

Analysis and simulation of PM_{2.5} pollution characteristics under the influence of the New Year's Day effect

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Table S1 Validation of simulation results of PM_{2.5} in 22 cities before and after New Year's Day in 2022. (OBS: observed value, MEAN: average of simulated and observed values, NMB: the normalized mean bias, NME: the normalized mean error, R: Pearson correlation coefficient [1], Case16/Case17: model simulation using MECI emission inventory from 2016/2017).

City	MEAN			NMB		NME		R	
	OBS	Case16	Case17	Case16	Case17	Case16	Case17	Case16	Case17
Beijing	26.7	62.7	34.8	134.60%	30.20%	143.50%	20.70%	0.85	0.82
Hangzhou	65.9	75.5	32.1	14.50%	-51.20%	38.70%	45.20%	0.75	0.68
Jinan	69.1	67.9	38.1	-1.70%	-44.90%	37.90%	48.70%	0.55	0.51
Nanjing	63.1	75.9	49.1	14.90%	-22.30%	24.80%	26.20%	0.83	0.7
Shijiazhuang	45.5	92.5	48.9	103.10%	7.40%	117.80%	18.80%	0.64	0.62
Tianjin	36.2	75.5	39.7	108.90%	9.90%	116.60%	14.50%	0.82	0.86
Zhengzhou	102.2	117.3	55.7	14.90%	-45.50%	33.20%	40.80%	0.66	0.55
Nanyang	118.6	115	53.2	-2.40%	-54.80%	26.40%	55.00%	0.79	0.69
Jiaozuo	76.4	67.8	37.5	-10.70%	-50.60%	28.50%	51.50%	0.77	0.64
Xiangyang	117.1	113.5	65.1	-2.50%	-44.00%	23.50%	44.70%	0.8	0.74
Laiocheng	94.6	100.1	50.9	6.50%	-45.90%	27.90%	47.30%	0.63	0.64
Fuzhou	33	25.1	15.1	-23.90%	-54.10%	46.60%	74.10%	0.46	0.35
Hefei	76.5	90.1	61.8	14.30%	-19.20%	27.20%	24.70%	0.91	0.67
Nanchang	86.1	99.7	42.6	14.20%	-50.50%	20.70%	62.40%	0.82	0.12
Shanghai	51	37.9	19.2	-25.70%	-62.30%	37.50%	84.50%	0.7	0.73
Taiyuan	62.9	79.6	36.4	23.60%	-42.10%	29.10%	49.20%	0.85	0.54
Wuhan	88.1	108.2	61.9	37.50%	-29.80%	33.00%	26.90%	0.84	0.44
Luoyang	78.6	89.3	46.6	14.30%	-40.40%	33.20%	40.60%	0.8	0.82
Xinyang	100.9	113.5	47.2	13.10%	-53.00%	31.50%	54.00%	0.72	0.7
Luohe	130.6	127.2	58.3	-2.00%	-55.10%	22.30%	55.50%	0.81	0.66
Jingzhou	114.7	116.2	60.4	1.90%	-47.00%	27.70%	47.50%	0.69	0.53
Heze	114.5	122.5	51.5	7.60%	-54.80%	31.60%	55.20%	0.58	0.57

Table S2 Validation of meteorological simulation results for 12 cities before and after New Year's Day in 2022. (Among them, T: temperature, R: relative humidity, WS: wind speed, WD: wind direction, P: air pressure, MP: meteorological parameters, OBS: the observed average, MOD: the model simulation average, MB: the average deviation, ME: the average error, RMSE: the root mean square error, R: the Pearson correlation coefficient).

