



Measurements of aerosol chemical composition in boreal forest summer conditions

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Boreal forests are an important biome, covering vast areas of the northern hemisphere and affecting the global climate change via various feedbacks [1]. Despite having relatively few anthropogenic primary aerosol sources, they always contain a non-negligible aerosol population [2]. This study describes aerosol chemical composition measurements using Aerodyne Aerosol Mass Spectrometer (C-ToF AMS, [3]), carried out at a boreal forest area in Hytyälä, Southern Finland. The site, Helsinki University SMEAR II measurement station [4], is situated at a homogeneous Scots pine (*Pinus sylvestris*) forest stand. In addition to the station's permanent aerosol, gas phase and meteorological instruments, during the HUMPPA (Hytyälä United Measurements of Photochemistry and Particles in Air) campaign in July 2010, a very comprehensive set of atmospheric chemistry measurement instrumentation was provided by the Max Planck Institute for chemistry, Johannes Gutenberg-University, University of California and the Finnish Meteorological institute. In this study aerosol chemical composition measurements from the campaign are presented.

The dominant aerosol chemical species during the campaign were the organics, although periods with elevated amounts of particulate sulfates were also seen. The overall AMS measured particle mass concentrations varied from near zero to 27 $\mu\text{g}/\text{m}^3$ observed during a forest fire smoke episode. The AMS measured aerosol mass loadings were found to agree well with DMPS derived mass concentrations ($r^2=0.998$). The AMS data was also compared with three other aerosol instruments. The Marga instrument [5] was used to provide a quantitative semi-online measurement of inorganic chemical compounds in particle phase. Fourier Transform Infrared Spectroscopy (FTIR) analysis was performed on daily filter samples, enabling the identification and quantification of organic aerosol subspecies. Finally an Atmospheric Pressure Chemical Ionization Ion Trap Mass Spectrometer (APCI-IT-MS, [6]) was measuring gas and particle phase aerosol composition, offering additional information on molecular compositions. Overall, the availability of a variety of aerosol chemical characterization instruments provided a good opportunity for a comparison of the results obtained by these four very different measurement approaches. Overall the results were found to agree. The inorganic particulate masses measured with the AMS and Marga were found to correlate especially well for sulphates ($r^2=0.92$) and ammonia compounds ($r^2=0.82$). The organic mass seen by the AMS was correlated with the FTIR filter analysis ($r^2=0.87$) and the APCI-IT-MS ($r^2=0.88$).

References

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