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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Advantages of city-scale emission inventory for urban air quality research and policy: the case of Nanjing, a typical industrial city in the Yangtze River Delta, China" *by* Y. Zhao et al.

Anonymous Referee #1

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This paper develops an emissions inventory of air pollutants and carbon dioxide for an industrial city in China. An important feature of this work are field surveys of power plants and industrial facilities used to estimate and map point source emissions. Results of this study are compared with other commonly used inventories, including MEIC. The authors then evaluate the inventories with atmospheric data. The main finding is that a bottom-up emission inventory with local information on activity and emission factors outperforms down-scaled inventories that are estimated at a provincial or national level.

The authors' survey approach to estimate stationary emissions is a significant and novel contribution to modelling air pollution in China, and highlights that more work is needed to improve emissions characterization of Chinese power generation and industrial activity. My main critique relates to some of the emissions and observational comparisons made in the analysis (detailed below), as well as highlighting areas where additional documentation would be helpful. Overall, the manuscript reads well and the presentation is clear (except where noted). I recommend that with revision, this manuscript be considered for publication in ACP.

General Comments

1. Some summary tables or figures are needed on activity levels (2010-2012) used in this analysis either in the supplemental material or main text, especially for coal-fired power plants, and other major industrial sectors. The authors highlight significant uncertainties in energy statistics for China (Section 4.6), so it is important that activity estimates are clearly summarized for reference.

2. Captions are needed for all figures in the supplemental material.

Specific Comments

3. Abstract. The horizontal resolution of the emissions inventory should be included. It is not clear what the authors mean by "high-resolution" for a reader just glancing at the manuscript.

4. Section 2.1. This is where a table on activity of point and area sources (like Table S3 for EF) would be helpful.

5. Page 18699, Line 13. How comprehensive is the spatial coverage of the Intelligent Traffic Violation Monitoring System? Does it cover all roads, or mostly highways? Could some traffic be missing from the monitoring system, which would contribute to underestimating emissions from motor vehicles? Also, can the authors provide a short description of how the monitoring system derives traffic flows (e.g. loop detectors,

cameras, mobile cellphone data, etc.)?

6. Section 3.1. What explains the growth and then decrease in NOx emissions shown in Figure 1a?

7. Figure S2. A caption with acronym meanings would be helpful here. The color coding scheme is also hard to follow? It may help to color major source categories a single color (e.g. transportation, power plant, industrial, area, etc.), and different shades of that color for subcategories (e.g. cement, iron & steel production, etc.).

8. Section 3.1. If the penetration and removal efficiency dramatically increased for NOx control at coal-fired power plants (Table 1) between 2010 and 2012, why did the NOx emissions distribution among sources not change much year-to-year (Figure S2)?

9. Figures S3a and S3b. It is not clear in the figure which line refers to MEIC and which refers to emissions from this study. Also, a caption is needed. What does A and B refer to in panel a?

10. Section 4.1. I have some questions with regards to the inter-annual comparison of the emissions inventory with satellite NO2 column data, and the statement that NOx levels in the atmosphere decreased along with decreases in emissions (Line 24). First, what explains the large fluctuations in the vertical column densities in the beginning of 2010, 2011, and 2012 that are not seen in the preceding years? To what extent do year-to-year changes in meteorology affect the trend? Second, what are the uncertainties bars on the satellite-derived trends in NO2, and are these uncertainties larger than the changes in NOx emissions? If there is a decreasing trend after 2011, the analysis would be strengthened if additional years of satellite data were added beyond 2012.

11. Section 4.1, last paragraph. Could atmospheric chemistry and transport of urban emissions also be important for NOx enhancements seen over the Yangtze River? Are these areas downwind of Nanjing?

12. Figure 5. For clarity, the caption should mention that panel (a) refers to city-scale

emissions from “this study”.

13. Section 4.2. Given that NOx has a relatively short atmospheric lifetime, why is the slope in the correlation of emissions and concentrations so flat? What explains the large y-intercept? A more direct comparison of local emissions is to plot emissions versus enhancements in NOx, SO2, and CO above regional background levels.

14. Section 4.3.2. What was the basis for why the authors used the lowest daily OC/EC value observed as a surrogate for the primary emissions ratio? Also a figure with time series data of the OC/EC ratio should be included in supplemental material.

15. Section 4.3.2, Line 15. McDonald et al. also found factor of 2 higher OC/EC ratios from Los Angeles filter samples that did not use backup filters to correct for a positive OC artifact. Given the large uncertainty in the OC measurements used in this study, how confident can the authors be that their emissions ratio is closer to the artifact corrected ambient OC/EC ratio than MEIC (Line 4)? It is possible that the true ambient OC/EC ratio is lower than the two emission inventories.

McDonald, B.C., A.H. Goldstein, and R.A. Harley, Long-term trends in California mobile source emissions and ambient concentrations of black carbon and organic aerosols. Environmental Science & Technology, 2015. DOI: 10.1021/es505912b.

16. Section 4.3.3. The authors suggest that oxidation of NMVOCs could be an important source of secondary CO (Page 18716, Line 17). To control for chemistry, the authors could also see how ambient ratios of CO2/CO compare during morning periods (i.e., when photochemistry is slower).

17. Table 1. What does “Gas release ratio” mean?

18. Figure 1(b). The points are hard to see when they overlap. Maybe a bar chart would be better here, similar to panel (a).

19. Table S1. What do stages mean?

20. Table S3. For completeness, emission factors for coal-fired power plants and cement facilities should be added to the table.

Minor comments

21. Title: Should read “Advantages of *a* city-scale emission inventory”.

22. Figure 8. “Original” observation is misspelled in the figure.

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