Supplementary Information

Regional Influence of Wildfires on Aerosol Chemistry in the Western US and Insights into Atmospheric Aging of Biomass Burning Organic Aerosol

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Table S1. The average (± 1σ) value of measured aerosol and gas phase parameters for three aerosol regimes.

	"No BB"		"BB Infl"		"BB Plm"	
	Mean	1σ	Mean	1σ	Mean	1σ
f_{60}	0.18%	0.1%	0.43%	0.05%	0.77%	0.29%
CO [c]	87.8	17.9	121.4	24.8	178.3	68.8
NR-PM_1 [a]	3.66	4.22	13.42	7.15	25.67	19.89
Organics [a]	3.11	3.69	12.40	6.71	24.30	18.95
Sulfate [a]	0.42	0.37	0.61	0.20	0.62	0.22
Nitrate [a]	0.03	0.03	0.15	0.12	0.35	0.47
Ammonium [a]	0.10	0.12	0.25	0.11	0.38	0.23
Chloride [a]	0.006	0.003	0.012	0.018	0.018	0.021
σ_{550nm} [b]	6.7	8.0	32.7	19.3	88.3	74.1
NO [c]	0.012	0.01	0.017	0.02	0.019	0.02
NO_2 [c]	0.13	0.04	0.17	0.06	0.14	0.07
PAN [c]	0.08	0.05	0.23	0.06	0.36	0.07
NO_y [c]	0.44	0.07	0.75	0.08	1.03	0.22
O_3 [c]	44.7	0.23	49.7	0.21	47.3	0.51

[a] $\mu g\ m^{-3}$.
[b] Mm^{-1}
[c] ppbv

Table S2. Correlation Coefficient (r^2) between tracers and the total BBOA (= BBOA-1 + BBOA-2 + BBOA-3), as well as each OA factor.

Variables	BBOA	BBOA-1	BBOA-2	BBOA-3	BL-OOA	LV-OOA
BBOA	1					
BBOA-1	0.84	1				
BBOA-2	0.84	0.54	1			
BBOA-3	0.91	0.59	0.80	1		
BL-OOA	0.07	0.03	0.06	0.10	1	
LV-OOA	0.06	0.06	0.03	0.07	0.02	1
Organics	0.98	0.79	0.83	0.90	0.16	0.04
Sulfate	< 0.01	< 0.01	0.01	0.01	0.08	0.66
Nitrate	0.47	0.60	0.33	0.28	<0.01	0.02
Ammonium	0.63	0.51	0.57	0.56	0.07	0.12
Chloride	0.25	0.33	0.18	0.14	0.01	0.01
$C_2H_3O^+$	0.93	0.70	0.87	0.87	0.22	0.03
CO_2^+	0.87	0.57	0.79	0.95	0.21	0.02
CHO_2^+	0.93	0.67	0.91	0.90	0.15	0.01
$C_4H_9^+$	0.94	0.95	0.71	0.75	0.06	0.07
$C_2H_4O_2^+$	0.86	0.94	0.65	0.62	0.03	0.04
$C_3H_5O_2^+$	0.95	0.92	0.78	0.76	0.05	0.05
$CH_3SO_2^+$	0.34	0.22	0.31	0.38	0.47	0.02
CO	0.89	0.70	0.73	0.86	0.09	0.08
σ_{550nm}	0.93	0.77	0.74	0.90	0.08	0.09
NO	0.04	0.02	0.06	0.04	0.04	0.01
NO_2	< 0.01	< 0.01	0.01	< 0.01	0.04	0.07
NO_x	< 0.01	< 0.01	< 0.01	< 0.01	0.06	0.05
NO_y	0.75	0.67	0.59	0.66	0.09	< 0.01
PAN	0.60	0.48	0.49	0.59	0.02	0.01

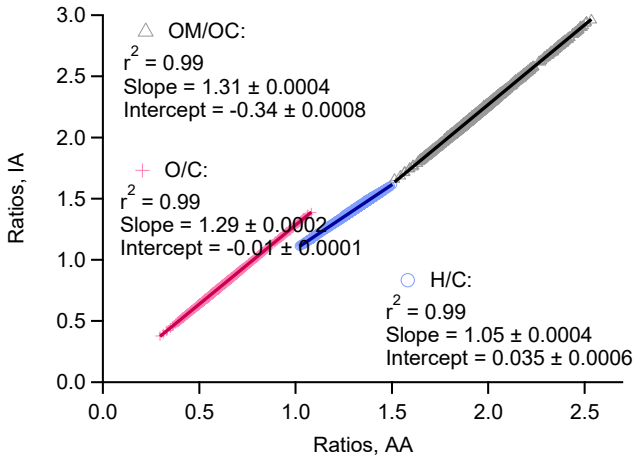


Fig. S1. Scatter plot of OM/OC, O/C, and H/C calculated with the Improved Ambient (IA) method vs. that with the Aiken-Ambient (AA) method. Data fitting was performed using the orthogonal distance regression (ODR).

