Supporting Information for

Vertical distribution of particle-phase dicarboxylic acids, oxoacids and α-dicarbonyls in the urban boundary layer based on the 325-meter tower in Beijing

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Table S1. Average vertical ratios of diacids and related organic compounds observed at the tower in Beijing in summer 2015.

Ratio	Ground level (8 m)	Mean±SD	120 m	Mean±SD	260 m	Mean±SD
OC/EC	5.0–10	7.5±1.5	2.6–12	7.0±2.2	2.5–12	7.0±2.4
SOC/POC	NA–1.2	0.5±0.3	NA–3.6	1.8±0.8	NA–3.6	1.9±0.9
C_3/C_4	0.77−1.3	1.1±0.14	0.6−1.4	1.1±0.2	0.65−1.4	1.2±0.21
C_9/total diacids	0.04−0.13	0.07±0.02	0.03−0.13	0.06±0.02	0.03−0.07	0.05±0.01
diacids-C/OC	0.9–2.2	1.5±0.3	1.1–3.0	1.6±0.4	1.2–2.5	1.7±0.3
diacids-C/TC	0.8–2.0	1.4±0.3	0.9–2.1	1.4±0.3	1.2–1.9	1.5±0.3
oxoacids-C/OC	0.75−0.35	0.23±0.06	0.03−0.66	0.27±0.11	0.14−0.4	0.27±0.06
oxoacids-C/TC	0.06−0.31	0.21±0.05	0.02−0.47	0.23±0.09	0.12−0.35	0.23±0.05
dicarbonyls-C/OC	0.03−0.09	0.04±0.02	0.0−0.11	0.05±0.03	0.03−0.1	0.06±0.03
dicarbonyls-C/TC	0.02−0.08	0.04±0.01	0.0−0.1	0.04±0.02	0.03−0.1	0.05±0.02

NA = not available.

Table S2. The decrease percent of diacids and related compound concentrations in restriction period compared to the first (DR/N1, %) and second (DR/N2, %) non-restriction period in Beijing.

	DR/N1			DR/N2		
	Ground level (8 m)	120 m	260 m	Ground level (8 m)	120 m	260 m
C_2	51	57	59	26	29	34
C_3	44	50	51	23	18	25
C_4	39	52	53	25	29	33
C_5	43	50	50	24	30	36
C_6	43	39	ND	14	16	ND
C_9	18	29	41	27	20	18
Ph	27	41	41	ND	10	14
tPh	63	67	69	42	46	55
Pyr	55	64	66	40	52	42
ωC_2	63	59	65	40	41	45
Gly	44	45	55	31	40	38
MeGly	53	41	55	27	37	39
Total diacids	47	53	55	22	27	31
Total oxoacids	52	53	58	31	32	36
Total dicarbonyls	50	43	55	29	36	39

ND = no decrease.

Table S3. The P/T ratios of C_2-C/WSOC, Pyr-C/WSOC, ωC_2-C/WSOC, Gly-C/WSOC and MeGly-C/WSOC observed at the tower in Beijing in summer 2015.

	P1/T1			P3/T3		
	Ground level (8 m)	120 m	260 m	Ground level (8 m)	120 m	260 m
C_2-C/WSOC	2.3	1.0	1.3	4.1	1.4	1.2
Pyr-C/WSOC	2.7	0.9	1.8	5.6	1.5	1.5
ωC_2-C/WSOC	2.3	1.3	1.5	5.2	1.8	1.4
Gly-C/WSOC	2.0	1.3	1.4	5.7	1.8	1.6
MeGly-C/WSOC	1.4	0.9	1.8	5.8	2.0	1.5

Table S4. Summary of error estimation diagnostics from BS and DISP for PMF.

