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Particle size distribution and particle mass measurements at urban,near-city and rural level in the Copenhagen area and Southern Sweden

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Abstract. Particle size distribution (size-range 3-900nm) and PM10 was measured simultaneously at an urban background station in Copenhagen, a near-city background and a rural location during a period in September-November 2002. The study investigates the contribution from urban versus regional sources of particle number and mass concentration.
The total particle number (ToN) and NO_x are well correlated at the urban and near-city level and show a distinct diurnal variation, indicating the common traffic source. The average ToN at the three stations differs by a factor of 3. The observed concentrations are 2500#cm $^{-3}$, 4500#cm $^{-3}$ and 7700#cm $^{-3}$ at rural, near-city and urban level, respectively.

PM10 and total particle volume (ToV) are well correlated between the three different stations and show similar concentration levels, in average within 30% relative difference, indicating a common source from long-range transport that dominates the concentrations at all locations.

Measures to reduce the local urban emissions of NO_x and ToN are likely to affect both the street level and urban background concentrations, while for PM10 and ToV only measurable effects at the street level are probable. Taking into account the supposed stronger health effects of ultrafine particles reduction measures should address particle number emissions.

The traffic source contributes strongest in the 10-200nm particle size range. The maximum of the size distribution shifts from about 20-30nm at kerbside to 50-60nm at rural level. Particle formation events were observed in the 3-20nm size range at rural location in the afternoon hours, mainly under conditions with low concentrations of pre-existing aerosol particles.

The maximum in the size distribution of the "traffic contribution" seems to be shifted to about 28nm in the urban location compared to 22nm at kerbside. Assuming NO_x as an inert tracer on urban scale allows to estimate that ToN at urban level is reduced by 15-30% compared to kerbside. Particle removal processes, e.g. deposition and coagulation, which are most efficient for smallest particle sizes ($<$20nm) and condensational growth are likely mechanisms for the loss of particle number and the shift in particle size.

Final Revised Paper (PDF, 478 KB) Discussion Paper (ACPD)

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