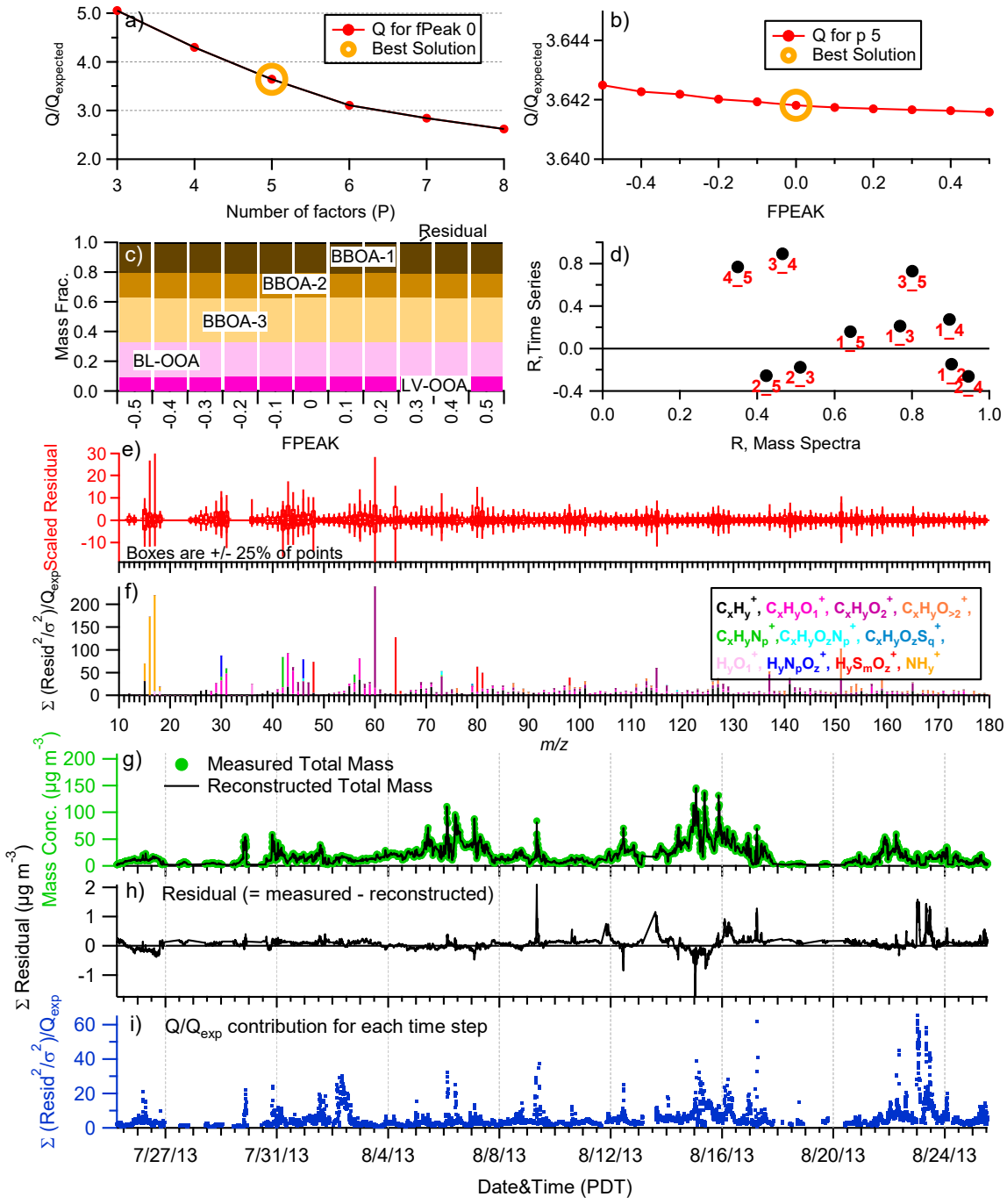


Fig. S2. Summary of the evaluation of the PMF results for the 5-factor solution: (a) Q/Q_{exp} as a function of number of factors (P), (b) Q/Q_{exp} as a function of fPeak values, (c) fractions of PMF factors as a function of fPeak values, (d) correlation between the 5 factors in terms of mass spectrum and time series (1: BL-OOA, 2: LV-OOA, 3: BBOA-2, 4: BBOA-3, 5: BBOA-1), (e) box plot of the scaled residuals for each ion, (f) Q/Q_{exp} values for each ion, (g) time series of the measured NR-PM_1 mass concentration and the reconstructed mass, (h) Residual time series, and (i) Q/Q_{exp} time series.