BS Mapping (R≥0.6)		Secondary sulfate formation	Secondary nitrate formation	Plants emissions	Biomass burning	Vehicle exhausts	Coal combustion	Unmapped
Secondary sulfate formation		49	0	1	0	0	0	0
Secondary nitrate formation		0	50	1.8	0	0	0	0
Plants emissions		8	0	41	0	0	1	0
Biomass burning		0	0	0	50	0	0	0
Vehicle exhausts		0	0	0	0	50	0	0
Coal combustion		0	0	0	0	0	50	0
DISP Diagnostics		Error code: 0			Largest decrease in Q: −0.031			
Factor Swaps	dQ^{max}=4	0	0	0	0	0	0	
	dQ^{max}=8	4	0	4	0	0	4	
	dQ^{max}=15	12	0	12	0	0	9	
	dQ^{max}=25	18	0	18	1	0	11	

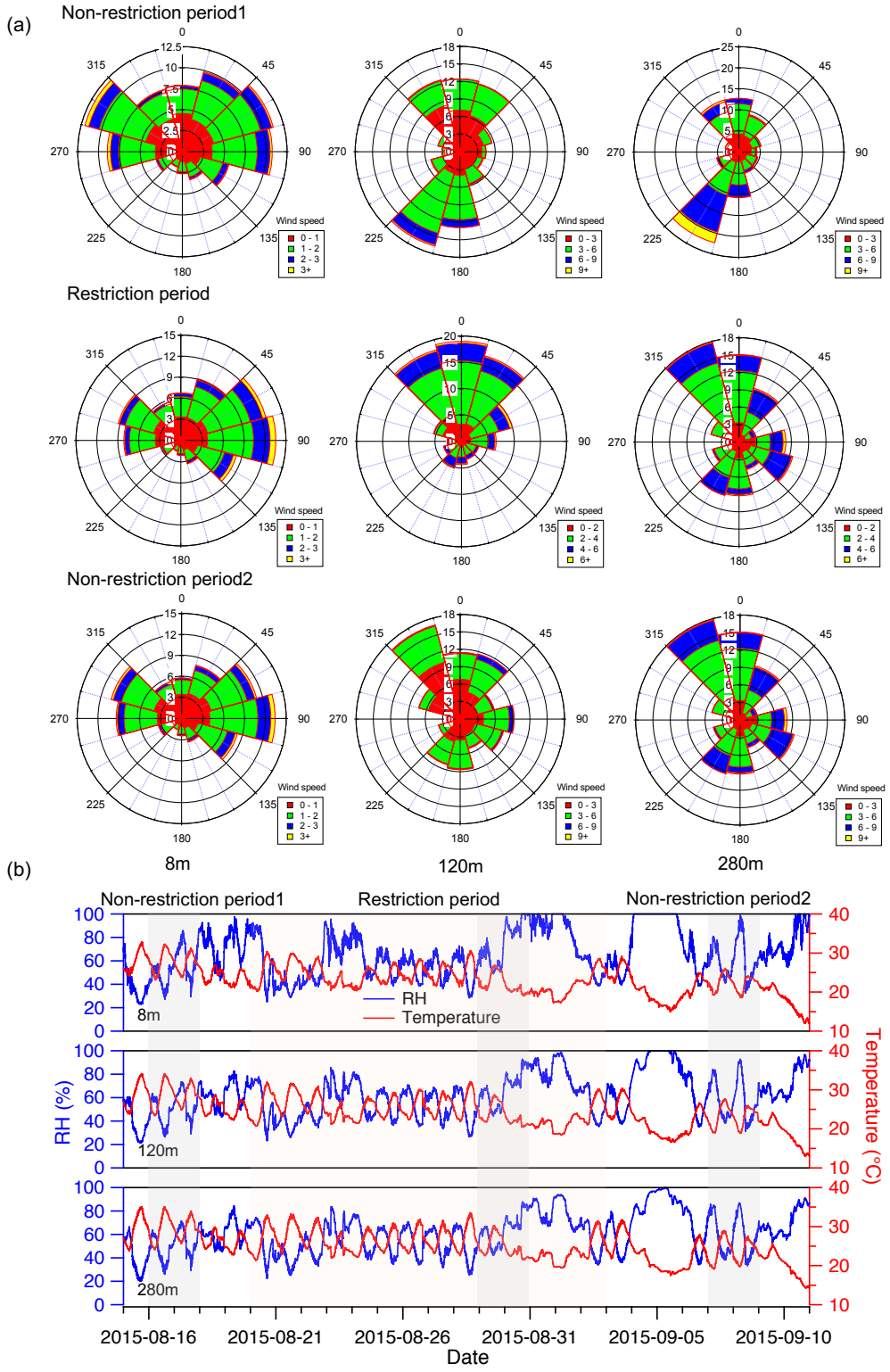

Figure S1: (a) Wind rose diagrams, (b) time series of temperature (℃) and relative humidity (%) at ground level, 120m and 280m in Beijing in summer 2015.

