

1 Supporting information for

2 **Measurement report: Vertical distribution of biogenic and
3 anthropogenic secondary organic aerosols in the urban
4 boundary layer over Beijing during late summer**

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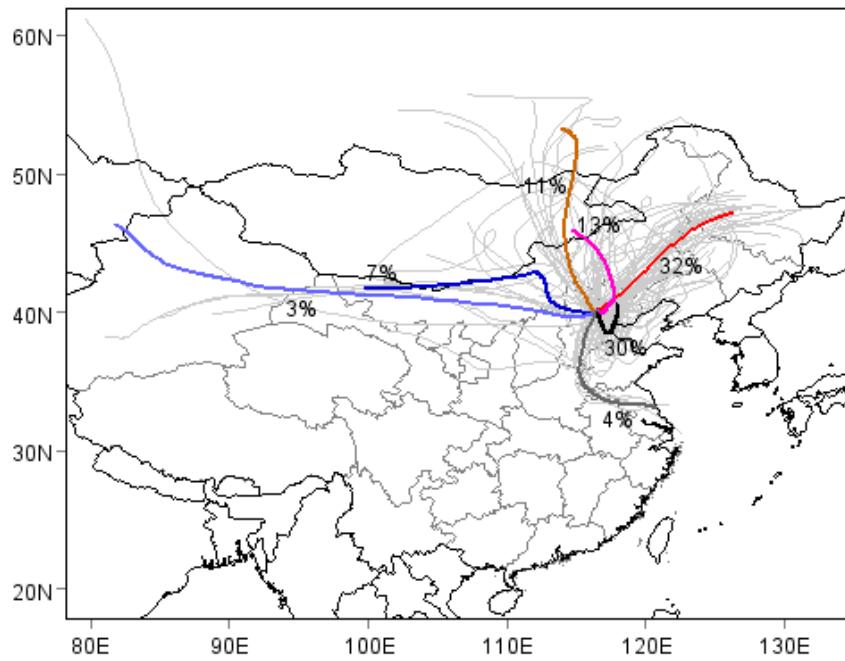
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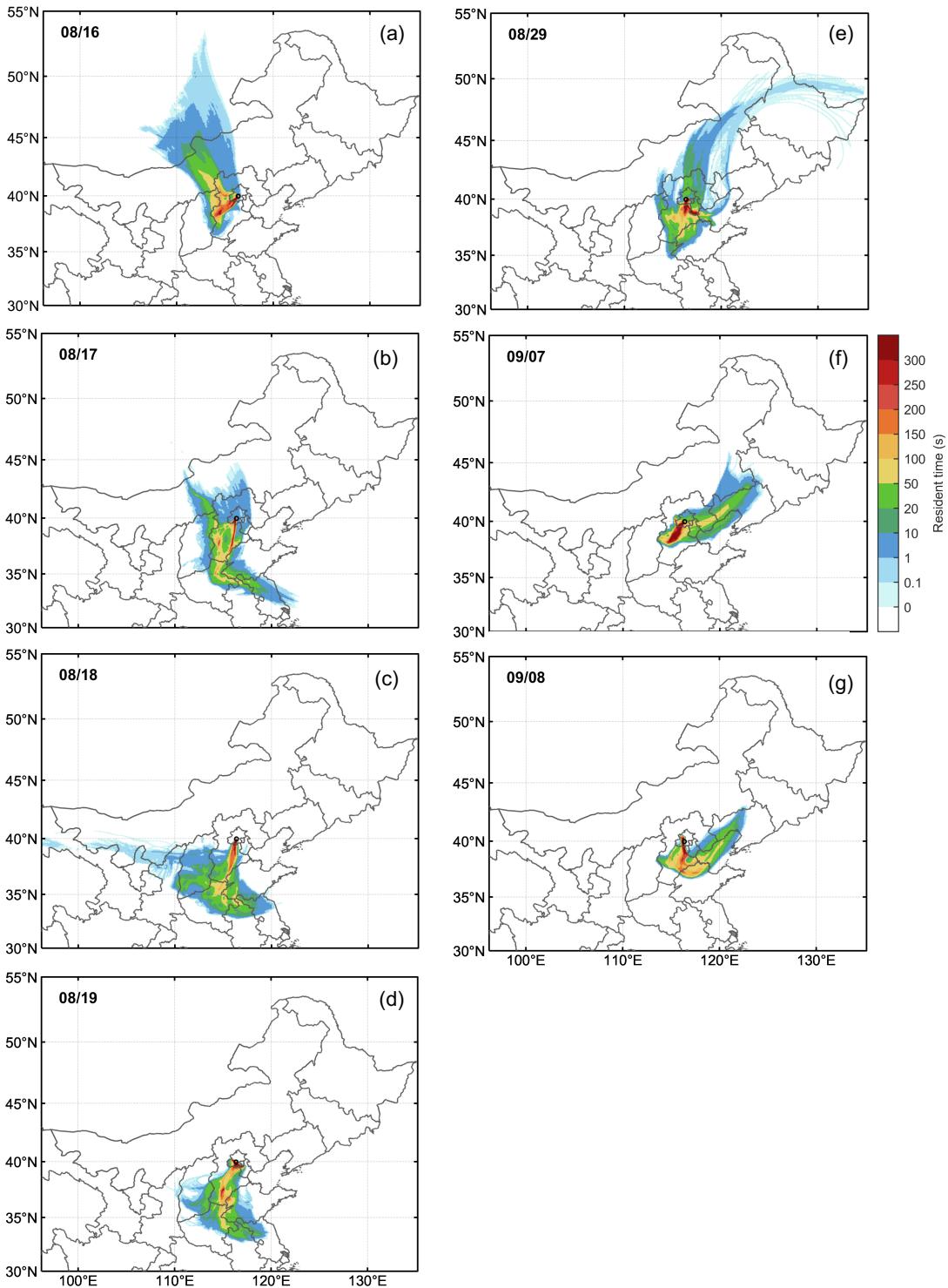
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19 Figure S1. Three-day back trajectories of air mass during August 15th to September 10th at 300 m (a.g.l) by using
 20 MeteoInfo Software with the meteorological date from the NOAA website
 21 (<https://ready.arl.noaa.gov/archives.php>). The trajectories are calculated every 6 hours. Total seven air mass
 22 clusters are calculated, the numbers in the figure indicate the percentages of air mass with each cluster and
 23 marked with different color. Main origins of air masses were southeast and northeast.

