Organic vapors from wood, straw, cow dung, and coal burning using Vocus PTR-TOF

Tiantian Wang et al.

General comments

This manuscript included interesting topic and monitored not only gaseous organic compounds but also other tracers such as CO_2, CO, and aerosols which can assess different six fuel types. The authors used several tools using monitoring data to identify characteristics of each fuel type. In the aspects of reduction and verification for their emissions on climate and air quality issue, this study would be valuable reference for research community in the future.

Even though its value, this manuscript was not well written.

First, this manuscript would be more suitable to 'measurement report' type rather than 'research article' (https://www.atmospheric-chemistry-and-physics.net/about/manuscript_types.html).

Next, the title of this manuscript doesn't cover and represent of whole manuscript. The title makes readers misunderstand that this paper focus on Vocus PTR-TOF instrument. However, the manuscript includes more than that. Therefore, it would be good to find appropriate title.

The terms were used too complicated to understand. There are several terms which seems like same or subtly different but used together without any clear categorizations (e.g. burning, burning type, fuels, fuel type, biomass burning, wood, and solid fuels).

Authors might assume many researchers can distinguish and realize those terms by themselves without clear explanation. However, in the scientific manuscript, clear definitions and unify the term in a whole manuscript are very important tools for making readers understand what authors would like to say.

Similarly, many of undefined (or unclear) terms were used in whole manuscript such as 'common compounds' and 'characteristic compounds' including 'selected characteristic compounds'. It was not clear what common compounds (and also characteristic compounds) mean and represent of.

For the results and discussion Sect., authors handled with lots of information and data all together. This absolutely contributes to research community as a good reference.

However, every section displayed very independently and did not link together without any explanation of purpose for each section. This might be very confusing for readers. Therefore, I would like authors to re-organize structures in the manuscript and make it appealing.

Unfortunately, the authors did not seem to give their attention meticulously. For example, some figures should be swamped (not be matched with each figure explanations), there are many abbreviations without full names, reference and explanation were not matched, etc.

Overall, even if a research topic and result are great, if authors cannot deliver the results efficiently, that papers would be difficult to be accepted. Because readers cannot read and fully understand the manuscript and its value.

My specific comments more focused on writing rather than paper's scientific logic and value. Also, there might be more terms/words and sentences I could not find out at the moment.

Hope authors consider specific comments and revise/improve its whole manuscript. And then re-submit the manuscript. After this, we can discuss it on a scientific level.

Regards,

Specific comments

1. P1 L19: Through whole manuscript, real-time gas-phase emissions analysis was not occupied large part. There is no timeseries data set without

2. P1 L25-27: Please explain explicitly with a clear sentence. Authors use this type of sentence in the whole manuscript. It would be good to make short sentences with clear sentence.

   - The CxHyOz family is the most abundant group (of what?),
   - but a greater contribution of nitrogen-containing species (than what?)

   and CxHy families (related to polycyclic aromatic hydrocarbons) could be found in cow dung burning and coal burning, respectively.

   This sentence is quite vague to read because authors use conjunctions couple of times such as 'but' and 'and' in one sentence.

3. P1 L28: Please explain explicitly with a clear sentence.
   - especially for spruce and pine branches and needles (39.3%), and coal (31.1%)
   - To: especially for spruce/pine branches and needles (39.3%) and coal (31.1%)

4. P1 L33: What does the characteristic product mean? It is only for $C_9H_{12}O$? Is it scientific term people use in this field? Is it different from 'characteristic compounds' on line 32? What is 'characteristic compounds'?

5. P2 L64: Author used the term of 'characteristic compounds'. But never define what it means. This is totally different from the term such as 'organic compounds'. Because readers can know what 'organic' is that it is not necessary to explain. However, 'characteristic' means a lot. Therefore if it is scientific term, authors should explain what it is or what kind of gases are belonging to this category. If it is not a scientific term, it is wrong expression.

6. P3 L93 and L97: Author mentioned that 'Vocus PTR time-of-flight mass spectrometer (hereafter Vocus)' but in L97, mentioned again Vocus PTR-TOF.

   If it is same word, please add TOF in L93 and swamp 'Vocus PTR-TOF' to 'Vocus'.

7. P3 L113: The title of section 'Fuel and burning set-up' can 'Fuel and burning types set-up'. Without 'types', the title sounds like physical set-up (of course, it includes the concept though.)

