Supplementary information: Comparison of size distribution and electrical particle sensor measurement methods for lung deposited surface area (LDSA[al]) in road traffic sites with varying conditions

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Measurement locations
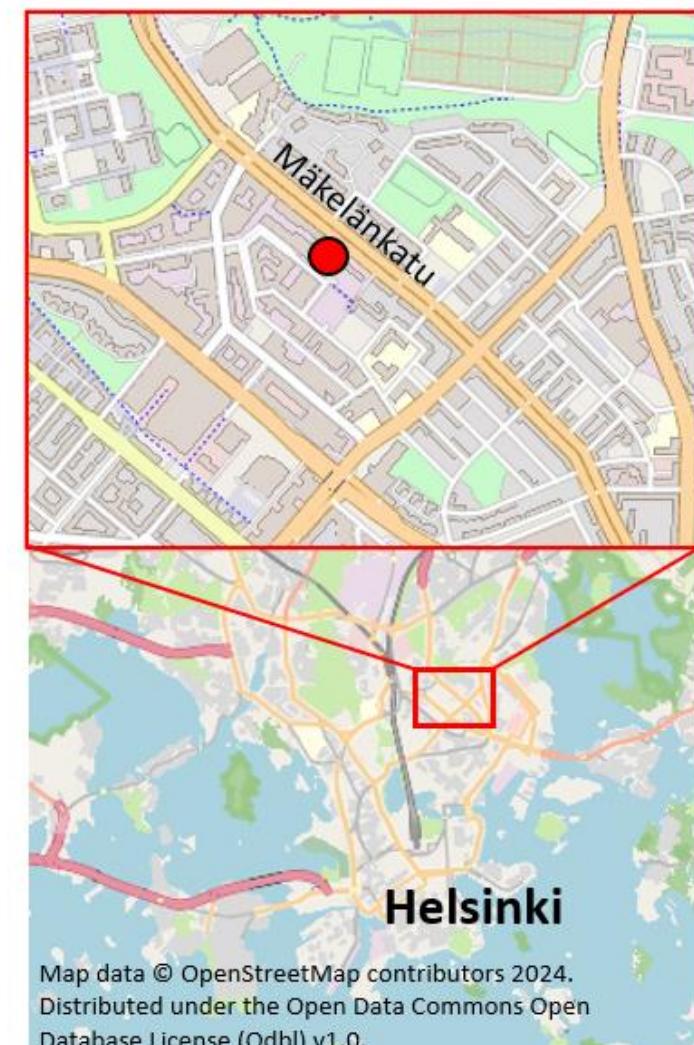
Figure S1: Measurement location in Helsinki (see also Teinilä et al. 2024)