MP	City	OBS	MOD	MB	ME	RMSE	R
T(°C)	Jinan	2.93	0.72	-2.10	2.57	2.86	0.86
	Taiyuan	-3.70	-3.66	0.04	1.43	1.83	0.93
	Zhengzhou	3.52	2.48	-1.05	1.63	2.29	0.86
	Luoyang	2.43	2.31	-0.12	1.52	1.98	0.86
	Nanyang	3.88	4.63	0.75	1.63	1.93	0.89
	Xinyang	5.21	5.09	-0.12	1.83	2.19	0.85
	Jiaozuo	1.57	0.65	-0.92	1.47	1.93	0.89
	Luohe	2.78	3.87	1.09	1.67	2.11	0.91
	Xiangyang	4.91	5.76	0.85	1.51	2.02	0.88
	Jingzhou	6.48	7.91	1.43	1.78	2.14	0.91
	Liaocheng	1.04	1.15	0.11	1.06	1.34	0.93
	Heze	2.14	2.29	0.16	1.49	1.73	0.89
RH(%)	Jinan	41.84	45.63	3.79	5.74	9.05	0.87
	Taiyuan	46.22	44.97	-1.25	9.48	11.92	0.79
	Zhengzhou	50.84	48.51	-2.33	5.83	7.96	0.96
	Luoyang	50.36	45.80	-4.55	6.03	7.96	0.97
	Nanyang	57.68	47.83	-9.84	11.39	13.99	0.93
	Xinyang	61.32	46.75	-14.57	15.78	19.09	0.90
	Jiaozuo	52.05	44.43	-7.61	9.85	12.54	0.88
	Luohe	66.02	51.08	-14.94	15.59	20.54	0.87
	Xiangyang	62.90	48.08	-14.83	17.52	22.20	0.79
	Jingzhou	75.21	50.69	-24.52	24.57	32.26	0.72
	Liaocheng	60.49	54.85	-5.64	8.49	11.79	0.87
	Heze	64.61	57.77	-6.83	8.96	11.59	0.93
WS(m/s)	Jinan	1.85	2.19	0.34	0.72	1.14	0.59
	Taiyuan	1.27	1.41	0.14	0.41	0.67	0.83
	Zhengzhou	0.54	1.10	0.56	0.77	1.08	0.83
	Luoyang	2.96	2.96	0.00	0.46	0.67	0.86
	Nanyang	2.61	2.83	0.22	0.56	0.75	0.84
	Xinyang	5.53	2.90	-2.63	2.80	3.39	0.65
	Jiaozuo	2.04	2.27	0.23	0.40	0.67	0.79
	Luohe	1.86	1.96	0.10	0.43	0.62	0.81
	Xiangyang	1.09	1.37	0.28	0.43	0.67	0.78
	Jingzhou	1.41	1.58	0.17	0.33	0.45	0.93
	Liaocheng	1.63	1.67	0.04	0.32	0.40	0.93
	Heze	1.75	2.13	0.38	0.53	0.71	0.84
WD(°)	Jinan	177.94	147.07	-24.52	61.52	96.32	0.50
	Taiyuan	148.82	199.46	50.63	94.49	113.98	0.40
	Zhengzhou	163.72	182.99	19.27	55.65	94.03	0.71
	Luoyang	153.67	184.13	30.46	47.88	69.60	0.84
	Nanyang	126.14	91.72	-34.43	77.35	129.69	0.29
	Xinyang	210.09	230.93	20.84	63.92	101.08	0.69
	Jiaozuo	218.06	210.08	-7.97	68.85	121.06	0.46
	Luohe	239.63	207.97	-31.65	85.39	137.79	0.42
	Xiangyang	132.96	140.81	7.85	136.00	189.28	0.31

	Jingzhou	78.21	105.33	27.12	74.08	125.82	0.36
	Liaocheng	140.19	138.60	-1.59	77.93	130.42	0.34
	Heze	104.96	107.97	3.00	45.27	88.60	0.48
P(hPa)	Jinan	1029.6	1029.8	0.12	0.11	0.12	0.94
	Taiyuan	1031.4	1032.7	0.13	0.13	0.16	0.96
	Zhengzhou	1029.3	1028.3	-0.10	0.11	0.15	0.90
	Luoyang	1029.4	1029.2	-0.02	0.08	0.11	0.92
	Nanyang	1028.8	1029.0	0.01	0.06	0.08	0.96
	Xinyang	1028.2	1028.4	0.02	0.08	0.10	0.95
	Jiaozuo	1029.5	1028.4	-0.11	0.12	0.16	0.91
	Luohe	1028.7	1027.6	-0.11	0.12	0.16	0.93
	Xiangyang	1028.5	1027.4	-0.11	0.11	0.14	0.97
	Jingzhou	1027.4	1026.4	-0.10	0.10	0.13	0.97
	Liaocheng	1029.4	1028.6	-0.08	0.09	0.12	0.94
	Heze	1029.4	1028.1	-0.13	0.13	0.16	0.94

Table S3 Changes in meteorological parameters such as temperature (T), relative humidity (R), wind speed (WS), wind direction (WD), and air pressure (P) during and around New Year's Day. MP: Meteorological parameters, BNY: Before the New Year's Day holiday. DNY: During the New Year's Day holiday. ANY: After the New Year's Day holiday.

