Supplement of

Assessing the impact of anthropogenic pollution on isoprene-derived secondary organic aerosol formation in $PM_{2.5}$ collected from the Birmingham, Alabama ground site during the 2013 Southern Oxidant and Aerosol Study

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Table S1. Instrumentation and time resolution of collocated measurements at BHM.

Category	Variable	Analyzer/Sensor	Time Resolution (Interval, average) (minutes)
Meteorology	Wind Speed/Direction	RMYoung 81000 sonic	5, 60
	T/RH/BP	Paroscientific Met4A	5, 60
	T/RH	Vaisala	5, 60
	PAR	Licor	5, 60
	Precipitation	ETI-NOAH IV	5, 60
	Aerosol/cloud layers	JenOptik CHM 15k ceilometer	5, 60
	Surface wetness	Vaisala (SWS2)	5, 60
Trace Gases	O_3	Thermo 49i	5, 60
	CO	Thermo 48i	5, 60
	SO_2	Thermo 43i	5, 60
	NO	Thermo 42i	5, 60
	NO_2	Photolysis/Thermo 49i	5, 60
	HNO_3	Continuous denuder diff/Thermo 42i	5, 60
	NO_y	Cat. reduction/Thermo 42i	5, 60
	NH_3	Continuous denuder diff/Thermo 42i	5, 60
Continuous PM	$PM_{2.5}$ Mass	TEOM	60
	PMcoarse Mass	Dichotomous TEOM	60
	$PM_{2.5}$ SO_4	Cat. reduction/Thermo 43i	60
	$PM_{2.5}$ NO_3	Cat. reduction/Thermo 42i	60
	$PM_{2.5}$ NH_4	Cat. oxidation/Thermo 42i	60
	$PM_{2.5}$ TC/EC	Sunset	60
	Dry Babs (880 nm)	Radiance Research M903	5, 60
	Dry Bsp (530 nm)	Magee 2ch. Aeth	5, 60
	Ambient Bsp (530 nm)	Optec NGN-2a	5, 60
Filter-Based PM	$PM_{2.5}$ Mass	gravimetry	1440, daily
	$PM_{2.5}$ ions	IC	1440, 1 in 3 days
	$PM_{2.5}$ major/minor elements	XRF	1440, daily
	$PM_{2.5}$ water-soluble metals	ICPMS	1440, 1 in 3 days
	$PM_{2.5}$ OC/EC	TOR	1440, 1 in 3 days
	PM_{coarse} Mass	gravimetry	1440, 1 in 3 days
	PM_{coarse} ions	IC	1440, 1 in 3 days
	PM_{coarse} major/minor elements	XRF	1440, 1 in 3 days
	PM_{coarse} water-soluble metals	ICPMS	1440, 1 in 3 days
Hi-Vol Based PM	$PM_{2.5}$ OC/EC	TOR	23-hr, daily
	$PM_{2.5}$ ions	IC	23-hr, daily
	$PM_{2.5}$ (other)	Various	11-hr, daily

Table S2. Correlation (r^2) of isoprene-derived SOA tracers and collocated measurements during regular day sampling (8 am – 7 pm).

SOA tracers	CO	O_3	NO_x	NO_y	SO_2	NH_3	SO_4	NO_3	NH_4	OC	WSOC	pH
MAE/HMML-derived SOA tracers	**0.31**	**0.72**	**0.04**	**0.00**	**0.20**	**0.34**	**0.51**	**0.10**	**0.53**	**0.44**	**0.48**	**0.01**
2-methylglyceric acid	0.14	0.44	0.01	0.00	0.09	0.15	0.19	0.03	0.27	0.09	0.12	0.00
MAE-derived OS	0.28	0.60	0.04	0.00	0.14	0.31	0.66	0.14	0.56	0.58	0.52	0.01
IEPOX-derived SOA tracers	**0.09**	**0.26**	**0.01**	**0.01**	**0.08**	**0.12**	**0.41**	**0.04**	**0.41**	**0.31**	**0.32**	**0.01**
2-methylerythritol	0.04	0.30	0.03	0.00	0.05	0.04	0.31	0.00	0.31	0.24	0.30	0.01
2-methylthreitol	0.02	0.20	0.02	0.00	0.06	0.03	0.21	0.00	0.23	0.13	0.19	0.00
(E)-2-methylbut-3-ene-1,2,4-triol	0.05	0.24	0.02	0.00	0.03	0.05	0.33	0.02	0.32	0.22	0.27	0.00
(Z)-2-methylbut-3-ene-1,2,4-triol	0.10	0.11	0.00	0.01	0.09	0.17	0.34	0.10	0.32	0.24	0.16	0.01
2-methylbut-3-ene-1,2,3-triol	0.11	0.11	0.00	0.01	0.09	0.18	0.36	0.10	0.34	0.25	0.17	0.01
IEPOX-derived OS	0.17	0.41	0.01	0.01	0.08	0.19	0.47	0.07	0.50	0.53	0.59	0.01
IEPOX dimer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other isoprene SOA tracers												
GA sulfate												
$C_2H_3O_6S^-$	0.22	0.20	0.00	0.00	0.07	0.19	0.49	0.20	0.39	0.33	0.21	0.01
Methylglyoxal-derived OS												
$C_3H_5O_6S^-$	0.25	0.40	0.01	0.01	0.11	0.11	0.57	0.05	0.46	0.41	0.47	0.01
Isoprene-derived OSs												
$C_5H_7O_7S^-$	0.13	0.34	0.01	0.01	0.02	0.17	0.35	0.11	0.40	0.21	0.28	0.00
$C_5H_{10}NO_9S^-$	0.02	0.37	0.12	0.06	0.00	0.01	0.48	0.12	0.38	0.18	0.12	0.11
$C_5H_9N_2O_{11}S^-$ *	0.25	0.56	0.48	0.40	0.15	0.40	0.52	0.28	0.24	0.57	0.46	0.00
Hydroxyacetone-derived OS												
$C_2H_3O_5S^-$	0.42	0.73	0.06	0.16	0.00	0.18	0.55	0.23	0.71	0.57	0.66	0.00
Other tracer												
Levoglucosan	0.26	0.34	0.00	0.00	0.09	0.21	0.44	0.10	0.47	0.22	0.25	0.01

* Found only in 6 of 120 filters

The correlations in this table are positive.

