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Vertical characterization of aerosol optical properties and brown carbon in winter in urban Beijing, China

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Table S1. A summary of continuous vertical measurements in this study.

Number	Height (m)	Date	Up starting time	Up ending time	Down starting time	Down ending time
1	260	11-25-2016	15:26:30	15:56:42	16:10:10	16:47:30
2	240	11-25-2016	18:47:25	19:12:08	19:22:25	19:46:38
3	240	11-25-2016	23:16:44	23:41:26	23:51:53	(11-26) 00:16:07
4	240	11-26-2016	04:26:43	04:51:26	05:02:14	05:26:32
5	260	11-26-2016	08:31:33	08:58:08	09:09:32	09:35:46
6	260	11-26-2016	13:27:17	13:54:05	14:04:47	14:31:03
7	260	11-30-2016	12:09:46	12:36:31	12:46:58	13:13:15
8	260	11-30-2016	15:00:58	15:27:40	15:40:36	16:06:46
9	200	11-30-2016	20:01:27	20:22:30	20:32:41	20:53:14
10	260	12-01-2016	08:09:22	08:36:02	08:46:24	09:12:55
11	260	12-01-2016	11:29:38	11:54:15	12:04:18	12:30:30
12	260	12-01-2016	14:55:15	15:21:55	15:31:35	15:57:46
13	240	12-01-2016	18:51:02	19:15:39	19:28:00	19:52:13
14	240	12-01-2016	23:19:12	23:43:53	(12-02) 00:01:28	(12-02) 00:25:06
15	240	12-02-2016	06:07:23	06:32:02	06:42:54	07:06:10
16	260	12-02-2016	09:10:43	09:37:22	09:51:43	10:17:54
17	260	12-02-2016	14:33:48	15:00:30	15:10:24	15:36:34
18	240	12-02-2016	19:34:42	19:59:19	20:10:34	20:34:45
19	240	12-03-2016	00:26:58	00:51:50	01:18:38	01:42:56
20	240	12-03-2016	06:05:06	06:29:43	06:40:45	07:04:59
21	260	12-03-2016	10:29:54	10:56:20	11:06:39	11:32:43
22	260	12-03-2016	15:45:28	16:12:10	16:22:45	16:49:04
23	240	12-03-2016	20:57:41	21:22:13	21:33:47	21:58:03
24	240	12-04-2016	02:05:38	02:30:20	02:38:48	03:03:03
25	260	12-04-2016	07:30:57	07:57:37	08:10:47	08:37:00

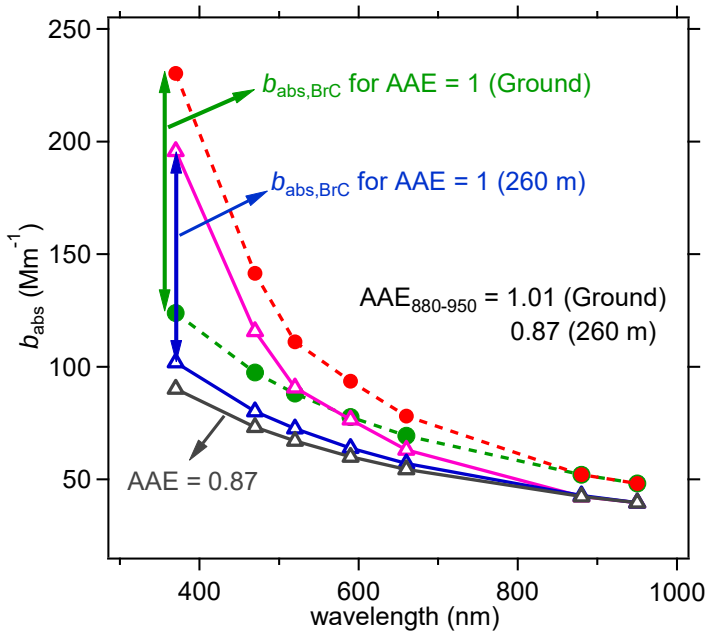

Figure S1. Measured b_{abs} at ground (red dots) and 260 m (pink triangles) as a function of wavelengths. Estimation of b_{abs} for pure BC are also shown with the assumption that AAE equal to 1 and values derived from b_{abs} at 880 and 950 nm.

