

### Beijing Tieta

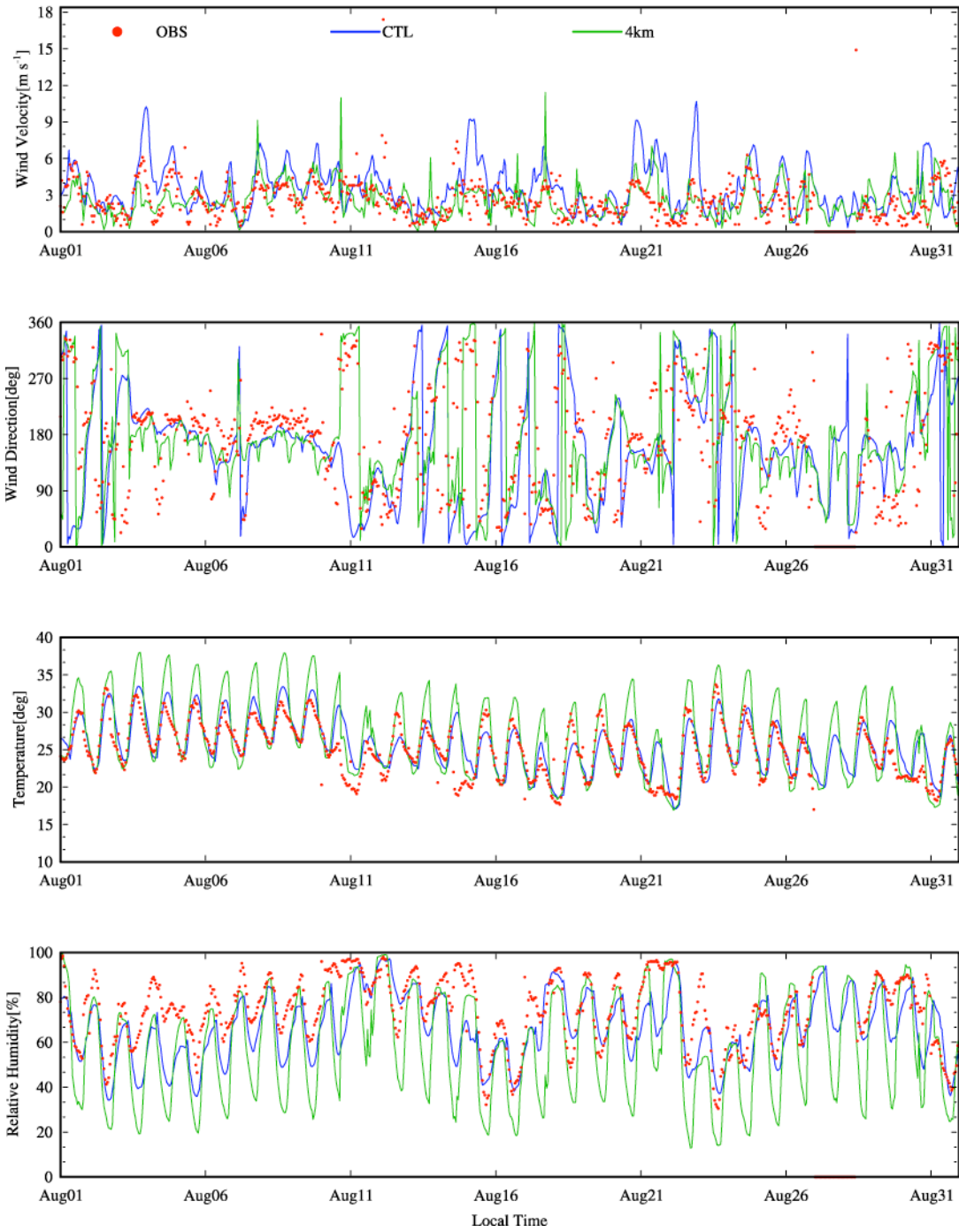


Figure S1. Comparison of model outputs at  $\sim 100$  m (model level 4 from bottom) from CTL case (blue line) and 4 km WRF simulation (green line) with observed hourly wind speed, wind direction, temperature and relative humidity at the seventh platform (100 m) of the 325-m meteorological tower ( $40^{\circ}\text{N}$ ,  $116.4^{\circ}\text{E}$ ) at the Institute of Atmospheric Physics in Beijing for August 2008.

