Table S1. The list of observation sites information

Number	Site name (ID)	Longitude	Latitude
WDCGG Dataset			
1	abp312s00.noa	-38.2	-12.8
2	alt482n00.ec.	-62.5	82.45
3	asc107s00.noa	-14.4	-7.92
4	ask123n00.noa	5.63	23.27
5	ask123n00.onm	5.63	23.27
6	azr638n00.noa	-27.4	38.77
7	bal655n00.noa	17.22	55.35
8	beo642n00.inr	23.59	42.18
9	bhd541s00.noa	174.9	-41.4
10	bkt500s00.bmg	100.3	-0.2
11	bkt500s00.noa	100.3	-0.2
12	bme432n00.noa	-64.7	32.37
13	bmw432n00.noa	-64.9	32.27
14	brw471n00.noa -	156.6	71.32
15	bsc644n00.noa	28.67	44.17
16	cba455n00.noa -	162.7	55.2
17	cdl453n00.ec. -	104.7	53.87
18	cfa519s00.csi	147.1	-19.3
19	cgo540s00.csi	144.7	-40.7
20	cgo540s00.noa	144.7	-40.7
21	chm449n00.ec.	-74.3	49.68
22	chr501n00.noa -	157.2	1.7
23	cmn644n00.isa	10.7	44.18
24	cpt134s00.saw	18.48	-34.4
25	cri215n00.csi	73.83	15.08
26	crz146s00.noa	51.85	-46.5
27	cvo116n00.uyr	-24.9	16.85
28	cya766s00.csi	110.5	-66.3
29	egb444n01.ec.	-79.8	44.23
30	eic327s00.noa -	109.5	-27.1
31	esp449n00.ec. -	126.6	49.38
32	etl454n00.ec. -	105	54.35
33	fsd449n00.ec.	-81.6	49.88
34	glh636n00.uml	14.22	36.07
35	gmi513n00.noa	144.8	13.43
36	hba775s00.bas	-26.5	-75.6
37	hba775s00.noa	-26.5	-75.6
38	hpb647n00.dwd	11.02	47.8
39	hpb647n00.noa	11.02	47.8
40	hun646n00.noa	16.65	46.95

Number	Site name (ID)	Longitude	Latitude
41	ice663n00.noa	-20.3	63.4
42	izo128n00.aem	-16.5	28.3
43	jfj646n00.emp	7.99	46.55
44	key425n00.noa	-80.2	25.67
45	kmw653n00.riv	6.28	53.33
46	kos649n00.chm	15.08	49.58
47	kum519n00.noa -	154.8	19.52
48	kvv646n00.ars	14.53	46.3
49	kzd244n00.noa	75.57	44.45
50	kzm243n00.noa	77.87	43.25
51	lef445n00.noa	-90.3	45.92
52	llb454n00.noa -	112.5	54.95
53	llb454n01.ec. -	112.5	54.95
54	lln223n00.noa	120.9	23.47
55	lmp635n00.noa	12.63	35.52
56	maa767s00.csi	62.87	-67.6
57	mex419n00.noa	-97.2	19.98
58	mhd653n00.aga	-9.9	53.33
59	mhd653n00.noa	-9.9	53.33
60	mid528n00.noa -	177.4	28.2
61	mkn100s00.noa	37.3	-0.06
62	mlo519n00.csi -	155.6	19.54
63	mnm224n00.jma	154	24.28
64	mqa554s00.csi	159	-54.5
65	nat306s00.noa	-35.2	-6
66	ngl653n00.uba	13.03	53.17
67	nmb123s00.noa	15.02	-23.6
68	nwr440n01.noa -	105.6	40.05
69	oxk650n00.noa	11.8	50.03
70	pal667n00.noa	24.12	67.97
71	pay646n00.emp	6.95	46.82
72	pdi221n00.nhm	103.5	21.57
73	pdm642n00.la.	0.14	42.94
74	poc900n00.noa -	155	0
75	poc905n00.noa -	151	5
76	poc905s00.noa -	159	-5
77	poc910n00.noa -	149	10
78	poc910s00.noa -	161	-10
79	poc915n00.noa -	145	15
80	poc915s00.noa -	171	-15
81	poc920n00.noa -	141	20
82	poc920s00.noa -	174	-20
83	poc925n00.noa -	139	25

