On Urban Air Pollution Measurements:

Analysis for Identification and Classification of Sources

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ABSTRACT

The high levels of air pollutants in urban areas have led to a call for a better understanding on how to classify the different pollution sources. It is also important to understand how different conditions affect the measured concentrations.

The work presented in this licentiate thesis is based on field measurement campaigns aimed at a deeper understanding of the behaviour of particles and other air pollutants. A wide range of variables and tools has been used in the analysis. Although they are mainly meteorological in origin, traffic intensity patterns, air mass back trajectories and statistical tools such as correlation analysis and principal component analysis have also been used.

Vertical gradient measurements were conducted during the autumn 1999 at the Gustavii Cathedral in central Göteborg, Sweden at two different heights (10 and 32 m, i.e. below and above surrounding roof levels). Sulphur dioxide, nitric acid, particulate sulphate and nitrate were sampled by the denuder technique and later analysed using an ion chromatograph. Online gas detectors with high time resolution were used to sample sulphur dioxide and nitrogen oxides. Total suspended particles, TSP, were collected on filters and analysed by Energy Dispersive X-Ray Fluorescence (EDXRF) spectroscopy. A strong negative gradient was found for TSP mass and for the soil-derived elements (e.g. iron, titanium and manganese) and a positive gradient was found for HNO_3. Further analysis revealed other features e.g. positive gradients for SO_2 during the high-pressure conditions in September and positive and negative gradients for NO_x during northeasterly and northwesterly winds respectively.

Roadside particle measurements were made along the RV45, 15 km north of central Göteborg during three weeks in June 2000. The particle size distribution between 10 and 368 nm was measured using a Differential Mobility Particle Sizer system (DMPS). Particulate mass ($PM_{2.5}$) was collected on a daily basis with subsequent elemental analysis using EDXRF-spectroscopy. A strong correlation between $PM_{2.5}$ and lower accumulation mode particles (100-368 nm) was observed. The ultrafine particles (10-100 nm) were however, not correlated with the larger particles. The particle number concentration showed a strong dependency on wind speed and direction. Wind speed was the dominant factor affecting the smallest particles. Traffic intensity information together with wind data made it possible to isolate the contribution to the pollution from the traffic contribution as well as its size distribution.

Keywords: Vertical gradients, Sulphur, $PM_{2.5}$, TSP, Ultra fine particles, Particle size distribution, Air mass trajectories, Traffic emissions, DMPS, EDXRF