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Chromophores and chemical compositions of brown carbon aerosol before and after photooxidation of combustion emissions

Feng Jiang et al.

Correspondence to: Feng Jiang (jiangfeng@aust.edu.cn) and Harald Saathoff (harald.saathoff@kit.edu)

S1. Explanation of Equations

We observed typically about 2871 mass peaks corresponding to different oxygenated organic compounds in particles by using FIGARO-CIMS. The individual compounds were assigned to the mass peaks by fitting, $C_cH_hO_oN_n$, different number of atoms: c carbon, h hydrogen, o oxygen, n nitrogen (Lopez-Hilfiker et al., 2014). A double bond equivalent (DBE) can be calculated as follows (Daumit et al., 2013):

$$DBE = \frac{n-h}{2} + c + 1$$

Modified Aromaticity Index (AI_{mod}) equation:

$$AImod = \frac{1 + C - \frac{1}{2}O - S - \frac{1}{2}(N+H)}{C - \frac{1}{2}O - N}$$

Oxidation state (OSc) equation (Kroll et al., 2015):

$$OSc = \frac{2O}{C} + \frac{3N}{C} - \frac{H}{C}$$

S2. The Spearman rank correlation analysis

PARAFAC component intensities were normalized to the sum of component fluorescence intensities for a given sample. And the mass concentrations of each molecule were normalized to the total mass concentration from FIGAERO-CIMS for a given sample. The Spearman's correlation coefficient (r) was calculated as the Pearson's correlation coefficient between the ranked variables. For our samples size of 8, the 8 raw scores X_i (i.e. PARAFAC component intensities), Y_i (i.e. FIGAERO-CIMS peak intensities) were converted to ranks X_i, Y_i, and r was computed (Tang et al., 2024; Stubbins et al., 2014). To assess the significance of Spearman's correlation coefficients, one tailed test was performed. For a sample size of 8, a threshold for Spearman's coefficient (r_s) was calculated to be significant at the $\alpha = 0.05$ confidence level, using the following equation:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Where t = 1.943 and n =8, A r_s value of 0.643 was calculated as significant at the 95% confidence limit (one tailed test value for Spearman)(Stubbins et al., 2014). Spearman's correlations were derived between each molecule and PARAFAC data across 8 samples. Molecules correlated to PARAFAC component intensities with Spearman's $r \geq 0.643$ (one tailed test) were assigned to each PARAFAC component.

Table S1. List of filter collection and particle types during the PSI combustion campaign.

Fuel types	Aerosol type	Particle types	Quartz filter No.	Teflon filter No.
Straw	Directing emission	Straw POA	1	1
	Photooxidation	straw POA+SOA	2	2
Beech	Directing emission	Beech POA	3	3
	Photooxidation	Beech POA+SOA	4	4
Cow dung	Directing emission	Cow dung POA	5	5
	Photooxidation	Cow dung SOA	6	6
Plastic	Directing emission	Plastic POA	7	7
	Photooxidation	Plastic SOA	8	8

Table S2. Results of the PARAFAC model

Parameters	Fitting of observed concentrations and predicted concentrations	Split-half analysis	Core consistency	Eemqual
Values	0.962	0.996	0.954	0.913

The fitting of observed concentrations and predicted concentrations was 0.96. It indicates that the predicted concentrations by 3 components can well explain the observed concentrations. The split-half analysis was 0.99. It indicates that the split-half analysis was well done. A new diagnostic called the core consistency diagnostic (CORCONDIA) is suggested for determining the proper number of components for a PARAFAC models. Models specified with an appropriate number of components should have high core consistencies (near 100%), whereas low core consistencies indicate that too many components were specified. The core consistency diagnostic should protect against over-fitting but rigid adherence to guidelines can lead to under-fitted models. Core consistency in this study is 0.954. It indicates that the 3 components are appropriate numbers for the PARAFAC model. The EEMqual is a quality parameter integrating the model fit. It was calculated with the following equation:

$$\text{EEMqual} = \text{Fit} * \text{Core consistency} * \text{Split half analysis}$$

Thus, when EEMqual is close to one, all three measures are high and the model analysis successful.

Table S3. Top 20 major compounds in the particle phases identified in fresh OA from combustion emissions (straw fresh OA, cow dung fresh OA, beech fresh OA, plastic fresh OA)