MP	City	BNY	DNY	ANY	City	BNY	DNY	ANY
T(°C)	Jinan	3.01	3.43	2.30	Taiyaun	-3.83	-4.36	-2.57
	Zhengzhou	4.59	4.07	1.63	Luoyang	3.43	3.37	0.02
	Nanyang	4.28	4.10	3.16	Xinyang	5.31	6.43	3.29
	Jiaozuo	3.16	1.54	0.02	Luohe	2.45	3.41	2.18
	Xiangyang	4.06	5.70	4.59	Jingzhou	5.78	6.90	6.54
	Liaocheng	0.56	1.72	0.50	Heze	1.83	3.08	1.02
RH(%)	Jinan	31.31	42.02	56.50	Taiyaun	40.69	47.81	49.38
	Zhengzhou	31.00	42.55	83.13	Luoyang	28.62	42.21	84.31
	Nanyang	43.31	51.50	81.31	Xinyang	46.69	53.13	88.25
	Jiaozuo	37.93	49.16	70.49	Luohe	48.86	60.11	92.05
	Xiangyang	53.96	56.16	81.97	Jingzhou	68.82	71.71	86.86
	Liaocheng	53.87	52.39	79.26	Heze	52.19	56.00	89.94
WS(m/s)	Jinan	2.18	2.49	1.16	Taiyaun	1.41	1.31	1.07
	Zhengzhou	0.51	0.71	0.33	Luoyang	2.50	3.39	2.77
	Nanyang	1.90	2.58	3.37	Xinyang	3.69	4.60	8.78
	Jiaozuo	2.32	2.04	1.74	Luohe	1.46	1.79	2.38
	Xiangyang	0.82	0.83	1.75	Jingzhou	0.77	1.10	2.51
	Liaocheng	1.53	2.00	1.17	Heze	1.42	2.03	1.68
WD(°)	Jinan	180.12	166.82	185.56	Taiyaun	167.13	153.67	123.25
	Zhengzhou	204.23	168.34	116.38	Luoyang	238.10	168.14	47.52
	Nanyang	181.04	137.06	55.06	Xinyang	180.44	179.50	285.63
	Jiaozuo	236.75	216.68	201.64	Luohe	168.14	228.42	327.91
	Xiangyang	135.28	136.54	125.39	Jingzhou	80.49	114.81	21.02
	Liaocheng	160.75	108.31	167.49	Heze	150.81	104.46	59.88
P(hPa)	Jinan	1031.8	1028.2	1029.7	Taiyaun	1034.6	1030.6	1029.3
	Zhengzhou	1031.7	1027.5	1029.5	Luoyang	1032.3	1027.6	1029.1
	Nanyang	1032.2	1027.3	1027.8	Xinyang	1031.9	1026.8	1026.6
	Jiaozuo	1031.0	1028.0	1030.0	Luohe	1032.1	1027.1	1027.6
	Xiangyang	1032.3	1027.1	1026.6	Jingzhou	1031.3	1026.5	1024.9
	Liaocheng	1031.5	1027.8	1029.5	Heze	1032.1	1027.7	1029.2

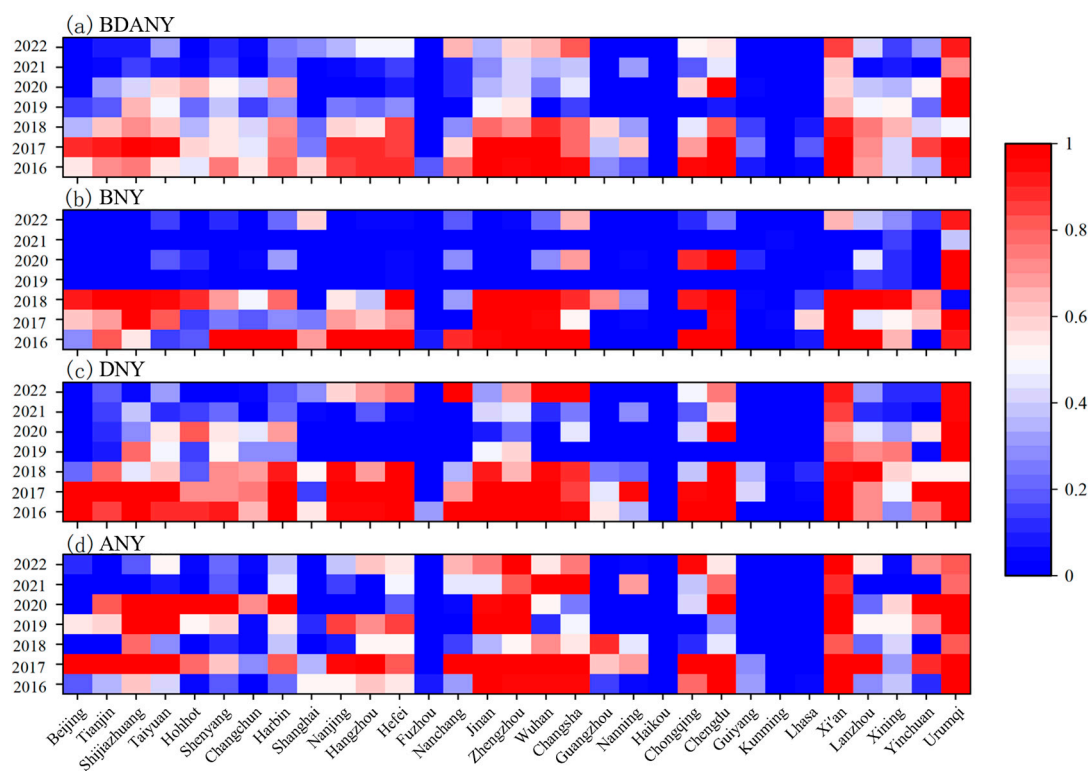


Figure S1 The exceeding rate of $PM_{2.5}$ concentration in 31 administrative cities across the country during and before New Year's Day.