Number	Site name (ID)	Longitude	Latitude
84	poc925s00.noa -	171	-25
85	poc930n00.noa -	135	30
86	poc930s00.noa -	176	-30
87	psa764s00.noa	-64	-64.9
88	pta438n00.noa -	123.7	38.95
89	puy645n00.lam	2.97	45.77
90	rig646n00.emp	8.45	46.07
91	rpb413n00.noa	-59.4	13.17
92	ryo239n00.jma	141.8	39.03
93	sey104s00.noa	55.17	-4.67
94	sgp436n00.noa	-97.5	36.78
95	shm452n00.noa	174.1	52.72
96	smo514s00.noa -	170.6	-14.2
97	snb647n00.uba	12.95	47.05
98	spo789s00.csi	-24.8	-89.4
99	ssl647n00.uba	7.92	47.92
100	stm666n00.noa	2	66
101	sum672n00.noa	-38.5	72.58
102	syo769s00.noa	39.58	-69
103	tap236n00.noa	126.1	36.72
104	tdf354s00.noa	-68.5	-54.9
105	thd441n00.noa -	124.2	41.05
106	tll330s00.dmc	-70.8	-30.2
107	ush354s00.noa	-68.3	-54.9
108	uta439n00.noa -	113.7	39.88
109	uum244n00.noa	111.1	44.45
110	wis631n00.noa	34.87	31.12
111	wlg236n00.cma	100.9	36.28
112	wsa443n00.ec.	-60	43.93
113	yon224n00.jma	123	24.47
114	zep678n00.noa	11.88	78.9
115	zsf647n00.uba	10.98	47.42
116	aht662n00.fmi	24.2	62.58
117	bur642n00.nim	27.48	42.48
118	dig654n00.ioe	22.07	54.15
119	irb645n00.ars	14.87	45.57
120	kam643n00.rhm	21.95	43.4
121	kps646n00.hms	19.55	46.97
122	oul666n00.fmi	29.4	66.32
123	pld642n00.nim	24.75	42.13
124	plv643n00.nim	24.6	43.42
125	rcv656n00.lhm	21.17	56.16
126	sof642n00.nim	23.38	42.65

Number	Site name (ID)	Longitude	Latitude
127	uto659n00.fmi	21.38	59.78
128	vir660n00.fmi	27.67	60.53
129	vrn643n00.nim	27.92	43.2
130	zsn657n00.lhm	25.54	57.08
131	alt482n00.aqr	-62.5	82.45
132	amy236n00.kma	126.3	36.53
133	arh777s00.noa	166.7	-77.8
134	bhd541s00.niw	174.9	-41.4
135	bra450n00.aqr	-105	50.2
136	brw471n00.noa	-157	71.32
137	cai130n00.ema	31.28	30.08
138	cps449n00.aqr	-75	49.82
139	dbl656n00.lhm	23.19	56.37
140	dcc775s00.isa	123.3	-75.1
141	dmv504n00.mmd	117.8	4.97
142	egb444n00.aqr	-79.8	44.23
143	ela449n00.aqr	-93.7	49.67
144	est451n00.aqr	-110	51.67
145	isk242n00.ksn	76.98	42.62
146	kej444n00.aqr	-65.2	44.43
147	kvk646n00.ars	15.1	46.12
148	lau545s00.noa	169.7	-45
149	lgb652n00.uba	10.77	52.8
150	mbi764s00.smn	-56.6	-64.2
151	mhd653n00.nui	-9.9	53.33
152	mlo519n00.noa	-156	19.54
153	nmy770s00.awi	-8.25	-70.7
154	nwr440n00.noa	-106	40.04
155	pal667n00.fmi	24.12	67.97
156	prs645n00.rse	7.7	45.93
157	pyr227n00.isa	86.81	27.96
158	sat448n00.aqr	-123	48.78
159	smo514s00.noa	-171	-14.2
160	spo789s00.noa	-24.8	-89.4
161	syo769s00.jma	39.58	-69
162	thd441n00.noa	-124	41.05
163	tkb236n10.jma	140.1	36.05
164	ush354s00.smn	-68.3	-54.9
165	vdl664n00.ivl	19.77	64.25
166	wes654n00.uba	8.32	54.93
167	wkt431n00.noa	-97.3	31.32
168	zgt654n00.uba	12.73	54.43
169	zrn646n00.ars	15	46.43