Number	Straw fresh OA		Cow dung fresh OA		Beech fresh OA		Plastic fresh OA	
	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)
1	C6H10O5	14.24	C6H10O5	15.78	C6H10O5	30.87	C6H10O5	34.29
2	C27H54O2	1.43	C5H8O4	3.62	C5H8O4	5.58	C8H12O6	3.16
3	C8H12O6	1.43	C8H12O6	2.46	C8H12O6	3.25	C16H32O2	1.51
4	C32H64O2	1.08	C32H64O2	2.32	C6H6O3	2.61	C18H34O2	1.50
5	C9H6O3	1.07	C29H56O3	2.24	C6H12O5	2.37	C18H32O2	1.05
6	C5H8O4	0.89	C16H32O2	1.51	C5H10O4	1.81	C5H8O4	1.01
7	C16H32O2	0.88	C18H34O2	1.33	C6H10O4	1.14	C18H36O2	0.98
8	C29H56O3	0.69	C32H64N2O2	1.05	C8H14O6	0.81	C9H6O3	0.79
9	C28H56O2	0.63	C18H36O2	1.03	C8H8O3	0.81	C6H12O5	0.73
10	C7H7NO4	0.43	C9H6O3	1.02	C7H8O3	0.80	C24H48O2	0.66
11	C18H32O2	0.43	C28H56O2	0.93	C9H10O4	0.77	C22H44O2	0.64
12	C18H34O2	0.39	C29H58O2	0.89	C7H6O3	0.72	C29H56O3	0.47
13	C8H14O6	0.37	C10H12O4	0.75	C7H10O5	0.72	C9H8O3	0.42
14	C6H5NO4	0.34	C18H32O2	0.55	C9H10O3	0.72	C28H56O2	0.42
15	C15H12O2	0.32	C7H10O5	0.54	C6H14O4	0.70	C7H10O6	0.41
16	C24H48O2	0.32	C32H66N2O	0.53	C10H10O3	0.64	C8H14O6	0.39
17	C9H8O3	0.32	C24H48O2	0.51	C7H12O6	0.63	C19H36O3	0.36
18	C19H36O3	0.31	C6H10O4	0.51	C7H10O6	0.62	C7H7NO4	0.35
19	C18H34O3	0.30	C10H10O3	0.50	C7H12O5	0.62	C9H14O6	0.35
20	C18H36O2	0.30	C30H62N2O	0.46	C6H8O4	0.57	C7H8O6	0.33

Table S4. Top 20 major compounds in the particle phases identified in aged OA after photooxidation (straw aged OA, cow dung aged OA, beech aged OA, plastic aged OA), Please note that the samples contain primary emissions and secondary aerosol after photooxidation, we named these samples as the secondary organic aerosol.

Number	Straw aged OA		Cow Dung aged OA		Beech aged OA		Plastic aged OA	
	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)	Molecules	Mass fraction (%)
1	C6H10O5	15.31	C2H2O4	11.69	C6H10O5	27.99	C6H10O5	11.68
2	C2H2O4	7.50	C6H10O5	5.92	C2H2O4	3.09	C2H2O4	5.35
3	C5H8O5	2.52	C3H4O4	5.22	C8H12O6	1.90	C5H8O5	2.98
4	C3H4O4	2.07	C5H8O5	4.07	C5H8O5	1.62	C4H6O5	1.51
5	C4H6O4	1.72	C4H6O4	2.53	C5H8O4	1.41	C4H8O4	1.47
6	C4H6O5	1.56	C4H8O4	1.78	C3H4O4	1.01	C3H4O4	1.11
7	C4H8O4	1.46	C8H6O2	1.57	C4H6O5	0.87	C5H8O4	1.10
8	C5H8O4	1.28	C5H8O4	1.45	C4H8O4	0.82	C10H8O4	1.04
9	C8H12O6	1.11	C4H6O5	1.37	C6H12O5	0.68	C6H14O4	0.89
10	C7H6O	1.05	C10H8O3	1.16	C4H6O4	0.57	C8H6O2	0.86
11	C8H6O2	0.89	C9H6O2	1.05	C7H10O6	0.54	C8H12O6	0.83
12	C5H6O4	0.87	C7H6O	1.00	C6H10O4	0.52	C4H6O4	0.79
13	C7H10O5	0.76	C7H10O5	1.00	C9H8O3	0.49	C10H8O3	0.76
14	C2H4O3	0.73	C9H6O3	0.93	C9H6O3	0.46	C9H8O3	0.72
15	C7H7NO4	0.69	C5H6O4	0.85	C10H8O3	0.43	C5H6O6	0.62
16	C10H8O3	0.66	C10H8O2	0.78	C6H8O5	0.40	C7H10O5	0.59
17	C6H8O4	0.66	C6H8O4	0.74	C8H6O2	0.39	C9H6O2	0.51
18	C9H6O3	0.62	C3H6O3	0.69	C7H10O5	0.38	C6H8O6	0.50
19	C6H5NO4	0.61	C6H6O5	0.67	C6H8O6	0.38	C4H4O4	0.49
20	C6H8O5	0.59	C10H8O4	0.63	C7H7NO4	0.38	C16H32O2	0.46

Table S5. Lists of 49 organic molecules correlated LO-HULIS chromophore, where the correlations are higher than 0.643 (1-sided t-test).

