# I/O aerosol characterization in a kindergarten

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In recent decades, people spend more and more time in the indoor environment. When indoor sources are present, they usually dominate the chemical composition, number/mass concentration and determine the pattern of size distribution. Without the presence of indoor sources, the indoor concentrations and shape of size distribution usually follow the outdoor concentration with certain time delay given by penetration characteristics (Hussein et al., 2005).

Numerous epidemiological studies show direct links between adverse health effects and dose/exposure to fine and ultrafine particles (Dockery et al., 1993). Not only adults are exposed to aerosol particles of various sizes, chemical composition and toxicity. Children are also exposed to the same aerosol and in their case the negative effect can be even more pronounced. Children spend relatively long time indoors since their very young age - e.g. nursery, kindergarten, school. Therefore it is very important to monitor, evaluate and understand the behaviour of indoor aerosol in such educational environment (Fromme et al., 2007). Not only the indoor aerosol is of concern here, but also the influence of corresponding outdoor environment with its sources and daily pattern is important for complete understanding.

Based on the above mentioned facts, we designed an I/O measurement campaign in a kindergarten in a small town with moderate industry (e.g. plastic tubing production, iron-casting), located close to Prague. The measurement was performed during a two week period in January 2015. The set of instruments used within this campaign included SMPS, two OPS and six low volume samplers ($PM_{2.5}$ and $PM_{10}$). The SMPS was equipped with a switching valve allowing for alternate sampling indoors and outdoors. The sampling pattern was two 5 minute scans outdoors followed by two 5 minute scans indoors. The low volume samplers were split into two sets (both including $PM_{2.5}$ and $PM_{10}$ quartz fibre filters and $PM_{2.5}$ with Teflon filter) for indoor and outdoor sampling. The indoor instruments were located in the small room next to the cloak room close to one of the classrooms. Placement of the instruments inside a classroom was not possible due to presence of the small kids and noise produced by the instruments during kids sleeping pause. The outdoor instrumentation was placed on a small yard, where the kids played during nice weather periods. The gravimetric analysis of filters from low volume samplers was followed by chemical analysis (IC and PIXE).

The data obtained from SMPS monitoring the number size distribution indoors/outdoors were separated according to the sampling place and kindergarten working hours (7 A.M. - 5 P.M.). The results show clear differences in patterns between working/non-working hours and indoor/outdoor aerosol (Fig. 1). The unimodal shape (accumulation mode only) with lowest concentration and lowest inter-quartile span is represented by non-working hours in indoor environment. It is evident that the shape of the indoor size distribution in this case (without indoor sources) follows corresponding outdoor size distribution with smallest particles lost during penetration and by deposition indoors. The highest concentrations were observed for working hours and outdoor sampling point. This size distribution is multi-modal with clear contribution of nanoparticles coming most probably from combination of traffic, domestic heating and industrial processes.

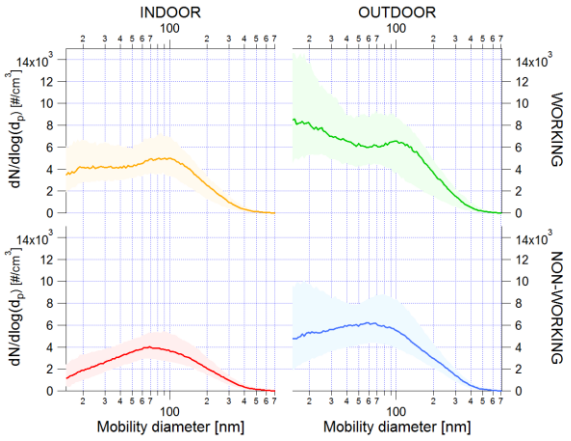


Figure 1. I/O number size distribution during working and non-working hours (shaded 25th-75th percentile).

In regard to concentration of coarse particles, represented in this case by measurements of $PM_{2.5}$ and $PM_{10}$, the indoor concentration was in some cases slightly higher compared to those measured outdoors during working days. On the contrary, the concentration measured outdoors was higher during weekends. This points towards kids and especially their movement as a main source of coarse particles indoors substantially increasing the indoor mass concentrations.

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Fromme et al. (2007) *Atmos. Environ.*, **41(4)**, 854-866.
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