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Figure S2. Retroplumes of air masses at 300 m (a.g.l) at the sampling site (marked as black dot) using the FLEXPART model. The color scales indicate the residence times (s) of air masses in the grid cell. The longer residence time in the region, the greater impact from that region.

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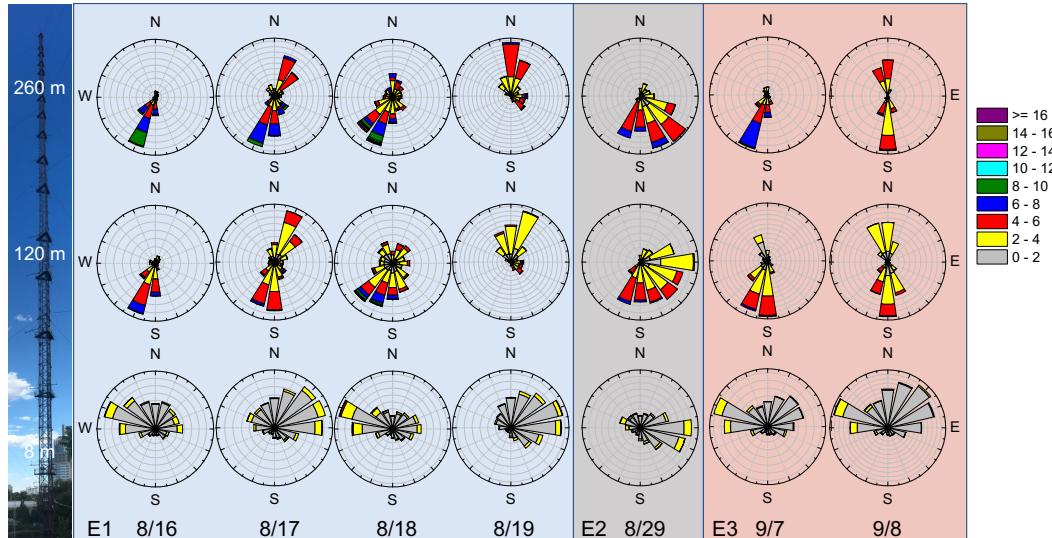
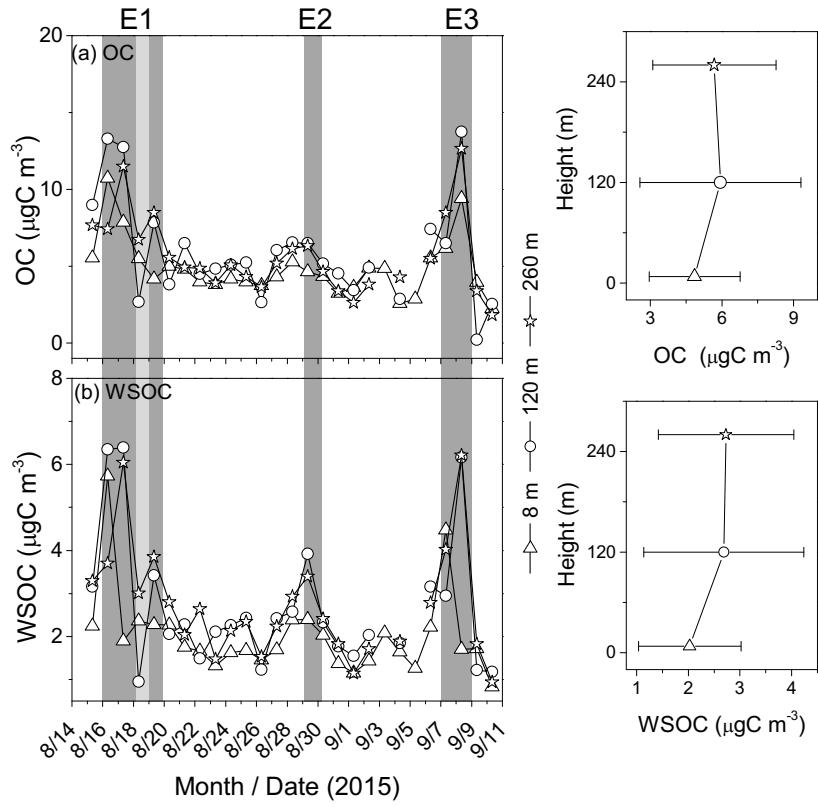


