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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Improved provincial emission inventory and speciation profiles of anthropogenic non-methane volatile organic compounds: a case study for Jiangsu, China" *by* Yu Zhao et al.

Anonymous Referee #1

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This paper describes the development and updates of a bottom-up regional anthropogenic emissions inventory for the Jiangsu province in China. Source profiles of industrial facilities were improved compared to previous inventories through measurements at the facility level of NMVOCs from canister samples. Differences to other inventories are discussed and regional CMAQ modeling studies with the various inventories were performed and it was found that using the current inventory improves, albeit still underestimates, ozone predictions. Improving anthropogenic emission inventories is the main pathway to improving air quality and climate modeling and forecasting, especially in areas such as China, which makes this paper a very valuable contribution.

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Unfortunately, the paper is difficult to read because of necessary information hidden in the SI, important data sources missing from the description and generally inconsistent description of the different source types and as a result this paper needs major changes, before it is acceptable.

General Comment:

My main issue with this paper is that the description of the inventory development in chapters 2.2 and 2.3 is pretty unclear. First of all, the essential information of the source types is in the SI and not in the main text. A paper needs to be understandable even without reading the SI in detail and that is certainly not the case here. Tables S1 and S3 should be combined into one and moved to the main text. I also think that Tables S4, S5 and S6 should be combined and moved to the main text. Then the source types and the data sources for each type need to be discussed in more detail.

I would like to see a discussion on why these source types were chosen. They are the same as in previous inventories, but is this a good choice? Can there improvements be made at this level already? Next it should be discussed what source types are most important, making big changes to a very small source type, is not going to change the total emissions significantly. Besides, emissions in China and Jiangsu in particular are dominated by solvent use and industrial processes, which is not the case in other regions and this needs to be pointed out early.

What is completely missing is a description of the data sources for the activity level data and a comparison to the previous emission inventories. It is not clear to me what was taken from the literature and what is really new here from this work in terms of activity data. These are essential for building this inventory and some of it is hinted on in Figure S3, but needs to be discussed here.

The discussion of the inventory development would benefit from re-organizing. I suggest discussing each source type in order and include activity factor, emission factor, speciation, source profile and uncertainty. As is, in chapters 2.2 to 2.5 the source types

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are covered very inconsistent, which means that a lot of information is missing. All of this means some major re-organization of the first half of the paper, but without it cannot be judged what is new and important from this work. The rest of the paper was often difficult to follow, because it was not clear what all was included in the source type analysis.

Major Comments:

Page 6 line 125: Why did you choose these specific facilities? Were there no data on them?

Page 7 lines 146-150: Please explain why all these different stages were necessary for the GC analysis.

Page 9 line 207-212: The priorities for the emission factor determination need more detail. Are the emission limits for laws and regulations strictly enforced? If so, they can be used as an upper limit. If not, experience from other regions shows that these regulations rarely have much correlation with actual emissions. Also, what do you mean with expert judgment? Are those literature values or estimates from industry officials? Please explain!

Page 12 line 303: How much of the total emissions were covered with these measurements? Do they represent and help update much of the emissions? The source profile update in Figure 6 seems significant only for a few species?

Figure 6: The units in this Figure cannot be correct.

Page 14 line 353: Can you indicate how much the measurements changed the inventory? Were they an essential improvement compared to the previous inventories?

Page 15 line 382: I assume the units are g/kg?

Page 15 lines 396-405: Can you explain what “certain proxies” means?

Page 17 line 437-442: Please explain why the OFP to emissions ratio is important.

Page 17 lines 444-448: You need to provide the information about the most important species in the main text as well.

Page 17 lines 450-458: What are the most important species in the modeling shown later in the manuscript?

Page 17 lines 460-470: The text does not provide enough information on how the uncertainties are estimated, because of the many things that are not included in the inventory development section. It is therefore difficult to judge, if the emission factors are indeed the largest uncertainty. Can you indicate in this chapter, what would be the most helpful for improving the uncertainties. Would actual emissions measurements be critical?

Page 19: The omission of for example basic chemistry production in the activity data seems to be a clear indicator that the current emission inventory is more likely a lower limit of the emissions, because some of the activity is just not captured.

Page 19 line 520: What is your indication that the emissions in downtown are actually overestimated? It is clear that this method has a large uncertainty, but this does not necessarily mean an overestimation. Is this because the large point source emitters are not located in downtown and you include those in the downscaling method?

Page 21 line 556 (and elsewhere): Thylacetate is really not a very common chemical and I am surprised about the large atmospheric emissions. I think a discussion is warranted on what this compound is and why it is produced in such large quantities. I am wondering, if you meant ethyl acetate, which is pretty common?

Page 21 line 562-571: Overall the changes are not very large. What are the changes in OFP and total emissions and how much influence does the update have on ozone modeling?

Page 21 line 576: The qualification of the REAS inventory as extremely high should be removed. “Extremely high” is a very subjective term and should not be used. Please

be quantitative. Besides, it seems to me that this bottom up inventory provides more likely a lower limit for the emission, because there is a large potential for processes not being included. Also the modeling shows that ozone is still under-predicted, which also points to low emissions in this inventory.

Page 22 line 581: similar type of comment: “much larger emissions” is a very subjective term, so please be quantitative. I actually also disagree with the statement, the inventories are pretty close to each other, clearly within the stated uncertainties.

Chapter 4.4: I think the modeling shows that the inventory is still likely an underestimation of the actual emissions and I think this should be pointed out in the text.

Page 24 line 639: Please give a reference for the statement about VOC-limited.

Technical Comments:

Page 2 line 7: “field measurements of source profiles of the chemical industry. A total of 56 NMVOC samples”

Page 3 line 50: “during a heavy haze period”

Page 3 line54: “ozone formation was recognized”

Page 4 line 78: “6-18 times that of normal”

Page 5 line 95: “increasingly, domestic field measurements”

Page 5 line 104: “series of measurements have been conducted”

Page 6 line 133: “the canisters were made out of stainless steel”

Page 6 line 139: The sampling time was 10 minutes until the pressure in the canister reached ambient?

Page 6 line 140: “ 50 meters downwind of the production”

Page 6 line 142: “ a total of 56 samples”

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Page 6 line 144: “ NMVOC samples were analyzed”

Page 7 line 146: Firstly, the sample”

Page 13 line 337: SPECIATE

Page 13 line 344: “ in which a solvent”

Page 15 line 392: emissions of motorcycles

Page 16 line 417: and other were between 26-30%

Page 21 line 560: cooking

Page 22 line 596: various

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