Comment on acp-2022-268

Anonymous Referee #2

Referee comment on "Sources of organic aerosols in eastern China: A modeling study with high-resolution intermediate-volatility and semi-volatile organic compound emissions" by Jingyu An et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-268-RC2, 2022

Comment on "Sources of organic aerosols in eastern China: A modeling study with high-resolution intermediate-volatility and semi-volatile organic compound emissions" by An et al.

General Comments:

An and coauthors have assembled an emission inventory of organic compounds spanning likely particle-phase, semivolatile, intermediate volatility, and highly volatile pollutants for a comprehensive list of key sources in China. After a brief summary of the changes incurred by this new inventory relative to an existing Base, the authors apply both inventories to model ambient air concentrations of primary and secondary OA using a state-of-the-art chemical transport model, CMAQ. The methods used in this study appear generally sound (with an exception discussed below) and the analysis is complete. The information provided by the study in terms of source contributions for OA should be valuable, I expect, to policy-makers in China, and to the larger Earth system modeling community. I was particularly impressed at the model performance improvement that the authors were able to document. I have some concerns about details of the implementation, some questions about surprising results, and several minor suggestions, which I have included below.

Major Concerns:

- I am missing something fundamental from the presentation in the paper. The authors have documented both I/SVOC-G emissions and I/SVOC-P emissions, but are they

being added together in the model? I think it is very likely that there is overlap in this region and that if both are used, then they will be double-counting some emissions, especially the SVOCs, but also the IVOCs. Can the authors be much more specific about how they fit these pieces together? In lines 241-242, the authors mention subtracting the semivolatile portion from the total POA, but there needs to be more detailed description in one place of what is going on here.

- It is surprising in Table 2 that there are no I/SVOC-P emissions from the industrial processes, aircraft, and coal combustion emissions. Do the authors consider this realistic, or is this an area where more data are needed?
- Can the authors explain some of the interesting trends shown in Fig. 2. Specifically, I find it curious that there is a substantial fraction of I/SVOC-G in the $C^*=0.1$ ug m-3 bin for agricultural sources. Also, the residential source has an odd volatility trend, with very little emissions in the lower IVOC range. Do the authors think this is realistic? I recommend replacing gas-phase and particle-phase in Fig. 2 with 'I/SVOC-G' and 'I/SVOC-P' or something similarly precise. These are not necessarily gas-phase or particle-phase emissions, but are instead emissions based on VOC and filter OC measurements (I assume; it's not really discussed in the description of the emission inventory).
- I was surprised to not see a multi-panel figure showing the spatial emissions of LVOC, SVOC, IVOC and VOC. Can this be added? This would aid comparison to contemporary studies like Chang et al. (2022; https://www.sciencedirect.com/science/article/pii/S2590332222001488)
- In Fig. 6, it is surprising that the POA trend is relatively unchanged between the BASE and IMPROVE cases, when perhaps 60% of the POA is being evaporated (line 329-330). Can the authors shed some light here? Is most of the I/SVOC-P going into the LVOC bins? Judging by Table S2, it doesn't seem like it.
- Although the authors have a done a commendable job in the writing, there are more than a few grammatically incorrect and awkward phrases throughout. I recommend the authors have a technical writer give feedback, or someone from the journal staff.

Minor Suggestions/ Typos:

- Line 53: Jathara --> Jathar.
- Line 53-54: Recommend rephrasing to: "It is challenging to constrain the abundance of OA precursors and to identify key sources."
- Line 57: Please add references for studies using the three source apportionment techniques. Also add a reference for the AMS to the next sentence.
- Line 74: model --> modeling
- Line 75: which advantages in --> which has advantages for
- Line 77-78: Please be careful here. Some models do include multi-generational oxidation of vapors. Are you referring to a specific model here? A specific CMAQ version? Note that CMAQ has included aging via oligomerization of anthropogenic and biogenic vapors for some time.
- Line 87: Recommend rephrasing 'due to the missing of' to 'due to the underestimation of'
- Line 102-104: Many of these profiles are not in SPECIATE5.1, and SPECIATE5.1 generally does not support lumped species by volatility. Recommend removing this sentence, or change 'most' to 'some'.
- Line 106: Is 30% really dominating? Maybe replace 'dominates' with 'contributes significantly to'?
- Line 116-127: Recommend moving to Methods section

- Line 199: What was used for biogenic emissions? MEGAN?
- Line 206-207: The AERO7 CMAQ aerosol scheme does not include IVOCs with C* between 10^4 and 10^6 ug m-3. It also doesn't include aromatic IVOCs. Did the authors add these?
- Line 228-230: Is the multigenerational oxidation scheme equivalent to that used in Lu et al and Murphy et al, or did the authors derive their own?
- Table 1: Recommend reformatting to get rid of the repeated phrase "VOC and I/SVOC emissions in the region". Maybe change the column 'Emission settings' to something like 'Sources with added I/SVOC emissions'. Then the first row would be 'none', the second row 'all', and each latter row would be something like 'all except XX'. I don't think you need the Notes column.
- Line 296-300: I don't understand these sentences. Please rephrase.
- Line 358-359: Please be careful here when referring to species as 'gas-phase'. You have chosen to plot these data as particle-phase or gas-phase, which I don't think is the best way to go, since in reality, they are just scaled off the particle-phase and gas-phase emissions, respectively. They could be in either phase when emitted.
- There are two tables labelled Table S6.
- 5: Color axes are difficult to read. Please enlarge them.
- Section 3.3: I recommend adding a few sentences comparing to the YRD-specific source contributions reported by Chang et al. (2022) since the goals of these studies are highly related.
- Line 610: supe-regional --> super-regional