Supplement of:

Measurement report: Large contribution of biomass burning and aqueous-phase processes to the wintertime secondary organic aerosol formation in Xi'an, Northwest China

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Table S1 Summary of mass concentrations of NR-$PM_{2.5}$ species (μg m^{-3}), OA sources (μg m^{-3}), gaseous pollutants (μg m^{-3} for SO_2, NO_2, O_3, and mg m^{-3} for CO), ALWC (μg m^{-3}), meteorological parameters (RH, Temperature (T)) and elemental ratios (H/C, O/C) during different periods according to this study.

Species	**Entire study**	**reference**	**SIA-P1**	**SIA-P2**
NR-$PM_{2.5}$	68.0±42.8	44.1±25.5	131.0±49.6	84.9±30.7
OA	37.1±19.2	28.7±16.4	68.0±20.7	37.7±11.7
SO_4^{2-}	8.7±8.5	3.5±2.8	18.4±10.2	14.7±7.2
NO_3^-	13.3±11.4	6.8±4.9	27.4±13.4	19.9±9.3
NH_4^+	6.8±5.7	3.3±2.2	13.3±6.5	10.8±4.6
Cl^-	2.1±1.8	1.8±1.8	3.9±1.9	1.8±0.7
HOA	3.0±3.9	3.3±4.2	4.6±4.2	1.3±1.3
COA	4.8±4.2	4.8±4.4	7.0±4.8	3.5±2.3
CCOA	3.2±2.5	3.0±2.3	5.8±2.8	2.0±1.5
BBOA	4.3±5.9	3.9±5.6	9.6±7.7	2.1±2.6
OOA-BB	9.0±7.3	8.8±7.8	14.8±6.4	6.1±3.9
aq-OOA	12.8±12.6	4.9±3.7	26.2±14.6	22.7±10.7
SO_2	16.9±8.9	19.5±9.8	17.2±5.2	10.6±4.1
NO_2	64.4±25.4	64.8±26.2	82.8±18.9	52.2±19.5
O_3	30.0±26.7	28.6±25.8	16.3±12.4	41.9±30.1
CO	1.5±0.6	1.3±0.5	2.2±0.5	1.4±0.3
ALWC	38.8±69.7	12.8±66.8	90.4±104.5	73.7±84.3
RH (%)	58.1±22.0	50.3±20.4	67.9±19.6	70.4±18.7
T (℃)	1.4±5.9	1.7±6.0	-2.8±4.8	3.1±4.9
H/C	1.71±0.07	1.74±0.06	1.72±0.05	1.65±0.04
O/C	0.50±0.15	0.41±0.10	0.52±0.10	0.67±0.11

Table S2 Summary of elemental ratios (H/C and O/C) of the bulk OA and specific OA factors resolved from PMF based on HR-AMS measurements in recent years in China as well as some European or American sites.