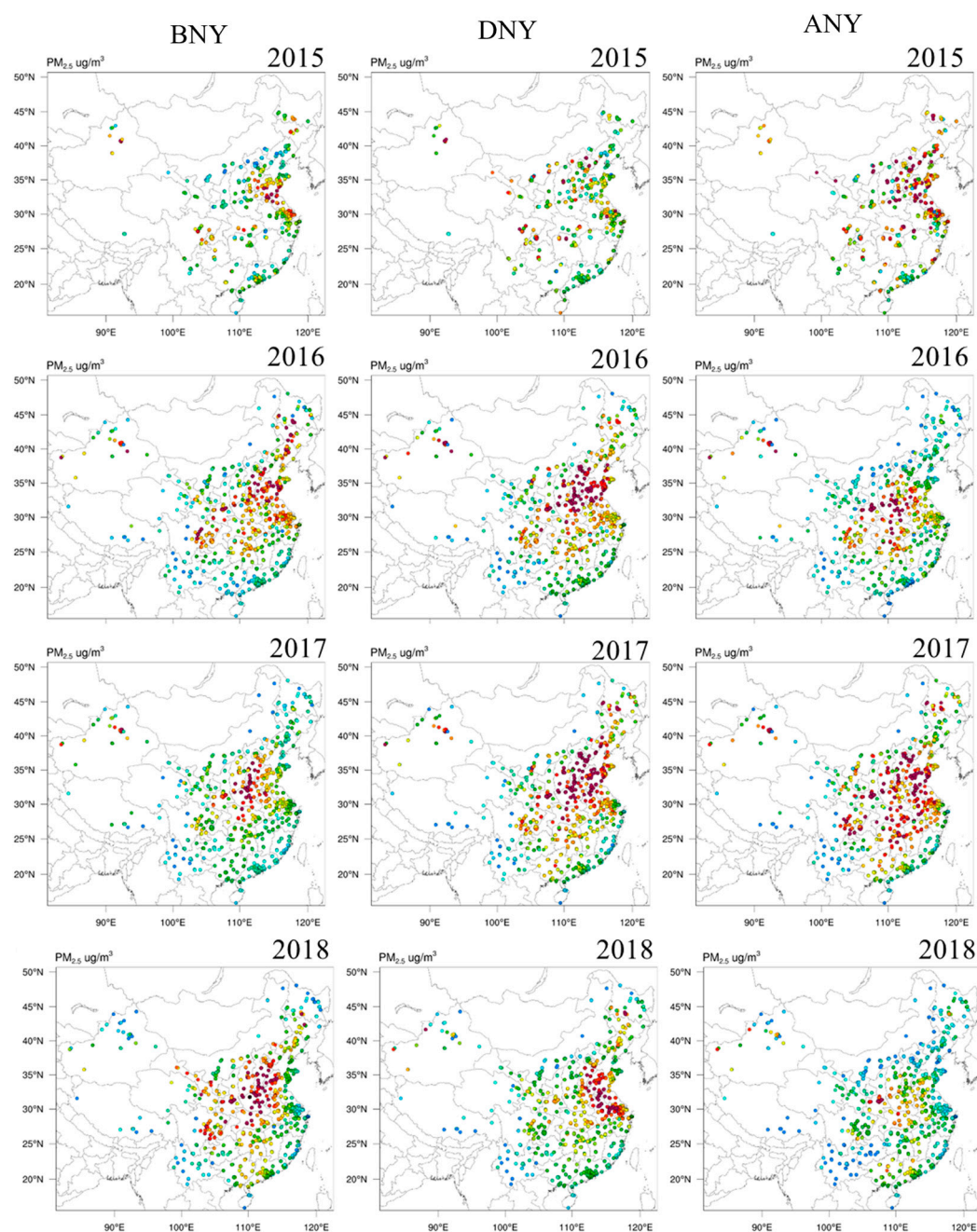


Figure S2 The spatial distribution of $PM_{2.5}$ pollutant mass concentration during the New Year's Day period from 2015 to 2018 nationwide. BNY: Before the New Year's Day holiday. DNY: During the New Year's Day holiday. ANY: After the New Year's Day holiday.

