

Comments to the ACPD

Adachi et al. Composition and mixing state of Arctic aerosol and cloud residual particles from long-term single-particle observations at Zeppelin Observatory, Svalbard.

Reviewer's comments

The paper presents a study of ambient aerosol particles and residual cloud particles at the Zeppelin Observatory in Svalbard. The manuscript is interesting because the authors analyzed particle samples collected over four years in the Arctic, a region that can be greatly affected by global warming. The research focused solely on image analysis and a study of the elemental composition of atmospheric particles using TEM and STEM techniques coupled to an EDS detector. Although the manuscript is well structured and well written, some sections could be improved. For example, it could be very useful to present a general analysis of the meteorological conditions during each season, which could help to understand the seasonal differences in particle composition.

On the other hand, since similar electron microscopy studies of fine particles have already been reported (i.e., Weinbruch et al., 2012; Hara et al., 2003) the authors must place more emphasis on the large number of samples collected and analyzed over four years.

Introduction

- The authors should provide more information on studies on the elemental composition of fine particles. It would be important to provide a brief comparison with measurements of fine particle elemental composition.
- In lines 103-105: What does "TEM Samples Preset" mean? Does it refer to the nominal cutoff sizes of the sampler stages? It would be important to indicate the 16 and 24 preset sizes in the samplers.

Methodology

- On line 106: it is important to indicate particle sizes obtained on TEM grids.
- The following sections (section 3.1.5) describe the elemental composition of the carbonaceous aerosol. Can the composition of the polymeric Formvar film affect the analysis of this type of particle (soot)?
- How is the effect of formvar composition on carbon quantification corrected with the EDS detector?
- In the article, a pixel/magnification ratio (100/6000x) is used to establish the particle size. In addition, particle size is measured using the equivalent diameter in area. Why didn't you use the physical diameter of the particles? Why didn't you use the microscope scale to establish particle size?
- Did you use the microscope scale to calibrate and establish particle size?

- Instead of establishing the diameter in terms of area, it might be better to make a relationship between the aerodynamic diameter (D_a) and the physical diameter (D_f). See the article by Wang, (1987).

Results

Is there any possible explanation for why temperature determines the composition of residual cloud samples? What role does relative humidity play on mineral dust and salt particles at temperatures below 0°C?

Consulted references

- Hara, K., Yamagata, S., Yamanouchi, T., Saton, K., Herber, A., Iwasaka, Y., Nagatani, M., and Nakata, H.: Mixing states of individual aerosol particles in spring Arctic troposphere during ASTAR 2000 campaign, *J. Geophys. Res. Atmos.*, 108, <https://doi.org/10.1029/2002jd002513>, 2003.
- Wang, H. C.: Particle density correction for the aerodynamic particle sizer, *Aerosol Sci. Technol.*, 6, <https://doi.org/10.1080/02786828708959132>, 1987.
- Weinbruch, S., Wiesemann, D., Ebert, M., Schütze, K., Kallenborn, R., and Ström, J.: Chemical composition and sources of aerosol particles at Zeppelin Mountain (Ny ålesund, Svalbard): An electron microscopy study, *Atmos. Environ.*, 49, <https://doi.org/10.1016/j.atmosenv.2011.12.008>, 2012.