

Interactive comment on “Burning-derived vanillic acid in an Arctic ice core from Tunu, Northeastern Greenland” by Mackenzie M. Grieman

Anonymous Referee #1

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The authors present a valuable record of vanillic acid (VA) from the Tunu ice core in northeastern Greenland. This record is part of a growing suite of high latitude biomass burning records in recent years that have been analyzed by the authors as well as other research groups. These data are an important contribution to the paleoclimate, ice core and fire science communities. This work fits squarely within the goals of “Climate of the Past”.

Unfortunately, the paper seems as if the authors wrote the manuscript in a rush. The authors stretch to find correlations where these relationships are not clear, and only briefly discuss any possible climatic influences (Section 3.6). The authors do not compare the Tunu VA record to any other proxy information derived from the Tunu core, other than accumulation, which is surprising as the ice core data would help to bet-

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ter link the fire activity recorded at Tunu to climate variables influencing the site. I understand that we often have deadlines by which to submit papers in order to meet outside goals, which may be the reason for a possible rush. However, this paper needs substantial revision as the current form contains multiple interpretations that are not supported by the data.

Section 2.2: The authors mention that they do not report p-HBA in any of the samples due to interference at the m/z 137- \rightarrow 93 mass transition, and ascribe this interference to a possible contamination during sample handling and/or storage. However, this interference is also present in the blanks. Are these blanks the 58 MilliQ water blanks that were previously mentioned? Does the interference also occur in the procedural blanks? (It is unclear if you have both lab and procedural blanks. Please specify exactly how you created your blanks). This peak also occurs in your standards, suggesting that the source of contamination is local, yet you are able to quantify detection limits for p-HBA. Please explain.

Section 2.2: I can understand the want to just site a previous method study to then move on more quickly to the results and discussion. However, more information from the Grieman et al., 2015 method paper is necessary within Section 2.2 of this paper. (Please also change your citations from Grieman et al., 2017, 2018, in review, to Grieman et al., 2015 and 2017 to correctly cite to work to which you refer). For example, what QA/QC measures do you use? Do you apply an internal standard? Readers cannot analyze your interpretations of the data without having a clear indication of the quality of the data.

Section 3.3: If 17% of the back-trajectories are from North America in the summer, and if 3% are from European ecofloristic zones, and 2% from Siberian ecofloristic zones, where is the source of the rest of the summer back-trajectories? I was hoping the Figure S7 would help determine where the other 78% of the summer back-trajectories originate, but this is not the case. It would be good to demonstrate in another figure in the Supplementary Information the paths of the other summer back-trajectories, as

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well as the back-trajectories of the 3% from Europe, and 2% from Siberia.

Section 3.4 and Figure 8: You mention that “the results show a strong positive correlation for all the records from 650-1200 CE and a more variable and weaker relationship thereafter”. The approach of computing the “correlation coefficient between the three pairs of proxies in a 200-year moving window (Fig. 8, lower panel)” is an excellent way to demonstrate the relationships between these three proxies. However, while the relationships between these proxies after 1200 CE certainly are variable, and do not demonstrate any patterns either between themselves or with each other. The only relationship that does seem to exist – and this is really quite stretching the interpretation – is that the correlation coefficients for Tunu VA, NEEM NH4 versus Tunu VA, NEEM BC are out of phase with one another after 1300 CE. It is better to state that after 1300 CE no major relationships exist between these data. Panel 2 is difficult to read. Either separating each proxy or elongating the y-axis will help the reader.

Section 3.5 and Figure S9: You mention “the qualitative similarities between the Tunu VA and western Canadian charcoal record suggest that this may be a source region of the Greenland burning signals, but the correlation is not significant at the 95% confidence interval.” However, in examining Figure S9 closely, the only correlation occurs at 1400 CE, while all other peaks and low points are offset from one another. These records do not correlate, and ascribing western Canada as a source region based on this data is overreaching what the data actually demonstrate.

Section 3.6 and Figure 9: “The data suggest a positive correlation between North American fire and hemispheric mean temperature.” This statement assumes that Tunu VA represents North American fire rather than boreal fire and/or regional fire. The comparison between Tunu VA and temperature for the entire northern hemisphere differs from your plots showing that the back-trajectories are primarily for high latitude regions. Using a temperature record that reflects your source region is a better comparison. (Using a representative temperature record is especially important as the MCA and LIA vary regionally, and therefore influence your time periods of interest).

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Did you calculate this correlation? Or do the data only “suggest” this correlation? The peak in Tunu VA and the peak in the NHT anomaly are offset by at least a century. The decreased temperature and lower concentrations of Tunu VA do occur during similar time periods.

Conclusions and abstract: The correlation between Tunu VA, and Neem ammonium and black carbon in the NEEM ice core only exists between 600 to 1200 CE, and so following statement is misleading: “The correlation between Tunu VA, and NEEM ammonium and black carbon in the NEEM ice core is encouraging evidence that a consistent pattern of centennial-scale variability in North American high latitude fire is recorded in Greenland ice, but further measurements on multiple ice cores will be needed to validate this conclusion”. A similar sentence is also present in the abstract. This correlation is only true for one part of the record, but absolutely does not apply to the rest of the record.

Conclusions: The statement “A clear link between the VA variability in Greenland ice and North American sedimentary charcoal is not evident, although a tentative connection to the Quebec region was noted”. This statement contradicts your text in Section 3.5 in which you highlight possible similarities (with which the data do not actually demonstrate, as mentioned in the above comment addressing Section 3.5) between the Tunu NA and western Canadian charcoal syntheses. It is essential to omit the conclusion regarding Quebec.

Figure 5: The information given by the fraction of ice core samples exceeding the 70th percentile actually detracts from highlighting the difference between the fraction of ice core samples exceeding the set peak threshold in the 65th and 75th percentiles. However, as you use the 70th percentile in section 3.4 and as the basis for the second and third panels of Figure 8, it may be better to only show the 70th percentile. These colors (as in Figure 8) are unfortunately the most difficult to differentiate for people who are color blind, resulting in a figure that is unreadable for many people. Please choose other colors.

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Miscellaneous: (Page numbers apply to the PDF version available to reviewers)

Page 3 Lines 32 and 33 (and continuing throughout the paper): PC's and RC's should be changed to PCs and RCs. As these components are not possessive, they do not require an apostrophe.

Page 4, Line 11: Place "of" between "frequency large".

Page 4, Line 12: Change "fiers" to "fires".

Page 4, Line 15: Omit the comma after "fluxes".

Page 6, Line 25: "The Canada charcoal record exhibits no linear trend and century scale variability that is not significant at the 95% confidence interval". This is double negative. Do you mean "The Canada charcoal record exhibits neither a linear trend nor century-scale variability that is significant at the 95% confidence interval"?

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