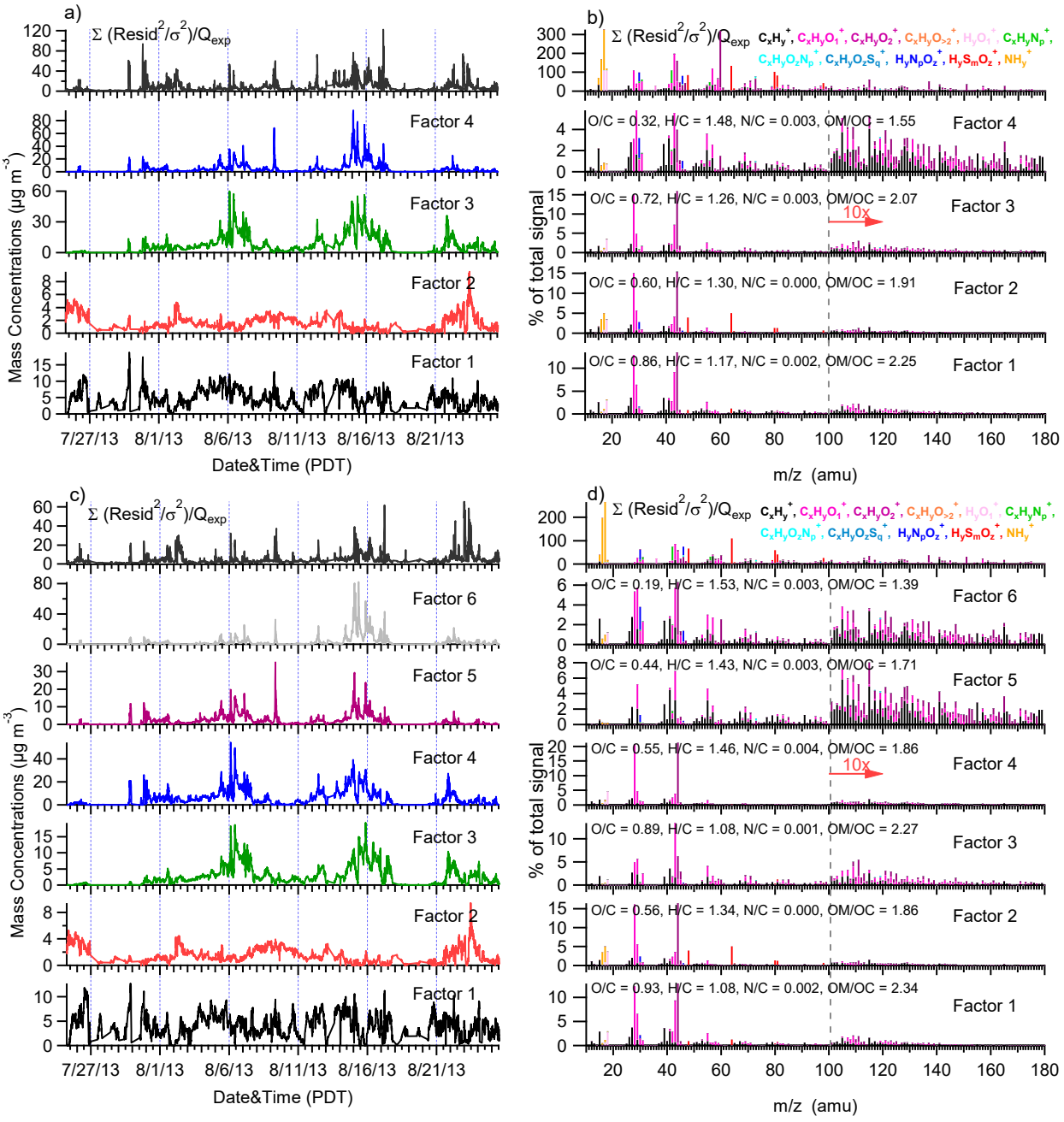


Fig. S3. The time series and mass spectral profile of total Q/Q_{exp} and each OA factor for the 4-factor (a, b) and 6-factor (c, d) solution.