Site	Site type	Sampling period	OA	HOA	COA	BBOA	CCOA	LO-OOA	MO-OOA	reference
Beijing, China	urban	Jul-Sep, 2008	O/C=0.41 H/C=1.67	O/C=0.21 H/C=1.72	O/C=0.14 H/C=1.89			OOA O/C=0.60 H/C=1.47		Huang et al., 2010
Beijing, China	urban	Nov-Dec, 2010	O/C=0.32 H/C=1.65	O/C=0.15 H/C=1.75	O/C=0.14 H/C=1.75	O/C=0.22 H/C=1.55	O/C=0.16 H/C=1.56	O/C=0.47 H/C=1.65	O/C=0.58 H/C=1.47	Hu WW et al., 2016
Beijing, China	urban	Dec 2010-Jan 2011	O/C=0.17 H/C=1.70							Liu et al., 2012
Beijing, China	urban	Aug-Sep, 2011	O/C=0.56 H/C=1.61	O/C=0.22 H/C=1.78	O/C=0.17 H/C=1.80			O/C=0.62 H/C=1.45	O/C=0.82 H/C=1.24	Hu WW et al., 2016
Beijing, China	urban	Aug, 2012		O/C=0.18 H/C=1.81	O/C=0.24 H/C=1.82			OOA O/C=1.09 H/C=1.32		Zhang et al., 2015
Beijing, China	urban	Oct, 2012		O/C=0.23 H/C=1.81	O/C=0.09 H/C=1.91			O/C=0.44 H/C=1.61	O/C=1.01 H/C=1.32	Zhang et al., 2015
Beijing, China	urban	Mar-May, 2012	O/C=0.49 H/C=1.63	O/C=0.18 H/C=1.81	O/C=0.13 H/C=1.89	O/C=0.31 H/C=1.67		OOA O/C=1.00 H/C=1.38		Hu et al., 2017
Beijing, China	urban	Jul-Aug, 2012	O/C=0.53 H/C=1.61	O/C=0.19 H/C=1.71	O/C=0.17 H/C=1.85			O/C=0.67 H/C=1.51	O/C=0.91 H/C=1.40	Hu et al., 2017
Beijing, China	urban	Oct-Nov, 2012	O/C=0.46 H/C=1.58	O/C=0.07 H/C=1.94	O/C=0.13 H/C=1.82	O/C=0.24 H/C=1.53		OOA O/C=0.88 H/C=1.32		Hu et al., 2017
Beijing, China	urban	Jan-Mar, 2013	O/C=0.47 H/C=1.52	O/C=0.36 H/C=1.66	O/C=0.23 H/C=1.73		O/C=0.14 H/C=1.45	O/C=0.77 H/C=1.72	O/C=0.84 H/C=1.34	Hu et al., 2017
Beijing, China	urban	Jan, 2013	O/C=0.43 H/C=1.57	O/C=0.14 H/C=1.69	O/C=0.14 H/C=1.86		O/C=0.35 H/C=1.75	O/C=0.50 H/C=1.47	O/C=1.05 H/C=1.32	Zhang et al., 2014
Beijing, China	urban	Dec 2013-Jan 2014	O/C=0.37 H/C=1.73							Sun et al., 2016
Beijing, China	urban	Oct-Nov, 2014	O/C=0.51 H/C=1.69	O/C=0.19 H/C=1.93	O/C=0.16 H/C=1.92	O/C=0.63 H/C=1.77		O/C=0.59 H/C=1.49	O/C=1.24 H/C=1.40	Xu et al., 2015
Beijing, China	urban	Oct, 2014		O/C=0.07 H/C=1.75	O/C=0.13 H/C=1.61	O/C=0.20 H/C=1.53		O/C=0.54 H/C=1.46	O/C=0.84 H/C=1.13	Zhang et al., 2016
Beijing, China	urban	Dec, 2014		O/C=0.08 H/C=1.66	O/C=0.10 H/C=1.68		O/C=0.25 H/C=1.19	O/C=0.56 H/C=1.42		Zhang et al., 2016
Beijing, China	urban	Dec 2013-Jan 2014	O/C=0.37 H/C=1.75	O/C=0.11 H/C=2.08	O/C=0.14 H/C=1.88	O/C=0.14 H/C=1.67	O/C=0.36 H/C=1.67	O/C=0.75 H/C=1.51	O/C=0.81 H/C=1.75	Xu et al., 2017
Beijing, China	urban	Jun-Jul, 2014	O/C=0.57 H/C=1.70	O/C=0.30 H/C=1.80	O/C=0.15 H/C=1.88			O/C=0.78 H/C=1.55	O/C=1.15 H/C=1.45	Xu et al., 2017
Beijing,	urban	Oct-Nov,	O/C=0.51	O/C=0.19	O/C=0.13	O/C=0.65		O/C=0.58	O/C=1.23	Xu et al.,