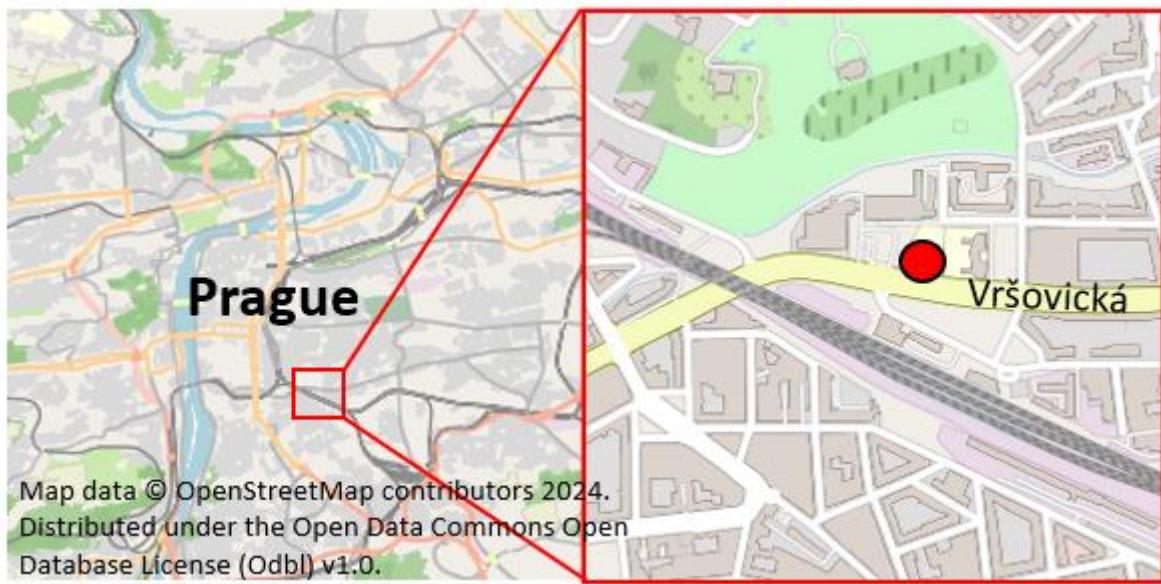
Figure S2: Measurement location in Prague (see also Lepistö et al. 2023)
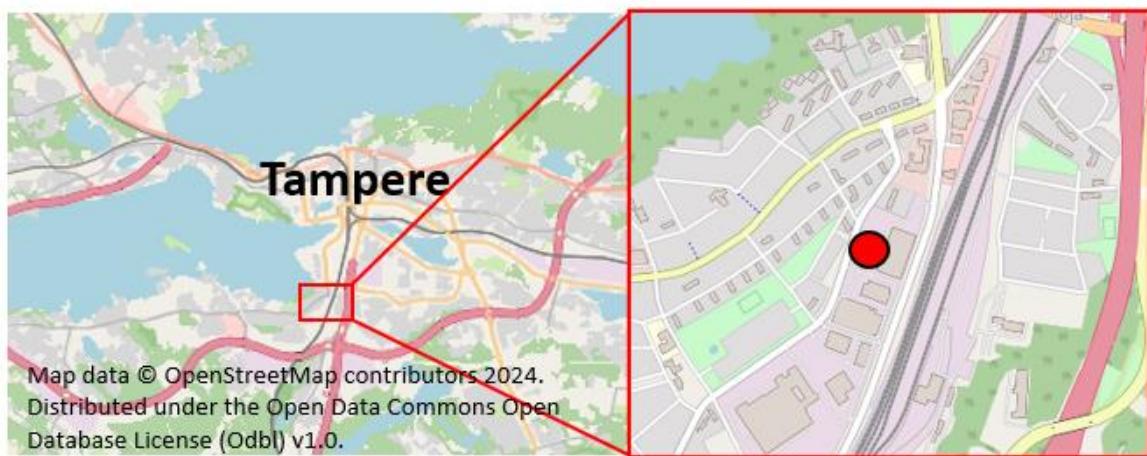
Figure S3: Measurement location in Tampere (see also Silvonen et al. 2023)
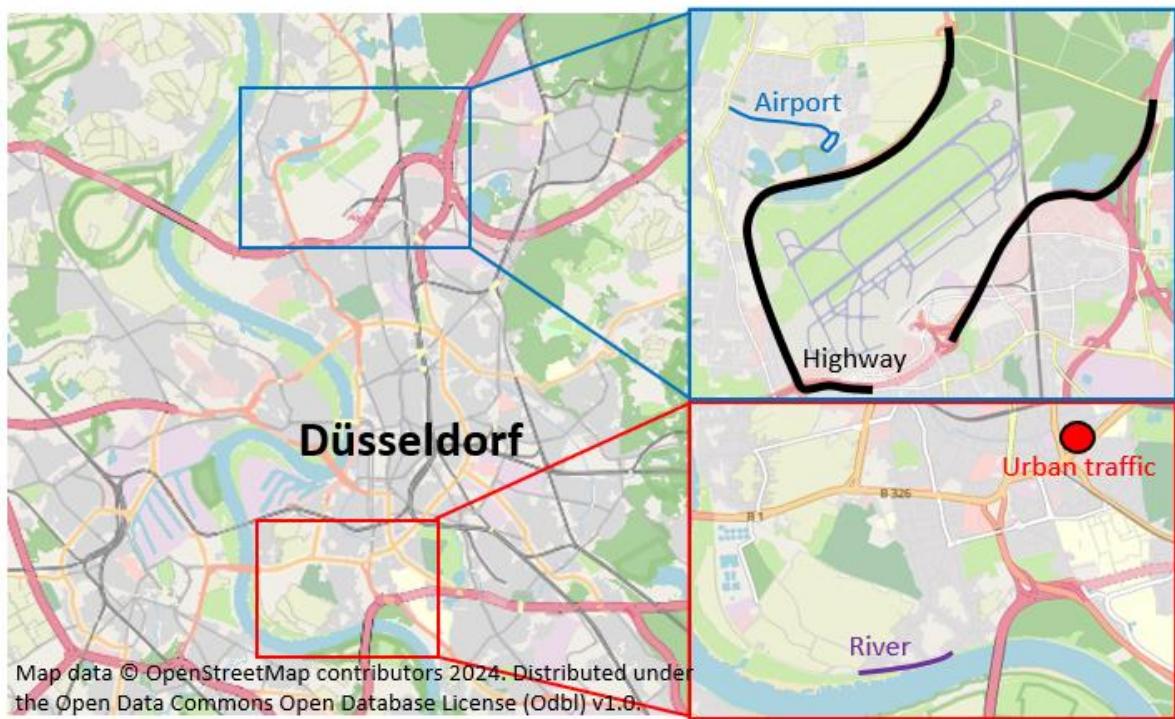
Figure S4: Measurement locations in Düsseldorf. Black and purple lines indicate driving measurements (see also Lepistö et al. 2023).