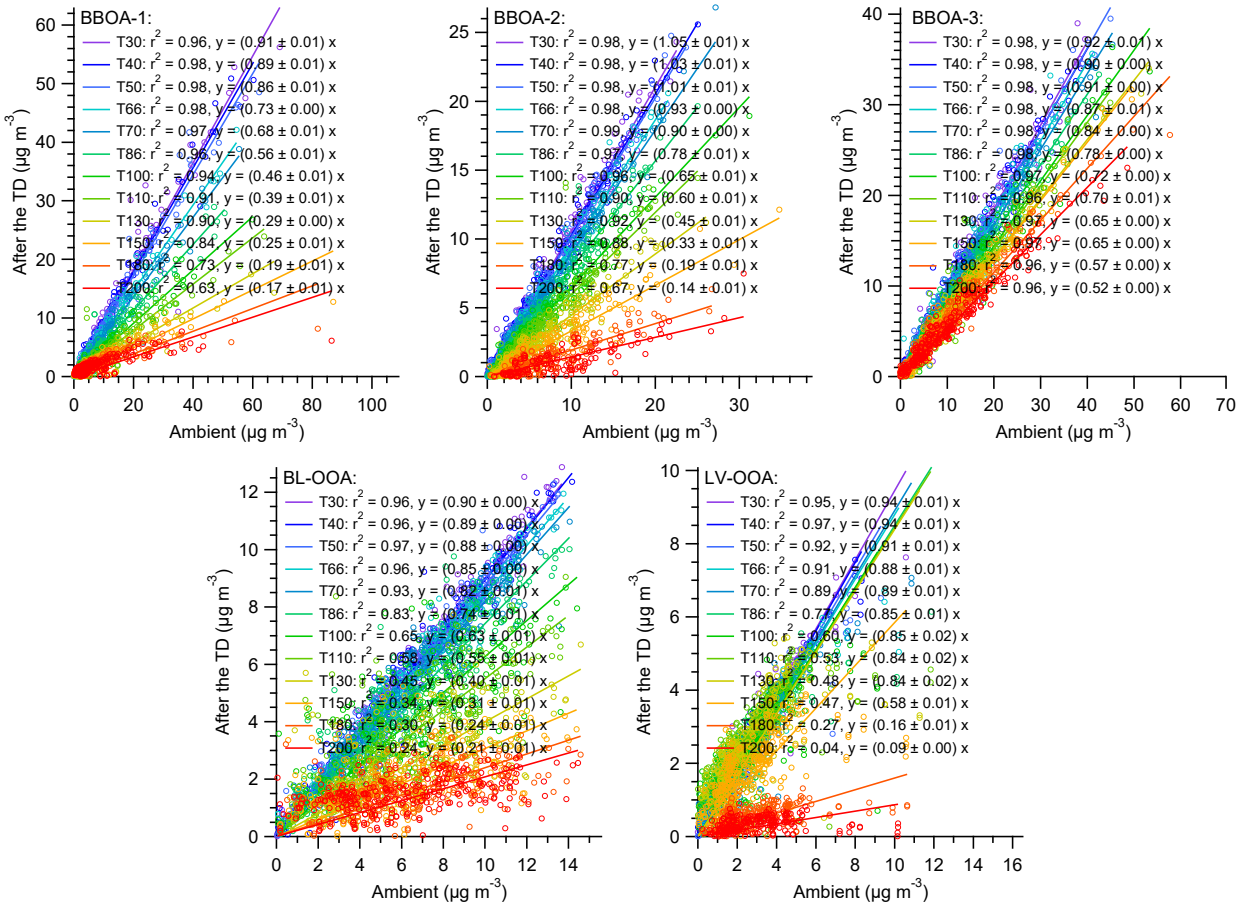


Fig. S4. Scatter plots of data after the TD vs. ambient for OA factors. Data fitting was performed using the orthogonal distance regression (ODR) forced through origin.

