Tabel S1 Detail timetable of the vertical profile measurement

Date	Ascending start time	Ascending start time	Descending start time	Descending end time
6/15	14:01	14:25	15:01	15:31
6/17	7:04	7:34	8:15	8:45
6/17	18:03:16	18:33:39	19:15:33	19:45:47
6/17	22:00	22:30:30	23:00:05	23:30:25
6/18	7:00	7:31	8:15	8:45:25
6/18	11:00	11:30:38	12:16:20	12:46:40
6/18	18:00	18:30:30	19:15:02	19:45:20
6/24	18:00:15	18:30:40	19:15:07	19:45:22
6/24	22:00:05	22:30	23:15	23:45
6/25	7:00	7:30:30	8:15	8:45:22
6/25	11:00	11:30:37	12:15:15	12:46
6/25	18:00	18:30:22	19:15	19:45:25
6/27	18:30:15	19:00:45	19:45	20:15:20
6/27	22:00:50	22:31:15	23:14:40	23:45:30
6/28	11:00	11:30:30	12:15:09	12:45:22
6/28	18:00:01	18:30:23	19:15:04	19:45:28
6/29	11:00:03	11:30:30	12:15:03	12:45:20
6/29	18:00:05	18:30:25	19:15:05	19:45:20
6/29	22:06:10	22:36:40	23:21	23:51
6/30	7:00:05	7:30:25	8:15:05	8:45:30
6/30	10:59:55	11:30:30	12:15	12:45:16
6/30	18:00	18:30:20	19:15	19:45:40
7/1	11:00	11:30:24	12:15	12:45:12
7/1	18:00	18:30:23	19:50	20:15:00
7/1	22:00	22:30:28	23:15	23:45:22
7/2	7:00	7:30:32	8:15:04	8:45:30
7/2	11:00	11:30:30	12:15:04	12:45:30
7/2	18:00	18:30:32	19:15	19:45:25
7/2	22:00	22:30:30	23:15	12:45:30
7/7	7:04	7:34:40	8:18:11	8:48:50
7/7	11:02:16	11:32:45	12:17:06	12:47:30
7/7	18:00	18:30:30	19:15	19:45:20
7/7	22:00	22:30:40	23:15	23:45:30
7/8	7:00:29	7:30:48	8:15:05	8:45:32
7/8	11:00:11	11:30:41	12:15:10	12:45:40
7/8	18:00:00	18:30:25	19:15:10	19:45:25
7/8	22:00:00	22:30:23	23:15:05	23:45:25
7/9	11:00:00	11:30:30	12:15:00	12:45:25
7/9	18:00:02	18:30:32	19:15	19:45:30
7/9	22:00:03	22:30:35	22:46:00	23:16:35
7/10	11:00	11:30:28	12:15	12:45:25
7/10	18:00	18:30:26	19:15	19:45:30
7/10	22:00	22:30:26	23:15	23:45:20
7/11	6:00:00	06:30:25	07:15:02	7:45
7/11	11:00:00	11:30:26	12:15:05	12:45:30
7/11	18:00:00	18:30:23	19:15:06	19:42:00
7/12	22:00:00	22:30	23:15	23:45
7/13	6:00:02	6:30:30	7:15:02	7:45:30
7/13	11:00:02	11:30:30	12:15:02	12:45:30
7/13	22:00:02	22:30:30	23:15:10	23:45:42
7/14	8:00	8:30:30	9:15	9:45:30
7/14	11:00	11:30:30	12:15:05	12:45:24
7/14	22:00	22:30:33	23:15:00	23:45:20
7/15	6:00	6:30:25	7:15	7:45:46

7/15	11:03:40	11:34:00	12:15:00	12:45:20
7/15	22:00:05	22:30:25	23:15:00	23:45:20

Tabel S2 Brief summarize of the instruments in the moveable container

Instruments	Abbreviation	Manufactory	Measuring parameters
Single particle soot photometer	SP2	Droplet measurement technologies	BC concentration MMD D_p/D_c
Photoacoustic extinctiometer	PAX	Droplet measurement technologies	$PM_{2.5}$ b_{sca} (λ= 870 nm)
Aethalometer	AE33	Magee Scientific Corp.	b_{abs} (λ= 880 nm)
49i O_3 analyzer		Thermo Scientific	O_3 concentration
42i NO-NO_2-NO_x analyze		Thermo Scientific	NO,NO_2 concentration
48i CO analyzer		Thermo Scientific	CO concentration

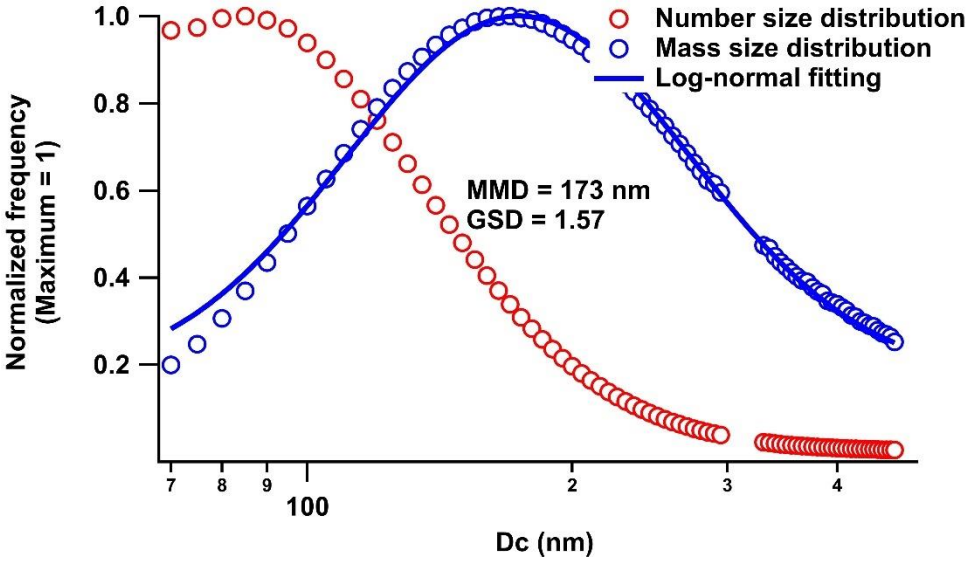


Figure. S1 Size distribution of BC core during the entire observation.

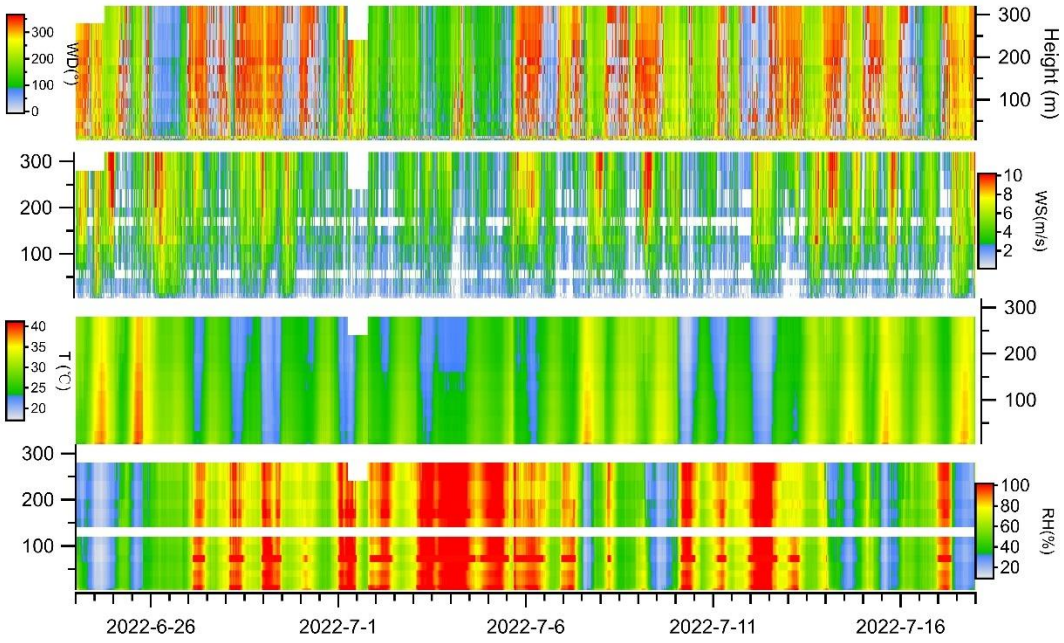


Figure. S2 Meteorology conditions (0-320 m) during the observation period.

