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Number concentration and modal Structure of indoor/outdoor fine particles in four European Cities

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Indoor/outdoor measurements campaigns were performed in naturally ventilated houses and offices in four European cities to investigate the relationship between indoor and outdoor particle number concentrations and aerosol modal structures. The measurements sites were located in Oslo (Norway), Prague (Czech Republic), Milan (Italy) and Athens (Greece). A number of ordinary indoor activities (cooking, smoking, candle burning, etc.) were performed during the measurements to quantify the contribution of particles emitted from indoor sources and the contribution of outdoor particles to the change of the indoor aerosol size spectra.

The size and time resolved particle concentrations in the size range 10 nm – 600 nm were measured by scanning mobility particle sizers (SMPS). The results were analysed, and the modal structure of the measured particle number size distribution data, along with the number concentration in each of the modes comprising the aerosol size distribution, were computed.

The analysis of the measurements showed that in absence of indoor sources, indoor number concentration followed the variations of the outdoor concentration. Figure 1 presents the correlation between diurnal median values of indoor and outdoor number concentrations for the measurements conducted in Prague. Indoor concentration was highly correlated to the outdoor concentration when the apartment was unoccupied, but poor correlation was observed during periods with indoor activities (e.e., cooking).

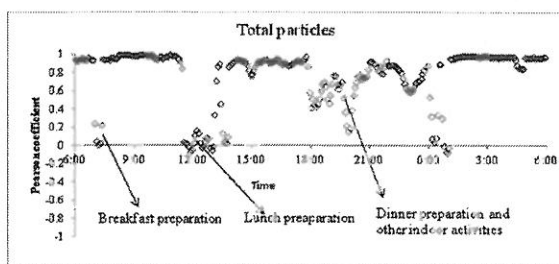


Figure 1. Correlation of indoor and outdoor diurnal median number concentrations for the measurements conducted in Prague (Czech Republic).

Emissions from indoor sources resulted in elevated indoor number concentrations and I/O ratios. Furthermore, the aerosol spectra presented different characteristics during periods with indoor activities as depicted in Table 1. The outdoor size distribution was similar to the indoor size distribution suggesting that in naturally ventilated buildings the indoor size spectra is formed according to the penetration efficiency of the outdoor particles to the indoor environment and to the emission characteristics of indoor sources.

Table 1a,b: Median values of GMDs, for the first and second mode, sorted according to time period without indoor activities(a) and with indoor activities (b) in the measurements sites of Oslo, Prague and Milan.

Median values for time periods without indoor activities			
		GMD [nm]	
		1	2
Unimodal	Prague	120	
	Oslo	57	
	Milan	74	
Bimodal	Prague	34	132
	Oslo	23	91
	Milan	41	128

(a)

Median values for periods with indoor activities			
		GMD [nm]	
		1	2
Unimodal	Prague	85	
	Oslo	85	
	Milan	129	
Bimodal	Prague	45	182
	Oslo	20	101
	Milan	48	150

(b)

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