Table S1. Summary of the locations, sampling information, and campaign-average mass concentrations of sulfate, nitrate, ammonium, and OA of the 77 online measurements from literature.

Site	Site Name / Region	References	Site Type	Instrument	Sampling Period	Lon (°)	Lat (°)	Mass Concentrations (μg m^{-3})			
								Sulfate	Nitrate	Ammonium	OA
1	CMA / NCP	Zhang et al. (2012)	urban	Q-AMS	1/4/2008-2/3/2008	116.32	39.95	8.1	12	6.2	42.34
2	PKU / NCP	Hu et al. (2016b)	urban	HR-ToF-AMS	11/22/2010-12/22/2010	116.31	39.99	8.7	6.8	7.7	34.5
3	IAP / NCP	J. K. Zhang et al. (2014)	urban	HR-ToF-AMS	1/1/2013-2/1/2013	116.37	39.97	19.65	12.5	8.93	44.65
4	PKU / NCP	Hu et al. (2017)	urban	HR-ToF-AMS	1/23/2013-3/2/2013	116.31	39.99	17.4	16.2	11.7	29.7
5	IAP / NCP	Y. Sun et al. (2016a)	urban	HR-ToF-AMS	12/17/2013-1/17/2014	116.37	39.97	9.4	7.2	5.4	38.1
6	IAP / NCP	J. K. Zhang et al. (2015a)	urban	HR-ToF-AMS	1/1/2014-2/3/2014	116.37	39.97	8.58	8.08	4.55	27.27
7*	IRSDE / NCP	Elser et al. (2016)	urban	HR-ToF-AMS	1/9/2014-1/26/2014	116.38	40.00	16.12	11.59	6.43	49.18
8	IAP / NCP	Zhang et al. (2016a)	urban	HR-ToF-AMS	12/10/2014-12/31/2014	116.37	39.97	6.75	3.37	2.25	20.25
9	CMA / NCP	Zhang et al. (2012)	urban	Q-AMS	4/10/2008-5/4/2008	116.32	39.95	**	**	**	37.8
10	PKU / NCP	Hu et al. (2017)	urban	HR-ToF-AMS	3/30/2012-5/7/2012	116.31	39.99	9.3	10.2	7.3	14
11	CAMS / NCP	Sun et al. (2010)	urban	Q-AMS	7/9/2006-7/21/2006	116.33	39.95	20.3	17.3	13.1	28.1
12	CMA / NCP	Zhang et al. (2012)	urban	Q-AMS	6/5/2008-7/3/2008	116.32	39.95	24.8	20.1	13.7	33.84
13	PKU / NCP	Huang et al. (2010)	urban	HR-ToF-AMS	7/24/2008-9/20/2008	116.31	39.99	16.85	9.97	10.03	23.91
14	PKU / NCP	Hu et al. (2017)	urban	HR-ToF-AMS	7/29/2012-8/29/2012	116.31	39.99	9.7	6.4	5.4	12.5
15	IAP / NCP	J. K. Zhang et al. (2015b)	urban	HR-ToF-AMS	8/1/2012-8/31/2012	116.37	39.97	**	**	**	13
16	PKU / NCP	Hu et al. (2016b)	urban	HR-ToF-AMS	8/3/2011-9/15/2011	116.31	39.99	22	16.8	13.7	26.4
17	IAP / NCP	Xu et al. (2017)	urban	HR-ToF-AMS	6/3/2014-7/11/2014	116.37	39.97	**	**	**	18.1
18	THU / NCP	H. Li et al. (2018)	urban	ACSM	6/30/2015-7/27/2015	116.30	40.00	6.3	8.4	4.3	12.2
19	CMA / NCP	Zhang et al. (2012)	urban	Q-AMS	10/4/2008-10/18/2008	116.32	39.95	**	**	**	23.97
20	IAP / NCP	J. K. Zhang et al. (2015b)	urban	HR-ToF-AMS	10/1/2012-10/31/2012	116.37	39.97	**	**	**	27
21	PKU / NCP	Hu et al. (2017)	urban	HR-ToF-AMS	10/13/2012-11/13/2012	116.31	39.99	5.5	7.9	4.5	18.2
22	IAP / NCP	Zhang et al. (2016a)	urban	HR-ToF-AMS	10/1/2014-10/27/2014	116.37	39.97	11.52	16.46	9.05	34.57
23	IAP / NCP	Xu et al. (2015)	urban	HR-ToF-AMS	10/10/2014-11/2/2014	116.37	39.97	9.1	17.8	7.8	29.4
24	IAP / NCP	Zhang et al. (2016b)	urban	HR-ToF-AMS	10/17/2014-11/2/2014	116.37	39.97	13.13	21.21	10.1	44.44
25	IAP / NCP	Xu et al. (2017)	urban	HR-ToF-AMS	10/14/2014-11/12/2014	116.37	39.97	**	**	**	29.58
26	IAP / NCP	Zhao et al. (2017)	urban	HR-ToF-AMS	9/4/2015-9/30/2015	116.37	39.97	9.09	9.23	5.53	18.31
27	Handan / NCP	Li et al. (2017)	urban	ACSM	12/4/2015-2/5/2016	114.50	36.57	28.12	26.25	22.5	82.5

