

Supplementary Information for:

Characterization and Source Apportionment of Fine and Coarse Particulate Matter in Houston, TX during DISCOVER-AQ

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S1: Detailed Calculation for BC Correction

Based on Schmid et al. [1] absorption coefficient correction (equation 1), calculation for light scattering (C) [1] and shadowing effect ($R(ATN)$) [2] are needed:

$$R(ATN) = \left(\frac{1}{f} - 1\right) \left(\frac{\ln ATN - \ln 10}{\ln 50 - \ln 10}\right) + 1, \quad (S1)$$

$$\frac{C}{C_{ref}} = \frac{\lambda^{A \ln(\lambda/nm) + B}}{\lambda_{ref}^{A \ln(\lambda_{ref}/nm) + B}}, \quad (S2)$$

The shadowing effect is negligible when the $ATN < 10$. The correction was made only when $ATN > 10$. For the equation S1, the f shadowing factor is devised by the linear fit equation for the attenuation of pure internally and externally mixed diesel soot:

$$f = a(1 - \omega_0) + 1, \quad (S3)$$

where the ω_0 is the single scattering albedo (SSA). An SSA value of 0.80 was used for the correction. This 0.80 value was an averaged SSA value based on measurements made at several sites across the Houston metropolitan area [3].

The light scattering correction, C value (Equation (S2)), is normalized to the C_{ref} value, at wavelength 552 nm, which is determined by the following equation:

$$C_{ref} = C^* + m_s \frac{\omega_0}{1 - \omega_0}, \quad (S4)$$

where $C^* = C_{532} = 2.1$ for pure or externally mixed soot [1] and m_s is non-negligible aerosol scattering correction factor. The m_s is a relationship factor to directly compare C and C^* which is 0.0523 [4].

The values for A and B for equation S2 are derived using a quadratic fit of A and B with respect to the absorption Angstrom exponent (AAE; α), and given by:

$$A = 0.102 \alpha_a^2 - 0.187 \alpha_a - 0.141, \quad (S5)$$

$$B = -1.275 \alpha_a^2 + 2.564 \alpha_a + 1.827, \quad (S6)$$

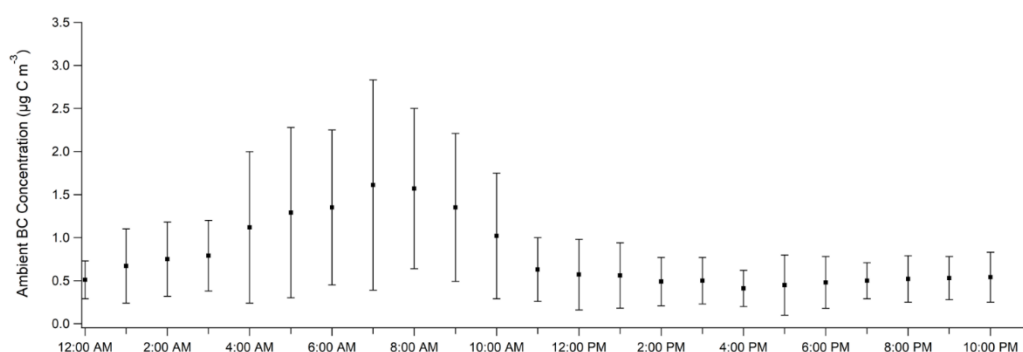


Figure S1. Hourly averaged ambient BC concentration including 1 standard deviation error bars.

Table S1. Bulk carbon including OC and EC (and respectively uncertainty) ambient concentration for all PM_{2.5} and TSP samples from MT. Each sample is identified by the sample date (YYMMDD) followed by the sampling period which includes morning (M), afternoon (A), day (D), night (N) and 24 h samples.