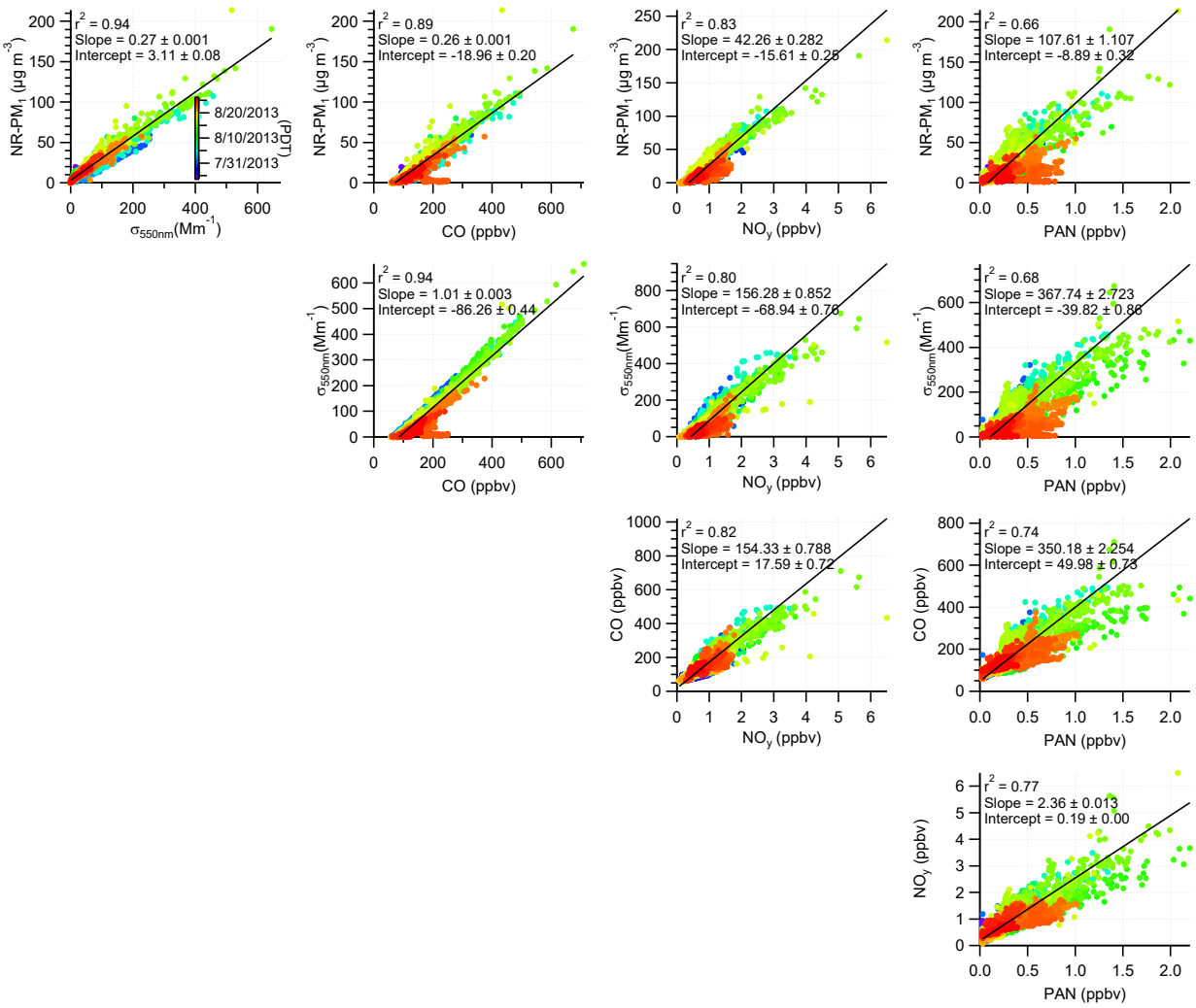


Fig. S5. Scatter plots of the cross correlations between NR-PM_1, σ_{550nm}, CO, NO_y, and PAN, colored by time. Data fitting was performed using the orthogonal distance regression (ODR).