Table S3. Correlation (r^2) of isoprene-derived SOA tracers and collocated measurements during intensive 1 sampling (8 am – 11 am).

SOA tracers	CO	O_3	NO_x	NO_y	SO_2	NH_3	SO_4	NO_3	NH_4	OC	WSOC	pH
MAE/HMML-derived SOA tracers	**0.00**	**0.20**	**0.04**	**0.16**	**0.01**	**0.07**	**0.35**	**0.25**	**0.46**	**0.47**	**0.16**	**0.18**
2-methylglyceric acid	0.03	0.22	0.05	0.10	0.00	0.07	0.00	0.43	0.11	0.46	0.07	0.08
MAE-derived OS	0.01	0.09	0.02	0.12	0.01	0.03	0.72	0.06	0.62	0.26	0.08	0.18
IEPOX-derived SOA tracers	**0.11**	**0.04**	**0.05**	**0.00**	**0.06**	**0.26**	**0.30**	**0.00**	**0.16**	**0.04**	**0.02**	**0.03**
2-methylerythritol	0.15	0.01	0.02	0.00	0.16	0.52	0.22	0.03	0.18	0.00	0.00	0.15
2-methylthreitol	0.04	0.00	0.00	0.00	0.10	0.19	0.13	0.02	0.16	0.00	0.02	0.13
(E)-2-methylbut-3-ene-1,2,4-triol	0.12	0.03	0.06	0.01	0.01	0.27	0.23	0.00	0.09	0.11	0.05	0.00
(Z)-2-methylbut-3-ene-1,2,4-triol	0.13	0.02	0.05	0.01	0.03	0.32	0.28	0.00	0.08	0.09	0.05	0.00
2-methylbut-3-ene-1,2,3-triol	0.07	0.02	0.02	0.00	0.02	0.26	0.22	0.01	0.03	0.04	0.28	0.01
IEPOX-derived OS	0.09	0.07	0.07	0.00	0.05	0.19	0.30	0.00	0.17	0.04	0.00	0.02
IEPOX dimer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other isoprene SOA tracers												
GA sulfate $C_2H_3O_6S^-$	0.00	0.19	0.03	0.01	0.01	0.03	0.37	0.02	0.44	0.25	0.11	0.00
Methylglyoxal-derived OS $C_3H_5O_6S^-$	0.05	0.05	0.18	0.28	0.02	0.00	0.01	0.11	0.24	0.09	0.56	0.03
Isoprene-derived OSs												
$C_5H_7O_7S^-$	0.09	0.15	0.00	0.20	0.05	0.02	0.36	0.12	0.25	0.40	0.00	0.02
$C_5H_{10}NO_9S^-$	0.00	0.05	0.02	0.06	0.06	0.04	0.38	0.00	0.23	0.17	0.18	0.37
$C_5H_9N_2O_{11}S^-$ *	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Hydroxyacetone-derived OS												
$C_2H_3O_5S^-$	0.25	0.67	0.71	0.65	0.21	0.21	0.03	0.26	0.12	0.50	0.00	0.70
Other tracer												
Levoglucosan	0.03	0.07	0.02	0.00	0.07	0.07	0.08	0.11	0.01	0.03	0.02	0.24

* Found only in 6 of 120 filters

The correlations in this table are positive.

Table S4. Correlation (r^2) of isoprene-derived SOA tracers and collocated measurements during intensive 2 sampling (12 pm – 3 pm).

