

This paper reports on the concentration of aromatic acids (vanillic and parahydroxybenzoic) measured along a Eurasian Arctic ice core covering the last 3000 years. These acids that are used as proxies of biomass burning were measured by using a newly developed technique (IC-ESI-MS/MS). The obtained records are then compared to those from other ice cores extracted at sites potentially impacted by boreal forest fires including the Altai, the Kamchatka, and the Greenland ice cap.

Data on past frequency of boreal fires are of great importance since the boreal forest represents an important carbon reservoir and experiences predominantly natural fires of which the severity is expected to change with future warming and the subsequent modification of spring/summer conditions. In contrast to Canadian (or Alaskan) fires, Siberian fires are far less documented except for the very last decades when satellite data has strongly increased the accuracy of estimated burned area of this region. This paper that provides a rather unique record of Siberian fires over several past millennia is therefore of great interest for scientific communities working on forest fire records in ice cores and lake sediments as well as for the general topic of climate/fire conditions/vegetation interactions.

Overall the manuscript is already in a very good state (presentation of data, figures, scientific discussions, references) and my major comment is related to one statement made in the introduction (lines 20-24) and a paragraph within section 4.2 where authors compare their findings with Greenland ice core ones (see below). I therefore recommend publication of the manuscript (after authors consider the question rise below).

Page 2, Line 20-24: Please refer that this point has been extensively addressed in Legrand et al. (2006) and it was concluded that “for Greenland ice, ammonium, formate, OC (DOC or TOC), BC, as well as vanillic and glycolic acids were enhanced well above their background values during fire events. »

Comments on Section 4.2:

Line 24-29, Page 9 (also lines 15-18, page 10): This paragraph needs to be reworded since, as it stands, it gives to the reader the overall impression that only levoglucosan records in Greenland ice are available and useful to discuss past biomass burning activity, which is not correct. In fact, the NEEM record (5-year average) of levoglucosan (Zennaro et al., 2014) suggests an outstanding maximum around 1600 (not revealed by the sub-annual BC and ammonium profiles). At the opposite, the two NEEM and the Summit high-resolution ammonium records consistently indicate high fire activity from 1200 to 1500 and after 1850, whereas low fire activity occurred particularly from 1600 to 1800. These changes are also consistent with a composite series of charcoal records related to northeast boreal fires in North America were obtained (Power et al., 2012), confirming the high fire activity at the transition from the 19th to 20th century and to a lesser extent during the Medieval Warm Period, and the very low fire activity at the end of the Little Ice Age.

So making a too strong point on the past fire activity derived from a levoglucosan Greenland ice record would give the feeling that Greenland (in contrast to what tell us the air mass backward trajectories) better records Siberian than

Canadian fires. Concerning the levoglucosan, first as mentioned line 2 (page3) (“the utility of this compound as a quantitative tracer is somewhat controversial due to the potential for rapid degradation in the atmosphere (Hoffmann et al., 2010; Hennigan et al., 2010; Slade and Knopf, 2013) »). Second, I just would like to emphasize that the comparison between the Greenland ice levoglucosan record and the Akdemii Nauk one is a bit misleading since your record shows numerous events with elevated level of aromatic acids (your figure 3) within the 1460-1660 CE time period for instance, whereas the « corresponding » levoglucosan Greenland peak is made of one or two outstanding values.

Therefore, I would like to propose a more adequate wording in updating the paragraph as follows (it is of course a suggestion):

“Ammonium ice records that consistently indicate Canada as the main source for fire plumes reaching Greenland also suggest changes in fire activity in response to climatic fluctuations over the last millennium (Legrand et al., 2016 and references therein). Indeed, the ammonium records from two NEEM and one Summit ice core reveal high fire activity from 1200 to 1500 and after 1850, whereas low fire activity occurred particularly from 1600 to 1800. These Greenland records suggest temporal changes coinciding fairly well with the occurrence of the warm and dry climate of the Warm Medieval Period (MWP; 1200–1350) and the cold climate of the Little Ice Age (LIA; 1600–1830). These past changes are consistent with composite series of charcoal records related to northeast boreal fires in North America (Power et al., 2012) indicating a high fire activity at the transition from the 19th to 20th century and to a lesser extent during MWP, and a very low fire activity at the end of the LIA. If correct, that suggests a different response of the Siberian and Canadian fire activity over the last millennium. To date, the NEEM record (5-year average) of levoglucosan (Zennaro et al., 2014) suggests a different picture for past changes with an outstanding maximum around 1600 (not revealed by the sub-annual BC and ammonium profiles). But, as discussed by Legrand et al. (2016), further works are here needed to understand the cause of the observed difference in past fire activity changes derived from levoglucosan, black carbon, and ammonium Greenland ice records.”

Power, M. J., Mayle, F. E., Bartlein, P. J., Marlon, J. R., Anderson, R. S., Behling, H., Brown, K. J., Carcaillet, C., Colombaroli, D., Gavin, D. G., Hallett, D. J., Horn, S.P., Kennedy, L. M., Lane, C.S., Long, C. J., Moreno, P. I., Paitre, C., Robinson, G., Taylor, Z., and Walsh, M. K.: Climatic control of the biomass-burning decline in the Americas after AD 1500, *The Holocene*, 23, 3–13, doi:10.1177/0959683612450196, 2013.

End of the review