Particle effective density
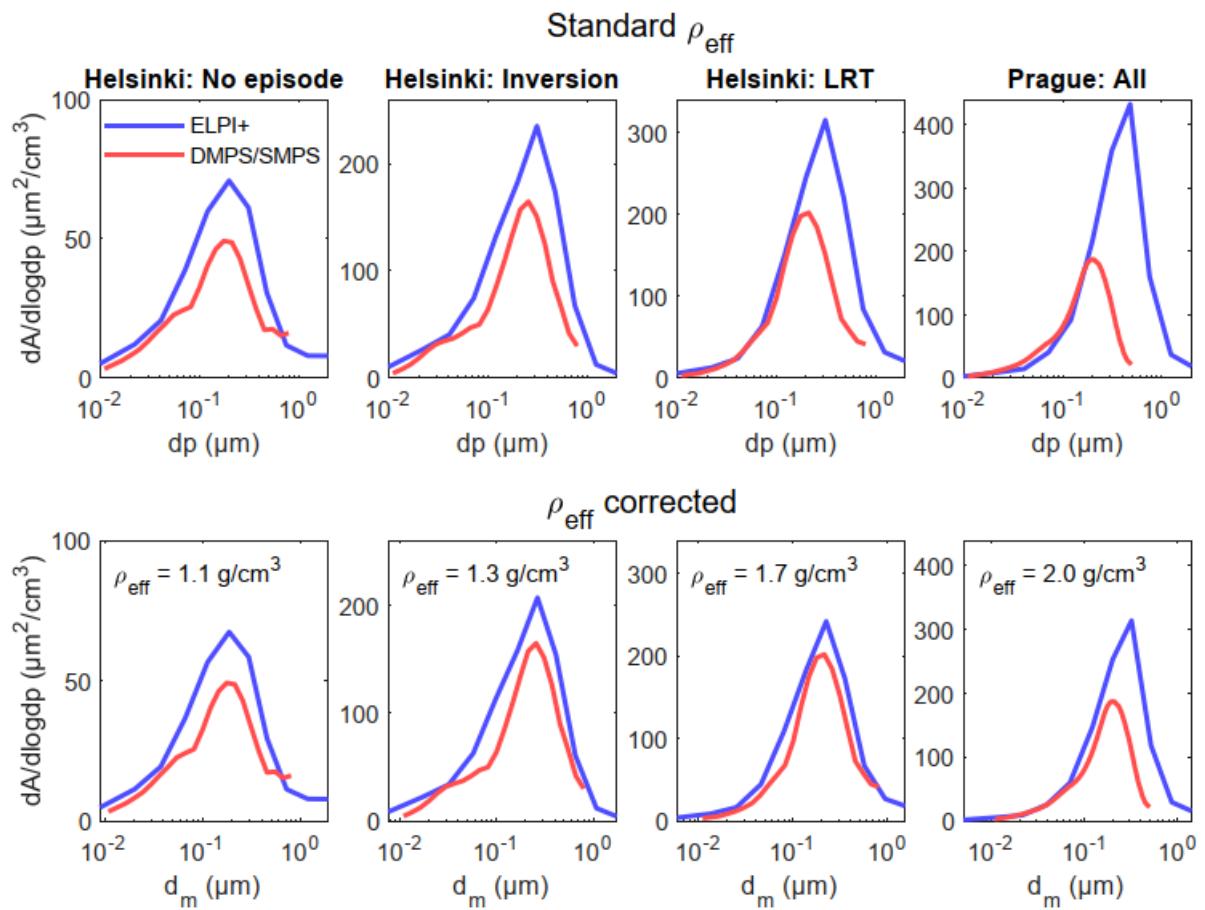
Figure S5: Average particle surface area size distributions measured with the ELPI+, DMPS (Helsinki) and SMPS (Prague) during the studied periods with and without corrections for the particle effective density.
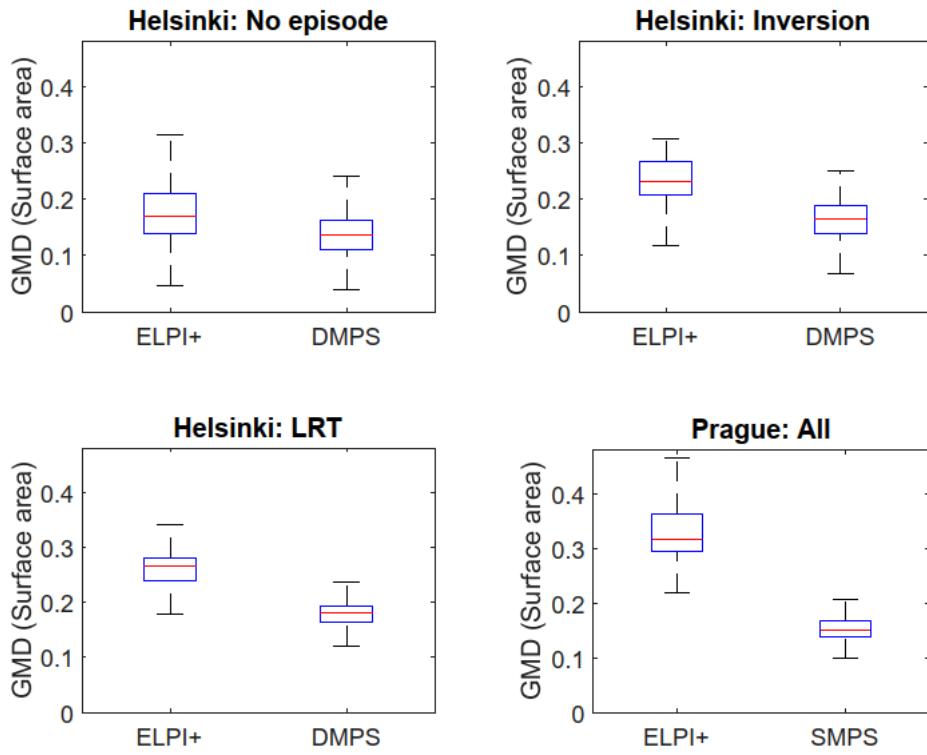
Figure S6: Boxplots of the measured geometric mean diameters of particle surface area size distributions with the ELPI+ (aerodynamic diameter) and DMPS or SMPS (mobility equivalent diameter).

