The concentrations, formations, relationships and modeling of sulfate, nitrate and ammonium (SNA) aerosols over China

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Northern and southern China areas

Northern and southern China are divided by a demarcation line, Qinling Mountains—Huaihe River Line (Gao et al., 2011a) as shown in Fig. S1: Northern China includes 15 provinces, autonomous regions and municipalities: Heilongjiang, Jilin, Liaoning, Inner Mongolia, Beijing, Tianjin, Shandong, Henan, Hebei, Shanxi, Shaanxi, Ningxia, Gansu, Qinghai and Xinjiang, and southern China includes the other 16 provinces, autonomous regions, municipalities and 2 Special Administrative Regions: Jiangsu, Shanghai, Anhui, Hubei, Hunan, Chongqing, Sichuan, Tibet, Yunnan, Guizhou, Guangxi, Guangdong, Jiangxi, Fujian, Zhejiang, Hainan, Hong Kong and Macao.

Figure S1: Map of China.

Quality assurance and quality control (QA/QC)

In the two data bases, the QA/QC of the references included the procedures from sample collection to chemical analysis: sampling site, sampling method selection, sampler calibration, co-located sampling, selection of filter media, filter preparation, sampling execution, filter weighing, filter segregation (Oanh et al., 2006). Blank experiments were performed from the beginning of the monitoring (blank filter) to samples' analysis (blank solution/standard solution) (Zhao et al., 2011). Parallel sampling were carried out in the field measurement at the same site, and the agreement was examined (He et al., 2001). In these measurements, all samples were stored in the refrigerator in under -4°C to reduce the volatilization of volatile organic/inorganic compounds.

All SNA in the two data bases were analyzed by ion chromatograph (IC). Meantime, the samplers and facilities in these experiments were cleaned by ultrasonic bath and washed out with de-ionized water to reduce the loss of quality in sample analysis. The analyzed data were blank corrected. In some special experiments from different laboratories, to judge the accuracy of analysis for the samples, the results of ion chromatograph (IC) were compared to the results from X-ray fluorescence (XRF) (Ye et al., 2003). It was found that the IC chloride and nitrate were lower than XRF chloride and nitrate due to the volatilization of ammonium chloride and ammonium nitrate from the denuded filter used in the IC analysis.

Table S1 Data sources of sulfate, nitrate and ammonium mass concentrations in $PM_{2.5}$ used in analysis

Location	Sampling Dates	Sampling Description	Sampling substrate	$PM_{2.5}$, ($\mu g/m^3$)	SO_4^{2-} ($\mu g/m^3$)	NO_3^- ($\mu g/m^3$)	NH_4^+ ($\mu g/m^3$)	References
Beijing (E116.17°-117.12°,N39.80°-40.65°)								
Beijing 1	Jul. 1999-Sep. 2000	urban (Chegongzhuang)	Teflon	115.00	14.47	10.30	6.22	(He et al., 2001)
	Jul. 1999-Sep. 2000	urban (Tsinghua University)		127.00	14.08	9.90	6.51	
	Mar.-May 2000	urban (Chegongzhuang)		88.60	10.15	7.26	4.28	
	Jul.-Sep. 1999	urban (Chegongzhuang)		74.00$	17.14	4.59	5.70	
	Sep.-Oct. 1999	urban (Chegongzhuang)		111.60	12.55	11.16	4.91	
	Nov. 1999-Mar. 2000	urban (Chegongzhuang)		175.90	24.87	15.35	7.80	
Beijing 2	Aug. 2001-Sep. 2002	urban (Chegongzhuang)	Teflon	96.55	9.90	6.89	5.78	(Duan et al., 2006)
	Spring	urban (Chegongzhuang)		76.41	6.71	4.66	4.13	
	Summer	urban (Chegongzhuang)		88.99	13.43	5.36	5.90	
	Autumn	urban (Chegongzhuang)		79.80	9.61	8.18	5.94	
	Winter	urban (Chegongzhuang)		122.09	9.88	10.72	7.13	
	Aug. 2001-Sep. 2002	urban (Tsinghua University)		106.94	10.55	7.83	5.46	
Beijing 3	2001-2003	five sites average ((3 urban,	Teflon	154.26	17.07	11.52	8.72	(Wang et al., 2005)
	Spring	1 rural, 1 suburban)		162.06	13.52	11.92	6.47	
	Summer			93.29	18.42	11.18	10.10	
	Autumn			105.22	12.69	9.14	6.33	
	Winter			214.23	20.96	12.29	10.64	
Beijing 4	May-Oct. 2001-2004	urban (RCEES/BNU)	Cellulose，teflon	104.00	17.90	12.00	10.40	(Kim Oanh et al., 2006)
	other months 2001-2004			168.00	20.80	14.20	12.50	
Beijing 5	Summer 2002-2003	urban (BNU)	Quartz	77.30	16.00	12.20	10.40	(Sun et al., 2004)
		urban (Capital Steel Company)		82.20	19.20	13.30	11.00	
		urban (Yihai Garden)		75.40	19.70	13.20	9.75	
	Winter 2002-2003	urban (BNU)		135.70	30.40	17.00	12.90	
		urban (Capital Steel Company)		140.80	23.10	13.50	13.30	
		urban (Yihai Garden)		182.20	29.90	19.30	20.30	
Beijing 6	3-20 Jan. 2003	urban (IAP, CAS)	Quartz	115.60	20.00	13.10	9.40	(Cao et al., 2012)
	3 Jun.-30 Jul.2003			131.60	22.60	2.70	9.80	
Beijing 7	17 Jul.-2 Aug. 2004	rural (Shangdianzi)	Teflon	66.00	24.45	5.81	13.05	(Yan et al., 2012)
	7 Feb.-20 Feb. 2004			76.90	13.75	9.78	6.22	
Beijing 8	29 Jun.-2 Aug. 2005	rural (Hei Shan Zhai)	Teflon	68.00	22.60	9.90	4.70	(Pathak et al., 2009)
Beijing 9	Mar. 2005-Feb. 2006	urban (Tsinghua University)	Teflon	118.50	15.70	10.10	7.40	(He et al., 2011)
	Mar. 2005-Feb. 2006	rural (Miyun Reservoir)		68.40	13.00	6.40	6.10	
Beijing 10	22 Aug.-4 Sep. 2006 (average)	urban (Peking University)	Teflon	87.48	23.13‡	8.83 ‡	10.78‡	(Huo et al., 2011)
Beijing 11	Jul. 2008-Apr. 2009	urban (CRAES）	Teflon	91.11£	14.82	11.53	8.35	(Deng et al., 2011b)
Beijing 12	1-31 Aug. 2009	urban (CRAES)	Quartz	102.50	26.90	16.10	15.80	(Lin et al., 2011)
Gansu (E103.68°,N36.13°;E101.1°,N38.30°)								