China		2014	H/C=1.69	H/C=1.95	H/C=1.87	H/C=1.81		H/C=1.50	H/C=1.44	2017
Beijing, China	urban	Nov-Dec, 2014	O/C=0.40 H/C=1.69	O/C=0.22 H/C=1.69	O/C=0.16 H/C=1.82	O/C=0.32 H/C=1.98		OOA O/C=1.09 H/C=1.27	aq-OOA O/C=0.82 H/C=1.75	Xu et al., 2019a
Beijing, China	urban	Nov-Dec, 2016	O/C=0.45 H/C=1.68	O/C=0.16 H/C=1.83	O/C=0.19 H/C=1.83	O/C=0.39 H/C=1.75		OOA O/C=1.09 H/C=1.59	aq-OOA O/C=0.65 H/C=1.82	Xu et al., 2019a
Beijing, China	urban	Aug-Sep, 2015		O/C=0.23 H/C=1.89	O/C=0.13 H/C=1.85			O/C=0.84 H/C=1.55	O/C=1.00 H/C=1.39	Zhao et al., 2017
Beijing, China	urban	Sep, 2015	O/C=0.47 H/C=1.60	O/C=0.16 H/C=1.62	O/C=0.09 H/C=1.71			O/C=0.45 H/C=1.40	O/C=0.88 H/C=1.11	Li et al., 2020
Beijing, China	urban	Jun, 2017	O/C=0.57 H/C=1.64	O/C=0.10 H/C=1.89	O/C=0.23 H/C=1.82			O/C=0.62 H/C=1.62		Xu et al., 2019b
Beijing, China	urban	May-Jun, 2018	O/C=0.68 H/C=1.50	O/C=0.17 H/C=1.83	O/C=0.27 H/C=1.76			O/C=0.76 H/C=1.44	O/C=1.3 H/C=1.13	Xu et al., 2019b
Xi'an, China	urban	Jun-Jul, 2019	O/C=0.58 H/C=1.64	O/C=0.15 H/C=1.91	O/C=0.18 H/C=1.79			LO-OOA O/C=0.55 H/C=1.56	MO-OOA O/C=0.78 H/C=1.38 aq-OOA O/C=0.85 H/C=1.54	Duan et al., 2021
Xi'an, China	urban	Dec 2018- Mar 2019	O/C=0.50 H/C=1.71	O/C=0.09 H/C=2.04	O/C=0.13 H/C=1.81	O/C=0.30 H/C=1.74	O/C=0.21 H/C=1.64	OOA-BB O/C=0.57 H/C=1.59	aq-OOA O/C=0.82 H/C=1.47	This study
Lanzhou, China	urban	Jul-Aug, 2012	O/C=0.41 H/C=1.62	O/C=0.13 H/C=2.02	O/C=0.13 H/C=2.07			O/C=0.35 H/C=1.45	O/C=0.85 H/C=1.42	Xu et al., 2014
Lanzhou, China	urban	Jan-Feb, 2014	O/C=0.35 H/C=1.69	O/C=0.13 H/C=2.03	O/C=0.09 H/C=1.89	O/C=0.30 H/C=1.69	O/C=0.25 H/C=1.68	O/C=0.41 H/C=1.60	O/C=1.00 H/C=1.24	Xu et al., 2016
Shanghai, China	urban	May-Jun, 2010	O/C=0.40 H/C=1.92	O/C=0.20 H/C=1.93				O/C=0.44 H/C=1.61	O/C=0.81 H/C=1.62	Huang et al., 2012
Nanjing, China	urban	Apr, 2015	O/C=0.27 H/C=1.52	O/C=0.13 H/C=1.91	O/C=0.20 H/C=1.82			O/C=0.40 H/C=1.6	O/C=0.69 H/C=1.38	Wang et al., 2016
Hangzhou, China	urban	Aug-Sep, 2016(G20)	Before O/C=0.39 H/C=1.78 during O/C=0.58 H/C=1.65 after O/C=0.51 H/C=1.69	O/C=0.07 H/C=2.17	O/C=0.18 H/C=1.83			O/C=0.49 H/C=1.67	O/C=0.78 H/C=1.54	Li et al., 2018
Shenzhen, China	urban	Oct-Dec, 2009	O/C=0.39 H/C=1.83	O/C=0.14 H/C=1.85		O/C=0.40 H/C=1.60		O/C=0.56 H/C=1.58	O/C=0.74 H/C=1.37	He et al., 2011
Shenzhen,	urban	Dec 2014-	O/C=0.52	O/C=0.10	O/C=0.18	O/C=0.33		O/C=0.76	O/C=0.95	Cao et al.,