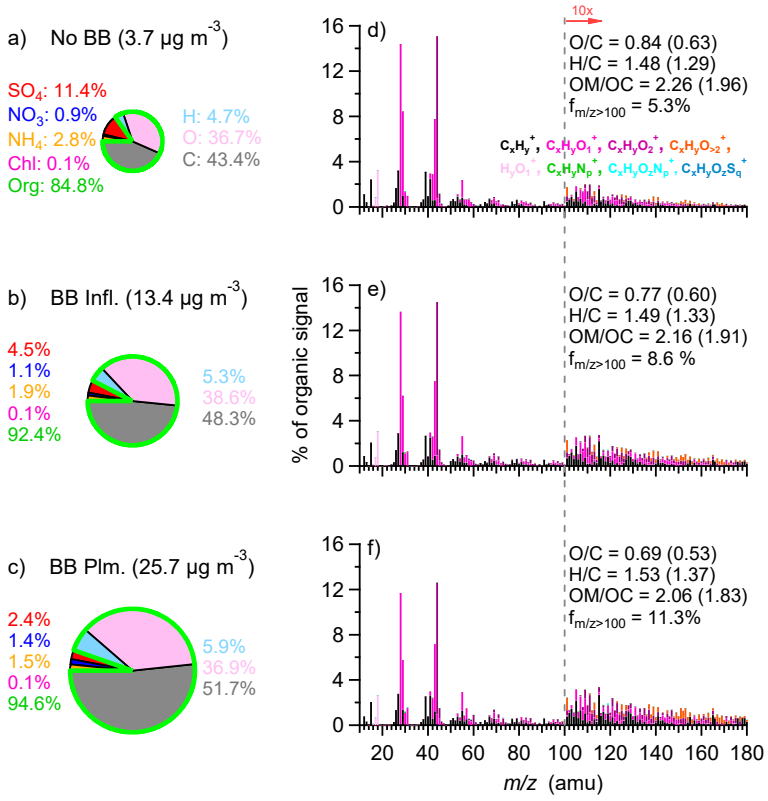


Fig. S6. The average NR-PM_1 composition (a-c) and OA HRMS (d-f) colored by eight ion families (i.e., $C_xH_y^+$, $C_xH_yO_1^+$, $C_xH_yO_2^+$, $C_xH_yO_{>2}^+$, $H_yO_1^+$, $C_xH_yN_p^+$, $C_xH_yO_zN_p^+$, and $C_xH_yO_zS_q^+$), for "No BB" (a and d), "BB Infl" (b and e), and "BB Plm" regimes (c and f), respectively. Organic portion in the pie charts are colored by four elements (i.e., C, O, H, and N). Numbers for in the pie charts corresponds to the mass fractional contribution of each species and element to total NR-PM_1 mass. The elemental ratios calculated with the IA method are shown in the legends of with those obtained using the AA method in parenthesis.

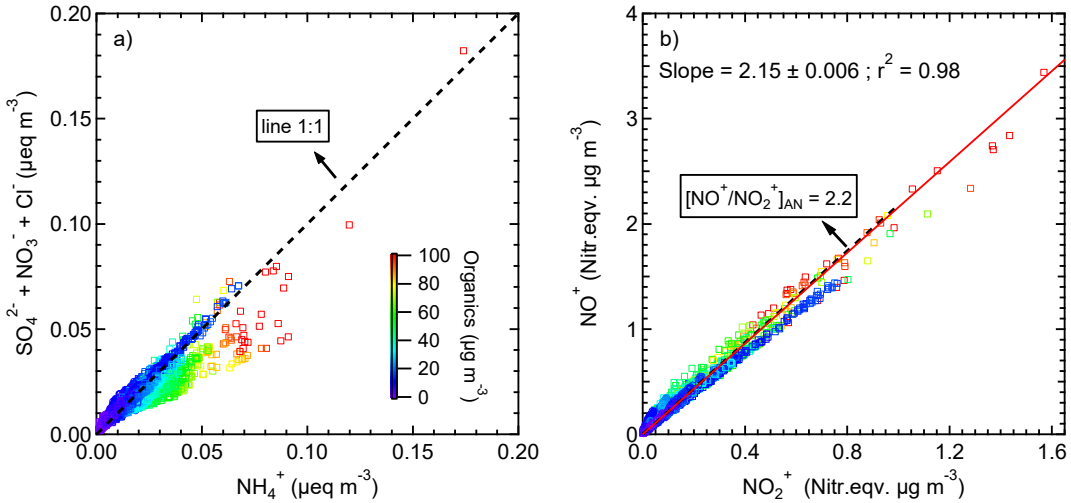


Fig. S7. Scatter plots of (a) the sum of all anion concentration (sulfate + nitrate + chloride) vs. cation concentration (ammonium) and (b) NO^+ vs. NO_2^+ for data with f_{60} > 0.3% (i.e., "BB Infl" and "BB Plm" periods) colored by organic mass concentration. Data fitting in (b) was performed using the orthogonal distance regression (ODR) forced through origin.

