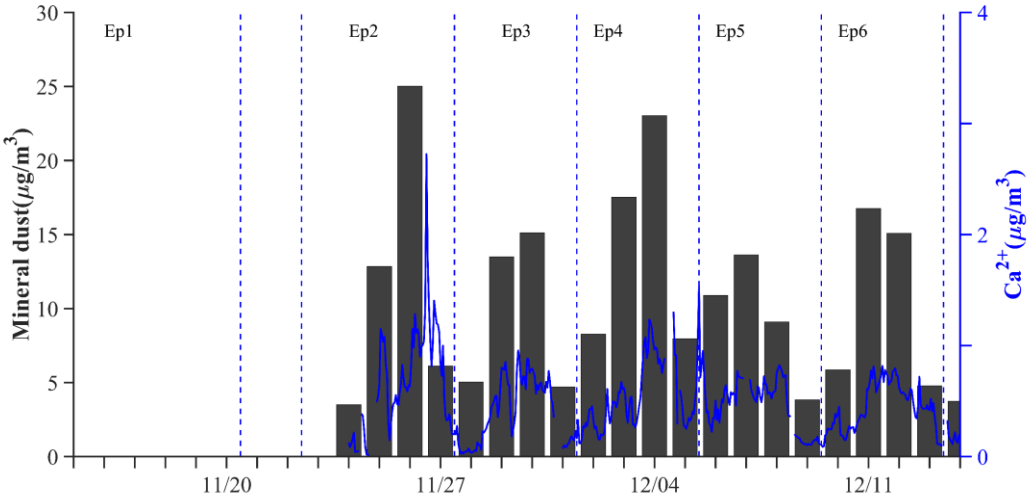

Figure S1. Concentration of mineral dust and Ca^{2+} in $PM_{2.5}$ during the study period. And $\text{Mineral} = 2.2 \times [\text{Al}] + 2.49 \times [\text{Si}] + 1.63 \times [\text{Ca}] + 2.42 \times [\text{Fe}] + 1.94 \times [\text{Ti}]$.

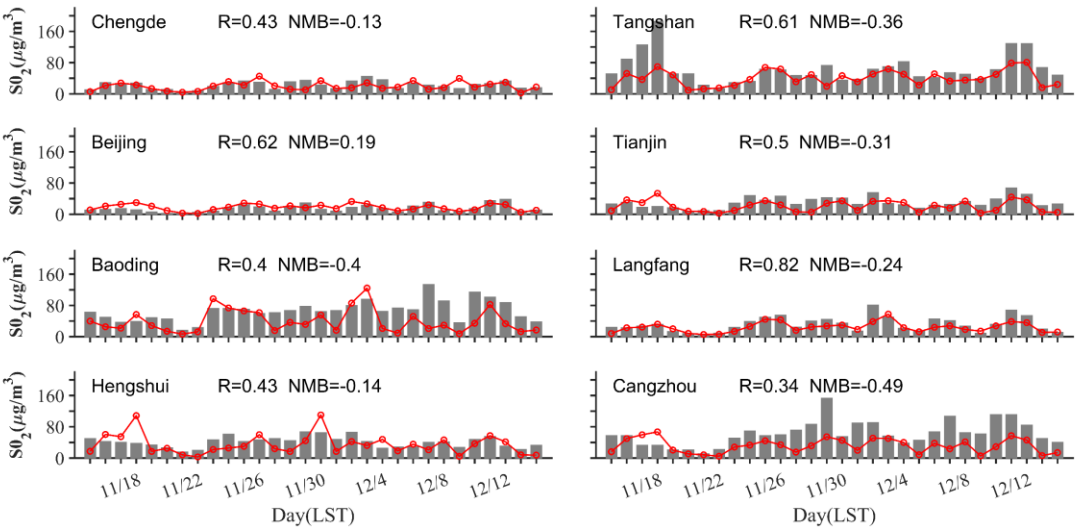

Figure S2. Comparison between the simulated (red) and observed (gray bars) daily concentrations of SO_2.