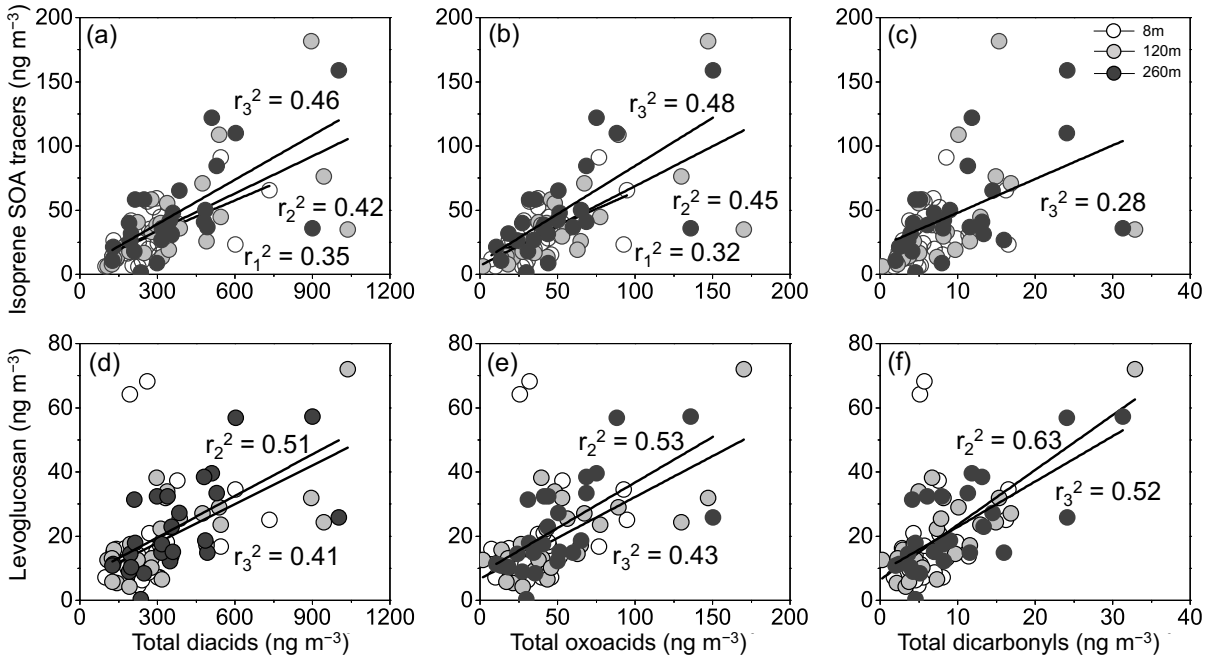

Figure S2: Linear relationships for total diacids, oxoacids and dicarbonyls with levoglucosan, isoprene SOA tracers at ground level, 120 m and 260 m in Beijing. The r_1^2, r_2^2, and r_3^2 represent the correlation coefficients at 8 m, 120 m and 260 m, respectively.

