Spatial Distribution of Combustion Related Ultrafine Particles in Innsbruck, Austria

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ABSTRACT

The air quality in urban areas is usually measured at a few stations. This approach allows for a very accurate but only locally valid determination of pollutants such as ozone, NOx (NO + NO2) or particulate matter (PM10 and PM2.5). While a point measurement of PM10 might be representative for the fine particle distribution in a whole city, ultrafine particles (UFP; particles with a diameter smaller than 100 nm) are distributed quite differently. The number concentration of UFP is dominated by local sources, which are mainly traffic-related in a city. Modern combustion engines, which are not equipped with special particle filters, emit a large number of UFPs whose surfaces are loaded with toxic compounds. UFPs have a short lifetime of minutes before they are lost through coagulation with larger particles. High UFP number concentrations are therefore only found in the immediate vicinity of their sources. The UFP exposure of a cyclist can be assessed by the Lung Deposition Surface Area (LDSA). UFP penetrate deep into the lungs and are deposited efficiently in the alveoli.

In this study we investigated the spatial distribution of LDSA values in the Innsbruck area. The measurements took place from December 2017 to December 2018. More than 2000 km were covered on a bicycle equipped with an Partector, a GPS and a GoPro. The same streets were often covered at different times of the day and under different meteorological conditions throughout the year. In addition, on some days the particle size distribution from 10 to 1000 nm was recorded near the highway and in the city in summer and winter.

Results demonstrate, that the spatial extend of “hot spots” strongly depends on weather conditions. Under foehn conditions, high levels of pollution can only be observed at very short distances from their emission sources (busy street crossings). In high-pressure weather conditions, these hot spots are spatially far more extended.