Figure S3. Wind roses of each day at 8 m, 120 m and 260 m during the E1, E2 and E3 periods. E1 is light blue shadow, E2 is light grey shadow and E3 is pink shadow.

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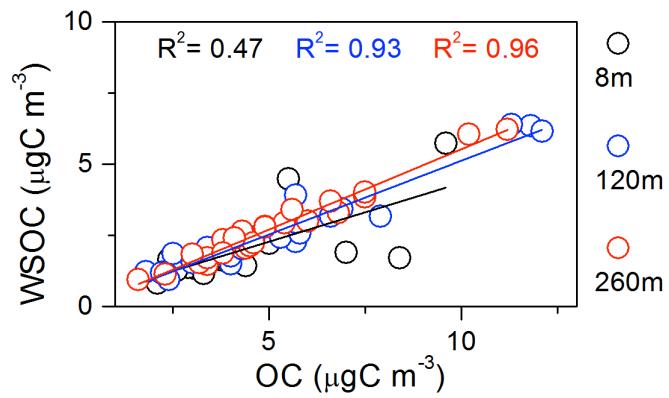
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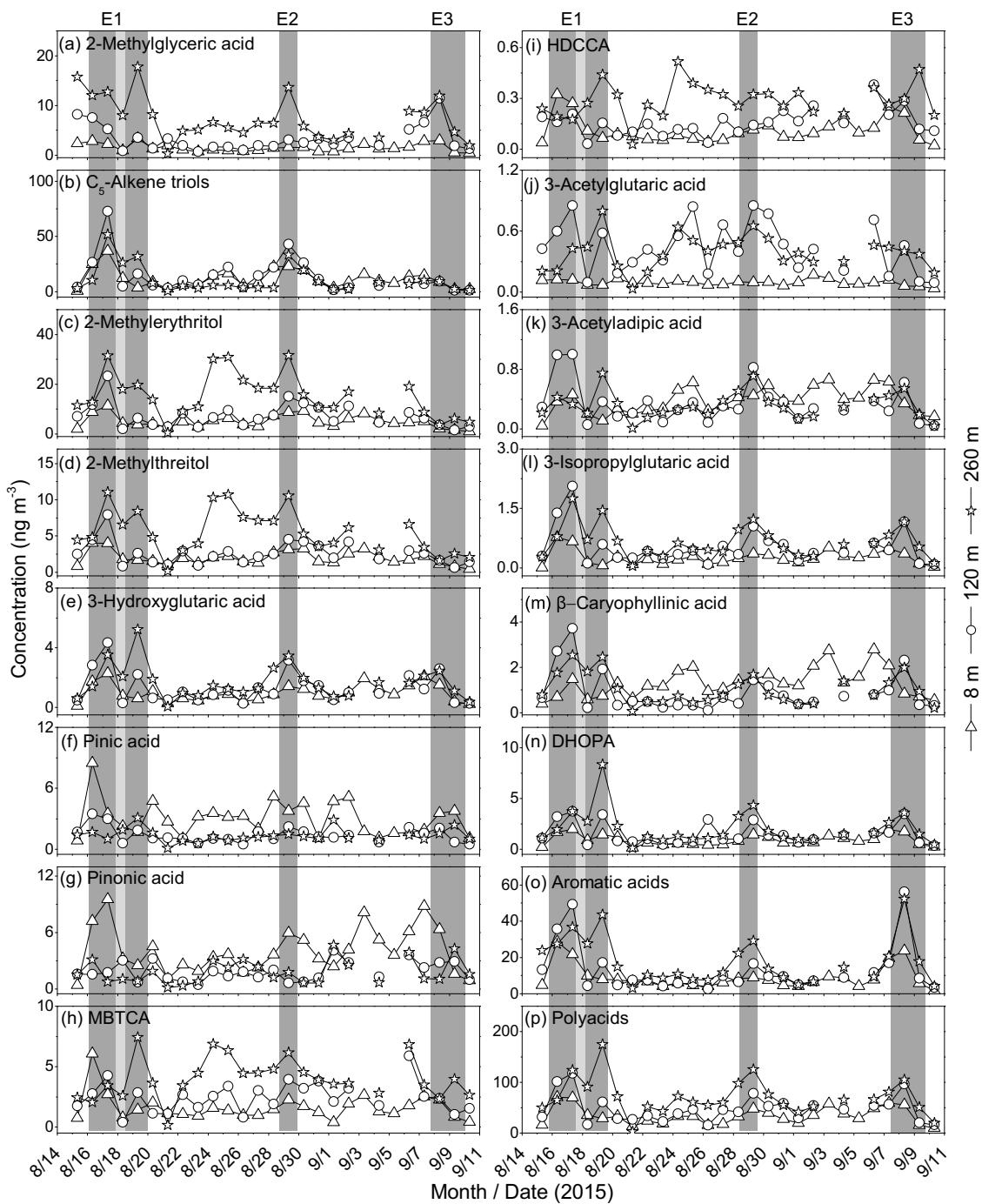
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Figure S4. Time variations in (a) organic carbon (OC) and (b) water soluble organic carbon (WSOC) and their vertical distributions in $\text{PM}_{2.5}$ of Beijing.