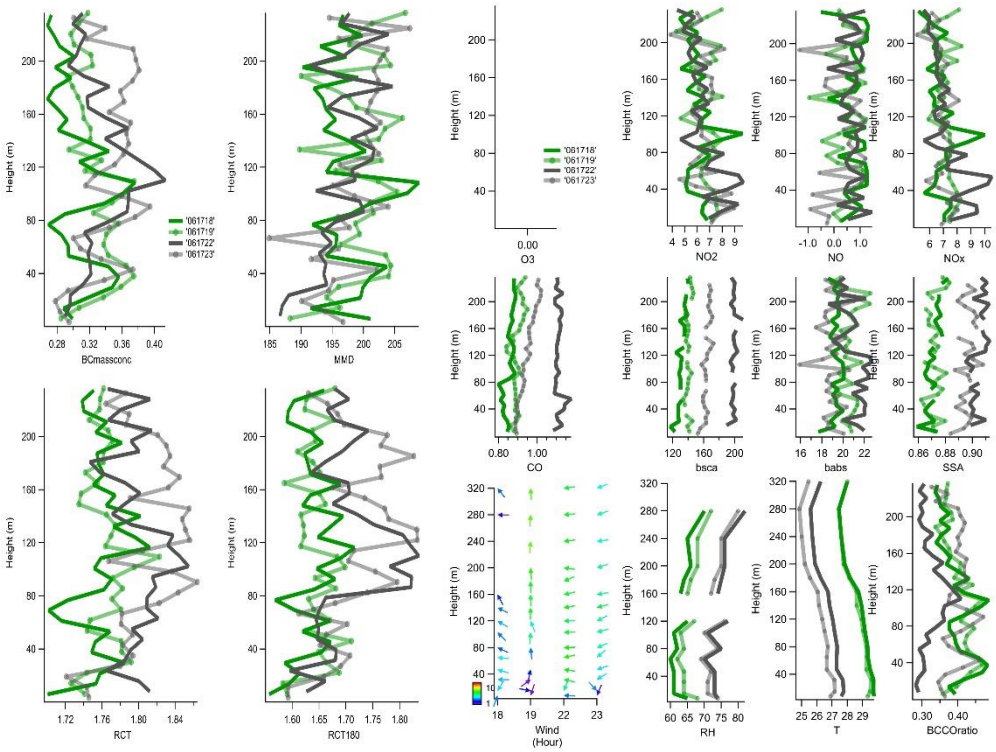


Figure S3 Vertical profiles during 17th June. RCT denotes D_p/D_c and RCT180 denotes the D_p/D_c for BC with D_c = 180±10 nm.