28	Xinxiang / NCP	H. Li et al. (2018)	urban	ACSM	6/8/2017-6/25/2017	113.90	35.30	14.4	16.5	12.2	18
29	Yufa / NCP	Gunthe et al. (2011)	suburban	Q-AMS	8/10/2006-9/9/2006	116.31	39.51	8.2	2.88	4.07	10.83
30	Xianghe / NCP	Y. Sun et al. (2016b)	regional	ACSM	6/1/2013-6/30/2013	116.96	39.80	12.8	14.3	8.8	28.3
31	Shanghai / YRD	Huang et al. (2012)	urban	HR-ToF-AMS	5/15/2010-6/10/2010	121.53	31.23	9.72	4.76	3.91	8.38
32	Nanjing / YRD	Tang et al. (2014)	urban	ACSM	1/4/2013-1/31/2013	118.73	32.21	14.56	21.15	10.73	26.26
33	Jiangsu / YRD	Y. Zhang et al. (2015)	urban	ACSM	12/1/2013-12/31/2013	118.77	32.05	14.29	22.32	12.5	38.4
34	NUIST / YRD	Ge et al. (2017)	urban	SP-AMS	2/20/2015-3/23/2015	118.71	32.21	5.81	3.44	3.3	6.25
35	Nanjing Olympic center / YRD	J. Wang et al. (2016)	urban	SP-AMS	4/13/2015-4/29/2015	118.73	32.01	5.44	3.83	3.13	12.69
36	Jiangsu / YRD	Y. J. Zhang et al. (2015)	urban	ACSM	6/1/2013-6/15/2013	118.76	32.08	5	9	7	15.4
37	Jiangsu / YRD	Y. J. Zhang et al. (2014)	urban	ACSM	8/1/2013-8/31/2013	118.77	32.05	4.15	2.55	2.79	10.3
38	Jiangxin Island / YRD	Ge et al. (2017)	urban	SP-AMS	8/11/2014-9/18/2014	118.73	32.01	10.83	11.21	7.86	12.09
39	Jiangsu / YRD	Y. J. Zhang et al. (2015)	urban	ACSM	10/15/2013-10/30/2013	118.76	32.08	4.7	9.2	6.4	22.3
40***	Jiangsu / YRD	Y. Zhang et al. (2017)	urban	ACSM	10/20/2015-11/19/2015	118.75	32.04	5.9	**	**	11.3
41	Hanzhou / YRD	K. Li et al. (2018)	urban	HR-ToF-AMS	8/5/2016-8/21/2016	120.21	30.21	4.6	2.1	2.7	17
42	Hanzhou / YRD	K. Li et al. (2018)	urban	HR-ToF-AMS	9/7/2016-9/23/2016	120.21	30.21	6.7	8.7	5.5	18.5
43	Jiaxing / YRD	Huang et al. (2013)	regional	HR-ToF-AMS	6/29/2010-7/15/2010	120.80	30.80	8.29	5.92	4.14	10.56
44	Jiaxing / YRD	Huang et al. (2013)	regional	HR-ToF-AMS	12/11/2010-12/23/2010	120.80	30.80	7.12	7.46	4.86	12.7
45	Lin'an / YRD	L. Zhang et al. (2015)	regional	Q-AMS	3/1/2013-3/31/2013	119.73	30.30	8.1	9.8	6.9	17.7
46	Lin'an / YRD	Y. W. Zhang et al. (2015)	regional	Q-AMS	11/16/2013-12/18/2013	119.73	30.30	10	15	7.7	29
47	Shenzhen / PRD	Yao et al. (2010)	urban	HR-ToF-AMS	1/17/2009-2/16/2009	113.90	22.60	13	7.3	7.7	27
48	Shenzhen / PRD	Cao et al. (2018)	urban	HR-ToF-AMS	12/31/2015-1/23/2015	113.90	22.60	9.05	4.87	4.44	18.45
49	Shenzhen / PRD	Y.-Y. Li et al. (2015)	urban	HR-ToF-AMS	8/7/2013-9/7/2013	113.90	22.60	4.7	1.4	1.9	8.2
50	Shenzhen / PRD	He et al. (2011)	urban	HR-ToF-AMS	10/25/2009-12/2/2009	113.90	22.60	10.9	4.45	4.54	17.67
51	HKUST / PRD	Y. J. Li et al. (2015)	seafront	HR-ToF-AMS	1/19/2012-3/1/2012	114.26	22.34	6.2	1.6	2.4	5.1
52	Mong Kok / PRD	Lee et al. (2015)	urban	HR-ToF-AMS	3/7/2013-5/15/2013	114.17	22.32	7	2.5	2.6	12.8
53	HKUST / PRD	Y. J. Li et al. (2015)	seafront	HR-ToF-AMS	4/25/2011-6/1/2011	114.26	22.34	7.4	0.6	2.3	4
54	Mong Kok / PRD	Lee et al. (2015)	urban	HR-ToF-AMS	5/16/2013-7/19/2013	114.17	22.32	3.4	0.4	1.1	7.9
55	HKUST / PRD	Y. J. Li et al. (2015)	seafront	HR-ToF-AMS	9/1/2011-9/29/2011	114.26	22.34	8.7	0.4	2.4	4.1
56	HKUST / PRD	Y. J. Li et al. (2015)	seafront	HR-ToF-AMS	10/28/2011-12/15/2011	114.26	22.34	7.1	0.7	2.1	6
57	HKEPD / PRD	C. Sun et al. (2016)	urban	ACSM	9/3/2013-12/31/2013	114.17	22.32	6	1.7	3	15.1

58	Dongguan / PRD	Zhu et al. (2018)	urban	HR-ToF-AMS	12/12/2013-1/1/2014	113.75	23.03	**	**	**	23.3
59	GPACS / PRD	Qin et al. (2017)	suburban	HR-ToF-AMS	11/07/2014-1/3/2015	113.35	23.00	12.8	6.2	5.04	25.65
60	Kaiping / PRD	Huang et al. (2011)	rural	HR-ToF-AMS	10/12/2008-11/18/2008	112.53	22.32	11.15	3.54	4.63	11.19
61	Back Garden / PRD	Xiao et al. (2011)	rural	Q-AMS	7/12/2006-7/30/2006	113.03	23.49	11.8	**	**	13.5
62	Heshan / PRD	Gong et al. (2012)	urban outflow	HR-ToF-AMS	11/13/2010-12/1/2010	112.93	22.71	10.01	6.18	4.6	17.39
63	IEECAS / NW	Wang et al. (2014)	urban	ACSM	12/23/2012-1/18/2013	109.01	34.22	18.3	13.6	16.7	73.8
64*	Xi'an / NW	Elser et al. (2016)	urban	HR-ToF-AMS	12/13/2013-1/6/2014	108.88	34.23	52.12	27.83	18.75	128.5
65	Baoji / NW	Wang et al. (2017)	urban	ACSM	2/26/2013-3/27/2014	107.14	34.35	8.64	8.1	5.94	29.7
66	CAREERI / NW	Xu et al. (2014)	urban	HR-ToF-AMS	7/11/2012-8/7/2012	103.86	36.05	3.92	2.45	2.7	11.51
67	LZU / NW	Xu et al. (2016)	urban	HR-ToF-AMS	1/10/2014-2/4/2014	103.85	36.05	7.16	9.45	5.9	29.33
68	Gansu / NW	X. Zhang et al. (2017)	urban	Q-AMS	10/27/2014-12/3/2014	103.88	36.04	6.1	5.7	5	18.2
69	Xinzhou / OTR	Q. Wang et al. (2016)	suburban	ACSM	7/17/2014-9/5/2014	112.12	38.07	11.47	5.1	4.18	11.72
70	Changdao / OTR	Hu et al. (2013)	receptor	HR-ToF-AMS	3/21/2011-4/24/2011	120.70	37.99	8.3	12.2	6.5	13.4
71	Qingdao / OTR	Zhu et al. (2018)	urban	HR-ToF-AMS	11/1/2013-11/30/2013	120.47	36.10	**	**	**	10.43
72	NBS / OTR	Du et al. (2015)	background	ACSM	9/5/2013-10/15/2013	101.26	37.61	3.2	1.2	1.4	4.9
73	Mt. Yulong / OTR	Zheng et al. (2017)	regional	HR-ToF-AMS	3/22/2015-4/14/2015	100.2	27.20	0.8	0.23	0.28	3.88
74	Ziyang / OTR	Hu et al. (2016a)	suburban	HR-ToF-AMS	12/3/2012-1/5/2013	104.64	30.15	11.7	9.4	8.3	21.5
75	Lake Hongze / OTR	Zhu et al. (2016)	background	HR-ToF-AMS	3/19/2011-4/24/2011	118.33	33.23	7.7	9.4	5.5	9.8
76	Mt. Wuzhi / OTR	Zhu et al. (2016)	background	HR-ToF-AMS	3/18/2015-4/15/2015	109.49	18.84	3.4	0.5	1.5	4.9
77	Xiamen / OTR	Cao et al. (2017)	suburban	HR-ToF-AMS	5/1/2015-5/18/2015	118.05	24.60	11.5	9.52	7.48	13.07

