

SOURCE IDENTIFICATION OF FINE PARTICLE EMISSIONS IN URBAN AIR BY MOBILE MEASUREMENTS

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Summary

This study aims to characterize winter aerosols in the hot spot areas of poor air quality in the Helsinki Metropolitan area. An advanced on-line measurement technique was installed into a mobile laboratory van to measure chemical and physical characteristics of fine particles. This study shows that the properties of particles from different sources can be distinguished. For example, the particles originated from residential wood combustion and traffic possessed most abundant concentrations of black carbon thus affecting the radiative properties of the atmosphere. Furthermore, the number concentration of particles from traffic was highest, and due to their small sizes they might be most harmful for human health.

Introduction

Particle emissions from traffic and wood combustion are known to significantly contribute to regional air quality and climate. Detailed monitoring of aerosol particle properties in urban and suburban areas is a challenging task, since their concentration, size, composition and sources vary strongly in time and space. As a part of the MMEA Programme (Measurement, Monitoring and Environmental Assessment, 2010-2014), a field campaign in street canyons and densely populated small house areas with local wood burning as well as on major roads was conducted in the Helsinki Metropolitan area. An advanced on-line measurement technique was used to monitor composition, size distribution and volatility of fine particles.

Methodology and Results

Two weeks intensive winter campaign by mobile laboratory 'Sniffer' (e.g. Pirjola et al., 2012) was performed in the Helsinki Metropolitan area in February 2012. The particle number concentration and size distribution were measured by ELPI (diameter > 7 nm) and SMPS (diameter > 3 nm), PM₁ chemical composition by soot particle aerosol mass spectrometer SP-AMS and aethalometer, and mass concentrations PM₁ and PM_{2.5} by DustTraks. Volatility properties of particles were studied by a thermodenuder. Also measured continuously were NO, NO₂, NO_x, CO, CO₂, meteorological and geographical parameters.

Four types of winter aerosol were recognized: (1) very clean period (CLEAN) at urban background site on seashore due to air flows from the Atlantic Ocean, (2) strong long-range transported pollution episode (LRT-EPI) at urban background site on seashore due to air flows from eastern Europe, (3) fresh smoke plumes from residential wood combustion (SMOKE) in suburban small house area mixed with LRT pollution, and (4) fresh emissions from traffic (TRAFFIC) while driving on a busy street in Helsinki city centre during morning rush hour.

As a result the characteristic physical and chemical properties of particles from the different sources were identified (Figs. 1 and 2). Particles of type 1 possessed low number and volume concentrations. Particles of type 2 and 3 were mostly in the accumulation mode and contained high organic and sulphate concentrations. Furthermore type 3 particles had high black carbon concentration, like traffic particles. Contrary to type 3 particles, the number concentration of type 4 particles was high and a major part of particles were in the nucleation mode.

Conclusions

The installed state-of-the-art instrumentation into the mobile laboratory van enabled us to obtain a comprehensive view on aerosol properties and sources in urban air. To better understand the characteristics of fine particles from different emission sources is important for air quality assessment and for climate models.

Acknowledgement

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References

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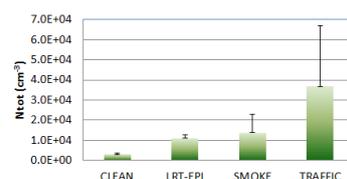


Fig.1 Averaged number concentration of particles for four sources

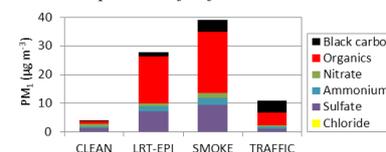


Fig.2 PM₁ bulk chemical composition