Jinchang	3-20 Jan. 2003	urban (Jinchang Meteorological Bureau)	Quartz	86.80	11.60	2.10	6.60	(Cao et al., 2012)
	3 Jun.-30 Jul. 2003			49.70	7.80	0.90	0.40	
Lanzhou	18 Jun.-17 Jul. 2006	surburban (Renshoushan)	Teflon	65.00	9.80	3.20	4.10	(Pathak et al., 2009)
Inner Mongolia (E122.27°,N43.60°)								
Tongliao	3 Mar.-31 May 2005	rural-sand (Horqin sand land)	Quartz	104.30	5.11	1.45	0.85	(Shen et al., 2007a)
Jilin (E128.47°,N42.40°;E125.30°,N42.40°)								
Changchun	3-20 Jan. 2003	urban (Jilin University)	Teflon	148.10	17.00	11.70	9.40	(Duan et al., 2006)
	3 Jun.-30 Jul.2003			51.00	8.40	2.70	2.10	
Mt. Changbai	23-28 Jul. 2007	forest area	Quartz	38.80	12.97	0.33	3.94	(Li et al., 2010)
Shaanxi (E108.90°,N34.20°;E109.80°,N38.30°)								
Yulin	3-20 Jan. 2003	urban (Shaanxi Desert Institute)	Teflon	141.30	20.20	10.90	10.60	(Pathak et al., 2009)
	3 Jun.-30 Jul.2003			45.60	9.00	1.50	0.70	
Xi'an 1	3-20 Jan. 2003	urban (IEE)	Teflon	356.30	53.80	29.00	29.80	(Duan et al., 2006)
	3 Jun.-30 Jul.2003			102.80	16.80	5.10	4.30	
Xi'an 2	10 Mar.-31 May 2005	urban (IEE, CAS)	Teflon	159.90	20.40	7.60	6.60	(Shen et al., 2007b)
Xi'an 3	Mar. 2006	urban (IEE, CAS)	Quartz	221.45	17.64	9.95	3.15	(Zhang et al., 2007)
	Apr. 2006			183.67	24.13	11.65	5.59	
	May 2006			130.76	21.70	7.18	5.25	
	Jun. 2006			139.68	24.81	8.00	6.61	
	Jul. 2006			141.53	46.41	13.76	12.15	
	Aug. 2006			134.46	45.31	13.56	12.41	
	Sep. 2006			190.06	45.61	19.56	12.35	
	Average 2006			163.09	33.31	11.87	8.67	
Xi'an 4	Mar. 2006-Mar. 2007	urban (IEE, CAS)	Quartz	194.10	35.60	16.40	11.40	(Zhang et al., 2011)
	Summer			138.60	38.90	11.80	10.50	
	Winter			266.80	35.00	20.20	14.30	
Shandong (E116.95°-121.00°,N36.00°-36.67°)								
Qingdao 1	Spring 1997-2000	suburban (Gaokeyuan Monitoring Station)	Polyvinyl chloride	43.56	11.94‡	3.40‡	5.79‡	(Hu et al., 2002)
	Summer 1997-2000			47.91	12.26	2.54	5.37	
	Autumn 1997-2000			38.15	11.60	3.05	3.93	
	Winter 1997-2000			56.88	16.10	9.04	8.13	
Qingdao 2	17 Feb.-2 Mar. 2001	rural (Tianheng Island)	Teflon	56.50	10.79‡	7.06‡	5.76‡	(Takami et al., 2006)
	25 Feb. 2002-15 Mar. 2002			53.30	6.34‡	5.49‡	2.93‡	
Qingdao 3	3-20 Jan. 2003	urban (Chinese Ocean University)	Quartz	134.80	21.10	19.30	15.30	(Cao et al., 2012)
	3 Jun.-30 Jul.2003			27.30	6.70	1.80	1.60	
Ji'nan 1	Nov. 2004-Sep. 2005	urban (Shandong University)	Glass	138.00	28.80	15.10	16.60	(Yang et al., 2007)
	Spring			108.00	20.70	11.90	8.20	
	Summer			116.00	29.90	3.40	13.30	