China		Jan 2015	H/C=1.61	H/C=2.00	H/C=1.77	H/C=1.52		H/C=1.54	H/C=1.18	2018
Nao'Ao island, China	urban	Dec 2015-Jan, 2016		O/C=0.06 H/C=1.81		O/C=0.60 H/C=1.75			O/C=0.96 H/C=1.24	Cao et al., 2019
Beijing, China	suburban	Aug-Sep, 2018	O/C=0.54 H/C=1.67	O/C=0.15 H/C=1.41				O/C=0.33 H/C=1.19	O/C=0.42 H/C=1.15	Chen et al., 2020
Jiaxing, China	suburban	Jun-Jul, 2010	O/C=0.36 H/C=1.94	O/C=0.16 H/C=1.93				OOA O/C=0.51 H/C=1.60		Huang et al., 2013
Jiaxing, China	suburban	Dec, 2010	O/C=0.43 H/C=1.73	O/C=0.14 H/C=2.02		O/C=0.34 H/C=1.65		OOA O/C=0.74 H/C=1.41		Huang et al., 2013
Ziyang, China	suburban	Dec 2012-Jan 2013	O/C=0.65 H/C=1.56	O/C=0.10 H/C=1.81		O/C=0.32 H/C=1.67		O/C=0.73 H/C=1.48	O/C=1.02 H/C=1.46	Hu W. et al., 2016
Kaiping, China	suburban	Oct-Nov, 2008	O/C=0.60 H/C=1.64			O/C=0.33 H/C=1.77		O/C=0.49 H/C=1.61	O/C=0.80 H/C=1.42	Huang et al., 2011
Heshan, China	suburban	Nov-Dec, 2011	O/C=0.50 H/C=1.63	O/C=0.11 H/C=1.96		O/C=0.24 H/C=1.54		O/C=0.46 H/C=1.45	O/C=0.69 H/C=1.42	Gong et al., 2012
Panyu, China	suburban	Nov-Dec, 2014	O/C=0.53 H/C=1.64	O/C=0.22 H/C=1.91	O/C=0.12 H/C=1.83	O/C=0.51 H/C=1.92		O/C=0.69 H/C=1.68	O/C=0.92 H/C=1.37	Qin et al., 2017
Hongkong, China	suburban	Apr-Jun, 2011	O/C=0.40 H/C=1.33							Li et al., 2013
Hongkong, China	suburban	May, 2011	O/C=0.48 H/C=1.50	O/C=0.11 H/C=1.82	O/C=0.10 H/C=1.90			O/C=0.29 H/C=1.59	O/C=0.85 H/C=1.23	Li et al., 2015
Hongkong, China	suburban	Sep, 2011	O/C=0.66 H/C=1.51	O/C=0.31 H/C=1.82	O/C=0.14 H/C=1.84			O/C=0.53 H/C=1.50	O/C=0.99 H/C=1.42	Li et al., 2015
Hongkong, China	suburban	Nov, 2011	O/C=0.53 H/C=1.54	O/C=0.10 H/C=1.92	O/C=0.13 H/C=1.84			O/C=0.45 H/C=1.57	O/C=0.75 H/C=1.38	Li et al., 2015
Hongkong, China	suburban	Feb, 2012	O/C=0.55 H/C=1.55	O/C=0.11 H/C=1.93	O/C=0.15 H/C=1.81			O/C=0.34 H/C=1.61	O/C=0.79 H/C=1.36	Li et al., 2015
Hongkong, China	suburban	Oct, 2016	O/C=0.68 H/C=1.57	O/C=0.21 H/C=1.85				O/C=0.75 H/C=1.52	O/C=1.04 H/C=1.38	Li et al., 2019
Changping, China	suburban	Jun, 2016	O/C=0.52 H/C=1.64	O/C=0.05 H/C=2.06	O/C=0.22 H/C=1.81	O/C=0.46 H/C=1.76		O/C=0.48 H/C=1.53	O/C=0.79 H/C=1.51	Li et al., 2019
Changdao, China	remote	Mar-Apr, 2011	O/C=0.75 H/C=1.48	O/C=0.43 H/C=1.66			O/C=0.21 H/C=1.53	O/C=0.78 H/C=1.45	O/C=0.98 H/C=1.38	Hu et al., 2013
Lake, Hongze, China	background	Mar-Apr, 2011	O/C=0.67 H/C=1.52	O/C=0.28 H/C=1.73				OOA O/C=0.87 H/C=1.46		Zhu et al., 2016
Mount Wuzhi, China	background	Mar-Apr, 2015	O/C=0.98 H/C=1.31					O/C=0.55 H/C=1.57	O/C=1.35 H/C=1.08	Zhu et al., 2016
Waliguan, China	background	Jul, 2017	O/C=0.99 H/C=1.43	O/C=0.11 H/C=1.93		O/C=0.36 H/C=1.88		OOA O/C=1.00		Zhang et al., 2019