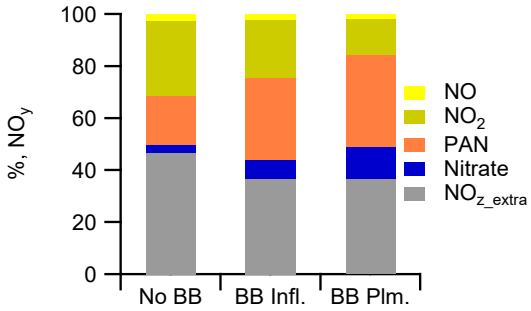
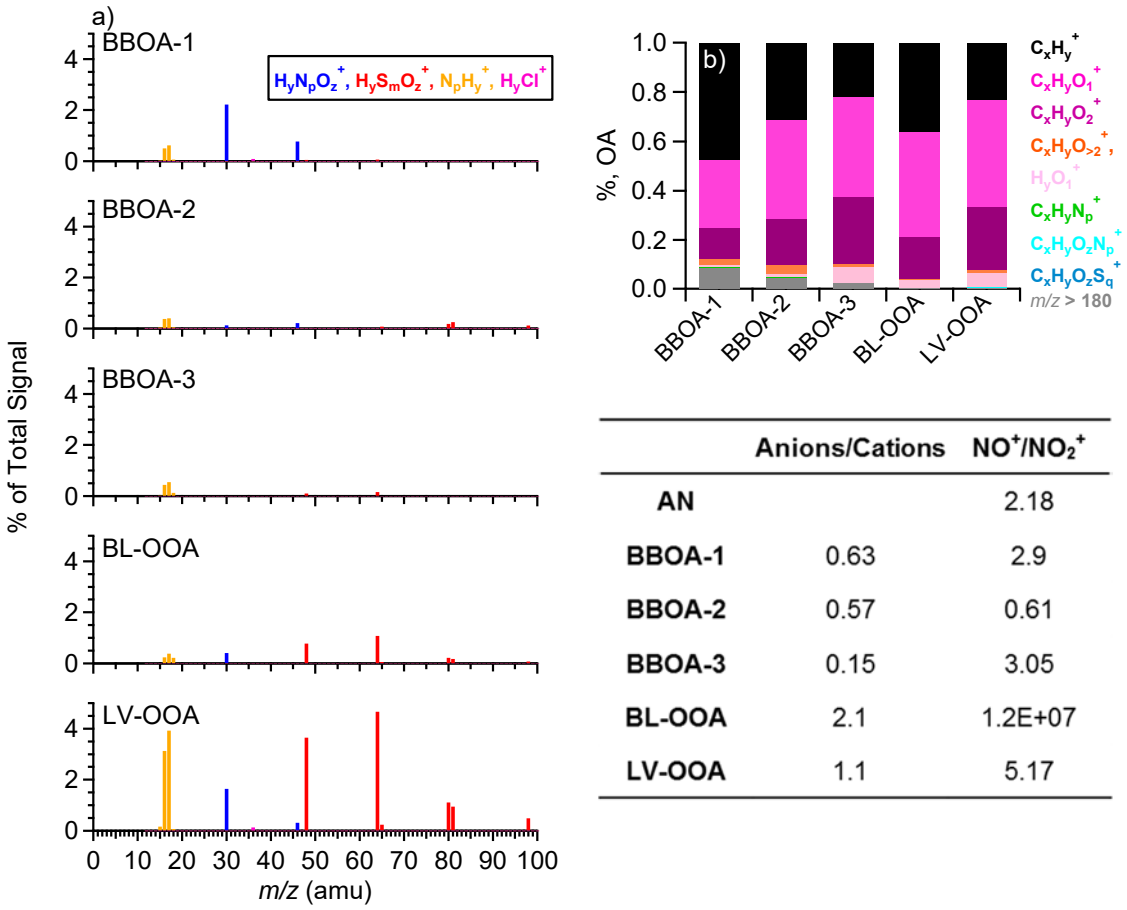
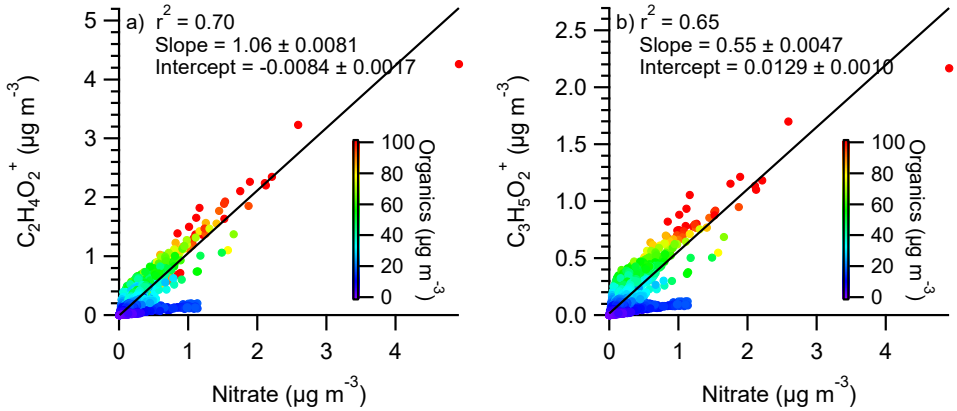


Fig. S8. The mass fractional contribution of nitrogen species (i.e., gas phase NO, NO_2, PAN, particle phase nitrate, and the rest NO_z ($NO_{z\_extra} = NO_y - (NO + NO_2 + PAN + nitrate)$) to total NO_y for the three regimes.



