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Vertical profiles of volatile organic compounds and fine particles in atmospheric air by using an aerial drone with miniaturized samplers and portable devices

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Supplemental Table S2. Repeatability studies for TENAX-GR-ITEX sampling system (i.e. within ITEX). Table includes all data points from repeatability series done by the lab-made autosampler. All values given for amines are reported as relative peak area per litre of sample. Each ITEX unit was run five times to get the repeatability value.

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Supplemental Table S7. Concentrations of nitrogen-containing compounds detected in gas and particle phases at mixed altitudes (50 – 400 m). Conversion from ng m^{-3} to ppt_v have been made using the conversion factor (ppt_v = Concentration (ng m^{-3}) : (0.0409 x (MW)).

Supplemental Table S8. Concentrations of other volatile organic compounds detected in gas and particle phases at mixed altitudes (50 – 400 m). Conversion from ng m^{-3} to ppt_v have been made using the conversion factor (ppt_v = Concentration (ng m^{-3}) : (0.0409 x (MW)).

Supplemental Table S9. Recoveries obtained for compounds collected by ITEX sampling system with filter accessory.

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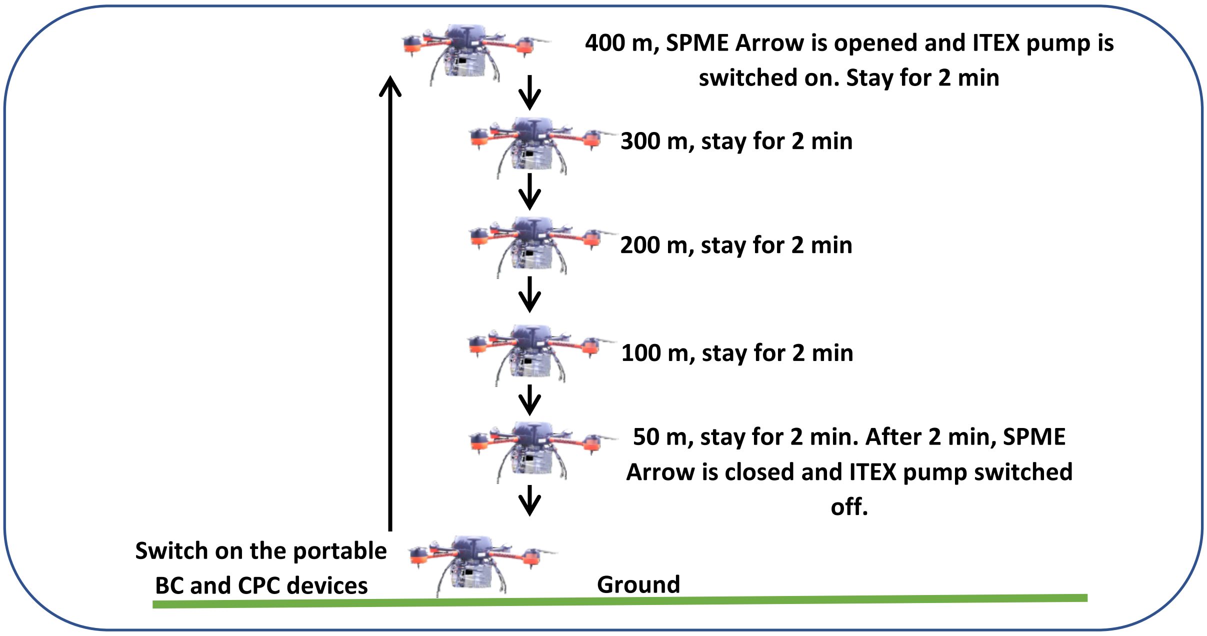
Supplemental Table S11. Two minutes average of black carbon (BC) and total particle concentrations measured at the altitudes of 100, 200, 300, and 400 m in three days measurement (9, 10, and 11 October 2021).

Supplemental Table S12. Daily average of black carbon (BC) and total particle concentrations measured at the altitudes of 100, 200, 300, and 400 m in three days measurement (9, 10, and 11 October 2021).