Number	Site name (ID)	Longitude	Latitude
EANET			
num	staid	lon	lat
1	PhnomPenh	104.83	11.55
2	Jakarta	106.83	-6.18
3	Serpong	106.57	6.25
4	Bandung	107.58	6.9
5	Rishiri	141.2	45.12
6	Ochishi	145.5	43.15
7	Tappi	140.35	41.25
8	Sado-seki	138.4	38.23
9	Ijira	136.68	35.57
10	Oki	133.18	36.28
11	Banryu	131.8	34.68
12	Hedo	128.25	26.87
13	Ogasawara	142.22	27.08
14	PetalingJaya	101.65	3.1
15	DanumValley	117.85	4.98
16	Yangon	96.12	16.5
17	Kanghwa	126.28	37.7
18	Cheju	126.17	33.3
19	Imsil	127.18	35.6
20	Listvyanka	104.9	51.85
21	Irkutsk	104.25	52.23
22	Primorskaya	132.12	43.7
23	Bangkok	100.53	13.77
24	Khanchanaburi	98.58	14.77
25	ChiangMai	98.93	18.77
26	NakhonRatchasima	101.88	14.45
27	Hanoi	105.85	21.02
28	HoaBinh	105.33	20.82
29	Tokyo	139.75	35.68
30	NakhonRatchasima	101.88	14.45
31	Mt.Sto.Tomas 1	120.6	6.42
32	Hongwen	118.13	24.47
33	XiangZhou	113.57	22.27
34	Kototabang	100.32	0.2
35	Ulaanbaatar	106.82	47.9
36	Samutprakarn	100.57	13.73
37	Mondy	101	51.67
38	Happo	137.8	36.7
39	MtStoTomas	120.6	16.42
40	Khanchanaburi	98.58	14.77
EMEP			

Number	Site name (ID)	Longitude	Latitude
1	Waldhof	10.76	52.8
2	Schauinsland	7.91	47.91
3	Neuglobsow	13.03	53.17
4	Lahemaa	25.9	59.5
5	Uto	21.38	59.78
6	Virolahti	27.69	60.53
7	Pallas	24.24	68
8	K-puszta	19.58	46.97
9	Oak	-6.92	52.87
10	Malin	-7.34	55.38
11	Carnsore	-6.36	52.18
12	Rucava	21.17	56.16
13	Birkenes	8.25	58.39
14	Karvatn	8.88	62.78
15	Zeppelin	11.89	78.91
16	Hurdal	11.08	60.37
17	Jarczew	21.97	51.81
18	Sniezka	15.74	50.74
19	Leba	17.53	54.75
20	Diabla	22.07	54.15
21	Danki	37.8	54.9
22	Iskrba	14.87	45.57
23	Starina	22.27	49.05
24	Melpitz_l	12.93	51.53
25	Ispra	8.63	45.8
26	Cabauw	4.92	51.97
27	Illmitz	16.77	47.77
28	Vorhegg	12.97	46.68
29	Zoebelboden	14.44	47.84
30	Payerne	6.94	46.81
31	Tanikon	8.9	47.48
32	Chaumont	6.98	47.05
33	Rigi	8.46	47.07
34	Churanov	13.6	49.07
35	Westerland	8.31	54.93
36	Zingst	12.73	54.43
37	Harwell	-1.32	51.57
38	Auchencorth	-3.24	55.79
39	Kamenicki	21.95	43.4
40	Schmucke	10.77	50.65
41	San	-4.35	39.55
42	Cabo	3.32	42.32
43	Zarra	-1.1	39.09