Particle hygroscopicity and the lung deposition
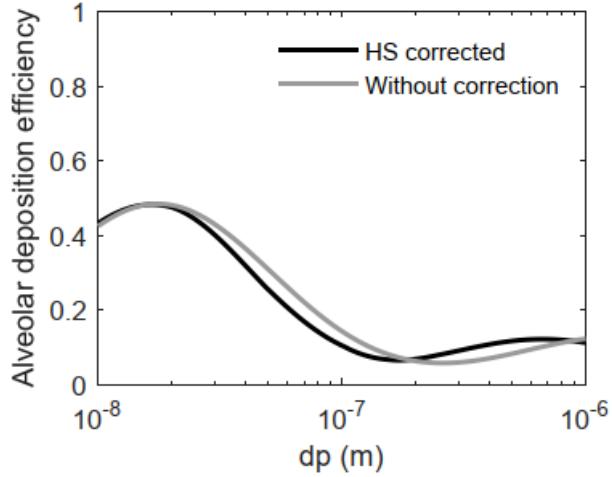
Figure S7: The utilised function of particle lung deposition efficiency (standard ρ_{eff}) in the lung alveoli with and without correction for the particle hygroscopicity (Vu et al. 2015) for road traffic environments.

Deviations of the measured concentrations
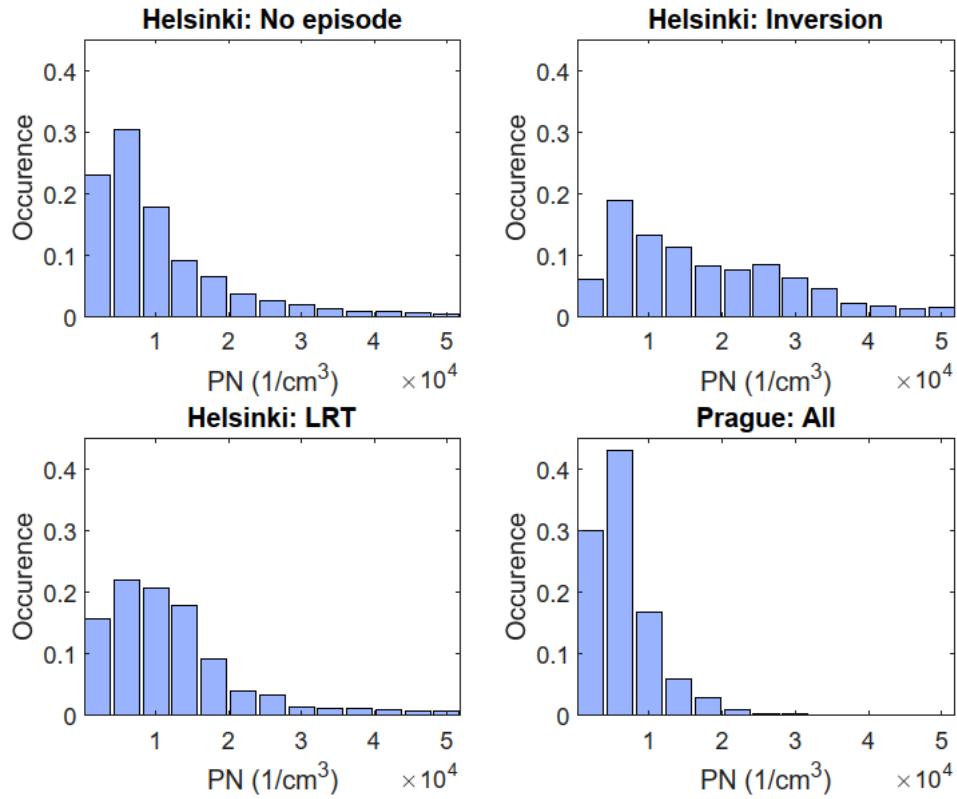
Figure S8: Deviation of the measured PN concentrations in Helsinki and Prague.