Supplemental information S1. Reagents and materials

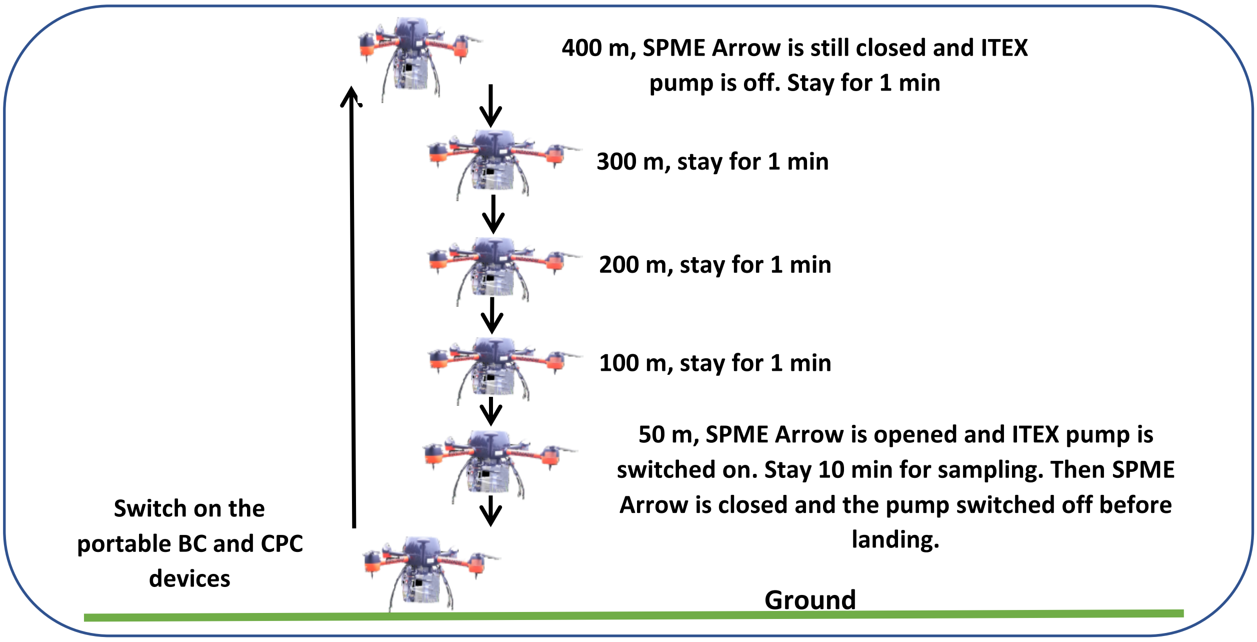
1-Butanamine (99%), 2-propen-1-amine (98%), 4-ketopimelic acid (98%), citric acid (≥99,5%), crotonic acid (98%), cis-pinonic acid (98%), decafluorobiphenyl (99%), ethylbenzene (99%), hexanal (98%), hexylamine (99%), isobutylamine (99%), N,N-dimethylformamide (≥99,9%), methyl isobutyl ketone (98.5%), p-cymene (99%), trimestic acid (95%), L-tartaric acid (99%), suberic acid (98%), and triphenyl phosphate (≥99%) were purchased from Sigma-Aldrich (St. Louis, MO, USA). Pyridine (~100%) and formic acid (99-100%) were purchased from VWR Chemicals (Fontenay-sous-Bois, France). 2,3-Butanedione (97%) and ethyl acetate (≥99.7%) were purchased from Sigma-Aldrich Chemie GmbH (Steinheim, Germany). 1-Butanenitrile (99%), 2-butanol (99.5%), acetic acid (≥99,8%), glutaric acid (≥99%), isobutanol (≥98.5%), phthalic acid (≥99.5%), and succinic acid (99%) were purchased from Merck KGaA (Darmstadt, Germany). Acetonitrile (≥99,9%) and methanol (≥99,9%) were purchased from Honeywell (USA). Ammonium carbonate (chem. Pure) was purchased from Riedel de Häen. Ammonium acetate (99.9 %) was purchased from Fisher Scientific. Azelaic acid (≥99%), benzaldehyde (≥99%), diethylamine (99%), fumaric acid (≥98%), glycolic acid (≥99%), maleic acid (≥99%), malonic acid (≥98%), sebaric acid (p.a.), and vanillic acid (≥97%) were purchased from Fluka AG (Switzerland). Adipic acid (≥99,9%) and mandelic acid (≥99,5%) were purchased from BDH Laboratory Reagent. Acetophenone was from The British Drug Houses Ltd. (Poole, England). Trimethylamine filled Dynacal Permeation Tube (type HE-XLT2) was from VICI Metronics Inc., (Poulsbo, USA).

Supplemental Figure S1



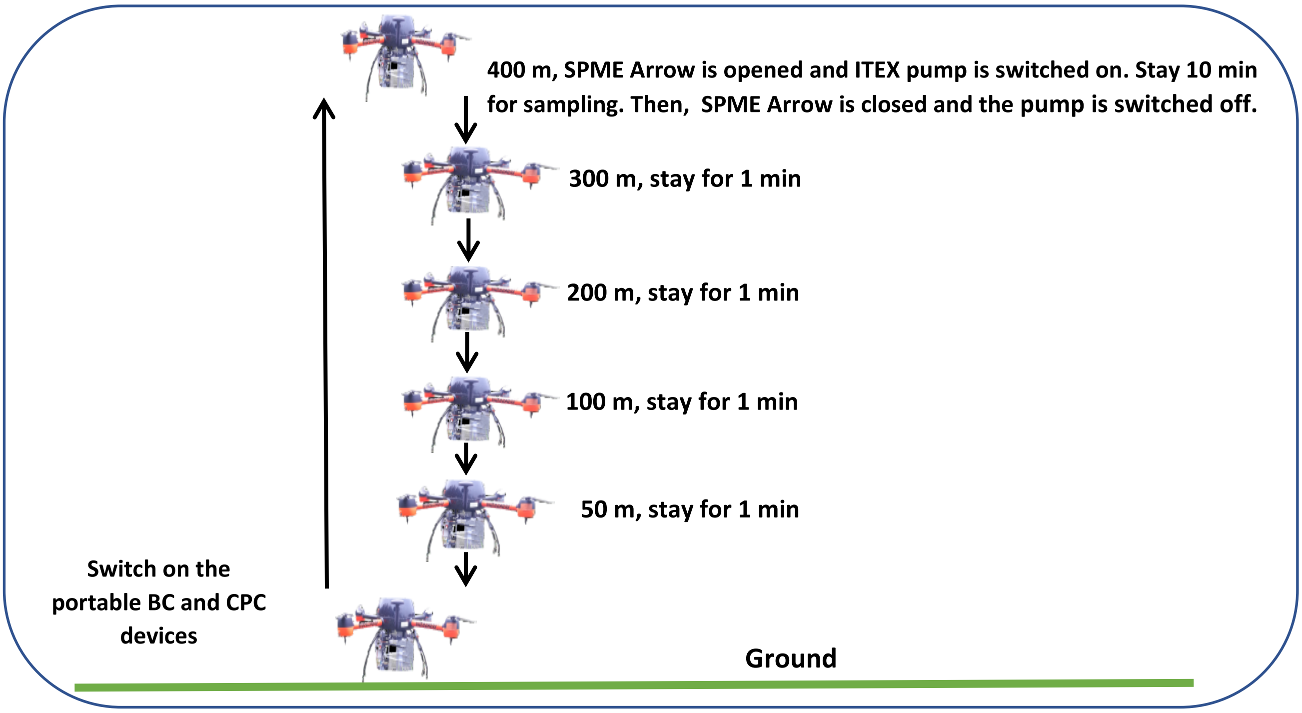
The schematic of sample collection using SPME Arrow and ITEX from mixed altitudes (from 50 to 400 m). During the flight of the drone, the portable BC monitor and CPC devices were carried out measurements.

