Figure S1. Annually variations in **(a)** SO_2 mixing ratios at SDZ and total SO_2 emissions in Beijing; **(b)** the 5th and 95th percentile of the hourly mean of SO_2 and SO_2 emissions in Beijing; **(c)** NO_x mixing ratios at SDZ and total NO_x emissions in Beijing; **(d)** the 5th and 95th percentile of the hourly mean of NO_x and NO_x emissions in Beijing.
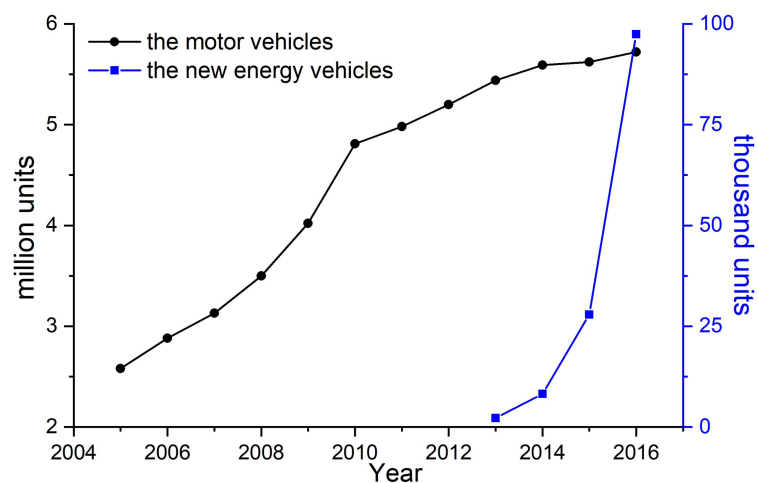
Figure S2. The motor vehicle and new energy vehicle population in Beijing in recent years.

(The data are provided by Beijing Traffic Management Bureau and Beijing Transportation Development Research Institute.)
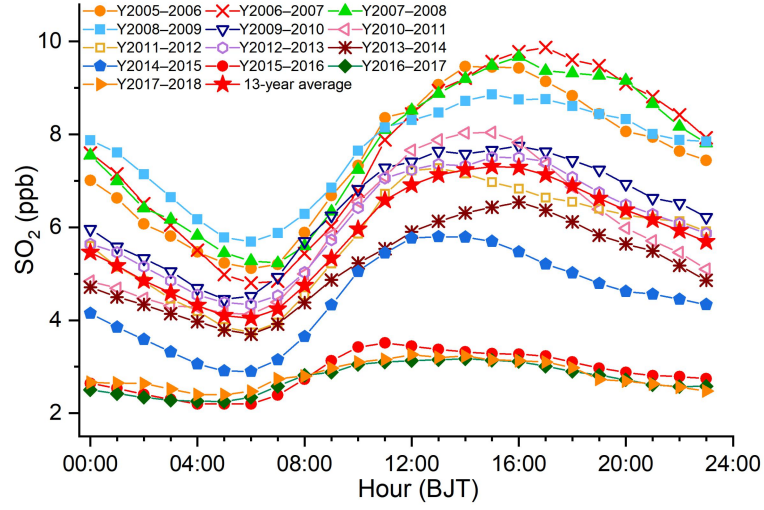
Figure S3. The average diurnal variations in SO$_2$ mixing ratios in different years at SDZ.
