Multi-zone measurement of particle number/mass and black carbon concentrations in a HVAC building equipped with a printer room

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Indoor air quality in office environments has great effect on human comfort and work performance. Pollutants may originate from indoor sources, most notably hardcopy devices (He et al., 2007) or from outdoors where mechanical ventilation plays a key role on indoor concentrations (Chatoutsidou et al., 2015).

The present study examined particle number/mass and black carbon concentrations in a multi-zone HVAC building with massive printer emissions. The objective was to evaluate the impact from human occupation in different locations of the building. Therefore, three offices and a printer room were selected to perform the measurements, whilst mechanical ventilation was turned off during the campaign.

The physical presence of the occupants had great impact on indoor PM_{10} concentrations on workdays due to resuspension activities. On the contrary, when the offices were not occupied (night, weekend) the main contribution on indoor PM_{10} originated from outdoors. Daily median concentrations varied between 9-43 μg/m^3, where lower concentrations obtained during no sources periods. Moreover, I\O ratios preserved high estimates for all offices ranging between 0.47-1.63, suggesting the presence of indoor sources, whilst increased ratios during no sources periods were associated with the absence of mechanical ventilation.

Emissions from printers had dominant effect on sub-micron particle number concentration in the printing room as shown in Figure 1. However, the sharp increase observed early in the morning and before any printing activity on workdays was due to cleaning activities.

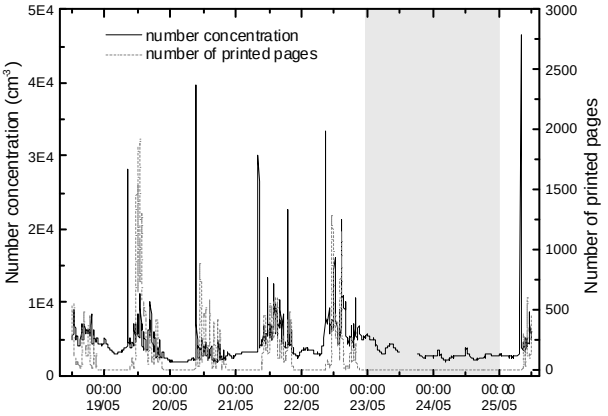

Figure 1: Number of printed pages and sub-micron particle number concentration in the printer room. The highlight area corresponds to weekend.

Furthermore, sub-micron particles originated from the printer room influenced particle number concentration in the three offices due to particle transport. Figure 2 presents the correlation of indoor particle number concentration between the printer room and a selected office. It suggests that sub-micron particle transport indoors is important. Lastly, black carbon preserved low concentrations and was not associated with printer emissions (Table 1). On the contrary, good correlation with indoor PM concentration was found (PM_1, R^2=0.52) which suggests origin from the outdoor environment.

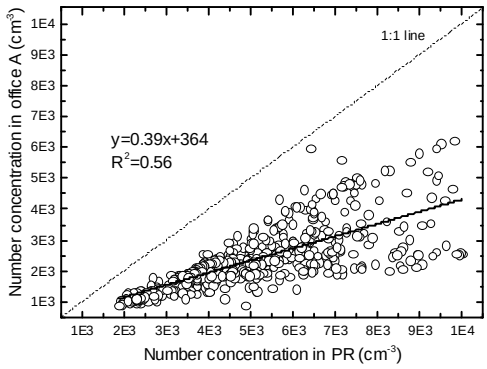

Figure 2: Correlation of particle number concentrations between printer room (PR) and office A.

Table 1: Mean (± SD) concentration of black carbon in the printer room and office B for occupied hours (OH) and not occupied hours (NOH).

Printer Room		Office B	
OH	NOH	OH	NOH
0.24±0.06	0.25±0.03	0.38±0.15	0.32±0.09

In summary, indoor particle number concentration was influenced by cleaning and printing activities, with particle transport playing an important role, whereas indoor PM_{10} concentration was influenced by resuspension activities due to human occupation.

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