Supplemental Figure S2



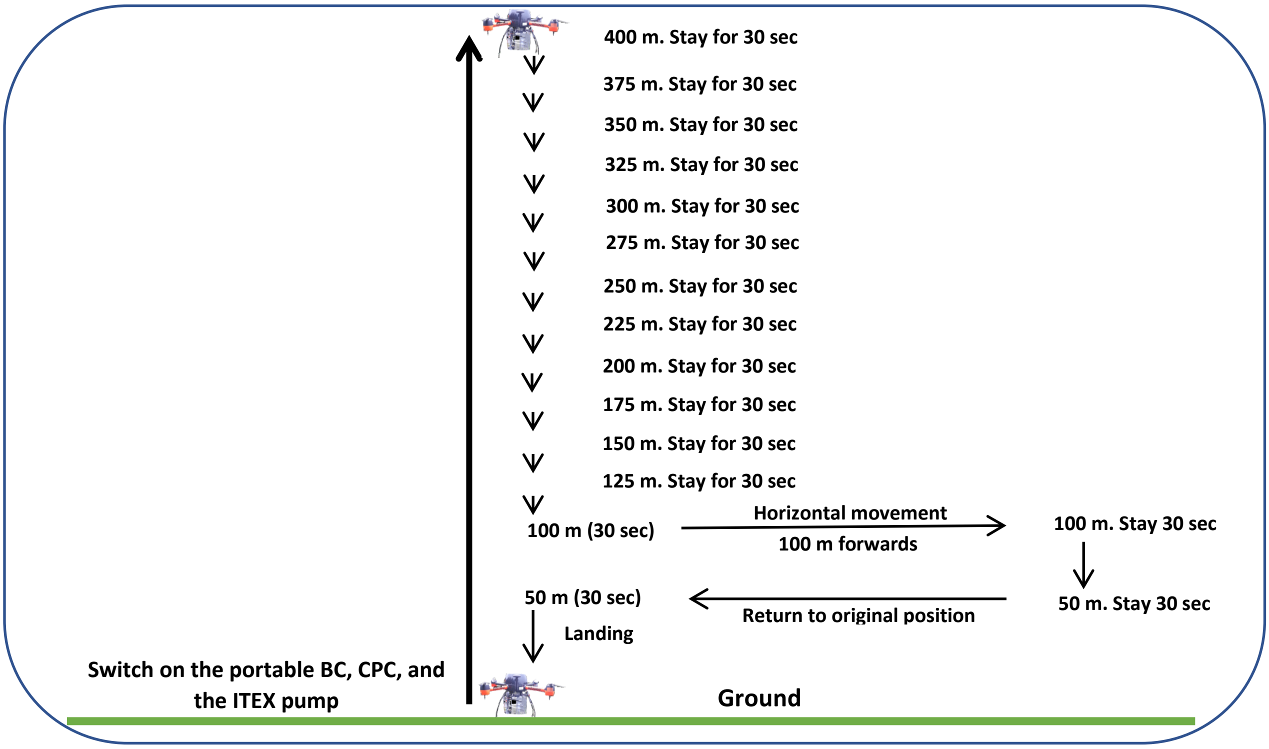
The schematic of sample collection using ITEX and SPME Arrow at the altitude of 50 m. During the flight of the drone, the portable BC monitor and CPC devices were carried out measurements.

Supplemental Figure S3



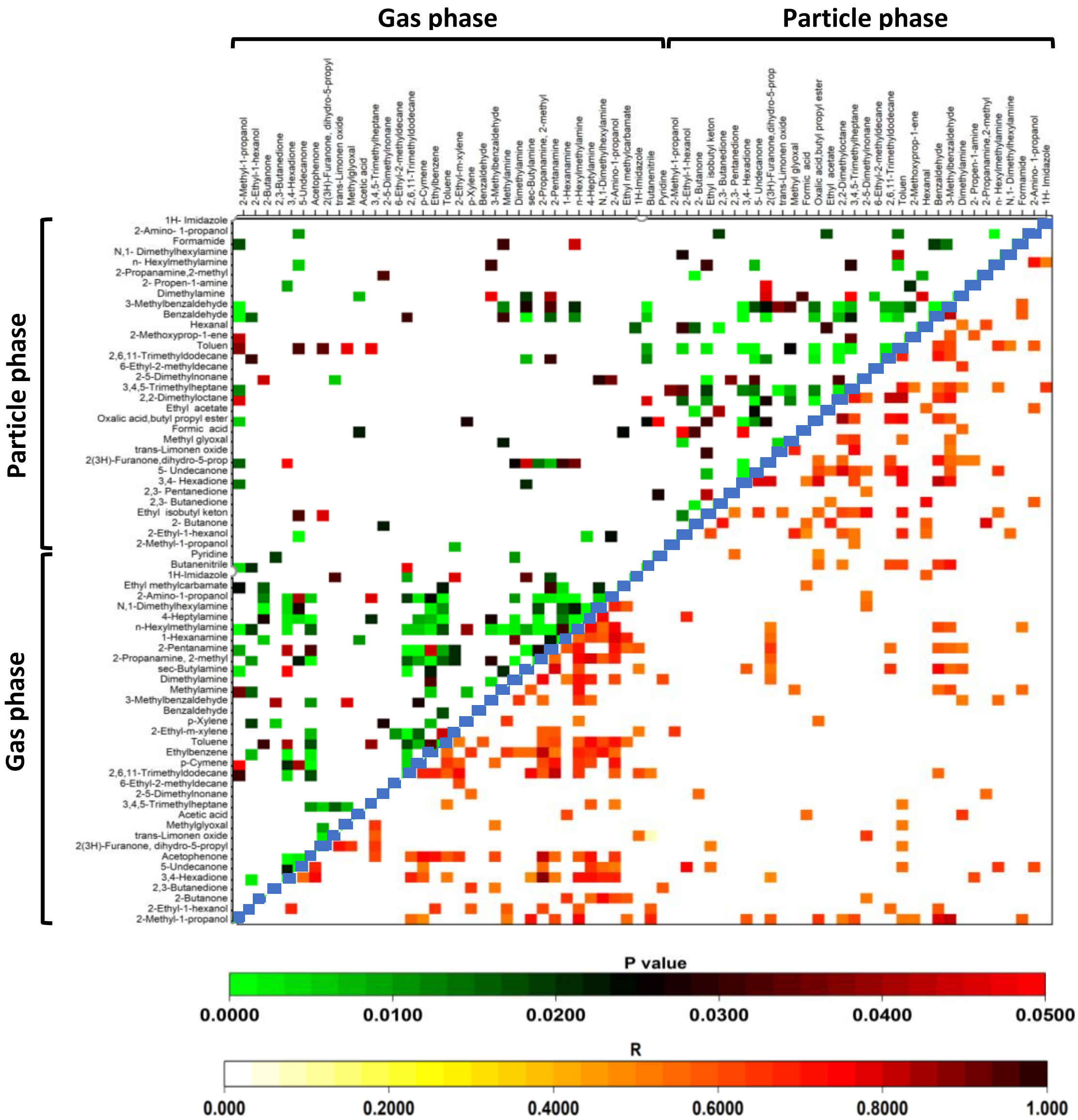
The schematic of sample collection using ITEX and SPME Arrow sampling systems at the altitude of 400 m. During the flight of the drone, the portable BC monitor and CPC devices were carried out measurements.