Number	Mass (g mol^{-1})	Formula	DBE	O/C	H/C
1	106.011	C2H2O5	2.00	2.50	1.00
2	76.029	C2H4O3	1.00	1.50	2.00
3	95.052	C3H3N4	4.50	0.00	1.00
4	92.061	C3H8O3	0.00	1.00	2.67
5	180.06	C9H8O4	6.00	0.44	0.89
6	365.064	C9H7O13N3	8.00	1.44	0.78
7	102.045	C4H6O3	2.00	0.75	1.50
8	118.044	C4H6O4	2.00	1.00	1.50
9	117.06	C4H7NO3	2.00	0.75	1.75
10	146.046	C9H6O2	7.00	0.22	0.67
11	122.076	C4H10O4	0.00	1.00	2.50
12	128.028	C5H4O4	4.00	0.80	0.80
13	114.045	C5H6O3	3.00	0.60	1.20
14	130.044	C5H6O4	3.00	0.80	1.20
15	166.074	C5H10O6	1.00	1.20	2.00
16	229.086	C5H11O9N	1.00	1.80	2.20
17	142.044	C6H6O4	4.00	0.67	1.00
18	144.06	C6H8O4	3.00	0.67	1.33
19	160.059	C6H8O5	3.00	0.83	1.33
20	207.072	C6H9NO7	3.00	1.17	1.50
21	119.046	C7H5NO	6.00	0.14	0.71
22	106.047	C7H6O	5.00	0.14	0.86
23	156.06	C7H8O4	4.00	0.57	1.14
24	281.1	C7H11N3O9	4.00	1.29	1.57
25	208.089	C7H12O7	2.00	1.00	1.71
26	147.045	C8H5NO2	7.00	0.25	0.63
27	271.101	C7H13O10N	2.00	1.43	1.86
28	184.059	C8H8O5	5.00	0.63	1.00
29	186.075	C8H10O5	4.00	0.63	1.25
30	176.124	C8H16O4	1.00	0.50	2.00
31	178.14	C8H18O4	0.00	0.50	2.25
32	145.062	C9H7NO	7.00	0.11	0.78
33	209.058	C9H7O5N	7.00	0.56	0.78
34	198.075	C9H10O5	5.00	0.56	1.11
35	160.062	C10H8O2	7.00	0.20	0.80
36	241.089	C10H11NO6	6.00	0.60	1.10
37	299.076	C19H9O3N	16.00	0.16	0.47
38	188.061	C11H8O3	8.00	0.27	0.73

39	206.076	C11H10O4	7.00	0.36	0.91
40	184.062	C12H8O2	9.00	0.17	0.67
41	218.076	C12H10O4	8.00	0.33	0.83
42	214.077	C13H10O3	9.00	0.23	0.77
43	248.091	C13H12O5	8.00	0.38	0.92
44	238.077	C15H10O3	11.00	0.20	0.67
45	256.092	C15H12O4	10.00	0.27	0.80
46	257.076	C16H7ON3	15.00	0.06	0.44
47	266.073	C12H10O7	8.00	0.58	0.83
48	344.115	C11H12O9N4	8.00	0.82	1.09
49	208.059	C10H8O5	7.00	0.50	0.80

Table S6. Lists of 143 organic molecules correlated HO-HULIS chromophore, where the correlations are higher than 0.643 (1-sided t-test).

Number	Mass (g mol^{-1})	Formula	DBE	O/C	H/C
1	106.0	C2H2O5	2.0	2.5	1.0
2	76.0	C2H4O3	1.0	1.5	2.0
3	90.0	C3H6O3	1.0	1.0	2.0
4	92.1	C3H8O3	0.0	1.0	2.7
5	365.1	C9H7O13N3	8.0	1.4	0.8
6	118.0	C4H6O4	2.0	1.0	1.5
7	178.0	C9H6O4	7.0	0.4	0.7
8	210.0	C9H6O6	7.0	0.7	0.7
9	233.1	C4H11O10N	0.0	2.5	2.8
10	174.1	C9H18O3	1.0	0.3	2.0
11	300.1	C9H16O11	2.0	1.2	1.8
12	329.1	C9H15O12N	3.0	1.3	1.7
13	279.1	C9H13O9N	4.0	1.0	1.4
14	177.1	C5H7NO6	3.0	1.2	1.4
15	263.1	C9H13O8N	4.0	0.9	1.4
16	295.1	C9H13O10N	4.0	1.1	1.4
17	231.1	C5H13O9N	0.0	1.8	2.6
18	140.0	C6H4O4	5.0	0.7	0.7
19	261.1	C9H11NO8	5.0	0.9	1.2
20	166.0	C8H6O4	6.0	0.5	0.8
21	198.0	C8H6O6	6.0	0.8	0.8
22	134.0	C8H6O2	6.0	0.3	0.8
23	146.1	C8H18O2	0.0	0.3	2.3
24	106.0	C7H6O	5.0	0.1	0.9
25	249.1	C8H11NO8	4.0	1.0	1.4
26	218.1	C8H10O7	4.0	0.9	1.3
27	219.1	C7H9O7N	4.0	1.0	1.3
28	235.1	C7H9NO8	4.0	1.1	1.3
29	221.1	C7H11NO7	3.0	1.0	1.6
30	253.1	C7H11NO9	3.0	1.3	1.6
31	204.1	C7H8O7	4.0	1.0	1.1
32	172.1	C7H8O5	4.0	0.7	1.1
33	136.0	C7H4O3	6.0	0.4	0.6
34	147.0	C8H5NO2	7.0	0.3	0.6
35	179.0	C8H5NO4	7.0	0.5	0.6
36	164.1	C7H16O4	0.0	0.6	2.3
37	271.1	C7H13O10N	2.0	1.4	1.9
38	133.1	C8H7NO	6.0	0.1	0.9