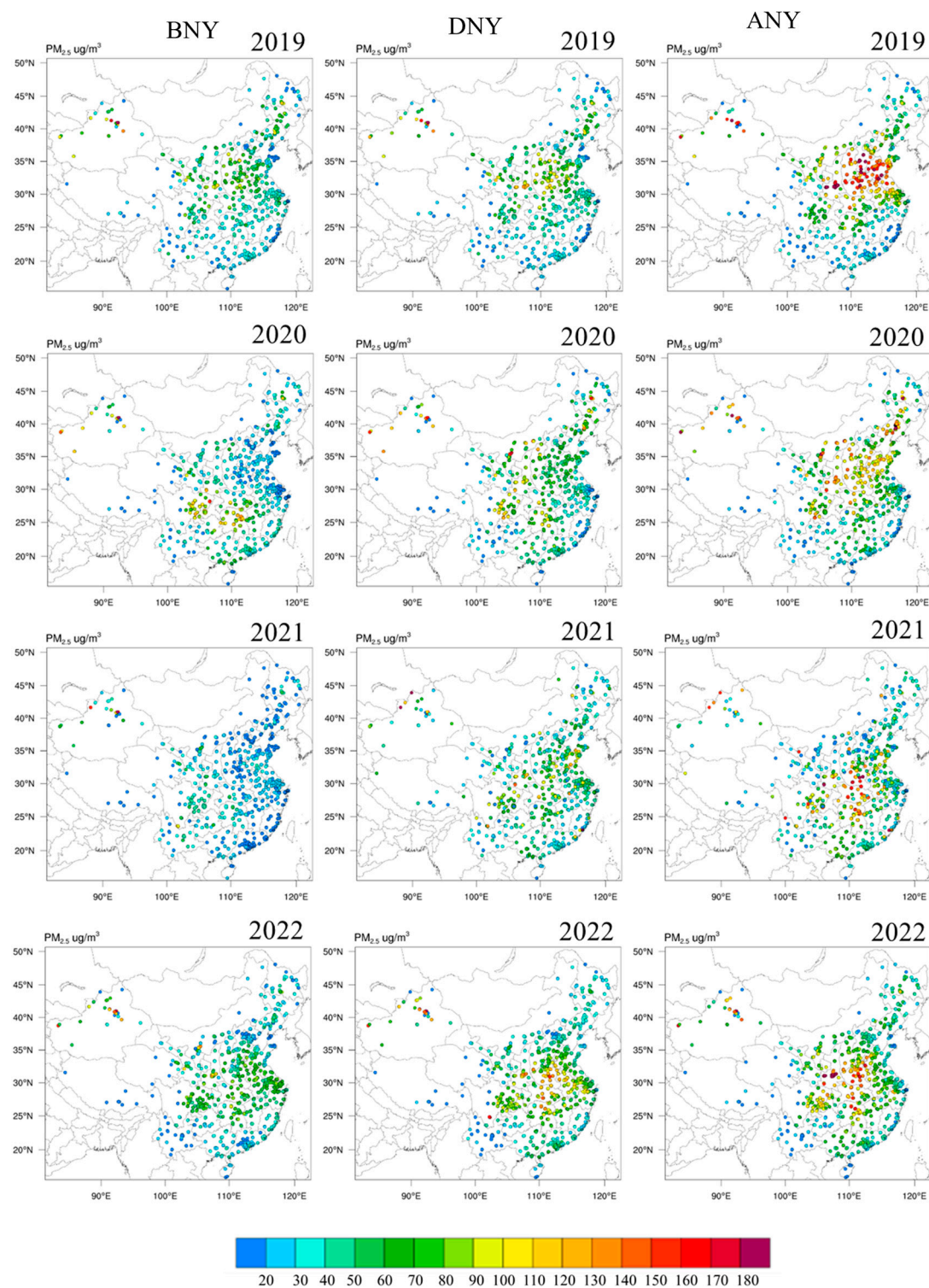


Figure S3 The spatial distribution of $PM_{2.5}$ pollutant mass concentration during the New Year's Day period from 2019 to 2022 nationwide. BNY: Before the New Year's Day holiday. DNY: During the New Year's Day holiday. ANY: After the New Year's Day holiday.

