Supplementary Materials

Response of PM$_{2.5}$ chemical composition to the variation of anthropogenic emission and meteorological conditions during COVID-19 lockdown

5 YitianGong[1], HaijunZhou[1,2,3*], Xi Chun[1,2,3], ZhiqiangWan[1,2,3], Jingwen Wang[1], Chun Liu[1]

[1]College of Geographical Sciences, Inner Mongolia Normal University, Hohhot 010022, China

[2]Provincial Key Laboratory of Mongolian Plateau's Climate System, Inner Mongolia Normal University, Hohhot 010022, China

[3]Inner Mongolia Repair Engineering Laboratory of Wetland Eco-environment System, Inner Mongolia

10 Normal University, Hohhot 010022, China

Correspondence to: Haijun Zhou (hjzhou@imnu.edu.cn)

Text S1: Data Analysis

The calculations for organic matter (OM), sulfur oxidation rate (SOR), nitrogen oxidation rate (NOR), and secondary organic carbon (SOC) were performed using the following formulas:

$$OM = OC \times 1.6 \tag{1}$$

$$SOR = (SO_4^{2-})/(SO_4^{2-}) + (SO_2) \tag{2}$$

$$NOR = (NO_3^-)/(NO_3^-) + (NO_2) \tag{3}$$

$$SOC = OC - (OC/EC)_{min} \times EC \tag{4}$$

where OM, SOR, NOR, and SOC represent organic matter, sulfur oxidation rate, nitrogen oxidation rate, and secondary organic carbon, respectively.

The contribution rates of anthropogenic emissions and meteorological conditions were calculated using Formulas 5 and 6.

$$Contribution_{meteorology}(\%) = \frac{C_{observed} - C_{deweathered}}{C_{observed}} \times 100\% \tag{5}$$

$$Contribution_{emission}(\%) = 1 - Contribution_{meteorology} \tag{6}$$
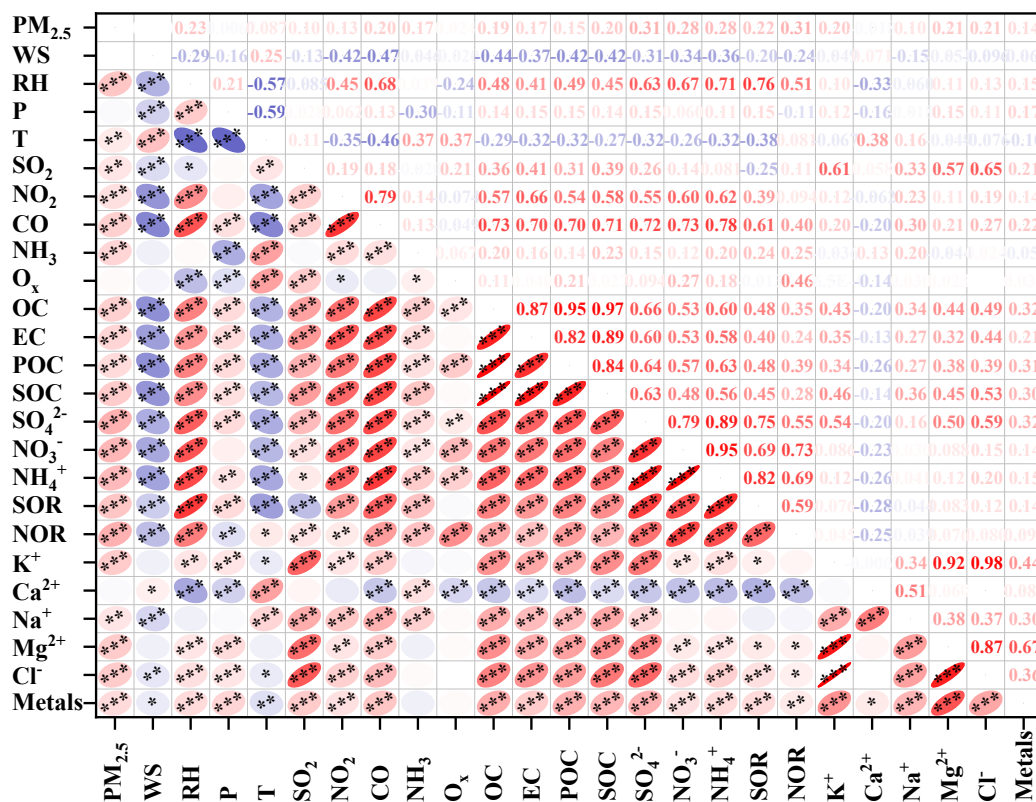
Figure S1. Correlation of aerosol compositions with gaseous pollutants and