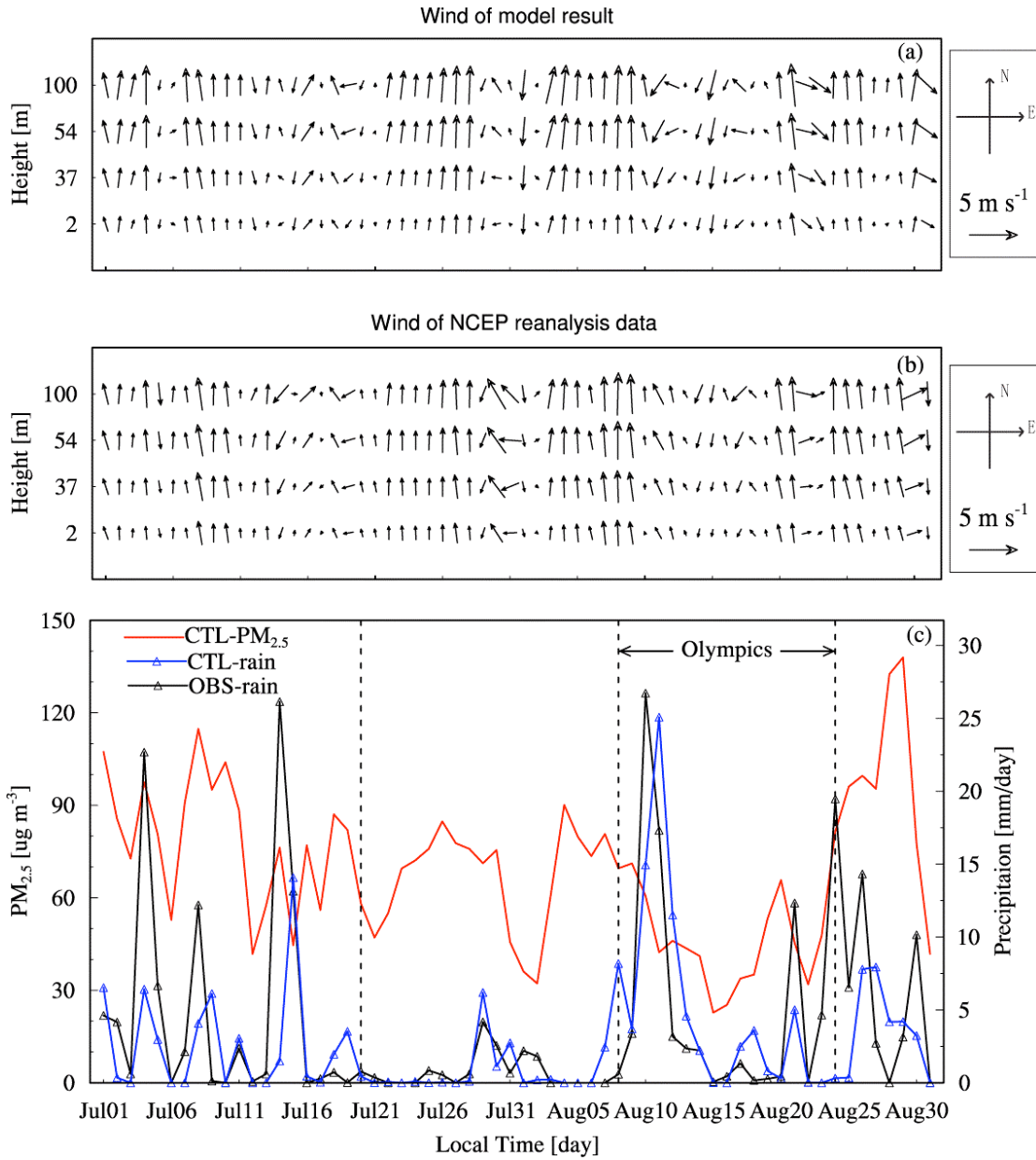


Figure S2. Time series of (a) daily mean and grid averaged horizontal wind speed and direction from CTL case at the lowest three layers over Beijing, (b) daily mean and grid averaged horizontal wind speed and direction from NCEP reanalysis data at the lowest three layers over Beijing, and (c) daily mean and grid averaged PM<sub>2.5</sub> concentration, daily sum and grid averaged precipitation rate from CTL case and observation over Beijing from 1 July to 31 August. Direction of arrows in (a) and (b) denotes the direction of horizontal wind and the length of arrows denotes wind speed.

