PARTICLE SURFACE AREA SIZE DISTRIBUTIONS IN DIFFERENT URBAN AEREAS

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Summary
The size distributions of the lung deposited surface area were measured in different urban areas in the metropolitan area of Helsinki. The electrical low pressure impactor (ELPI) was calibrated and used in these measurements. The average surface area size distributions from different urban environments clearly show different sources for the lung deposited surface area, from which the traffic seems to be most significant.

Introduction
Numerous of studies are reporting particle mass and number concentrations in urban areas (e.g. Putaud et al., 2004). However, it has been argued that none of these metrics describes properly the negative effect of particles on human health. In this respect, particle surface area concentration is more relevant (Oberdörster, 2001). Some surface related quantities, as the lung deposited surface area or the active surface area, have been proposed to be the metric for the negative health effects. Common for these surface related quantities is that they are rather close to the response of a diffusion charger. For example, the nanoparticle surface area monitor (NSAM) is based on diffusion charging and it measures the lung deposited surface area concentration. In this study, an electrical low pressure impactor (ELPI) is calibrated and used to measure the lung deposited surface area concentrations in different urban areas in Helsinki. The advantage of the ELPI is that, in addition to the total concentration, also the surface area size distributions can be analysed. Thus, the previous knowledge of the number size distributions, the chemical composition and the morphology of the particles can be compared to the lung deposited surface area.

Experimental
Measurements were carried out during two different measurement campaigns in the metropolitan area of Helsinki. The first campaign was held in February 2012 and the second campaign in October 2012. Both campaigns included stationary measurements at different measurement sites and on-road measurements with a mobile laboratory 'Sniffer'. One of the measurement stations was located at a residential area in Espoo, the second in a park close to the city centre representing urban background and the third next to a busy main road. On-road measurements represent the variety of different routes in the metropolitan area including the city centre, main roads and residential areas. In order to use the ELPI for surface area measurements, the instrument was calibrated by comparing the output of the instrument to the signal of an NSAM and to the size distributions given by a differential mobility particle sizer (DMPS). In all the experiments, an ELPI was used to measure particle surface area size distributions. The results were also compared to simultaneous PM2.5, PM10 and particle number measurements.

Results
The average surface area size distribution from three different measurement stations and on-road measurements are shown in *Fig. 1*. It is seen that the shape of the distributions varies and the surface area is emphasized in different size ranges at different environments. The total surface area concentration is clearly higher in the on-road and road side measurements compared to the results from urban background and residential area, as expected. Especially, the soot mode and non-volatile particles from traffic seem to dominate in the surface area distribution. In the residential area, the surface area distribution was highly affected by the amount of long range transported background aerosol.

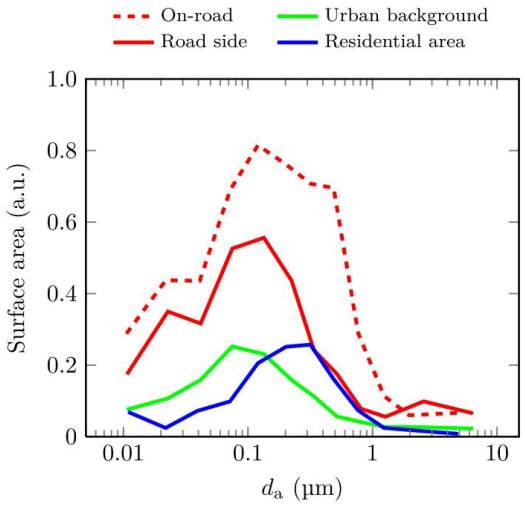

Fig. 1: The average surface area distributions from different environments. The distributions are normalized but comparable to each other.

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