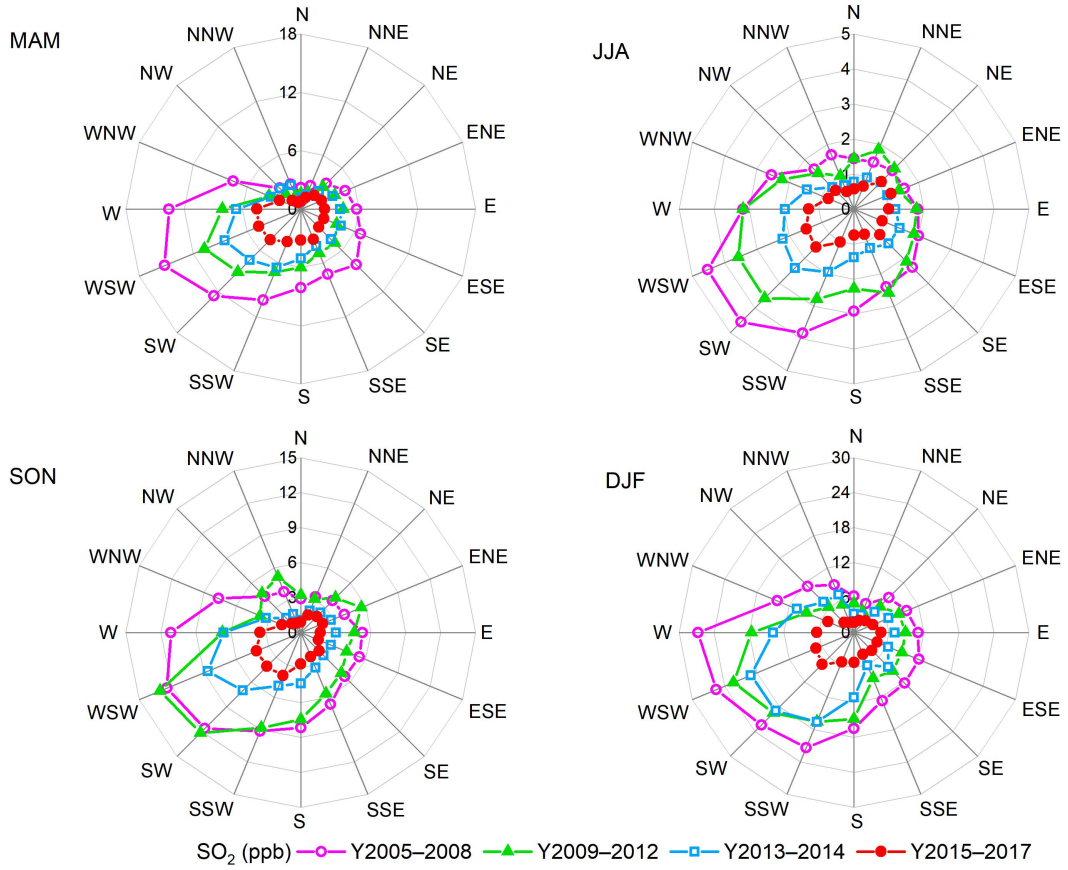
Figure S4. Mixing ratios of SO$_2$ in four seasons during different stages as a function of wind direction at SDZ.
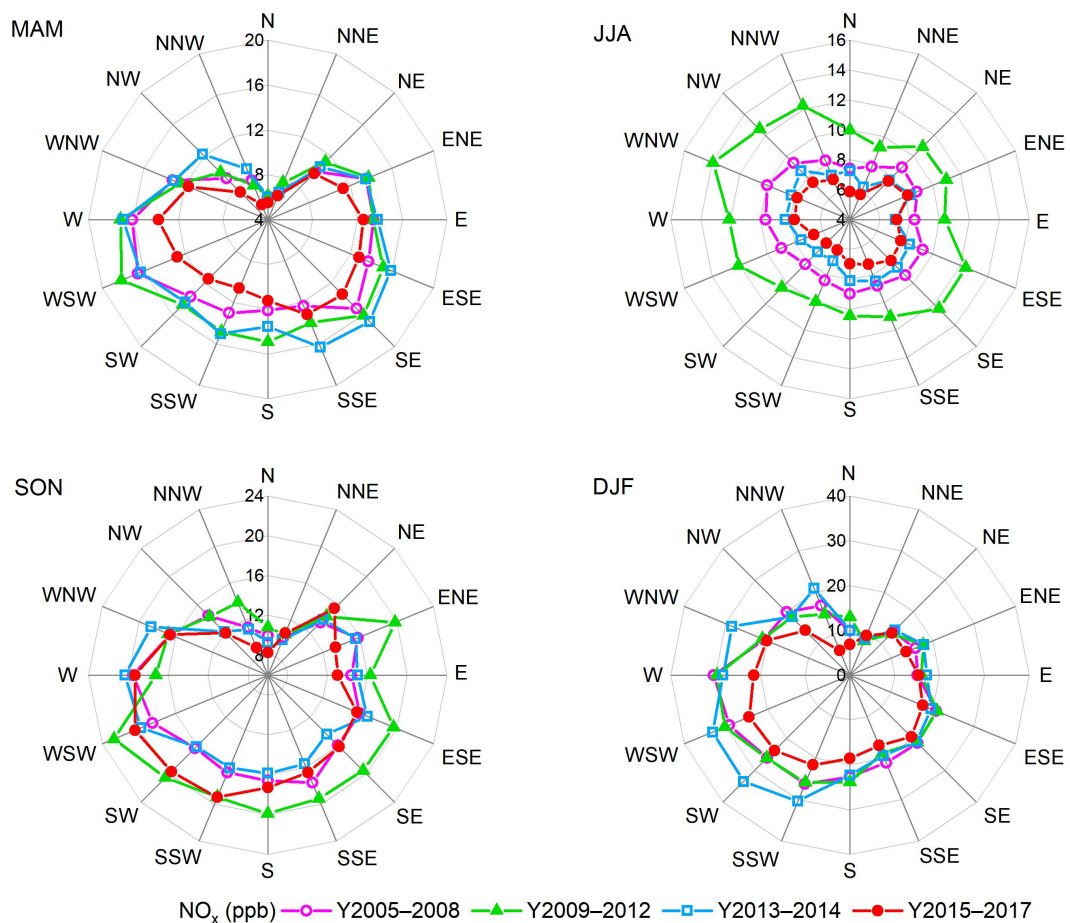
Figure S5. Mixing ratios of NO_x in four seasons during different stages as a function of wind direction at SDZ.
