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Published in:
NOSA proceedings 2009

2009

[Link to publication](#)

Citation for published version (APA):

Eriksson, A., Roldin, P., Pagels, J., & Swietlicki, E. (2009). Non-Refractory Chemical Composition of the Submicron Regional Background Aerosol in southern Sweden measured with HR-ToF-AMS. *NOSA proceedings 2009*.

Total number of authors:
4

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Non-Refractory Chemical Composition of the Submicron Regional Background Aerosol in southern Sweden measured with HR-ToF-AMS

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Keywords: Particulate Chemistry, HR-ToF-AMS, EMEP, Air Mass Trajectory

Introduction

The subject of this study is the chemical composition of the submicron particles at the EUSAAR regional background station Vavihill (13°09'E, 56°01'N, 175 m altitude) in southern Sweden. The measurements were conducted with an Aerodyne High Resolution Time of Flight Aerosol Mass Spectrometer. The AMS was operated during two EMEP intensive measurement campaigns; October 2008 and March 2009.

Method

Since these were the first ambient AMS measurements performed by LU, considerable efforts were made to compare the resulting data with those from co-located instruments. The size distributions obtained were compared with DMPS data from the same periods. The total mass loadings calculated from the AMS data were compared with those estimated from DMPS data and measured with TEOM (PM_{2.5}). The organic mass loadings were compared with those obtained through OC/EC filter analysis (EUSAAR protocol). Nephelometer aerosol scattering and PSAP aerosol absorption data is also available for closure and correlation studies. The mass fractions of all the measured chemical species were compared with those predicted by a model for Aerosol Dynamics, gas phase CHEMistry and radiative transfer calculations (ADCHEM), developed by Roldin et al., 2009. FLEXTRA Air mass backward trajectories from NILU, spanning over 7 days, were studied to gain insight in the previous movement of the aerosol measured upon.

Results and Conclusions

The sampled PM was found to consist mainly of organic compounds and nitrate. The chemical composition varied significantly on a timescale of hours and days, but the average composition was fairly similar for the autumn and spring campaigns. This implies that the high time resolution provided by the AMS (as opposed to filter measurements) is necessary for capturing the dynamics of ambient particulate chemistry. Figure 1 illustrates the correlation between AMS mass loading and DMPS estimated volume, which is surprisingly high given the fundamental differences of the two measurement techniques. The main deviations are found during events of high nitrate loading.

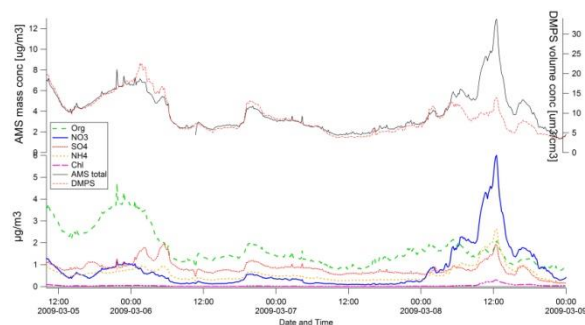


Figure 1. The chemically resolved mass loadings measured during part of March 2009 (lower half of figure), and corresponding DMPS-AMS comparison.

One possible explanation is that those particles were less prone to bounce of the vaporizer than the average ambient aerosol particle. This would increase the collection efficiency (CE) of the AMS during these nitrate-dominated events. Introducing a time dependent CE based on chemical composition does result in a somewhat improved correlation. The factor ~2 which separates the results from the two instruments is believed to originate mainly from inaccurately set ionization efficiency (IE) for the AMS. There still remain some uncertainties regarding the AMS IE calibration sessions, the issue is currently under investigation. Adding estimated refractory mass loadings to the AMS results will also mitigate the apparent discrepancy, but this is a minor effect. Nevertheless, the good overall correlation with DMPS and other co-located instrumentation implies that the AMS data obtained during these first field deployments are reliable. The lack of time trends in these correlations suggests that these two AMS deployments are useful as a frame of reference for future studies of aerosol particle chemistry at Vavihill.

This work was supported by the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS) and the Swedish Research Council (VR).

Roldin, P., Schurgers, G., Svenningsson, B., Erik Swietlicki, E., Eriksson, A., Pagels, J., Nilsson, E., Arneth, A., Ketzler, M., and Gustafson, S. (2009). *Modeling of aerosol dynamics and particle chemistry using the PSA nucleation theory*. NOSA 2009 Proceedings.