Aerosol cloud activation: optical properties at Puijo semi-urban site

A. Ruuskanen[1], H. Portin[1,3], S. Romakkaniemi[1], A. Arola[1], A. Virtanen[2], K. E. J. Lehtinen[1,2], M. Komppula[1] and A. Leskinen[1,2]

[1]Finnish Meteorological Institute, P.O.Box 1627, FI-70211, Kuopio, Finland
[2]University of Eastern Finland, Department of Applied Physics, P.O.Box 1627, FI-70211, Kuopio, Finland
[3]Helsinki Regional Environmental Services Authority, Regional and Environmental Information, P.O. Box 100, FI-00066 HSY

Keywords: cloud activation, aerosol optical properties, aerosol-cloud interaction

Presenting author email: antti.ruuskanen@fmi.fi

In this work we have studied cloud activation, or scavenging, of semi-urban aerosol particles from 5 October 2010 to 30 November 2014. We provide new information about aerosol optical properties during cloud activation process and optical properties of non-processed aerosol.

Measurement site of Puijo is located in Kuopio, Eastern Finland, surrounded by lake Kallavesi. The Puijo station has provided continuous data from summer 2006. The measurement station is located on top of the Puijo observation tower (306 m a.s.l, 224 m above the surrounding lake level). A more detailed overview of the station and the surrounding area can be found in Leskinen et al. (2009).

Measurements were conducted with total and interstitial sampling lines and four main devices: twin-DMPS, an integrating nephelometer and a MAAP. Sampling lines of the devices were switched between total and interstitial lines every 6 minutes. Measurement data was averaged over these 6 minute periods. After averaging the data was corrected by removing maintenance and other bad data, calculating truncation correction, and, calculating correction factor in cloud free situations. Cloudy periods were defined to have visibility less than 200 m or cloud base height less than 170 m. Clear periods were defined to have relative humidity less than 80% or visibility higher than 8000 m.

We observed temperature dependency of activated scattering compounds fraction to be linearly increasing 7.5% per 10°C (Fig. 1). However, temperature dependency of activated absorbing compounds (mainly black carbon) fraction seemed to be parabolic curve with maximum around 0-5°C. Similar but inverse parabolic effect was observed to be present with ratio of accumulation and total particle number concentrations temperature dependence. Minimum of the parabola was around 0°C. This means that with same amount of accessible water higher number of absorbing particles activate. Both activated scattering and absorbing compounds fractions had increasing dependency with activated volume fraction (Fig. 2). However, scattering compounds are more hydroscopic and activate better than absorbing compounds.

We confirm with long term studies the temperature dependency of activated fraction of scattering compounds. Furthermore, we observed similar temperature dependence of activated fraction of absorbing compounds as has been reported earlier.

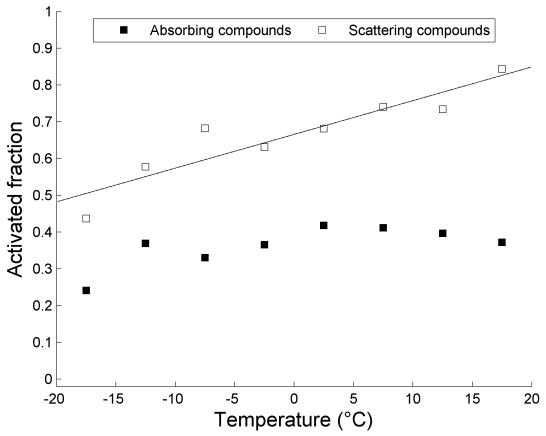

Figure 1. Activated fractions of absorbing and scattering compounds versus temperature.

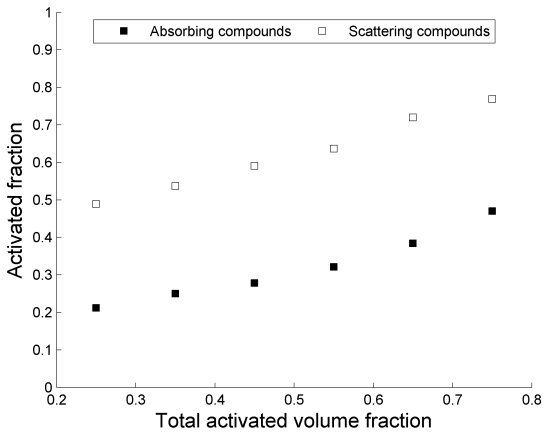

Figure 2. Activated fractions of absorbing and scattering compounds versus total activated volume fraction.

This work has been supported by the Maj and Tor Nessling Foundation (201500134, 201600105) for PhD thesis work, Academy of Finland (259005, 272041) and European Research Council (Starting Grant 335478).

Leskinen, A.; Portin, H.; Komppula, M.; Miettinen, P.; Arola, A.; Lihavainen, H.; Hatakka, J.; Laaksonen, A.; Lehtinen, K. E. J. (2009), Boreal Env. Res., 14, 576–590