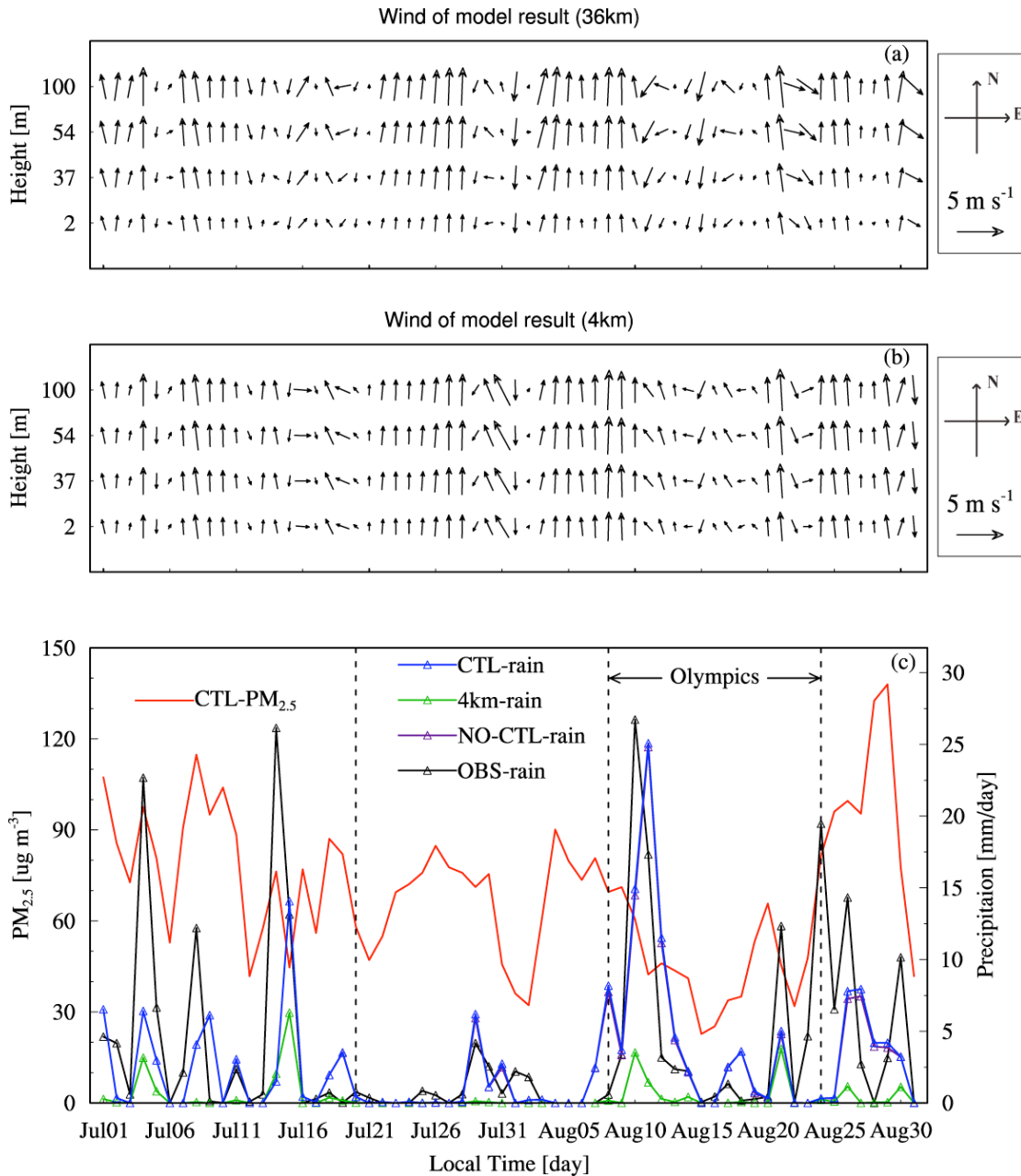


Figure S3. Time series of (a) daily mean and grid averaged horizontal wind speed and direction from CTL case at the lowest three layers over Beijing, (b) daily mean and grid averaged horizontal wind speed and direction from 4 km model simulation at the lowest three layers over Beijing, and (c) daily mean and grid averaged PM<sub>2.5</sub> concentration, daily sum and grid averaged precipitation rate from CTL case, NO-CTL case, 4 km model simulation and observation over Beijing from 1 July to 31 August. Direction of arrows in (a) and (b) denotes the direction of horizontal wind and the length of arrows denotes wind speed. The two lines of precipitation rate from CTL and NO-CTL in (c) are almost coincided with each other.