39	278.1	C8H10O9N2	5.0	1.1	1.3
40	233.1	C8H11NO7	4.0	0.9	1.4
41	176.1	C6H8O6	3.0	1.0	1.3
42	205.1	C6H7NO7	4.0	1.2	1.2
43	174.1	C8H14O4	2.0	0.5	1.8
44	174.0	C6H6O6	4.0	1.0	1.0
45	158.0	C6H6O5	4.0	0.8	1.0
46	163.1	C6H13O4N	1.0	0.7	2.2
47	194.0	C9H6O5	7.0	0.6	0.7
48	194.1	C6H10O7	2.0	1.2	1.7
49	178.1	C6H10O6	2.0	1.0	1.7
50	164.1	C5H8O6	2.0	1.2	1.6
51	136.1	C9H12O	4.0	0.1	1.3
52	162.0	C5H6O6	3.0	1.2	1.2
53	146.0	C5H6O5	3.0	1.0	1.2
54	175.0	C5H5NO6	4.0	1.2	1.0
55	204.0	C5H4O7N2	5.0	1.4	0.8
56	173.0	C5H3NO6	5.0	1.2	0.6
57	120.1	C4H8O4	1.0	1.0	2.0
58	136.1	C4H8O5	1.0	1.3	2.0
59	134.0	C4H6O5	2.0	1.3	1.5
60	382.2	C27H26O2	15.0	0.1	1.0
61	189.1	C10H7NO3	8.0	0.3	0.7
62	347.1	C24H13NO2	19.0	0.1	0.5
63	160.1	C10H8O2	7.0	0.2	0.8
64	351.1	C23H13O3N	18.0	0.1	0.6
65	340.2	C22H28O3	9.0	0.1	1.3
66	312.2	C21H28O2	8.0	0.1	1.3
67	282.3	C20H42	0.0	0.0	2.1
68	363.1	C20H13O6N	15.0	0.3	0.7
69	325.1	C19H7O3N3	18.0	0.2	0.4
70	384.3	C19H32O6N2	5.0	0.3	1.7
71	293.1	C10H15NO9	4.0	0.9	1.5
72	288.2	C19H28O2	6.0	0.1	1.5
73	333.1	C19H11O5N	15.0	0.3	0.6
74	312.3	C18H32O4	3.0	0.2	1.8
75	323.1	C18H13O5N	13.0	0.3	0.7
76	394.2	C17H30O10	3.0	0.6	1.8
77	267.1	C11H9NO7	8.0	0.6	0.8
78	246.2	C17H26O	5.0	0.1	1.5
79	260.2	C17H24O2	6.0	0.1	1.4
80	346.1	C17H14O8	11.0	0.5	0.8
81	327.1	C17H13O6N	12.0	0.4	0.8
82	339.1	C17H13O5N3	13.0	0.3	0.8

83	356.1	C17H12O7N2	13.0	0.4	0.7
84	325.1	C17H11O6N	13.0	0.4	0.6
85	309.1	C17H11O5N	13.0	0.3	0.6
86	402.1	C17H10O10N2	14.0	0.6	0.6
87	232.2	C11H20O5	2.0	0.5	1.8
88	204.2	C11H24O3	0.0	0.3	2.2
89	200.1	C12H8O3	9.0	0.3	0.7
90	319.1	C16H5O5N3	16.0	0.3	0.3
91	368.2	C16H32O9	1.0	0.6	2.0
92	318.1	C12H14O10	6.0	0.8	1.2
93	301.1	C12H15NO8	6.0	0.7	1.3
94	367.1	C16H17NO9	9.0	0.6	1.1
95	318.1	C16H14O7	10.0	0.4	0.9
96	260.3	C15H32O3	0.0	0.2	2.1
97	338.0	C15H2O8N2	16.0	0.5	0.1
98	232.2	C15H20O2	6.0	0.1	1.3
99	369.1	C15H15NO10	9.0	0.7	1.0
100	348.1	C15H12O8N2	11.0	0.5	0.8
101	362.1	C15H10O9N2	12.0	0.6	0.7
102	238.0	C14H6O4	12.0	0.3	0.4
103	246.2	C14H30O3	0.0	0.2	2.1
104	359.1	C14H17NO10	7.0	0.7	1.2
105	216.1	C14H16O2	7.0	0.1	1.1
106	308.1	C14H12O8	9.0	0.6	0.9
107	317.1	C14H11O6N3	11.0	0.4	0.8
108	321.1	C14H11NO8	10.0	0.6	0.8
109	232.2	C13H28O3	0.0	0.2	2.2
110	246.2	C13H26O4	1.0	0.3	2.0
111	256.2	C13H20O5	4.0	0.4	1.5
112	389.2	C14H31O11N	0.0	0.8	2.2
113	288.1	C15H12O6	10.0	0.4	0.8
114	264.1	C13H12O6	8.0	0.5	0.9
115	337.1	C15H15O8N	9.0	0.5	1.0
116	355.1	C15H17NO9	8.0	0.6	1.1
117	218.2	C12H26O3	0.0	0.3	2.2
118	383.2	C15H29O10N	2.0	0.7	1.9
119	280.2	C12H24O7	1.0	0.6	2.0
120	320.1	C12H16O10	5.0	0.8	1.3
121	294.1	C12H10O7N2	9.0	0.6	0.8
122	334.1	C16H14O8	10.0	0.5	0.9
123	266.1	C12H10O7	8.0	0.6	0.8
124	250.1	C12H10O6	8.0	0.5	0.8
125	216.1	C11H8O3N2	9.0	0.3	0.7
126	236.1	C11H8O6	8.0	0.5	0.7