SOA tracers	CO	O_3	NO_x	NO_y	SO_2	NH_3	SO_4	NO_3	NH_4	OC	WSOC	pH
MAE/HMML-derived SOA tracers	**0.13**	**0.42**	**0.0**	**0.12**	**0.04**	**0.01**	**0.14**	**0.05**	**0.29**	**0.55**	**0.19**	**0.00**
2-methylglyceric acid	0.01	0.47	0.25	0.32	0.00	0.04	0.00	0.05	0.04	0.17	0.07	005
MAE-derived OS	0.15	0.20	0.04	0.01	0.06	0.00	0.18	0.15	0.31	0.49	0.24	0.03
IEPOX-derived SOA tracers	**0.22**	**0.00**	**0.04**	**0.08**	**0.00**	**0.21**	**0.34**	**0.32**	**0.37**	**0.46**	**0.81**	**0.02**
2-methylerythritol	0.41	0.00	0.13	0.14	0.01	0.16	0.48	0.24	0.50	0.42	0.77	0.01
2-methylthreitol	0.29	0.00	0.03	0.07	0.00	0.07	0.22	0.41	0.39	0.32	0.70	0.02
(E)-2-methylbut-3-ene-1,2,4-triol	0.17	0.00	0.04	0.07	0.01	0.17	0.30	0.31	0.29	0.44	0.61	0.02
(Z)-2-methylbut-3-ene-1,2,4-triol	0.21	0.00	0.05	0.07	0.01	0.17	0.33	0.29	0.31	0.45	0.64	0.01
2-methylbut-3-ene-1,2,3-triol	0.03	0.02	0.00	0.02	0.03	0.07	0.13	0.21	0.06	0.09	0.62	0.03
IEPOX-derived OS	0.19	0.02	0.11	0.21	0.00	0.32	0.43	0.16	0.39	0.52	0.58	0.00
IEPOX dimer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other isoprene SOA tracers												
GA sulfate $C_2H_3O_6S^-$	0.24	0.23	0.00	0.08	0.00	0.06	0.32	0.23	0.46	0.46	0.48	0.00
Methylglyoxal-derived OS $C_3H_5O_6S^-$	0.27	0.28	0.01	0.02	0.01	0.06	0.29	0.00	0.29	0.33	0.43	0.03
Isoprene-derived OSs												
$C_5H_7O_7S^-$	0.14	0.02	0.06	0.07	0.03	0.06	0.16	0.00	0.18	0.18	0.09	0.00
$C_5H_{10}NO_9S^-$	0.00	0.15	0.07	0.05	0.21	0.34	0.03	0.05	0.00	0.06	0.00	0.18
$C_5H_9N_2O_{11}S^-$ *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroxyacetone-derived OS												
$C_2H_3O_5S^-$	0.09	0.40	0.01	0.01	0.10	0.05	0.04	0.07	0.10	0.07	0.62	0.01
Other tracer												
Levoglucosan	0.03	0.00	0.22	0.13	0.00	0.01	0.03	0.17	0.00	0.02	0.00	0.07

* Found only in 6 of 120 filters

The correlations in this table are positive.

Table S5. Correlation (r^2) of isoprene-derived SOA tracers and collocated measurements during intensive 3 sampling (4 pm – 7 pm).

SOA tracers	CO	O_3	NO_x	NO_y	SO_2	NH_3	SO_4	NO_3	NH_4	OC	WSOC	pH
MAE/HMML-derived SOA tracers	**0.01**	**0.47**	**0.45**	**0.39**	**0.47**	**0.00**	**0.19**	**0.10**	**0.12**	**0.54**	**0.23**	**0.15**
2-methylglyceric acid	0.12	0.37	0.03	0.17	0.25	0.00	0.00	0.05	0.02	0.34	0.50	0.15
MAE-derived OS	0.00	0.37	0.44	0.39	0.41	0.01	0.25	0.09	0.13	0.45	0.04	0.10
IEPOX-derived SOA tracers	**0.10**	**0.15**	**0.18**	**0.14**	**0.50**	**0.17**	**0.47**	**0.00**	**0.18**	**0.31**	**0.24**	**0.03**
2-methylerythritol	0.03	0.34	0.08	0.04	0.58	0.12	0.34	0.01	0.14	0.42	0.22	0.00
2-methylthreitol	0.04	0.32	0.03	0.01	0.43	0.17	0.25	0.03	0.14	0.54	0.21	0.01
(E)-2-methylbut-3-ene-1,2,4-triol	0.00	0.21	0.05	0.02	0.70	0.13	0.33	0.00	0.12	0.38	0.01	0.02
(Z)-2-methylbut-3-ene-1,2,4-triol	0.00	0.21	0.09	0.05	0.77	0.14	0.41	0.00	0.13	0.27	0.01	0.01
2-methylbut-3-ene-1,2,3-triol	0.54	0.00	0.12	0.13	0.00	0.01	0.18	0.04	0.06	0.00	0.33	0.02
IEPOX-derived OS	0.15	0.10	0.17	0.12	0.42	0.16	0.41	0.00	0.15	0.24	0.29	0.03
IEPOX dimer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other isoprene SOA tracers												
GA sulfate $C_2H_3O_6S^-$	0.20	0.28	0.43	0.32	0.02	0.00	0.19	0.16	0.30	0.55	0.01	0.21
Methylglyoxal-derived OS $C_3H_5O_6S^-$	0.26	0.16	0.01	0.01	0.10	0.12	0.57	0.34	0.60	0.03	0.00	0.02
Isoprene-derived OSs												
$C_5H_7O_7S^-$	0.06	0.18	0.19	0.13	0.12	0.14	0.45	0.02	0.35	0.55	0.02	0.00
$C_5H_{10}NO_9S^-$	0.06	0.45	0.00	0.03	0.80	0.05	0.44	0.03	0.18	0.27	0.15	0.00
$C_5H_9N_2O_{11}S^-$ *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroxyacetone-derived OS												
$C_2H_3O_5S^-$	0.49	0.01	0.10	0.20	0.13	0.05	0.44	0.24	0.11	0.06	0.29	0.10
Other tracer												
Levoglucosan	0.00	0.01	0.02	0.04	0.00	0.06	0.00	0.02	0.00	0.20	0.01	0.04

* Found only in 6 of 120 filters

The correlations in this table are positive.

Table S6. Correlation (r^2) of isoprene-derived SOA tracers and collocated measurements during intensive 4 and regular nighttime (8 pm – 7 am next day).