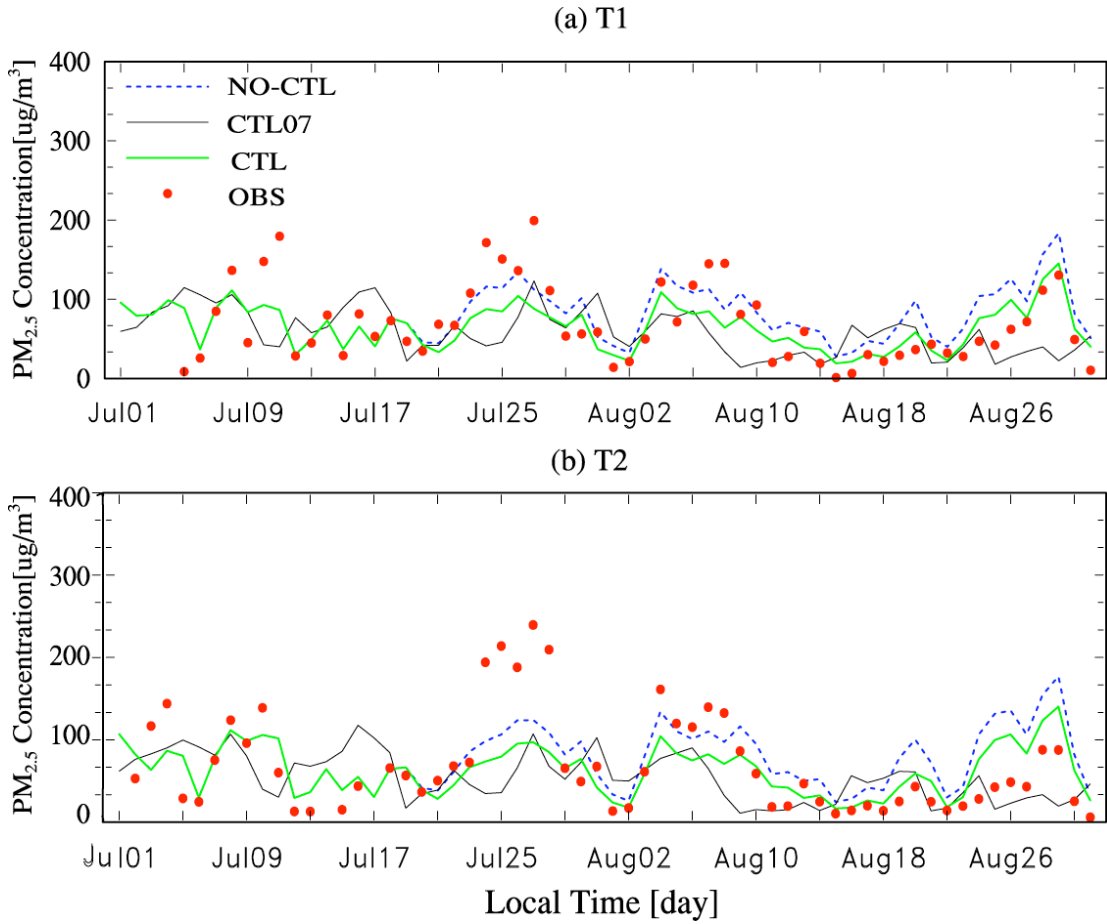


Figure S4. Daily  $PM_{2.5}$  concentration from observations and the corresponding WRF-Chem simulations in CTL, NO-CTL and CTL07 cases from 1 July to 31 August at the two sites (T1 and T2). The CTL07 case is the simulation with 2007 meteorological condition and 2008 emission with emission controls. It is shown that the  $PM_{2.5}$  concentration in CTL07 case can be either higher or lower than the CTL case (with 2008 meteorology and 2008 emission with emission controls) during July and August due to the strong interannual variability of meteorological fields between 2007 and 2008.