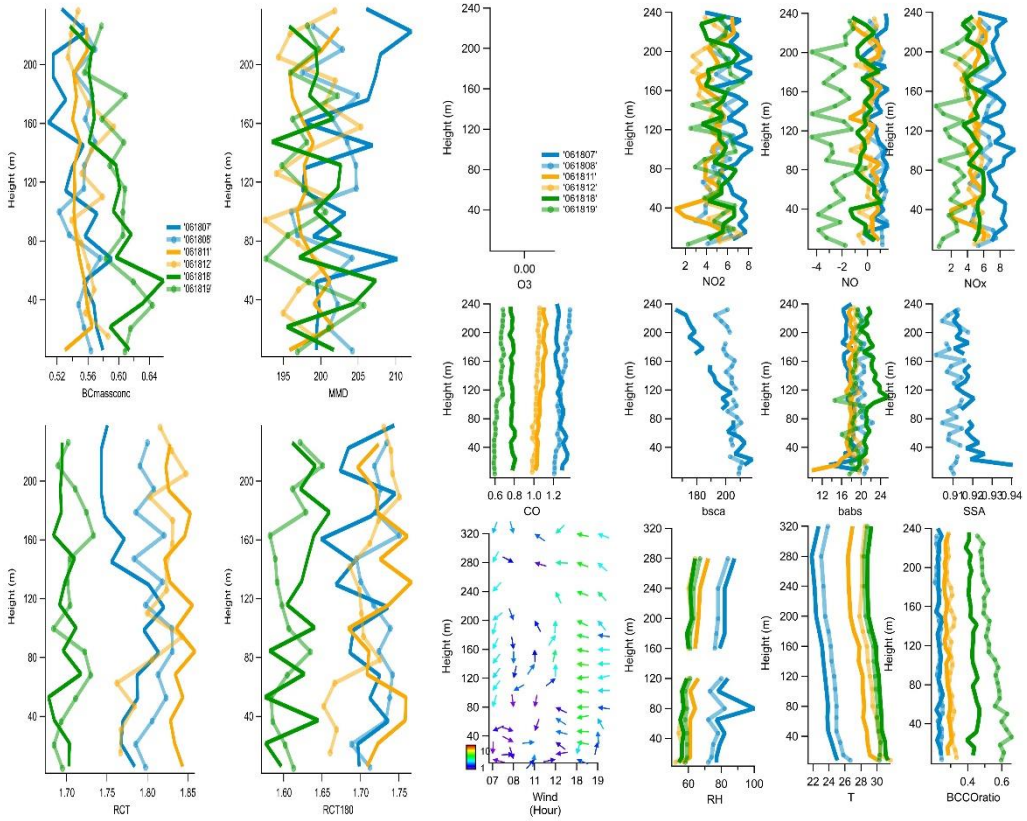


Figure S4 Vertical profiles during 18th June

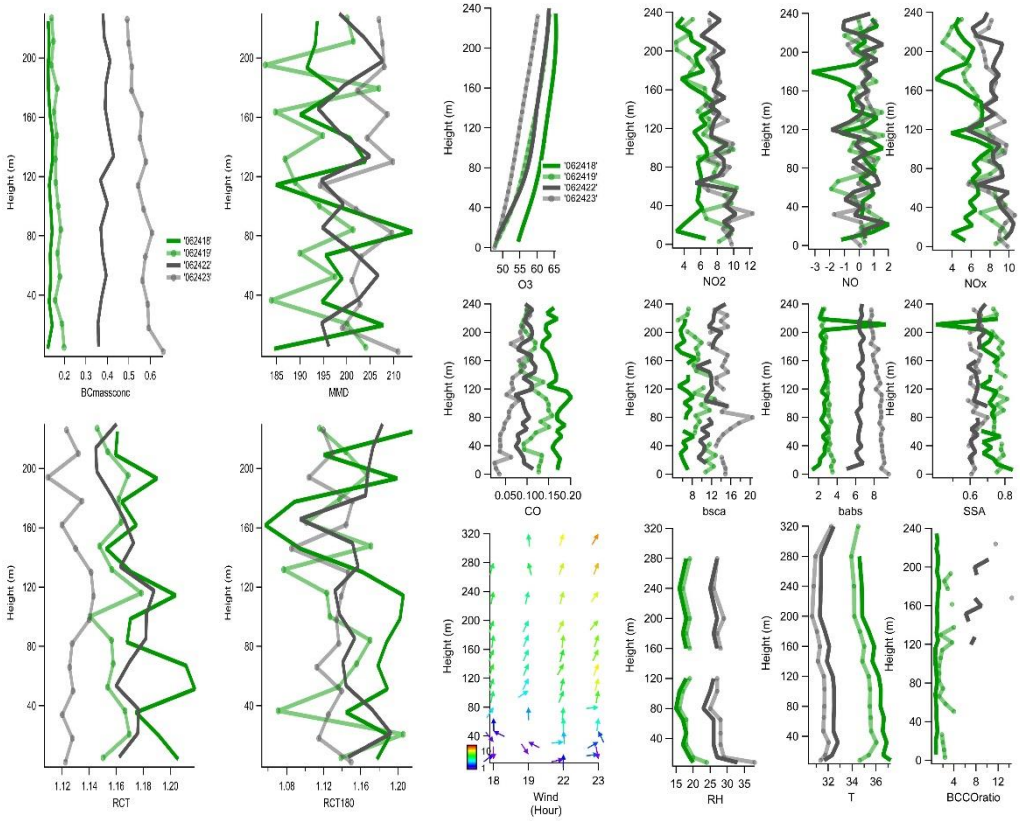


Figure S5 Vertical profiles during 24th June

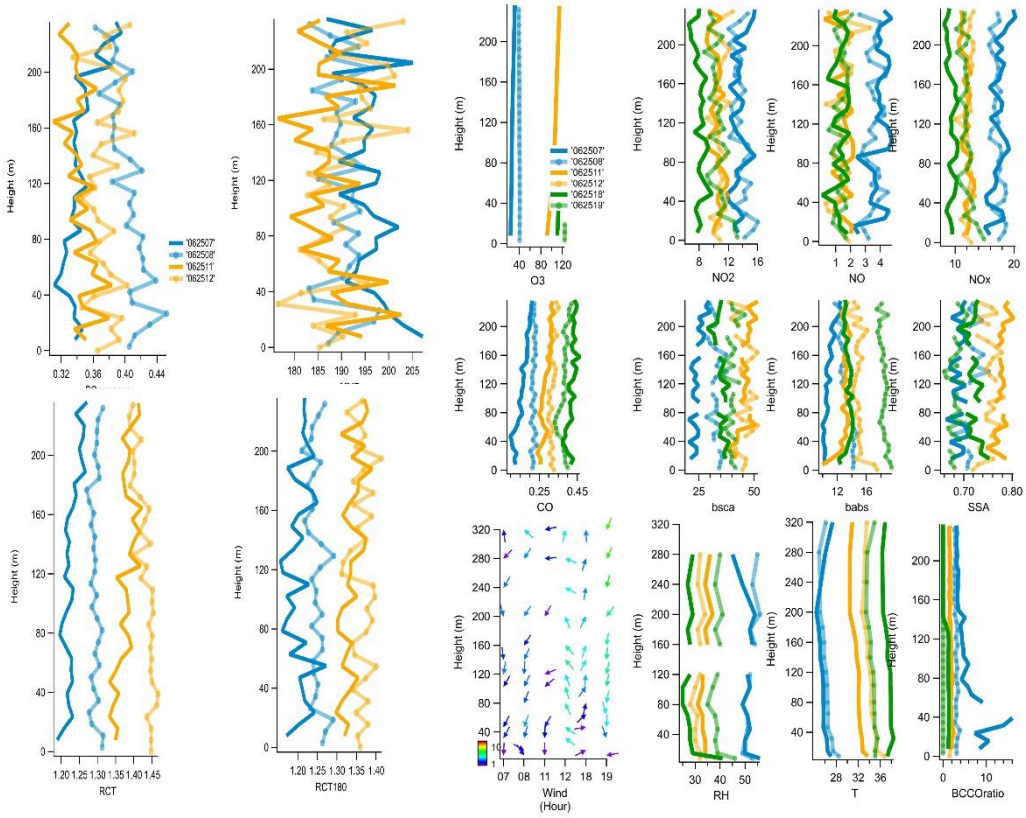


Figure S6 Vertical profiles during 25th June

