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Annual particle flux observations over a heterogeneous urban area

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Abstract. Long-term eddy covariance particle number flux measurements for the diameter range 6 nm to 5 μm were performed at the SMEAR III station over an urban area in Helsinki, Finland. The heterogeneity of the urban measurement location allowed us to study the effect of different land-use classes in different wind directions on the measured fluxes. The particle number fluxes were highest in the direction of a local road on weekdays, with a daytime median flux of 0.8×10^{9} m^{-2} s^{-1}. The particle fluxes showed a clear dependence on traffic rates and on the mixing conditions of the boundary layer. The measurement footprint was estimated by the use of both numerical and analytical models. Using the crosswind integrated form of the footprint function, we estimated the emission factor for the mixed vehicle fleet, yielding a median particle number emission factor per vehicle of 3.0×10^{14} # km^{-1}. Particle fluxes from the vegetated area were the lowest with daytime median fluxes below 0.2×10^{9} m^{-2} s^{-1}. During weekends and nights, the particle fluxes were low from all land use sectors being in the order of $0.02–0.1\times10^{9}$ m^{-2} s^{-1}. On an annual scale the highest fluxes were measured in winter, when emissions from stationary combustion sources are also highest. Particle number fluxes were compared with the simultaneously measured CO_2 fluxes and similarity in their sources was distinguishable. For CO_2, the median emission factor of vehicles was estimated to be 370 g km^{-1}.

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