(1) Changping

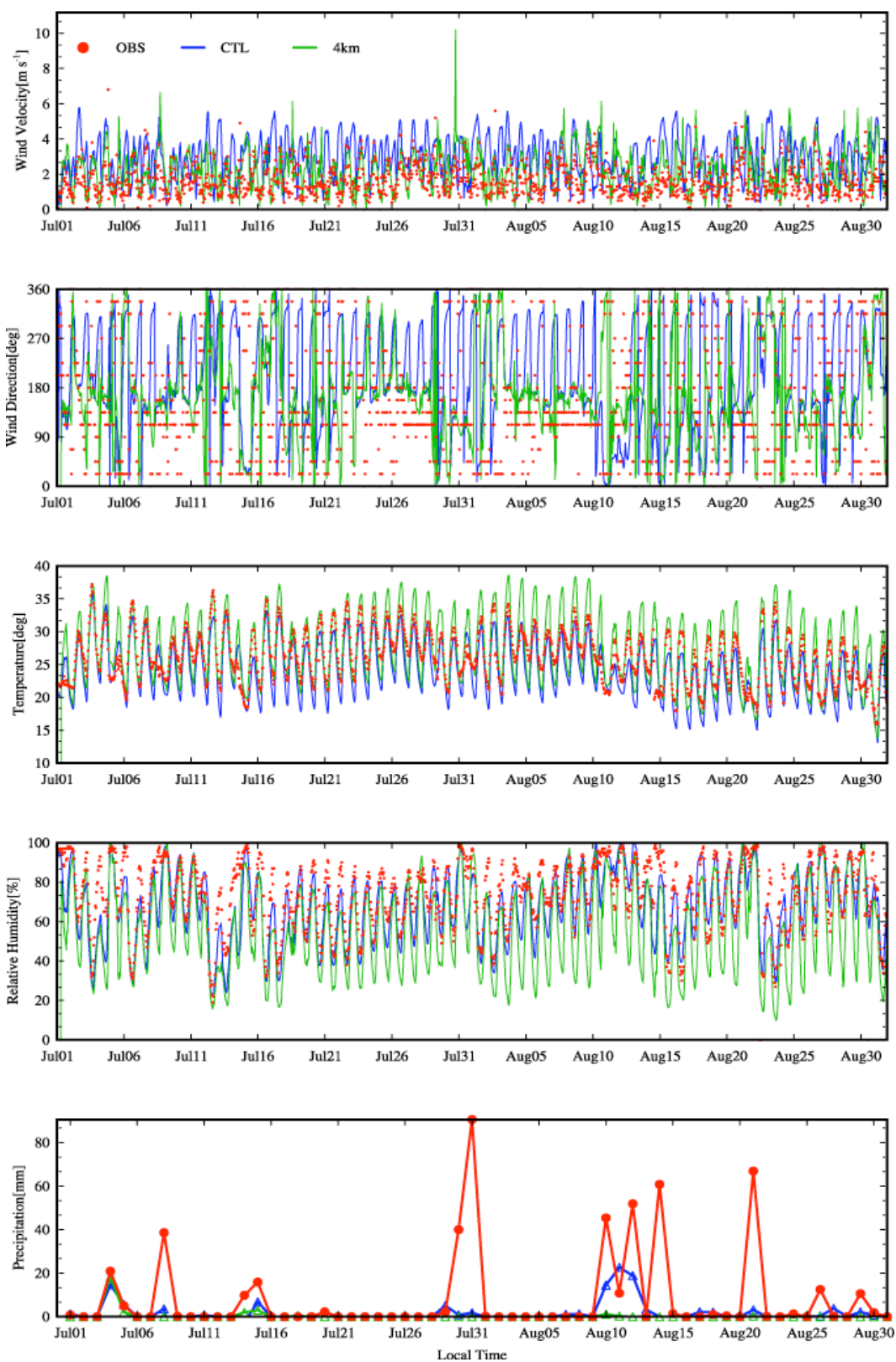
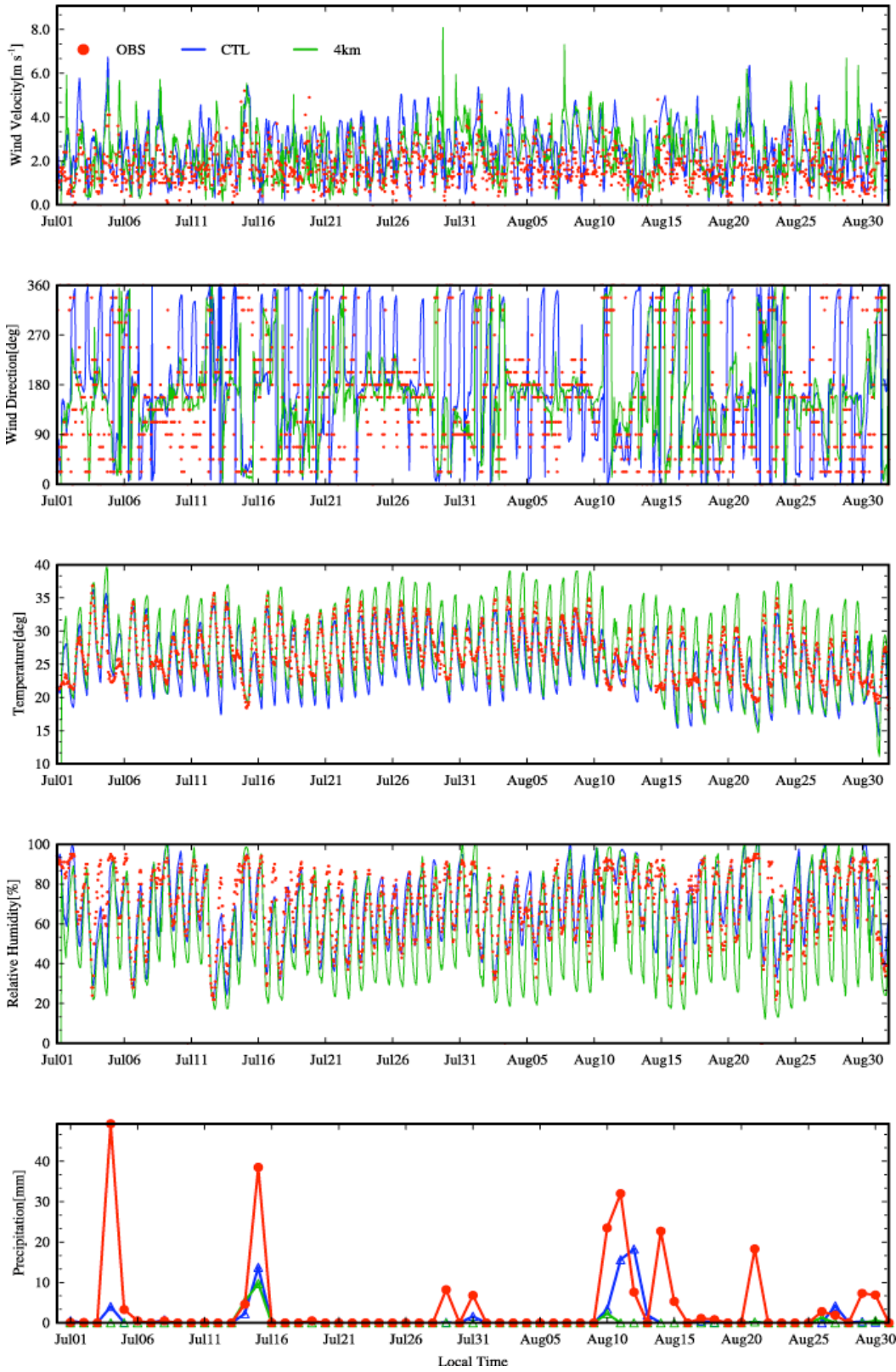


