

Particle Size, Mass and Chemical Transitions from an Outdoor to Indoor Environment in Prague, Czech Republic with Attention to Nitrate.

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In the absence of internal sources, particle number concentrations indoors are largely dependent on concentrations outdoors (Hussein *et al.*, 2006). Once indoors, particles are subjected to changes in temperature, relative humidity and different organic compounds, changing the particles physio-chemical state. (Lunden *et al.*, 2003).

As people spend most of their time indoors it's important to understand these processes in terms of epidemiology. However, species volatility can complicate indoor data, change distribution profiles and implant positive artifacts on measurements. Although there is good awareness of these issues, the impacts are rarely well defined. This research details resulting changes to size, mass and chemical composition of outdoor originating particulate penetrating indoors.

Data was collected from a ground floor flat in Suchbátka, Prague over weekend 30th – 31st August 2014. The flat is located in a residential area in northwestern Prague about 6 km from the city centre and is recognized as a suburban background site. Particle number size distribution profiles were collected using a Scanning Mobility Particle Sizer (SMPS) model TSI 3936L consisting of a long DMA 3081 and CPC 3775. The SMPS scanned 64 channels per decade, through sizes 14.8-724nm with 3-minute up-scan, 30 second down scan and 90 second purge. An Aerodyne Compact Time of Flight Aerosol Mass Spectrometer (C-ToF AMS) ran alongside the SMPS sampling every minute, providing real-time chemical composition data (Drewnick *et al.*, 2005).

Sequential sampling was conducted using an automated switching valve which allowed two-5 minute SMPS scans outdoors followed by two scans indoors. Two Berner Low Pressure Impactors (BLPI) were used for a size resolved chemical composition analysis with one BLPI located indoors and one outside. Substrate filters were changed every 24 hours. Meteorological data and gaseous pollutants (NO_x and O₃) were collected from a permanent air research station located within the same ICPF compound where all measurements were collected.

A New Particle Formation (NPF) event on the afternoon of Saturday 30th (fig.1) shows a clearly defined, size resolved, outdoor-indoors infiltration. This allowed for the calculation of a I/O ratio (*I_r*) using time/size subsets during the NPF event. Ultrafine particles <40nm in diameter had the lowest I/O ratio at

0.4 whilst particles >80nm in diameter gave a consistent ratio between 0.65-0.7. Apparent growth rate defining particle growth between 20-50nm during the same NPF event were 4.4nm/hr outdoors. Comparisons of mass from integrated real-time SMPS measurements and normalized BLPI impactor samples revealed losses of 16% of mass on filters for aerodynamic sizes 250-450nm

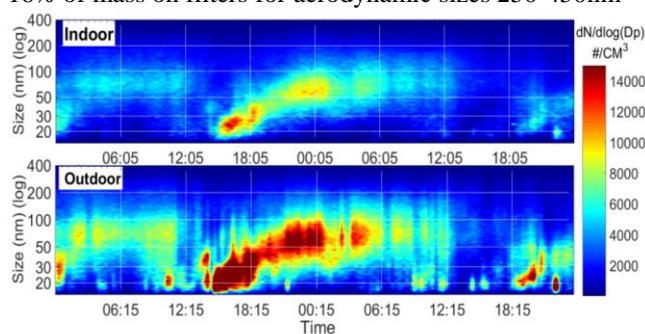


Figure 1: NPF event outdoors seen to infiltrate indoors with changing size and concentration.

Size characterization by the AMS displays modal diameters for Organics, NH₄, NO₃ and SO₃ between 200-400nm. Further intercomparison of these non-refractory species shows indoor NO₃ concentrations were much lower than those outside. This is a result of NH₄NO₃ volatility as the probable cause of losses on BLPI measurements.

Finally, NO₃ volatility in terms of temperature and relative humidity was characterized for this period. Dissociation occurred when outdoor temperatures reached 22.5°C and 68% RH but due to hysteresis particle reformation were not observed until 17 °C and RH 87%.

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