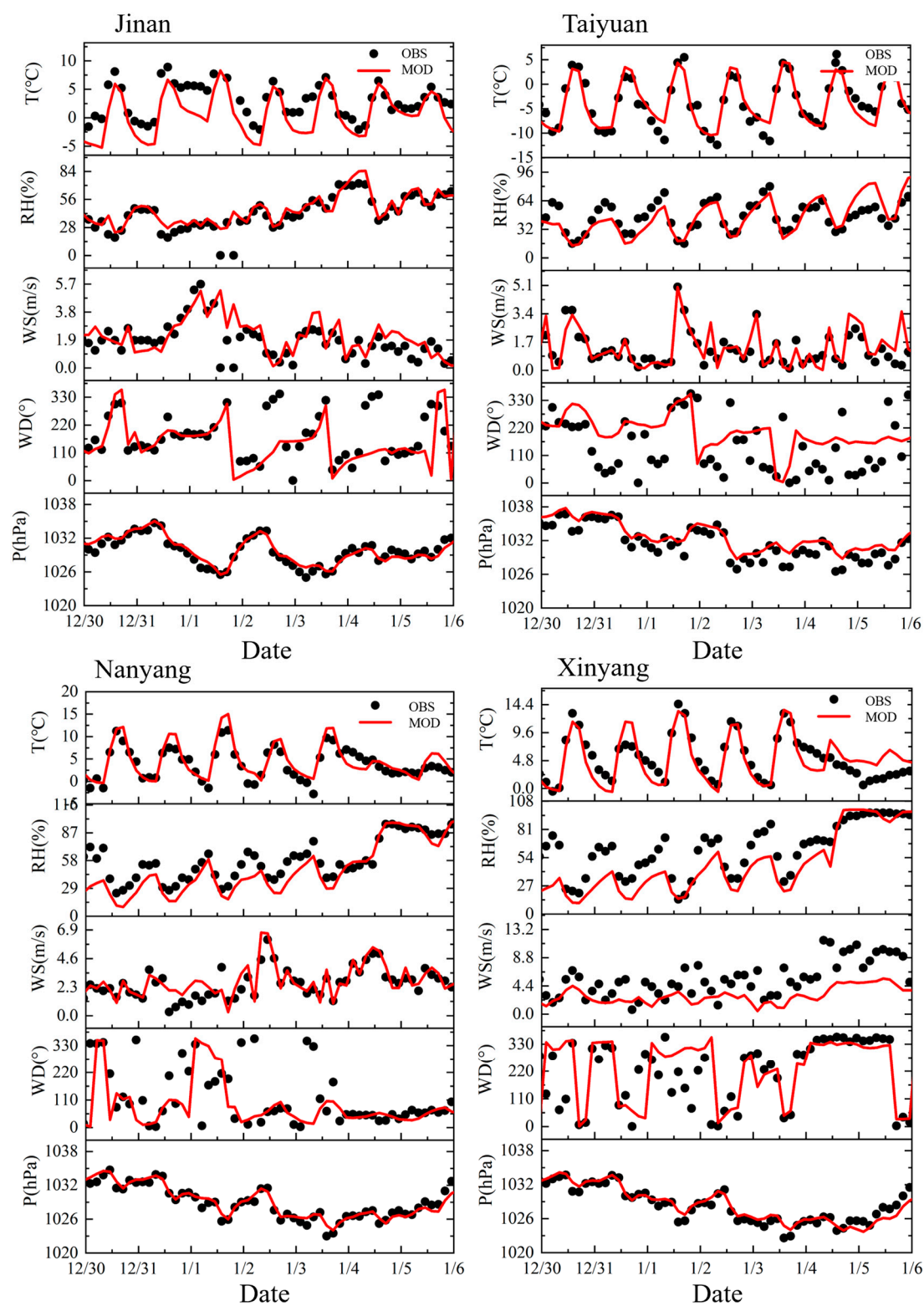


Figure S4 The time series comparison of simulated and observed meteorological parameters for Jinan, Taiyuan, Nanyang and Xinyang.