127	337.1	C11H15O11N	5.0	1.0	1.4
128	321.1	C11H15O10N	5.0	0.9	1.4
129	344.1	C11H12O9N4	8.0	0.8	1.1
130	380.1	C17H16O10	10.0	0.6	0.9
131	332.1	C17H16O7	10.0	0.4	0.9
132	346.1	C11H10O11N2	8.0	1.0	0.9
133	208.1	C10H8O5	7.0	0.5	0.8
134	396.3	C18H36O9	1.0	0.5	2.0
135	206.0	C10H6O5	8.0	0.5	0.6
136	222.0	C10H6O6	8.0	0.6	0.6
137	204.2	C10H20O4	1.0	0.4	2.0
138	396.3	C20H32O6N2	6.0	0.3	1.6
139	291.1	C10H13NO9	5.0	0.9	1.3
140	275.1	C10H13NO8	5.0	0.8	1.3
141	289.1	C10H11NO9	6.0	0.9	1.1
142	273.1	C10H11NO8	6.0	0.8	1.1
143	306.1	C10H10O11	6.0	1.1	1.0

Table S7. Lists of 108 organic molecules correlated PLS chromophore, where the correlations are higher than 0.643 (1-sided t-test).

Number	Mass (g mol^{-1})	Formula	DBE	O/C	H/C
1	135.1	C4H9NO4	1.00	1.00	2.25
2	131.1	C5H9NO3	2.00	0.60	1.80
3	134.1	C5H10O4	1.00	0.80	2.00
4	165.1	C5H11NO5	1.00	1.00	2.20
5	152.1	C5H12O5	0.00	1.00	2.40
6	145.1	C6H11NO3	2.00	0.50	1.83
7	148.1	C6H12O4	1.00	0.67	2.00
8	164.1	C6H12O5	1.00	0.83	2.00
9	179.1	C6H13NO5	1.00	0.83	2.17
10	166.1	C6H14O5	0.00	0.83	2.33
11	182.1	C6H14O6	0.00	1.00	2.33
12	122.0	C7H6O2	5.00	0.29	0.86
13	138.0	C7H6O3	5.00	0.43	0.86
14	126.1	C7H10O2	3.00	0.29	1.43
15	176.1	C7H12O5	2.00	0.71	1.71
16	192.1	C7H12O6	2.00	0.86	1.71
17	159.1	C7H13NO3	2.00	0.43	1.86
18	191.1	C7H13NO5	2.00	0.71	1.86
19	178.1	C7H14O5	1.00	0.71	2.00
20	194.1	C7H14O6	1.00	0.86	2.00
21	177.1	C7H15O4N	1.00	0.57	2.14
22	152.1	C8H8O3	5.00	0.38	1.00
23	183.1	C8H9NO4	5.00	0.50	1.13
24	182.1	C8H10N2O3	5.00	0.38	1.25
25	156.1	C8H12O3	3.00	0.38	1.50
26	204.1	C8H12O6	3.00	0.75	1.50
27	187.1	C8H13O4N	3.00	0.50	1.63
28	206.1	C8H14O6	2.00	0.75	1.75
29	222.1	C8H14O7	2.00	0.88	1.75
30	173.1	C8H15NO3	2.00	0.38	1.88
31	208.1	C8H16O6	1.00	0.75	2.00
32	240.1	C8H16O8	1.00	1.00	2.00
33	210.1	C8H18O6	0.00	0.75	2.25
34	166.1	C9H10O3	5.00	0.33	1.11
35	165.1	C9H11NO2	5.00	0.22	1.22
36	197.1	C9H11NO4	5.00	0.44	1.22
37	168.1	C9H12O3	4.00	0.33	1.33
38	184.1	C9H12O4	4.00	0.44	1.33