Sample Type	Sample (YYMMDD_period)	OC ($\mu\text{g m}^{-3}$)	OC unc ($\mu\text{g m}^{-3}$)	EC ($\mu\text{g m}^{-3}$)	EC unc ($\mu\text{g m}^{-3}$)
PM _{2.5}	130904_M	1.43	0.44	0.67	0.34
	130904_A	2.89	0.27	0.34	0.12
	130904_N	2.38	0.24	0.47	0.12
	130905_M	6.90	0.71	1.94	0.40
	130906_24h	3.38	0.27	0.59	0.11
	130907_24h	3.43	0.27	0.64	0.12
	130908_D	1.77	0.18	0.38	0.10
	130908_24h	1.51	0.18	0.27	0.10
	130909_D	2.95	0.24	0.44	0.10
	130909_24h	2.65	0.23	0.36	0.10
	130910_D	3.77	0.28	0.56	0.11
	130910_24h	3.36	0.27	0.48	0.11
	130911_D	3.49	0.27	0.37	0.10
	130911_24h	3.62	0.28	0.46	0.11
	130912_D	3.56	0.27	0.49	0.10
	130912_24h	2.79	0.24	0.52	0.11
	130913_D	5.18	0.35	0.86	0.12
	130913_24h	4.59	0.33	0.72	0.12
	130914_D	5.88	0.39	0.44	0.10
	130914_24h	5.78	0.39	0.39	0.10
	130915_D	3.41	0.27	0.44	0.10
	130915_24h	2.43	0.23	0.31	0.10
	130916_D	1.92	0.19	0.53	0.10
	130916_24h	2.22	0.21	0.54	0.11
	130917_M	3.47	0.49	1.25	0.33
	130917_A	1.62	0.21	0.24	0.12
	130917_24h	2.11	0.21	0.58	0.11
	130918_D	2.38	0.21	0.56	0.10
	130918_24h	1.56	0.18	0.39	0.10
	130919_M	3.34	0.49	1.36	0.33
	130919_A	1.68	0.22	0.43	0.13
	130919_24h	1.23	0.16	0.69	0.12
	130920_D	0.79	0.13	0.33	0.09
	130920_24h	0.79	0.14	0.32	0.10
	130921_D	2.34	0.21	0.15	0.08
	130921_24h	3.27	0.27	0.16	0.09
	130922_D	3.75	0.28	0.17	0.08
	130922_24h	3.85	0.30	0.18	0.09
	130923_D	4.81	0.33	0.43	0.10
	130923_24h	5.13	0.36	0.42	0.11
	130924_D	5.38	0.36	0.47	0.10
	130924_24h	7.06	0.46	0.75	0.12
	130925_D	6.94	0.44	0.71	0.11
	130925_24h	6.41	0.42	0.51	0.11
	130926_D	3.93	0.29	0.31	0.09
	130926_24h	4.63	0.33	0.35	0.10
	130927_D	3.03	0.24	0.31	0.09
	130927_24h	3.02	0.25	0.29	0.10