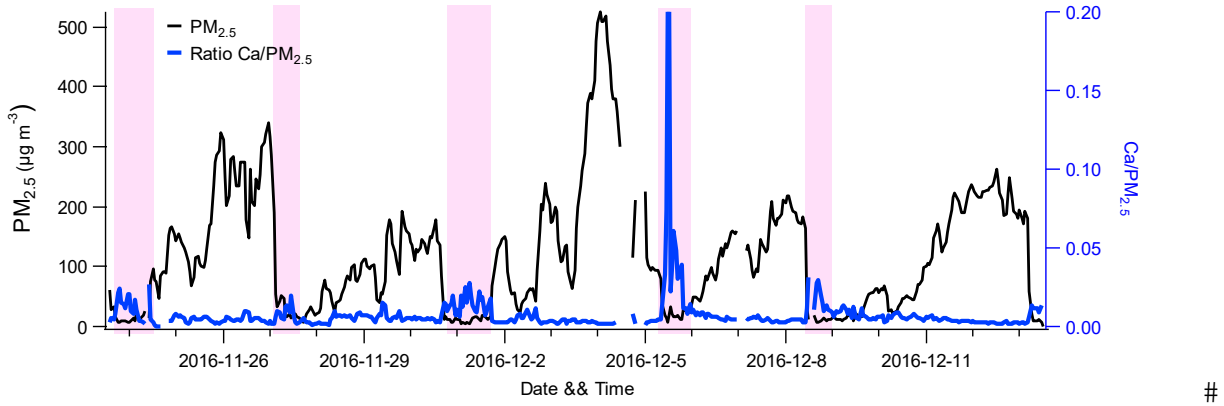

Figure S2. Time series of $PM_{2.5}$ and Ca content during this study. The periods with high $Ca/PM_{2.5}$ (shaded areas) are excluded when calculating the absorption and AAE of BrC.

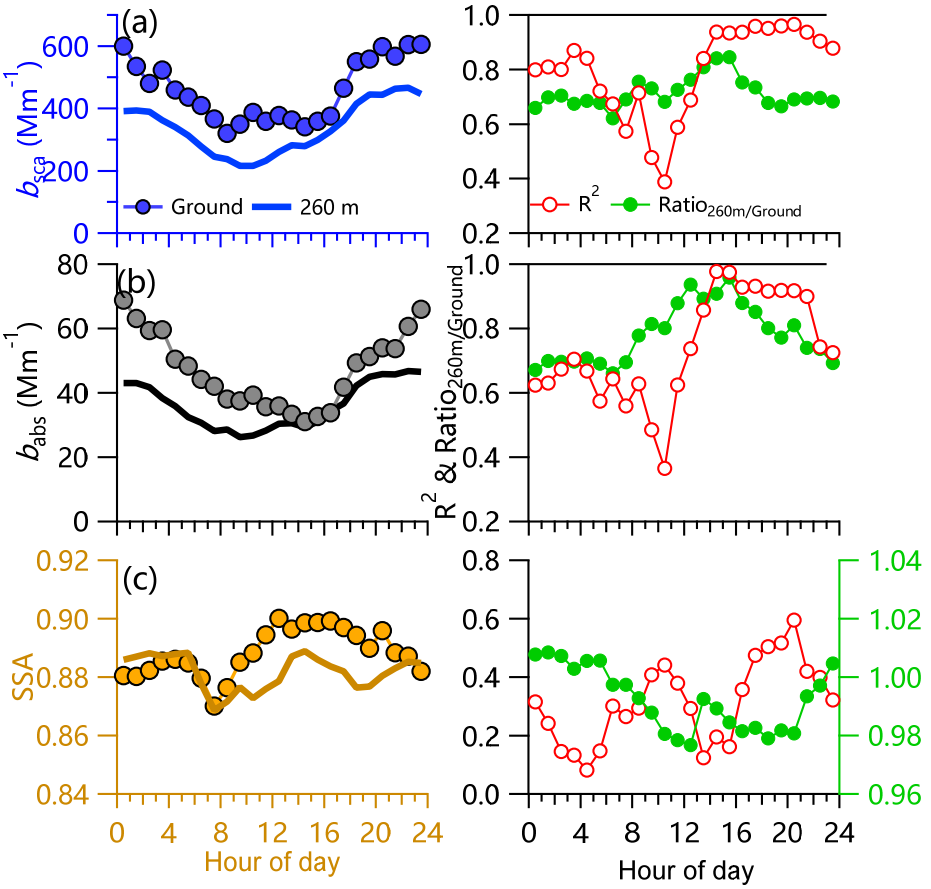

Figure S3. Diurnal cycles of (a) b_{sca}, (b) b_{abs}, and (c) SSA at 260 m and ground level for the entire study. Right panel shows the diurnal cycles of correlation coefficients (R^2) and ratio$_{260m/ground}$ for b_{sca}, b_{abs}, and SSA.#