SOA tracers	CO	O_3	NO_x	NO_y	SO_2	NH_3	SO_4	NO_3	NH_4	OC	WSOC	pH
MAE/HMML-derived SOA tracers	**0.35**	**0.08**	**0.18**	**0.21**	**0.17**	**0.39**	**0.48**	**0.15**	**0.42**	**0.53**	**0.15**	**0.01**
2-methylglyceric acid	0.18	0.00	0.13	0.10	0.12	0.18	0.17	0.05	0.22	0.17	0.01	0.04
MAE-derived OS	0.35	0.14	0.15	0.17	0.11	0.32	0.51	0.17	0.36	0.58	0.20	0.00
IEPOX-derived SOA tracers	**0.10**	**0.10**	**0.02**	**0.03**	**0.08**	**0.10**	**0.37**	**0.02**	**0.30**	**0.27**	**0.15**	**0.00**
2-methylerythritol	0.02	0.12	0.00	0.00	0.05	0.01	0.23	0.00	0.20	0.14	0.09	0.00
2-methylthreitol	0.06	0.09	0.00	0.01	0.09	0.05	0.38	0.01	0.30	0.21	0.15	0.00
(E)-2-methylbut-3-ene-1,2,4-triol	0.09	0.08	0.02	0.03	0.10	0.10	0.35	0.03	0.28	0.26	0.11	0.00
(Z)-2-methylbut-3-ene-1,2,4-triol	0.07	0.07	0.01	0.02	0.10	0.07	0.32	0.02	0.27	0.22	0.08	0.00
2-methylbut-3-ene-1,2,3-triol	0.02	0.05	0.00	0.01	0.03	0.02	0.18	0.01	0.16	0.15	0.09	0.00
IEPOX-derived OS	0.17	0.10	0.08	0.10	0.01	0.16	0.27	0.03	0.21	0.31	0.14	0.01
IEPOX dimer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other isoprene SOA tracers												
GA sulfate $C_2H_3O_6S^-$	0.12	0.22	0.02	0.04	0.04	0.14	0.28	0.01	0.15	0.31	0.26	0.01
Methylglyoxal-derived OS $C_3H_5O_6S^-$	0.16	0.05	0.03	0.05	0.00	0.18	0.19	0.01	0.17	0.26	0.24	0.00
Isoprene-derived OSs												
$C_5H_7O_7S^-$	0.12	0.15	0.01	0.02	0.02	0.09	0.22	0.01	0.11	0.17	0.12	0.00
$C_5H_{10}NO_9S^-$	0.20	0.00	0.11	0.12	0.08	0.21	0.39	0.18	0.33	0.30	0.09	0.00
$C_5H_9N_2O_{11}S^-$ *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroxyacetone-derived OS												
$C_2H_3O_5S^-$	0.89	0.09	0.83	0.89	0.30	0.83	0.00	0.00	0.17	0.40	0.59	0.01
Other tracer												
Levoglucosan	0.23	0.00	0.22	0.24	0.08	0.21	0.13	0.01	0.18	0.25	0.11	0.00

* Found only in 6 of 120 filters

The correlations in this table are positive.

Table S7. Regression and correlation (r^2) analysis at the 95% confidence interval

	Variables		Regression Statistics					*p-value*
	Y	x	Number of observations	Multiple r	r^2	Adjusted r^2	Standard error	
Nighttime: MAE/HMML-derived SOA vs $P[NO_3]$	MAE/HMML - derived SOA	$P[NO_3]$	40	0.7532	0.5673	0.5559	12.5098	2.05E-08
Nighttime: IEPOX-derived SOA vs $P[NO_3]$	IEPOX-derived SOA	$P[NO_3]$	40	0.5086	0.2587	0.2392	393.7399	8.05E-04
Regular day sampling: MAE/HMML-derived SOA vs O_3	MAE/HMML - derived SOA	O_3	30	0.8457	0.7153	0.7051	8.9517	4.00E-09
Daytime: 2-methyltetrols vs O_3	2-methyltetrols	O_3	64	0.3610	0.1303	0.1163	254.4175	3.39E-03
Intensive 3: MAE/HMML-derived SOA vs O_3	MAE/HMML - derived SOA	O_3	15	0.6844	0.4683	0.4274	18.3128	4.89E-03
Intensive 3: 2-methyltetrols vs O_3	2-methyltetrols	O_3	15	0.5844	0.3415	0.2908	259.0249	2.22E-02
MAE/HMML-derived SOA vs SO_4	MAE/HMML - derived SOA	SO_4	117	0.5779	0.3340	0.3282	15.8648	8.96E-12
IEPOX-derived SOA vs SO_4	IEPOX-derived SOA	SO_4	117	0.6027	0.3632	0.3577	310.4400	6.51E-13