	Autumn			151.00	32.00	9.60	20.60	
	Winter			177.00	32.60	35.60	24.30	
Ji'nan 2	Dec. 2004– Sep. 2005	urban (Shandong University)	Glass	124.39	29.03	14.50	17.08	(Cheng et al., 2011)
	Feb. 2006–Feb. 2007			148.71	30.92	10.58	13.99	
	Dec. 2007–Oct. 2008			156.25	39.84	18.00	19.22	
Ji'nan 3	Mar. 2006-Feb. 2007	urban (Shandong University)	Glass	148.71	30.92	10.58	13.99	(Yang et al., 2012)
	Spring			143.25	21.91	9.06	9.69	
	Summer			129.04	37.36	6.71	14.67	
	Autumn			134.89	27.80	9.15	12.57	
	Winter			204.89	37.70	20.12	20.47	
	Mar. 2006-Feb. 2007	rural (Miaopu Park)		97.59	18.43	5.49	7.97	
	Spring			93.46	15.40	7.27	6.66	
	Summer			69.56	24.63	1.83	8.17	
	Autumn			93.21	14.73	4.32	6.11	
	Winter			146.80	18.34	9.73	11.15	
Mt. Tai 1	14 Mar. -6 May 2006 and 26 Mar. -18 May 2007	mountain site	Teflon	62.1†	2.72	3.24	0.88	(Deng et al., 2011a)
	2-30 Jun. 2006			123.10	20.26	8.21	9.56	
Mt. Tai 2	27 Mar.-22 Apr. 2007	mountain site		47.64*	9.43	4.73	4.53	(Gao et al., 2011b)
	15 Jun.-20 Jul. 2007			38.63	13.12	1.85	5.79	
Mt. Tai 3	21 Mar.-23 Apr. 2007	mountain site	Teflon	63.00	12.76	5.81	5.55	(Zhou et al., 2009)
	15 Jun.-15 Jul. 2007			59.30	22.92	4.03	8.03	
Tianjin (E117.17°-117.27°,N39.06°-39.10°)								
Tianjin 1	3-20 Jan. 2003	urban (Nankai University)	Quartz	203.10	32.50	25.50	22.20	(Cao et al., 2012)
	3 Jun.-30 Jul.2003			101.70	22.10	8.70	7.70	
Tianjin 2	Aug. 2006	urban (ABLOS)	Quartz	103.90	31.41	9.02	4.42	(Li et al., 2010)
	Sep. 2006			125.00	14.50	7.22	3.81	
	Oct. 2006			131.10	11.02	7.60	5.81	
	Nov. 2006			129.40	15.00	10.72	7.00	
	Dec. 2006			217.40	29.85	14.61	14.31	
Tianjin 3	28 Dec. 2006-31 Jan. 2007	urban (commercial /residential sites)	Quartz	206.60	40.90	17.10	11.30	(Li et al., 2009)
		suburban (industrial site)		248.20	32.50	13.60	11.50	
		urban (coastal site)		215.60	45.60	16.80	10.90	
Tianjin 4	6-24 Jan. 2008	urban (ABLOS)	Quartz	144.60	24.10	16.60	8.70	(Gu et al., 2011)
Xinjiang (E86.63°-88.97°,N42.76°-44.13°)								
Urumqi 1	Feb.-Mar. 2007	urban	Quartz	187.70	48.51	9.45	23.86	(Li et al., 2008)
Urumqi 2	Dec. 2007-Jan. 2008	urban	Quartz	279.00	59.90	14.40	11.20	(Tursun et al., 2010)
Chongqing (E106.42°-106.53°,N29.48°-29.83°)								
Chongqing 1	3-20 Jan. 2003	urban (Chongqing Academy of Environmental Sciences)	Quartz	316.60	60.90	18.10	28.80	(Cao et al., 2012)
	3 Jun.-30 Jul.2003			106.90	20.40	4.20	7.00	
Chongqing 2	Mar. 2005-Feb. 2006	urban (Chongqing Monitor Center)	Teflon	129.00	25.50	5.30	7.90	(He et al., 2011)

		urban (Dadukou)		133.70	23.40	5.00	7.70	
		rural (Beibei)		126.10	23.90	4.80	7.30	
Fujian (E118.09°-119.32°,N24.40°-26.10°)								
Xiamen 1	3-20 Jan. 2003	urban (Xiamen University)	Quartz	74.20	13.50	7.60	7.00	(Cao et al., 2012)
Xiamen 2	Jun. 2009	suburban (Jimei University)	Quartz	58.61	6.88	2.54	2.22	(Zhang et al., 2012a)
	Jul. 2009			61.05	7.22	2.69	3.16	
	Aug. 2009			67.13	7.27	4.02	2.76	
	Sep. 2009			75.14	9.85	4.32	3.62	
	Oct. 2009			82.34	9.54	4.71	3.87	
	Nov. 2009			93.76	11.53	5.37	4.09	
	Dec. 2009			109.17	19.83	9.95	6.79	
	Jan. 2010			108.16	17.67	13.15	9.17	
	Feb. 2010			109.39	16.03	9.41	7.03	
	Mar. 2010			99.16	11.12	7.26	4.09	
	Apr. 2010			92.67	10.13	5.37	4.01	
	May 2010			77.33	7.59	3.72	3.64	
	Average			86.16	11.22	6.04	4.54	
Fuzhou	Apr. 2007-Jan. 2008	urban	Quartz					(Xu et al., 2012)
	Spring			49.78	10.14	4.60	2.49	
	Summer			23.58	6.62	1.10	1.32	
	Autumn			44.14	11.59	3.13	3.91	
	Winter			59.81	14.78	8.77	7.86	
Guangdong (E112.53°-113.94°,N22.27°-23.64°)								
Guangzhou 1	Oct. and Dec. 2002, Mar. and Jun. 2003	urban	Teflon, quartz	70.60	14.70	4.00	4.50	(Hagler et al., 2006)
Guangzhou 2	3-20 Jan. 2003	urban (Zhongshan Uinversity)	Quartz	110.20	20.60	11.50	8.50	(Cao et al., 2012)
	3 Jun.-30 Jul. 2003			39.70	6.40	1.20	1.20	
Guangzhou 3	8 Jan.-8 Feb. 2002	urban (Zhongshan University)	Quartz	90.50	15.00	10.20	3.90	(Lai et al., 2007)
		urban (Huangpu)		104.00	12.90	4.70	1.90	
		bankground (Longgui)		138.60	17.30	11.20	7.40	
Guangzhou 4	Jun.-Jul. 2002	urban (Zhongshan University)		66.30	15.70	2.90	0.60	
		urban (Huangpu)		101.70	22.40	4.70	2.70	
		background (Longgui)		78.20	13.60	4.60	2.00	
Guangzhou 5	15-27 May 2004	suburban (Wan Qing Sha)	Teflon	55.00	13.10	5.20	4.80	(Pathak et al., 2009)
Guangzhou 6	2 Aug.-10 Sep. 2004	semi-rural (Baiyun)	Polypropylene, quartz	90.85	31.22	2.83	6.07	(Wang et al., 2006b)
		urban (Liwan)		91.40	42.69	2.22	7.41	
		urban (Haizhu)		103.35	26.52	3.35	5.90	
		urban (Tianhe)		104.58	27.00	1.50	5.08	

