Supplementary Information

Performance evaluation of four cascade impactors for airborne UFP collection: Influence of particle type, concentration, mass and chemical nature

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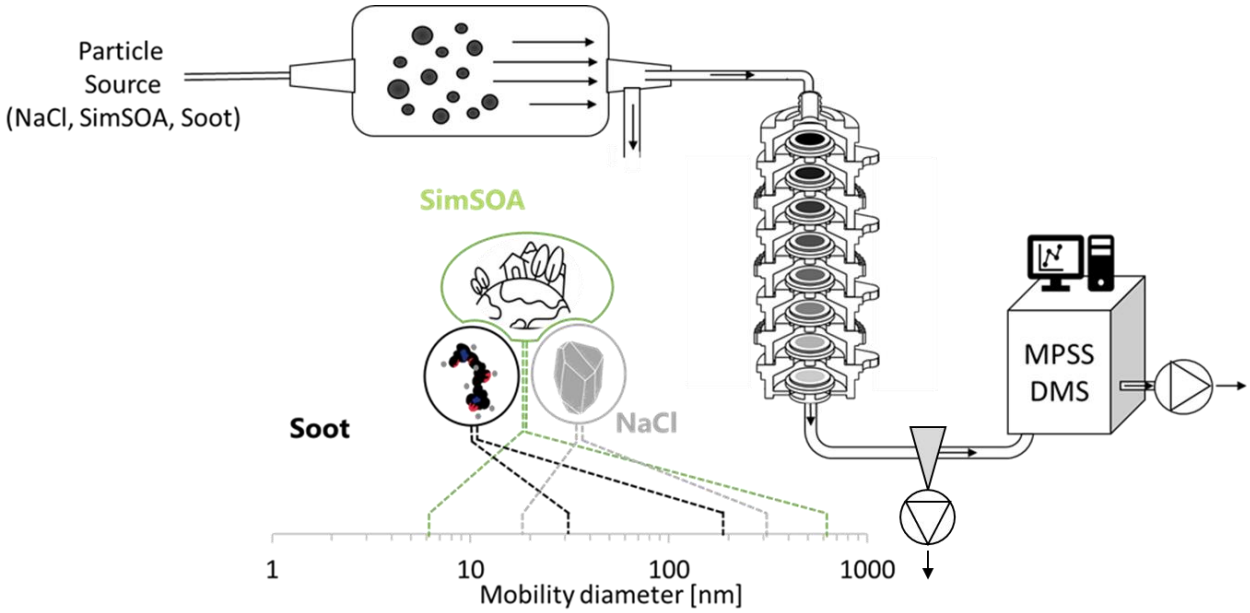

Figure S1: Schematic experimental setup used to evaluate the cut-off characteristics of various impactors, namely 120R MOUDI, ELPI, PENS, and ultraMOUDI. Three different types of particles were generated: (1) NaCl (produced by spraying a saline solution), (2) SimSOA (generated through a chamber experiment involving particle formation from alpha-pinene and ozone, including seed particles), and (3) soot (produced by a diesel engine) (Section 2.2.2). These particles were passed through the impactor (both with and without nozzles and impaction plates). The transmitted particle size distributions were measured downstream of the impactor using either a DMS500 or MPSS. Additionally, a pump was placed behind the impactor to regulate the flow through the impactor. An overview of the size distributions of each generated particle type is also provided.

Table S1: Overview of HPLC methods applied for mass based chemical analyisis applied on the environmental UFP samples.

Parameter	**HPLC-MS neg**	**HPLC-MS pos**	**HPLC-FLD**
Analytical column	Gemini 5u C18 110A (150 mm x 4.6 mm, 5 µm)	Gemini 5u C18 110A (150 mm x 4.6 mm, 5 µm)	EC 125/4 Nucleosil 100-5 C18 HD (125 mm x 4 mm, 5 µm)
Column temperature	40 °C	30 °C	30 °C
Injection volume	20 µL	20 µL	25 µL
Autosampler temperature	–	–	-5 °C
Flow rate	0.5 mL/min	0.3 - 0.5 mL/min	1 mL/min
Gradient	**A) 80% ACN, B) 4 mM HCOOH** 0 min 5% A 1 min 5% A 18 min 50% A 21 min 100% A 29 min 100% A 31 min 5% A	**A) 80%MeOH, B) 4 mM HCOOH** 0 min 50% A 3 min 80% A 12 min 100% A 18 min 90% A 20 min 50% A 25 min 75% A	**A) ACN, B) H_2O (Milli-pore)** 0 min 60% A 5 min 70% A 8 min 70% A 12 min 80% A 15 min 80% A 19 min 90% A 22 min 60% A
Detector	MSD **Time ESI(-)-m/z-ions** 0 min 207 8 min 111, 157, 171, 185 18 min 121, 135, 183 25 min 193, 217	MSD **Time ESI(+)-m/z-ions** 0 min 212, 227, 269 12 min 257, 261, 299	FLD **Time λ_{ex} / λ_{em} [nm]** 0 min 259 / 386 3.3 min 242 / 388 5.8 min 250 / 370 7.5 min 270 / 390 13 min 290 / 430