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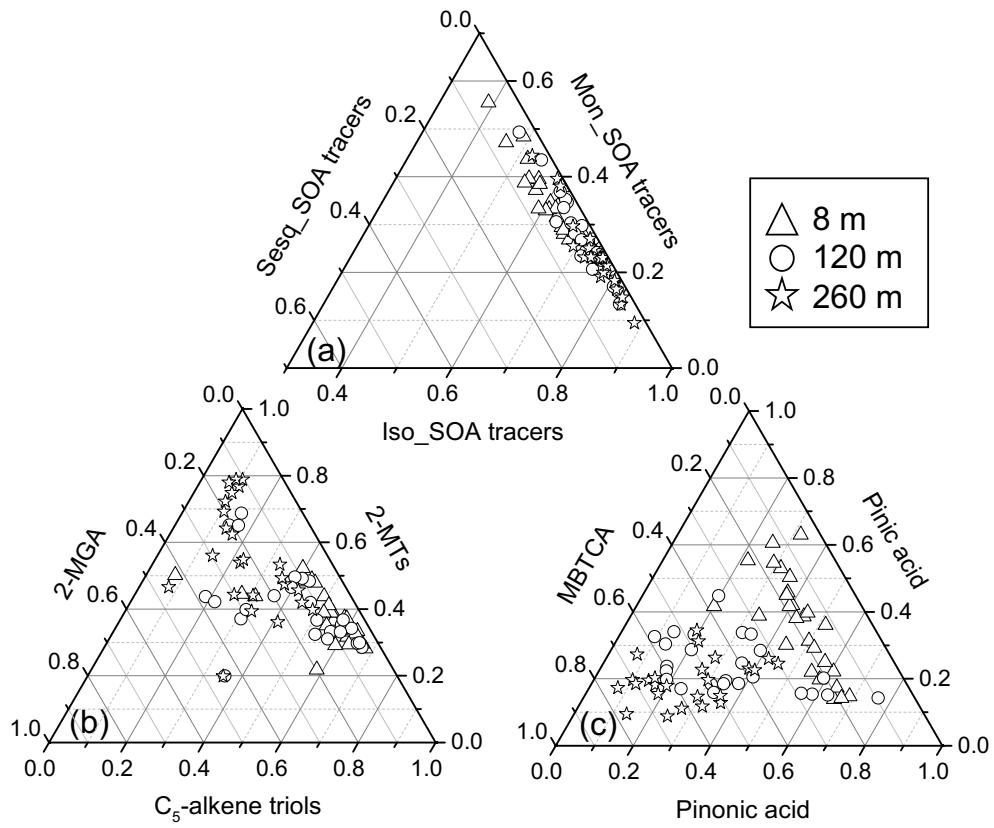




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42 **Figure S6.** Time variations in (a–d) Isoprene SOA tracers, (e–l) Monoterpene SOA tracers, (m) β -Caryophyllinic
43 acid, (n) Dihydroxy-4-oxopentanoic acid (DHOPA), (o) Aromatic acid, and (p) Polyacids in $\text{PM}_{2.5}$ of Beijing.

