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Technical Note: In-situ quantification of aerosol sources and sinks over regional geographical scales

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Abstract. In order to obtain the source/sink functions for atmospheric particulates located on the planetary surface or elevated in the atmosphere; direct aerosol emission measurements are required. For this purpose, the performance of an airborne aerosol flux measurement system with an improved 3-kilometer (km) spatial resolution is evaluated in this study. Eddy covariance method was used in flux calculations. A footprint for airborne flux sampling with the increased resolution becomes comparable in area to the footprint for tower sampling (with the footprint length being 2 to 10 km). The improvement in spatial resolution allows the quantification of emission rates from individual sources located several kilometers apart such as highway segments, city blocks, and remote and industrial areas. The advantage is a moving platform that allows scanning of aerosol emissions or depositions over regional geographic scales. Airborne flux measurements with the improved spatial resolution were conducted in various environments ranging from clean to partly polluted marine to polluted continental environment with low (<500 m) mixed boundary layer heights. The upward and downward fluxes from the clean marine environment were smaller than 0.5×10^6 particles m^{-2} s^{-1} in absolute value. The effective emissions measured from a ship plume ranged from 2×10^8 to 3×10^8 m^{-2} s^{-1}, and effective fluxes measured crossing cities plumes with populations of 10 000 to 12 000 inhabitants were in the range of 2×10^8 to 3×10^8 m^{-2} s^{-1}. Correlations between heat and aerosol fluxes are evaluated.

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