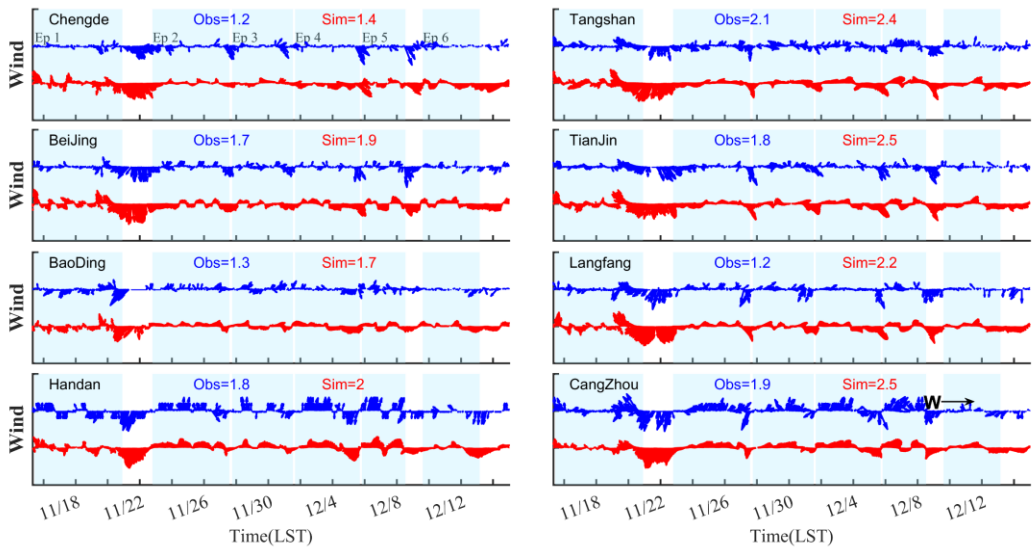

Figure S3. Comparison between simulated (red) and observed (blue) wind vector and wind speeds (data) at cities of BTH.

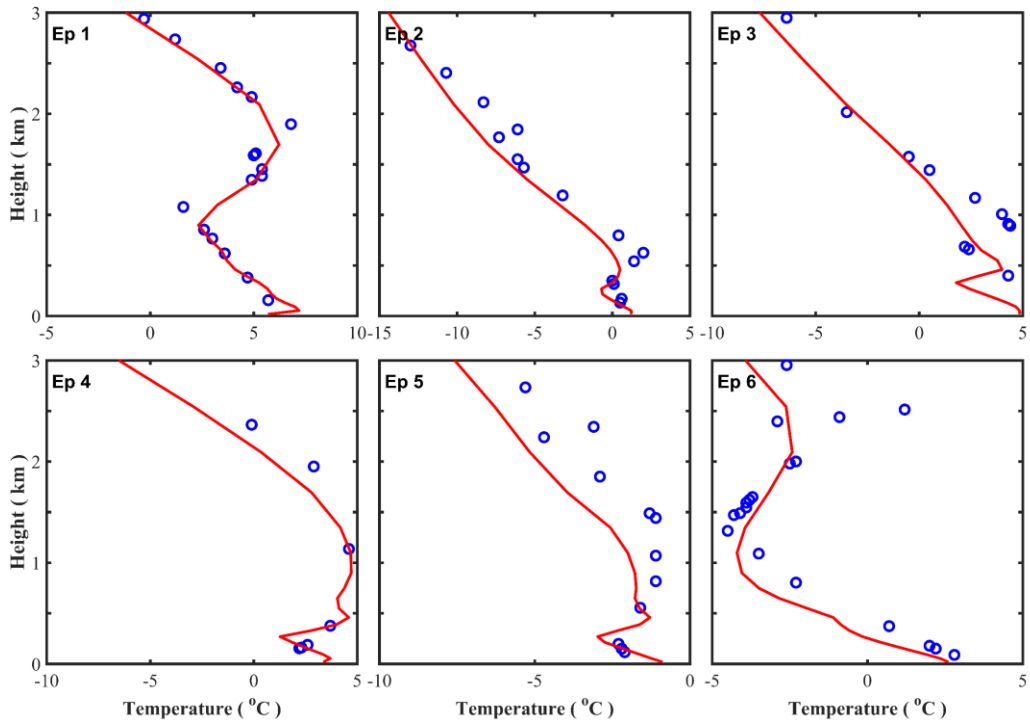

Figure S4. Comparison between simulated (red solid line) and observed (blue dot) temperature profiles during episodes in Beijing.

Table S1. Statistics performances of meteorological simulations

		Obs	Sim	NMB	R	RMSE
T2(K)	Beijing	2.42	3.31	0.37	0.88	2.11

	Tianjin	4.05	3.73	-0.08	0.93	1.48
	Langfang	2.13	3.06	0.44	0.89	2.13
	Chengde	-3.39	-1.66	-0.51	0.89	3.31
RH2(%)	Beijing	53.93	39.53	-0.27	0.69	21.87
	Tianjin	56.95	47.58	-0.16	0.73	18.09
	Langfang	60.39	46.54	-0.23	0.71	21.54
	Chengde	61.56	55.96	-0.09	0.47	20.26
WS10(m/s)	Beijing	1.68	1.93	0.15	0.65	1.30
	Tianjin	1.76	2.46	0.39	0.70	1.50
	Langfang	1.23	2.15	0.74	0.57	1.56
	Chengde	1.16	1.41	0.21	0.63	1.22