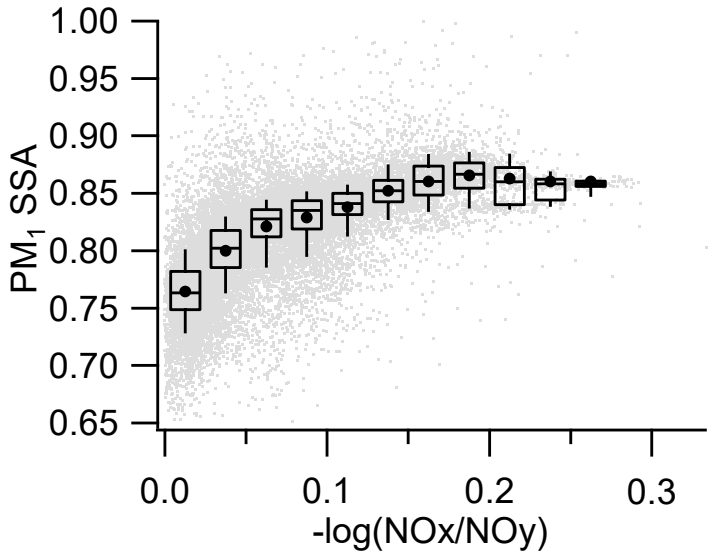

Figure S4. Single scattering albedo of PM_1 as a function of $-\log(NO_x/NO_y)$. The solid circles and horizontal lines are mean and median values, respectively. The bottom and top of the box are 25th and 75th percentiles, and the bottom and top whiskers are 10th and 90th percentiles.