Guangzhou 7	11-25 Oct. 2004	urban (Guangdong Provincial Environmental Monitoring Center)	Teflon, quartz	102.90	27.80	4.31	12.10	(Andreae et al., 2008)
Guangzhou 8	1-31 Jul. 2007	urban (South China Institute of Environmental Sciences)	Quartz	53.70	14.20	2.30	3.20	(Tao et al., 2010)
Guangzhou 9	Dec. 2008-Feb. 2009	urban (Guangzhou Institute of Geochemistry, CAS)	Quartz	81.70	5.60	12.00	4.70	(Yang et al., 2011)
Shenzhen 1	8 Jan.-8 Feb. 2002	urban (Luohu)	Quartz	60.80	13.00	4.40	2.00	(Lai et al., 2007)
	Jun.-Jul. 2002			47.10	8.70	2.50	0.40	
Shenzhen 2	Oct.-Dec. 2002, Mar.-Jun. 2003	urban	Teflon, quartz	47.10	10.00	2.30	3.20	(Hagler et al., 2006)
Zhuhai	8 Jan.-8 Feb. 2002	urban (Xiangzhou)	Quartz	59.30	17.10	8.60	4.50	(Lai et al., 2007)
	Jun.-Jul. 2002			31.00	11.20	1.40	1.00	
Zhongshan	Oct. and Dec. 2002, Mar. and Jun. 2003	urban	Teflon, quartz	46.50	11.90	1.80	3.30	(Hagler et al., 2006)
Conghua	Oct. and Dec. 2002, Mar. and Jun. 2003	background	Teflon, quartz	36.80	10.40	0.30	2.40	(Hagler et al., 2006)
Xinken	4 Oct.-4 Dec. 2004	suburban	Teflon	53.00	24.10	7.20	9.20	(Hu et al., 2008)
Mt. Dinghu 1	2-10 Aug. 2006	rural	Quartz	30.80	10.24	0.47	3.04	(Li et al., 2010)
Mt. Dinghu 2	24 Nov.-8 Dec. 2008	rural		76.90	20.00	2.60	6.80	
Hainan (E108.82°,N18.67°)								
Jianfengling	20 Nov.-26 Dec. 2006	rural (Jianfengling Tropical Forests Nature Reserve)	Quartz	18.00	2.17	0.13	0.56	(Li et al., 2010)
Hong Kong (E113.86°-114.36°,N22.10°-22.47°)								
Hong Kong 1	23 Nov. 2000-23 Feb. 2001	urban (Hung Hom)	Quartz	50.92	12.76	2.27	3.16	(Ho et al., 2003)
		urban (Kwun Tong)		57.38	15.29	2.50	3.00	
		background (Hok Tsui)		42.37	13.07	1.32	1.66	
Hong Kong 2	6 Nov. 2000-26 Oct. 2001	urban (Mong Kok)	Quartz	58.05	9.44	1.67	3.16	(Louie et al., 2005)
		urban (Tsuen Wan)		33.89	9.09	1.29	2.91	
		background (Hok Tsui)		23.68	8.69	0.70	2.17	
Hong Kong 3	Nov. 2000-Feb. 2001 and Jun.-Aug. 2001	urban (Polytechnic University)	Quartz	41.73	8.10	1.20	1.84	(Ho et al., 2006)
		urban (Kwun Tong)		43.93	10.04	1.46	1.78	
Hong Kong 4	6 Jan.-8 Feb. 2002	urban (Polytechnic University)	Quartz	60.40	10.70	6.10	2.80	(Lai et al., 2007)
		urban (Baptist University)		48.50	8.10	4.20	1.50	
		bankground (Hok Tsui)		41.30	11.80	3.50	2.10	
	Jun.-Jul. 2002	urban (Polytechnic University)		40.10	9.10	1.70	1.80	
		urban (Baptist University)		30.80	5.70	1.50	0.10	