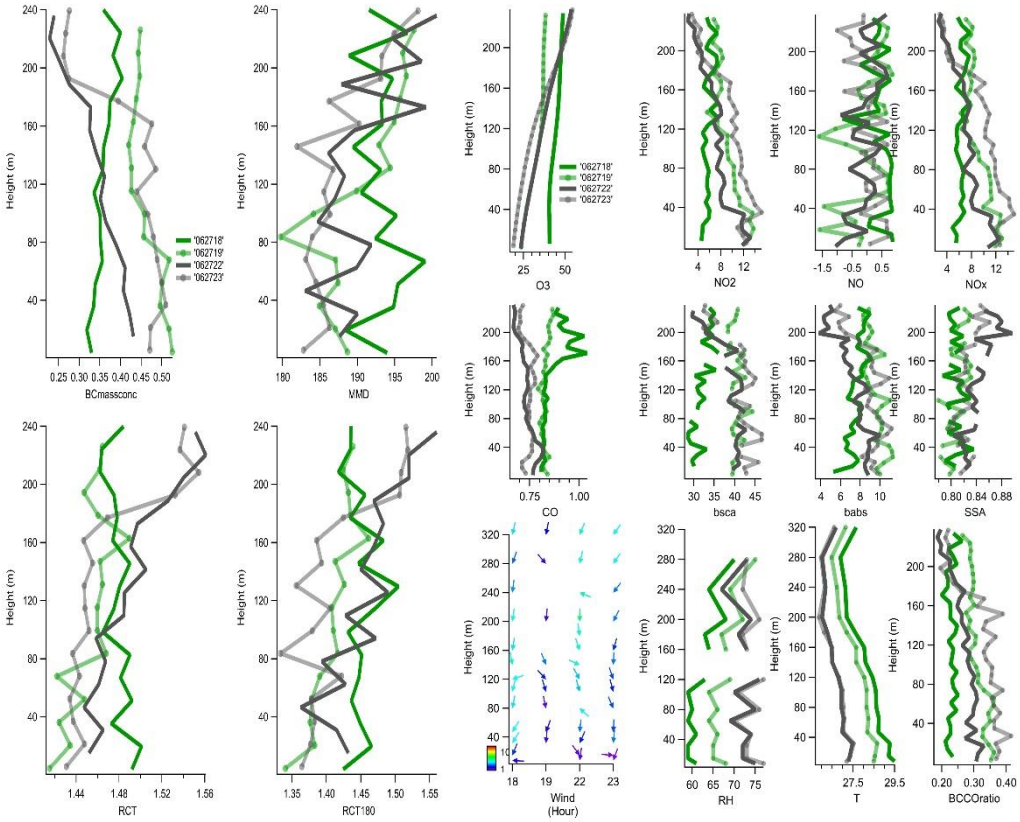


Figure S7 Vertical profiles during 27th June

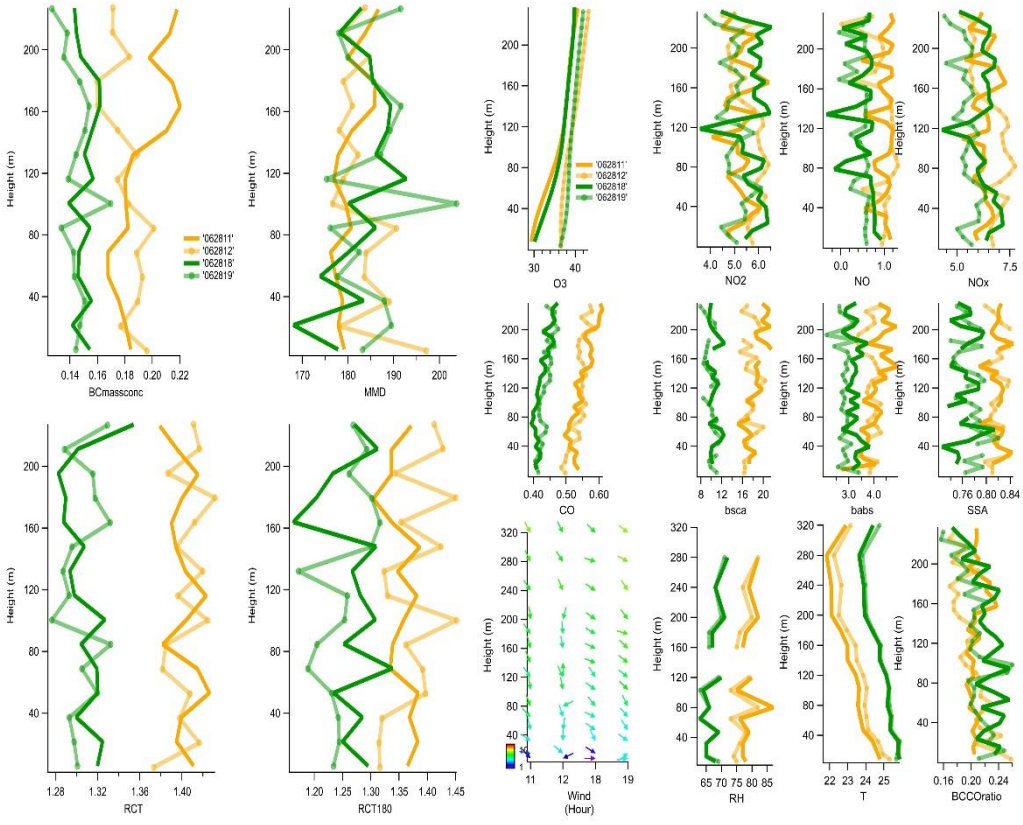


Figure S8 Vertical profiles during 28th June

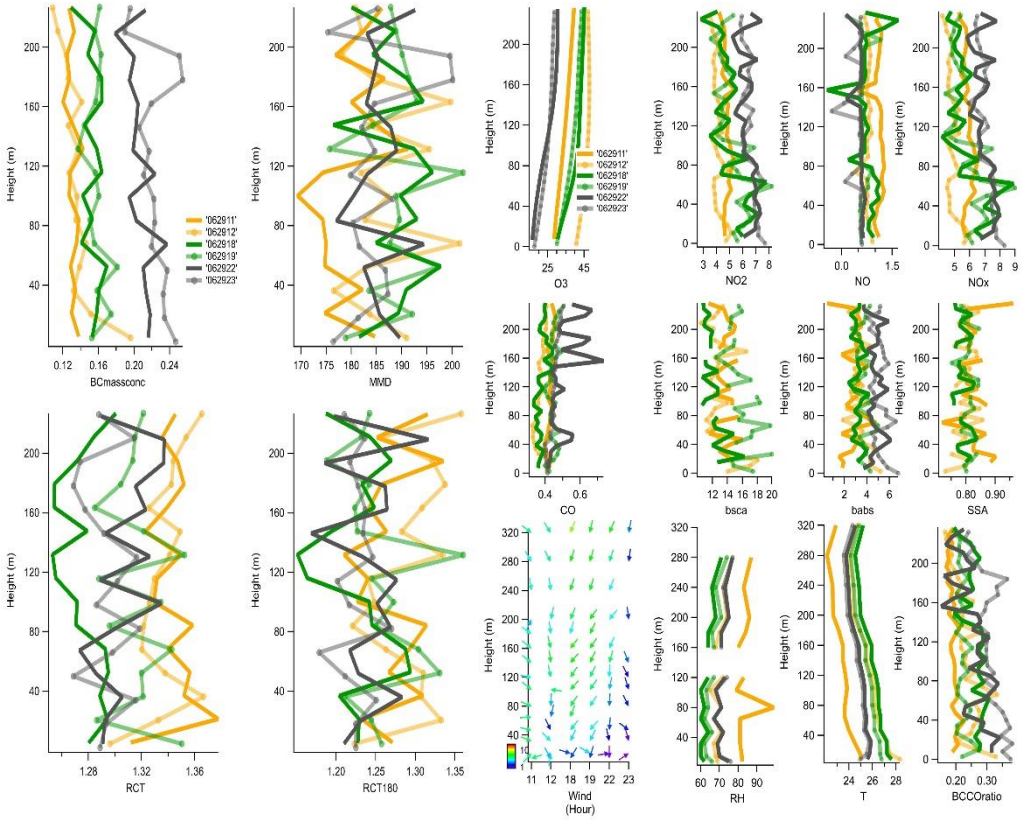


Figure S9 Vertical profiles during 29th June