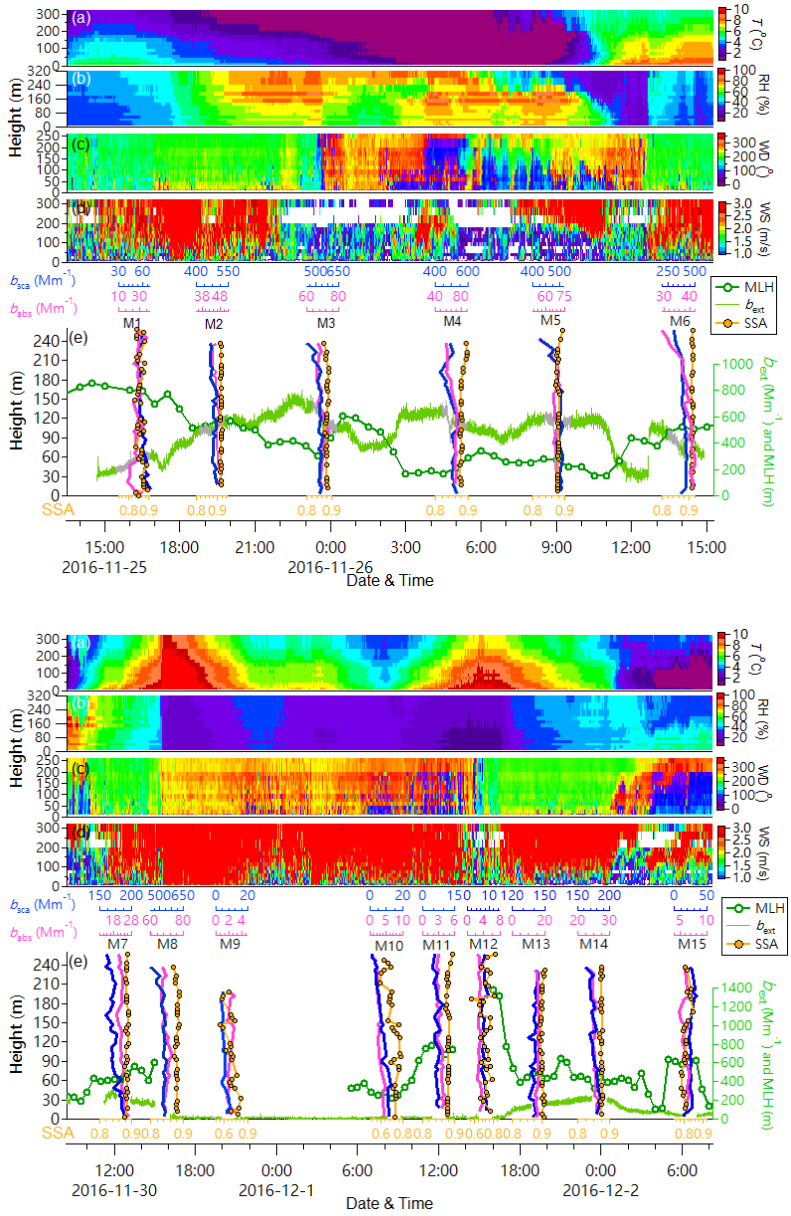

Figure S5. Evolution of vertical profiles of b_{sca}, b_{abs} and SSA during 25-26 November (top) and during 30 November – 2 December (bottom). Also shown are (a-d) meteorological variable of *T*, RH, WD, and WS, and (e) time series of b_{ext} at ground and MLH. M1-M15 refer to the number of measurements.

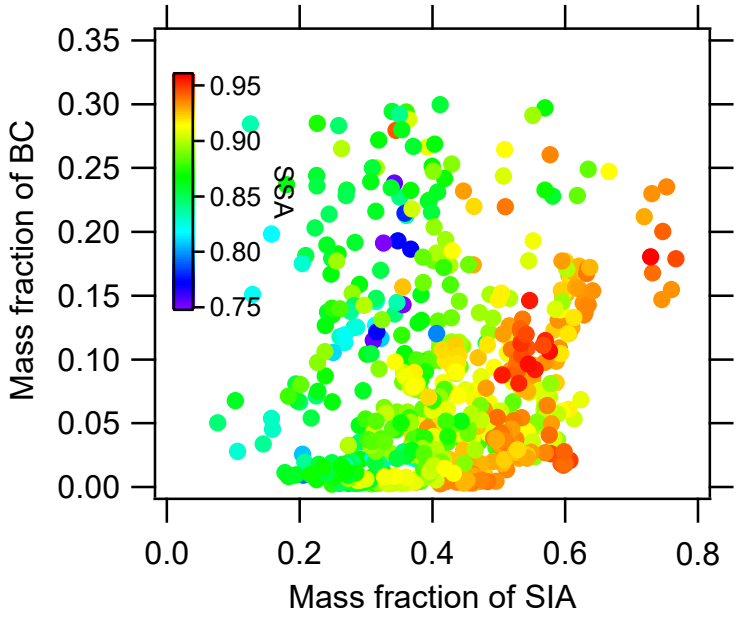

Figure S6. Relationship between mass fraction of BC and secondary inorganic aerosol (SIA) in PM_1, colored by SSA.