Supplemental Figure S4



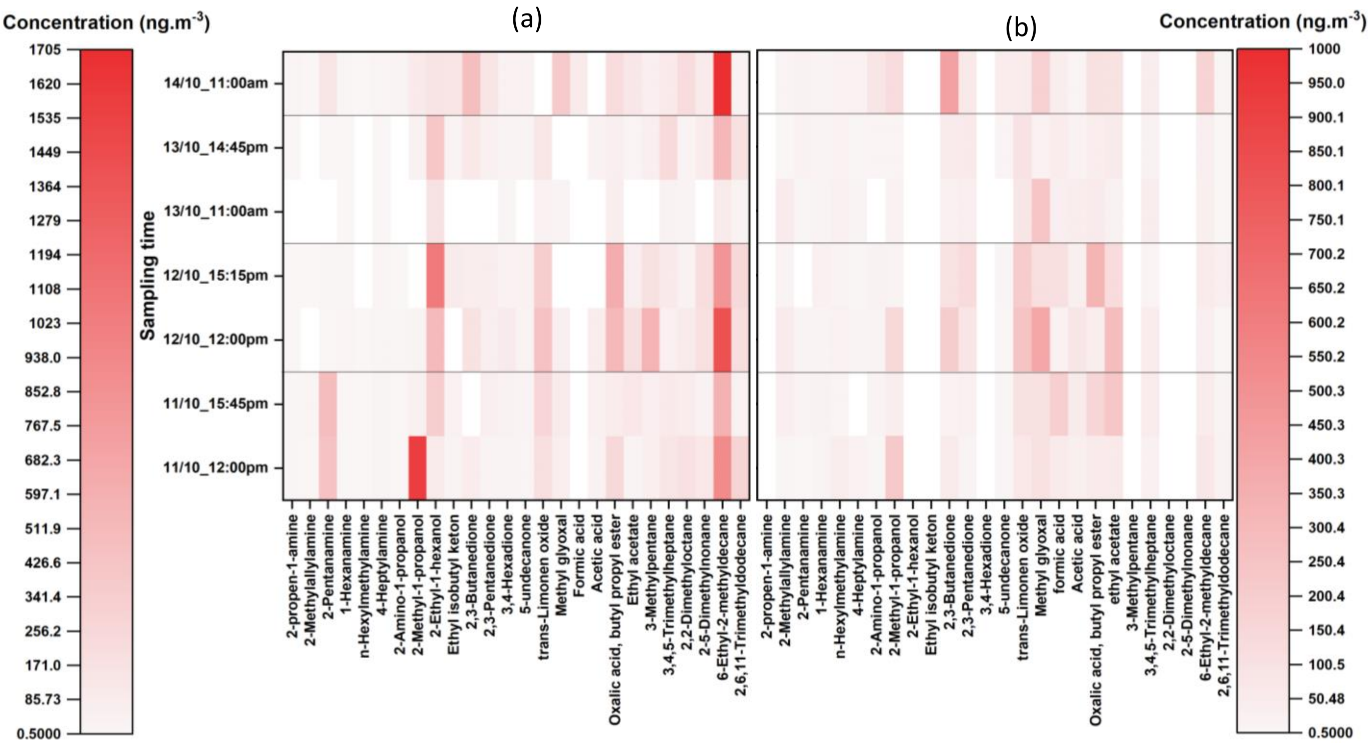
The schematic of sample collection, specifically those of aerosol particles, using ITEX with filter accessories, during horizontal and vertical concentration gradients. During the flight of the drone, the portable BC monitor and CPC devices were carried out measurements.