[*] Measurements for $PM_{2.5}$. Others are for PM_1.

[**] Values are not available in the original publications.

[***] Only the PM_1 data are included here.

Table S2. The statistics of model-observation comparisons of the campaign-average concentrations of sulfate, nitrate, ammonium, and OA in the standard simulation for the NCP, YRD, PRD, and NW regions in China. "OBS" and "SIM" represent the mean values of the observations and the simulated results, respectively.

		NCP (urban: 28 non-urban: 2)	YRD (urban: 12 non-urban: 4)	PRD (urban: 8 non-urban: 8)	NW (urban: 6 non-urban: 0)
Sulfate (μg m^{-3})	OBS	16.28	9.78	10.77	17.88
	SIM	8.81	8.52	6.16	7.10
	NMB (%)	-45.90	-12.90	-42.77	-60.29
	NME (%)	51.90	36.89	42.77	63.75
	RMSE	10.11	4.79	5.46	17.81
Nitrate (μg m^{-3})	OBS	15.48	11.37	3.74	12.83
	SIM	28.86	22.58	6.99	16.05
	NMB (%)	86.50	98.59	87.11	25.16
	NME (%)	89.47	104.12	93.64	42.78
	RMSE	18.71	14.15	4.94	7.96
Ammonium (μg m^{-3})	OBS	10.62	7.45	4.35	10.68
	SIM	11.35	9.55	4.33	7.04
	NMB (%)	6.88	28.18	-0.51	-34.09
	NME (%)	38.09	48.27	28.12	47.36
	RMSE	5.68	4.28	1.85	5.91
OA (μg m^{-3})	OBS	35.88	21.00	16.98	55.28
	SIM	25.28	18.82	15.15	24.83
	NMB (%)	-29.54	-10.41	-10.81	-55.08
	NME (%)	39.48	28.80	45.14	55.08
	RMSE	16.77	7.89	9.46	39.10

Table S3. The statistics of model-observation comparisons of the campaign-average concentrations of sulfate, nitrate, ammonium, and OA in the standard simulation at the urban and non-urban sites in China. “OBS” and “SIM” represent the mean values of the observations and the simulated results, respectively.

		Urban (n_{max} = 55)	Non-urban (n_{max} = 22)
Sulfate (μg m^{-3})	OBS	13.91	10.67
	SIM	7.86	7.80
	NMB (%)	-43.54	-26.92
	NME (%)	51.98	33.49
	RMSE	10.13	4.47
Nitrate (μg m^{-3})	OBS	12.56	7.27
	SIM	21.60	16.11
	NMB (%)	71.93	121.59
	NME (%)	78.41	131.54
	RMSE	13.53	14.80
Ammonium (μg m^{-3})	OBS	9.06	5.66
	SIM	8.95	7.53
	NMB (%)	-1.21	32.97
	NME (%)	38.66	49.93
	RMSE	4.61	4.50
OA (μg m^{-3})	OBS	32.43	15.86
	SIM	22.46	15.98
	NMB (%)	-30.76	0.76
	NME (%)	40.67	44.69
	RMSE	18.45	9.99

Table S4. The statistics of model-observation comparisons of the campaign-average concentrations of sulfate, nitrate, ammonium, and OA in the standard simulation for four seasons. “OBS” and “SIM” represent the mean values of the observations and the simulated results, respectively.

		DJF (n_{max} = 21)	MAM (n_{max} = 14)	JJA (n_{max} = 22)	SON (n_{max} = 20)
Sulfate ($\mu g\ m^{-3}$)	OBS	17.22	8.95	13.14	10.32
	SIM	7.94	7.16	9.16	6.60
	NMB (%)	-53.87	-20.06	-30.26	-36.06
	NME (%)	55.72	33.79	45.42	41.16
	RMSE (%)	12.99	3.75	8.02	5.12
	R	0.49	0.47	0.44	0.34
Nitrate ($\mu g\ m^{-3}$)	OBS	14.21	7.22	10.62	10.06
	SIM	19.99	15.55	24.24	17.96
	NMB (%)	40.74	115.46	128.18	78.60
	NME (%)	53.02	131.65	129.44	78.60
	RMSE	11.49	12.39	18.43	11.35
	R	0.62	0.57	0.46	0.74
Ammonium ($\mu g\ m^{-3}$)	OBS	10.50	5.45	8.23	6.56
	SIM	8.26	6.99	10.53	7.58
	NMB (%)	-21.35	28.27	27.88	15.58
	NME (%)	34.82	56.18	48.16	32.76
	RMSE	4.90	3.87	5.56	3.05
	R	0.72	0.53	0.52	0.70
OA ($\mu g\ m^{-3}$)	OBS	45.41	16.82	20.56	24.57
	SIM	36.52	13.09	14.52	15.85
	NMB (%)	-19.58	-22.16	-29.40	-35.46
	NME (%)	38.91	40.98	43.15	44.51
	RMSE	24.46	10.84	11.14	14.12
	R	0.61	0.49	0.28	0.50

Table S5. The observed and simulated campaign-average concentrations of isoprene, benzene, toluene, and xylene as well as their simulation-to-observation ratios. Unit: ppbv.