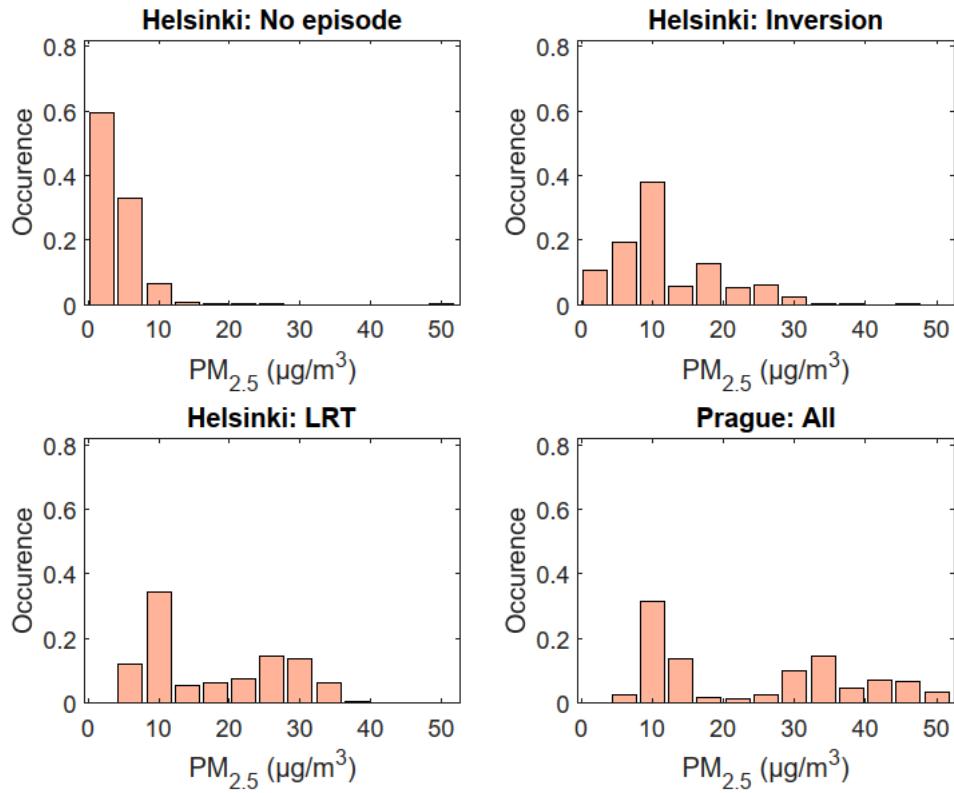
Figure S9: Deviation of the measured PM$_{2.5}$ concentrations in Helsinki and Prague measurements.
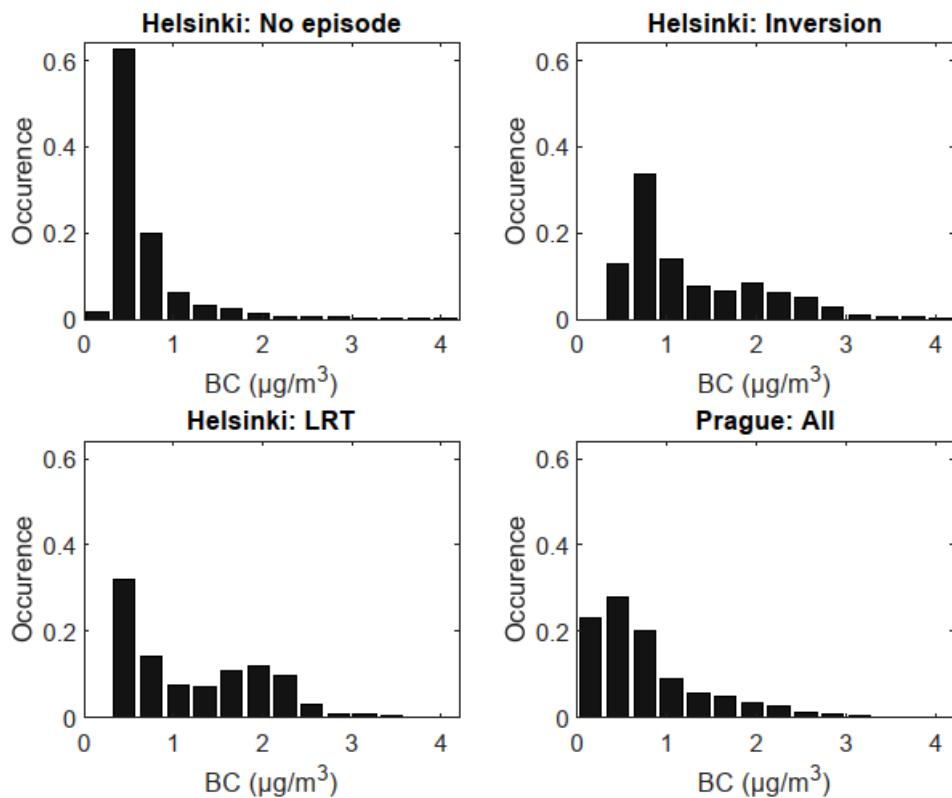
Figure S10: Deviation of the measured BC concentrations in Helsinki and Prague measurements.
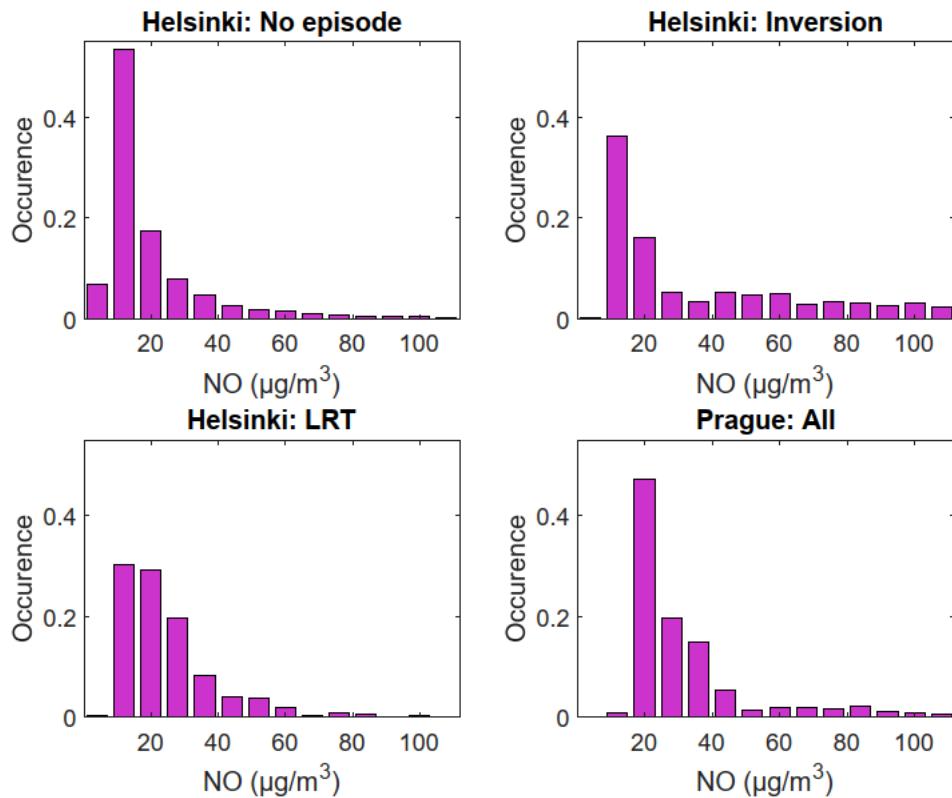
Figure S11: Deviation of the measured NO concentrations in Helsinki and Prague measurements.