	130928_D	2.10	0.20	0.19	0.09
	130928_24h	2.04	0.20	0.24	0.09
TSP	130904_M	5.60	0.64	0.97	0.38
	130904_A	6.57	0.45	0.76	0.15
	130904_N	5.37	0.39	0.97	0.16
	130905_M	15.98	1.14	2.32	0.44
	130905_N	4.43	0.34	0.80	0.15
	130906_N	2.84	0.26	0.73	0.15
	130907_D	6.78	0.43	1.03	0.14
	130907_N	7.64	0.50	1.02	0.16
	130908_D	4.55	0.32	0.48	0.11
	130908_N	3.10	0.27	0.62	0.14
	130909_D	6.71	0.43	1.08	0.14
	130909_N	4.97	0.36	0.71	0.14
	130910_D	5.84	0.38	1.07	0.14
	130910_N	5.55	0.39	0.86	0.15
	130911_D	7.69	0.48	1.10	0.14
	130911_N	6.39	0.46	1.34	0.20
	130912_D	8.52	0.52	1.40	0.16
	130913_M	14.98	1.05	3.49	0.46
	130913_A	10.69	0.78	0.83	0.28
	130914_D	10.92	0.64	1.31	0.15
	130914_N	8.06	0.53	0.80	0.16
	130915_D	6.13	0.40	0.91	0.13
	130915_N	2.62	0.25	0.22	0.12
	130916_M	10.35	0.82	1.92	0.38
	130916_N	4.68	0.35	0.81	0.15
	130917_M	11.30	0.88	2.13	0.40
	130917_A	3.36	0.29	0.48	0.14
	130917_N	5.29	0.39	0.87	0.16
	130918_24h	4.12	0.26	0.94	0.10
	130919_24h	3.04	0.20	0.89	0.09
	130921_D	4.06	0.29	0.19	0.09
	130922_D	7.29	0.45	0.25	0.09
	130923_D	9.92	0.58	0.92	0.13
	130923_N	8.78	0.56	0.87	0.16
	130924_D	8.49	0.51	0.77	0.12
	130924_N	13.95	0.83	1.33	0.19
	130925_D	10.29	0.60	1.03	0.13
	130925_N	7.22	0.51	0.90	0.18
	130926_D	8.17	0.49	0.91	0.13
	130926_N	6.24	0.46	0.67	0.17
	130927_D	6.70	0.42	0.93	0.13
	130928_D	3.77	0.27	0.59	0.11
	130916_N	4.68	0.35	0.81	0.15
	130917_M	11.30	0.88	2.13	0.40
	130917_A	3.36	0.29	0.48	0.14
	130917_N	5.29	0.39	0.87	0.16
	130918_24h	4.12	0.26	0.94	0.10
	130919_24h	3.04	0.20	0.89	0.09
	130921_D	4.06	0.29	0.19	0.09
	130922_D	7.29	0.45	0.25	0.09
	130923_D	9.92	0.58	0.92	0.13
	130923_N	8.78	0.56	0.87	0.16
	130924_D	8.49	0.51	0.77	0.12
	130924_N	13.95	0.83	1.33	0.19

130925_D	10.29	0.60	1.03	0.13
130925_N	7.22	0.51	0.90	0.18
130926_D	8.17	0.49	0.91	0.13
130926_N	6.24	0.46	0.67	0.17
130927_D	6.70	0.42	0.93	0.13
130928_D	3.77	0.27	0.59	0.11

Table S2. Contemporary and fossil carbon (and respective uncertainty) ambient concentration of TC from ^{14}C analysis and its uncertainty for all PM_{2.5} and TSP samples from MT. Samples from Moody Tower (MT) and La Porte (LP) are included. Each sample is identified by the sample date (YYMMDD) followed by the sampling period which includes day (D), night (N) and 24 h samples. .

Site - Sample Type	Sample (YYMMDD_ period)	Contemporary Carbon ($\mu\text{g m}^{-3}$)	Contemporary Carbon unc ($\mu\text{g m}^{-3}$)	Fossil Carbon ($\mu\text{g m}^{-3}$)	Fossil Carbon unc ($\mu\text{g m}^{-3}$)
MT-PM _{2.5}	130921_D	1.95	0.24	0.54	0.24
	130922_D	2.30	0.15	1.61	0.15
	130923_D	2.90	0.19	2.33	0.19
	130923_24h	3.38	0.23	2.18	0.23
	130924_D	4.11	0.29	1.75	0.29
	130924_24h	5.09	0.32	2.72	0.32
	130925_D	4.20	0.26	3.45	0.26
	130925_24h	4.14	0.27	2.77	0.27
	130926_D	2.80	0.21	1.45	0.21
	130926_24h	3.32	0.25	1.66	0.25
	130927_D	1.61	0.11	1.72	0.11
	130928_D	1.34	0.12	0.96	0.12
	130925_24h	4.14	0.27	2.77	0.27
	130926_D	2.80	0.21	1.45	0.21
	130926_24h	3.32	0.25	1.66	0.25
	130927_D	1.61	0.11	1.72	0.11
	130928_D	1.34	0.12	0.96	0.12
MT-TSP	130923_D	5.54	0.34	5.30	0.34
	130923_N	6.06	0.35	3.60	0.35
	130924_D	5.69	0.33	3.57	0.33
	130924_N	8.67	0.52	6.61	0.52
	130925_D	6.02	0.36	5.31	0.36
	130925_N	5.25	0.31	2.87	0.31
LP-TSP	130921_24h	6.41	0.36	1.35	0.36
	130922_24h	8.45	0.47	1.76	0.47
	130923_24h	5.64	0.33	3.08	0.33
	130924_24h	8.44	0.49	4.13	0.49
	130925_24h	8.41	0.51	8.01	0.51
	130926_24h	5.01	0.30	3.90	0.30

Table S3. Hourly-averaged ambient BC concentration during sampling period. Dates are formatted as YYMMDD.