Supplemental Figure S5



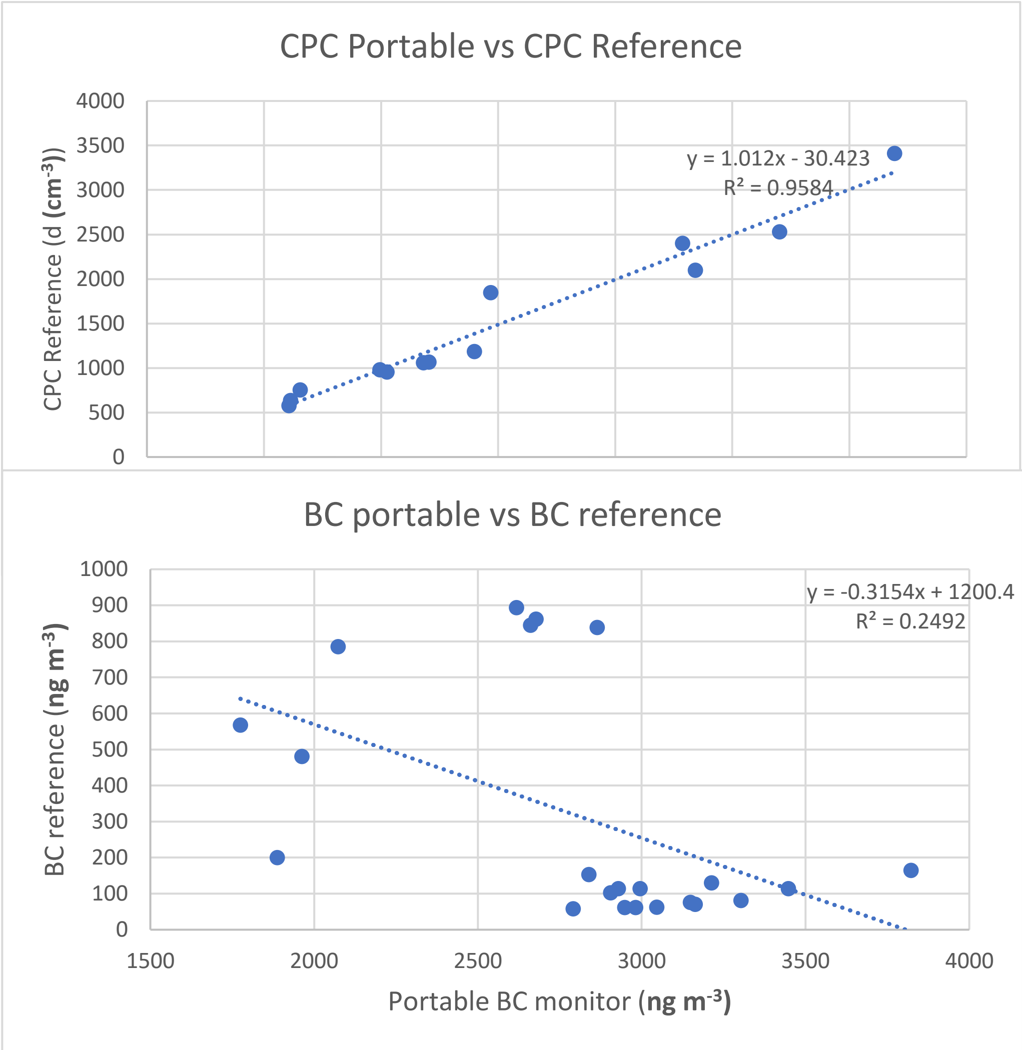
Correlation of VOCs detected at the SMEAR II Station at the mixed altitudes from 50 to 400 m.

Supplemental Figure S6



Evaluation of ITEX filter accessories in collecting gas phase. The gaseous samples were collected using (a) TENAX-GR-ITEX system with filter accessories and (b) CWR-SPME-Arrow system at the altitudes from 50 to 400 m. White color represents that compound was not detected.

Supplemental Figure S7



The comparison studies of portable CPC and portable BC monitor located in the drone with their reference instruments.

Supplementary Table S1

The average of ambient pressures and temperatures at certain altitudes between 9 to 11 October 2021 at SMEAR II Station, Hyytiälä. Ambient temperatures were measured by a sensor attached in the drone box (Figure 1d in main article).

Altitude (m)	P_0 (Pa)	P_1 (Pa)	T_0 (K)	T_1 (ºC)	T_1 (K)	[a] Correction factor
400 m	101325	96493	293	7.8	280.8	0.994
375 m	101325	96791	293	7.9	280.9	0.996
365 m	101325	96909	293	7.9	280.9	0.998
350 m	101325	97088	293	7.9	280.9	0.999
325 m	101325	97386	293	7.9	280.9	1.002
300 m	101325	97685	293	8.0	281.0	1.005
275 m	101325	97986	293	8.1	281.1	1.008
250 m	101325	98287	293	8.2	281.2	1.011
225 m	101325	98588	293	8.3	281.3	1.013
200 m	101325	98893	293	8.7	281.7	1.015
175 m	101325	99195	293	8.8	281.8	1.018
150 m	101325	99497	293	8.8	281.8	1.021
125 m	101325	99800	293	8.9	281.9	1.024
100 m	101325	100105	293	9.3	282.3	1.025
50 m	101325	100714	293	9.6	282.6	1.030
0 m	101325	101325	293	10.2	283.2	1.035
[b]Mixed alt	101325	98465	293	8.4	281.4	1.012

*P_0 = standard atmospheric pressure (101.3 kPa)
*P_1 = Average of ambient atmospheric pressure at certain altitude
*T_0 = standard temperature (293 K)
*T_1 = Average of ambient temperature at certain altitude
*a = Calculated correction factor at certain altitude, consider different temperature and pressure.
*b = Mixed altitudes (from 50 m to 400 m).

Supplementary Table S2.

Repeatability studies for TENAX-GR-ITEX sampling system (i.e. within ITEX). Table includes all data points from repeatability series done by the lab-made autosampler. All values given for amines are reported as relative peak area per litre of sample. Each ITEX unit was run five times to get the repeatability value.

ITEX (Repetition)	**#1**	**#2**	**#3**	**#4**	**#5**	**Avg (SD)**	**Avg (RSD)**
Model Compounds	**Avg**	**Avg**	**Avg**	**Avg**	**Avg**		
2-Propen-1-amine	4.4	4	3.8	4.4	4.2	0.1	3.5
Diethylamine	2.3	2.5	2.4	2.6	2.6	0.2	7.1
Isobutylamine	7.2	6.5	6.3	7	6.7	0.2	3.5
1-Hexanamine	14.1	11.8	11.6	13.9	13.4	0.4	3.5
Triethylamine	48.7	43.7	42.8	43.7	42.6	1.5	3.4
1-Nitropropane	0.3	0.2	0.2	0.3	0.3	0	5.8
Pyridine	8.5	7.7	7.5	8.1	7.9	0.3	3.7
Dipropylamine	28.9	25.9	25.3	26.6	25.6	0.9	3.7

*Avg = Average
*SD = Standard deviation
*RSD = Relative standard deviation

Supplementary Table S3.

Reproducibility between ITEX units used in injections by lab-made autosampler.

Model Compounds	**ITEX (repetition)**					**Avg 1-5**	**SD**	**RSD**
	#1	**#2**	**#3**	**#4**	**#5**			
2-Propen-1-amine	4.4	4	3.8	4.4	4.2	4.2	0.2	5.6
Diethylamine	2.3	2.5	2.4	2.6	2.6	2.5	0.1	4.7
Isobutylamine	7.2	6.5	6.3	7	6.7	6.7	0.3	4.8
1-Hexanamine	14.1	11.8	11.6	13.9	13.4	13	1.1	8.1
Triethylamine	48.7	43.7	42.8	43.7	42.6	44.3	2.2	5.1
1-Nitropropane	0.3	0.2	0.2	0.3	0.3	0.3	0	18.8
Pyridine	8.5	7.7	7.5	8.1	7.9	7.9	0.3	4.3
Dipropylamine	28.9	25.9	25.3	26.6	25.6	26.5	1.3	4.9

*Avg = Average
*SD = Standard deviation
*RSD = Relative standard deviation

Supplementary Table S4.