		background (Hok Tusi)		15.80	3.20	0.60	0.10	
Hong Kong 5	26 Nov.-31 Dec. 2002	rural/coastal (Tai O)	Teflon	41.30	10.10	0.40	4.10	(Cheung et al., 2005)
Hong Kong 6	Oct. and Dec. 2002, Mar. and Jun. 2003	background (Tap Mun)	Teflon, quartz	28.70	9.20	0.50	2.30	(Hagler et al., 2006)
		suburban (Tung Chung)		32.50	9.00	0.80	2.50	
		urban (central and western)		34.30	9.30	1.00	2.50	
Hong Kong 7	3-20 Jan. 2003	urban (Polytechnic University)	Quartz	88.37	21.40	9.50	8.00	(Cao et al., 2012)
	3 Jun.-30 Jul.2003	urban (Polytechnic University)		30.40	4.30	1.20	0.30	
Hong Kong 8	7 Apr.-12 May 2004	urban (Kowloon Peninsula)	Quartz	37.50	11.20	1.70	2.70	(Sang et al., 2011)
	7 Apr.-12 May 2004	rural (Hok Tsui)		30.80	11.90	0.80	2.40	
Hubei (E114.20°,N30.50°)								
Wuhan	3-20 Jan. 2003	urban (CUG)	Quartz	172.30	31.40	22.20	18.40	(Cao et al., 2012)
	3 Jun.-30 Jul. 2003	urban (CUG)		70.70	12.40	2.70	2.90	
Hunan (E112.70°,N27.30°)								
Mt. Heng	15 Mar.-31 May 2009	mountain site		38.40	8.02	1.47	2.94	(Gao et al., 2012)
Jiangsu (E118.78°-119.95°,N31.79°-32.07°)								
Nanjing 1	Feb. 2001	urban (Nanjing University)	Quartz	67.10	14.00	8.06	8.40	(Yang et al., 2005)
	Sep. 2001	urban (Nanjing University)		46.90	11.50	3.24	3.55	
	Feb. 2001	suburban (Purple Mountain Observatory)		80.50	24.40	12.90	12.20	
Nanjing 2	14-19 Mar. 2002 (average)	urban (Nanjing University)		211.10	7.97	5.93	5.95	
Xueyan	15 Jul. 2002-14 Jan. 2003	rural	Vinylidene Chloride					(Zhou et al., 2007)
	Summer			144.38	15.79	5.43	7.69	
	Autumn			119.91	13.14	5.24	7.11	
	Winter			151.68	12.82	16.54	12.70	
	Summer	rural (Taihu Station)		109.40	14.86	0.38	7.41	
	Autumn			66.75	9.93	4.20	3.76	
	Winter			140.16	12.77	8.37	8.14	
Shanghai (E121.10°-121.70°,N30.83°-31.45°)								
Shanghai 1	5 May 1999-20 Mar. 2000	urban (Hainan Road)	Teflon	67.60	14.56	6.30	6.07	(Ye et al., 2003)
	Summer			35.85	9.32	4.76	3.34	
	Autumn			67.78	14.31	5.12	6.59	
	Winter			93.91	19.22	10.10	8.09	
	5 May 1999-20 Mar. 2000	urban (Tongji University)		62.40	13.48	5.77	5.67	
	Spring			61.66	12.60	5.41	5.53	
	Summer			36.80	10.01	2.92	3.49	
	Autumn			64.77	13.55	5.12	6.26	
	Winter			88.57	17.78	9.64	7.38	
Shanghai 2	3-20 Jan. 2003	urban (Donghua University)	Quartz	139.40	21.60	17.50	14.50	(Cao et al., 2012)

	3 Jun.-30 Jul.2003			54.00	12.00	2.60	3.50	
Shanghai 3	9 Mar. -20 Apr. 2004	urban (Fudan University)	Quartz	134.77	11.73	9.05	4.05	(Wang et al., 2006c)
	15 Jul. -16 Aug. 2004	urban (Fudan University)		71.66	5.43	2.59	2.44	
	4 Sep. -10 Oct. 2003	urban (Fudan University)		96.38	8.70	3.70	3.60	
	6:00–17:00 24 Nov. 2004-4 Jan. 2005	urban (Taopu)		76.09	12.79	8.53	4.38	
	17:00–6:00 24 Nov.2004-4 Jan. 2005	urban (Taopu)		89.16	13.06	6.96	4.36	
	Sep. 2003-Jan. 2005			94.64	10.39	6.23	3.78	
Shanghai 4	5 May-15 Jun. 2005	surburb (Taicang Meterological Station)	Teflon	67.00	15.80	7.10	4.10	(Pathak et al., 2009)
Shanghai 5	13-15 Jun. 2006	rural (Dongping National Forest Park, Chongming)		89.20	23.14	10.89	10.28	
Zhejiang (E119.73°-120.89°,N30.20°-30.31°)								
Lin'an 1	**Nov. 1999**	rural	Teflon	90.00	21.20	7.70	8.60	(Xu et al., 2002)
Lin'an 2	**16-29 Aug. 2004**	rural	Teflon	40.10	15.38	1.13	5.49	(Yan et al., 2012)
	15 Jan.-3 Feb. 2005	rural		71.70	15.44	8.81	7.44	
Hangzhou 1	**3-20 Jan. 2003**	urban (Hangzhou Environmental Monitoring Station)	Quartz	177.30	33.40	25.70	19.10	Cao et al.(2012)
	3 Jun.-30 Jul.2003	urban (Hangzhou Environmental Monitoring Station)		80.00	16.50	5.50	5.30	
Hangzhou 2	Apr. 2004-Mar. 2005							
	Spring	urban (HJ)	Glass	121.80	19.55	7.78	8.48	(Liu et al., 2007)
	Summer	urban (HJ)		72.90	13.80	3.40	5.01	
	Autumn	urban (HJ)		119.00	16.87	8.02	7.86	
	Winter	urban (HJ)		144.90	17.07	11.44	10.00	
	Spring	urban (MZ)		120.70	16.99	9.03	10.80	
	Summer	urban (MZ)		70.90	15.61	4.76	6.99	
	Autumn	urban (MZ)		113.30	17.99	8.16	10.29	
	Winter	urban (MZ)		136.00	15.48	10.75	11.92	
	Spring	urban (MZ)		105.80	18.12	8.69	10.81	
	Summer	urban (JK)		75.40	14.24	5.53	6.98	
	Autumn	urban (JK)		110.40	22.31	11.77	11.62	
	Winter	urban (JK)		127.90	14.82	10.31	11.55	
Hangzhou 3	2006	suburban and urban	Polypropylene, quartz	77.50	12.82	5.89	5.32	(Zhen et al., 2010)
Average				99.63	17.96	7.66	7.26	
Standard deviation				54.69	10.23	5.68	5.11	

