Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 6, 1021-1031, 2006
www.atmos-chem-phys.net/6/1021/2006/

Atmospheric number size distributions of soot particles and estimation of emission factors

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Abstract. Number fractions of externally mixed particles of four different sizes (30, 50, 80, and 150 nm in diameter) were measured using a Volatility Tandem DMA. The system was operated in a street canyon (Eisenbahnstrasse, EI) and at an urban background site (Institute for Tropospheric Research, IfT), both in the city of Leipzig, Germany as well as at a rural site (Melpitz (ME), a village near Leipzig). Intensive campaigns of 3–5 weeks each took place in summer 2003 as well as in winter 2003/04. The data set thus obtained provides mean number fractions of externally mixed soot particles of atmospheric aerosols in differently polluted areas and different seasons (e.g. at 80 nm on working days, 60% (EI), 22% (IfT), and 6% (ME) in summer and 26% (IfT), and 13% (ME) in winter). Furthermore, a new method is used to calculate the size distribution of these externally mixed soot particles from parallel number size distribution measurements. A decrease of the externally mixed soot fraction with decreasing urbanity and a diurnal variation linked to the daily traffic changes demonstrate, that the traffic emissions have a significant impact on the soot fraction in urban areas. This influence becomes less in rural areas, due to atmospheric mixing and transformation processes. For estimating the source strength of soot particles emitted by vehicles (veh), soot particle emission factors were calculated using the Operational Street Pollution Model (OSPM). The emission factor for an average vehicle was found to be $(1.5\pm0.4)\cdot10^{14}$ #(km·veh). The separation of the emission factor into passenger cars ($(5.8\pm2)\cdot10^{13}$} #(km·veh)) and trucks ($(2.5\pm0.9)\cdot10^{15}$ #(km·veh)) yielded in a 40-times higher emission factor for trucks compared to passenger cars.

Final Revised Paper (PDF, 2013 KB) Discussion Paper (ACPD)

Citation: Rose, D., Wehner, B., Ketzel, M., Engler, C., Voigtländer, J., Tuch, T., and Wiedensohler, A.: Atmospheric number size distributions of soot particles and estimation of emission factors, Atmos. Chem. Phys., 6, 1021-1031, 2006. Bibtex EndNote Reference Manager