The tested compositions of the HILIC-MS/MS eluent.

Eluent combination	Solvent A	Solvent B	pH of Solvent B
A	ACN (75 %)	100 mM $(NH_4)_2CO_3$ (25 %)	8*
B	ACN (75 %)	32 mM CH_3COONH_4 (25 %)	4.99
C	ACN (80 %)	0.05 % FA (20 %)	2.75
D	ACN (80 %)	0.05 % AA (20 %)	3.36

*Assessed with pH paper
* ACN = Acetonitrile; FA = Formic acid; AA=Acetic acid

Supplementary Table S5.

Established MRM method parameters for each compound. Based on the product ion scans, the optimal collision energy (CE) was determined for the compounds to obtain maximum response to the most abundant product ion

Compound	Precursor (m/z)	Product (m/z)	Fragmentor (V)	CE (V)	CAV (V)
Triphenyl phosphate	327	77*	150	45	3
		168	150	45	3
cis-Pinonic acid	183	69	100	10	6
Sebacic acid	201	139	100	15	6
Azelaic acid	187	125	100	15	6
Vanillic acid	167	152	100	10	8
Suberic acid	173	111	100	15	1
Mandelic acid	151	107	80	10	1
Adipic acid	145	101	80	15	1
Glutaric acid	131	87	80	10	4
Pyruvic acid	87	N/A	40	0	8
4-Ketopimelic acid	173	155	80	10	1
Glycolic acid	75	N/A	40	0	8
Succinic acid	117	73	60	10	5
Fumaric acid	115	71	40	10	6
Benzoic acid	121	77	100	10	5
Phthalic acid	165	77	80	15	1
Maleic acid	115	71	40	10	0
Trimesic acid	209	165	100	10	6
2-Oxoglutaric acid	145	101	60	5	0
Malonic acid	103	N/A	60	0	0

* Set as quantifier
*CE = Collision energy; CAV = Cell acceleration voltage

Supplementary Table S6.

The calculated LOQs for results achieved by ITEX and SPME Arrow systems.

LOQ	SPME Arrow			ITEX	
	CWR (µg/m3)	DVB/PDMS (µg/m3)	MCM-41 (µg/m3)	Tenax-GR (ng)	MCM-41-TP (ng)
Pyridine	0.066	0.429	0.195	0.186	0.240
Sec-butylamine	0.053	0.019	0.011	1.157	0.025
1-Butanamine	0.209	0.118	0.193	0.431	0.217
1-Butanenitrile	1.171	1.841	1.558	1.776	1.575
1-Propen-1-amine	0.291	2.177	0.019	0.596	0.108
Diethylamine	0.154	0.012	0.271	0.623	0.977
Dimethylformamide	0.220	0.400	0.130	0.791	0.484
Trimethylamine	1.380	0.182	0.096	0.259	0.086
Ethyl acetate	0.705	0.429	0.775	0.676	0.330
Isobutanol	1.114	1.510	0.598	0.003	0.202
Methyl isobutyl ketone	0.105	0.065	0.125	0.175	0.094
Hexanal	0.185	0.061	0.111	0.221	0.050
Nonane	1.006	0.162	1.485	3.236	1.415
2,3-Butanedione	0.034	-	0.144	0.162	2.624
Benzaldehyde	0.031	0.043	0.168	0.080	0.440
Acetophenone	1.611	0.006	0.550	0.113	0.058
p-Cymene	0.571	0.094	1.777	3.021	0.497
Ethylbenzene	0.877	0.362	4.651	11.752	4.324

*LOQ = Limit of quantification
*SPME Arrow = Solid-phase micro extraction arrow
*ITEX = in-tube extraction

Supplementary Table S7

Concentrations of nitrogen-containing compounds detected in gas and particle phases at mixed altitudes (50 – 400 m). Conversion from ng m^{-3} to ppt_v have been made using the conversion factor (ppt_v = Concentration (ng m^{-3}) : (0.0409 x (MW)). (Finlayson-Pitts and Pitts, James N., 2000)

Compound	Mr	Concentration in Gas-phase		Concentration in Particle-phase	
		(ng m^{-3})	(pptv)	(ng m^{-3})	(pptv)
Methylamine	31.1	≤ 431.6	≤ 339.31	≤ 212.1	≤ 166.7
Dimethylamine	45.1	≤ 1004.4	≤ 544.5	≤ 5908.9	≤ 3203.3
sec-Butylamine	73.1	≤ 156.3	≤ 52.2	≤ 4089.6	≤ 1367.8
2-Propen-1-amine	57.1	≤ 30.0	≤ 12.8	≤ 134.1	≤ 57.4
2-Propanamine, 2-methyl	73.1	≤ 196.2	≤ 65.6	≤ 238.8	≤ 79.8
1-Butanamine	73.1	≤ 388.9	≤ 130.0	≤ 711.4	≤ 237.9
2-Pentanamine	87.2	≤ 395.4	≤ 110.8	≤ 211.1	≤ 59.1
1-Hexanamine	101.2	≤ 493.3	≤ 119.1	≤ 4315.6	≤ 1042.6
n-Hexylmethylamine	115.2	≤ 340.2	≤ 72.2	≤ 573.2	≤ 121.6
4-Heptylamine	115.2	≤ 257.3	≤ 54.6	≤ 189.9	≤ 40.3
N,1-Dimethylhexylamine	129.2	≤1239.6	≤ 234.5	≤ 686.3	≤ 129.8
Formamide	45.0	≤ 396.5	≤ 215.4	-	-
2-Amino-1-propanol	75.1	≤ 789.9	≤ 257.1	≤ 129.0	≤ 42.0
Ethyl methylcarbamate	103.1	≤ 81.3	≤ 19.2	≤ 125.9	≤ 29.8
2-Propenamide	71.1	≤ 94.5	≤ 32.5	-	-
1H-Imidazole	68.1	≤ 136.1	≤ 48.8	≤ 645.5	≤ 231.7
Butanenitrile	69.1	≤ 2005.0	≤ 709.4	≤ 6121.6	≤ 2166.0
Pyridine	79.1	≤ 491.5	≤ 151.9	≤ 958.2	≤ 296.1