Time	Date						
	130903	130904	130905	130906	130907	130908	130909
0:00	0.39	0.66	0.79	0.58	0.86	0.95	0.40
1:00	0.19	0.60	0.64	1.66	1.09	1.99	0.87
2:00	0.26	0.57	1.30	1.35	1.27	1.33	0.86
3:00	0.21	0.98	1.51	0.80	0.82	1.26	0.59
4:00	0.24	0.68	1.58	1.30	1.35	1.03	0.66
5:00	0.39	0.59	3.29	2.87	1.66	1.30	1.08

6:00	0.81	0.78	2.62	3.87	1.62	1.37	0.77
7:00	0.62	0.93	3.31	5.30	2.62	1.25	2.50
8:00	0.62	1.51	2.44	2.72	2.94	0.94	3.28
9:00	0.57	1.67	1.59	1.48	2.15	0.78	2.40
10:00	0.60	0.71	0.98	1.71	0.38	0.86	0.59
11:00	0.66	1.58	0.94	0.53	1.02	0.39	0.37
12:00	0.35	1.98	1.38	1.13	0.50	0.18	0.47
13:00	0.53	0.78	0.83	1.45	0.89	0.27	0.47
14:00	0.38	0.65	0.76	1.41	0.41	0.36	0.40
15:00	0.41	0.59	0.98	0.75	0.73	0.30	0.65
16:00	0.41	0.37	1.06	0.23	0.83	0.25	0.42
17:00	0.30	0.51	0.69	0.34	0.95	0.23	0.59
18:00	0.27	0.75	0.43	0.35	0.43	0.48	0.78
19:00	0.32	0.42	0.40	0.32	0.57	0.45	0.41
20:00	0.34	0.44	0.37	0.48	0.66	0.61	1.01
21:00	0.24	0.64	0.42	0.51	0.84	0.36	0.68
22:00	0.49	0.66	0.51	0.77	0.63	0.55	0.29
23:00	0.52	0.57	0.49	1.96	0.87	1.22	0.44

Date							
Time	130910	130911	130912	130913	130914	130915	130916
0:00	0.49	0.51	0.42	0.31	0.62	0.65	0.68
1:00	0.33	0.56	0.65	0.59	0.82	0.96	0.64
2:00	0.37	0.54	0.65	0.90	0.63	1.61	0.49
3:00	0.67	1.48	1.38	0.64	0.92	1.11	0.73
4:00	1.23	2.18	2.96	2.34	3.03	1.00	0.86
5:00	1.91	1.36	3.04	2.14	2.25	0.95	0.99
6:00	2.49	1.34	2.09	2.65	2.04	1.74	1.05
7:00	3.47	2.01	1.94	3.39	1.97	2.40	1.58
8:00	2.45	1.78	1.48	3.30	0.97	2.51	1.61
9:00	3.02	1.81	1.13	2.54	1.02	2.49	1.46
10:00	2.75	1.37	0.90	1.37	0.77	1.37	1.74
11:00	0.52	0.61	0.58	1.00	0.90	0.40	1.25
12:00	0.52	0.59	0.50	0.47	0.91	0.29	1.15
13:00	1.16	0.65	0.41	0.31	0.99	0.21	1.67
14:00	0.68	0.47	0.36	0.41	0.61	0.31	1.29
15:00	0.51	0.60	0.37	0.49	0.70	0.32	1.44
16:00	0.47	0.58	0.45	0.49	0.69	0.29	0.61
17:00	0.36	0.53	0.26	0.41	0.62	0.31	1.99
18:00	0.33	0.44	0.28	0.36	0.64	0.34	1.78
19:00	0.43	0.43	0.44	0.47	0.96	1.28	0.72
20:00	0.41	0.29	0.45	0.42	1.07	0.25	0.68
21:00	0.51	0.35	0.52	0.42	0.48	0.38	0.83
22:00	1.55	0.60	0.48	0.45	0.50	0.32	0.84
23:00	0.52	0.51	0.40	0.47	0.50	0.64	0.54