meteorological variables during observation. (* represent p<=0.05, **represent p<=0.01,***represent p<=0.001)
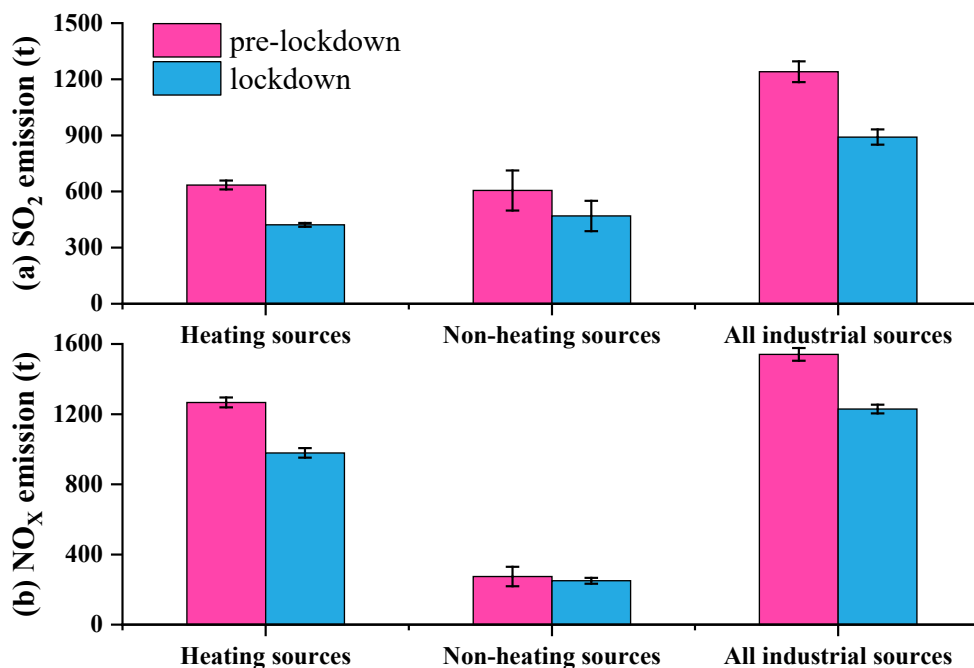
Figure S2. Comparison of (a) SO$_2$ and (b) NO$_X$ emissions in different periods
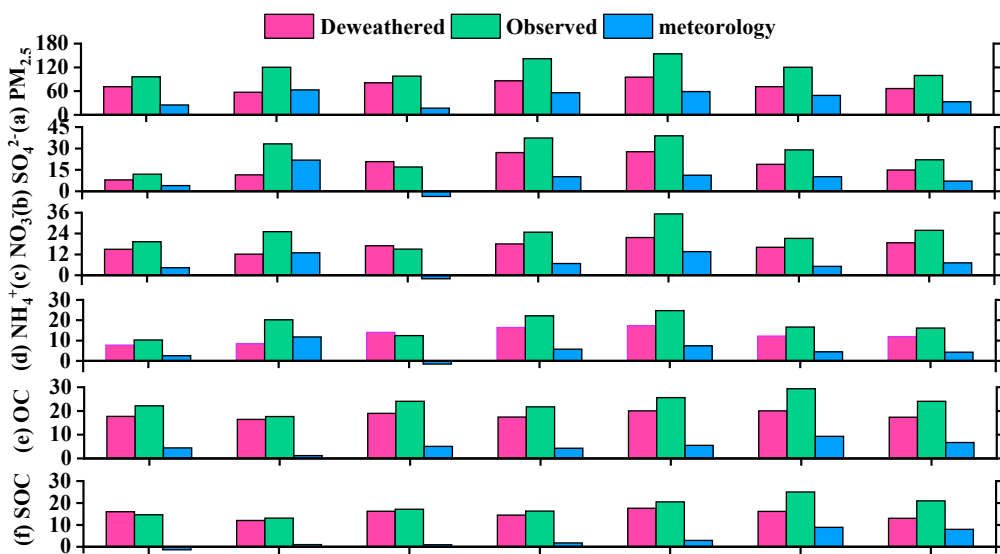
Figure S3. The contribution of anthropogenic emission and meteorological conditions to (a) PM$_{2.5}$, (b) SO$_4^{2-}$, (c) NO$_3^-$, (d) NH$_4^+$, (e) OC, and (f) SOC during the pollution episodes.

