Vertical gradients of atmospheric aerosols chemical composition

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Atmospheric aerosols differ in concentration and chemical composition with altitude above the Earth's surface. At higher altitudes, aerosol constitution is significantly influenced by long-range transport. The National Atmospheric Observatory Košetice with its 250 m high tower is a unique installation that enables the study of vertical gradient of atmospheric aerosols chemical composition over extended periods of time.

The aim of this work is to obtain data on the chemical composition of aerosols at two heights (4–5 metres above ground and at 230 metres on the atmospheric tower's measurement platform). The following analytical methods and sampling techniques will be used:

AMS (Aerosol Mass Spectrometry) – in combination with PMF (Positive Matrix Factorisation), this method deconvolves complex mass spectrum allowing us to distinguish individual chemical species or groups. Numerous field studies have demonstrated that aerosol mass concentrations and size distributions measured by AMS generally agree well with data acquired from other instruments.[1–4]

ACSM (Aerosol Chemical Speciation Monitor) – in contrast to AMS, the ACSM is simplified, compact-sized, lower-priced and does not provide particle size measurement. On the other hand, AMS features better mass resolution and detection limits.[5]

PILS-IC (Particle Into Liquid Sampler coupled with Ion Chromatography) – this technique is designed for the continuous monitoring of aerosol chemical composition. Particles are mixed with saturated vapour generated from ultrapure water, forming droplets that are then collected.[6,7] Liquid-phase samples are analysed with IC or can also be stored frozen and analysed with other methods of choice. PILS-IC provides near real-time measurements for long-term operation. Additionally, accessory denuders will be applied. These denuders cut off any influence of species present in ambient air in the gas phase.[8]

Filtering – the oldest method for aerosol chemical composition analysis still plays an irreplaceable role. Various materials can be used (fibrous – e. g. glass, polymer; and porous – e.g. polycarbonate, cellulose), each of them having advantages and disadvantages. The most commonly used material is quartz fibre; universal but suffers from high levels of hygroscopicity.

Results obtained using the above mentioned analytical methods and sampling techniques will be evaluated with regard to meteorological parameters, mainly atmospheric conditions such as boundary layer height and gradient of wind speed and direction. The contribution of long-range transport on concentration of individual species will be also evaluated. Online methods of aerosol mass spectrometry (AMS/ACSM) as well as semi-online (PILS) and offline (filters) will be used and compared. Chemical composition will be also evaluated with regard to daily and seasonal cycles.

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