	Anions/Cations	NO^+/NO_2^+
AN		2.18
BBOA-1	0.63	2.9
BBOA-2	0.57	0.61
BBOA-3	0.15	3.05
BL-OOA	2.1	1.2E+07
LV-OOA	1.1	5.17

Fig. S9. (a) HRMS of inorganics and (b) OA composition colored by eight ion families and signal at *m/z* > 180 for each PMF factor. Table summarized the ratios of the molar equivalent of the sum of HR-AMS measured anionic species, i.e., sulfate, nitrate and chloride, to that of the cation species, ammonium (Anions/Cations) and NO^+ to NO_2^+ for pure ammonium nitrate (AN) and each PMF factor.



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65 **Fig. S10.** Scatter plots of (a) $C_2H_4O_2^+$ and (b) $C_3H_5O_2^+$ versus nitrate, colored by organic mass concentrations.

66 Data fitting was performed using the orthogonal distance regression (ODR).

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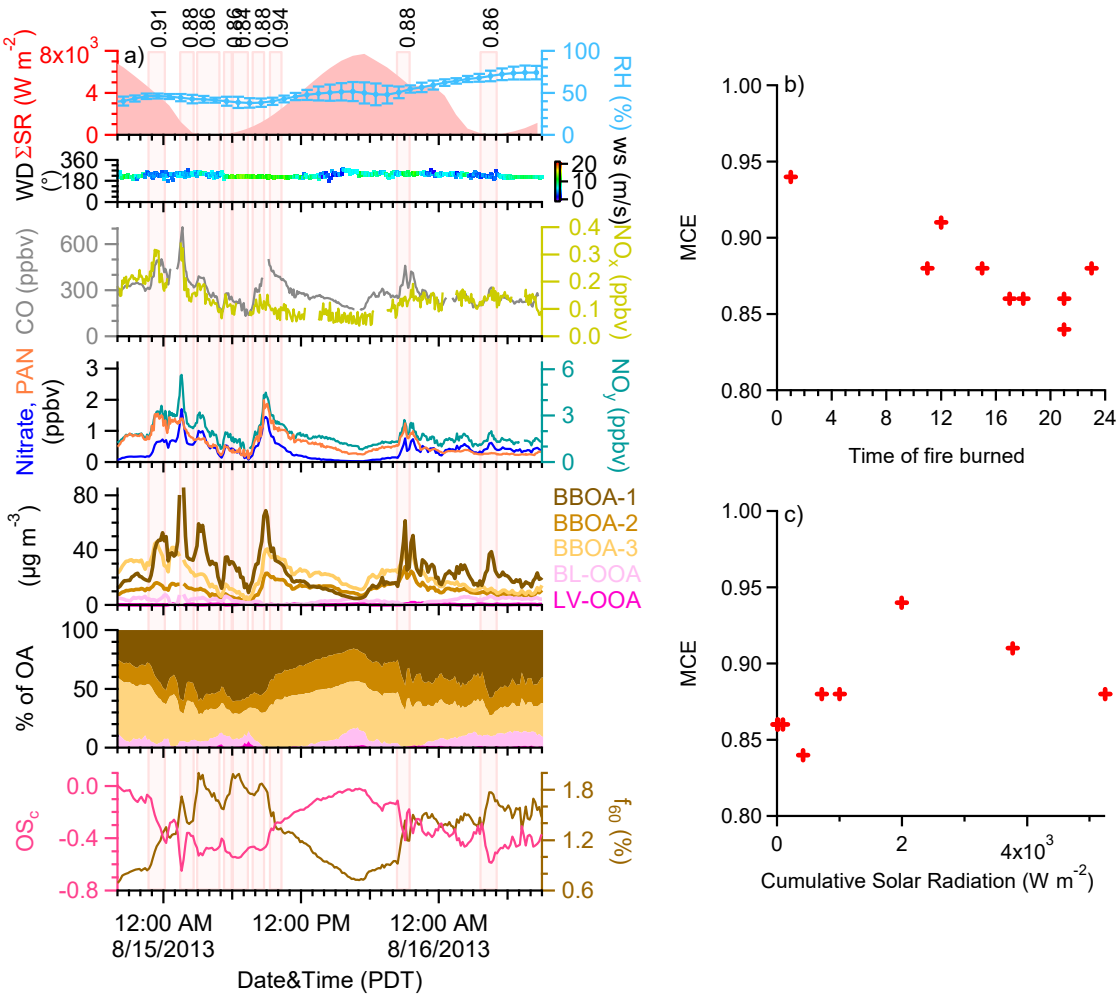

Fig. S11. (a) The overview plot for the Salmon River Complex Fire Case Study (the right panel of Fig. 6) with 9 events calculated for modified combustion efficiency (MCE) highlighted. The numbers on the top are MCE values. (b) MCE values versus time of fire burned, and (c) MCE values versus Cumulative Solar Radiation for these 9 events.