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Interactive comment on "Ice core records of biomass burning tracers (levoglucosan, dehydroabietic and vanillic acids) from Aurora Peak in Alaska since 1660s: A new dimension of forest fire activities in the Northern Hemisphere" *by* Ambarish Pokhrel et al.

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Reviewers #3 Interactive comment on "Ice core records of biomass burning tracers (levoglucosan, dehydroabietic and vanillic acids) from Aurora Peak in Alaska since 1660s: A new dimension of forest fire activities in the Northern Hemisphere" by Ambarish Pokhrel et al.

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biomass burning tracers levoglucosan, dehydroabietic acid and vanillic acid from an ice core retrieved at Aurora Peak, Alaska, and covering the time period from ca. 1660 to 2009. In general, this seems to be a high quality data set, which may be interesting and may deserve publication, since only few ice core records of such tracers are available up to now. Unfortunately, the manuscript does not meet basic scientific criteria, as outlined below, is very descriptive and not well-written (requires English editing), and lacks a clear structure, which makes it hard to digest. Before becoming publishable, major revisions are therefore required.

1. Method description is incomplete (no detection limits) and basic ice core data are missing (dating, dating uncertainty, melt extend, etc.). Response: Thank you. Taking reviewer comment, we have added several paragraphs on methods in this section 2. Please see revised section 2, lines 104-174.

2. The record presented is incomplete, only 40% of the core was analysed, i.e. the records are not suitable to discuss short-term biomass burning events. Response: Thank you very much. Only 40% samples were available for analyzing organic compounds (e.g., anhydrosugars). Based upon the available data, we have discussed the source of biomass burning tracers as best as we could.

3. Records should not be shown as continuous line; data points should indicate for which time period they are representative. Response: Thank you. We have added new figure in the revised MS. Please see Figure 2.

4. The Aurora ice core is affected by melting with melt feature percentages of up to 100%. It should be discussed how this effects the records of biomass burning tracers. Response: Thank you very much. The annual snow accumulations rate is 8 mm yr-1 since 1900 to onwards and drastically increasedincrease to 23 mm yr-1 after the Great Pacific Climate Shift. Meanwhile, the average temperature anomalies for 1923-1942, 1943-1945, and 1976-2007 were +0.73, -0.65 and +0.55ïĆřC, respectively (Tsushima et al., 2015). Please see line 536.

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We assumed that there was not 100 percent melting of snowfall in the saddle of the Aurora. The correlations of ïĄd'D record of this ice core and detrended annual accumulation rates of snowfall are well correlated with air temperature and precipitation amount at Aurora. The average annual amplitude of ïĄd'D from this ice core is 30.9%. This high amplitude of 30% cannot be maintained if a higher percentage (e.g., 100%) of the melting occurred in the past (Tsushima et al., 2015; Tsushima, 2015). These points are added in the revised MS. Please see lines 114113-117 116 and 541536-550545.

5. Recent other publications in this field should be discussed and cited (list at the end of this review). Response: Thank you. We have used new potential papers throughout out the MS. Please see revised MS.

6. There is no discussion with respect to other available data. Concentrations in the Aurora core seem to be higher than in the Kamchatka core, although Aurora is located much further away from the sources. Response: We compared our data with several other ice core studies in the revised MS. Please see Figure 6a-e.

7. What is the reasoning behind conducting a correlation analysis with nss-sulphate and nss-calcium. They are not expected to have a biomass burning source. Where the ion records averaged to match the incomplete sampling of the organic tracers? Response: Thank you. We have deleted these paragraphs.

8. It is unclear what can be learned from the fire spot data. Here you need to come up with a quantitative number to compare with ice core records. Response: We have prepared new fire counts with fire intensity and air mass backward trajectories. Please see Figure 7(a-f).

9. There are no conclusions, just a summary. Response: Thank you, this time we have added new paragraphs in this section. Please see the summary and conclusions in the revised MS.

10. Fig. 1: Already shown in Pokhrel et al., 2015 and Pokhrel et al., 2016, is this not a

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copyright issue? 10. Response: Thank you. We have changed it. Please see Figure 1.

Thank you very much for your valuable time and comments.

Gambaro, A., et al. (2008). "Direct Determination of Levoglucosan at the Picogram per Milliliter Level in Antarctic Ice by High-Performance Liquid Chromatography/Electrospray Ionization Triple Quadrupole Mass Spectrometry." Analytical Chemistry 80(5): 1649-1655. Grieman, M. M., et al. (2017). "Aromatic acids in a Eurasian Arctic ice core: a 2600- year proxy record of biomass burning." Clim. Past 13(4): 395-410. Grieman, M. M., et al. (2018). "Aromatic acids in an Arctic ice core from Svalbard: a proxy record of biomass burning." Clim. Past 14(5): 637-651. Grieman, M. M., et al. (2018) "Burning-derived vanillic acid in an Arctic ice core from Tunu, northeastern Greenland." Clim. Past 14(11): 1625-1637. Grieman, M. M., et al. (2015). "A method for analysis of vanillic acid in polar ice cores." Clim. Past 11(2): 227-232. Kehrwald, N., et al. (2012). "Levoglucosan as a specific marker of fire events in Greenland snow." Tellus B: Chemical and Physical Meteorology 64(1): 18196. Zennaro, P., et al. (2014). "Fire in ice: two millennia of boreal forest fire history from the Greenland NEEM ice core." Clim. Past 10(5): 1905-1924.

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