Table S1. Diagnostic index of random forest model

pollutants	dataset	RMSE	R	FAC2	MB	MGE	NMB	NMGE	COE	IOA
$PM_{2.5}$	Test data	18.36	0.89	0.73	0.25	12.23	0.01	0.35	0.57	0.79
	Training	16.63	0.91	0.75	0.00	11.01	0.00	0.32	0.61	0.80
SO_4^{2-}	Test data	4.13	0.92	0.75	0.03	1.90	0.01	0.33	0.66	0.83
	Training	3.12	0.95	0.76	-0.01	1.63	0.00	0.29	0.70	0.85
NO_3^-	Test data	2.58	0.95	0.65	0.01	1.63	0.01	0.30	0.71	0.85
	Training	2.24	0.96	0.65	0.00	1.53	0.00	0.28	0.72	0.86
NH_4^+	Test data	1.88	0.95	0.71	0.03	1.11	0.01	0.29	0.71	0.85
	Training	1.54	0.97	0.73	-0.01	0.99	0.00	0.26	0.74	0.87
SOC	Test data	5.34	0.71	0.98	-0.02	1.86	0.00	0.24	0.60	0.80
	Training	2.67	0.92	0.99	0.02	1.44	0.00	0.19	0.68	0.84
OC	Test data	3.79	0.88	0.97	0.19	2.17	0.02	0.25	0.61	0.81
	Training	3.57	0.91	0.97	0.01	1.83	0.00	0.21	0.69	0.84
SO_2	Test data	5.44	0.85	0.76	0.03	3.34	0.00	0.36	0.55	0.78
	Training	4.47	0.89	0.77	0.02	2.89	0.00	0.32	0.60	0.80
NO_2	Test data	9.79	0.88	0.90	-0.30	7.11	-0.01	0.26	0.58	0.79
	Training	8.27	0.91	0.91	-0.01	6.03	0.00	0.22	0.64	0.82
O_3	Test data	15.52	0.93	0.95	-0.17	11.94	0.00	0.15	0.66	0.83
	Training	14.39	0.95	0.96	0.04	11.05	0.00	0.14	0.69	0.84
CO	Test data	0.24	0.91	0.96	0.00	0.17	0.00	0.22	0.61	0.81
	Training	0.22	0.93	0.96	0.00	0.15	0.00	0.20	0.65	0.82

Table S2. Variations of chemical compositions in PM$_{2.5}$ at different pollution levels

category	PM$_{2.5}$	SO$_4^{2-}$	NO$_3^-$	NH$_4^+$	OC	EC	POC	SOC	SO$_2$	NO$_2$	CO	O$_3$	T	WS	RH	P
0-35	20.0	3.7	3.3	2.4	8.8	1.0	1.6	7.1	12.2	20.8	0.7	93	-5.7	2.3	50	895
36-75	53.0	9.1	9.7	6.5	17.7	2.2	3.7	14.0	18.9	38.3	1.3	77	-5.1	1.6	59	894
76-115	89.4	17.1	18.2	12.1	22.4	2.8	4.9	17.5	24.4	45.8	1.7	79	-7.7	1.2	65	896
116-150	134.3	36.2	26.5	22.0	26.7	2.6	4.4	22.3	12.9	41.5	1.9	74	-8.9	1.0	79	894
> 150	179.9	46.2	31.9	26.3	27.4	3.7	6.4	21.1	21.9	58.8	2.3	54	-10.6	1.1	75	895
pre-lockdown	89.4	20.1	17.2	13.1	20.9	2.8	4.9	16.0	20.5	49.2	1.7	63	-9.8	1.4	65	895
lockdown	58.3	12.8	10.4	7.7	17.5	1.3	2.2	15.3	17.7	24.9	1.2	106	-4.5	1.8	54	895

40