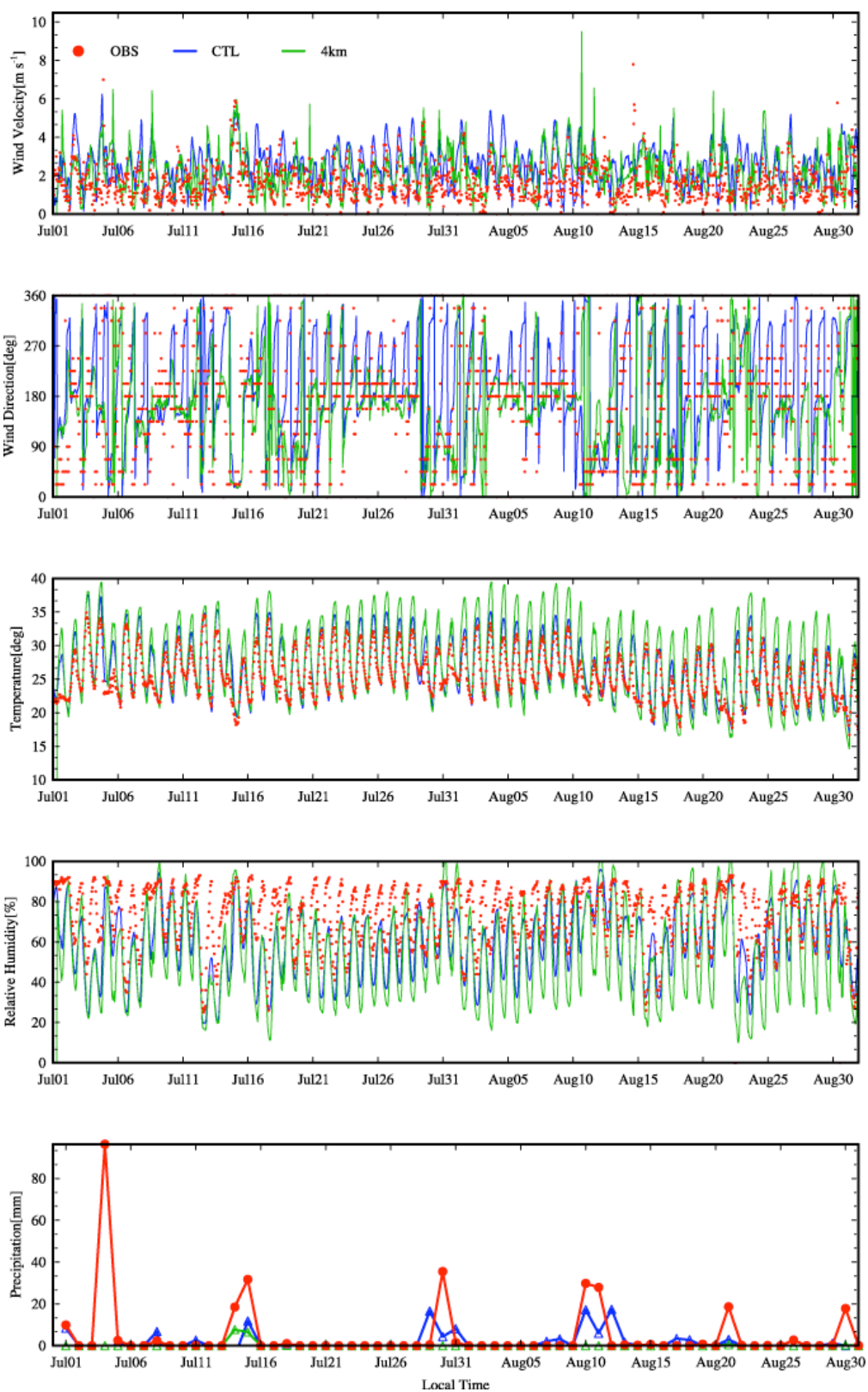
Figure S5 (1)-(7). Comparison of model outputs at surface with observed hourly wind

speed, wind direction, temperature, relative humidity and daily precipitation rate at surface at seven sites in Beijing. Observations of surface meteorological conditions are from the internet (<http://dc.bjmb.gov.cn/gongzhong.asp?id=24>). The seven sites are Changping (40.22°N, 116.22°E), Chaoyang (39.95°N, 116.48°E), Fangshan (39.7°N, 116.00°E), Haidian (39.98°N, 116.28°E), Jinhaihu (40.18°N, 117.33°E), Nanjiao (39.93°N, 116.28°E) and Shunyi (40.12°N, 116.63°E). We note that wind directions were only measured at 16 directions (north, south, west, east, northwest, northeast, southeast, southwest, north-northeast, east-northeast, east-southeast, south-southeast, west-northwest, north-northwest, west-southwest, and south-southwest).