8. P3 L117: Author mentioned six fuel type but did not explain why those were chosen for experiment.

9. P3 L121 to 130: Through the whole manuscript, it is very difficult to find the linkage those explanations to the results. More efficient way to deliver how to categorize the burning type is to suggest 'Six burning type with different fuels' first. For example, *'with those six different fuels, we categorized six burning types for this experiment. 1) beech logs stove, 2) spruce and pine logs stove, 3) spruce and pine branches and needles open, 4) straw open, 5) cow dung open and 6) coal stove. Among the list above, 1) and 2) are representative of residential wood burning..... (Table 1). '*

10. P4 L125: There are lots of commas so that it makes readers difficult to understand. On this manuscript, there are many sentences with similar structures to this sentence.

    'Combustion of agricultural waste, straw, and a mixture of fresh spruce and pine branches and needles were in an open stainless-steel cylinder measuring 65 cm in diameter and 35 cm in height.'

    Authors can divide into two sentences or make it simple. Example below:
    For combustion of agricultural waste, ...spruce/pine branches and needles...'

11. P4 L132: Section title is not clear. It can be sampling and analysis method.
12. P4 L134: Pure Air with N2, O2, Ar? The purity percentage?
13. P4 L137: diluter ... Diluted by what?
14. P4 L151: Black Carbon (BC)?
15. P4 L152: A LI-7000 CO2 analyzer (LI-COR) provided continuous measurements of carbon dioxide (CO2).
    Is it same instrument of CO2/CO monitor in Figure S1? In this case, please add carbon monoxide as well.

16. P5 L160: The Vocus was calibrated before and after......
    For the reliable data for other species, it would be good to suggest calibration strategy to other instrument as well.

17. P5 L162 and L165: Please clarify pure air and zero air difference. If it is same, please unify the term. And also make it clear that only dried air used for background measurement.

18. P5 L173: Why did not authors make the title clear? In section 2.4, the title is very clear what will be discussed in the section. However for section 2.3, the title is very vague.

19. P5 L176: excess mixing ratio above what? If you use the excess mixing ratio of CO and CO_2 above background air, please add information of background air (where those data you download or how you measure it.) And also this methods in Equation 1. seems like little different from the reference (Ward and Radke, 1993).

20. P5 L179: The sentence seems like not organized well.

If authors would like to add instrument information inside blank, please add all of instrument information. If authors would like to describe species, please unify the species all. And clarify that meaning of conventional gases.

21. P5 L182: mass concentration.

Author use the unit as combination of mixing ratio and mass concentration. However it is different unit.

(mass) mixing ratio: Number of the mass of the target gas (species) per mass of air (possible units are ppmm (also ppmw) = parts per million of air molecules by mass (weight), etc.). A specification whether it refers to dry or moist air is required.

However, mass concentration is mass/volume.

Please clarify all units.

22. P5 L182: ΔOC: This was not discussed in section 2.2.
23. P5 L184: OM also was not discussed at all.
24. P6 L203: In this study, the mixing ratio relative contribution for more than 1500 species from six different fuels 204 for all 28 test burns was quantified by using Vocus.

It is difficult to understand the meaning of 'mixing ratio relative contribution'. Relative contribution to what?

25. P6 L204: characteristic compounds. This term never mentioned before in this manuscript.
26. P6 L213-L218: make the sentences clear.

However, due to the similarity in fuel types between burning spruce and pine logs, as well as spruce and pine branches and needles, they were categorized as separate fuel sources for this test and not compared with each other but were only compared with the other four types of fuels.

- It would be good to make it simple: for this test, 'spruce and pine logs' and 'spruce/pine branches and needles' were in the same fuel type category due to similar characteristics.
- And then readers can have questions, if so (they have same characteristics), why did authors use all of them as different fuels at the beginning?
- If author define 6 different fuel type, please keep the term of 'fuel type' in the whole manuscript. Please don't change to fuel sources or other. It makes confusions. Using term should be clear and same. For burning type as well.
- The sentence below is difficult as well.

Similarly, due to the composition of cow dung "cakes," which comprise a mixture of dried cow dung and crop residues and a relatively high correlation between cow dung and straw (Figure 1), the Mann-Whitney U test was carried out without accounting for the presence of the other fuels.

27. P7 L226: Emission factors from solid-fuel combustion to 'The characteristics of EF and MCE from different fuel types.' ? make it more clear.
28. P7 L237: did author mention that NMOG is primary organic gases in the above manuscript? It would make easier to readers if you mentioned that NMOG is primary organic gases in the introduction. or Just using NMOG is necessary in whole manuscript. It is very important that using same term in whole manuscript for readers.
29. P7 L243: The slightly higher EFs for pine and spruce wood burning can be attributed to the more extensive analysis of NMOGs in our study compared to previous research (37.3 245 g/kg) (Hatch et al., 2017).