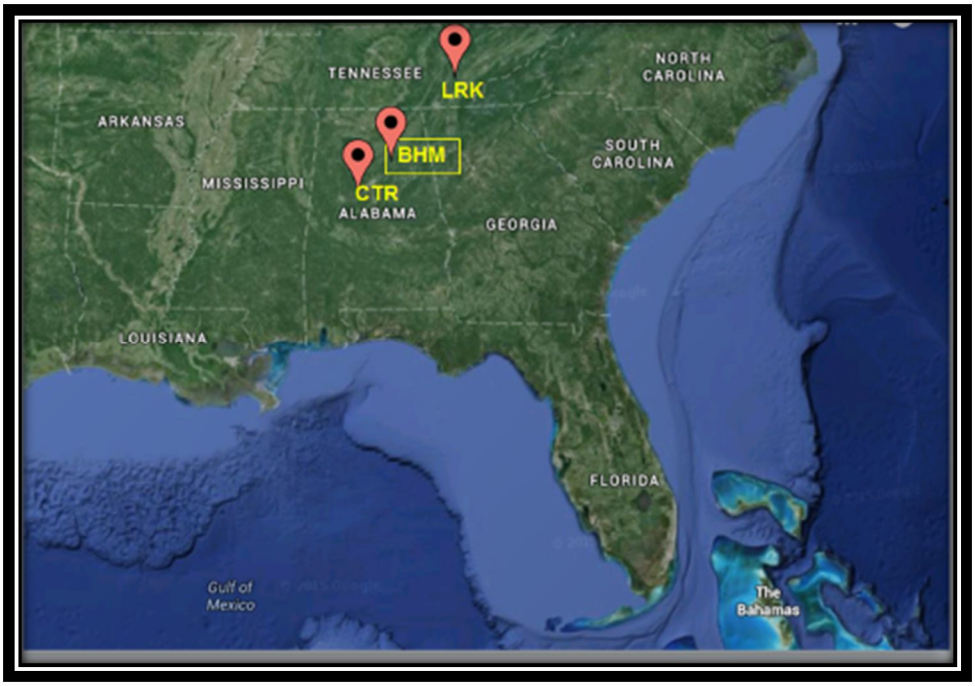


Figure S1. The locations of the three sampling sites during 2013 SOAS: BHM, CTR, and LRK. BHM was the focused site in this study.

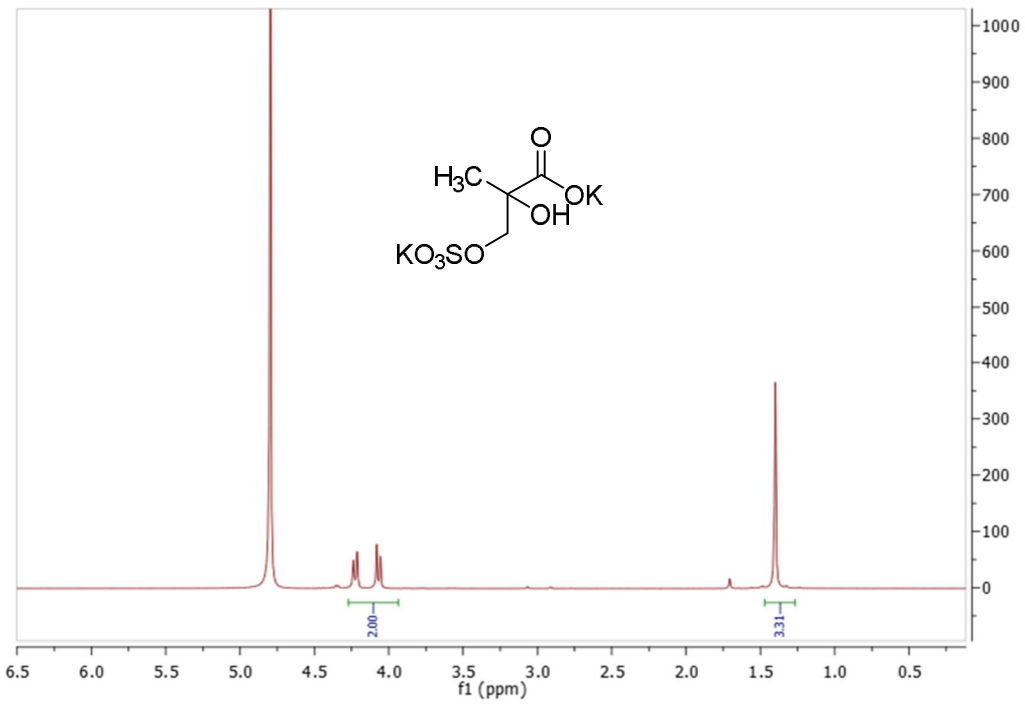
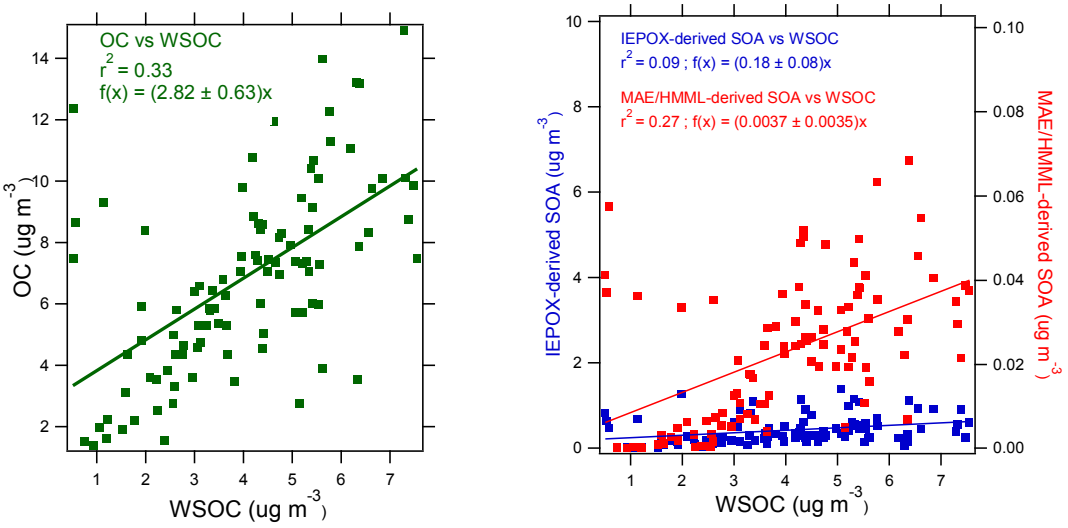


Figure S2. ^{1}H NMR (400 MHz, D_2O) of the MAE/HMML-derived OS.