39	170.1	C9H14O3	3.00	0.33	1.56
40	218.1	C9H14O6	3.00	0.67	1.56
41	220.1	C9H16O6	2.00	0.67	1.78
42	236.1	C9H16O7	2.00	0.78	1.78
43	187.1	C9H17O3N	2.00	0.33	1.89
44	254.1	C9H18O8	1.00	0.89	2.00
45	222.1	C9H18O6	1.00	0.67	2.00
46	159.1	C10H9NO	7.00	0.10	0.90
47	178.1	C10H10O3	6.00	0.30	1.00
48	177.1	C10H11NO2	6.00	0.20	1.10
49	193.1	C10H11NO3	6.00	0.30	1.10
50	180.1	C10H12O3	5.00	0.30	1.20
51	196.1	C10H12O4	5.00	0.40	1.20
52	214.1	C10H14O5	4.00	0.50	1.40
53	198.1	C10H14O4	4.00	0.40	1.40
54	230.1	C10H14O6	4.00	0.60	1.40
55	248.1	C10H16O7	3.00	0.70	1.60
56	232.1	C10H16O6	3.00	0.60	1.60
57	202.1	C10H18O4	2.00	0.40	1.80
58	201.2	C10H19O3N	2.00	0.30	1.90
59	220.2	C10H20O5	1.00	0.50	2.00
60	222.2	C10H22O5	0.00	0.50	2.20
61	238.2	C10H22O6	0.00	0.60	2.20
62	192.1	C11H12O3	6.00	0.27	1.09
63	208.1	C11H12O4	6.00	0.36	1.09
64	207.1	C11H13O3N	6.00	0.27	1.18
65	210.1	C11H14O4	5.00	0.36	1.27
66	194.1	C11H14O3	5.00	0.27	1.27
67	193.1	C11H15O2N	5.00	0.18	1.36
68	196.1	C11H16O3	4.00	0.27	1.45
69	212.1	C11H16O4	4.00	0.36	1.45
70	206.1	C12H14O3	6.00	0.25	1.17
71	222.1	C12H14O4	6.00	0.33	1.17
72	208.1	C12H16O3	5.00	0.25	1.33
73	256.1	C12H16O6	5.00	0.50	1.33
74	224.1	C12H16O4	5.00	0.33	1.33
75	274.1	C12H18O7	4.00	0.58	1.50
76	229.2	C12H23O3N	2.00	0.25	1.92
77	234.1	C13H14O4	7.00	0.31	1.08
78	201.1	C13H15ON	7.00	0.08	1.15
79	220.1	C13H16O3	6.00	0.23	1.23
80	236.1	C13H16O4	6.00	0.31	1.23
81	222.1	C13H18O3	5.00	0.23	1.38
82	224.2	C13H20O3	4.00	0.23	1.54

83	210.2	C13H22O2	3.00	0.15	1.69
84	373.2	C13H27O11N	1.00	0.85	2.08
85	210.1	C14H10O2	10.00	0.14	0.71
86	193.1	C14H11N	10.00	0.00	0.79
87	212.1	C14H12O2	9.00	0.14	0.86
88	250.1	C14H18O4	6.00	0.29	1.29
89	226.2	C14H26O2	2.00	0.14	1.86
90	257.2	C14H27O3N	2.00	0.21	1.93
91	228.2	C14H28O2	1.00	0.14	2.00
92	278.2	C14H30O5	0.00	0.36	2.14
93	325.2	C15H19NO7	7.00	0.47	1.27
94	240.2	C15H28O2	2.00	0.13	1.87
95	242.2	C15H30O2	1.00	0.13	2.00
96	238.1	C16H14O2	10.00	0.13	0.88
97	274.1	C16H18O4	8.00	0.25	1.13
98	252.2	C16H28O2	3.00	0.13	1.75
99	254.2	C16H30O2	2.00	0.13	1.88
100	247.1	C17H13ON	12.00	0.06	0.76
101	333.2	C17H19O6N	9.00	0.35	1.12
102	268.3	C17H32O2	2.00	0.12	1.88
103	270.3	C17H34O2	1.00	0.12	2.00
104	242.2	C18H26	6.00	0.00	1.44
105	278.2	C18H30O2	4.00	0.11	1.67
106	280.3	C18H32O2	3.00	0.11	1.78
107	282.3	C18H34O2	2.00	0.11	1.89
108	325.3	C18H35O2N3	3.00	0.11	1.94

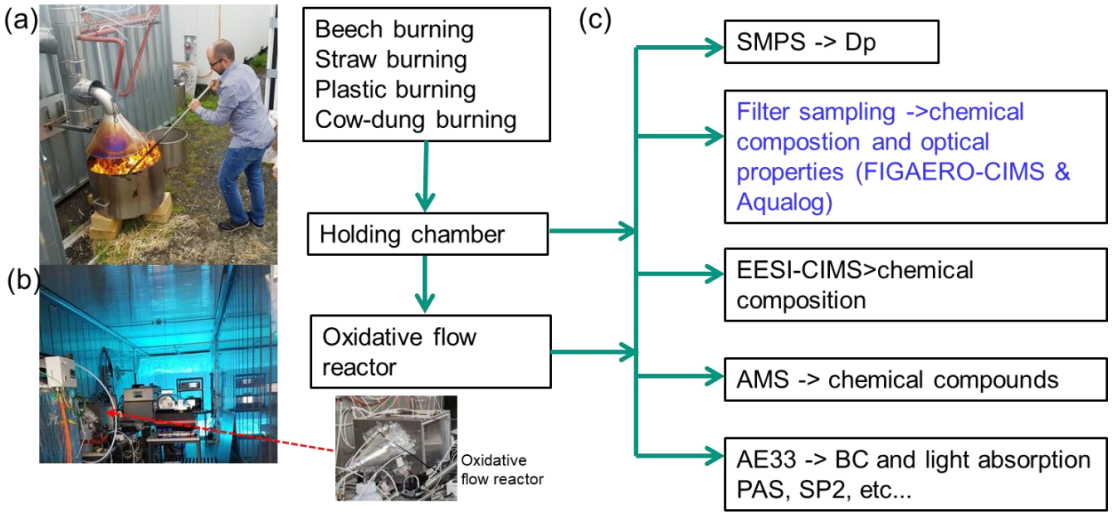

Figure S1. Schematic of the combustion experiment and instrumentations at Paul Scherrer Institute, Switzerland. (a) An example of straw combustion was controlled by Dr. David Bell. (b) Instrumentations (AE33 and SMPS) and chambers (a holding chamber and an oxidative flow reactor) in a container. (c) Setup of the experiments and instrumentations. The contents with blue label were done by our laboratory. The filters were analyzed by FIGAERO-CIMS and Aqualog. FIGAERO-CIMS will provide the chemical compositions, volatility, and thermograms of molecules. The Aqualog will provide the light absorption and excitation-emission matrices of chromophores.