(2) Chaoyang

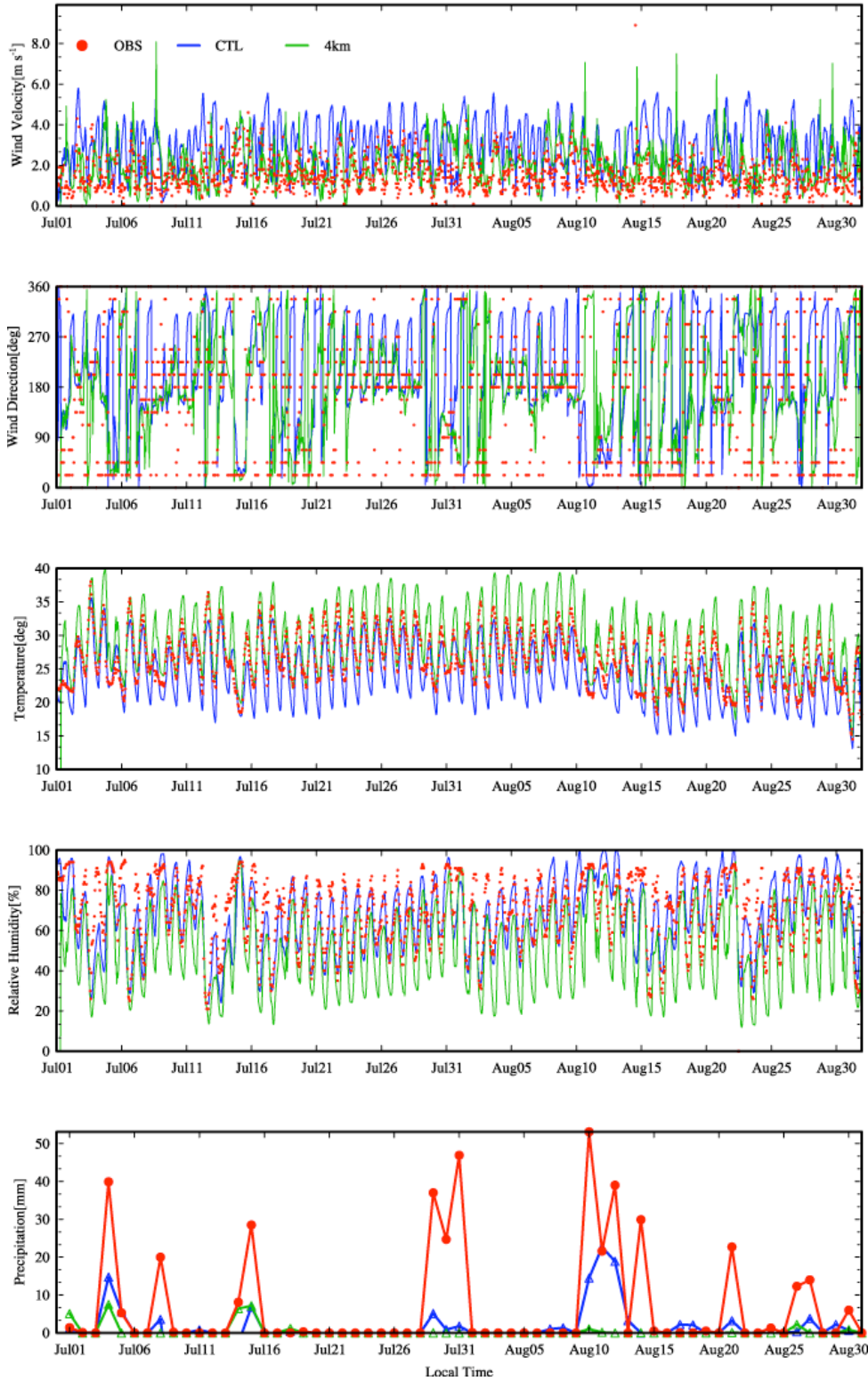


### (3) Fangshan

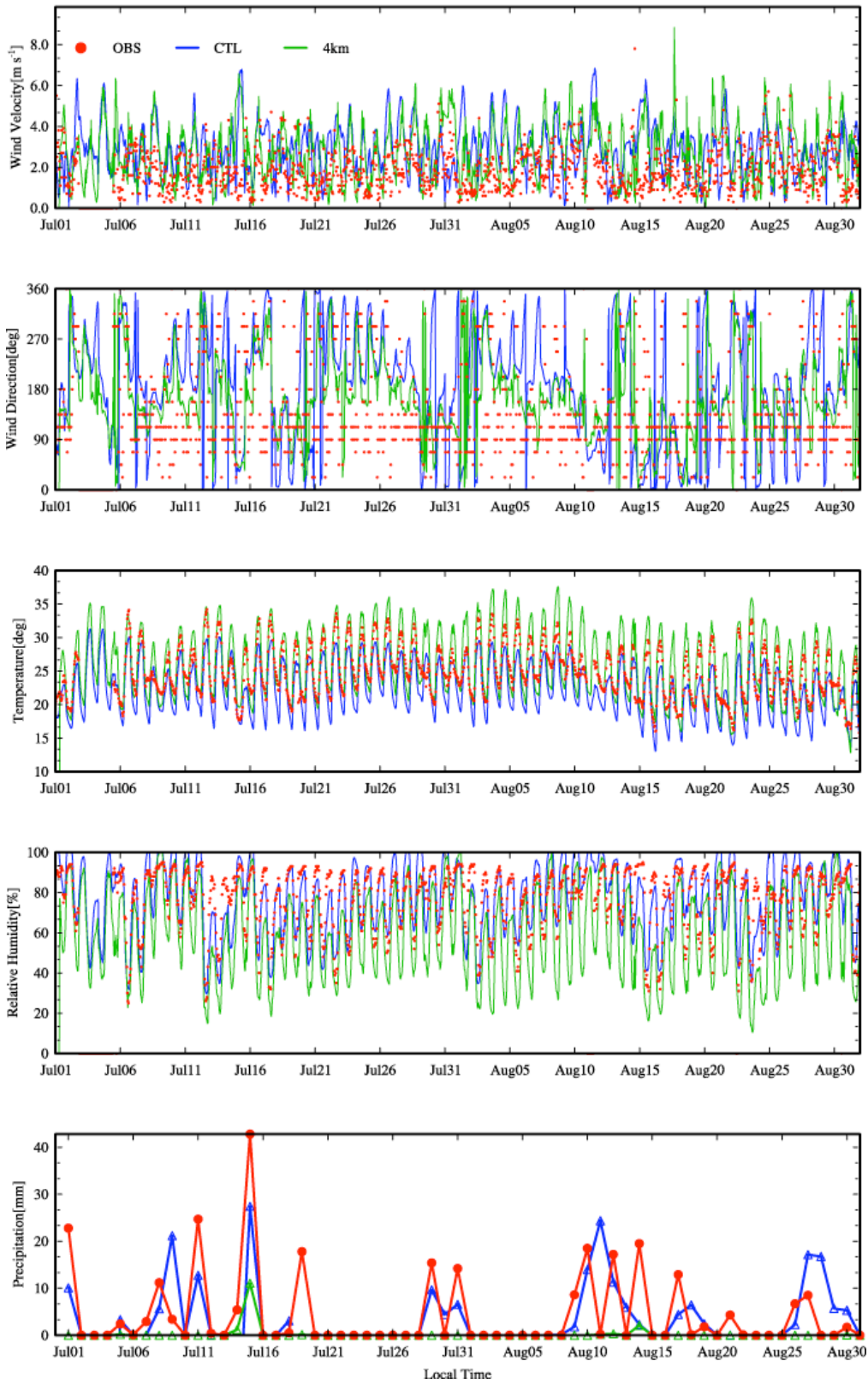