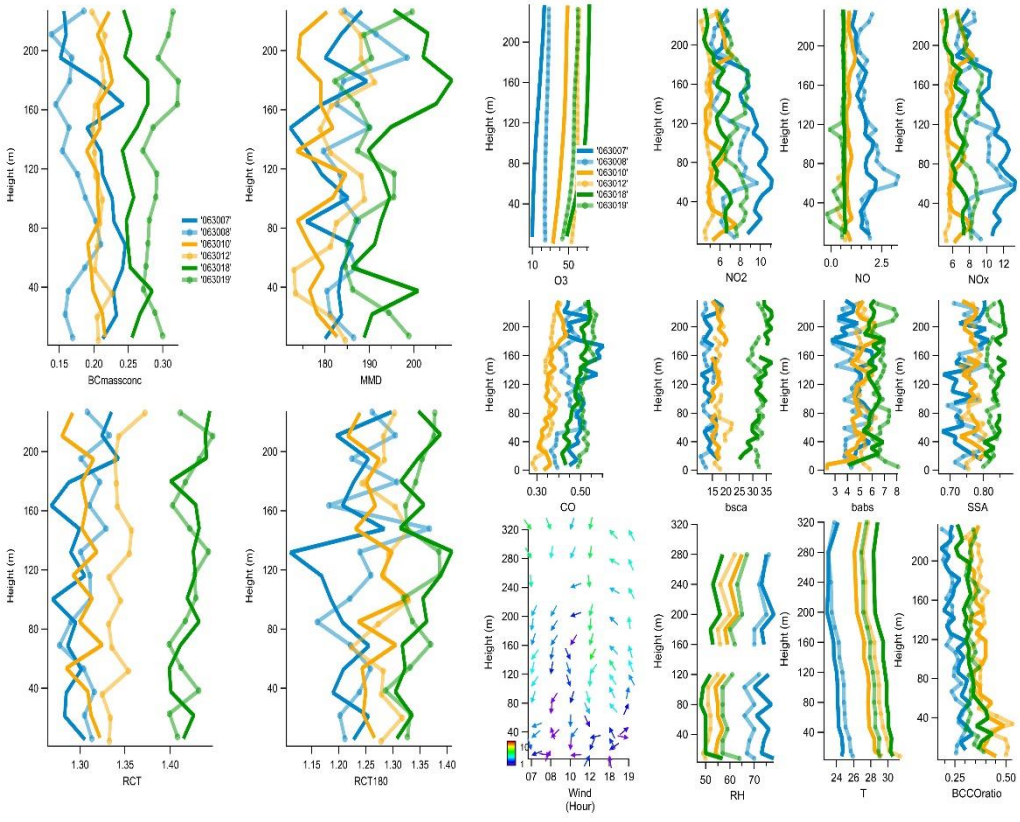


Figure S10 Vertical profiles during 30th June

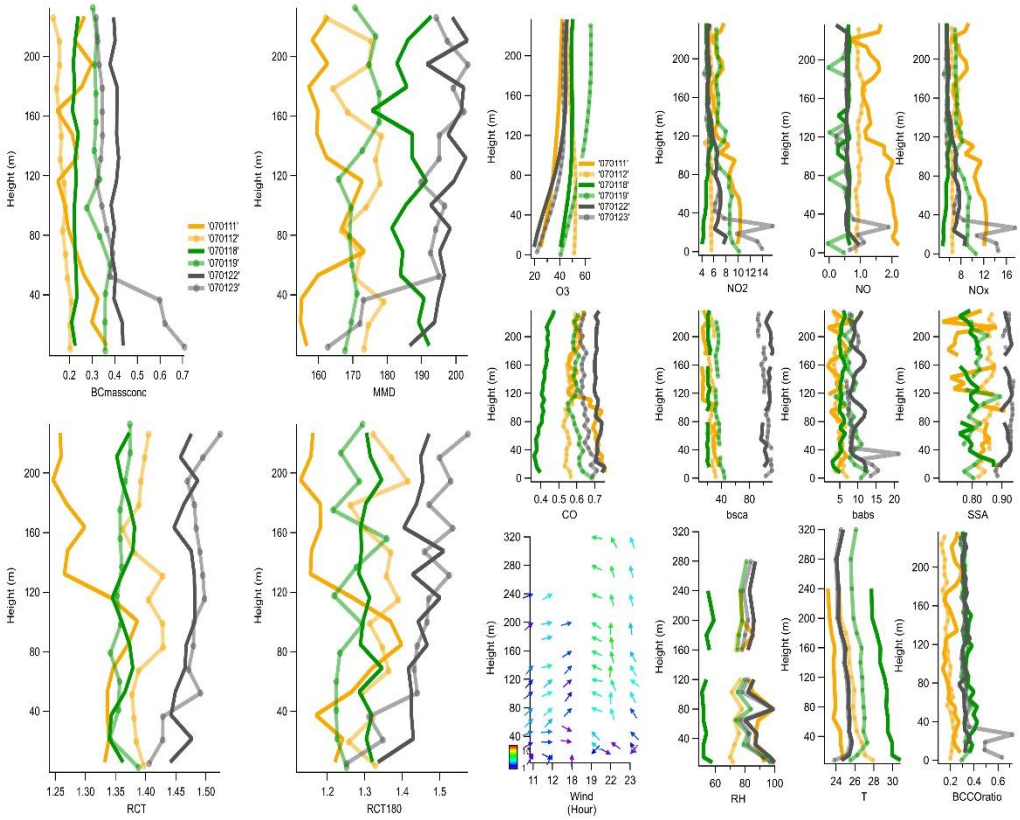


Figure S11 Vertical profiles during 1st July

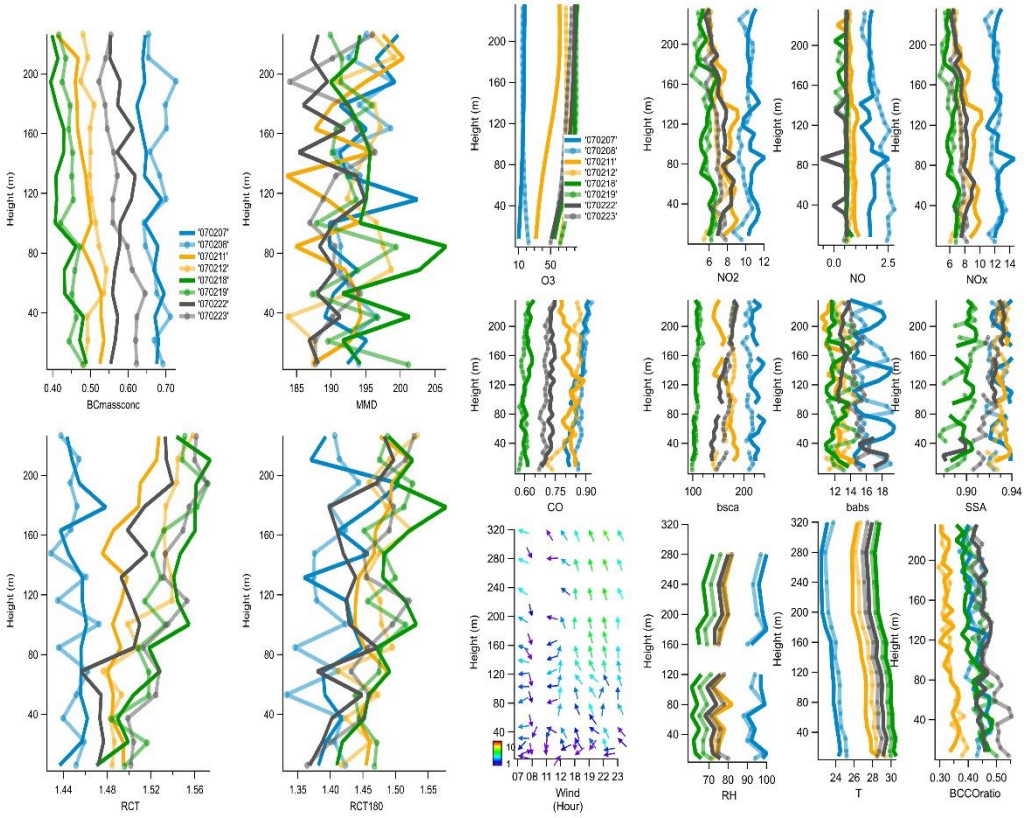
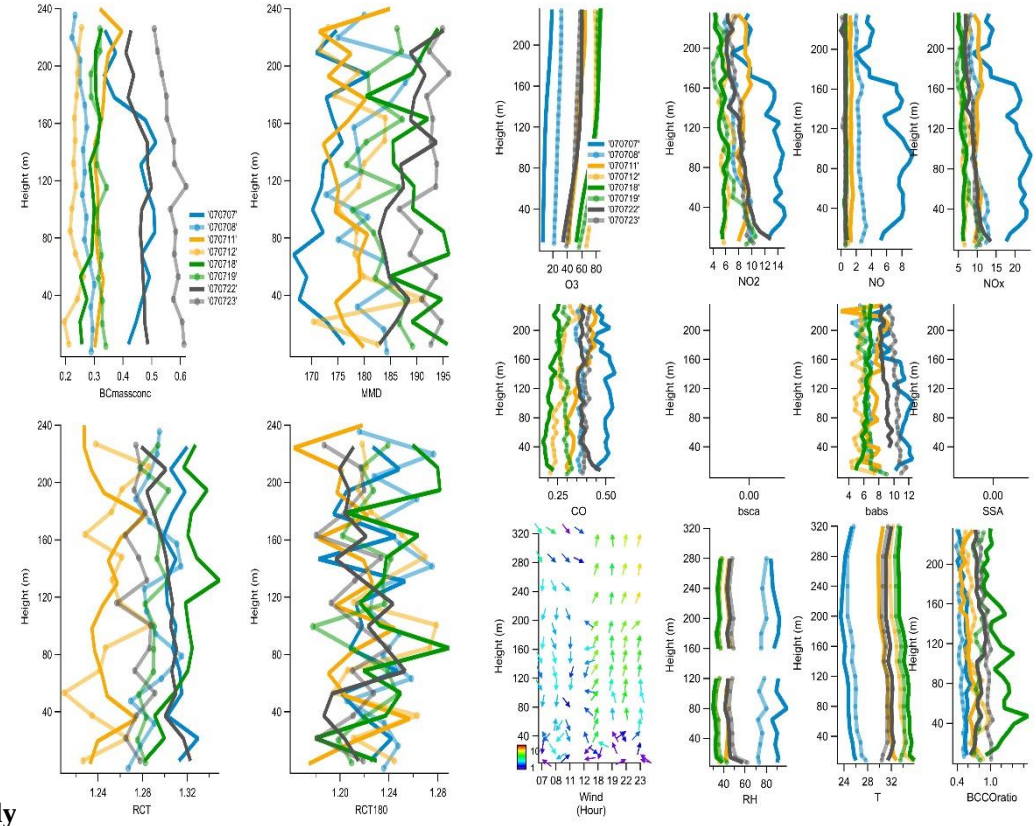