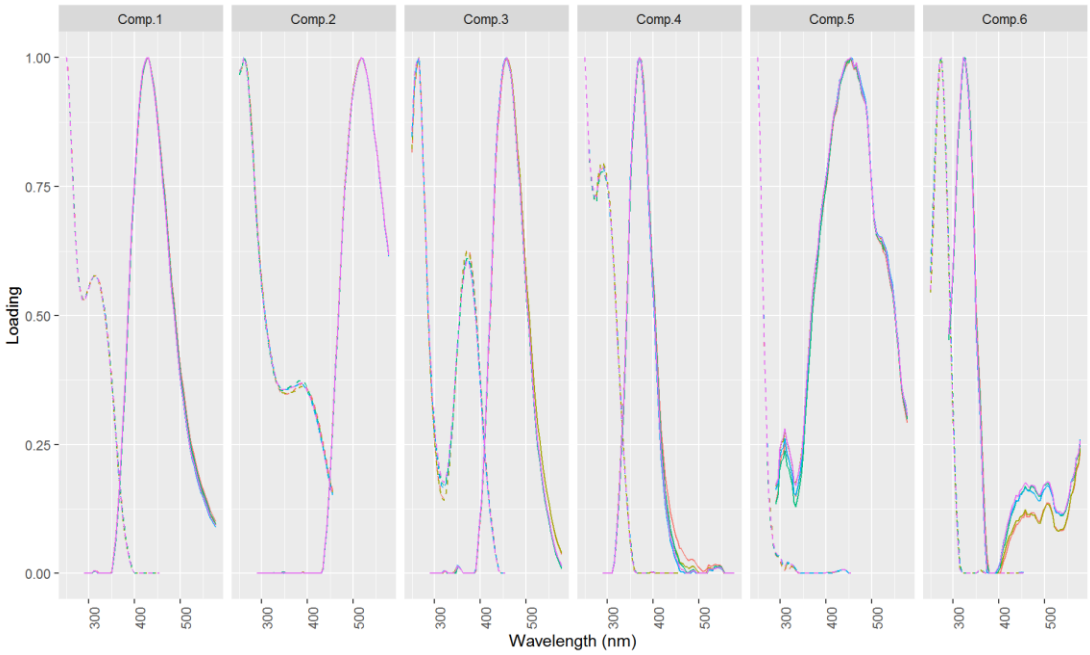

Figure S2. Split analysis of 6-component PARAFAC model with the split style “S4C6T3” for all EEM of methanol extract solution.

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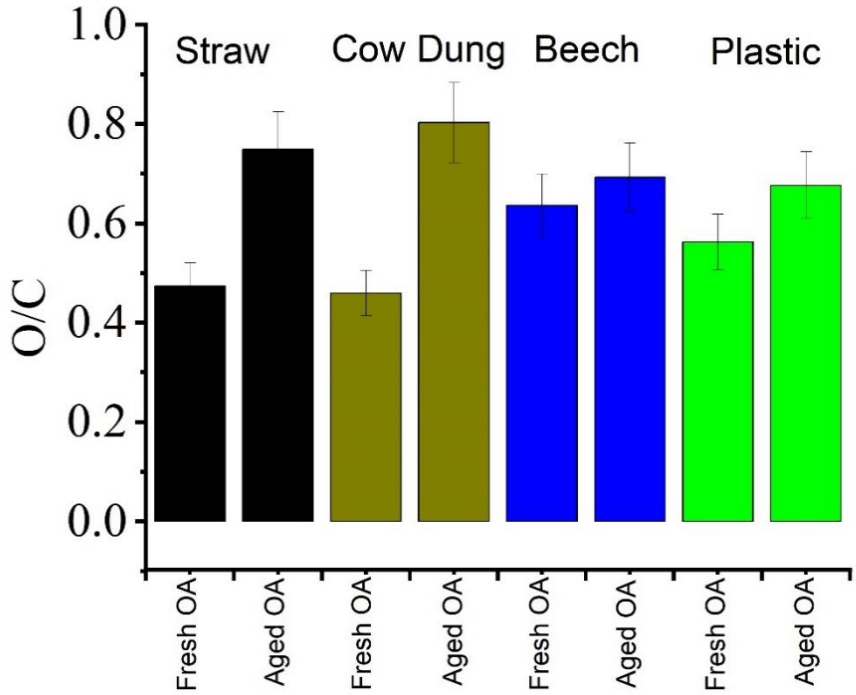

Figure S3. The O/C ratio of POA and SOA from FIGEARO-CIMS measurement (black: straw, brown: cow dung, blue: beech wood, and green: plastic.