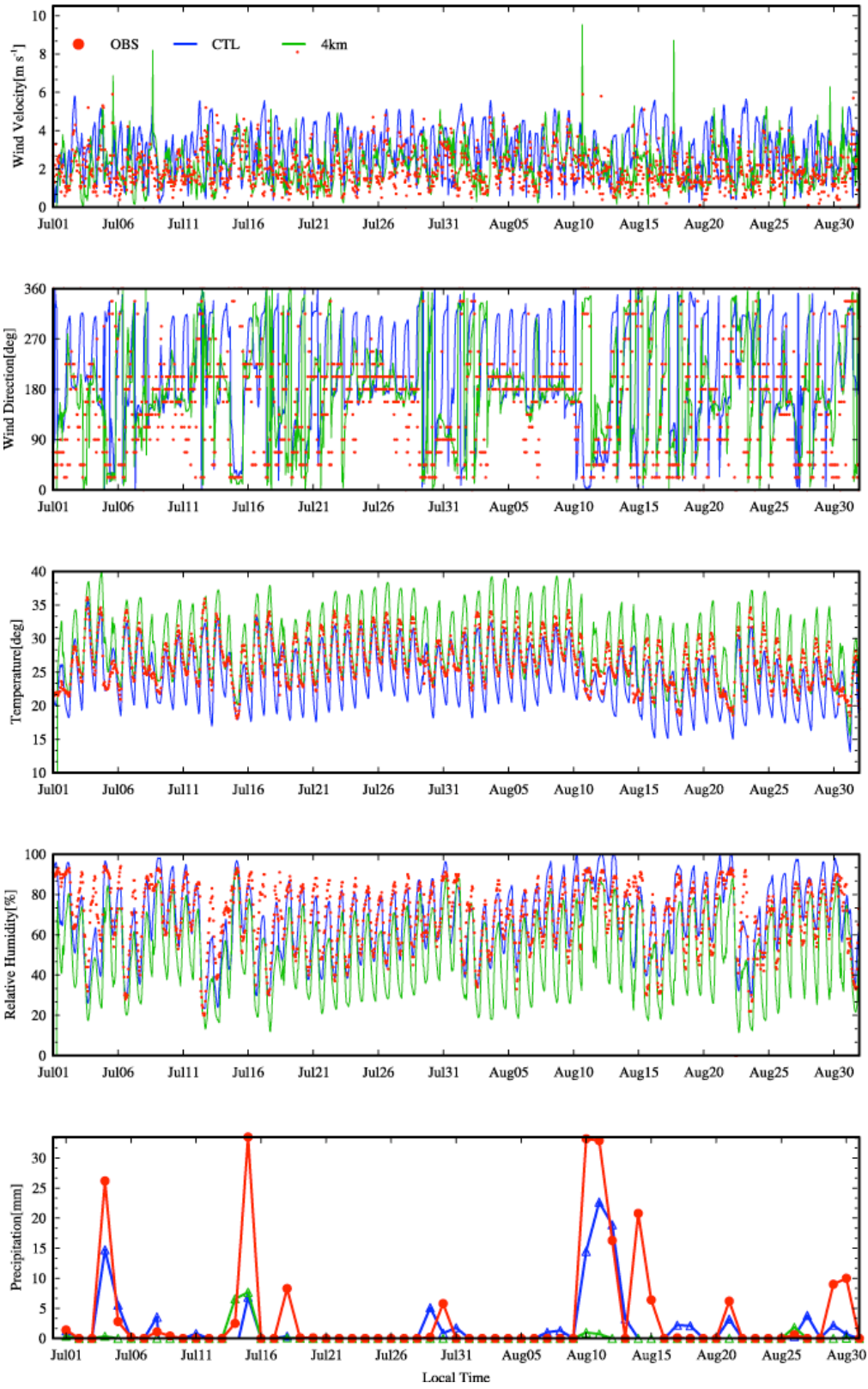
(4) Haidian



(5) Jinhaihu



(6) Nanjiao



(7) Shunyi