Figure S12 Vertical profiles during 2nd



July

Figure S13 Vertical profiles during 3rd July

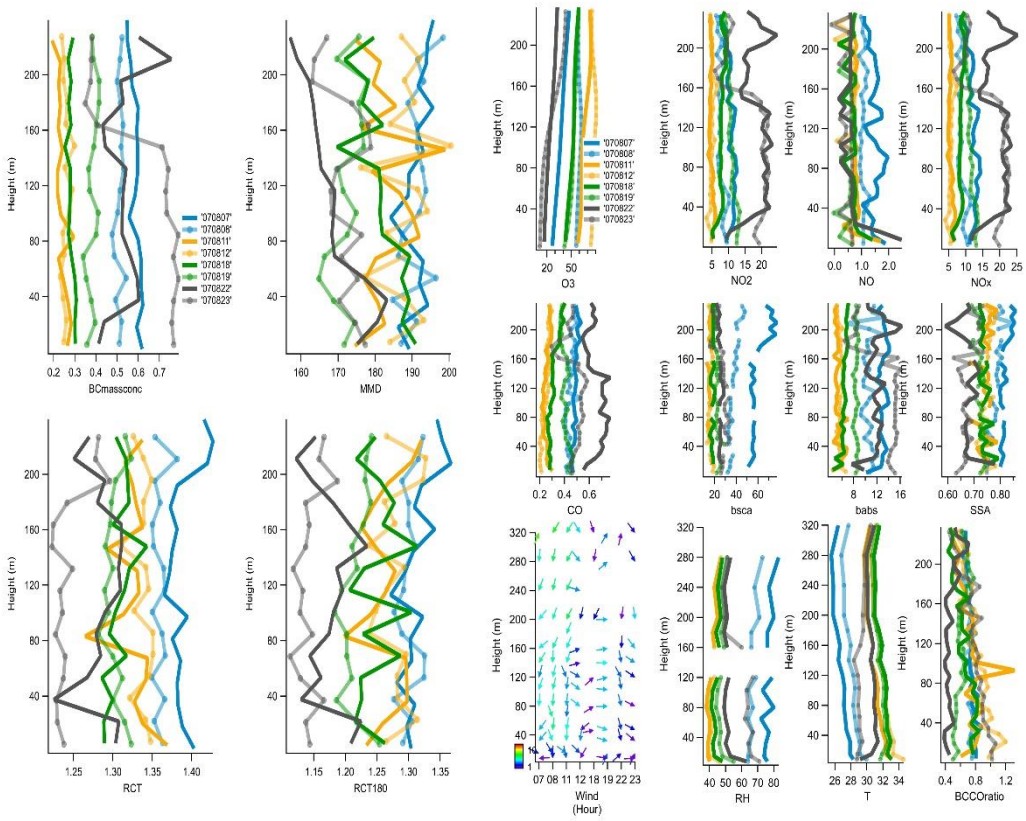


Figure S14 Vertical profiles during 8th July

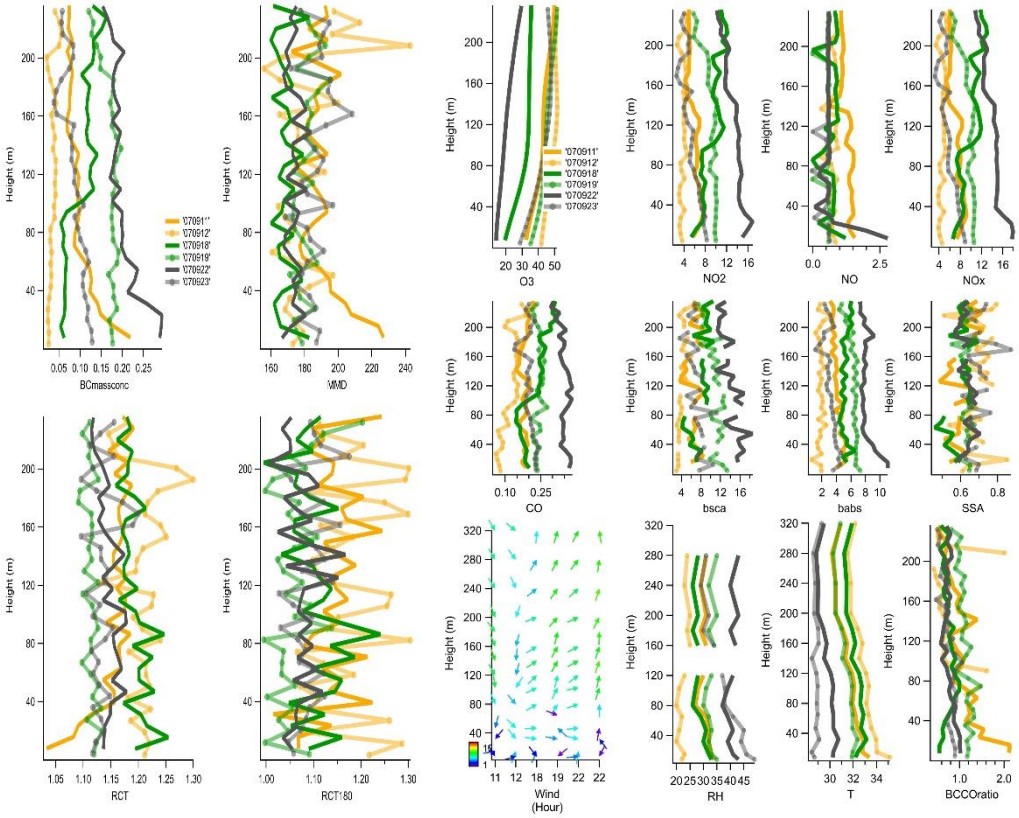


Figure S15 Vertical profiles during 9th July

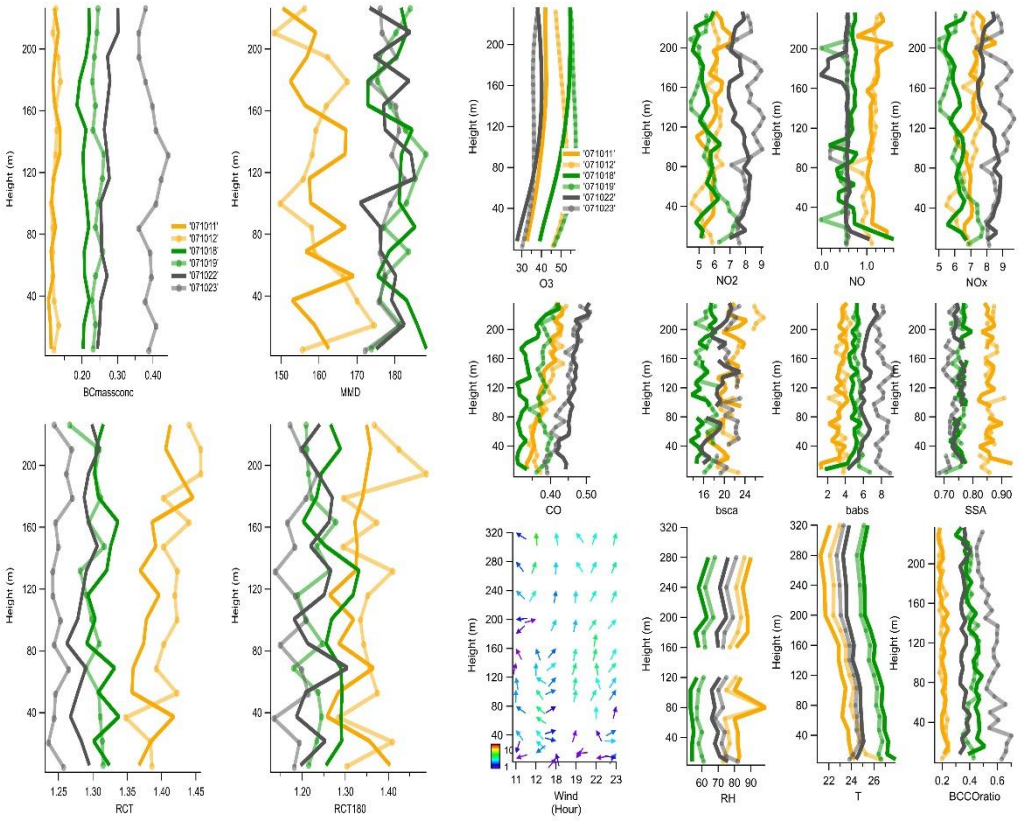


Figure S16 Vertical profiles during 10th July

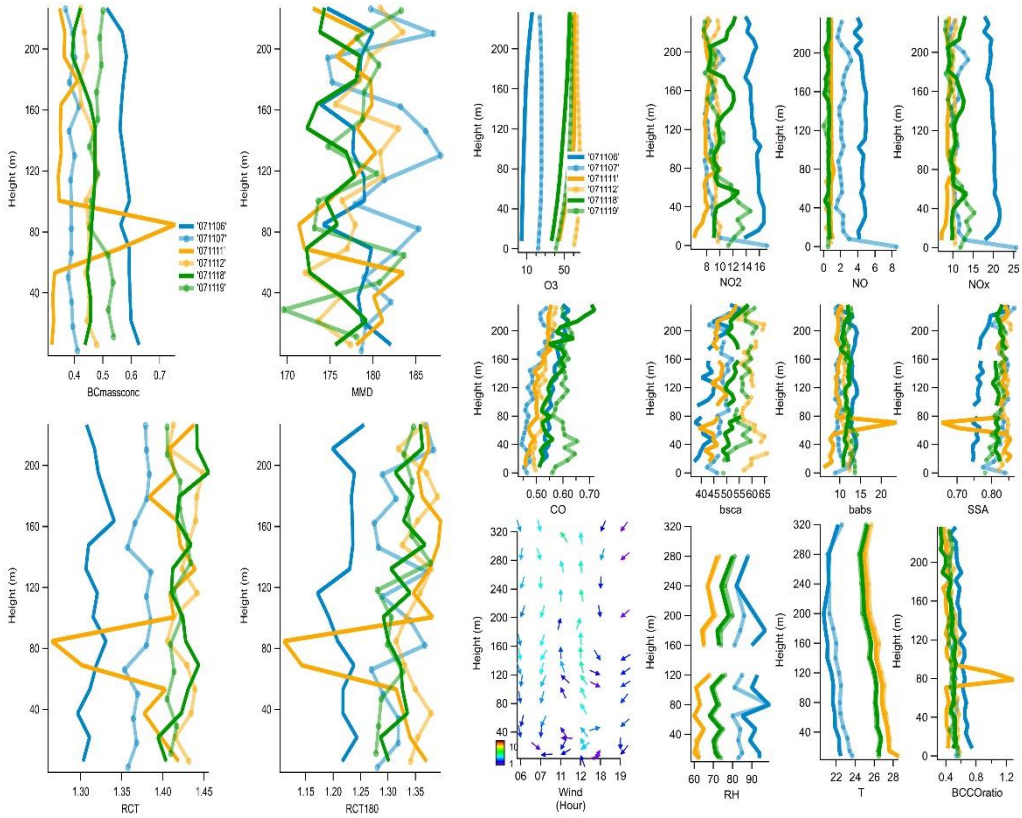


Figure S17 Vertical profiles during 11th July

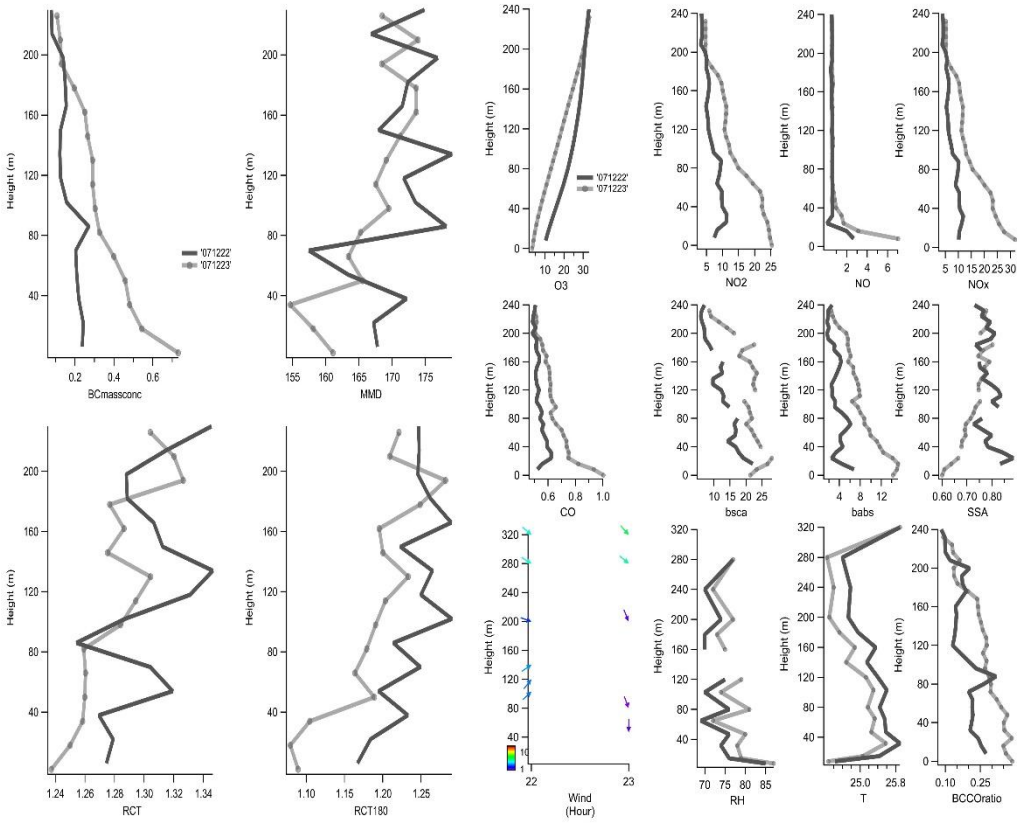