Number	Site name (ID)	Longitude	Latitude
44	Penausende	-5.87	41.28
45	Els	0.72	41.4
46	Rao	11.91	57.39
IMPROVE			
1	ACAD1	-68.261	44.377
2	BLMO1	-96.191	43.716
3	BRMA1	-70.729	44.107
4	CEBL1	-99.763	38.77
5	DENA1	-148.968	63.723
6	EVER1	-80.681	25.391
7	GAAR1	-151.517	66.903
8	GRRI1	-91.405	43.937
9	HEGL1	-92.922	36.614
10	KALM1	-124.059	42.552
11	LOST1	-102.402	48.642
12	MING1	-90.143	36.972
13	NEBR1	-100.339	41.889
14	OWVL1	-118.331	37.361
15	PMRF1	-72.869	44.528
16	RAFA1	-120.007	34.734
17	SAGO1	-116.913	34.194
18	SENE1	-85.95	46.289
19	SIME1	-160.506	55.325
20	TALL1	-96.56	38.434
21	TRIN1	-122.805	40.786
22	WHIT1	-105.535	33.469
23	ZICA1	-113.151	37.198
EPA			
1	10730023	-86.82	33.55
2	40128000	-113.56	34.24
3	60530002	-121.64	36.7
4	60831008	-120.05	34.49
5	90090027	-72.9	41.3
6	120573002	-82.54	27.89
7	120860033	-80.16	25.73
8	170310022	-87.64	41.88
9	171190024	-90.16	38.61
10	180570007	-85.77	39.29
11	191770006	-92.01	40.7
12	201330003	-95.48	37.68
13	360610079	-73.9	40.82
14	380171004	-96.86	46.93
15	380250003	-102.53	47.31

16	410510080	-122.6	45.5
17	420010001	-77.31	39.92
18	420031008	-79.73	40.61
19	450450015	-82.41	34.84
20	460990006	-96.7	43.55
21	461030020	-103.27	44.09
22	461270001	-96.71	42.75
23	550870009	-88.81	45.56
24	560030003	-108.39	44.84
25	20200018	-149.82	61.21
26	21100004	-134.57	58.39
27	21221006	-151.69	59.46
28	21700008	-149.03	61.53
29	40131003	-111.87	33.41
30	40133010	-112.12	33.46
31	40278011	-114.61	32.69
32	51190007	-92.28	34.76
33	60070008	-121.84	39.76
34	60090001	-120.68	38.2
35	60510005	-119.12	37.96
36	60970001	-123.02	38.8
37	60990005	-120.99	37.64
38	120570083	-82.38	27.86
39	150030010	-158.09	21.32
40	300290009	-114.34	48.4
41	300710010	-107.86	48.32
42	410390059	-123.14	44.07
43	420030003	-79.77	40.45
44	530330080	-122.31	47.57
45	530630021	-117.36	47.67
46	560350100	-110.06	42.79
47	560370007	-109.22	41.59
48	560370300	-109.79	41.75
49	560370866	-109.79	41.63
50	560370867	-108.67	41.75
51	10030010	-87.88	30.5
52	21220008	-151.07	60.49
53	40011235	-109.44	35.88
54	50010011	-91.56	34.52
55	60010007	-121.78	37.69
56	60410001	-122.52	37.97
57	60670006	-121.37	38.61
58	60710306	-117.33	34.51
59	60730003	-116.94	32.79

