Fig.1S Triple-nested domains of **(a)** the LAPS-WRF-CMAQ model system and **(b)** the distribution of meteorological/environmental monitoring stations.
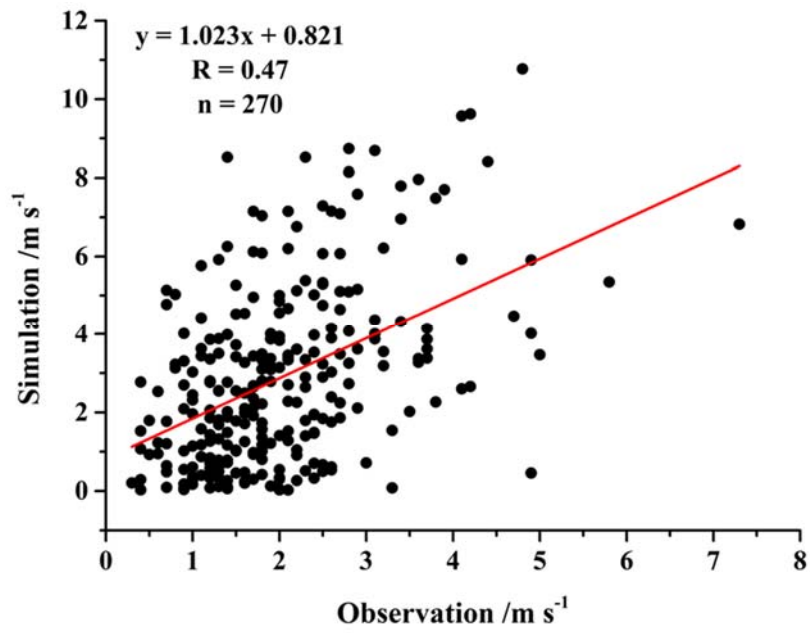
Fig.2S Scatterplot of simulated wind speed and observations at four stations in Beijing.
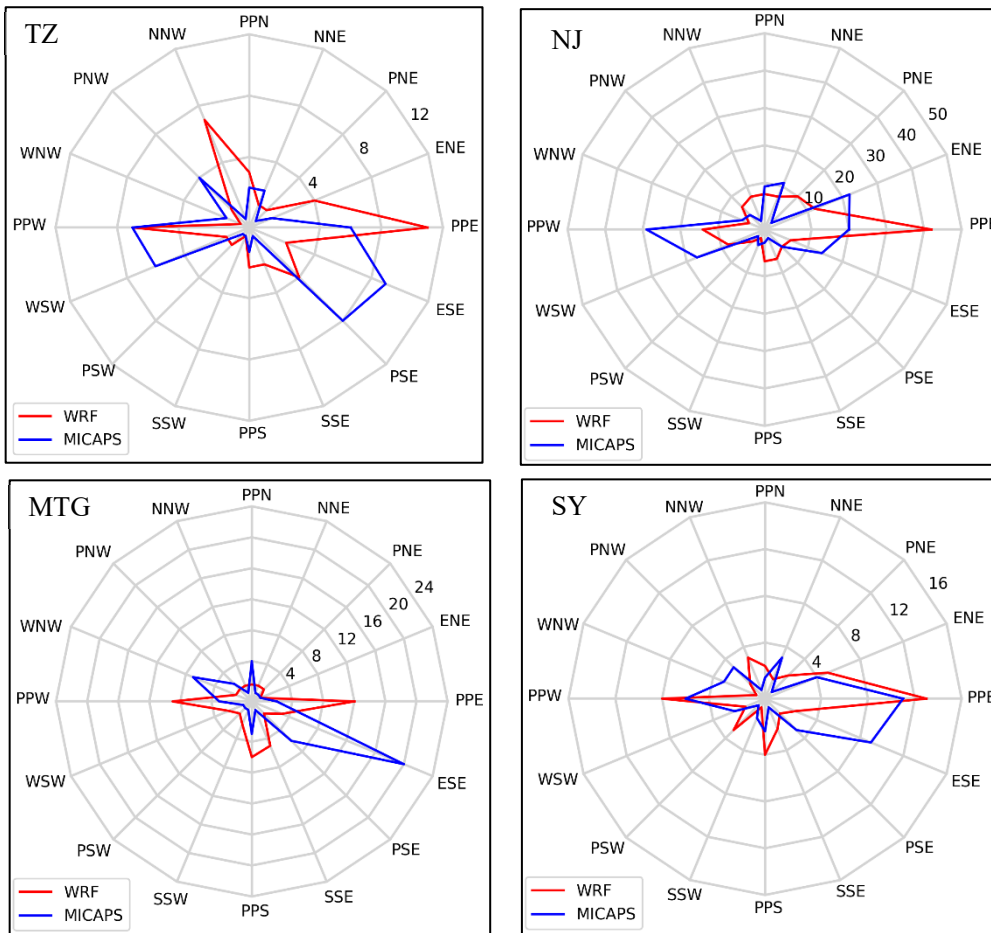
Fig.3S Wind rose of simulated wind direction and observations from MICAPS datasets at four stations in Beijing.