Notes:

$ evaluated; * $PM_{1.8}$ instead of $PM_{2.5}$

‡mass concentrations of species calculated by mass concentration of $PM_{2.5}$ and percentage of species in $PM_{2.5}$

£$PM_{2.5}$ mass concentration was calculated by mass concentration and percentage of total ions in $PM_{2.5}$

†$PM_{2.5}$ mass concentration obtained from the average of the two spring (46.6 μg/m^3 in 2006 and 70.1 μg/m^3 in 2007))

Abbreviation: IAP, Institute of Atmospheric Physics; CAS, Chinese Academy of Sciences; RCEES, Research Centre for Eco-Environmental Sciences; BNU, Beijing Normal University; CRAES, Chinese Research Academy of Environmental Science; IEE, Institute of Earth Environment; ABLOS, Atmospheric Boundary Layer Observation Station; CUG, China University of Geoscience.

Table S2 Data sources of sulfate, nitrate and ammonium mass concentrations in PM_{10} used in analysis

Location	Sampling Dates	Sampling Description	Sampling substrate	PM_{10} ($\mu g/m^3$)	SO_4^{2-} ($\mu g/m^3$)	NO_3^- ($\mu g/m^3$)	NH_4^+ ($\mu g/m^3$)	References
Beijing (E116.17°-116.42°,N39.51°-40.03°)								
Beijing 1	May-Oct. 2001-2004	urban (RCEES/BNU)		180.00	25.10	19.10	12.10	(Kim Oanh et al., 2006)
	other months 2001-2004			262.00	29.30	19.00	13.40	
Beijing 2	Summer 2002-2003	urban (BNU)		172.20	24.8	21.1	11.9	(Sun et al., 2004)
		urban (Capital Steel Company)		170.00	24.9	18.6	12.1	
		urban (Yihai Garden)		150.10	25.4	18.2	10.8	
	Winter 2002-2003	urban (BNU)		184.40	34.5	18.7	13.7	
		urban (Capital Steel Company)		287.70	40.5	23.2	19.1	
		urban (Yihai Garden)		292.70	46	27.3	18.9	
Beijing 3	Jan. 2004	six sites average (4 urban, a suburban and a background)	Quartz	153.00	14.5	7.9	9	(Xie et al., 2008)
	Apr. 2004			295.00	28.2	23.2	5.3	
	Jul. 2004			164.00	44.1	12.2	11.8	
	Oct. 2004			166.00	18.5	23.4	7.9	
Beijing 4	Summer 2006	urban (Peking University)	Quartz	133.00	25	16	10	(Pinxteren et al., 2009)
	Summer 2006	suburban (Yufa)		112.00	20	10	8	
Beijing 5	22 Aug.-4 Sep. 2006 (average)	urban (Peking University)		118.6	23.34‡	11.30‡	12.48‡	(Huo et al., 2011)
Beijing 6	1-31 Aug, 2009	urban (CRAES)	Quartz	176.90	31.6	23.2	16.9	(Lin et al., 2011)
Gansu (E94.68°,N40.15°;E105.85°,N36.00°)								
Dunhuang	2006-2007	rural	Quartz	158.50	6.6	2.3	0.4	(Zhang et al., 2012b)
Gaolanshan	2006-2007	rural	Quartz	187.10	16.7	18.4	6.5	(Zhang et al., 2012b)
Hebei (E115.60°,N39.13°)								
Gucheng	2006-2007	semi-urban	Quartz	253.80	35.5	20	15.4	(Zhang et al., 2012b)
Henan (E113.68°,N34.78°)								
Zhengzhou	2006-2007	urban	Quartz	271.30	45	22.6	16.5	(Zhang et al., 2012b)
Liaoning (E121.50°-127.60°,N38.90°-44.73°)								
Dalian	25 Feb.-16 Mar. 2002	urban	Teflon	92.90	11.89‡	11.98‡	5.48‡	(Takami et al., 2006)
Dalian	2006-2007	urban	Quartz	156.80	23.3	13.5	7.7	(Zhang et al., 2012b)
Longfengshan	2006-2007	rural	Quartz	81.80	10	4.9	2.5	(Zhang et al., 2012b)
Fushun	Jan. -Feb. 2006 and Jan. 2007	five sites average (4 urban and 1 urban background)		140.40	12.77	2.59	1.73	
	Sep. 2006 and 2007			103.20	7.16	2.32	0.8	
	Apr. 2006			147.10	8.06	3.92	1.01	
Shaanxi (E106.30°-110.08°,N33.58°-35.10°)								
Xi'an	2006-2007	urban	Quartz	328.50	46.7	20.7	14.4	(Zhang et al., 2012b)
Baoji 1	15-19 Feb. 2008	urban (residential area site)	Quartz	383.00	52.00	42.00	31.00	(Hu et al., 2010)
		urban (artery traffic site)		461.00	44.00	40.00	27.00	