60	60731006	-116.77	32.84
61	60750005	-122.4	37.77
62	60771002	-121.27	37.95
63	61111004	-119.23	34.45
64	100010002	-75.56	38.99
65	131210039	-84.44	33.8
66	131350002	-84.07	33.96
67	150011006	-155.11	19.72
68	160410001	-111.81	42.01
69	330115001	-71.88	42.86
70	380070002	-103.38	46.89
71	471570047	-90.02	35.17
72	550090005	-87.99	44.51
73	560290001	-109.07	44.53
74	20900034	-147.73	64.85
75	40070009	-110.86	33.4
76	60010011	-122.28	37.81
77	80013001	-104.95	39.84
78	90010012	-73.16	41.2
79	120110010	-80.17	26.13
80	120170006	-82.64	28.96
81	160050004	-112.52	42.92
82	170191001	-88.37	40.05
83	220150008	-93.75	32.54
84	230090103	-68.26	44.38
85	230112005	-69.79	44.23
86	230310009	-70.77	43.11
87	240053001	-76.47	39.31
88	271095008	-92.45	44
89	300490004	-111.99	46.85
90	390350038	-81.68	41.48
91	390810017	-80.62	40.37
92	390850003	-81.42	41.67
93	401430235	-96	36.13
CAWNET			
1	Chengdu	104.3	30.6
2	Dalian	121.6	38.9
3	Dunhuang	94.67	40.1
4	Gaolanshan	105.8	36
5	Gucheng	115.8	39.1
6	Jinsha	114.2	29.6
7	LinAn	119.7	30.3
8	Longfengshan	127.5	44.7
9	Shangdianzi	117.1	40.7

10	Taiyangshan	111.7	29.2
11	Xian	109	34.5
12	Zhenbeitai	109.2	38.5
13	Zhengzhou	113.7	34.8

CNEMC			
1	110000041	116.17	40.29
2	110000244	116.43	39.95
3	110000245	116.43	39.87
4	110000246	116.4	39.98
5	110000247	116.47	39.97
6	110000249	116.22	39.93
7	110000250	116.36	39.94
8	110000251	116.32	39.99
9	110000252	116.37	39.87
10	110000253	116.72	40.14
11	110000254	116.64	40.39
12	110000255	116.23	40.2
13	440100051	113.24	23.14
14	440100057	113.26	23.13
15	440100063	113.28	23.16
16	440100064	113.26	23.1
17	440100073	113.32	23.14
18	440100088	113.35	23.09
19	440100089	113.43	23.1
20	440100090	113.35	22.95
21	440100091	113.21	23.39
22	440100092	113.57	23.28
23	442000051	113.38	22.52
24	442000052	113.39	22.55
25	442000053	113.41	22.51
26	131000402	116.68	39.52
27	131000403	116.77	39.57
28	131000407	116.71	39.56
29	131000408	116.75	39.53
30	410100051	113.64	34.75
31	410100052	113.6	34.75
32	410100053	113.68	34.75
33	410100054	113.64	34.77
34	410100062	113.68	34.8
35	410100063	113.56	34.8
36	410100064	113.73	34.72
37	410100065	113.73	34.72
38	420100051	114.28	30.62
39	420100052	114.15	30.48