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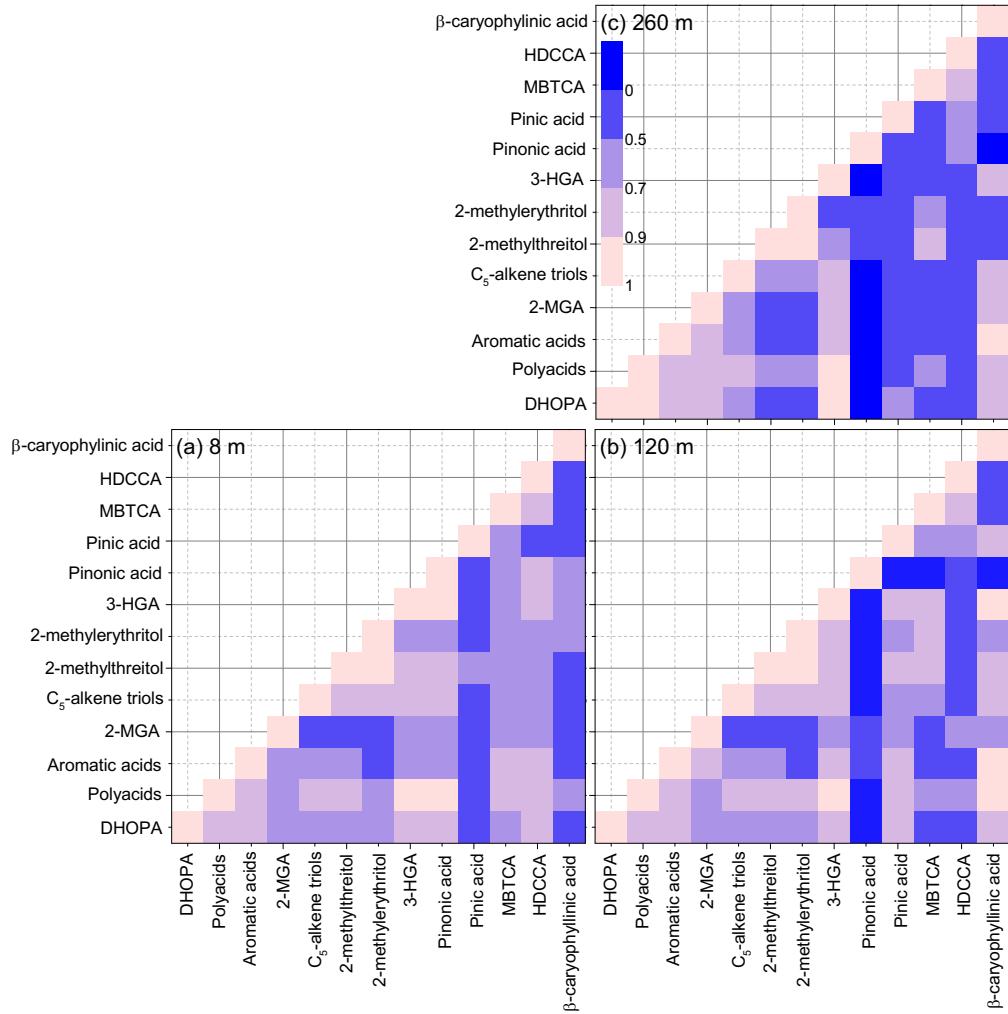
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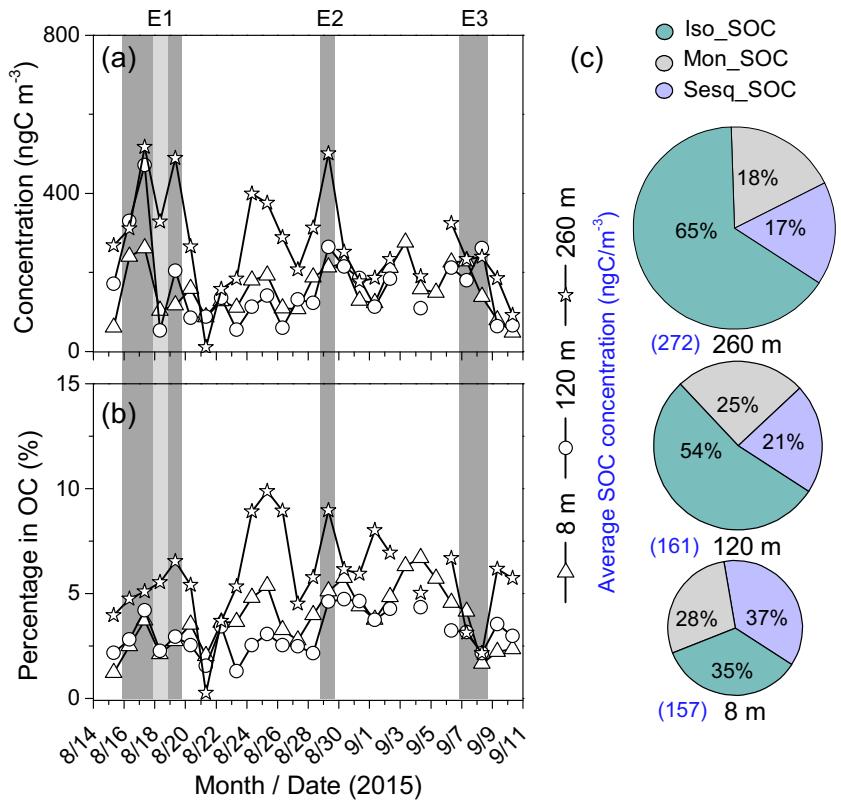