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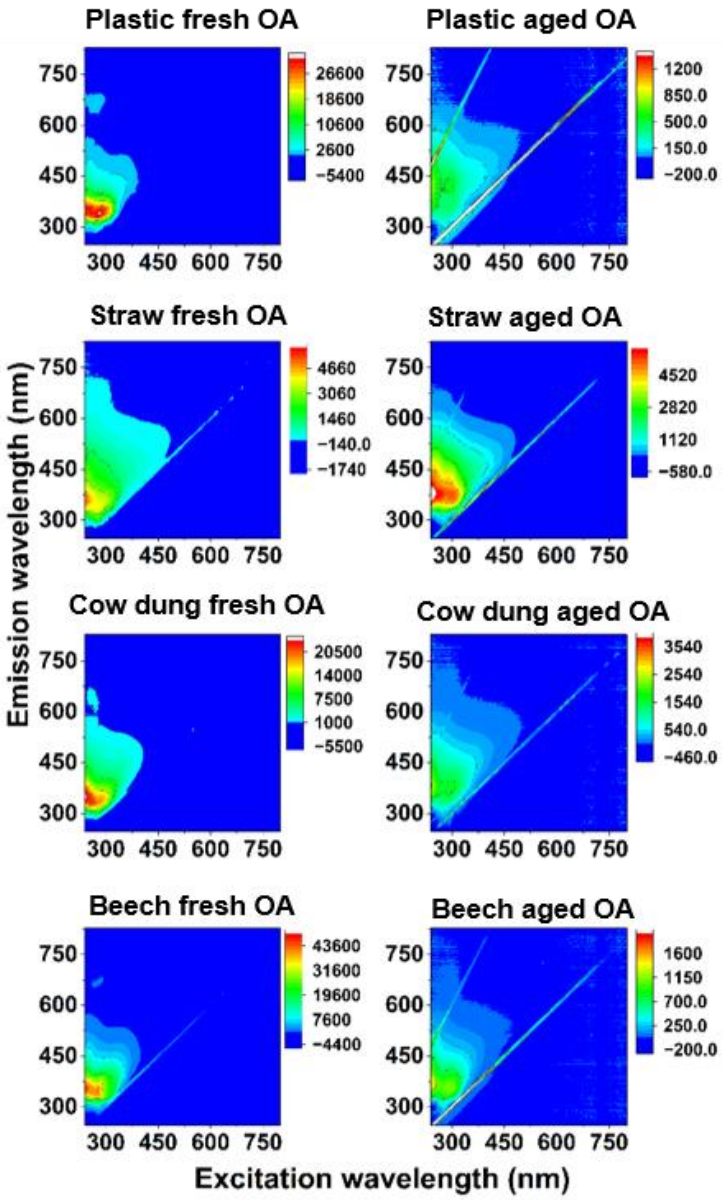

Figure S4. The excitation emission spectrum of methanol soluble organic carbon from all 8 samples.

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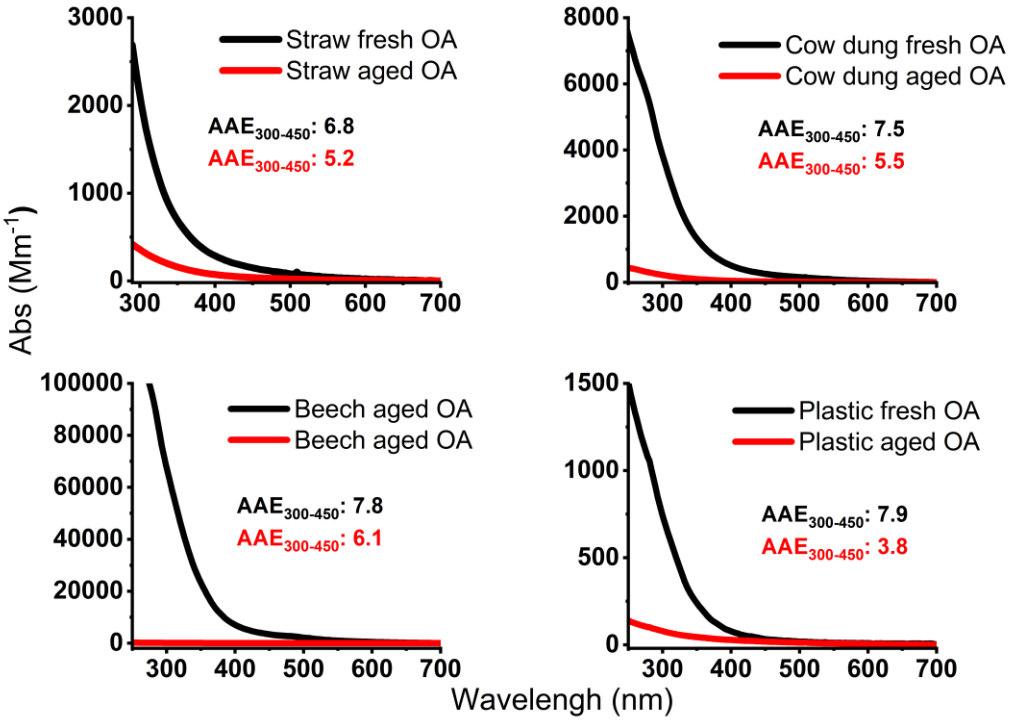

Figure S5. The light absorption of methanol soluble organic carbon from all 8 samples.

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