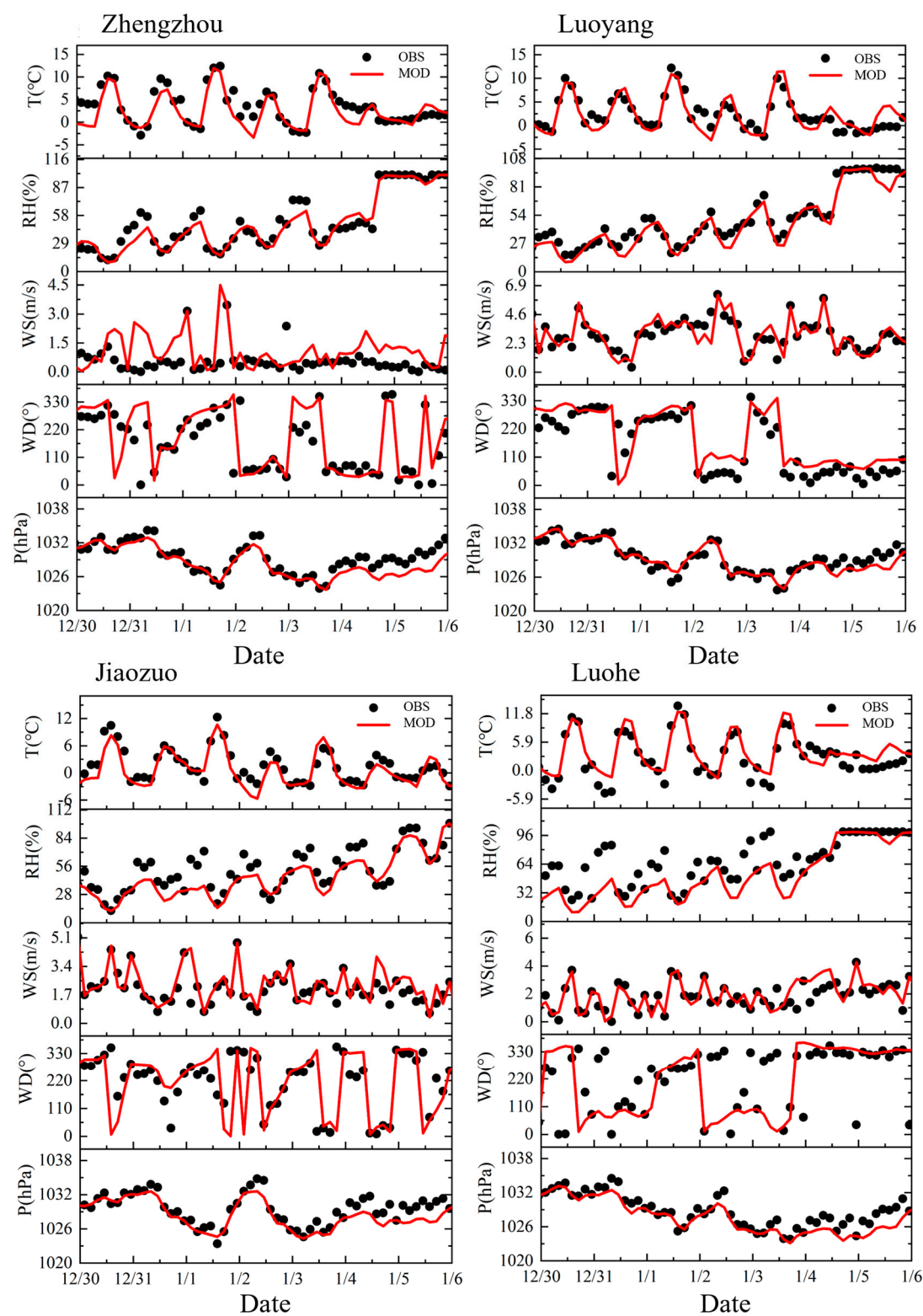


Figure S5 The time series comparison of simulated and observed meteorological parameters for Zhengzhou, Luoyang, Jiaozuo and Luohe.

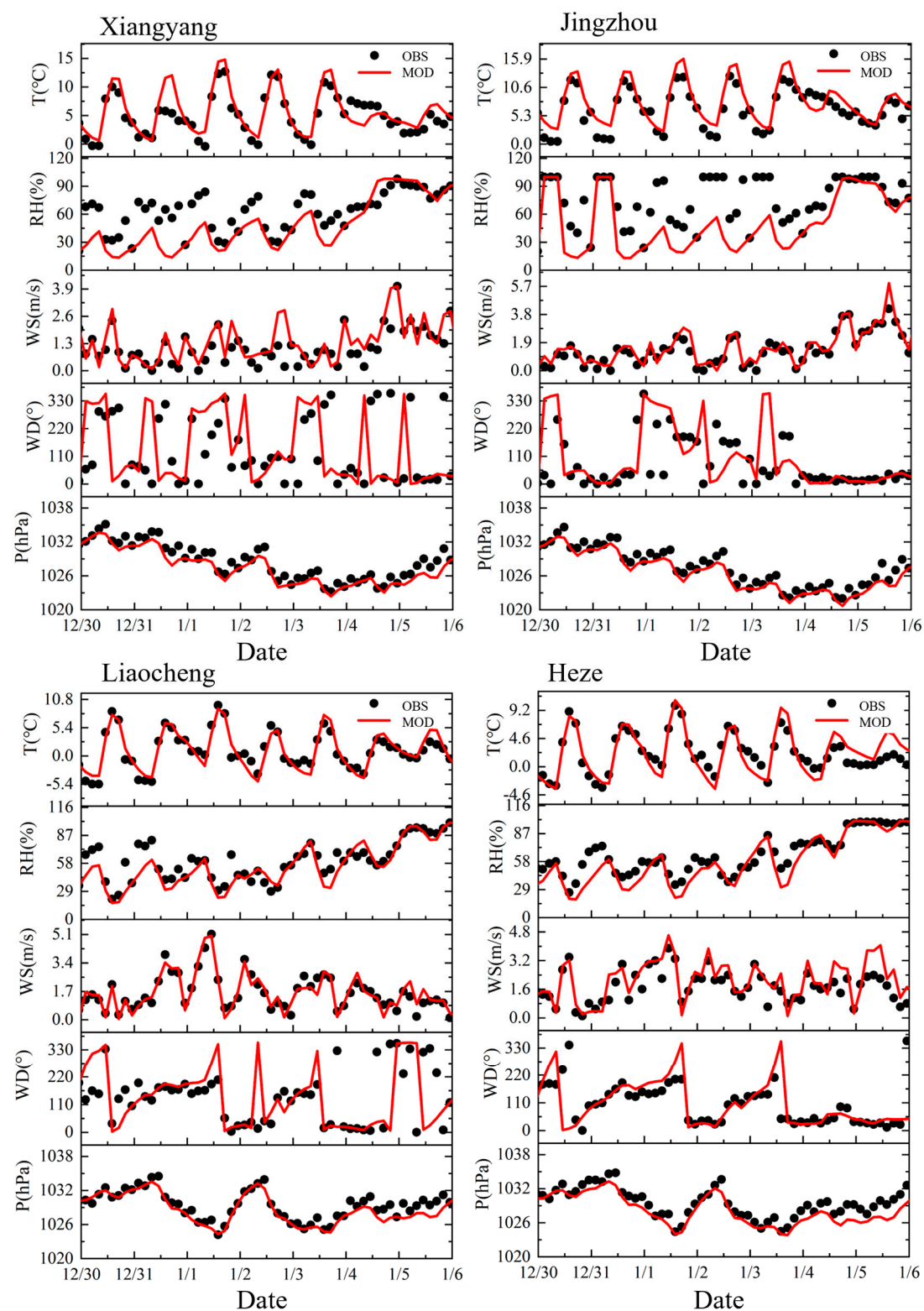


Figure S6 The time series comparison of simulated and observed meteorological parameters for Xiangyang, Jingzhou, Liaocheng and Heze.