	Season	Site location	Observation	Simulation	Simulation/Observation	Reference
Isoprene	Summer	Wangdu	0.50	0.26	0.52	Tan et al. (2017)
		PKUERS*	0.41	0.33	0.80	Q. Zhang et al. (2014)
Benzene	Summer	PKUERS	1.29	0.75	0.58	Wang et al. (2015)
			0.98	0.74	0.76	
	Winter		2.34	1.35	0.58	
Toluene	Summer	PKUERS	2.23	1.57	0.70	Wang et al. (2015)
			1.99	1.50	0.75	
	Winter		2.67	2.44	0.91	
Xylene	Summer	PKUERS	1.75	0.76	0.43	Wang et al. (2015)
			1.50	0.75	0.50	

*Daytime averages between 7 AM to 7 PM.

Table S6. Summary of the combinations of the tested factors in Cases 10 to 50. Categories a, b, and c represent the solid red circles, open red circles, and solid gray circles in Figs. 7a-b, respectively. Categories * and # represent solid blue circles and solid gray circles in Figs. 7c-d, respectively.

Case	Category	SO_2 emissions	OH levels	$\gamma_{SO2\text{-}RH}$	$\gamma_{SO2\text{-}ALWC}$	γ_{N2O5}	γ_{NO2}
10	c/*					○	○
11	a/#			○		○	
12	a/*			○			○
13	a/*			○		○	○
14	b/#				○	○	
15	b/*				○		○
16	b/*				○	○	○
17	c/#		○			○	
18	c/*		○				○
19	c/*		○			○	○
20	a/#		○	○			
21	a/#		○	○		○	
22	a/*		○	○			○
23	a/*		○	○		○	○
24	b/#		○		○		
25	b/#		○		○	○	
26	b*		○		○		○
27	b*		○		○	○	○
28	c/#	○				○	
29	c/*	○					○
30	c/*	○				○	○
31	a/#	○		○			
32	a/#	○		○		○	
33	a/*	○		○			○
34	a/*	○		○		○	○
35	b/#	○			○		
36	b/#	○			○	○	
37	b/*	○			○		○
38	b/*	○			○	○	○
39	c/#	○	○				
40	c/#	○	○			○	
41	c/*	○	○				○
42	c/*	○	○			○	○
43	a/#	○	○	○			
44	a/#	○	○	○		○	
45	a/*	○	○	○			○
46	a/*	○	○	○		○	○
47	b/#	○	○		○		
48	b/#	○	○		○	○	
49	b/*	○	○		○		○
50	b/*	○	○		○	○	○

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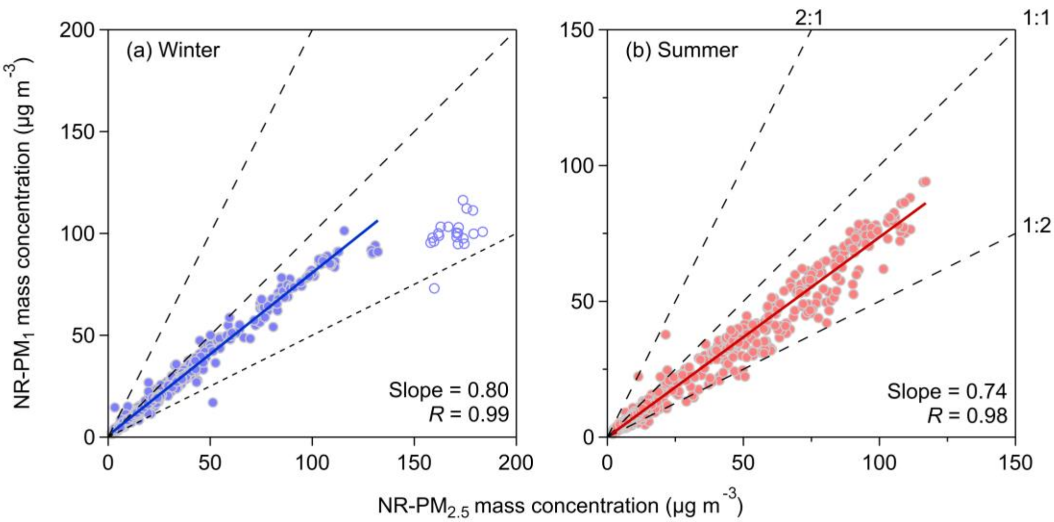

Figure S1. Mass concentrations of non-refractory PM_1 (NR-PM_1) and non-refractory $PM_{2.5}$ (NR-$PM_{2.5}$) measured by the time-of-flight ACSM with a capture vaporizer at the PKUERS site in Beijing for the periods of 3 September to 4 October 2016 and 13 December to 22 January 2017. The open circles represent the data of NR-$PM_{2.5}$ > 150 μg m^{-3}, which are not included in the fitting. The solid circles represent the rest of the data. Non-refractory particle components include OA, sulfate, nitrate, ammonium, and chloride.