40	420100053	114.25	30.55
41	420100054	114.3	30.55
42	420100055	114.37	30.57
43	420100056	114.43	30.61
44	420100057	114.3	30.59
45	420100075	114.39	30.48
46	420100076	114.21	30.64
47	320600073	120.86	32
48	320600074	120.87	32.02
49	320600077	120.94	31.93
50	320600078	120.81	32.04
51	320900401	120.12	33.4
52	320900402	120.16	33.39
53	320900403	120.13	33.37
54	320900406	120.22	33.39
55	310000051	121.4	31.24
56	310000052	121.54	31.27
57	310000053	121.48	31.2
58	310000055	121.47	31.3
59	310000056	121.43	31.23
60	310000057	121.41	31.17
61	310000058	121.53	31.23
62	310000059	121.58	31.21
63	310000251	121.7	31.19
64	510100051	104.05	30.66
65	510100052	104.03	30.65
66	510100054	104.12	30.64
67	510100064	104.07	30.68
68	510100073	104.08	30.57
69	510100074	104.18	30.69
70	510100075	103.97	30.71
71	120000051	117.15	39.1
72	120000062	117.14	39.17
73	120000072	117.18	39.12
74	120000081	117.19	39.17
75	120000095	117.24	39.11
76	120000100	117.27	39.13
77	120000104	117.2	39.09
78	120000137	117.46	38.84
79	120000143	117.71	39.03
80	120000168	117.31	39.09
81	120000186	117.18	39.23
82	120000301	117.4	39.12
83	120000302	117.76	39.16