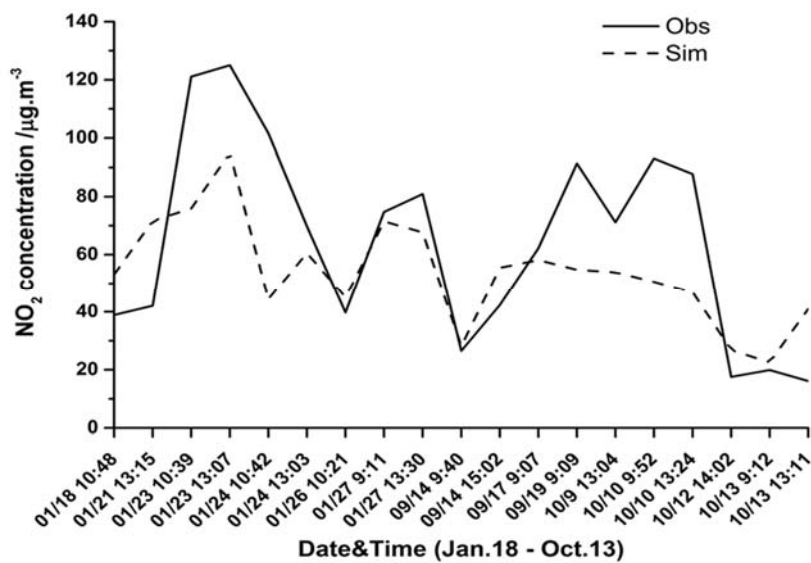
Fig.4S Time series of regional average simulation and in situ observation of NO_2 concentration at 12 stations in Beijing.
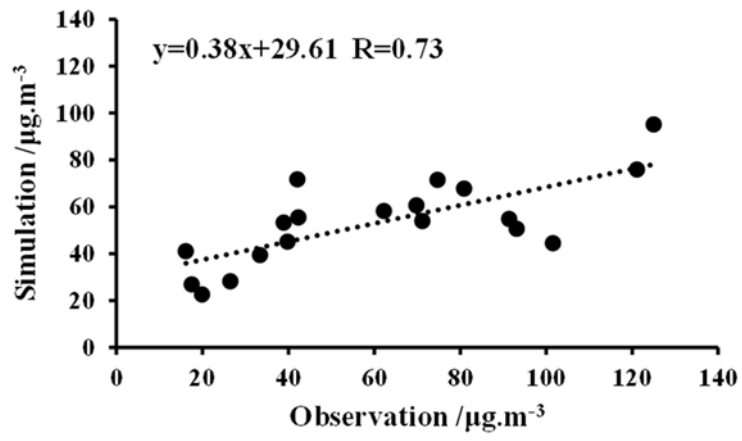
Fig.5S Scatter plot between regional average simulation and observation of NO_2 concentration at 12 stations in Beijing.