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Correlation between traffic density and particle size distribution in a street canyon and the dependence on wind direction

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Abstract. Combustion of fossil fuel in gasoline and diesel powered vehicles is a major source of aerosol particles in a city. In a street canyon, the number concentration of particles smaller than 300 nm in diameter, which can be inhaled and cause serious health effects, is dominated by particles originating from this source. In this study we measured both, particle number size distribution and traffic density continuously in a characteristic street canyon in Germany for a time period of 6 months. The street canyon with multistory buildings and 4 traffic lanes is very typical for larger cities. Thus, the measurements also are representative for many other street canyons in Europe. In contrast to previous studies, we measured and analyzed the particle number size distribution with high size resolution using a Twin Differential Mobility Analyzer (TDMPS). The measured size range was from 3 to 800 nm, separated into 40 size channels. Correlation coefficients between particle number concentration for integrated size ranges and traffic counts of 0.5 were determined. Correlations were also calculated for each of the 40 size channels of the DMPS system, respectively. We found a maximum of the correlation coefficients for nucleation mode particles in the size range between 10 and 20 nm in diameter. Furthermore, correlations between traffic and particles in dependence of meteorological data were calculated. Relevant parameters were identified by a multiple regression method. In our experiment only wind parameters have influenced the particle number concentration significantly. High correlation coefficients (up to 0.8) could be observed in the lee side of the street canyon for particles in the range between 10 and 100 nm in diameter. These values are significantly higher than correlation coefficients for other wind directions and other particle sizes. A minimum was found in the luff side of the street. These findings are in good agreement with theory of fluid dynamics in street canyons.

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