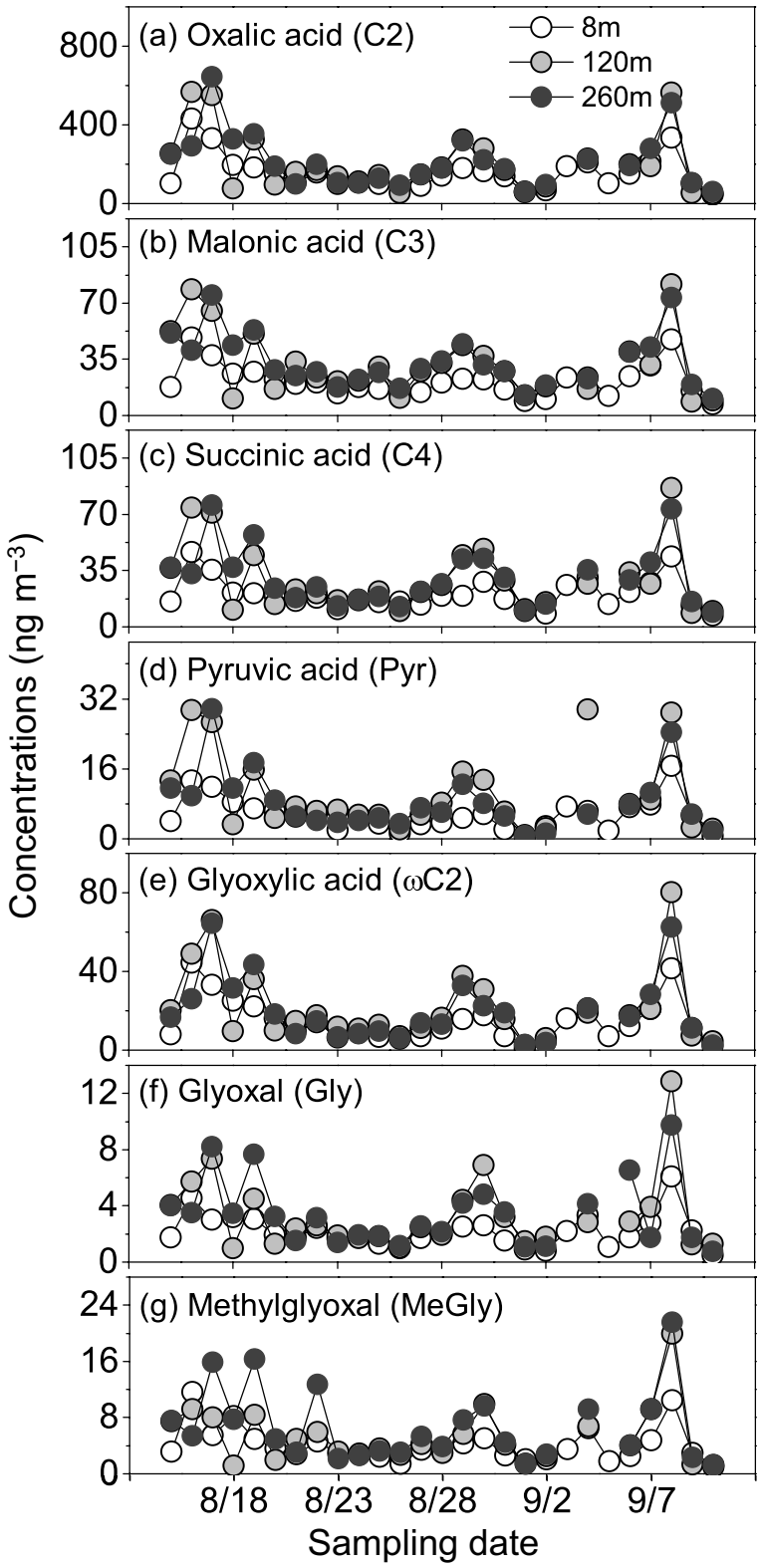

Figure S3: Daily variations in the concentrations of selected organic acids at three sampling layers in Beijing.