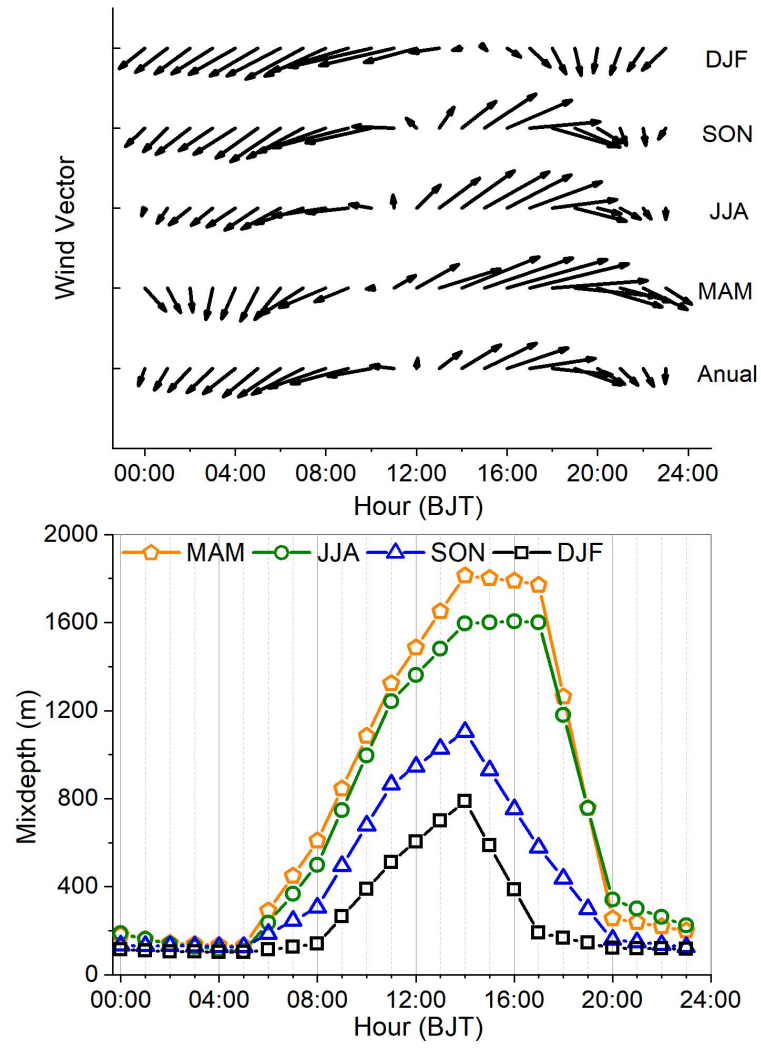
Figure S6. The average diurnal variations in wind vectors and mixing depth in different seasons at SDZ.

Table S1. The frequency distributions (%) of wind directions in different stages.

WD	Y2005–2008	Y2009–2012	Y2013–2014	Y2015–2017
N	3.4	3.4	2.9	3.8
NNE	5.4	6.1	5.4	8.0
NE	12.6	13.9	12.1	15.3
ENE	18.1	16.9	16.8	16.2
E	11.3	9.5	10.8	8.6
ESE	3.1	3.0	3.9	3.4
SE	2.2	2.2	2.6	2.4
SSE	1.6	1.9	2.2	2.0
S	1.8	2.1	2.3	2.1
SSW	3.4	4.0	3.5	4.5
SW	9.8	11.1	10.5	10.0
WSW	13.8	14.7	14.6	11.8
W	8.1	6.2	7.4	6.4
WNW	2.1	1.8	2.1	2.1
NW	1.4	1.4	1.3	1.5
NNW	1.8	1.9	1.6	1.9