

We thank the referee for her/his comments on our manuscript. We have listed referee's comments below and replied to them.

Referee comments

Comments:

- 1) Line 466-471: This could also be interpreted as cooking emissions captured during these events. CoOA increases during the morning but also at midday. Based on Fig. S1 the trajectory from the measurement location to the Roastery coincides with the location of 3 restaurants. Are there any measurements of aldehydes during the campaign that are known to originate from cooking (e.g., Klein et al., 2019)? These are also reactive compounds that could play a role in the OH and NO₃ determination. If these measurements don't exist then I would highlight the need for the measurement of more VOCs in the future and change the naming of the factor to include cooking.

Reply: We agree with the referee that the direction of coffee roastery coincides with the location of several restaurants but we disagree that CoOA originates or includes emissions from cooking. Cooking factor has not been found in any of the previous PMF analysis performed for that site (Saarikoski et al., 2021; Chen et al., 2022) whereas coffee roastery emissions have been reported in several studies in the area (Timonen et al., 2013; Carbone et al., 2014; Saarikoski et al., 2021; Kuula et al., 2000; Chen et al., 2022). Therefore, we decided not to change the name of the coffee roastery factor.

Unfortunately, we did not have measurement of aldehydes, but as the referee suggested, we included a sentence for the need of more VOC measurements (added to Conclusions):

"This highlights the need for a wider range VOC measurements as also cooking emissions could be identified with the specific VOCs such as unsaturated aldehydes (Klein et al., 2019)."

- 2) Section 3.5.1 and lines 274-275: I consider that the model sensitivity is not discussed in detail and could play a key role in the "true" OH and NO₃ concentrations. The authors currently vary the concentration of VOCs by 20% based on the uncertainty of the method which is not clear how it is defined. They see an equivalent change of 23% for OH and 11% for NO₃ which to me shows that the model is sensitive to such changes. I would consider that the missing aVOCs in this study are far more than 20%. Emission inventories of aVOCs could show what the expected fraction of the missing aVOCs is. Currently, there are missing cooking emissions that are highly reactive but also missing (major) less reactive emissions from other sources that could still play a key role in anthropogenic reactivity.

Reply: The overall uncertainty of the online TD-GC-MS method is about 18-25% for the measured monoterpenes and sesquiterpenes as reported in the supplementary material of Helin et al. (2020). We decided to use a unified value of 20% uncertainty to test the model sensitivity. As the model is constrained by the in situ measurements and does not rely on emissions, it captures the situation quite well. Highly reactive compounds (e.g. from cooking as the referee mentions, or diterpenes) have not been measured because they have very likely

reacted already before reaching the sampling site and their oxidation products are likely not highly reactive, which is why missing OH reactivity is small in urban environments (see the review by Yang et al., 2016).

The reference of Yang et al. (2016) was missing from the reference list but has now been added there.

- 3) Line 559-563: McDonald et al., 2018 and Coggon et al., 2022, cited by the authors, show that the reactivity from such sources is more than 50% and that even less reactive compounds can play a key role in the observed reactivity. Furthermore, missing reactivity is also dependent on the measurement location (Europe, China, USA, etc.) with multiple studies focusing on this. I consider adding one citation to conclude on the missing reactivity in urban environments to be rather limited.

Reply: The one citation that the referee finds limited is a review relying on results from OH reactivity studies. We have made it explicit in the main text that Yang et al. (2016) is a review. It is possible that the missing reactivity can be explained by volatile chemical products (VCPs), however, these were not detected at the site.

- 4) Line 649-650: I do agree that the measurement location of this study is dominated by biogenic emissions possibly due to the local trees. However, how do the authors conclude on this statement without proper sensitivity analysis? I would consider changing the anthropogenic emissions by a factor of 2 to 10 in the model as a necessary and easy check in order to validate such statements.

Reply: As the model is constrained by in situ observations and does not use emission factors, it is not possible to change anthropogenic emissions. Multiplying measured ambient concentrations by a factor 2 or 10 would depict a different situation than the one we were measuring.

Technical comments:

- 5) Title: There is a typo but even after fixing the typo I consider the title not easy to read. I am also not sure whether an acronym is appropriate for a title.

Reply: acronym has been changed to longer name. Also the title has been changed slightly to be: "Characterization of volatile organic compounds and submicron organic aerosol in a traffic environment"

- 6) I would recommend that the authors find all the times they use "very", "rather", etc., and either statistically quantify such statements or delete them.

Reply: most of “very” and “rather” words have been deleted or replaced by exact values or more exact words

7) Line 15: What do the authors mean by features? I would delete it.

Reply: “features” has been replaced by “characteristics”. Features were referring to the important quality or ability of VOCs and OA whereas characteristics refers now to unique qualities that makes them different from others.

8) Line 29: I would change to “The focus of this research was also on the oxidation potential of the measured VOCs and the association...”.

Reply: Modified as suggested by the referee.

9) Line 37-39: What do the authors mean by “due to specific VOCs attributed to biogenic emissions”? I would delete or rephrase.

Reply: Sentence rephrased to be: “Due to the specific VOCs attributed to biogenic emissions, the influence of biogenic emissions was more clearly detected in the VOC concentrations than in OA.”

10) Line 419: Delete “also”. This sentence is long and hard to follow.

Reply: “Also” deleted. The long sentence was also divided into two sentences.

11) Section 3.5.1: Change the title to “Oxidation of measured VOCs”.

Reply: Title of Chapter 3.5.1. has been changed as suggested.

References

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