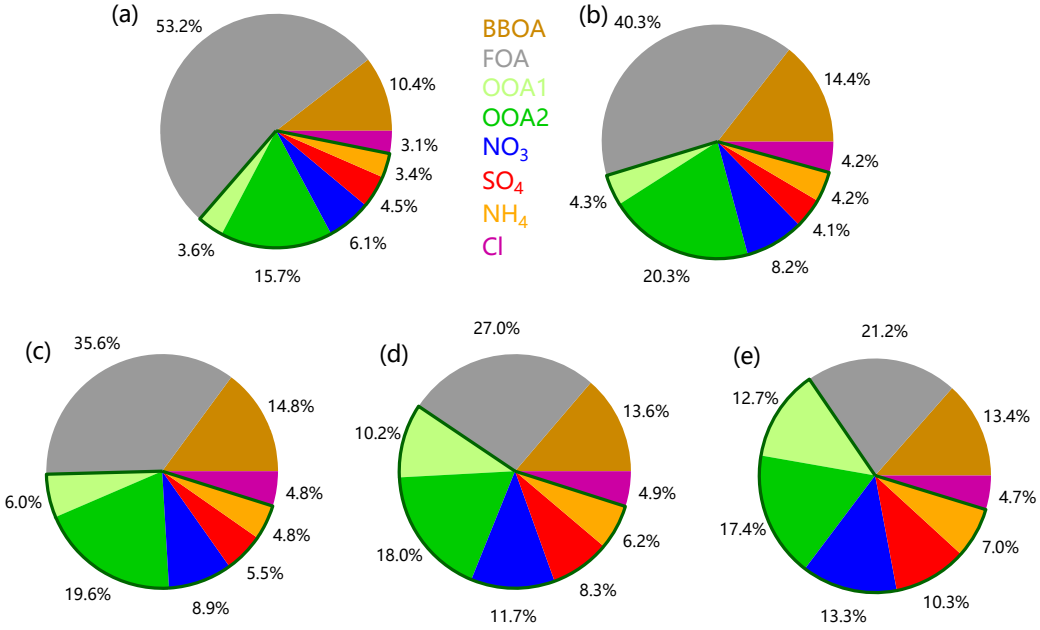

Figure S7. Composition of *r*BC coatings during different PM_1 levels: (a) < 50 μg m^{-3}, (b) 50 – 100 μg m^{-3}, (c) 100 – 150 μg m^{-3}, (d) 150 – 200 μg m^{-3}, (e) 200 – 250 μg m^{-3}.

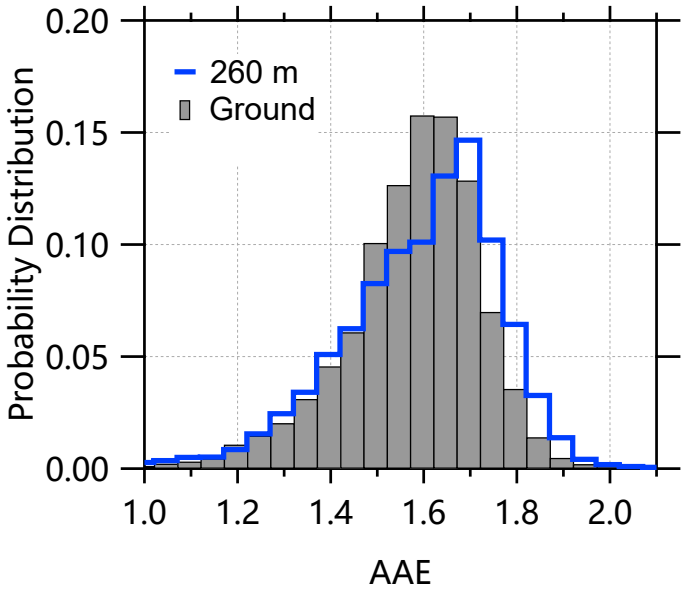

Figure S8. Probability distribution of absorption angstrom exponent (AAE) at ground level and at 260 m.#

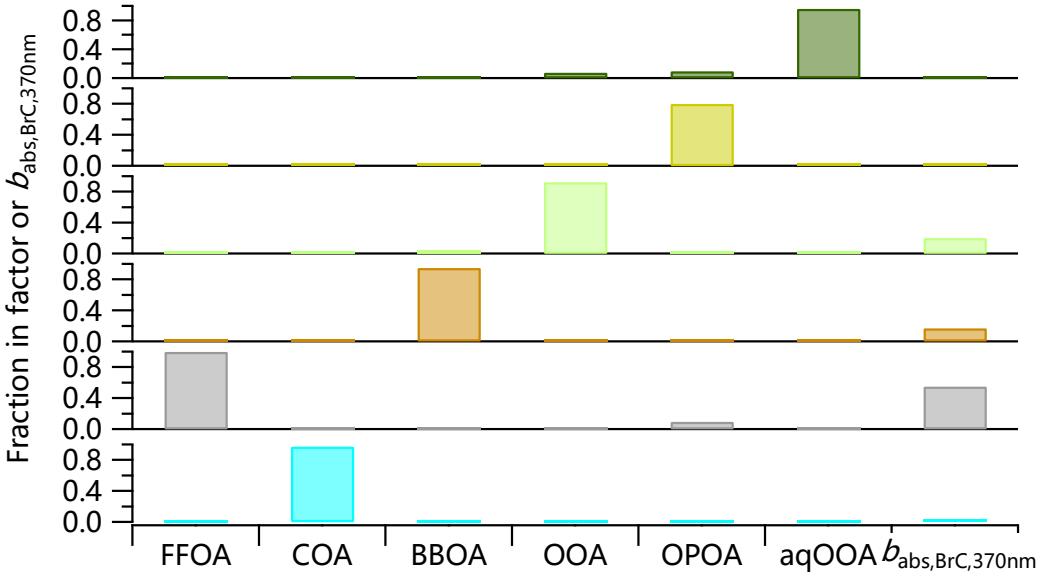

Figure S9. Factor profiles and the corresponding absorption apportionment analysis.