84	650100051	87.6	43.77
85	650100055	87.58	43.83
86	650100056	87.55	43.87
87	650100071	87.64	43.83
88	650100072	87.42	43.87
89	650100091	87.64	43.96
Aerosol sites in China			
1	Beijing	116.371	39.974
2	Xinzhou	112.12	38.07
3	Nanjing	118.749	32.057
4	Wuhan	114.284	30.62
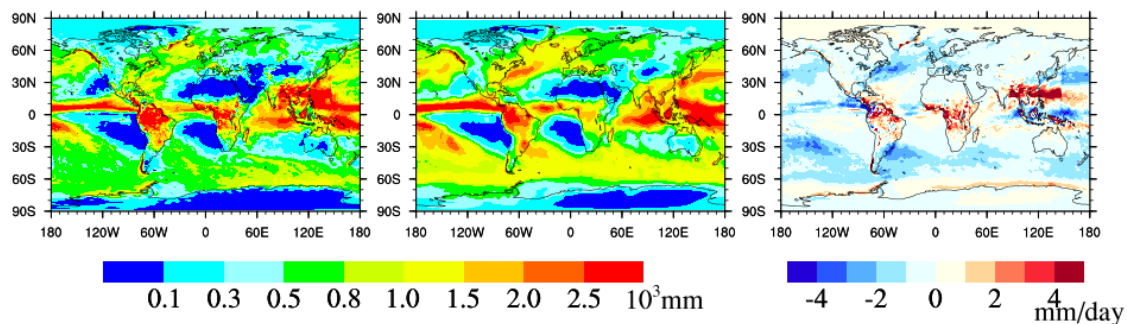
Fig. S1 Annual mean precipitation of WRF compared with GPCP data. The left column is WRF simulation (unit: mm), the middle column is GPCP reanalysis data (unit: mm), the right column is the difference between simulation and reanalysis (WRF-GPCP) (unit: mm day^{-1}).
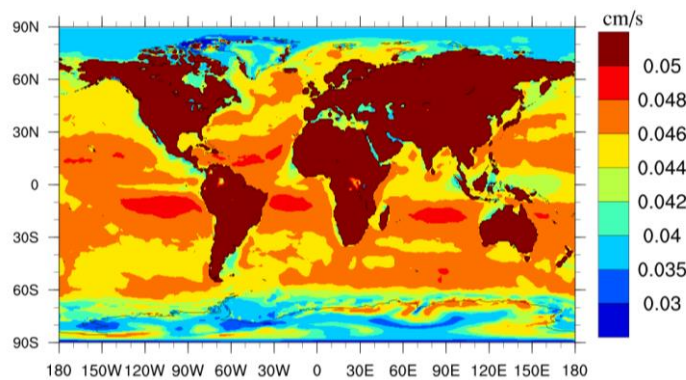
Fig. S2 Annual mean dry deposition velocity of ozone in IAP-AACM. The unit is cm s^{-1}.
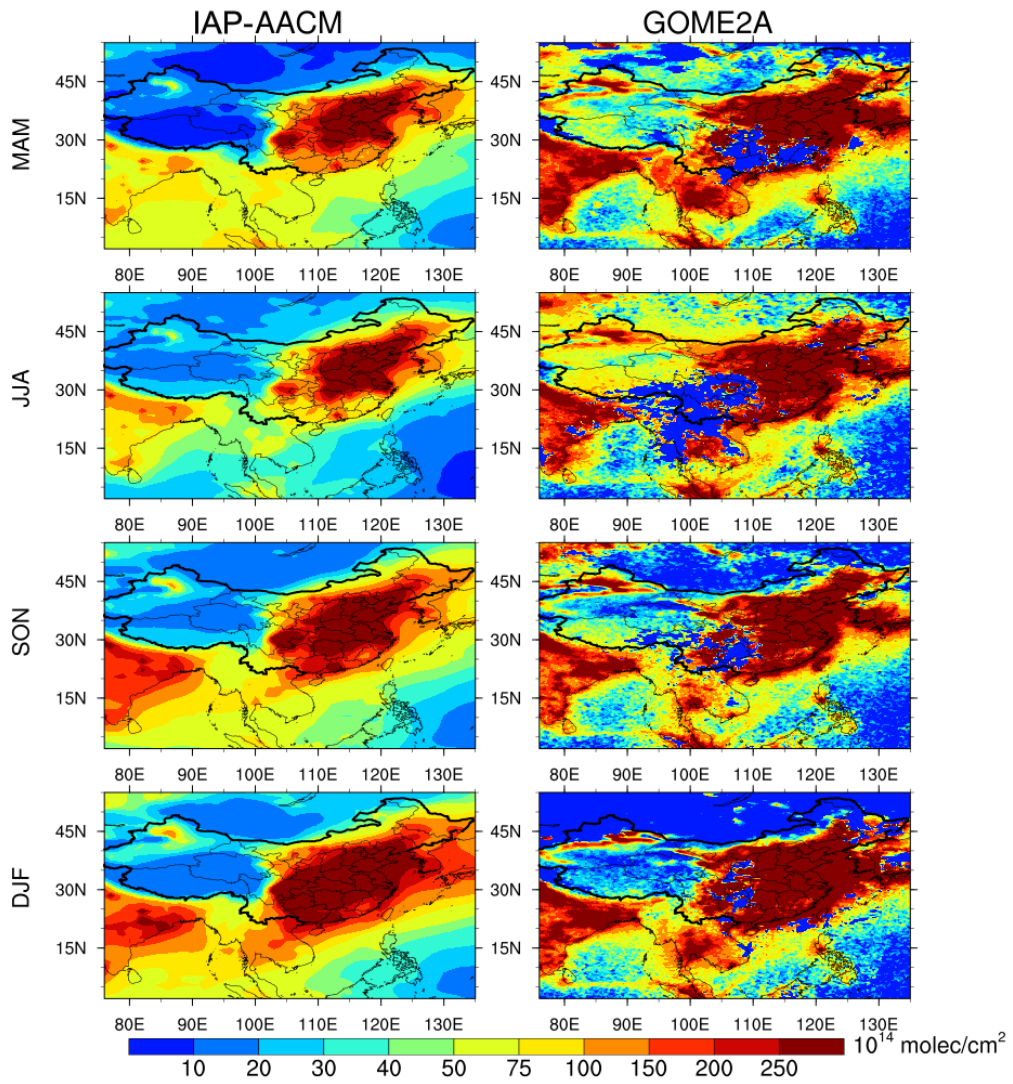
Fig. S3 Seasonal column concentration (10^{14} molecule cm^{-2}) of NO_2 in IAP-AACM and GOME-2A in China.