*Mr = Molecular weight (g/mol)

Supplementary Table S8

Concentrations of other volatile organic compounds detected in gas and particle phases at mixed altitudes (50 – 400 m). Conversion from ng m^{-3} to ppt_v have been made using the conversion factor (ppt_v = Concentration (ng m^{-3}) : (0.0409 x (MW)). (Finlayson-Pitts and Pitts, James N., 2000)

Compound	Mr	Concentration in Gas-phase		Concentration in Particle-phase	
		(ng m^{-3})	(pptv)	(ng m^{-3})	(pptv)
2-Methyl-1-propanol	74.1	≤ 4208.6	≤ 1388.6	≤ 1064.7	≤ 351.3
2-Ethyl-1-hexanol	130.1	< LOQ	< LOQ	≤ 4114.1	≤ 773.1
2-Butanone	72.1	≤ 218.9	≤ 74.2	≤ 2598.7	≤ 881.2
Ethyl isobutyl keton	114.2	< LOQ	< LOQ	≤ 806.1	≤ 172.5
2,3-Butanedione	86.1	≤ 2436.1	691.7	≤ 4865.3	≤ 1381.6
2,3-Pentanedione	100.1	≤ 483.2	118.0	≤ 2352.4	≤ 574.5
3,4-Hexadione	114.1	< LOQ	< LOQ	≤ 4871.9	≤ 1043.9
5-Undecanone	170.3	< LOQ	< LOQ	≤ 900.8	≤ 129.3
2(3H)-Furanone, dihydro-5-propyl	128.2	≤ 354.2	≤ 67.5	≤ 1829.0	≤ 348.8
trans-Limonen oxide	152.2	≤ 2210.9	≤ 355.1	≤ 6886.0	≤ 1106.2
Methyl glyoxal	72.1	≤ 4695.3	≤ 1592.2	≤ 8613.2	≤ 2920.8
Formic acid	46.0	≤ 3239.4	≤ 1721.8	≤ 380.2	≤ 202.0
2-Butenoic acid	86.1	-	0	≤ 294.8	≤ 83.7
Oxalic acid, butyl propyl ester	188.2	-	0	≤ 5299.4	≤ 688.4
Acetic acid	60.1	≤ 6898.3	≤ 2806.3	≤ 8603.4	≤ 3500.0
Ethyl acetate	88.1	≤ 2198.8	≤ 610.2	≤ 5105.2	≤ 1416.8
2,2-Dimethyloctane	142.3	< LOQ	< LOQ	≤ 4209.2	≤ 723.2
3,4,5-Trimethylheptane	142.3	≤ 279.2	≤ 47.9	≤ 5350.4	≤ 919.3
2-5-Dimethylnonane	156.3	< LOQ	< LOQ	≤ 3408.9	≤ 533.2
6-Ethyl-2-methyldecane	184.4	< LOQ	< LOQ	≤ 7091.0	≤ 940.2
2,6,11-Trimethyldodecane	212.4	< LOQ	< LOQ	≤ 1746.1	≤ 200.9
p-Cymene	134.2	≤ 104.4	≤ 19.0	≤ 7772.5	≤ 1416.0
Benzene	78.1	≤ 644.9	≤ 201.8	≤ 3418.0	≤ 1070.0
Ethylbenzene	106.2	≤ 363.6	≤ 83.7	≤ 3041.6	≤ 700.2
Toluene	92.1	≤ 143.6	≤ 38.1	≤ 7715.0	≤ 2048.1
2-Ethyl-m-xylene	134.2	≤ 35.1	≤ 6.4	≤ 1463.0	≤ 266.5
p-Xylene	106.2	≤ 198.7	≤ 45.7	≤ 1195.5	≤ 275.2
Propene	42.1	≤ 1715.0	≤ 995.9	≤ 1847.2	≤ 1072.7
2-Methoxypropene	72.1	≤ 1258.1	≤ 426.6	≤ 502.2	≤ 170.3
Hexanal	100.2	≤ 3984.0	≤ 972.1	≤ 1020.4	≤ 248.9
Benzaldehyde	106.0	≤ 185.8	≤ 42.8	≤ 1098.3	≤ 253.3
3-Methylbenzaldehyde	120.2	≤ 331.7	≤ 67.4	≤ 684.5	≤ 139.2

*Mr = Molecular weight (g/mol)

Supplementary Table S9

Recoveries obtained for compounds collected by ITEX sampling system with filter accessory.

Compounds	Recovery (%)	Compounds	Recovery (%)
2-Methyl-1-propanol	81.4	3,4,5-Trimethylheptane	26.8
2,3-Butanedione	58.3	6-Ethyl-2-methyldecane	37.5
2,3-Pentanedione	84.9	2,6,11-Trimethyldodecane	13.2
5-Undecanone	9.2	2-methyl-2-propen-1-amine	99.2
Trans-limonen oxide	94.4	2-Pentanamine	87.2
Methyl glyoxal	98.8	1-Hexanamine	96.8
Acetic acid	79.7	n-Hexylmethylamine	15.3
Oxalic acid, butyl propyl ester	5.8	4-Heptylamine	64.9
Ethyl acetate	95.1	2-Amino-1-propanol	41.4

Supplementary Table S10

Determined LODs and LOQs for the acids based on parameters provided by linear regression analysis using HILIC/MS-MS.