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Figure S8. Correlations in SOA tracers (DHOPA, sum of polyacids, sum of aromatic acids, BSOA tracers) at 8
52 m, 120 m and 260 m in PM_{2.5} of Beijing. The color bar (blue to pinky) is represented the magnitude of Pearson's
53 coefficient values (R).

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Figure S9. Temporal variations in (a) biogenic SOC concentrations, (b) biogenic SOC in OC percentages and (c) relative contributions.

Table S1. Summary of the average meteorological parameters, concentrations of secondary organic tracers (SOA), OC and WSOC and their ratios in PM_{2.5} collected at the surface layer (8 m, a two story building) and 120 m and 260 m (platform of the 325 m a.g.l. meteorological tower) in urban of Beijing during 2015 China Parade (Aug. 15th Aug to Sep. 10th).

Compound	8 m				120 m				260 m			
	Min	Max	Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std
Meteorological parameters												
Tem ^a	14.2	35.2	25.2	3.99	13.0	34.3	24.3	3.96	11.8	33.0	23.2	3.74
RH ^a	20.0	100	60.6	17.5	21.0	100	61.9	18.5	23.0	100	65.5	20.4
WS ^a	0.30	7.90	1.23	0.68	0.30	17.3	3.02	1.39	0.30	15.8	3.47	1.66
Isoprene SOA tracers (ng m⁻³)												
2-Methylglyceric acid	0.43	3.36	1.53	0.81	0.71	11.5	3.35	2.66	0.32	17.8	7.37	4.39
C5-alkene triols	0.43	36.8	11.3	8.47	1.13	72.7	13.8	15.9	0.39	51.81	10.6	12.6
2-Methylthreitol	0.43	4.02	1.95	0.95	0.65	7.91	2.61	1.60	0.15	11.1	5.56	3.02
2-Methylerythritol	0.98	11.3	4.99	2.58	1.54	23.2	7.32	4.87	0.42	31.6	15.4	8.80
Subtotal	4.02	54.3	19.7	12.0	5.20	109	27.1	22.4	1.27	107	38.7	24.1
Monoterpene SOA tracers (ng m⁻³)												
3-Hydroxyglutaric acid	0.10	2.27	0.96	0.58	0.26	4.33	1.30	1.05	0.05	5.23	1.67	1.14
Pinonic acid	0.40	9.55	4.06	2.46	0.47	4.10	1.84	1.01	0.15	4.69	1.81	1.27
Pinic acid	0.83	8.46	3.01	1.74	0.48	3.49	1.40	0.76	0.09	3.10	1.35	0.67
MBTCA ^b	0.38	6.08	1.61	1.10	0.38	5.88	2.46	1.24	0.15	7.43	4.01	1.71
HDCCA ^c	0.02	0.32	0.11	0.08	0.03	0.38	0.16	0.08	0.03	0.52	0.29	0.10
3-Acetylglutaric acid	0.03	0.17	0.09	0.03	0.09	0.85	0.43	0.25	0.03	0.80	0.39	0.17
3-Acetyl adipic acid	0.04	0.66	0.38	0.17	0.04	1.00	0.34	0.26	0.01	0.75	0.31	0.18
3-Isopropylglutaric acid	0.01	0.77	0.26	0.19	0.09	2.07	0.52	0.46	0.04	1.74	0.65	0.41
Subtotal	2.28	25.1	10.5	5.18	3.62	17.4	8.45	3.68	0.56	20.0	10.5	3.86
Sesquiterpene SOA tracer (ng m⁻³)												
β-Caryophyllinic acid	0.39	2.78	1.32	0.63	0.11	3.72	0.89	0.89	0.06	2.54	1.02	0.69
Total BSOA tracers	7.46	75.2	31.5	16.8	10.8	130.2	36.4	26.1	1.90	121	50.2	27.0