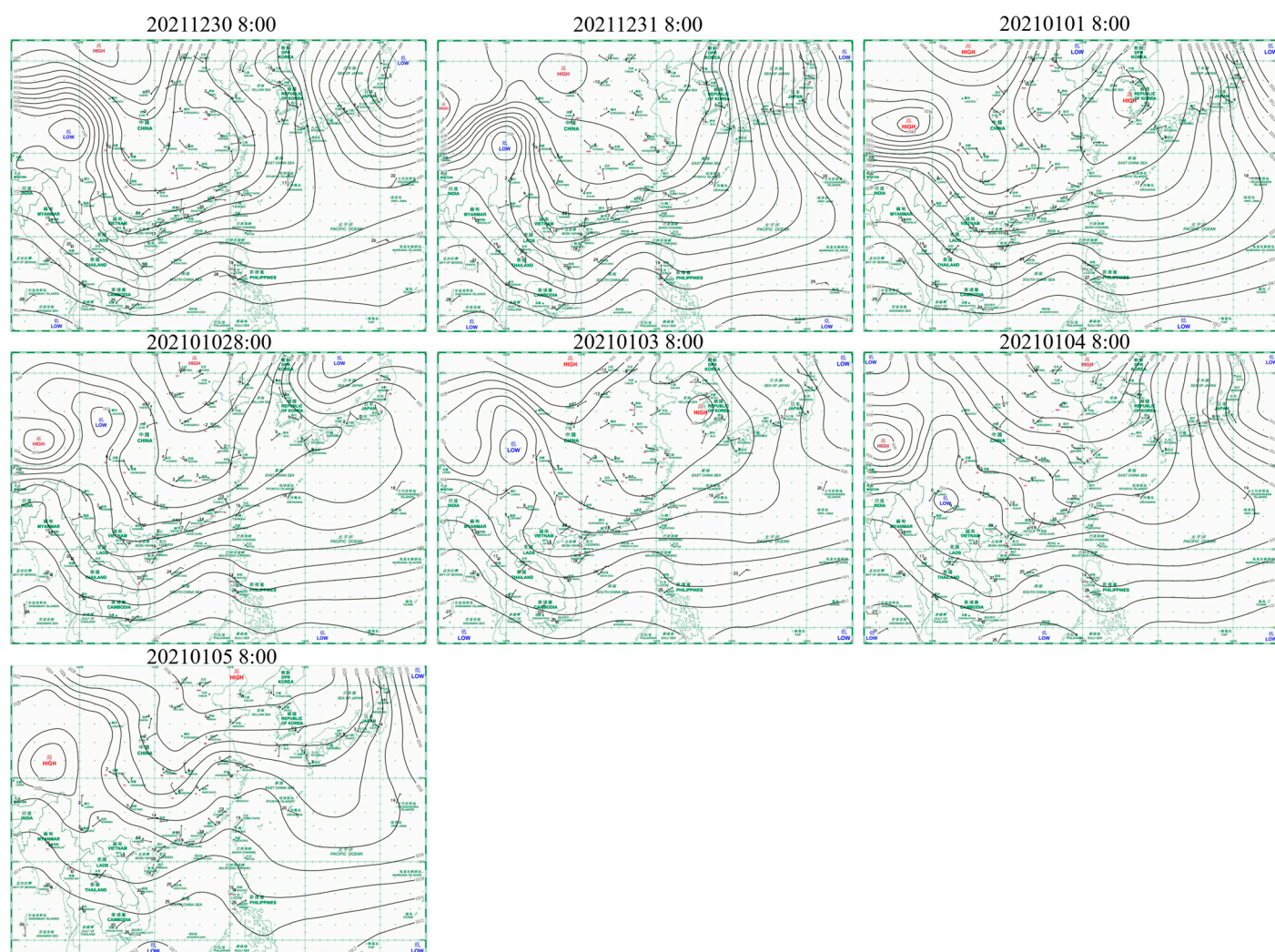


Figure S7 Evolution of near surface sea level isobars from December 30, 2021 to January 5, 2022.

References

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1. Yu, S.; Eder, B.; Dennis, R.; Chu, S.H.; Schwartz, S.E. New unbiased symmetric metrics for evaluation of air quality models. *Atmospheric Science Letters* **2006**, *7*, 26–34, doi:10.1002/asl.125.