Personal Exposure to Ultrafine Particles at Schools Microenvironment

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1 Introduction

This work was motivated by the limited knowledge on personal exposure to ultrafine (UF) particles, especially for children (Mejía et al. 2011). Most research efforts in the past have investigated particle mass concentration and only a limited number of studies have been conducted to quantify other particle metrics, such as particle number, in the classrooms and school microenvironment in general (Diapouli et al. 2008; Guo et al. 2008; Weichenthal et al. 2008; Mullen et al. 2011).

This paper aims to determine the personal exposure of children to UF particles (in terms of number) in the school microenvironment, particularly in relation to traffic emissions. This study is being conducted as part of the "Ultrafine Particles from Traffic Emissions and Children's Health (UPTECH)" project, which seeks to determine the effect of exposure to UF particles emitted from motor vehicles on the health of school children (http://www.ilaqh.qut.edu.au/Misc/UPTECH%20Home.htm). To achieve this, air quality and health data are being collected at 25 schools within the Brisbane Metropolitan Area in Australia over a two year period. The children's personal exposure to UF particles for the first 17 schools is presented here. These schools were tested between Oct 2010 and Dec 2011. Data collection in the remaining schools is expected to be complete by mid 2012.

2 Materials/Methods

In this study, personal exposure to UF particles was quantified using Philips Aerasense Nano Tracers (NT). The NT is a portable instrument measuring particle number concentration (PNC) up to 10^6 cm^{-3} and particle size in the range of 10-300 nm within the breathing zone. The NT can be operated using its internal rechargeable batteries for up to 8 hours or directly from the mains power supply. In this study, the NT was operated in the "advanced mode" so that both the concentration and particle size data were obtained with the sampling interval set to 16s.

At each school, 3 to 6 children aged 8 to 11 years old were asked to carry the NT and a global positioning system (GPS) all the times for a total 24 hours or have it in his or her close proximity when it was not being worn (e.g. during sports activities, when using the bathroom and sleeping). Each child and their parents or guardians were asked to fill in an activity diary, recording their travel times and activities, and the time and duration when the sampler was not with the child at any particular time, throughout the duration of the measurement.

3 Results and Discussion

A total of 63 children from 17 schools (S01 – S17) participated in the study. The time series of PNC data during the 24 hours of measurements for each child were used to identify peak concentration levels in the first instance. Each child's exposure was quantified during school hours, including the time spent in the classroom (indoors), or during time spent within the school grounds (outdoors), including breaks, as well as for after school hours, including transportation and travel time. The preliminary results for each school are presented as the average values for all children. The exposures are not exclusive to traffic related emissions, as they are affected by many factors relating to the children's activities, as well as the activities which were taking place in close proximity to the child, especially during after school hours (e.g. cooking or cleaning at home).

Figure 1 shows the average exposure to UF particles during indoor and outdoor activities at each school over the 24 hours of data collection. These results show that children's exposures during indoor and outdoor activities were lowest at S09 and highest at S03 and S02, respectively.

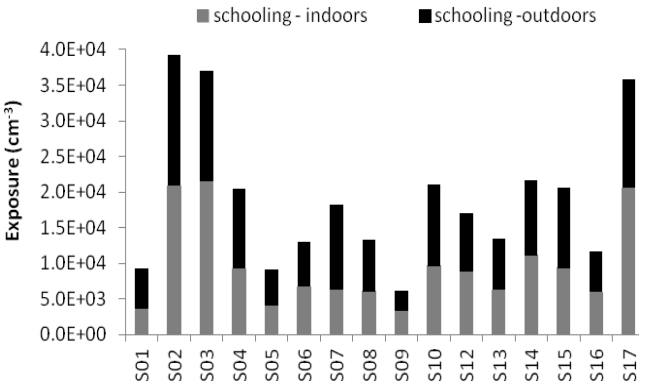

Figure 1: Average personal exposures to UF particles during schooling hours.

The children's average exposure during commuting and after school hours are presented in Figure 2. The data for after school hours includes commuting time as well. Children attending S07 and S08 had higher personal exposures during commuting and S01 had the lowest.

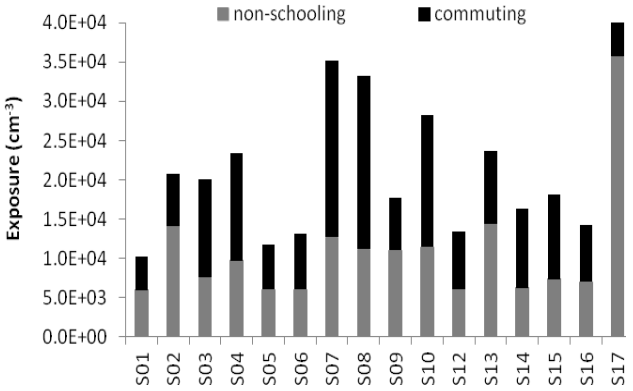

Figure 2: Average personal exposures to UF particles after school hours and during commuting.

The average particle diameter measured by the NTs ranged from 30 to 80nm during schooling hours and commuting (Figure 3). Walking and getting a ride by a private car were the main means of transport for the participating children (60% commuted by a private car, 13% walked and 18% used both). As expected, the diameters measured during commuting were generally smaller than those measured during schooling hours, except for S13.

4 Conclusions

Preliminary analysis indicates that the results are consistent with the general characteristics of the schools and local traffic conditions during data collection. Further analysis of the NT data is currently underway.

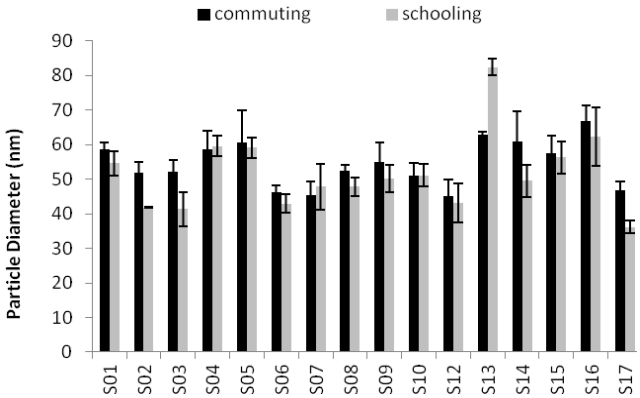

Figure 3: Average particle diameters measured by the NTs during schooling hours and commuting.

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