Supplement of Atmos. Chem. Phys., 18, 15581–15600, 2018
https://doi.org/10.5194/acp-18-15581-2018-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

Long-range transport impacts on surface aerosol concentrations and the contributions to haze events in China: an HTAP2 multi-model study

Xinyi Dong et al.

Correspondence to: Joshua S. Fu (jsfu@utk.edu)

1. Model evaluation

Evaluation statistics including mean bias (MB), coefficient of determination (R^2), and Normalized Mean Bias (NMB) for CO, SO_2, NH_3, NO_2, SO_4^{2-}, NO_3^-, and NH_4^+ are summarized in Table S1. Measurements from the EBAS and EANET dataset are used to validate the model performance in Europe and East Asia respectively. Both of them are averaged from daily frequency to monthly means to compromise with the model simulations. The number of stations that provide valid observation data is also listed to present the availability of the measurements, but it is important to realize that data from the stations falling into the same model grid is averaged first before comparing with model simulations.

Table S1 Evaluation statistics for model ensemble mean

Species	Model	Europe - EBAS			East Asia - EANET		
		MB	NMB	R^2	MB	NMB	R^2
CO	CAM-chem	-10.6 ppbv	-7.7%	0.4			
	CHASER	-8.8 ppbv	-6.4%	0.3			
	EMEP	2.5 ppbv	1.8%	0.5			
	GEOSCHEMADJOINT	-1.6 ppbv	-1.2%	0.5			
SO_2	CAM-chem	1.8 ppbv	114.7%	0.6	1.2 μg/m³	47.9%	0.9
	CHASER	1.9 ppbv	111.4%	0.5	0.6 μg/m³	22.8%	0.9
	EMEP	-0.5 ppbv	-31.6%	0.6	1.6 μg/m³	68.1%	0.9
	GEOS5	1.6 ppbv	95.9%	0.6	3.2 μg/m³	134.0%	0.9
	GEOSCHEMADJOINT	-0.6 ppbv	-36.5%	0.5	1.2 μg/m³	50.0%	0.9
	SPRINTARS	-0.6 ppbv	-36.2%	0.4	1.1 μg/m³	44.7%	0.9
NH_3	CAM-chem	-2.1 ppbv	-37.5%	0.7	-2.7 μg/m³	-74.1%	0.3
	CHASER	-1.2 ppbv	-20.5%	0.5	-2.4 μg/m³	-63.1%	0.3
	EMEP	-2.2 ppbv	-38.9%	0.8	-2.0 μg/m³	-52.3%	0.3
	GEOSCHEMADJOINT	0.1 ppbv	1.3%	0.7	-2.3 μg/m³	-58.9%	0.3
NO_2	CAM-chem	-37.2 ppbv	-85.3%	0.4	-11.1 μg/m³	-75.1%	0.8
	CHASER	-5.7 ppbv	-37.9%	0.2	-12.3 μg/m³	-83.9%	0.2
	EMEP	-7.9 ppbv	-52.9%	0.2	-8.5 μg/m³	-57.7%	0.8
	GEOSCHEMADJOINT	-34.6 ppbv	-79.3%	0.4	-11.9 μg/m³	-80.9%	0.8
SO_4^{2-}	CAM-chem	3.9 μg/m³	46.9%	0.5	1.0 μg/m³	28.4%	0.5
	CHASER	7.7 μg/m³	915.5%	0.7	1.7 μg/m³	44.4%	0.6
	EMEP	2.7 μg/m³	316.9%	0.3	-1.5 μg/m³	-41.3%	0.7
	GEOS5	2.2 μg/m³	261.9%	0.6	-1.6 μg/m³	-43.6%	0.7
	GEOSCHEMADJOINT	2.3 μg/m³	270.3%	0.6	-1.3 μg/m³	-35.7%	0.7
	SPRINTARS	2.9 μg/m³	350.6%	0.2	1.8 μg/m³	52.3%	0.3
NO_3^-	CHASER	9.5 μg/m³	110%	0.1	-0.7 μg/m³	-43.7%	0.5
	EMEP	0.6 μg/m³	22.6%	0.8	-0.1 μg/m³	-6.6%	0.6
	GEOSCHEMADJOINT	10.7 μg/m³	434.8%	0.7	0.2 μg/m³	15.0%	0.5
NH_4^+	CAM-chem	0.04 μg/m³	7.2%	0.2	0.62 μg/m³	61.4%	0.5
	CHASER	0.2 μg/m³	34.1%	0.3	0.8 μg/m³	76.2%	0.5
	EMEP	-0.3 μg/m³	-59.5%	0.2	-0.1 μg/m³	8.6%	0.7
	GEOSCHEMADJOINT	0.8 μg/m³	139.5%	0.2	1.3 μg/m³	120.6%	0.7

