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Lung deposited surface area concentrations in a street canyon

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Street canyons are interesting environments with respect to the dispersion of traffic emissions and human exposure. Pedestrians may be exposed to relatively high concentrations of fine particles and the vertical dispersion affects the human exposure above the ground level in buildings. Previously, particle concentrations have been measured in street canyons at a few different heights (Marini et al., 2015). The information on the lung deposited surface area (LDSA) concentration, which is a relevant metric for the negative health effects, is very limited even at the ground level of street canyons (Kuuluvainen et al., 2016). More information especially on the vertical dispersion and the ground level concentrations is needed, for instance, for the use of urban planning and the design of ventilation systems in buildings.

Measurements were carried out in a busy street canyon in Helsinki, Finland, at an urban super-site measurement station (Mäkelänkatu 50). The data included vertical concentration profiles measured in an intensive measurement campaign with a Partector (Naneos GmbH) installed into a drone, long-term measurements with an AQ Urban particle sensor (Pegasor Ltd.), and an extensive comparison measurement in the field with different devices measuring the LDSA. These devices were an AQ Urban, Partector, DiSCmini (Testo AG), NSAM (TSI Inc.), and an ELPI+ (Dekati Ltd.). In addition, continuous measurements of gas phase components, particle size distributions, and meteorology were run at the supersite.

The vertical profile measurements were con-ducted in November 2016 during two days. In the measurements, the drone was flown from the ground level to an altitude of 50 or 100 m, which is clearly above the roof level of the buildings. Altogether, 48 up-and-down flights were conducted during the two days. The vertical profiles were supported by continuous measurements at the ground level on both sides of the street canyon. The long-term measurements were conducted during the year 2016. A short period of data was also analysed with respect to the emissions of individual vehicles by using a recorded video of the traffic fleet.

As an example of the vertical profiles, Figure 1 shows the LDSA concentration as a function of the altitude. The data measured with a time resolution of one second is seen along with the values averaged for different altitude intervals. The effect of wind conditions and changes in the traffic fleet on the concentration profiles could be analysed. In addition to the vertical profiles, we were able to analyse the LDSA concentrations on the ground level with respect to long-term averages and rapid changes caused by different individual vehicles.

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