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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ship-based MAX-DOAS measurements of tropospheric NO_2, SO_2, and HCHO distribution along the Yangtze River" *by* Qianqian Hong et al.

Anonymous Referee #1

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The manuscript presents ship-based MAX-DOAS measurements along the Yangtze River to investigate the tropospheric pollutants distribution and their sources over eastern China. The study combines MAX-DOAS, lidar, satellite as well as in-situ sensors measurements to assess the spatial distribution and source appointment of pollutants along Yangtze River during winter time of 2015. The MAX-DOAS VCDs obtained were used to valid OMI satellite observations. The authors also use the NO2 to SO2 ratio to estimate the industrial and traffic emission over different areas along the river. In addition, primary and secondary sources of HCHO, an indicator of VOCs, were estimated using a simple regression model. In general, the topic is interesting and fitting well to the scope of journal. The manuscript is well written with clear scientific objectives. I

recommend publication after addressing the comments provided below.

Comments:

1) The authors use lidar aerosol profile for AMF calculations to convert SCDs to VCDs for trace gases. However, only aerosol profile at the lowest 2 km is used and aerosol above 2 km are ignored. I think it is necessary to estimate the uncertainty due to ignoring aerosols above 2 km. In addition, the lidar has a blind height of 195m, so how the aerosol at the lowest 195m were treated?

2) As described in Sect 2.2.4, the authors has finally employed the new method for VCD estimation in the mobile measurements, which is recommended by Wagner et al., 2010. Maybe the authors could shorten the introduction of the geometric approximation and standard method for the VCD estimation. Alternatively, I suggest the authors to provide the comparison of the retrieved VCD results between standard and suggested methods? For example, taking one day as an example, to present the time series of the DSCD_mea, DSCD_offset and AMF_trop as used in the E.q. (12).

3) In this study, OMI VCDs are computed using atmospheric profiles from WRF-Chem simulations. It would be interesting to show how the VCDs are different from other operational products, e.g., NASA product.

4) It is not clear how the pollution events are identified. From Figure 3, the NO2 VCD on 29 of Nov is also very high, however, this day is not identified as pollution event. The authors should provide more information on the criterion in selecting pollution events.

5) In section 3.1, trajectories are calculated to assess the pollutant transportation. However, it is not clear that these backward trajectories are calculated at which altitude level. It would be much better to show the height of the backward trajectories as well, so that readers could better intemperate how pollutants are transported.

6) It's novel and interested to identify the industrial and vehicle contribution by E.q. 13 and 14, which provide the new insights for the sources appointment. As one of

the most developed area in China, there were some more studies focusing on the emission inventories and source appointment for YRD areas. Maybe the authors can review previous results and compare with this study a little bit more in the discussion.

7) For the estimation of primary and secondary sources of HCHO, I have two questions: 1) which kind of the measured HCHO concentrations was used in the regression model? Since the HCHO levels were determined by MAX-DOAS as VCDs, however, the ambient HCHO concentrations were used in the model. How the authors obtain the ground surface concentration HCHO from the VCDs? Otherwise, why the authors can make regression of the HCHO VCDs with in-situ CO, Ox? 2) For the diurnal pattern, the authors inferred that secondary formation of HCHO shows a peak value during noon time (11:00-14:00), however, there was also another peak of relative contribution of secondary sources around 10:00 LT. How to consider this phenomenon?

Technical corrections:

1) Introduce abbreviation on the first time used in the manuscript, e.g., line 169 WRF-Chem.

2) Text on Figure 3-6 is too small to read. Considering the similarities of Fig.3 to Fig.5, I suggest to merge them together to show the time series of these three pollutants in each panel with a continuous X-axis.

3) Put error bars on Figure 13 and 14

4) Please uniform the units of VCDs. It's different in Figures (molec/cm2) and manuscript text (molec cm-2) now.

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