Table S2: Specifications regarding the different marker compounds that were analyzed and chosen for this study.

Marker	Method	Recovery	LOD_{Air} [pg/m^3]		External standard calculation	
			43.2 m^3	5.76 m^3	Response factor [AU/µg/L]	R^2
Levo	HPLC-MS neg	86 ± 9%	130.09	975.67	442.68	0.99
PA	HPLC-MS neg	84±6%	186.57	1399.28	4415.4	0.99
TA	HPLC-MS neg	85±6%,	171.76	1288.20	3352.9	0.99
6PPD	HPLC-MS pos	75±7%	40.17	301.26	26766	0.98
BaP	HPLC-FLD/UV	78±5%	1.62	12.15	10.116	1.00
BbF	HPLC-FLD/UV	74±4%	1.16	8.70	12.15	1.00

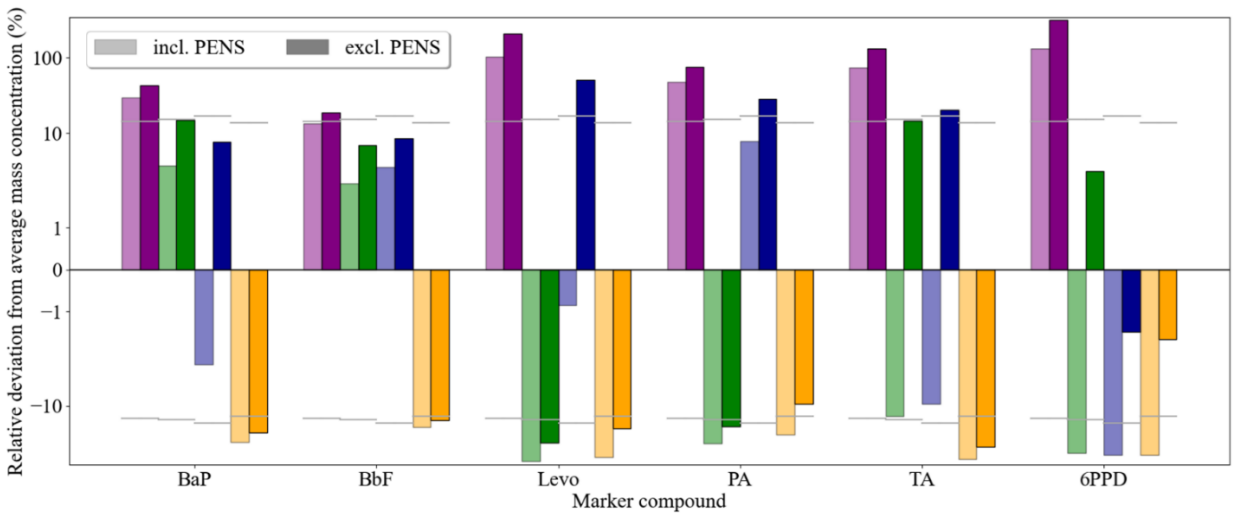

Figure S2: logarithmic representation of Fig. 6b.

1.1 Estimation of Impactor Uncertainties

To accurately assess the overall measurement uncertainty associated with the various impactors used in our study, we applied Gaussian error propagation. The overall chemical analysis error was 9% for all impactors. For the Ultra MOUDI impactor, in addition to the analysis error, the flow error was 10% and the handling error was increased to 10%. This adjustment leads to a total measurement uncertainty for the Ultra MOUDI of approximately 16.76%. The ELPI impactor had a flow error of 3% and an increased handling error of 15%, resulting in a total measurement uncertainty of around 17.75%. For the 120R MOUDI impactor, the flow error was 3% and the handling error was increased to 10%, leading to a total measurement uncertainty of approximately 13.78%. For the PENS impactor, the flow error was 5% and the handling error was increased to 10%, resulting in a total measurement uncertainty of approximately 14.35%.