Table S1: Data of the measured average LDSA[al] concentrations in Figures 1–6, including the 25th and 75th percentile whiskers. Note that Partector results cannot be corrected based on the particle effective density (ρ_{eff}) nor hygroscopicity.

Helsinki: No episodes, LDSA[al] ($\mu m^2/cm^3$)

	ELPI+	DMPS	Partector
General assumptions	*11.5 (6.9–17.7)*	*8.5 (5.0–13.7)*	
ρ_{eff}-corrected	*11.3 (6.8–17.4)*	*8.6 (5.0–13.8)*	10.5 (6.1–17.0)
ρ_{eff}- and hygroscopicity corrected	*10.2 (6.2–15.7)*	*8.2 (4.9–12.8)*	

Helsinki: Inversion, LDSA[al] ($\mu m^2/cm^3$)

	ELPI+	DMPS	Partector
General assumptions	*28.4 (16.3–53.9)*	*20.2 (11.1–39.3)*	
ρ_{eff}-corrected	*26.7 (15.3–51.9)*	*20.5 (11.2–39.9)*	24.7 (13.1–45.8)
ρ_{eff}- and hygroscopicity corrected	*26.5 (16.1–49.4)*	*20.7 (12.0–38.6)*	

Helsinki: LRT, LDSA[al] ($\mu m^2/cm^3$)

	ELPI+	DMPS	Partector
General assumptions	*26.9 (15.6–46.6)*	*18.6 (11.0–30.9)*	
ρ_{eff}-corrected	*24.7 (14.5–42.7)*	*19.5 (11.4–32.7)*	20.5 (11.5–34.1)
ρ_{eff}- and hygroscopicity corrected	*23.6 (12.8–44.8)*	*19.6 (11.0–34.4)*	

Prague: All, LDSA[al] ($\mu m^2/cm^3$)

	ELPI+	SMPS	Partector
General assumptions	*27.1 (15.6–42.3)*	*14.7 (9.5–20.5)*	
ρ_{eff}-corrected	*23.3 (13.6–35.7)*	*15.5 (9.9–21.7)*	18.1 (11.6–25.0)
ρ_{eff}- and hygroscopicity corrected	*24.7 (14.8–38.0)*	*15.0 (9.4–21.1)*	

Table S2: Data of Figure 8 and Figure S12 with 25th and 75th percentiles as well as Pearson correlation coefficients between LDSA[al] concentrations measured with the ELPI+ and Partector.

