

General Summary:

The work presented here reports the change in mixing ratio and distribution of several biogenic and anthropogenic VOC measured in a forest, as a response to increased temperature and transported biomass burning plumes. The authors emphasize the variability of VOCs and associated reactivity due to heat and smoke. This study investigating how the VOC distribution changes in response extreme events is highly relevant, and the authors have done quite a bit of work to improve upon the analysis from initial submission. The appropriate temperature responses have been added, and a section on reactivity has been included to expand the discussion of VOC variability and reactivity under extreme conditions. There are some minor adjustments that need to be made, but overall the reviewer is pleased with the additions and corrections the authors have made to help improve the manuscript. I recommend publication of the manuscript, after these small issues (addressed below) are rectified or clarified.

Minor comments:

I recommend abstract explicitly state the estimated and increased OH reactivity due to these exceptional events. This is a significant and informative addition that is highly relevant. The authors should do well to emphasize this!

Figure 1 is missing (A), Figure 1C is missing a label for the x-axis, not sure what this is representing?

L285 to L287: Minor point, but I would caution against the authors using “large” to broadly refer to particles >50 nm. Based on the geometric mean diameter shown in the supplementary information Fig. S2B, the particles fall into the accumulation mode and are technically “fine mode” aerosol. Large particles typically refer to particles in the coarse mode (e.g. >2500 nm or 2.5 microns). Suggest removing ‘large’ in lines 285 to 287, and instead simplify to say “..Particles >50 nm in diameter were observed...” and “...for the presence of these particles...” You could also consider stating the average (+/-) geometric mean of particles throughout the study for reference.

L381-383: It’s both interesting and intriguing that catechol also has a sharp peak after 6 PM in the diurnal cycle shown in Fig 2M. Is there some process responsible for this, or is that just an artifact from data averaging smoke impacted days? The lines here mention that it increased significantly to 300 ppt on some days, so it could just be that the timing of the smoke impact corresponded with that sharp increase?

L388: Make sure to specify/reiterate that smoke concentration is derived from HRRR. (E.g. “Figure 4 shows the HRRR-derived smoke concentration...”

Figure 4B: It's difficult to read/see the trajectory as an inset in the figure. Is it possible to make it its own separate panel, or move it to the supplement as part of figure S5?

L437-438: Are there units on this value of 8.5? Is this different from C_{sat} ?

L450-451: Presumably "low temperature" means $<32\text{ C}$ and extreme is $>32\text{ C}$? Suggest defining/stating this in parenthesis next to the statements to prevent ambiguity. Is the low temperature and corresponding reactivity in reference to the selected time period (July 8 to 17) or is that the average for non-impacted/non-extreme temp outside of that date range as well? Please clarify.

L450-L453: The additional reactivity calculations do a lot to help develop the work and associated impacts! These calculations are a highly useful addition. However, I think this section could be worked on a bit to provide more clarity and help emphasize the significance of what is shown. Is it possible to include OH reactivity during "background" or typical conditions during times not influenced by temperature or combustion? Looks like July 9th to 10th could be a possible time-frame that would work for this? L443 earlier states that average reactivity between July 8 to July 17 was 91.30 , but this average would presumably include days that experienced elevated temperature and BB impacts. What does the reactivity look like outside of these times? This would provide a useful benchmark for determining exactly how much the reactivity increased due to these extreme events. If it's not possible to calculate yourself, is there a study you can cite that might provide an estimate? I'm also confused as to how it's possible that the reactivity at low temperature (however that is defined) is higher than the average for this entire "impacted" period (98.92 low temp versus 91.30 s^{-1} average July 8 to July 17)? Clearer wording and phrasing throughout the paragraph would strengthen this finding.

L451: It would be useful to compare your estimates of OH reactivity to other studies (SOAS, CalNEX, WE-CAN, etc.), for context.

L453, & Figure 5: One thing not emphasized in the text that I think would benefit from more attention is that according to L453 and Figure 5, even though total VOC was lower during the BB event compared to extreme heat, total volatility increased (presumably due to presence of BB compounds like benzene and HCN as mentioned in text). Total reactivity under BB was comparable to reactivity under high temp conditions without any BB influence. Given the lower apparent tVOC, this really highlights how reactive BB gas phase species are! This should be emphasized, especially when considering the projected increase in BB and extreme temp events in the future, and also begs the question—under these future climate scenarios what will have more of an influence in this kind of environment: enhanced temperature, or enhanced BB?

L466-L470: Do you have data that you can add here to support this? (E.g % change enhancement due to increased temperature, or make a table in the supplement). Without the values there the reader is left to take the author's word for it.

Figure 6: The CxHyNz category is a bit washed out and difficult to see. Can you make it a different color or make it darker? Same for the error shading in diurnal plot Figure 6C.

L496: Define what a substantial number is. N=?

L504-505: Can you remind the reader of the significance of LogCsat >6? What do values higher than this imply? Reiterate the message you want to convey.

L512-513: *"This is unlikely due to the expected biogenic emission in the forest, although it came second with 34% contribution compared to 66% from the H-BB factor."* This sentence is worded strangely... Does "this" refer to the preceding sentence describing monoterpene and its fragment? Is "it" also monoterpene and its fragment? Not sure what This/it refers to here, can you please clarify?

L514-L515: Hmm, are BB events considered anthropogenic? I think this is the subject of ongoing debate and is a hot topic! 😊 The answer depends on where you are in the world. Suggest slight rephrasing to ..."originate from anthropogenic sources and BB events"

L525-526: Do you have a reference to support nighttime oxidation of NO₃ contributing to the formation of these species?

L528-529: *"During the transport of BB plumes, the secondary factor had a relatively low increase in signal compared to both BB factors, which shows that oxidation compounds were generally locally..."* I don't think this is true, given that one of your factors is literally called, "oxygenated BB", which implies that there was indeed some contribution from long-range transport... I think maybe what you mean to say is, "the secondary factor had... low increase... showing that secondary formation was predominantly locally generated..."

L530-531: Re-emphasize the change to chemistry during the BB impact to strengthen your messaging. What was the increase in reactivity during BB events compared to non-BB events (see earlier comment)? Add it here.

L533: What is meant by a "critical" VOC? Suggest removing this adjective and just saying, "VOCs have important contributions to several..."

L536: Change to "anthropogenic and fire emissions". Anthropogenic emissions typically refer to things like traffic, shipping, home heating, etc. While it's true that a significant portion of wildfires are started by humans, that's not always the case. Factors contributing to fire ignition are dependent on location and time of year, among others.

L538-539: Some of these are also sourced from anthropogenic emissions (e.g. benzene, toluene), so I suggest removing “in the forest” after typical VOCs, especially when they are referenced as AVOCs later in the conclusions (L545). Add the error to the average total mixing ratio reported at the end of the line in L539.

L541-L542: Add the uncertainty or standard deviation with these averages.

L557-L558: “...Increases could be significantly affected regionally by accompanying changes in atmospheric circulation.” I’m not sure what this means or is supposed to imply. Are you saying that the extent of predicted increases could be regionally impacted due to changes? Suggest rewording for clarity.

L565: Not sure what a typical VOC is. I think you mean to say background/typical conditions? “Typical VOC” likely changes based on location and environment.

L567: Important to note that this is for all of the measured VOCs*. Estimates could vary if additional species are measured to include those beyond the list of 250+ you have.

L568: But you had a whole factor named “oxygenated BB” that showed enhancement so it’s not clear to me how it’s fair to say, “During BB plume transport, less oxygenated compounds were enhanced...” ?