								H/C=1.57		
Taizhou, China	background	May-Jun, 2018(BB period)	O/C=0.57 H/C=1.66	O/C=0.23 H/C=1.88		O/C=0.29 H/C=1.81		LO-OOA O/C=0.64 H/C=1.60	MO-OOA O/C=0.87 H/C=1.49 aq-OOA O/C=0.80 H/C=1.55	Huang et al., 2020
Taizhou, China	background	May-Jun, 2018(clean period)	O/C=0.62 H/C=1.59	O/C=0.17 H/C=1.88		O/C=0.31 H/C=1.68		LO-OOA O/C=0.47 H/C=1.67	MO-OOA O/C=0.92 H/C=1.45 aq-OOA O/C=1.08 H/C=1.35	Huang et al., 2020
Xinglong, China	background	May, 2019	O/C=0.71 H/C=1.44	O/C=0.15 H/C=1.76				O/C=0.69 H/C=1.75	O/C=0.93 H/C=1.26	Li et al., 2021
Xinglong, China	background	Jun-Jul, 2019	O/C=0.75 H/C=1.41	O/C=0.12 H/C=1.83				O/C=0.63 H/C=1.44	O/C=0.94 H/C=1.36	Li et al., 2021
Xinglong, China	background	Oct-Nov, 2019	O/C=0.61 H/C=1.47	O/C=0.15 H/C=1.76				O/C=0.67 H/C=1.58	O/C=0.84 H/C=1.36	Li et al., 2021
Xinglong, China	background	Dec, 2019	O/C=0.54 H/C=1.53	O/C=0.11 H/C=1.84				O/C=0.57 H/C=0.80	O/C=0.80 H/C=1.40	Li et al., 2021
Mt. Yulong, China	background	Mar-Apr, 2015	O/C=1.11 H/C=1.40			O/C=0.37 H/C=1.87		OOA O/C=1.45 H/C=1.26	OOA-BB O/C=0.85 H/C=1.57	Zheng et al., 2017
Nam Co, Tibet, China	background	Jun, 2015	O/C=0.88 H/C=1.33					O/C=0.49 H/C=1.34	O/C=0.96 H/C=1.04	Xu et al., 2018
Qomolangma, Tibet, China	background	Apr-May, 2016	O/C=1.07 H/C=1.29			O/C=0.85 H/C=1.42			MO-OOA O/C=1.34 H/C=1.17	Zhang et al., 2018
Riverside, CA, US	urban	Jul-Aug, 2005	O/C=0.44 H/C=1.71							Docherty et al., 2011
Queens College, NYC, US	urban	Jul-Aug, 2009	O/C=0.46 H/C=1.65	O/C=0.06 H/C=1.83	O/C=0.18 H/C=1.58			O/C=0.38 H/C=1.40	O/C=0.63 H/C=1.29	Sun et al., 2011
Fresno, CA, US	urban	Jan, 2010	O/C=0.35 H/C=1.75	O/C=0.09 H/C=1.80	O/C=0.11 H/C=1.72	O/C=0.33 H/C=1.56		OOA O/C=0.42 H/C=1.43		Ge et al., 2012
Pasadena, CA, US	urban	May-Jun, 2010	O/C=0.52 H/C=1.58	O/C=0.14 H/C=1.60				O/C=0.38 H/C=1.40	O/C=0.80 H/C=1.20	Hayes et al., 2013
Houston, Texas, US	urban	May, 2015	O/C=0.72 H/C=1.50	O/C=0.06 H/C=1.26				O/C=0.61 H/C=1.57	O/C=1.24 H/C=1.21	Al-Naiema et al., 2018
Mexico City, MX	urban	Mar, 2006	O/C=0.53 H/C=1.82							Aiken et al., 2009

Barcelona, ES	urban	Feb-Mar, 2009	O/C=0.41 H/C=1.77							Mohr et al., 2012
SIRTA, Paris, Franch	urban	Jul, 2009	O/C=0.48 H/C=1.62	O/C=0.16 H/C=1.84	O/C=0.13 H/C=1.74			O/C=0.39 H/C=1.52	O/C=0.73 H/C=1.33	Crippa et al., 2013
Patras, Greece	urban	Feb-Mar, 2012	O/C=0.42 H/C=1.71	O/C=0.10 H/C=1.83	O/C=0.14 H/C=1.71	O/C=0.30 H/C=1.59		O/C=0.65 H/C=1.37		Florou et al., 2017
Athens, Greece	urban	Jan-Feb, 2013	O/C=0.32 H/C=1.72	O/C=0.13 H/C=1.74	O/C=0.11 H/C=1.68	O/C=0.27 H/C=1.47		O/C=0.46 H/C=1.45		Florou et al., 2017
SPC, Italy	urban	Jan, 2013	O/C=0.58 H/C=1.37							Brege et al., 2018
SPC, Italy	urban	Feb, 2013	O/C=0.80 H/C=1.29							Brege et al., 2018
Bologna, Italy	urban	Feb, 2013 (BB fresh)	O/C=0.24 H/C=1.65							Brege et al., 2018
Bologna, Italy	urban	Feb, 2013 (BB aged)	O/C=0.56 H/C=1.60							Brege et al., 2018
SPC, Po Valley, Italy	suburban	Mar-Apr, 2008	O/C=0.59 H/C=1.64							Saarikoski et al., 2012
Montseny, ES	suburban	Feb-Mar, 2009	O/C=0.74 H/C=1.60							Chen et al., 2015
Cool, CA, US	suburban	Jun, 2010	O/C=0.56 H/C=1.53							Setyan et al., 2012
Upton, NY, US	suburban	Jul-Aug, 2011	O/C=0.61 H/C=1.63							Chen et al., 2015
Davis, CA, US	suburban	Jan, 2011	O/C=0.51 H/C=1.56							Chen et al., 2015
Southern Great Plains, US	rural	Jun, 2007	O/C=0.69 H/C=1.40							Martin et al., 2008
Melpitz, DE	rural	May-Jun, 2008	O/C=0.52 H/C=1.51							Poulain et al., 2011
Melpitz, DE	rural	Sep-Nov, 2008	O/C=0.54 H/C=1.48							Poulain et al., 2011
Melpitz, DE	background	Feb-Mar, 2009	O/C=0.53 H/C=1.48							Poulain et al., 2011
Douai, France	rural	Feb-Mar, 2016	O/C=0.40 H/C=1.69	O/C=0.13 H/C=2.03		OOA-BB O/C=0.58 H/C=1.54		LO-OOA O/C=0.61 H/C=1.55		Rodelas et al., 2019
north-central Oklahoma	rural	April-May, 2016	O/C=0.84 H/C=1.39							Liu et al., 2021
north-	rural	Aug-Sep,	O/C=0.59							Liu et al.,

