Abstract

Air quality in Europe remains a significant environmental concern, affecting the health and quality of life of its population. While stationary network ambient air quality monitoring allows for the observation of main trends, it is not fully representative of personal exposure of citizens due to high spatio-temporal variability of atmospheric aerosol. Therefore, highly time-and-space resolved measurements with state-of-the-art instruments and methods are needed to observe the aerosol variability, dynamics, identify hot-spots, and pollution sources, which are necessary for successful targeted mitigation measures.

This thesis addresses this gap focusing on the characterization of spatio-temporal distribution of atmospheric aerosol in inhabited environments. Novel mobile measurement systems were developed and employed to investigate diverse environments, including rural, urban and suburban area. Aerosol source-apportionment were conducted, and the toxicological effects associated with these environments were also investigated.

A novel mobile measurement system was developed for personal exposure measurements and pollution mapping in urban and rural environments. The system was used to measure air quality in the Munich subway, revealing high aerosol dynamics with significantly higher concentrations of mainly coarse particles – primarily iron oxides from rail and wheel abrasions – compared to ambient air (*Manuscript 1*). A similar mobile system also was used to explore the spatio-temporal distribution of emissions from local heating sources during the winter season in rural locations at the Czech-German border within two similarly sized villages. The study revealed a decrease of the air quality, especially in the Czech Republic in the afternoon and evening due to a combination of low-quality combustion processes, meteorological, and geomorphological conditions (*Manuscript 2*).

Innovative tethered-balloon measurements of vertical temperature-humidity profiles allowed the detection of the inversion layer's height, which prevented the dispersion of pollutants in suburban location (*Manuscript 3*). Source-apportionment using the Positive Matrix Factorization (PMF) method from both aerosol elemental composition and particle number size distributions, delineated key pollution sources and their contribution in urban and suburban air quality in the Ostrava region (*Manuscript 4*). Additionally, the use of a high-volume cascade impactor for the sampling into 4 particle size fractions allowed the monitoring of daily variability of carcinogenic polycyclic aromatic hydrocarbons (c-PAHs) and their toxicity, with the upper accumulation mode of the aerosol contained 44% of c-PAHs (*Manuscript 5*). Furthermore, in laboratory experiments, the toxicology effects of anthropogenic and biogenic secondary organic aerosol (SOA) typical for urban areas and remote locations were investigated, revealing a higher toxicity from anthropogenic SOA, typical of urban areas (*Manuscript 6*).