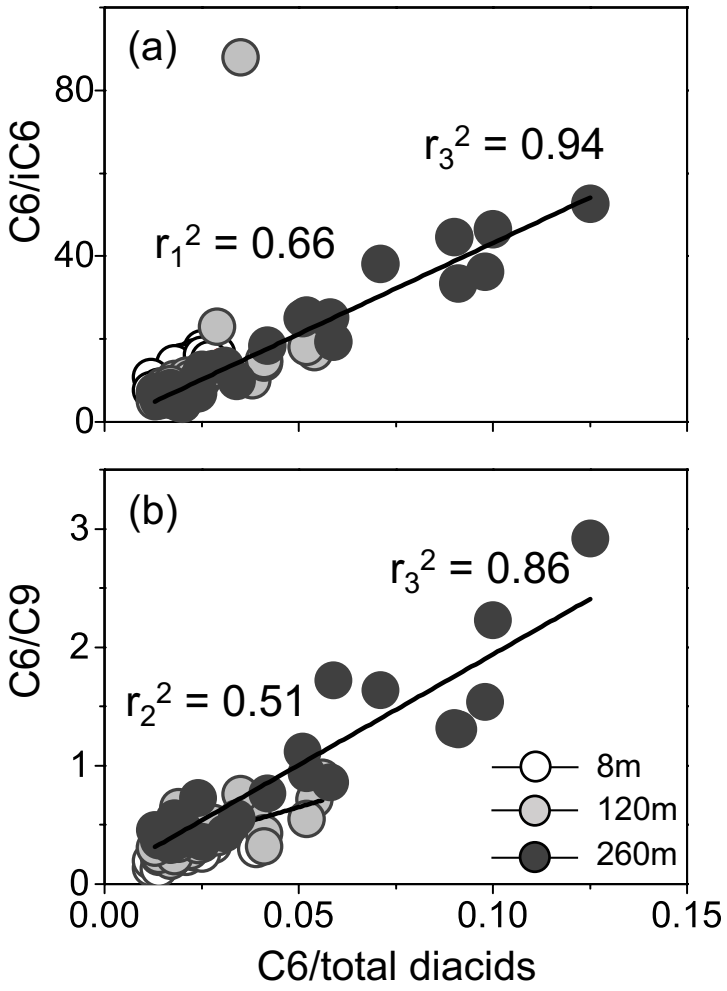

Figure S4: Relationships for C_6/total diacids with C_6/iC_6 and C_6/C_9 in Beijing in summer 2015. The r_1^2, r_2^2, and r_3^2 represent the correlation coefficients at 8 m, 120 m and 260 m, respectively.

