeppelin Observatory (Tunved et al. 2013) shows good agreement.

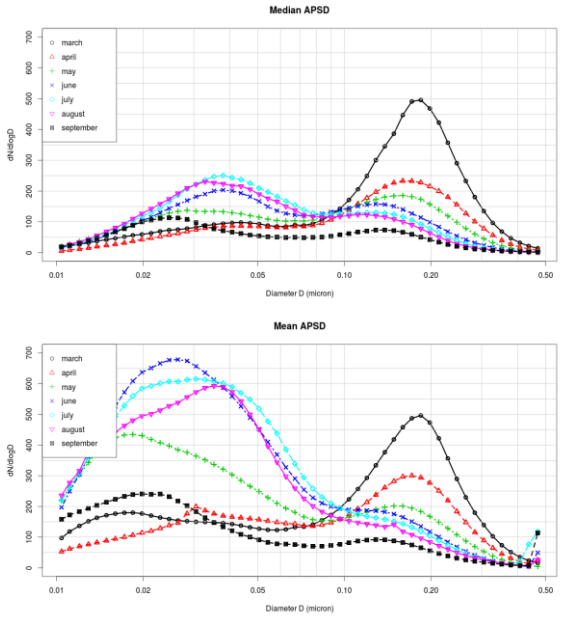


***Figure 1:*** *Monthly median (top) and mean (bottom) and number size distribution during the four campaigns; the grey symbols refer to data collected during the month of March and September, characterized by non-continuous measurements*

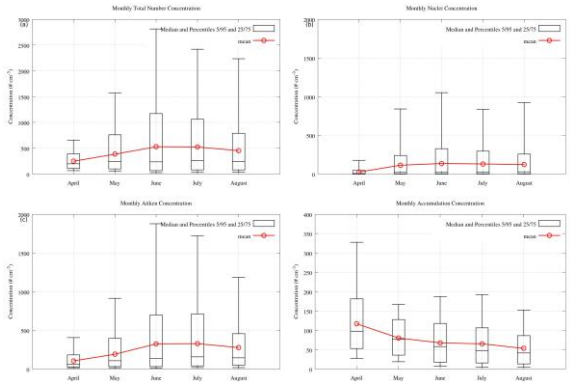

***Figure 2:*** *Monthly variation of the different mean (red open squares) and median numbers size distribution together with the 5/95 and 25/75 percentiles (whiskey bars): please note the different scale*

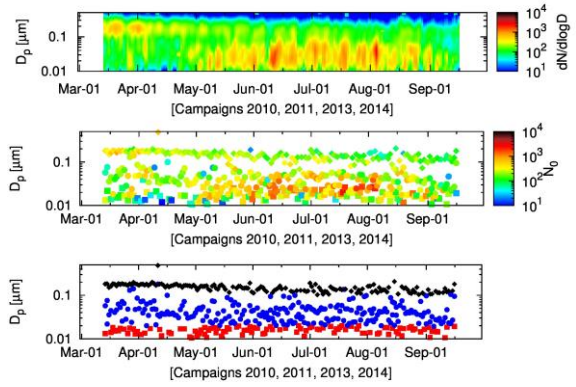


***Figure 3:*** *Top: mean annual daily APSD. Center: the various modal concentrations value. Bottom: the various modal diameter retrieved using a fitting procedure (black points for Accumulation, blue for Aitken and red for Nuclei).*

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