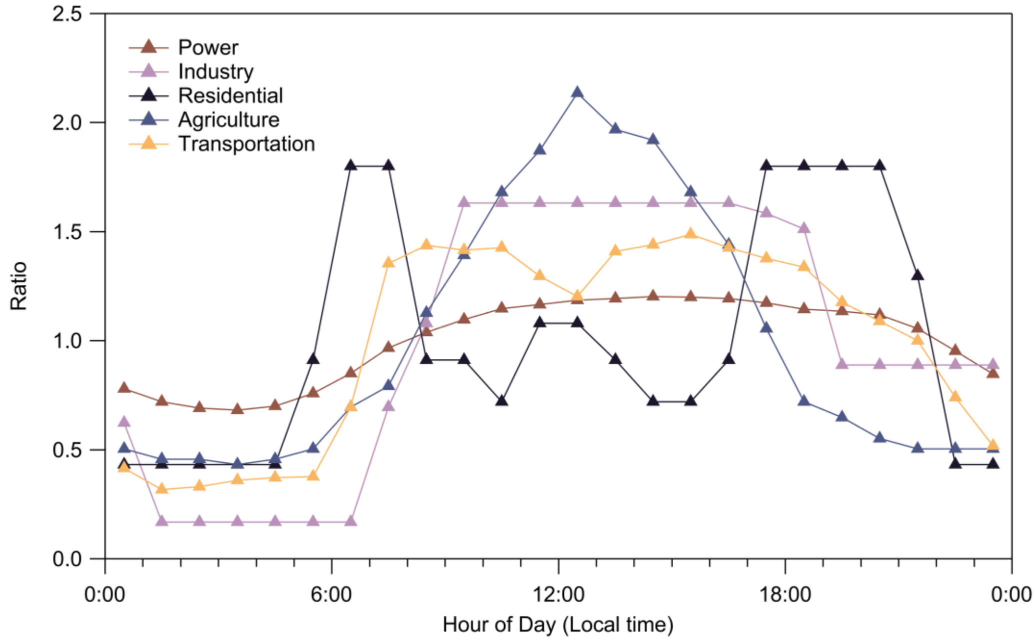

Figure S2. Diurnal patterns that are applied in the MEIC inventory for the anthropogenic emissions from power, industry, residential, and agriculture sectors.

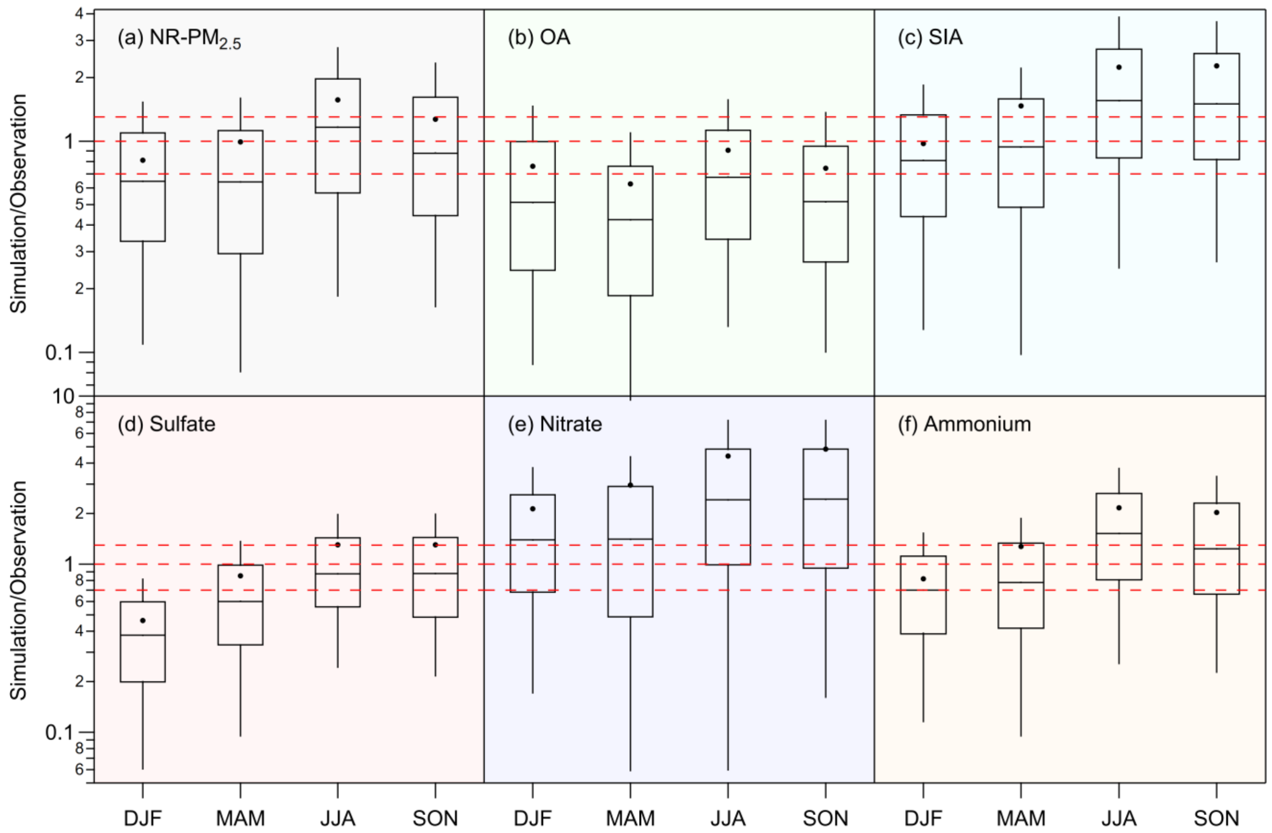

Figure S3. The statistical measures of the simulation-to-observation ratios of hourly mean mass concentrations of NR-$PM_{2.5}$, OA, secondary inorganic aerosol (SIA, the sum of sulfate, nitrate, and ammonium), sulfate, nitrate, and ammonium at the IAP site in Beijing from July 2011 to May 2013. The upper and lower edges of the boxes, the whiskers, the middle lines, and the solid dots denote the 25th and 75th percentiles, the 5th and 95th percentiles, the median values, and the mean values, respectively.