(a) (b)

Figure S3. (a) Comparison of organic carbon (OC) and water soluble organic carbon (WSOC), suggesting that 35% of OC at BHM was WSOC. (b) Comparison of IEPOX- and MAE-derived SOA tracers with WSOC, indicating that IEPOX- and MAE-derived SOA tracers explained 18 and 0.4% of the WSOC, respectively.

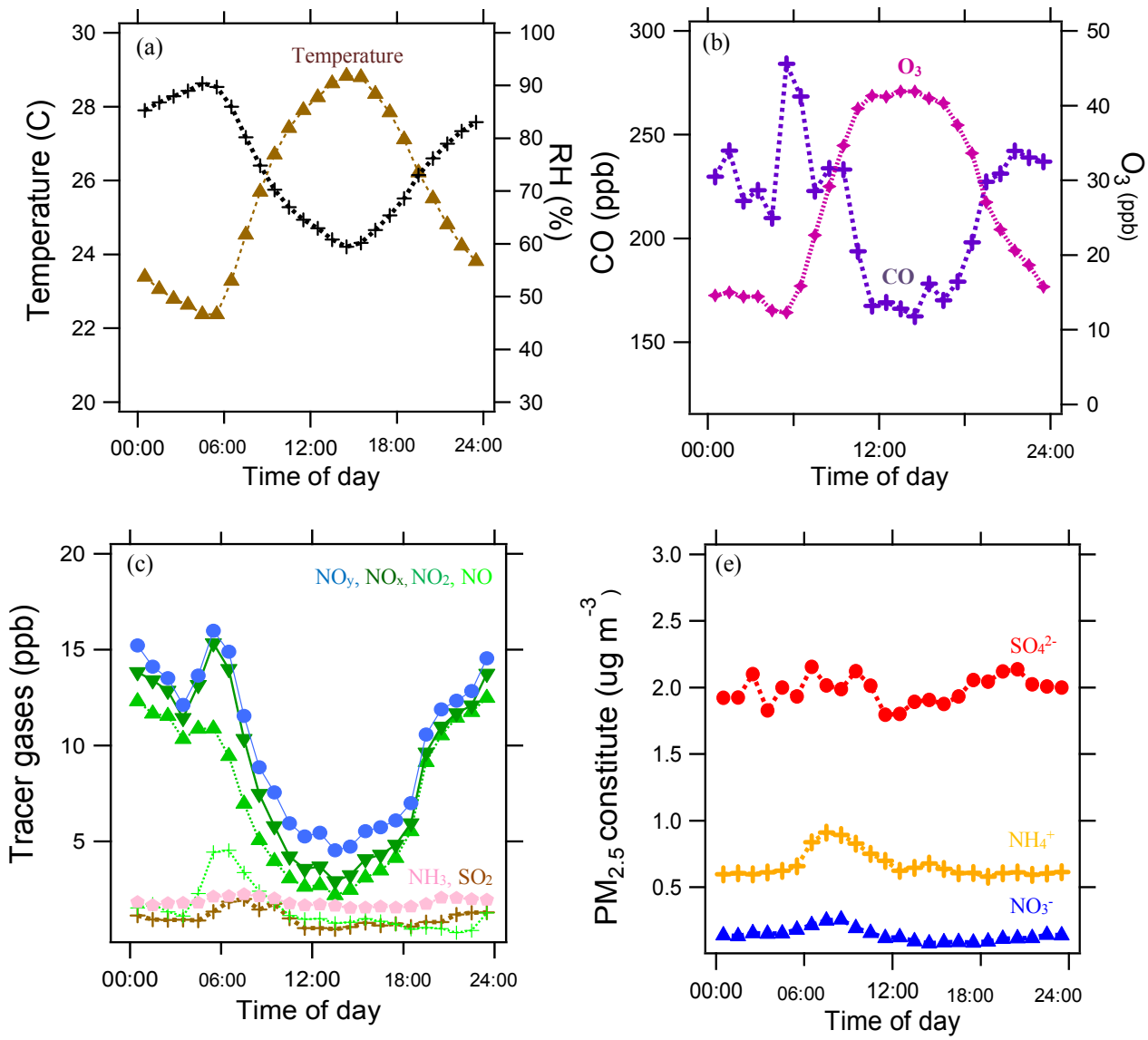


Figure S4. Diurnal variations of (a) meteorology, (b) O_3 and CO, (c) NO_y, NO, NO_2, and NO_x, and (d) $PM_{2.5}$ constituents at BHM during the 2013 SOAS campaign. High temperature and low RH were observed at 2-4 pm local time. O_3 reached its maximum, while CO dropped to its minimum in early afternoon. NO_x and NO_y were high during early morning hours and declined in the afternoon due to photochemical processes. No significant diurnal variation was observed for NH_3, SO_2, SO_4^{2-}, NH_4^+, and NO_3^-.