Table S1. Continued.

Compound	8 m				120 m				260 m			
	Min	Max	Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std
Toluene SOA tracer (ng m⁻³)												
DHOPA ^d	0.13	1.98	0.90	0.53	0.35	3.74	1.50	1.09	0.09	8.35	2.03	1.69
Poly acids (ng m⁻³)												
Glycolic acid	4.42	33.2	12.6	6.66	5.55	43.7	15.3	8.64	1.33	44.4	18.0	9.49
Salicylic acid	0.01	0.45	0.16	0.11	0.05	0.93	0.26	0.22	0.02	0.95	0.34	0.21
Glyceric acid	0.60	5.43	2.33	1.42	0.61	10.4	3.63	2.76	0.15	15.9	5.59	3.63
Malic acid	2.27	28.1	13.8	7.37	4.96	50.0	20.2	12.2	0.99	78.7	29.6	15.9
Tartaric acid	0.51	8.18	2.80	2.04	0.80	10.0	4.59	2.99	0.15	23.7	10.5	5.22
Citric acid	0.03	1.14	0.38	0.24	0.08	2.26	0.69	0.61	0.02	3.47	1.65	0.83
Tricarballylic acid	0.47	5.74	2.13	1.31	0.61	11.6	2.98	2.42	0.14	10.9	4.64	2.54
Subtotal	9.76	70.7	34.2	17.1	15.8	117.5	47.7	27.1	2.79	175	70.4	35.6
Aromatic acids (ng m⁻³)												
Benzoic acid	0.11	2.19	0.64	0.46	0.35	3.62	1.01	0.78	0.52	4.62	1.74	1.15
o-Toluic acid	0.04	0.25	0.10	0.05	0.05	0.32	0.12	0.07	0.04	0.34	0.13	0.07
m-Toluic acid	0.08	1.10	0.19	0.19	0.10	4.52	0.39	0.87	0.13	5.42	0.49	1.03
p-Toluic acid	0.06	0.25	0.11	0.05	0.05	0.49	0.13	0.09	0.05	0.46	0.17	0.10
Phthalic	0.53	5.71	2.66	1.27	0.65	9.97	3.59	2.54	1.00	14.7	5.17	2.89
Isophthalic	0.11	0.60	0.26	0.15	0.07	1.64	0.39	0.35	0.13	1.35	0.58	0.36
Terephthalic	0.81	20.8	4.90	4.85	1.21	37.5	7.44	9.73	1.10	33.5	9.23	8.42
Subtotal	1.78	28.7	8.86	6.58	2.51	56.1	13.06	13.8	2.98	52.2	17.5	12.8
Concentrations (µgC/m⁻³)												
WSOC ^e	0.83	5.73	2.03	0.99	0.95	6.36	2.69	1.55	0.94	6.21	2.73	1.31
OC ^e	2.06	9.63	4.37	1.69	1.82	12.15	5.32	2.88	1.60	11.2	5.03	2.28
EC ^e	0.32	1.66	0.60	0.30	0.28	2.06	0.82	0.48	0.20	2.16	0.84	0.52
Percentage in OC (%)												
WSOC / OC	20.2	81.2	46.9	11.9	37.6	72.9	51.1	8.88	42.7	61.6	54.0	5.63
EC / OC	8.89	19.8	13.6	2.92	8.37	38.8	16.2	7.13	8.79	40.3	16.7	7.69

^aTem: temperature, RH: relative humidity and WS: wind speed;

^b MBTCA: 3-methyl-1,2,3-butanetricarboxylic acid;

^c HDCCA: 3-(2-hydroxyethyl)-2,2-dimethyl-cyclobutane carboxylic acid;

^d DHOPA: 2,3-dihydroxy-4-oxopentanoic acid;

^e Water soluble organic carbon (WSOC), organic carbon (OC) detected in aerosols ($\mu\text{gC}/\text{m}^{-3}$)

Table S2. Results of single factor analysis to test the significantly different of these averages.

