Ultrafine particle concentrations: importance of local sources and new particle formation in two central European cities

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Ultrafine particle concentrations in urban areas are a major concern regarding air quality and public health. Local direct emissions of small, often carbonaceous, particles as well as new particle formation events are sources of fine and ultrafine particles, but meteorological conditions and the properties of the background aerosol moderate both the production and the fate of freshly produced particles. Concentrations of ultrafine particles from local sources are governed by human activity patterns and meteorology (Borsos *et al*, 2012, Kalafut-Pettibone *et al*, 2011, Salma *et al*, 2011), in particular boundary layer characteristics (Olofson *et al*, 2009). The timing and extent of new particle formation in urban areas is linked to precursor gas concentrations, solar radiation and condensational sink strength (Cheung *et al*, 2012, Stanier *et al*, 2004, Zhang *et al*, 2004), and often shows a strong seasonal dependence (Borsos *et al*, 2012, Salma *et al*, 2011, Stanier *et al*, 2004).

In this study, the importance of local primary sources and new particle formation as sources of fine and ultrafine particles is investigated for winter and summer in two central European cities. Particular attention is given to the impact of local meteorological characteristics: air mass origins play a large role in the characteristics of the background aerosol and the concentrations of trace gases associated with new particle formation and growth, and precipitation and thus the condensational sink.

The measurements were conducted in Prague (June 25 - July 9, 2012 and Jan. 14 - 30, 2013) and Vienna (July 16 - 30, 2012 and Feb. 4 - 16, 2013). Particle size distributions were measured continuously with an SMPS (Prague: TSI 3034 ,Vienna: DMA with CPC 3760A, TSI, Inc.). Black, brown, elemental and organic carbon concentrations were measured using a variety of methods (Hitzenberger *et al*, 2013). These measurements of carbonaceous aerosol concentration served as an indicator of human activity patterns and local anthropogenic emissions. Size-resolved chemical information was obtained from impactor data (ion chromatography). Meteorological data (temperature, relative humidity, precipitation, wind speed and direction) as well as solar radiation and concentrations of O_3, SO_2 and NH_3 were obtained from measurement networks. Air mass origin trajectories were calculated using the HYSPLIT model.

First results show that new particle formation events, which occurred mainly in summer, were often, but not always, linked to diurnal peaks in solar irradiation, and contributed substantially to fine particle concentrations. New particle formation events were absent in winter, due to both higher background aerosol concentrations and lower solar radiation in winter. Correspondingly, the contribution of fine and ultrafine particles to total number concentrations in winter was dominated by local anthropogenic sources.

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