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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 $0.8 \times 10^9 \text{ m}^{-2} \text{ s}^{-1}$. 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 $3.0 \times 10^{14} \# \text{ km}^{-1}$. Particle fluxes from the vegetated area were the lowest with daytime median fluxes below $0.2 \times 10^9 \text{ m}^{-2} \text{ s}^{-1}$. During weekends and nights, the particle fluxes were low from all land use sectors being in the order of $0.02\text{--}0.1 \times 10^9 \text{ m}^{-2} \text{ s}^{-1}$. 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 CO₂ fluxes and similarity in their sources was distinguishable. For CO₂, the median emission factor of vehicles was estimated to be 370 g km^{-1} .

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