Component (ng m ⁻³) ^a	8 m	120 m	260 m
Isoprene SOA tracers	19.7±12.0 b ^b	27.1±22.4 b	38.7±24.1 a
Monoterpene SOA tracers	10.5±5.18 a	8.45±3.68 a	10.5±3.86 a
β-Caryophyllinic acid	1.32±0.63 a	0.89±0.89 b	1.02±0.69 ab
DHOPA	0.90±0.53 b	1.50±1.09 ab	2.03±1.69 a
Phthalic	2.66±1.27 b	3.59±2.54 a	5.17±2.89 a
WSOC	2.03±0.99 a	2.69±1.55 a	2.73±1.31 a
OC	4.37±1.69 a	5.32±2.88 a	5.03±2.28 a
WSOC / OC (%)	46.9±11.9 b	51.1±8.88 a	54.0±5.63 a
2-MTs / 2-MGA	5.20 ± 2.24 a	3.80 ± 1.95 b	3.15 ± 1.83 b
2-MET / 2-MT	2.52±0.28 b	2.73±0.31 a	2.73±0.22 a
2-MTs / C5-alkene triols	0.97±1.17 b	1.33±1.24 b	3.97±3.08 a
MBTCA / (PAN+PN)	0.24±0.10 b	0.84±0.44 b	1.49±0.77 a

^a The concentrations of these components are expressed as mean ± STD;

^b Different lowercase letters indicate significant differences at P < 0.05 in aerosols collected at different heights.

Table S3. Concentrations and contributions of anthropogenic and biogenic photochemical oxidation organic carbons (ASOC and BSOC) in PM_{2.5} collected at the surface layer (8 m, a two story building) and 120 m and 260 m (platform of the 325 m a.g.l. meteorological tower) in urban of Beijing during 2015 China Parade (Aug. 15th Aug to Sep. 10th).

Component	8 m				120 m				260 m			
	Min	Max	Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std
Concentration (ngC / m³)												
Toluene SOC	16.1	251	114	67.5	43.9	474	189	137	12.0	1057	257	214
Naphthalene SOC	13.9	149	69.2	33.2	16.8	260	93.4	66.0	26.0	382	135	75.4
ASOC^a	45.1	400	184	98.2	68.9	734	283	195	38.0	1438	391	285
Iso_SOC	11.9	113	54.6	24.7	23.8	235	85.7	48.9	5.71	360	183	90.9
Mon_SOC	9.88	109	45.4	22.4	15.7	75.5	36.6	15.9	2.43	86.7	45.4	16.7
Sesq_SOC	17.0	121	57.4	27.5	4.57	162	38.7	38.8	2.81	110	44.4	29.8
BSOC^b	48.1	276	157	62.5	53.2	472	161	97.4	11.0	517	272	121
Total SOC	93.3	661	341	150	135	1205	444	283	49.0	1928	664	380
Percentage in OC (%)												
Toluene SOC	0.67	5.01	1.62	0.81	0.72	4.45	1.74	0.81	0.60	5.20	2.74	1.09
Naphthalene SOC	0.67	5.01	1.62	0.81	0.72	4.45	1.74	0.81	0.60	5.20	2.74	1.09
ASOC	1.27	10.8	4.25	1.98	2.07	16.5	5.52	3.17	0.87	19.2	7.63	3.51
Iso_SOC ^c	0.47	2.43	1.29	0.53	0.67	2.83	1.67	0.62	0.13	7.97	3.91	1.79
Mon_SOC ^c	0.20	1.82	1.05	0.37	0.36	1.28	0.76	0.25	0.06	2.44	1.05	0.52
Sesq_SOC ^c	0.31	2.73	1.45	0.73	0.19	1.43	0.66	0.35	0.06	1.60	0.84	0.36
BSOC	1.22	6.70	3.80	1.46	1.29	4.71	3.09	0.97	0.25	9.87	5.80	2.20
Total SOC	2.48	17.5	8.05	3.17	3.36	19.0	8.60	3.66	1.12	25.7	13.4	4.81

^a Anthropogenic secondary organic carbon (ASOC) : the sum of toluene SOC and naphthalene SOC;

^b Biogenic secondary organic carbons (BSOC): the sum of Iso_SOC, Mon_SOC and Sesq_SOC;

^c Iso_SOC: isoprene tracers estimated SOC, Mon_SOC: monoterpene tracers estimated SOC and Sesq_SOC: sesquiterpene tracer estimated SOC