central Oklahoma		2016	H/C=1.52							2021
Whistler Mountain, CA	background	Apr-May, 2006	O/C=0.83 H/C=1.66							Sun et al., 2009
Amazon, BR	background	Feb-Mar, 2008	O/C=0.58 H/C=1.60							Chen et al., 2015
Borneo, MY	background	Jun-Jul, 2008	O/C=0.71 H/C=1.62							Robinson et al., 2011
Mace Head, IE	background	Aug, 2009	O/C=0.60 H/C=1.25							Ovadnevaite et al., 2011
Whistler Mountain, CA	background	Jun-Jul, 2010	O/C=0.60 H/C=1.49							Chen et al., 2015
Manitou Forest, US	background	Jul-Aug, 2011	O/C=0.61 H/C=1.49							Chen et al., 2015
Mt. Cimone, Italy	background	Jun–Jul 2012	O/C=0.71 H/C=1.45				OOA1 O/C=0.67 H/C=1.51	OOA2 O/C=0.75 H/C=1.44	OOA3 O/C=1.02 H/C=1.07	Rinaldi et al., 2015
Mt. Bachelor, US	background	Jul-Aug, 2013	O/C=0.84 H/C=1.48			O/C=0.35 H/C=1.76	OOA-BB1 O/C=0.60 H/C=1.72	OOA-BB2 O/C=1.06 H/C=1.21	MO-OOA O/C=1.09 H/C=1.31	Zhou et al., 2017
BO, Po Valley, Italy	urban background	Fall, 2011		O/C=0.07 H/C=2.02		O/C=0.38 H/C=1.69		OOA-BB O/C=0.65 H/C=1.52	Aq-OOA-BB O/C=0.69 H/C=1.74	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Summer, 2012		O/C=0.16 H/C=1.91				OOA1 O/C=0.071 H/C=1.62	OOOA2 O/C=0.65 H/C=1.56	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Fall, 2012		O/C=0.15 H/C=2.00		O/C=0.35 H/C=1.76	OOA-BB O/C=0.73 H/C=1.55	OOA O/C=0.57 H/C=1.50	aq-OOA-BB O/C=0.72 H/C=1.80	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Winter, 2013		O/C=0.10 H/C=2.01		O/C=0.30 H/C=1.76	OOA-BB O/C=0.54 H/C=1.53	OOA O/C=0.84 H/C=1.53	aq-OOA-BB O/C=0.77 H/C=1.79	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Spring, 2013		O/C=0.05 H/C=1.94		O/C=0.35 H/C=1.63	OOA-BB O/C=0.44 H/C=1.65	OOA O/C=0.75 H/C=1.41	aq-OOA-BB O/C=0.88 H/C=1.77	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Fall, 2013		O/C=0.03 H/C=1.97		O/C=0.34 H/C=1.72	OOA1 O/C=0.52 H/C=1.67	OOA2 O/C=0.78 H/C=1.35	aq-OOA-BB O/C=0.96 H/C=1.83	Paglione et al., 2020
BO, Po Valley, Italy	urban background	Winter, 2014		O/C=0.04 H/C=2.01		O/C=0.47 H/C=1.76	OOA-BB O/C=0.55 H/C=1.93	OOA O/C=0.97 H/C=1.43	aq-OOA-BB O/C=0.90 H/C=1.57	Paglione et al., 2020

