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Interactive comment on “SO₂ noontime peak phenomenon in the North China Plain” by W. Y. Xu et al.

Anonymous Referee #2

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This manuscript presents a very interesting study to investigate the causes of noontime peak of SO₂ in the North China Plain and further discuss its potential impact on atmospheric chemistry and climate. The authors have done in-depth analysis, and well organized and wrote this paper. This referee would like to recommend its publication on Atmos. Chem. Phys. after the following minor points are appropriately addressed.

1) The noontime SO₂ peaks have been already reported by several previous works in Beijing (e.g. Wang et al., 2006; Gao et al., 2013) and other locations in China (e.g. Ding et al., 2013). It looks that there may be some difference in rural and urban sites. In urban sites, SO₂ pattern generally have morning and evening peaks because of influence of local emission. This referee suggest that the authors make a throughout comparison on results at the two different type of sites.

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2) The authors mentioned about the Mountains Yan and Taihang, the North China Plain and mountain breezes, it will be better to add a topographical map in Figure 1, in which clearly demonstrate the geographical location of the study regions.

3) Figure 2: Were these plots made using monthly averaged diurnal profiles? If not, what is the data resolution in the y-axis (Month or weekly)? It looks that there are some strange bands, like synoptically scale variations, in these figures. How about using the normalized results to make these plots here?

4) Page 12: On the discussion of stack height (10-240 m), plume rise, an important fact for elevated sources, should also be mentioned here. The effective height of plumes could be much higher than the stack height.

5) Page 14, Line 16-19. Besides transpiration process, atmospheric turbulence mixing around noontime will also increase the dry deposition. The stronger turbulence mixing will cause more deposition to the surface.

6) Sect. 3.3: About the discussion of SO₂ oxidation, because the authors' analysis already suggested that the downward mixing was an important factor influencing the noontime peak of SO₂, its will be better to using some data above the ground surface (e.g. vertical profile in the PBL) to estimate the O₃ concentration for the model calculation.

Biography

Wang, T. et al., Strong ozone production in urban plumes from Beijing, China. *Geophys. Res. Lett.*, 33, L21806, doi:10.1029/2006GL027689,2006.

Ding, A. et al., Ozone and fine particle in the western Yangtze River Delta: an overview of 1 yr data at the SORPES station, *Atmos. Chem. Phys.*, 13,11, 5813-5830, 2013.

Gao, X., et al., Highly Time-Resolved Measurements of Secondary Ions in PM_{2.5} during the 2008 Beijing Olympics: The Impacts of Control Measures and Regional Transport. *Aerosol and Air Quality Research* 13, 367-376, 2013.

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