	ELPI+ LDSA[al] < 2.5 µm ($\mu m^2/cm^3$)	ELPI+ LDSA[al] < 0.4 µm ($\mu m^2/cm^3$)	Partector LDSA[al] ($\mu m^2/cm^3$)	ELPI+ PN ($1/cm^3$)	ELPI+ PM$_{2.5}$ ($\mu g/m^3$)	R^2 (LDSA[al] ELPI+ vs. Partector)
Helsinki: No episode	11.5 (6.9–17.7)	9.8 (5.7–16.0)	10.5 (6.1–17.0)	7 700 (4 100–13 700)	3.4 (2.3–5.2)	0.98
Helsinki: Inversion	28.4 (16.3–53.9)	22.9 (11.9–45.3)	24.7 (13.1–45.8)	16 200 (8 100–29 200)	9.9 (7.2–16.6)	0.99
Helsinki: LRT	26.9 (15.6–46.6)	19.1 (11.1–31.2)	20.5 (11.5–34.1)	9 700 (5 600–15 500)	15.4 (9.5–26.8)	0.98
Prague: All	27.1 (15.6–42.3)	14.0 (9.2–19.4)	18.1 (11.6–25.0)	5 700 (3 700–8 100)	20.2 (11.1–35.3)	0.92
Tampere: No episode	8.3 (4.7–13.9)	5.7 (3.2–9.6)	6.3 (3.6–10.3)	2 800 (1 400–5 900)	4.2 (2.4–8.2)	0.97
Tampere: Inversion	55.5 (40.6–86.9)	44.6 (31.4–68.9)	46.8 (33.9–71.9)	23 800 (16 700–34 500)	22.9 (16.2–38.0)	0.98
Düsseldorf: Urban traffic	31.8 (21.3–49.3)	18.8 (13.4–23.4)	21.0 (15.1–26.7)	12 700 (8 700–16 600)	20.7 (12.0–35.1)	0.98
Düsseldorf: Highway	36.6 (24.8–47.5)	27.2 (17.9–38.3)	30.8 (20.6–43.5)	28 900 (16 300–48 700)	17.1 (11.6–24.6)	0.95
Düsseldorf: Airport	34.2 (30.6–41.9)	24.4 (19.1–31.7)	27.4 (21.8–35.6)	26 400 (16 100–44 500)	16.9 (13.0–25.5)	0.95
Düsseldorf: River	33.0 (24.9–50.2)	17.6 (12.5–24.9)	20.8 (15.2–28.5)	11 700 (8 300–13 600)	24.6 (19.7–44.3)	0.98