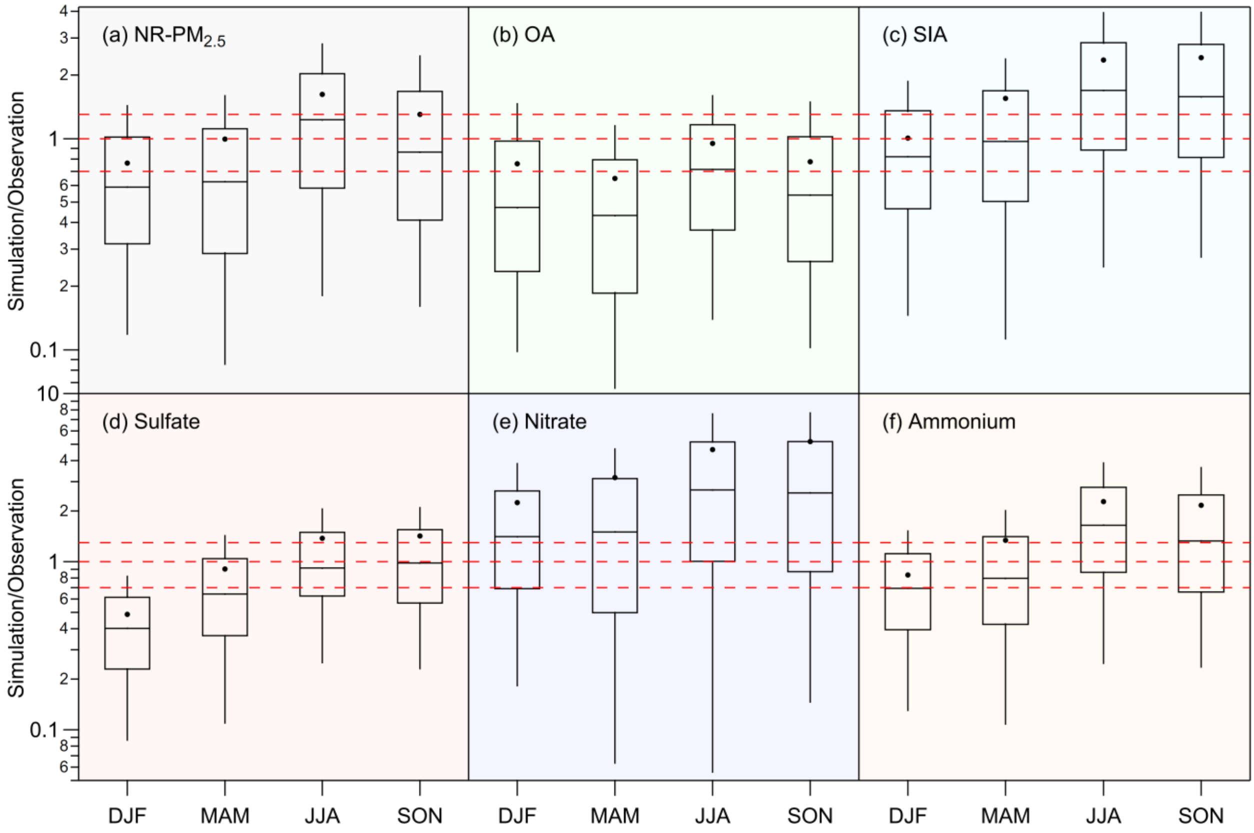

Figure S4. The statistical measures of the simulation-to-observation ratios of hourly mean mass concentrations of NR-$PM_{2.5}$, OA, SIA, sulfate, nitrate, and ammonium at the IAP site in Beijing from July 2011 to May 2013 after excluding the periods when the mass concentrations of NR-$PM_{2.5}$ are over 150 μg m^{-3}. The upper and lower edges of the boxes, the whiskers, the middle lines, and the solid dots denote the 25th and 75th percentiles, the 5th and 95th percentiles, the median values, and the mean values, respectively.

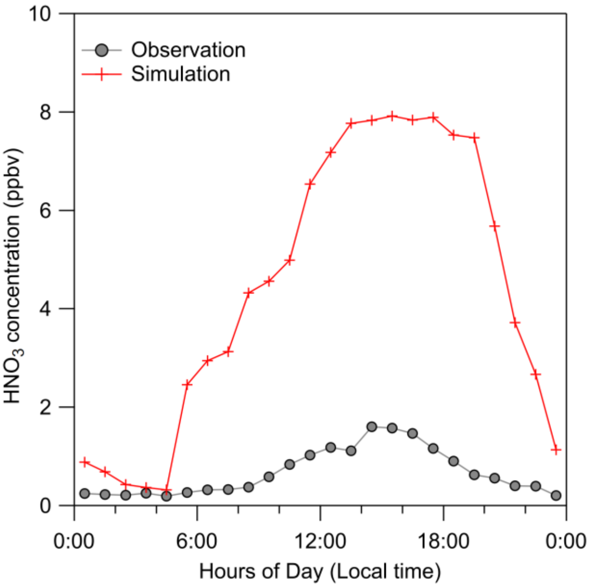

Figure S5. Diurnal profiles of the simulated and observed summertime HNO_3 concentrations at the Wangdu site in Beijing.

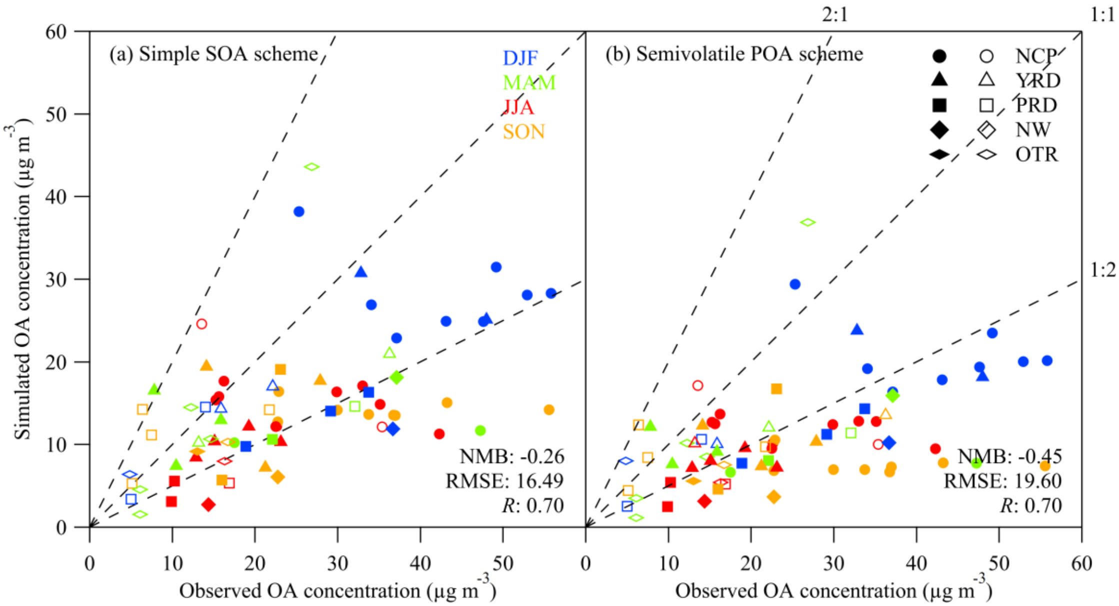

Figure S6. Scatter plots of the observed and simulated campaign-average concentrations of OA by (a) the Simple SOA scheme and (b) the Semivolatile POA scheme. The observation campaigns were conducted from 2006 to 2016 and the submicron-to-fine ratio was used to derive the concentration of fine particles. The simulation for the year of 2012 were used.