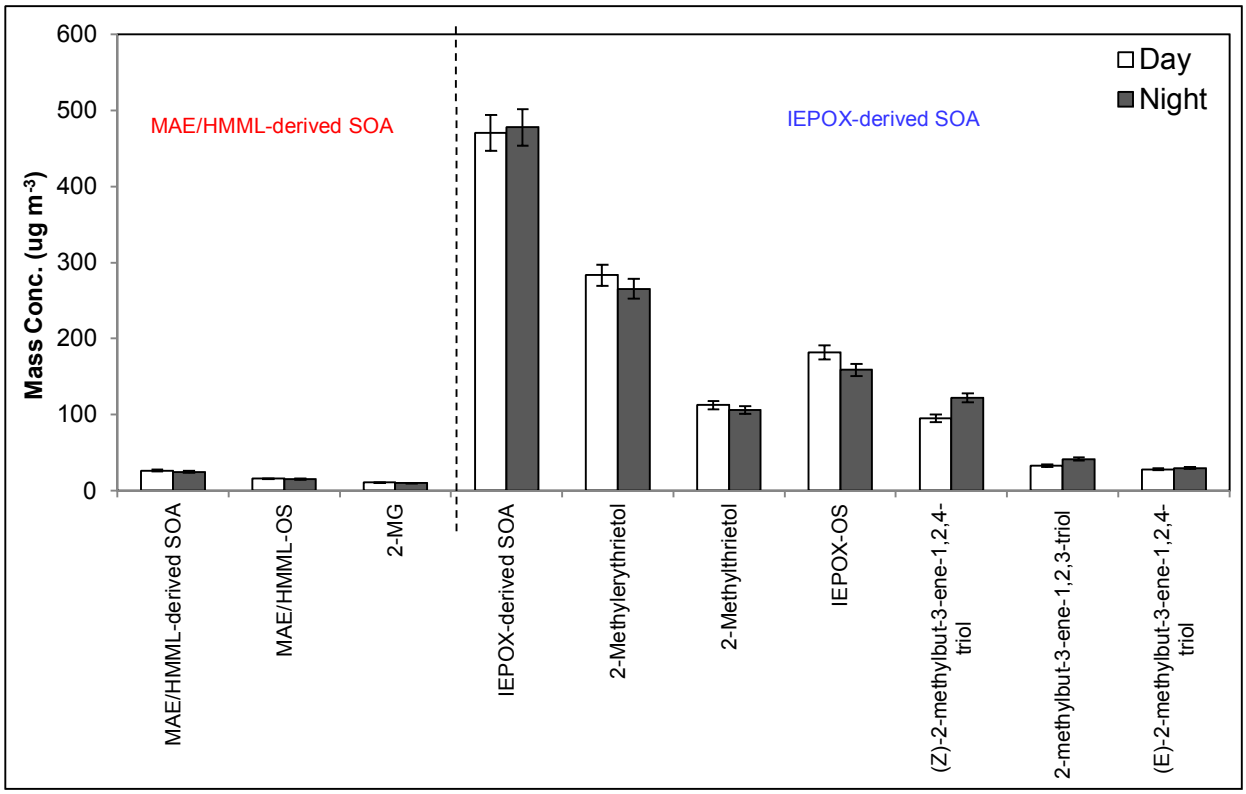


Figure S5. The bar chart shows average daytime and nighttime concentrations of isoprene-derived SOA tracers with 95% confident interval. No significant variation between daytime and nighttime was observed.