- Can we say this value is higher than pervious study even though the difference is in the uncertainty levels?

30. P7 L249: emissions. Does it mean EF? Authors know the difference between emissions and EF.

31. P7 L250: emission factors. If authors started using EF in place of emission factors, please use EF.
32. P7 L253: title again. Authors never mentioned about primary organic vapors in previous sections. It can be 'The characteristics of NMOG chemical composition from different fuel types'.
33. P7 L254: I don't think section 3.2.1 can be overview. In this section, general characteristics can be handled.
34. P7 L255: combustion fuel source mean burning type? Please keep same term.
35. P7 L257: what is primary NMOGs? So is it different from just NMOGs?
36. P7 L261: biomass samples. What kind of burning type are belonging to biomass samples. Please defined clearly.
37. P8 L273: What is H/C ratio?
38. P8 L274: What is O/C ratios?
39. P8 L278: Suggested its value. Science paper should suggest certain number otherwise 'slightly lower' means very subjective.
40. P8 L290-L301: I suggested this paragraph can come up the beginning of this section. And then authors can easily explain Figure 1 and Figure 2. On the other hand, I also wondered NMOG will be categorized only primary organic gases and secondary as well.
41. P9 L303: Hard to understand this sentence.
Based on the log10C* values of all organic compounds parameterized with the modified approach of Li et al. (2016) described in Sect. 2.4.
42. P9 L308: What kind of burning type are included in biomass burning emissions?
43. P9 L311: For all burns. Did author mean for all experiment or for all burning types?
44. P9 L320-323: I think the reference cannot support author's finding.
In general, spruce and pine branches and needles open burning released a higher proportion of IVOCs (39.3%) into the gas phase compared to stove logs burning (12.6% and 322 23.9%). Pallozzi et al. (2018) also reported a similar result, showing that needle/leaf combustion released a greater amount of volatile organic compounds into the atmosphere than branch combustion.

45. P9 L332: VBS. What does VBS mean?
46. P9 L333: wood burning. Did author define wood burning and biomass burning somewhere? What kind of burning type are in this category? And why do authors want to compare two stages? why do authors only analyze wood burning for this comparison?
47. P9 L335-337: I don't agree with authors point of view. CO increased when the stage was changed from flaming to smouldering.
In the top panel, the MCE is used to indicate 336 the flaming stage with a significant CO2 enhancement, while the smoldering stage exhibits high levels of CO.

48. P9 L338: What AAE means?
49. P9 L339: *f*60. Have ever author described what it is in the manuscript or table?
50. P9 L341: BB. What does it mean?
51. P10 L350: (31.4 g/kg) and (121.9 g/kg). Please add standard deviation or uncertainty ± value.
52. P10 L351: Large similarity. I cannot understand large similarities. Did authors mean similar trend?
53. P10 L352: Figure S7. doesn't have information that what each of #c and #o represent for and also its explanation does not match to the Figure.
54. P10 L356: What does OVOC stand for?
55. P10 L356: Figure S8. I assumed Figure S8 was not the figure Author would like to show.
56. P10 L365: What does 'common' mean?
57. P10 L382: Unify the term. there is no 'wood' in Figure 1.
58. P11 L395: solid-fuel combustion. This is very confusing that solid fuel, biomass burning, fuel type, wood... all things are very tangled so that hard to understand. Please keep same term and define each term clearly.
59. P11 L398: add number of table.
60. P11 L399: Very confusing between characteristic compounds and selected characteristic compounds. What are the differences between two of them?
61. P11 L401: In contrast, compounds from open burning of straw and cow dung
Does it different form characteristic compounds and selected characteristic compounds?

62. P12 L448: l solid fuel combustion, including residential burning (beech logs, a mixture of spruce and pine logs, and coal briquettes) and open combustion (spruce and pine branches and needles, straw, and cow dung).
    - Author also investigated biomass burning and woods? did you use biomass burning same to solid fuel?
    - The burning type category is very important here. Please use it clearly.
63. P13 L481: Still have questions of characteristic compounds and the common compounds.
64. Figures and table.
    - Figures label fonts were too small to read.
    - Figure labels and explanations in the captions should be same to the explanation in the manuscript.
    - Figure 4. What is key aerosols? Figure 4(b) the colour bar of Smouldering and Flaming can be moved to right side of the panel.
65. Reference.
    - Please give the space between the references at least.