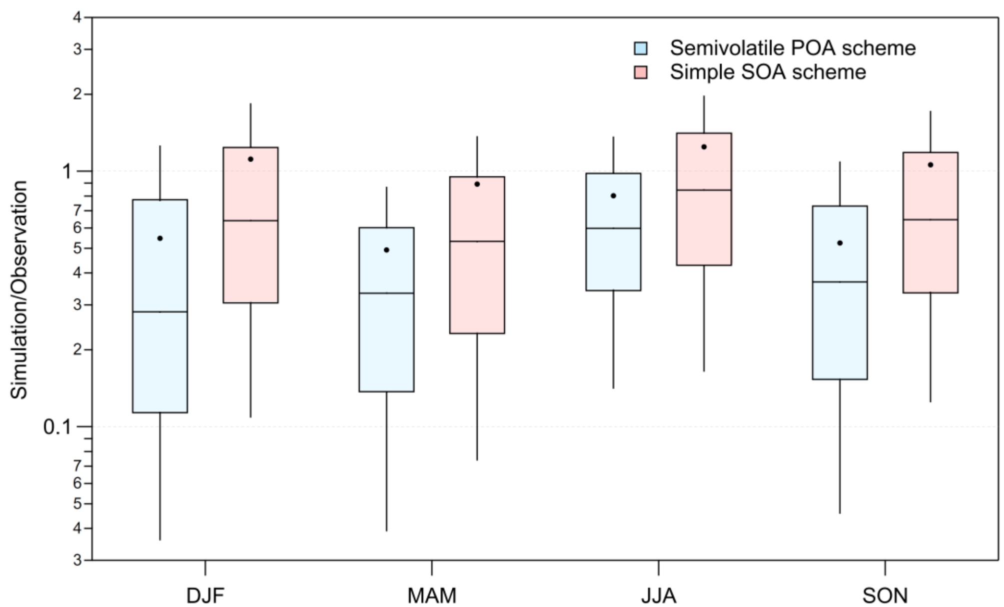

Figure S7. The statistical measures of the simulation-to-observation ratios of hourly mean mass concentrations of OA at the IAP site in Beijing from July 2011 to May 2013. The upper and lower edges of the boxes, the whiskers, the middle lines, and the solid dots denote the 25th and 75th percentiles, the 5th and 95th percentiles, the median values, and the mean values, respectively.

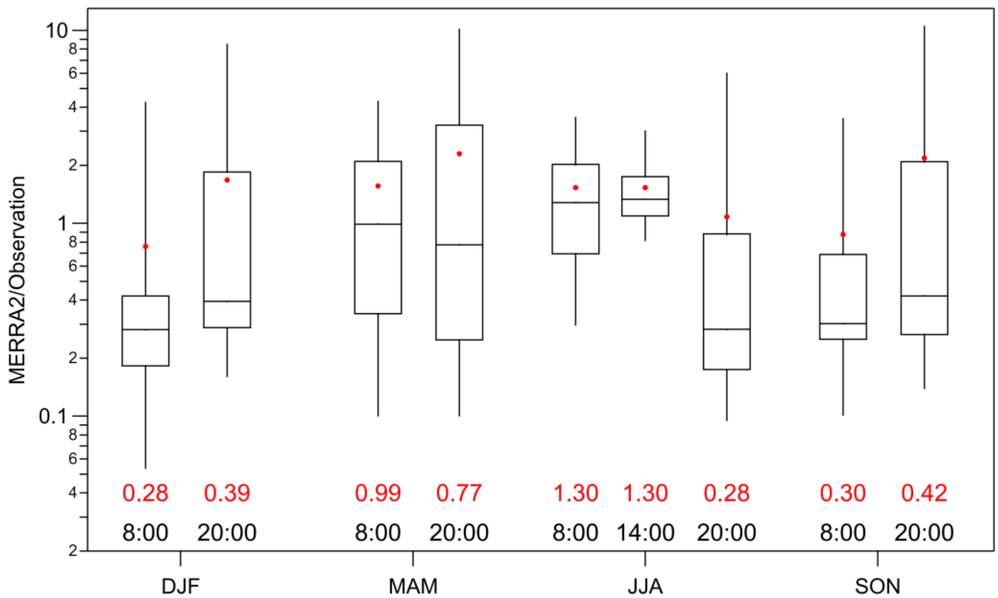

Figure S8. Box and whisker plots of the ratios of MERRA2- and radiosonde-derived BLH at 8:00 and 20:00 in the four seasons as well as 14:00 in summer in Beijing from July 2011 to May 2013. The upper and lower edges of the boxes, the whiskers, the middle lines, and the solid dots denote the 25th and 75th percentiles, the 5th and 95th percentiles, the median values, and the mean values, respectively.

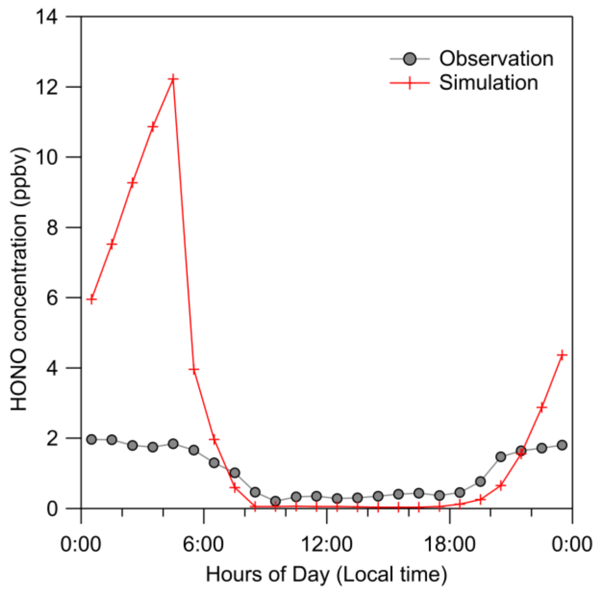

Figure S9. Diurnal profiles of the hourly-mean simulated and observed HONO concentrations at the Wangdu site in Beijing.

