

Interactive comment on “Biogenic volatile organic compound ambient mixing ratios and emission rates in the Alaskan Arctic tundra” by H el ene Angot et al.

Anonymous Referee #2

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Major comments The manuscript presents results from a series of well-designed experiments that explore emissions of isoprene and monoterpenes from Arctic plants to the atmosphere. The experimental design is sound and well-described, except for a few minor points noted below. The main conclusion is that the rapidly warming Arctic will cause sharply increased emissions of isoprene, which previous studies have shown to have a significant impact on atmospheric chemistry. Overall, this paper supports previous research findings, but the detail and atmospheric chemistry perspective make it a valuable contribution to the literature.

While the focus of the paper is from the atmosphere-exchange perspective, several

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ecophysiological concepts which have been discussed previously for Arctic BVOC emissions should be addressed. First, given the emphasis placed in the paper on the response of emissions to warming, the acclimation process should be addressed (see one reference below). Second, temperature in the current study refers to air temperature, but isoprene and other MT emissions respond to leaf temperature. And leaf temperature in turn depends on plant water relations in addition to air temperature. Given the unique eco-hydrology of tundra plants, some attention should be paid to this driver. In particular, was soil moisture monitored for any of the chamber experiments? Was SM measured at the tower?

<https://onlinelibrary.wiley.com/doi/pdf/10.1111/pce.12530>

Minor comments Line 62: Delete second “to.” Line 81: The term “flanks” is a bit odd. At least it should be singular. Line 86: Italicize “*Vaccinium vitis-idaea*.” Line 109: very briefly give the details on the “moisture trap.” Were cooled glass beads used? Line 110: What absorbents were used? Line 129: How large was this combined effect, in percent terms? Line 154: What uncertainty is introduced by data processing? Do you mean something related to statistics? Line 166: Please note when solar noon occurs at the site in AST. Line 179: Add a brief mention of how the tubes were capped. Lines 315-318: I concur with this conclusion. You could make this more clear and impactful by stating that both the intense wildfires regionally and the isoprene emissions locally were driven by high air temperature. But further, could there have been an influence on the photochemical lifetime of isoprene due to the products of the wildfire? Could the main isoprene oxidants, OH & ozone, be suppressed? Lines 319-335: Since you are integrating results and discussion, what’s the implication of these results? Lines 338: There is no need to refer explicitly back to the Materials and Methods section, so “(see Section 2.3)” can be removed. Lines 343-345: What’s the implication? Is the isoprene ‘sticking around’ from the more productive part of the day or is production continuing throughout the ‘night’ (low-PAR conditions). Lines 347-350: This is more than ‘consistent.’ I would change the wording to something along the lines of ‘expected.’

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Line 383: this is a really high number and should be highlighted in the abstract. Unadjusted for temperature, biomass and light, it's similar to results from many mid- and low-latitude forests. Later in the paragraph, you give the comparison, which is good. But, I think the key is that the extreme values are so high. Line 406-409: Should explicitly state that even with nearly 24 hours of light, still get the typical diurnal pattern. The key is that low sun angles translate to very low PAR (non-linearly), and therefore you still see the typical diurnal pattern. Later in the paragraph, you get to this explicitly, but the discussion should be combined for clarity. Also, this should be related to the diurnal balloon experiment results. Lines 455-459: This needs to be tempered a bit. There are issues of timescales and acclimation. Also, I assume there are relatively few chamber measurements between 35 and 40 deg C, hence a leveling off is within statistical probabilities. Also, you will argue against this point in the following paragraph, so this could be presented more clearly to readers. Lines 461-462: I think I understand what this sentence is trying to convey, but it is confusing and the statement could be clearer. You that for every year in the dataset, there were 1-23 days with a temp above 20 deg C? Line 471: "Under" might be a better word choice than "scarcely." Line 472: Same comment as Line 81 about "flanks." Line 474: "Elevated" compared to what? Expectations or previous measurements? Line 477: Thermotolerance hasn't been addressed previously in the manuscript. At the minimum, a citation is necessary, but it might be best to remove this if it's not explored more thoroughly with regards to Arctic plants. Line 485: Can remove "likely" since "suggesting" is already in the sentence and provides sufficient caution. Line 486-490: Here thermotolerance is addressed a bit further, with references. But it would be better to have a short paragraph or group of sentences that speculates specifically about the role thermotolerance could play in promoting isoprene-emitting species in the Arctic. The current allusions here and at Line 477 makes the topic appear as tacked on. Line 839, Table 1: some mention of the lack of measurements for *R. chamaemorus* would be useful, since it is the dominant species. Line 992, Figure 5: Solid, colored lines connecting the points would help visually highlight vertical trends.

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