

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2021-247-RC1>, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Review of Sumlin et al ACPD

Anonymous Referee #1

Referee comment on "Diel cycle impacts on the chemical and light absorption properties of organic carbon aerosol from wildfires in the western United States" by Benjamin Sumlin et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-247-RC1>, 2021

This paper describes absorption measurements for wildfire smoke in Oregon and Arizona using photoacoustic spectroscopy. The smoke is aged in a oxidation flow reactor using OH or NO₃ for the equivalent of ~5-20 days. The number of measurements are very limited (2 examples of aging with OH and 2 examples of aging with NO₃), but the approach hasn't been reported for field measurements. The paper is short and well-written. I recommend publication after the following comments are addressed.

- Line 55: Warneke 2018 is not published. Change to "in preparation".
- Section 2.1.1 and 2.1.2: Add the source for the vegetation identifications.
- Section 2.1.1 and 2.1.2: What were the average wind speeds during each of the four measurements?
- Section 2.1 is named "Wildfire emissions sampled during OFR experiments". It would make sense to move the final paragraph (lines 94-114) to Section 2.2 ("Instrumentation"). That paragraph introduces the Aerodyne Mobile Laboratory and fits more logically with instrumentation than with the description of the fires.
- Line 156: How accurately did the UV flux measurement at the exit flange represent the UV flux inside the OFR? How did you evaluate that?
- Line 160: The calculated mean residence time of the oxidation flow reactor was 123 s.

What was the observed residence time? If the OFR was abruptly filtered or overflowed with zero air, what was the observed residence time to fully flush the volume? Add this value as well.

- Figures S3 and S4 in the SI material show that the OH and NO₃ reagent concentrations were always changed monotonically. They began at the highest concentration, and then were decreased sequentially in steps. If the ambient aerosol properties are changing as a function of time, this approach risks confusing that change as a dependence on the OH or NO₃ concentration. It may also introduce an error if there are systematic measurement drifts. It would be better in the future to both 1) Introduce different reagent concentrations in random order; 2) Repeat one or two reagent concentrations to examine the repeatability of the measurements. It would be worth noting these in the paper as future approaches.

- Line 170-172: The word "steps" is awkward. Consider changing "steps" to "measurements." Also, it is confusing that oxidation steps are labeled as "OFR_OH_X" and "NO₃PAM_O3". The OFR and the PAM are the same thing. It would be better to name these consistently (not with some labels as PAM and some as OFR).

- Throughout the paper, NO₃ and OH equivalent exposures are given in units of "days" or "equivalent days". Since OH is present during the day and NO₃ is present at night (so that each equivalent day would take ~2 days in the ambient atmosphere), it may be clearer to give the exposures in "hours" or "equivalent hours".

- Line 230: It would be useful to specify that the AAE values calculated here are for both BC and BrC.

- Section 3.2: This section seems to introduce several results without explanation. Specifically:

- Line 239: NO_{3,EXT} is not defined. What is it and how was it measured or calculated?

- Line 240: The NO₃ reactivity of catechol is introduced, but there was no description of an instrument to measure gas-phase VOCs. How was this measured and calculated? There is no catechol data shown in figures or tables.

- Line 243: "The difference in external reactivities manifested in different E_{MAC}(λ) behavior at the two sites." What does external reactivities mean and where are they shown?

- The notation CHO₁N and CHO_{gt1}N are unclear. I suggest making two changes: 1) use x to indicate that molecules may contain multiple atoms of C, H, and N; 2) change gt1 to >1. For example: C_xH_xO₁N_x and C_xH_xO_{>1}N_x.