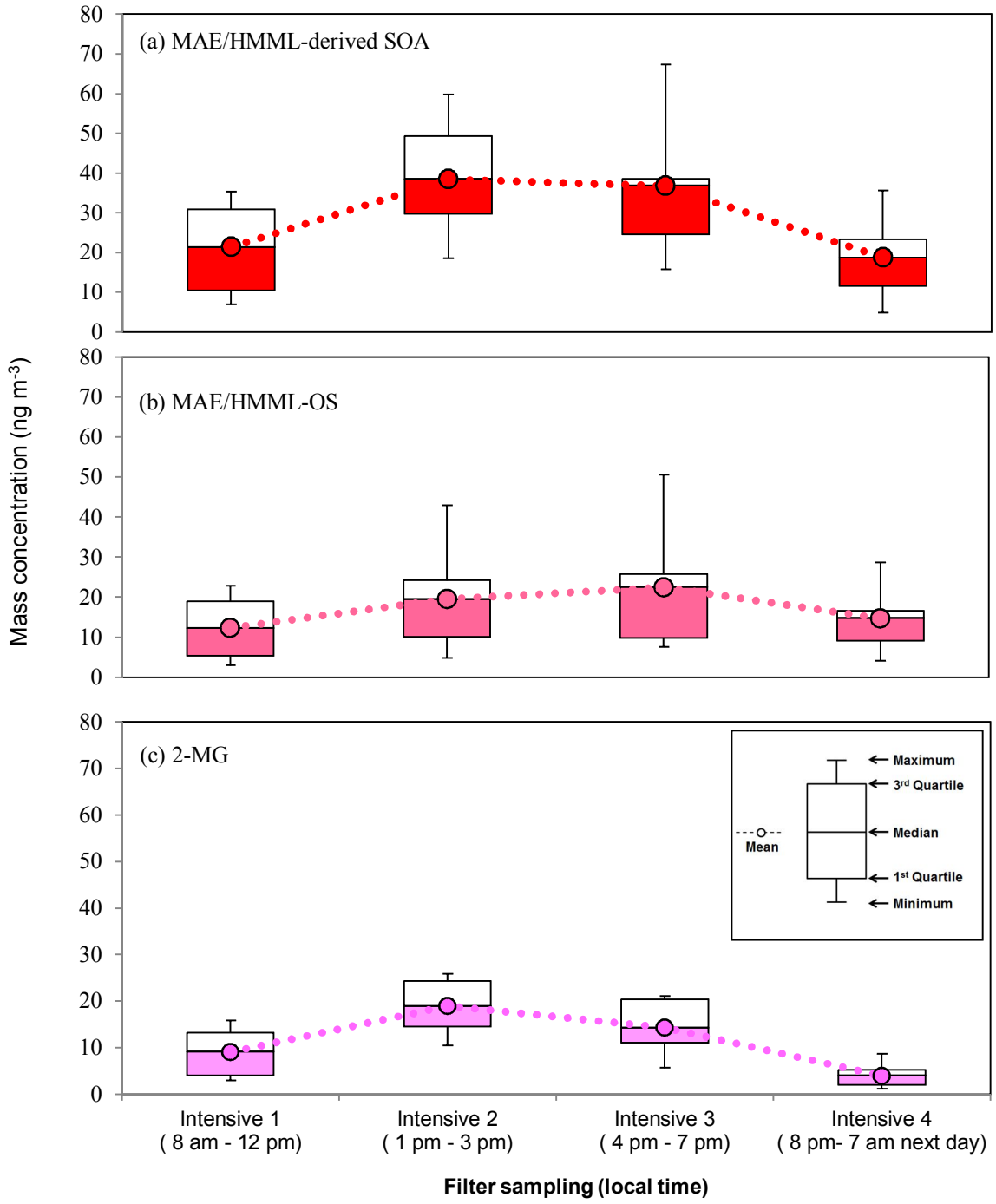


Figure S6. The box-and-whisker plot (n = 15) of (a) MAE/HMML-SOA, (b) MAE/HMML-OS, and (c) 2-MG. These demonstrate that the statistical distribution of SOA abundance during each intensive sampling period. No significant variation amongst intensive samples was observed.

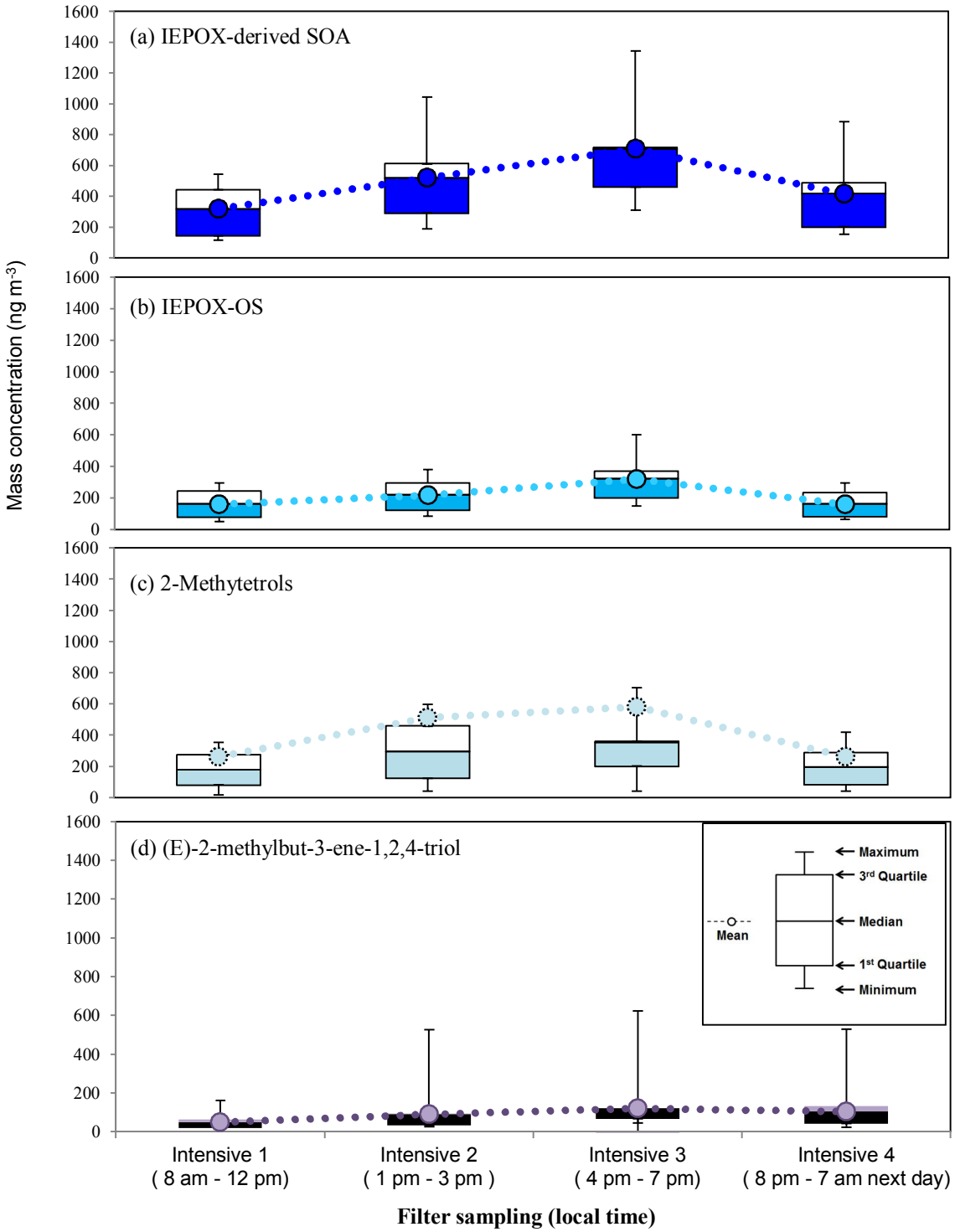


Figure S7. The box-and-whisker plot (n = 15) of (a) IEPOX-derived SOA, (b) IEPOX-OS, (c) 2-methyltetrols, and (d) (E)-2-methylbut-3-ene-1,2,4-triol. These demonstrate that the statistical distribution of SOA abundance during each intensive sampling period. No significant variation amongst intensive samples was observed.