Acid	Intercept	Std. Error of Intercept	Slope	LOD (ng/mL)	LOQ (ng/mL)
2-Oxoglutaric acid	-36.166	37.247	2.292	49	161
4-Ketopimelic	-641.995	54.629	16.508	9.9	33
Adipic acid	-188.943	27.922	23.168	3.6	12
Azelaic acid	-50.384	43.565	17.113	7.6	25
Benzoic acid	4.711	1.729	4.504	1.2	3.8
cis-Pinonic acid	23.434	4.790	2.386	6.0	20
Fumaric acid	-149.825	3.048	3.986	2.3	7.6
Glutaric acid	-62.521	32.090	21.988	4.4	14
Glycolic acid	-100.415	17.613	3.723	14	47
Maleic acid	28.810	22.979	8.818	7.8	26
Malonic acid	-4.592	0.598	1.185	1.5	5.0
Mandelic acid	18.588	17.224	17.813	2.9	10
Phthalic acid	33.560	15.300	10.644	4.3	14
Pyruvic acid	-1944.231	204.268	1.987	308	1 018
Sebacic acid	-179.209	34.928	28.576	3.7	12
Suberic acid	-55.378	6.770	22.078	0.92	3.0
Succinic acid	-17.288	24.260	20.605	3.5	12
Trimesic acid	499.680	294.814	3.477	254	839
Vanillic acid	15.056	0.361	0.915	1.2	3.9

Supplementary Table S11

Two minutes average of black carbon (BC) and total particle concentrations measured at the altitudes of 100, 200, 300, and 400 m in three days measurement (9, 10, and 11 October 2021).

100 m						
Time	BC (ng m-3)	STDev	RSD (%)	TPC (d(cm^{-3}))	STDev	RSD (%)
10.30 am	2930.7	1133.6	39.7	739.6	31.6	4.4
13.00 pm	2461.5	1299.9	54.2	591.7	0.0	0.0
17.00 pm	2567.6	1202.4	48.0	1113.9	15.4	1.4
10.23 am	3054.7	1348.8	45.3	1087.8	42.9	4.0
12.54 pm	2845.7	941.3	33.9	1316.2	12.9	1.0
13.30 pm	1429.7	1140.4	81.8	1263.3	91.2	7.4
17.00 pm	1841.6	1487.9	82.8	1467.6	41.1	2.9
09.00 am	2175.9	891.4	73.9	2530.6	62.3	2.5
12.00 pm	1744.9	1116.6	77.5	2082.9	177.9	8.8
12.30 pm	1750.4	1318.4	77.2	409.5	103.9	26.0
200 m						
Time	BC (ng m-3)	STDev	RSD (%)	TPC (d(cm^{-3}))	STDev	RSD (%)
10.30 am	2356.2	625.9	27.0	584.5	35.7	6.2
13.00 pm	2392.3	1637.5	69.5	608.1	0.0	0.0
17.00 pm	2335.8	985.3	42.8	1091.5	16.9	1.6
10.23 am	3265.4	1701.2	52.9	1178.6	86.5	7.5
12.54 pm	3433.7	2343.5	69.3	1366.7	24.1	1.8
13.30 pm	2795.2	1332.5	48.4	1175.4	22.6	1.9
17.00 pm	2394.6	1810.8	76.8	1477.5	34.5	2.4
09.00 am	2690.2	1464.3	55.3	2372.3	117.7	5.0
12.00 pm	2240.8	1062.0	48.1	2108.4	42.7	2.1
12.30 pm	1568.9	2012.6	130.2	389.1	69.7	18.2
300 m						
Time	BC (ng m-3)	STDev	RSD (%)	TPC (d(cm^{-3}))	STDev	RSD (%)
10.30 am	3349.9	412.3	12.4	595.5	57.2	9.7
13.00 pm	3364.1	929.8	27.8	564.3	4.1	0.7
17.00 pm	3507.9	641.0	18.4	1016.3	46.9	4.6
10.23 am	4076.5	981.5	24.2	827.6	114.9	14.0
12.54 pm	3531.7	2208.4	62.9	1436.3	135.5	9.5
13.30 pm	2896.5	4880.1	169.4	1178.0	32.6	2.8
17.00 pm	3986.7	1728.5	43.6	1432.4	36.9	2.6
09.00 am	4285.0	1693.2	39.7	2383.2	90.9	3.8
12.00 pm	3495.6	1623.1	46.7	2003.9	363.7	18.2
12.30 pm	3205.5	1388.5	43.5	1058.8	33.3	3.2

* BC = Black carbon
* TPC = Total particle concentration

Supplementary Table S11 (Cont..)

Two minutes average of black carbon (BC) and total particle concentrations measured at the altitudes of 100, 200, 300, and 400 m in three days measurement (9, 10, and 11 October 2021).

400m						
Time	BC (ng m-3)	STDev	RSD (%)	TPC (d(cm^{-3}))	STDev	RSD (%)
10.30 am	3423.2	631.9	18.3	622.0	33.1	5.3
13.00 pm	3386.3	382.6	11.2	615.9	70.1	11.3
17.00 pm	3692.4	434.3	11.7	768.3	17.0	2.2
10.23 am	4723.6	332.9	7.0	530.0	130.0	24.4
12.54 pm	4843.3	963.0	19.8	1065.0	138.1	12.9
13.30 pm	2798.7	530.2	18.8	843.0	73.8	8.7
17.00 pm	5304.9	1120.9	21.0	1276.1	80.0	6.2
09.00 am	5513.9	961.0	17.3	2049.7	101.5	4.9
12.00 pm	3765.9	724.4	19.1	1971.1	39.6	2.0
12.30 pm	2146.8	1218.3	56.4	946.2	60.8	6.4

* BC = Black carbon
* TPC = Total particle concentration

Supplementary Table S12

Daily average of black carbon (BC) and total particle concentrations measured at the altitudes of 100, 200, 300, and 400 m in three days measurement (9, 10, and 11 October 2021).

Day	Average at 100 m		Average at 200 m		Average at 300 m		Average at 400 m	
	BC (ng m^{-3})	TPC (d(cm^{-3})	BC (ng m^{-3})	TPC (d(cm^{-3})	BC (ng m^{-3})	TPC (d(cm^{-3})	BC (ng m^{-3})	TPC (d(cm^{-3})
1	2653.3	815.1	2361.4	761.3	3407.3	725.4	3500.6	668.8
2	2293.0	1283.7	2972.2	1299.5	3622.9	1218.6	4417.6	928.5
3	1890.4	1674.3	2166.7	1623.2	3662.0	1815.3	3808.9	1655.7

* BC = Black carbon
* TPC = Total particle concentration

Reference

Finlayson-Pitts, B.J., Pitts, James N., J., 2000. Chemistry of the upper and lower atmosphere : theory, experiments, and applications. Academic Press, San Diego.