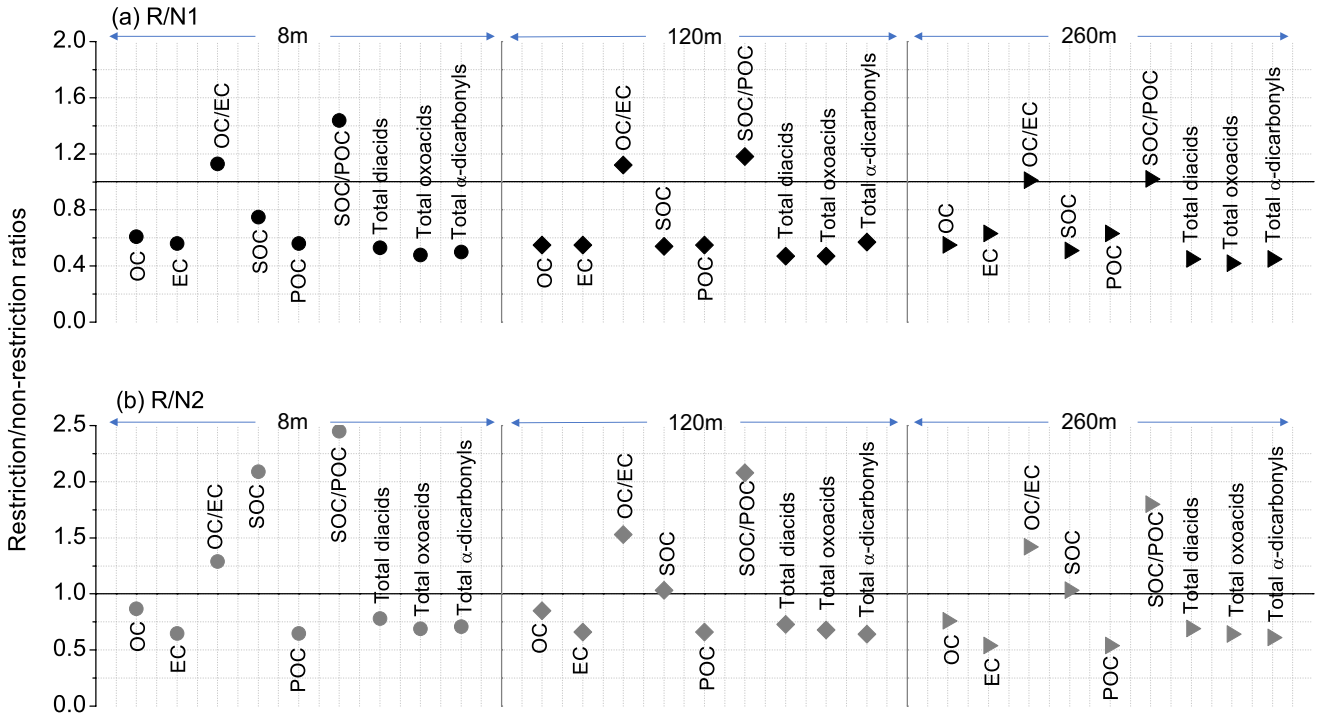

Figure S5: The R/N ratios of particulate compounds observed at the tower in Beijing in summer 2015.

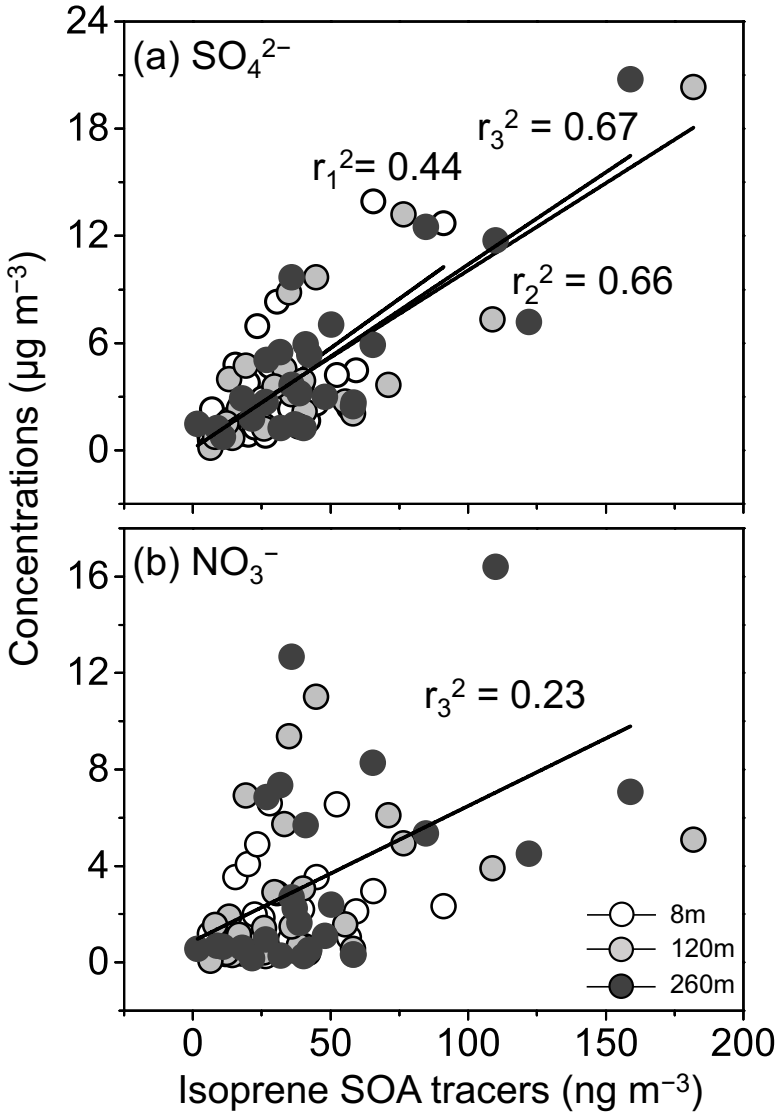

Figure S6: Relationships for isoprene SOA tracers with SO_4^{2-} and NO_3^- at ground level, 120 m and 260 m. The r_1^2, r_2^2, and r_3^2 represent the correlation coefficients at 8 m, 120 m and 260 m, respectively.