Figure S18 Vertical profiles during 12th July

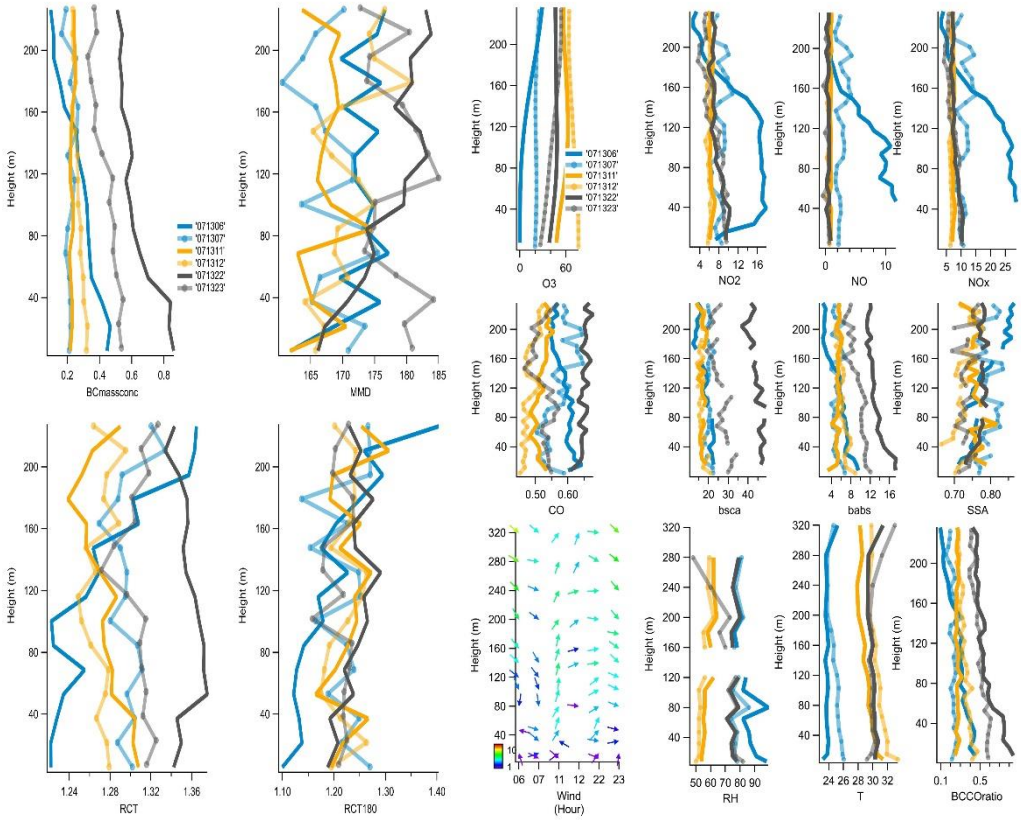


Figure S19 Vertical profiles during 13th July

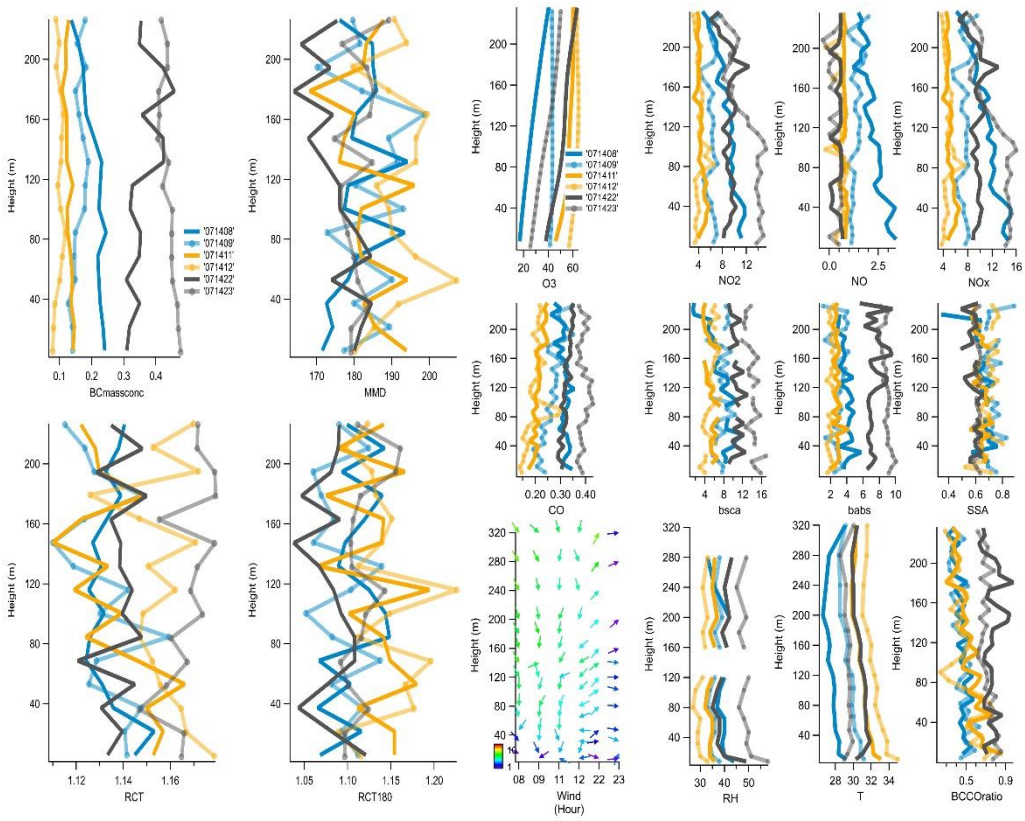


Figure S20 Vertical profiles during 14th July

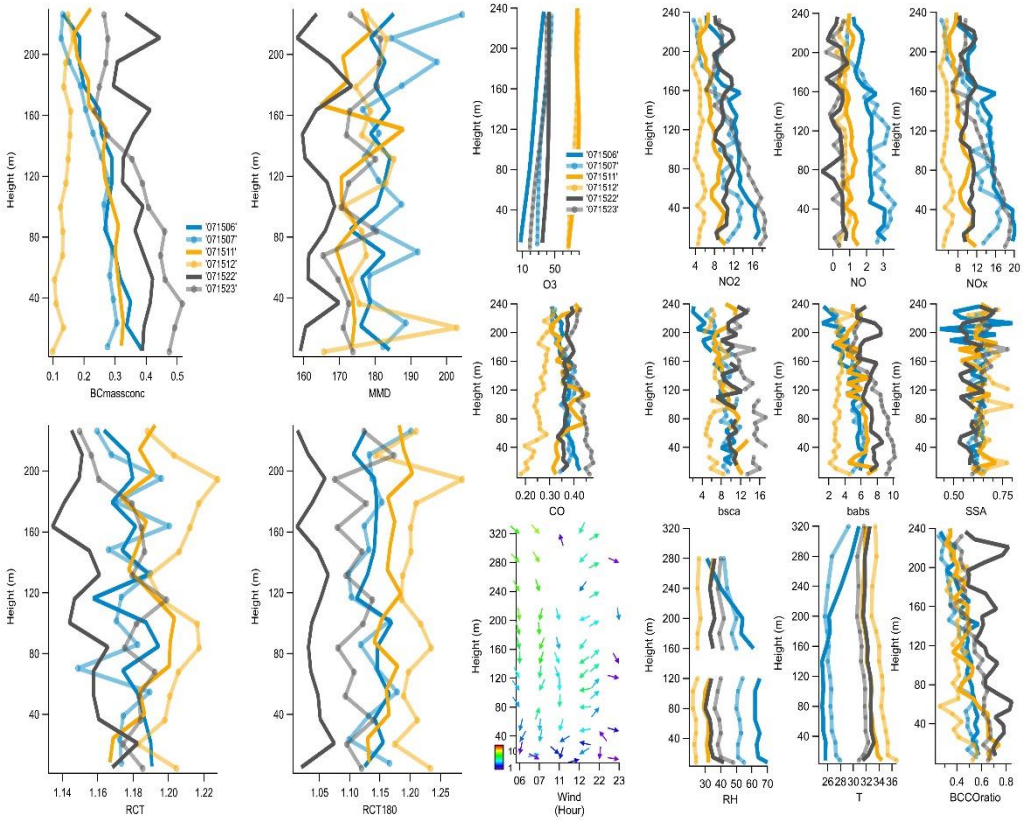


Figure S21 Vertical profiles during 15th July

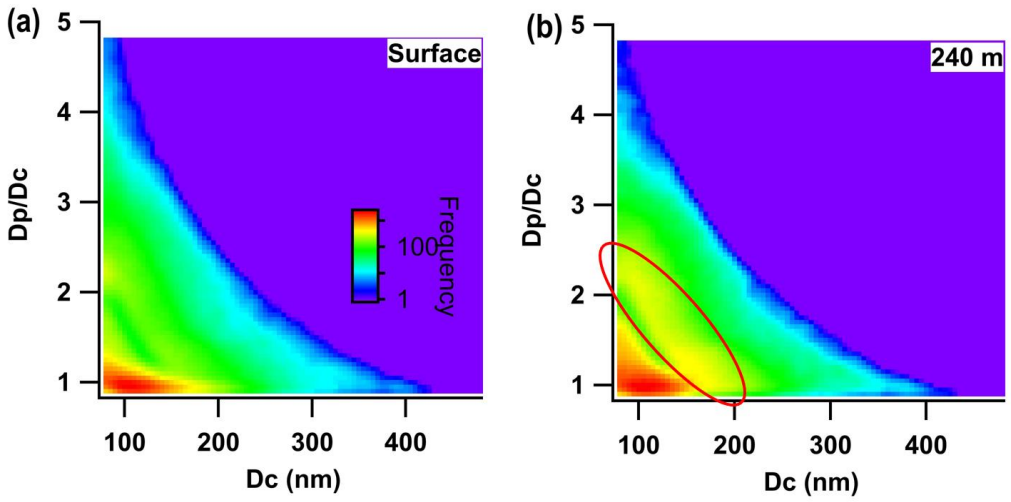


Figure S22 The size-resolved D_p/D_c at 23:00 27th June. (a) the surface level, (b) the 240 m level.