BO, Po Valley, Italy	urban background	Spring, 2014		O/C=0.03 H/C=1.97	O/C=0.26 H/C=1.75	O/C=0.31 H/C=1.63	OOA1 O/C=0.61 H/C=1.68	OOA2 O/C=0.80 H/C=1.42	OOA3 O/C=0.98 H/C=1.43	Paglione et al., 2020
SPC, Po Valley, Italy	rural background	Fall, 2011		O/C=0.29 H/C=1.80		O/C=0.33 H/C=1.79			aq-OOA-BB O/C=0.85 H/C=1.48	Paglione et al., 2020
SPC, Po Valley, Italy	rural background	Summer, 2012		O/C=0.12 H/C=1.90			OOA1 O/C=0.34 H/C=1.66	OOA2 O/C=0.43 H/C=1.88	OOA3 O/C=0.50 H/C=1.48	Paglione et al., 2020
SPC, Po Valley, Italy	rural background	Spring, 2013		O/C=0.14 H/C=1.90		O/C=0.33 H/C=1.63	OOA1 O/C=0.64 H/C=1.61	OOA2 O/C=0.91 H/C=1.46	OOA3 O/C=0.96 H/C=1.37	Paglione et al., 2020
SPC, Po Valley, Italy	rural background	Fall, 2013		O/C=0.05 H/C=2.05		O/C=0.54 H/C=1.64	OOA1 O/C=0.70 H/C=1.54	OOA2 O/C=1.00 H/C=1.30	aq-OOA-BB O/C=0.82 H/C=1.74	Paglione et al., 2020

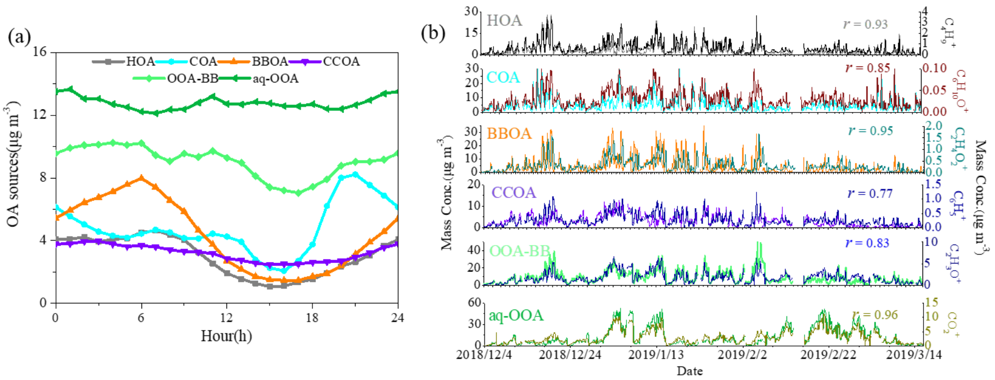

Fig. S1 Diurnal cycles of OA sources (a), and the time series of each source and their tracers during the winter campaign (b).

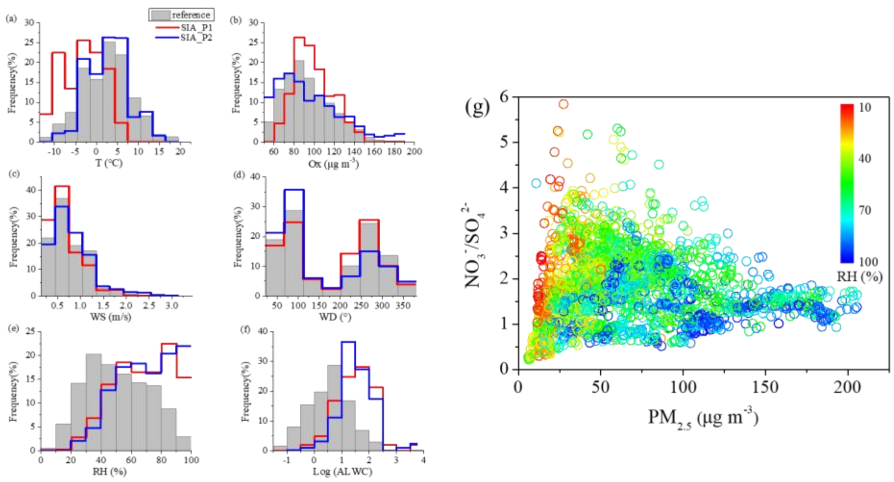

Fig. S2 Comparisons of frequencies of temperature(a), Ox concentration(b), WS(c), WD(d), RH(e) and ALWC(f) between reference days and SIA-enhanced periods (SIA_P1 and SIA_P2), and variation of NO_3^-/SO_4^{2-} ratio as a function of $PM_{2.5}$ mass, colored by RH during winter campaign (g).