Date							
Time	130917	130918	130919	130920	130921	130922	130923
0:00	0.48	0.51	0.14	0.26	0.37	0.41	0.34
1:00	0.43	0.43	0.21	1.06	0.30	0.50	0.38
2:00	1.81	0.56	0.21	0.89	0.32	0.41	0.35
3:00	1.56	1.37	0.23	0.78	0.22	0.58	0.26
4:00	1.86	2.68	0.19	1.91	0.30	0.22	0.30
5:00	1.34	3.31	0.67	2.29	0.20	0.15	0.35
6:00	1.96	2.28	1.14	1.56	0.28	0.19	0.49
7:00	1.81	1.70	1.24	0.23	0.26	0.25	0.71
8:00	2.90	1.46	1.71	1.32	0.37	0.30	0.88
9:00	3.37	1.56	1.74	0.45	0.39	0.24	0.83

10:00	3.37	0.86	1.14	0.44	0.47	0.23	0.96
11:00	0.50	0.42	0.56	0.28	0.28	0.22	0.84
12:00	0.23	0.41	0.24	0.20	0.37	0.18	0.75
13:00	0.24	0.34	0.33	0.21	0.30	0.22	0.74
14:00	0.26	0.45	0.49	0.22	0.29	0.13	0.41
15:00	0.29	0.30	0.58	0.16	0.33	0.14	0.58
16:00	0.30	0.15	0.28	0.10	0.32	0.10	0.51
17:00	0.29	0.16	0.33	0.16	0.26	0.13	0.54
18:00	0.26	0.18	0.60	0.29	0.36	0.22	0.62
19:00	0.40	0.21	0.55	0.35	0.50	0.51	0.64
20:00	0.53	0.21	1.05	0.41	0.48	0.31	0.82
21:00	0.51	0.17	0.70	0.32	0.20	0.41	0.81
22:00	0.55	0.27	0.33	0.27	0.40	0.41	0.63
23:00	0.71	0.15	0.13	0.23	0.25	0.42	0.48
Date							
Time	130924	130925	130926	130927	130928	130929	130930
0:00	0.35	1.14	0.46	0.47	0.40	0.39	0.39
1:00	0.42	1.31	0.56	0.75	0.41	0.23	0.23
2:00	0.63	1.09	0.49	0.65	0.39	0.55	0.55
3:00	0.57	0.80	0.47	0.75	0.35	0.50	0.50
4:00	0.64	0.85	0.43	0.68	0.30	0.28	0.28
5:00	0.74	0.64	0.45	1.02	0.63	0.23	0.23
6:00	0.68	1.01	0.74	0.87	0.81	0.23	0.23
7:00	0.88	1.30	0.55	1.51	1.01	0.21	0.21
8:00	1.12	1.77	0.95	1.22	0.86	0.24	0.24
9:00	1.40	1.26	0.77	0.77	0.40	0.28	0.28
10:00	1.30	1.42	0.80	0.59	0.39	0.19	0.19
11:00	0.82	1.38	0.36	0.55	0.24	0.23	0.23
12:00	0.46	0.86	0.40	0.52	0.44	0.27	0.27
13:00	0.39	0.42	0.22	0.50	0.31	0.38	0.38
14:00	0.45	0.43	0.28	0.50	0.63	0.33	0.33
15:00	0.29	0.38	0.40	0.60	0.48	0.32	0.32
16:00	0.26	0.37	0.30	0.57	0.42	0.32	0.32
17:00	0.25	0.37	0.25	0.40	0.34	0.53	0.53
18:00	0.34	0.59	0.31	0.44	0.58	0.54	0.54
19:00	0.60	0.50	0.39	0.37	0.51	0.43	0.43
20:00	1.18	0.32	0.43	0.42	0.47	0.30	0.30
21:00	1.38	0.87	0.38	0.40	0.68	0.46	0.46
22:00	1.18	0.81	0.36	0.41	0.36	0.30	0.30
23:00	1.45	0.48	0.56	0.47	0.37	0.34	0.34

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