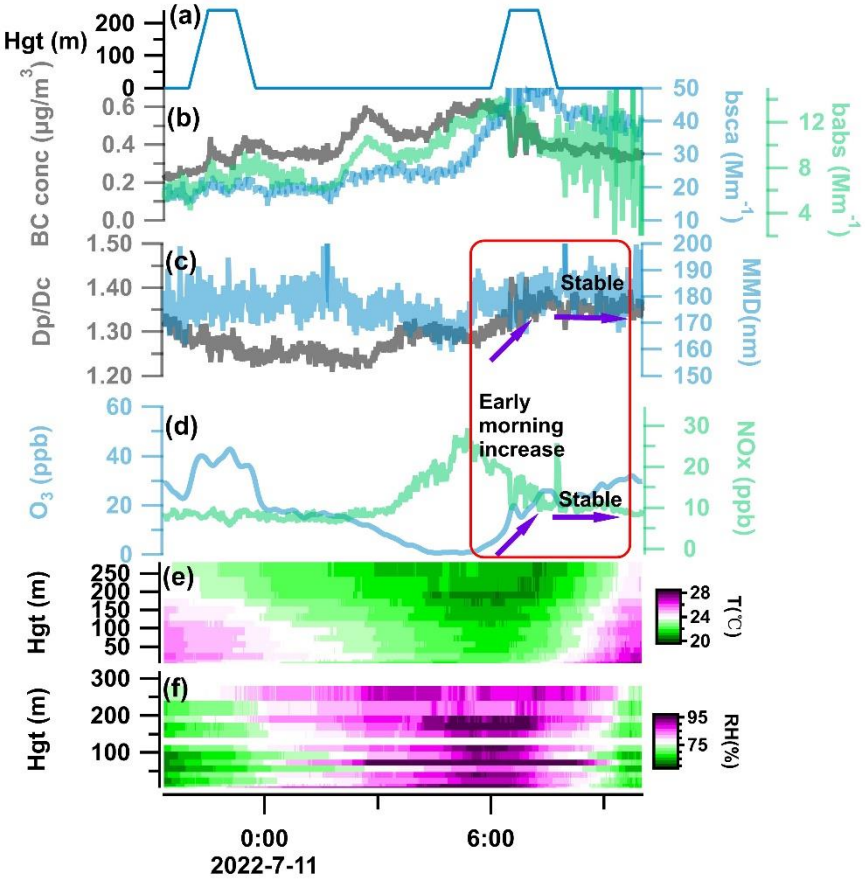


Figure S23 Another case of vertical mixing leading to the increase of O_3 and D_p/D_c in the morning.

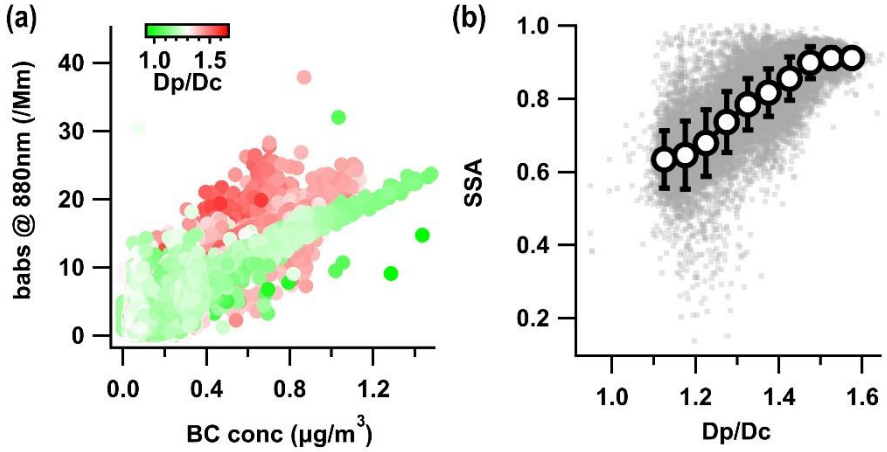


Figure S24 (a)The relationship between BC concentration and b_{abs}. (b)The relationship between SSA and D_p/D_c.

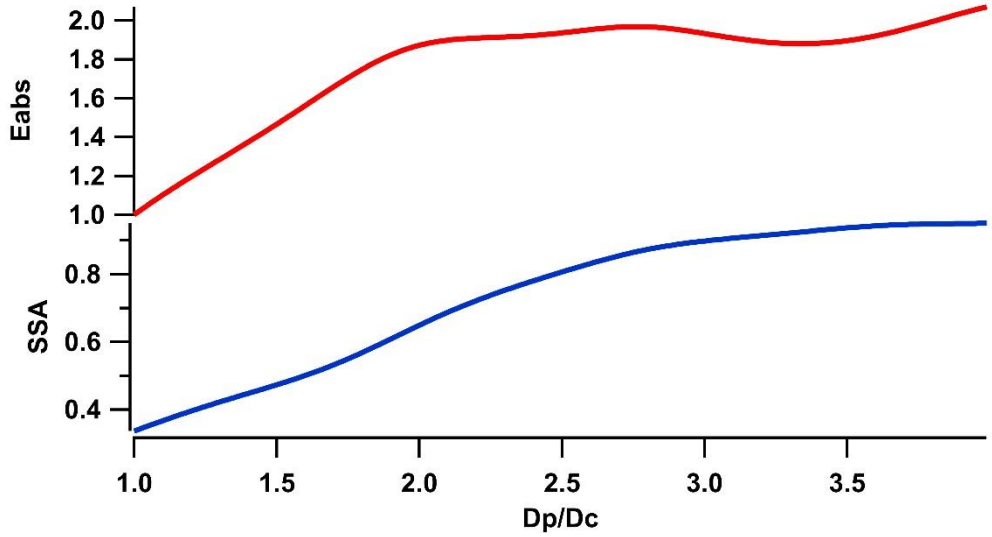


Figure S25 The variation of E_{abs} and SSA with D_p/D_c for BC-containing particles with D_c=170 nm through Mie-theory.

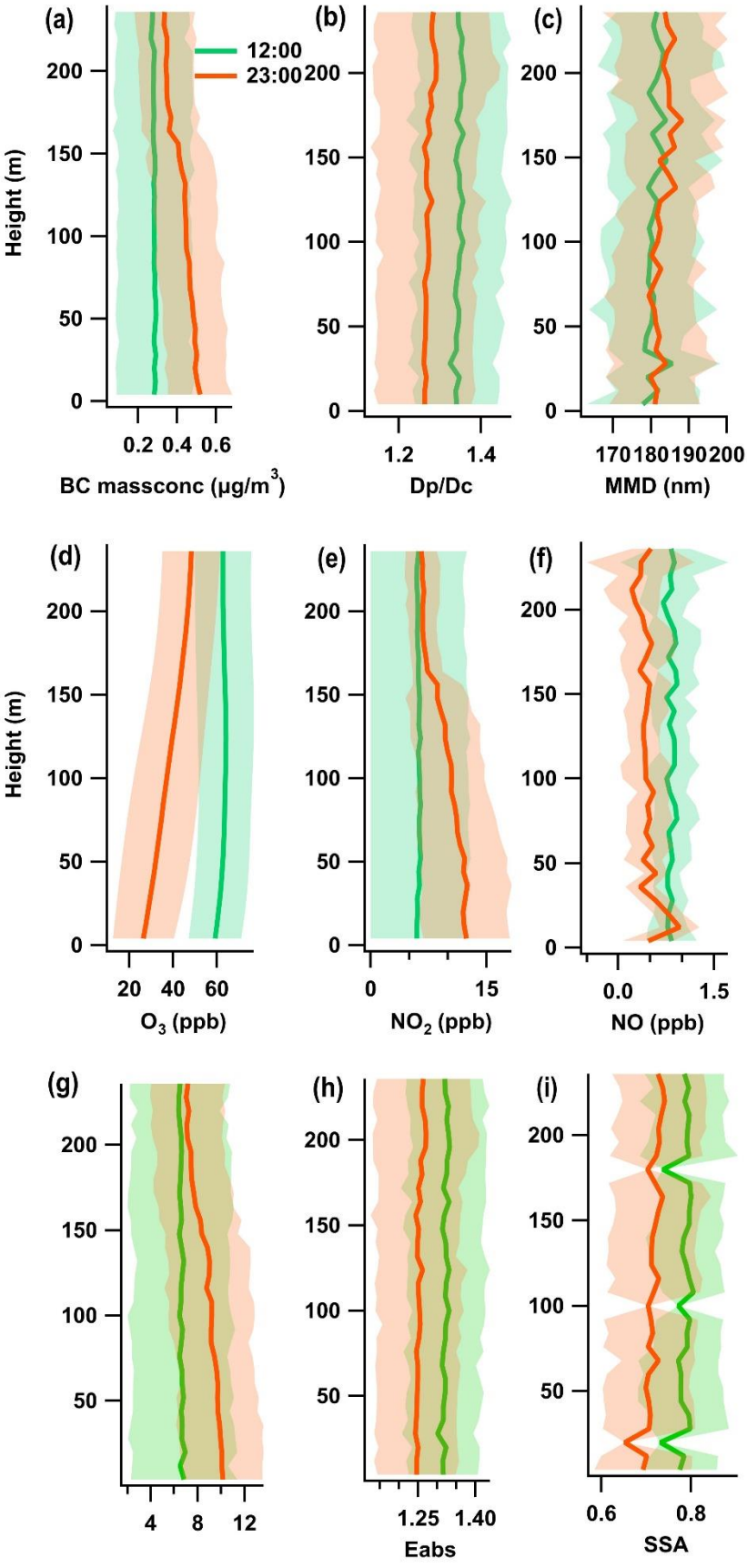


Figure S26 The same as Fig. 4 but with error bars.