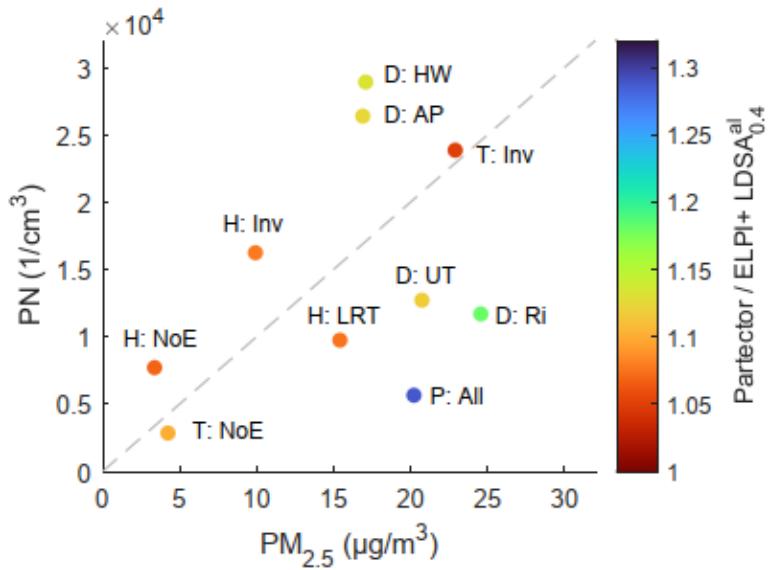
Figure S12: Comparison of LDSA^{al} concentrations measured with Partector and ELPI+ as a function of particle number (PN) and PM$_{2.5}$ concentration. With ELPI+ only particles smaller than 400 nm are considered (LDSA$^{al}_{0.4}$). Each dot represents individual measurements in different locations (Table S2).
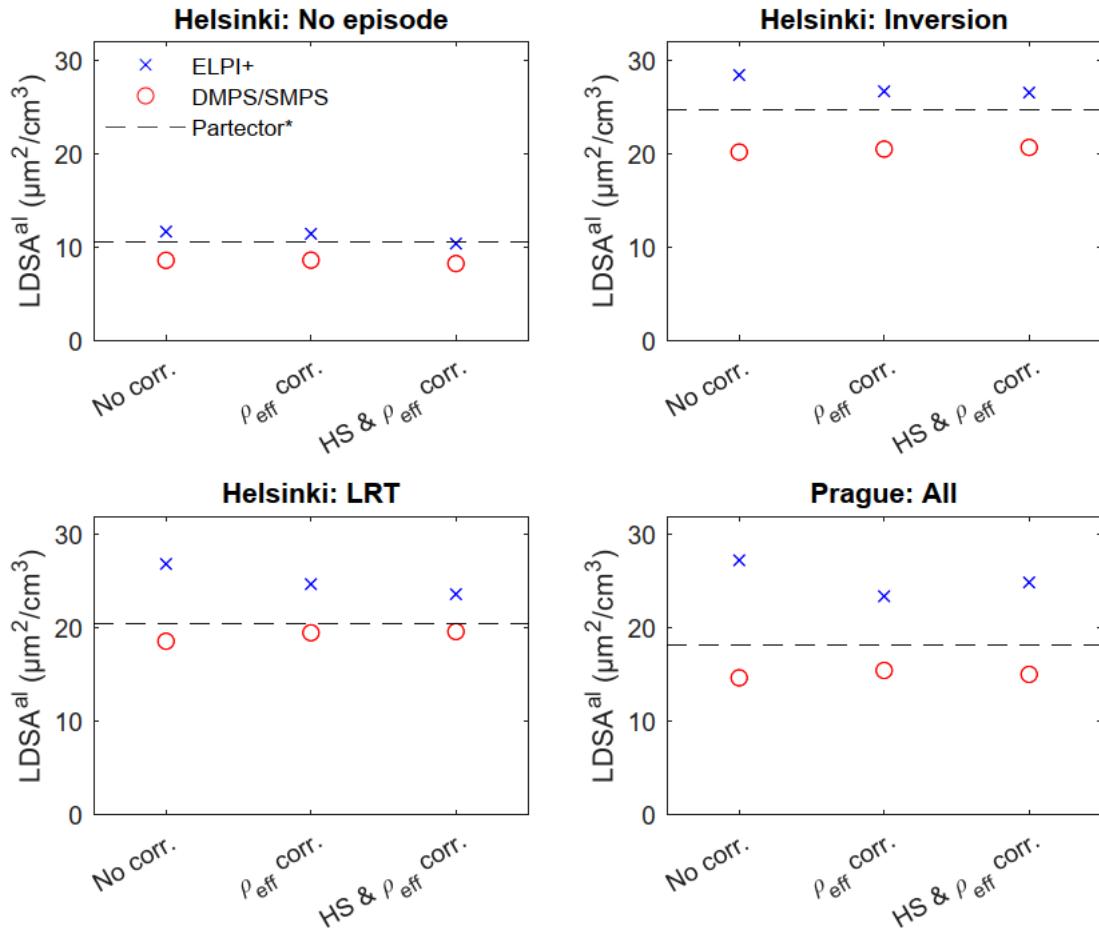
Figure S13: Comparison of average LDSA^{al} concentrations. "No corr." indicates data measured with the general assumptions, "ρ_{eff} corr." indicates data corrected with the effective density and "ρ_{eff} &HS corr." indicates data corrected with both effective density and hygroscopicity. The DMPS measured in Helsinki, and the SMPS in Prague. *Note that the corrections cannot be done with the Partector data.
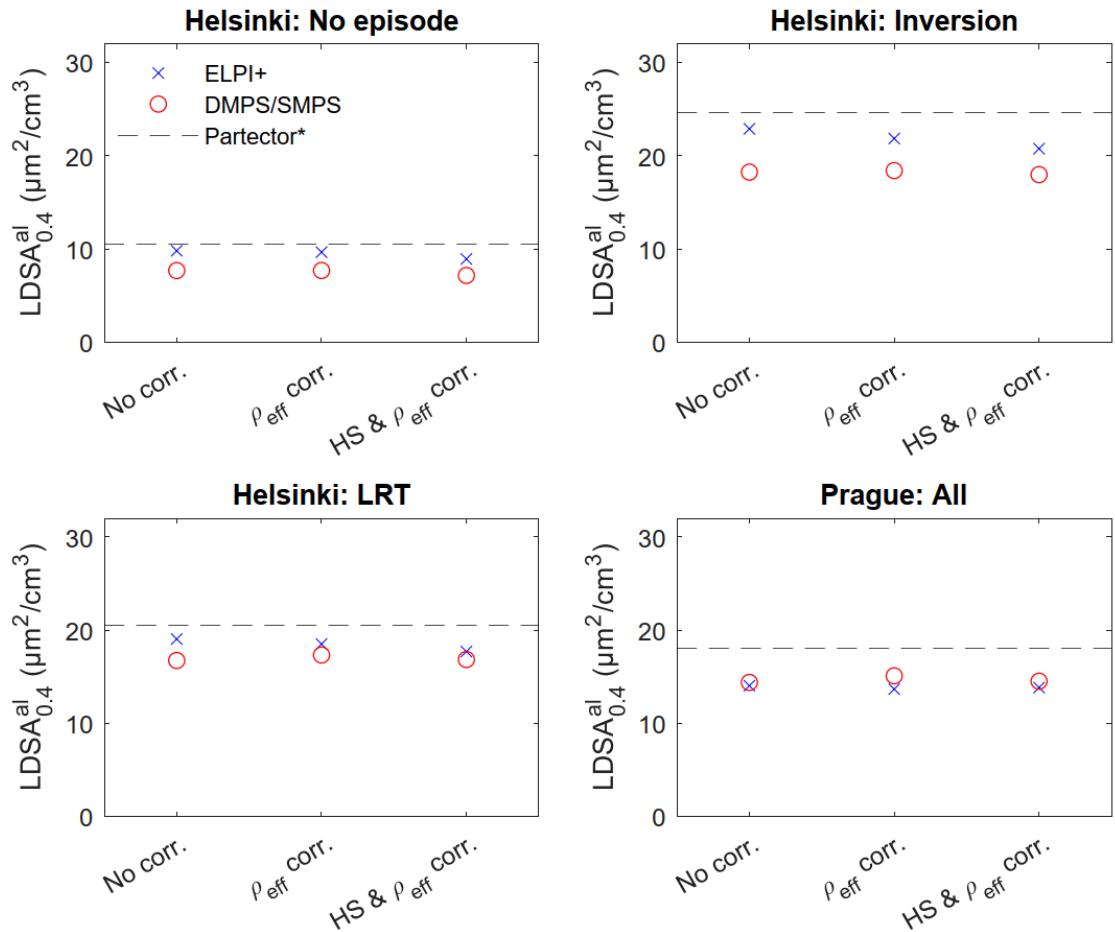
Figure S14: Comparison of average LDSA^{al} concentrations attributable to particles smaller than 400 nm. "No corr." indicates data measured with the general assumptions, "ρ_{eff} corr." indicates data corrected with the effective density and "ρ_{eff} &HS corr." indicates data corrected with both effective density and hygroscopicity. The DMPS measured in Helsinki, and the SMPS in Prague. *Note that the corrections cannot be done with the Partector data.