		urban (industrial area)		454.00	48.00	42.00	29.00	
		background		308.00	43.00	41.00	28.00	
	8-10,15-17 Apr. 2008	urban (residential area site)		338.00	28.00	29.00	17.00	
		urban (artery traffic site)		440.00	29.00	30.00	16.00	
		urban (industrial area)		556.00	32.00	32.00	16.00	
		background		296.00	28.00	29.00	18.00	
Baoji 2	10-15 Feb. 2008	urban	Quartz	433.00	47.63‡	40.27‡	28.58‡	(Wang et al., 2010)
		suburban		333.00	46.62‡	46.62‡	30.30‡	
	1-6 Apr. 2008	urban		448.00	31.36‡	33.15‡	17.92‡	
		suburban		296.00	29.6‡	32.56‡	19.83‡	
Mt. Hua	25 Mar.-29 Apr. 2009	moutain site	Quartz	71.00	13	5	2.5	(Wang et al., 2011)
Shandong (E121.00°,N36.50°;E117.10°,N36.27°)								
Qingdao	17 Feb.-2 Mar. 2001	rural (Tianheng Island)	Teflon	98.10	13.83‡	10.89‡	7.46‡	(Takami et al., 2006)
	25 Feb.-15 Mar. 2002			75.90	9.11‡	8.05‡	4.10‡	
Mt. Tai 1	27 Mar.-22 Apr. 2007	mountain site		118.45	13.08	8.4	5.22	(Gao et al., 2011b)
	15 Jun.-20 Jul. 2007			51.54	15.33	2.97	6.31	
Mt. Tai 2	27 Mar.- 29 Apr. 2009 (non dust storm)	moutain site	Quartz	159.00	16	20	12	(Wang et al., 2011)
Xinjiang (E86.63°-88.97°,N42.75°-47.10°)								
Akdala	Jul. 2004-Mar. 2005	background (on the north margin of the Zhungaer Basin)	Quartz	9.59 £	3.3	0.58	0.6	(Qu et al., 2008)
Urumqi	Dec. 2007-Jan. 2008	Tianshan, Shayibake, Xinshi, Shuimogou and Midongxin areas	Quartz	464.00	104.6	26.5	17.65	(Tursun et al., 2010)
Guangdong (E113.24°-113.82°,N22.27°-23.39°)								
Guangzhou 1	8 Jan.-8 Feb. 2002	urban (Zhongshan University)	Quartz	138.2	19.10	12.3	5.4	(Lai et al., 2007)
		urban (Huangpu)		167	14.90	6.2	2.8	
		bankground (Longgui)		203.4	22.10	15.9	8.8	
	Jun.-Jul. 2002	urban (Zhongshan University)		102.7	19.00	6.00	1.20	
		urban (Huangpu)		164.2	24.50	6.80	3.00	
		background (Longgui)		129.5	22.60	7.30	10.90	
Guangzhou 2	2 Aug.-10 Sep. 2004	semi-rural (BY)	Quartz	138.42	33	5.28	6.52	(Wang et al., 2006a)
		urban (LW)		142.57	43.74	4.98	7.66	
		urban (HZ)		144.52	27.59	7.12	6.14	
		urban (TH)		152.09	27.92	2.86	5.54	
Guangzhou 3	5-25 Jul. 2006 (daytime)	urban (Guangdong Environmental Protection Bureau)	Quartz	89.40	24.7	4.32	6.9	(Zhang et al., 2010)
	Nighttime			70.30	15.8	3.21	4.13	
Shenzhen	8 Jan.-8 Feb. 2002	urban (Luohu)	Quartz	83.7	13.70	6.3	3	(Lai et al., 2007)
	Jun.-Jul. 2002	urban (Luohu)		75.1	10.80	3.60	0.60	

Zhuhai	8 Jan.-8 Feb. 2002	urban (Xiangzhou)	Quartz	84.1	17.50	10.90	7.10	(Lai et al., 2007)
	Jun.-Jul. 2002	urban (Xiangzhou)		44	11.30	2.80	1.20	
Panyu	2006-2007	urban	Quartz	147.40	26.8	11.7	8.6	(Zhang et al., 2012b)
Guangxi (E108.35°,N22.82°)								
Nanning	2006-2007	urban	Quartz	98.90	21.6	5.1	5.8	(Zhang et al., 2012b)
Hong Kong (E114.14°-114.25°,N22.22°-22.34°)								
Hong Kong 1	23 Nov. 2000-23 Feb. 2001	urban (Hung Hom)	Quartz	83.52	15.9	5.29	3.31	(Ho et al., 2003)
		urban (Kwun Tong)		73.11	15.77	4.92	3.05	
		background (Hok Tsui)		80.01	14.23	4.45	3.06	
Hong Kong 2	6 Jan.-8 Feb. 2002	urban (Polytechnic University)	Quartz	78.4	11.20	6.3	3.3	(Lai et al., 2007)
		urban (Baptist University)		55.7	9.00	5.1	1.7	
		bankground (Hok Tsui)		82.9	14.60	7.4	3.1	
Hong Kong 3	Jun.-Jul. 2002	urban (Polytechnic University)	Quartz	40.8	9.20	3.80	2.20	(Lai et al., 2007)
	Jun.-Jul. 2002	urban (Baptist University)		38.6	7.60	2.50	0.40	
	Jun.-Jul. 2002	bankground (Hok Tsui)		31.9	5.10	2.90	0.20	
Hunan (E111.71°,N29.17°;E114.20°,N29.63°)								
Changde	2006-2007	rural	Quartz	128.20	28.8	8.5	7.9	(Zhang et al., 2012b)
Jinsha	2006-2007	rural	Quartz	107.40	26.6	7.2	7.6	(Zhang et al., 2012b)
Jiangsu (E118.78°,N32.06°)								
Nanjing	14-19 Mar. 2002 (average)	urban		316.07	10.01	8.42	5.34	(Wang et al., 2003)
Sichuan (E104.06°,N30.67°;E104.04°,N30.65°)								
Chengdu 1	8-22 Jan. 2002	urban		240.87£	27.7	13.9	8.3	(Wang et al., 2004)
Chengdu 2	2006-2007	urban	Quartz	235.7	40.5	15.1	14	(Zhang et al., 2012b)
Tibet (E91.13°,N29.67°)								
Lhasa	2006-2007	rural	Quartz	77.40	2.9	2.4	0.2	(Zhang et al., 2012b)
Yunnan (E99.72°,N28.00°)								
Zhuzhang	Aug. 2004-Feb. 2005	background	Quartz	6.58£	1.6	0.45	0.15	(Qu et al., 2008)
Zhejiang (E118.34°-120.75°,N29.25°-30.5°)								
Hangzhou 1	Sep. 2001-Aug. 2002	five sites average (4 urban and 1 background)	Teflon	119.20	20.1	7.12	7.03	(Cao et al., 2009)
	Spring			107.90	15.88	7.2	6	
	Summer			92.90	14.21	4.68	5.87	
	Autumn			136.80	22.81	7.07	8.15	
	Winter			157.20	21.64	11.19	9.32	
Hangzhou 2	2006	suburban and urban	Polyvinyl chloride, quartz	111.00	18.31	8.09	5.49	(Bao et al., 2010)
Lin'an	2006-2007	rural	Quartz	114.20	21.7	8.6	6.8	(Zhang et al., 2012b)
Average				175.28	23.85	13.76	9.18	
Standard deviation				118.94	14.94	11.40	7.55	

