

Interactive comment on “Isotopic characterization of nitrogen oxides (NO_x), nitrous acid (HONO), and nitrate (NO₃⁻(p)) from laboratory biomass burning during FIREX” by Jiajue Chai et al.

Anonymous Referee #2

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Summary: The authors applied the recently developed annular denuder system (ADS) to the collection of HONO and NO_x during the FIREX laboratory burns in 2016. They compare measurements of HONO across five different methods, showing decent agreement and suggesting good collection efficiency in the ADS method. Values were presented for d15N-NO_x, d15N-HONO, d18O-HONO, d15N-pNO₃⁻, and d18O-pNO₃⁻. Some of these values compared favorably with previous measurements, and others were the first of their kind. I found this manuscript to be well written. I recommend it for publication after some minor corrections and explanations.

Specific Comments:

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Abstract: I personally find that your abstract is too broad. In the first two paragraphs, there is a lot of text about describing the methods, and the real results of your work are getting buried in the later paragraphs. I think you could increase the impact of your work by removing some of the general statements and focusing on specific results (numbers and direct conclusions) as described in the latter two paragraphs.

Pg 5 Ln 152-153: How did you decide on the acronyms/abbreviations for each fuel type? Most of them don't seem to make any intuitive sense, and this is very distracting when trying to understand your results. I'd recommend you make them easier to understand, e.g., Douglas-fir (DFIR), etc.

Pg 6 Ln 225: I have several questions regarding this section about the NO_x measurements: a) Throughout the manuscript, whenever you give NO_x values or use NO_x values in calculations, are you using the values from the collection of NO_x after the ADS system, or are you using NO_x values measured using the Thermo instrument? My impression is that you always use the former, and never show any data from the Thermo instrument. If so, you really have no reason to mention the Thermo measurement at all here, and it could be removed. (If not, then please be explicit throughout the manuscript about where the NO_x data originated at each mention in the text). b) However, I don't suggest you remove the description of the Thermo instrument! Instead, I suggest you show the data that underlies the statement "The NO_x measurement verified the concentration of the NO_x collected for isotopic analysis, and the original NO_x data is available. . ." This would be a plot analogous to Fig. 3 but for NO_x, potentially in a new section analogous to Sect 3.2 (or in the SI, in which case the Thermo instrument description should also move there).

Pg 6 Ln 234-237: How important is the interference of HONO on the Thermo NO_x instrument? Please provide more information about how you corrected for it (e.g., what fraction of HONO did you assume gets converted to NO in the catalyst?), and provide the numbers for how large the correction was relative to the total NO_x measurement. At this point, you only mention the correction in passing, and a reader cannot determine

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how important the correction is.

Pg 9 Ln 330: It should be mentioned somewhere here that the PTR-ToF is a mass spectrometer. It is important for consistency that you also use the same acronym for the instrument as they use in the cited Koss and Yuan papers.

Pg 10 Ln 394: Your HONO/NO_x ratios were calculated as averages across the entire burn, correct? This is good for comparison to previous results, but I'm wondering if you can also calculate a time dependent HONO/NO_x ratio across each burn. In other words, as each burn transitions from flaming to smoldering, does this HONO/NO_x ratio change? This would be important to note for real wildfires that may have different ratios of flaming vs smoldering emissions.

Pg 14 Ln 567: This line suggests that the average combustion temperature was "moderate" (e.g. 700C) rather than high temp (>850C). How does that translate to flaming vs smoldering? What is a typical temperature for each phase? More specifically, my question is are you saying that the flaming during FIREX was typically closer to 700C than 850C, or are you saying that flaming could have been near the hotter end of the spectrum but the dominant source of emissions was from smoldering processes at lower temp?

General comment: Related to my previous comment, can you add a few sentences (perhaps in the conclusions section) about how exactly your measurements of fresh lab smoke may relate to measurements of fresh wildfire smoke? You've given some discussion about how you expect the d15N-HONO and d15N-NO_x to depend on combustion temperature, and in wildfires you are likely to have instances where the (average) combustion temperature is potentially very different than what you measured in the lab. To my understanding, there is currently no good way of determining exact combustion temperatures either in the lab or in the field, so I'm not asking you to solve this problem but rather to acknowledge it and provide some guidance for how future isotopic measurements in wildfires could be interpreted relative to your results.

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Figure 3: Please change the “CIMS” label in the legend to match the “PTR-ToF” designation in the caption.

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