2. Anthropogenic emission

Emission data shown in Table S2 is collected from the Emissions Database for Global Atmospheric Research (EDGARv4.3.1). National scale emissions are summed up to estimate the total anthropogenic emission for each region defined by the HTAP2 experiment, as: EUR: the Organisation for Economic Co-operation and Development (OECD) members, and central Europe countries; RBU: Russia, Belarussia, and Ukraine; EAS: China, Mongolia, North Korea, South Korea, and Japan. The data for none methane VOC (NMVOC) is from anthropogenic activities only (e.g., residential sector, production of chemicals, solvent and other product use) and does not include the biogenic sector.

Table S2. Anthropogenic emissions in ERU and EAS (unit is Tg/year)

	EUR				RBU				EAS			
	2000	2008	2009	2010	2000	2008	2009	2010	2000	2008	2009	2010
SO_2	9.95	6.80	6.26	6.18	5.31	4.22	3.88	3.88	25.75	33.09	32.99	34.23
NH_3	6.04	5.71	5.65	5.61	2.75	2.66	2.48	2.47	11.85	14.13	14.45	14.77
NO_x	11.17	10.17	9.49	9.46	5.73	5.34	4.96	4.83	19.58	27.81	28.23	29.01
BC	0.31	0.26	0.25	0.24	0.06	0.05	0.05	0.05	1.20	1.57	1.59	1.67
OC	0.47	0.43	0.43	0.45	0.19	0.16	0.14	0.13	3.30	3.75	3.81	3.98
NMVOC	8.00	5.57	5.26	5.03	4.36	4.84	4.66	4.53	13.61	17.76	17.96	18.78
PM	2.54	2.46	2.41	2.49	0.98	1.00	0.92	0.87	15.29	18.87	19.25	20.11

3. NCDC observations and haze events in China

The locations of the NCDC observation stations in China are shown in Fig.S1(a). Daily visibility and relatively humidity data is collected from a total of 473 NCDC stations to identify the location and time period of haze events. The number of haze days at each station are then mapped into the models grid to mark the haze existence and assist the analysis of model data. Fig.S1(b) shows the NCDC identified haze days mapped into the SPRINTARS model grid at 1.1°×1.1°. The NCDC observations suggested that majority of the haze events occurred in the central, northeast, and southeast part of China at above 105°E longitude areas.

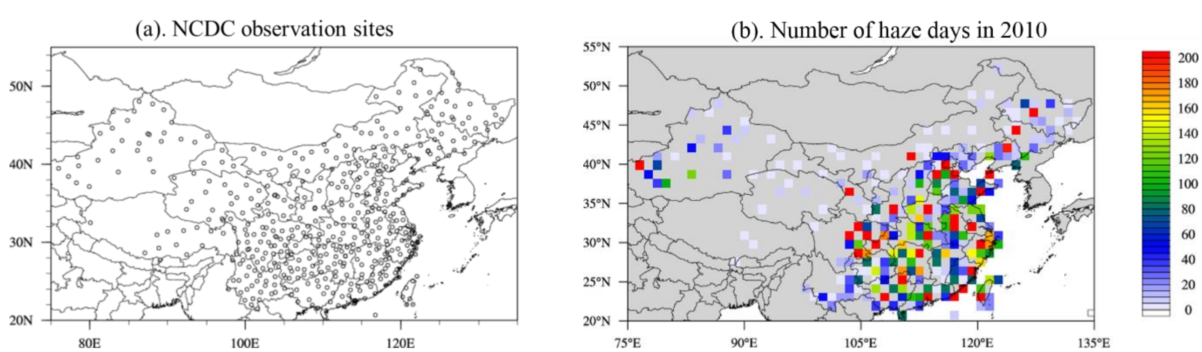

Figure S1. (a) Locations of the NCDC stations; (b) Number of haze days identified with NCDC observation and mapped into the SPRINTARS model grid.