Notes:

‡mass concentrations of species calculated by mass concentration of PM_{10} and percentage of species in PM_{10}

£PM_{10} mass concentration calculated by mass concentration and percentage of SO_4^{2-} in PM_{10}

Abbreviation: RCEES, Research Centre for Eco-Environmental Sciences; BNU, Beijing Normal University; CRAES, Chinese Research Academy of Environmental Science.

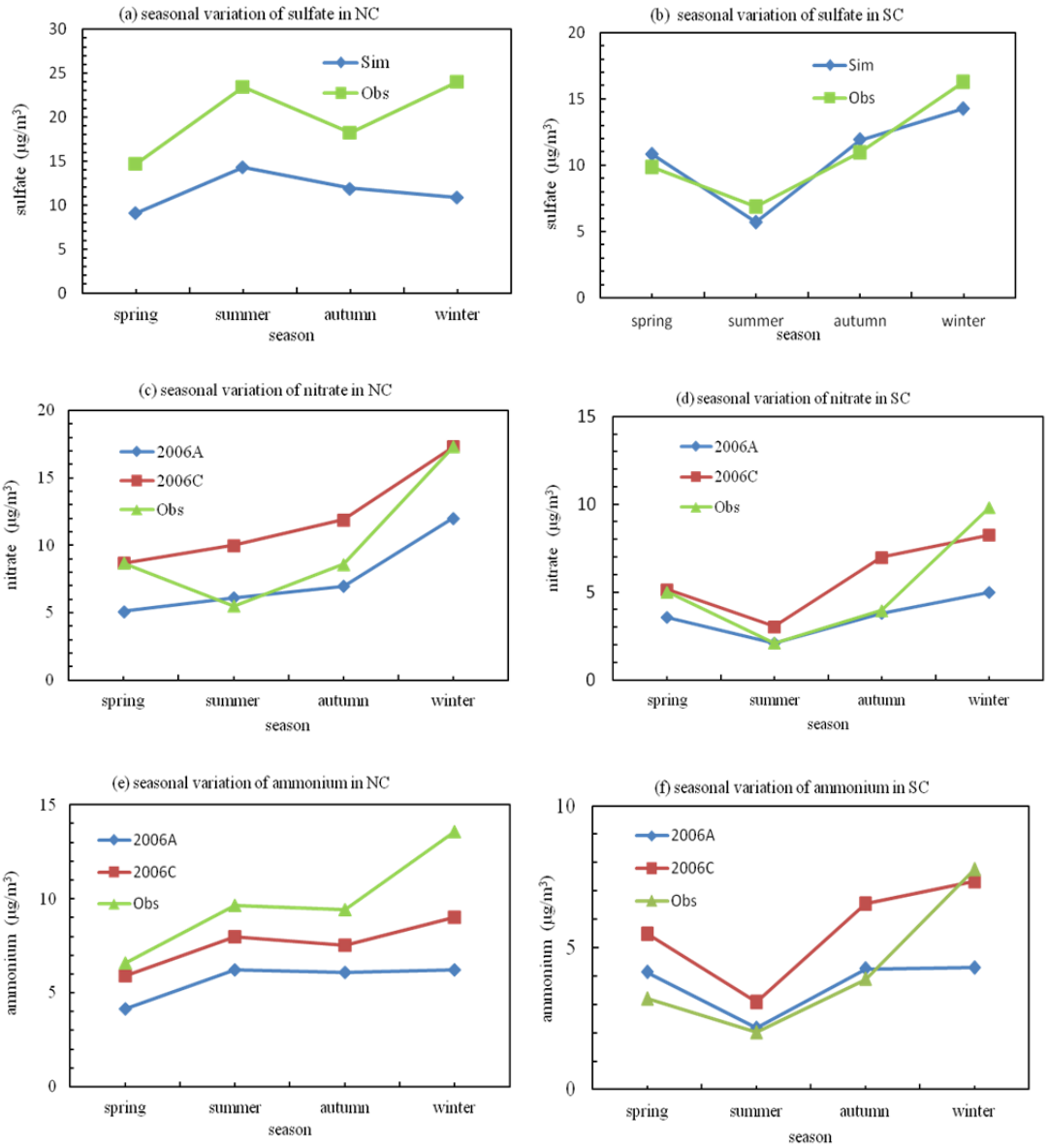

Fig. S2. Comparisons of seasonal concentrations of sulfate, nitrate and ammonium in $PM_{2.5}$ between the simulation (Wang et al., 2013) and observations in the investigation over NC (a. c. e.) and SC (b. d. f.). Note: the data in Table S1 was grouped in North China (NC, 32–42°N, 110–120°E) and South China (SC, 22–32°N, 110–120°E) according to the range in the paper of Wang et al. (2013)

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