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Interactive comment

Interactive comment on "Vertical profiles of NO₂, SO₂, HONO, HCHO, CHOCHO, and aerosols derived from MAX-DOAS measurements at a rural site in the central-western North China Plain and their relation to emission sources and effects of regional transport" by Yang Wang et al.

Anonymous Referee #3

Received and published: 17 January 2019

The paper presents a comprehensive study of vertical distributions of NO2, SO2, HONO, HCHO, CHOCHO and aerosols by MAX-DOAS measurements during a spring/summer period (from 8 May to 10 June 2016) at a suburban site of the North China Plain. The profiles of these gases (volume mixing ratio) and aerosols (extinction coefficient) retrieved by MAX-DOAS are compared with the independent data, including in-situ measurements, Sun photometer, visibility meter, lidar and aircraft measurements. The effects of emissions and transport on the observed results are also





analyzed using the backward trajectories and various satellite data. The study is interesting, providing important information to the scientific community on air quality issue in eastern China. The paper is well written and organized, I would recommend the paper to be published subject minor revisions.

My major concern is on the comparison of the vertical profiles between ground-based MAX-DOAS and in situ aircraft measurements. While Sect. 5 devotes too much for a discussion about the regional and local transport of pollutants, more detailed analyses and discussions should have be added in Sect. 4.3 for the comparison of MAX-DOAS with aircraft measurements.

- Aerosol extinction and SO2 mixing ratio are underestimated significantly by MAX-DOAS with comparison to the aircraft measurements on 21 May 2016 (black dots in Fig. 8b). Why are the aircraft profiles, instead of MAX-DOAS profiles, converted (or "corrected") for better comparison? Since the airplane flew in a spiral route, were the chemical instruments stable enough to get reliable data with increasing air pressure? What is the vertical resolution (or precision) of the profile inversion by MAX-DOAS? The concept of the smoothing effect of the MAX-DOAS profile inversion should be discussed more in detail. I cannot find sufficient evidences in Sect. 4.2 to support the conclusion "The smoothing effect can cause MAX-DOAS retrievals to underestimate pollutants above 2 km and overestimate below" stated in Page 21, Line 31-32.

- It is stated that "the deviations between the MAX-DOAS and aircraft measurements can probably also be attributed to inhomogeneous horizontal distributions of pollutants and their temporal variation during a period of aircraft measurements" in Sect. 4.3 (Page 13, Line 14-16). Did you find any regular horizontal distribution patterns of aerosols and gases from aircraft measurements? Will the comparison improve if only the aircraft measurements in the area that the MAX-DOAS instrument was pointed to are selected?

- In addition to co-author's research group, other aircraft measurement work in the NCP

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region should be credited, e,g, Ma et al. (2012) and Zhang et al. (2014); so did the MAX-DOAS measurement, e.g., Jin et al. (2016).

Technical issues: 1. Page 2, Line 32. What does "East-Aire" mean ?

2. Page 4, Line 23: What is the terrain height of the station?

3. Page 5, Line 15-20: The direction for the measurement should be mentioned.

4. Page 7, Line 12. Please check the punctuation here as well as elsewhere in the manuscript.

5. Page 8, Line 7-8. There are two references of Zhang et al., 2018. Please distinguish them when citing.

6. Page 9, Line 15-17. Please delete the repeating word of "be".

7. Page 12, Line 25-26. The agreement of the aerosol profiles from MAX-DOAS and lidar above 500m is not obvious, especially on 16 May, 2016. It is better to alter the color bar to show this point more clearly.

- 8. Page 12, Line 30. The content should move to the section 4.1.
- 9. Page 13, Line 20-22. This paragraph seems to be redundant.
- 10. Page 14, Line 4. The language expression needs to be improved.
- 11. Page 16, Line 6. Please note the subscript.

12. Page 16: Sect. 5.2.2. It is known that the MAX-DOAS measurements are performed during the daytime. However, the sorting here is mainly based on the nighttime trajectories. In addition, there are large differences between nighttime and daytime in Fig.S5, especially for the southerly trajectories.

- 13. Page 17, Line 34. Please change "Fig.12i" to "Fig.12l".
- 14. Page 22, Line 23, 26. Please check the names of the station "Wuxi" and software

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"WINDOAS".

15. Figure 6: Please clarify the temporal resolution of the data used in Fig.6.

16. Table 2: "outliers"?

References

Jin, J., Ma, J., Lin, W., Zhao, H., Shaiganfar, R., Beirle, S., and Wagner, T.: MAX-DOAS measurements and satellite validation of tropospheric NO2 and SO2 vertical column densities at a rural site of North China, Atmospheric Environment, 133, 12-25, http://dx.doi.org/10.1016/j.atmosenv.2016.03.031, 2016.

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Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1137, 2018.

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