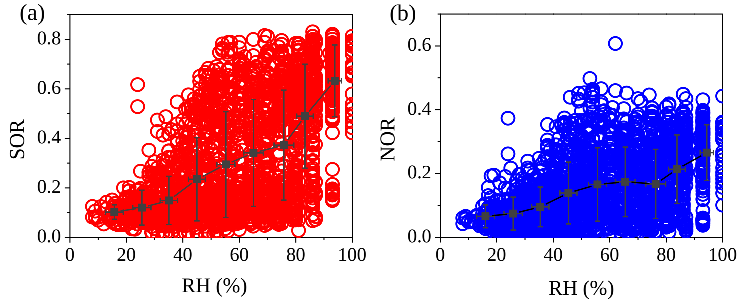

Fig. S3 Correlation between RH and SOR (a) or NOR (b) during the winter campaign in Xi'an.

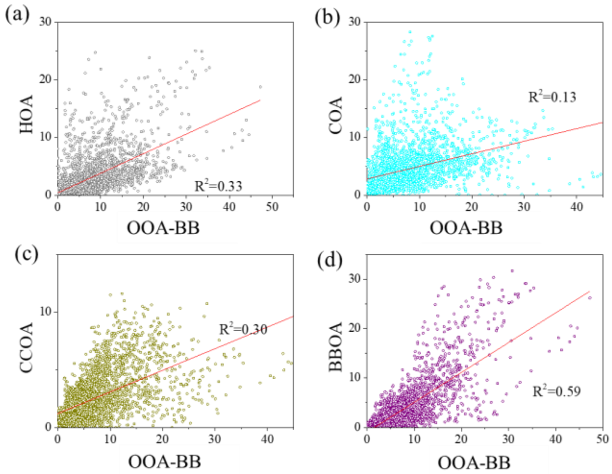

Fig. S4 Correlation between the concentration ($\mu g\ m^{-3}$) of OOA-BB and HOA (a), COA (b), CCOA (c) and BBOA (d).

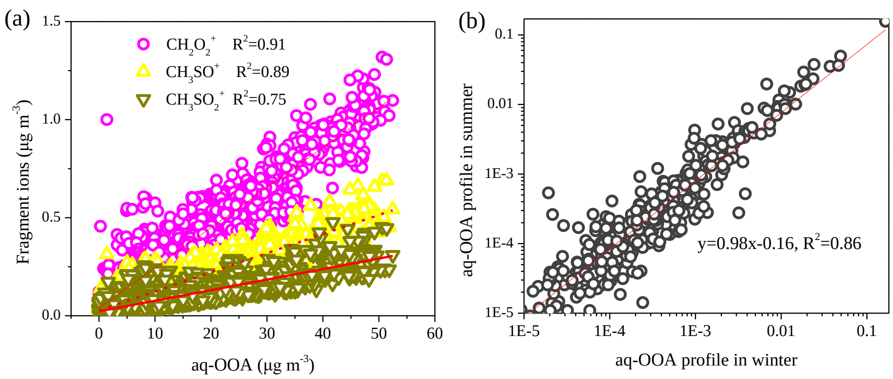

Fig. S5 Correlations between the concentration of aq-OOA and aqueous-phase processing fragment ions including $CH_2O_2^+$, CH_3SO^+, and $CH_3SO_2^+$ (a), and the correlation between the aq-OOA profile resolved in the winter campaign and the aq-OOA profile resolved in the summer of 2019 in Xi'an (b).

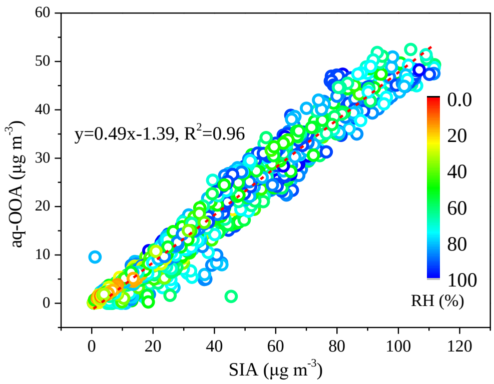

Fig. S6 Correlation between the concentration of aq-OOA and SIA during the entire winter campaign in Xi'an.

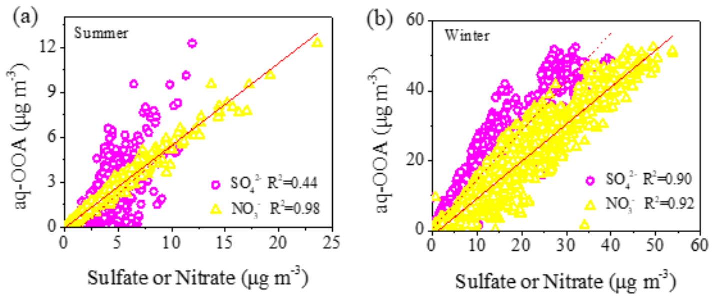

Fig. S7 Correlation between the concentration of aq-OOA and sulfate or nitrate during summer (a), and winter (b) in Xi'an.

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