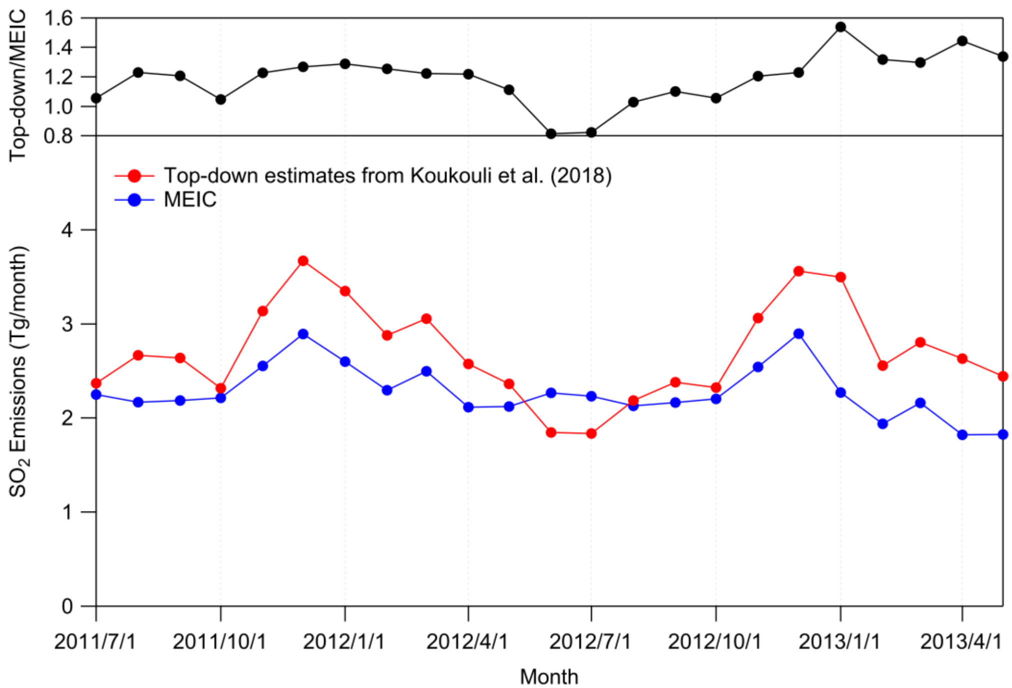

Figure S10. Monthly mean SO_2 emissions from the MEIC inventory and the top-down estimate derived by Koukouli et al. (2018) and the ratios between the two emissions.

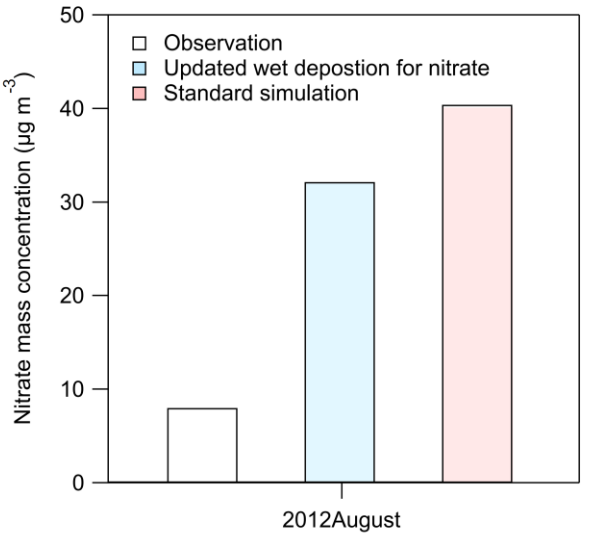

Figure S11. The monthly mean concentrations of nitrate in August 2012 in the observation, simulation with updated wet deposition for nitrate, and standard simulation at the IAP site in Beijing.

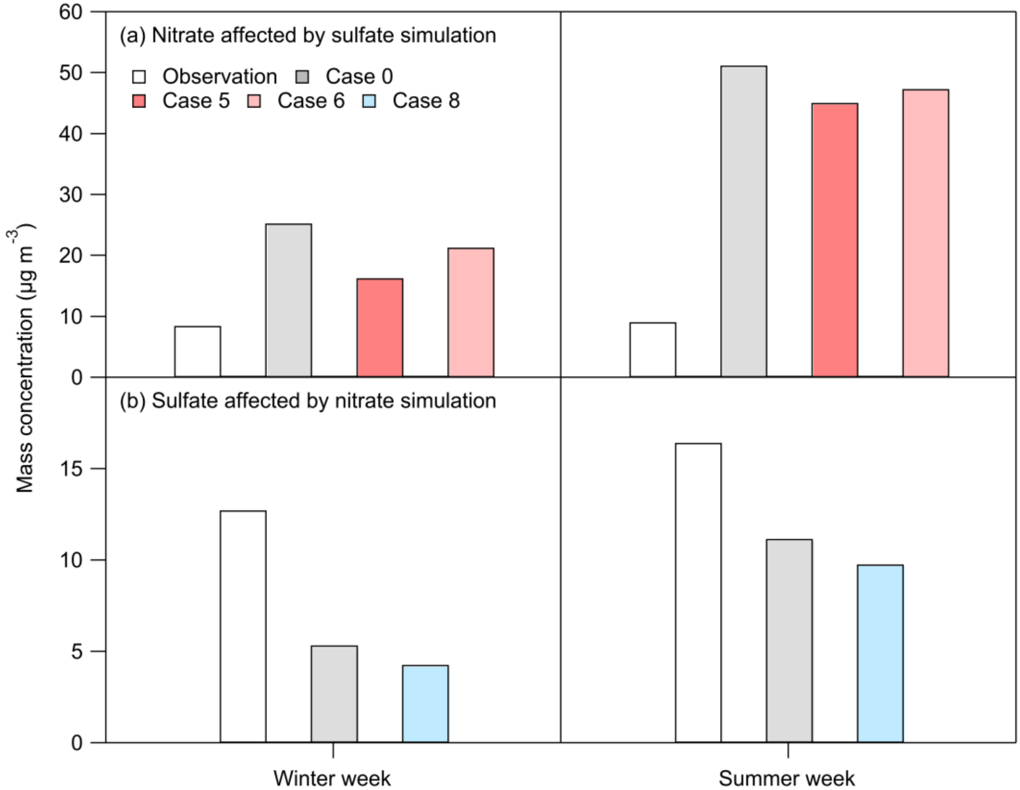

Figure S12. The weekly mean concentrations of (a) nitrate in the observation and Case 0, 5, and 6 and (b) sulfate in the observation and Case 0 and 8 at the IAP site in Beijing during the selected wintertime and summertime periods.