"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 and co-workers.

Overall evaluation:

The topics is of importance since fires are a major source of gases and aerosols that strongly impact chemical composition of the atmosphere and the radiation balance. In turn, climate changes directly disturb the fire regime, for instance through the duration of fire weather conditions and changes in vegetation, particularly in the boreal regions. In addition to this overall interest, the data presented in this paper would be useful to discuss the consistency between these three organic markers (levoglucosan, dehydroabietic and vanillic acids) and other potential proxy including ammonium. However, as it stands, the paper suffers from too many weaknesses to be recommended for publication at the ACP journal. I recommend to the authors to take time to revisit the existing literature and their data.

Major weaknesses:

1. Quality of the Aurora ice record: Some key information are missed in the manuscript for the reader to evaluate the quality Aurora ice core record. Indeed, when using an ice core record to infer atmospheric information, the reader (and the reviewers) needs to have some basic information that are not given in section 2 (Materials and Methods). I think that, given the rather low elevation (2850 m) of the Aurora site, we may expect frequent melting. If, so that has to be clearly stated in the manuscript and the authors would discuss the possible consequence for the quality of the ice record in terms of atmospheric signal. Since the effect of melting is not well know for organics, it would be nice to show the record of major ions (including ammonium, nitrate, and sulfate). Checking your Figure 4, i am very surprised by the nitrate levels that are shown to range between 0 and 34 ppb (i.e., very low levels). At the opposite, the nss-K level (ranging from 0 to around 50 ppb) exhibits several values exceeding 15 ppb (which is a lot): how much abundant is calcium in this core? (see my further comments on the use of fine potassium).

2. Inconsistencies: Since you will discuss in section 3 (as also mentioned in the abstract) the correlations of levoglucosan with NO2-, NO3-, nss-SO42-, nss-K+, and NH4+ that are all insignificant (suggesting that these anions and cations do not represent a gleaming signal of biomass burning activities in the source regions for southern Alaska)), it would be nice to show the profiles. This need to report these profiles also comes from the fact this observed absence of correlations contrasts with the statement that I find in the paper from Tsushima et al. (2005) stating "To confirm the dating based on D and Na+ seasonal cycles, we compared the dating of the ice core with reference horizons of known age (Fig. 3). We found a large peak of NO3 and NH4+ and a visible dirty layer at 8.55 m w.eq., which we ascribed to the year 2004. Generally, NO3 and NH4+ are released by forest fires (e.g., Legrand and Mayewski, 1997; Eichler et al., 2011). »

This point clearly needs to be discussed showing all the records, i think. Since, as also suggested by your figure 5, the 2004 year was characterized by large fires in Alaska, please also comment your organic records for this year ???

3. Numerous previous works are not cited or adequately cited in the manuscript:

In the introduction and at several places in the text, the previous works done on fire records in ice cores are not adequately cited, and some important references are missed including two reviews papers (see the list below). For example, you extensively cited the paper from Whitlow et al. (1994) for ammonium and nitrate biomass burning events that just follows the pioneering study from Legrand et al. (1992) for ammonium, nitrate and carboxylates. After the publication of these two papers, it becomes clear that, although some ammonium spikes are sometimes accompanied by nitrate peaks, it is not a general rule (Savarino and Legrand, 1998). This point was extensively discussed in the review from Legrand et al. (2016). The same is true for the non-sea-salt and non-dust potassium fraction. On this topic, in your manuscript I would recommend to report nss-non-dust-potassium (calculated by using your calcium data).

Finally, none of the Greenland ice core studies reported a sulfate perturbation with biomass burning peaks. So I will be more careful about that at line 246.

Legrand M., M. De Angelis, T. Staffelbach, A. Neftel, and B. Stauffer, Large perturbations of ammonium and organic acids content in the Summit Greenland ice core, fingerprint from forest fires ?, *Geophys. Res. Lett.*, 19, 473-475, 1992.

Legrand M., and M. De Angelis, Light carboxylic acids in Greenland ice: A record of past forest fires and vegetation emissions from the boreal zone, *J. Geophys. Res.*, 101, 4129-4145, 1996.

Savarino, J., and M. Legrand, High northern latitude forest fires and vegetation emissions over the last millenium inferred from the chemistry of a central Greenland ice core, *J. Geophys. Res.*, 103, 8267-8279, 1998.

Legrand, M., McConnell, J., Fischer, H., Wolff, E. W., Preunkert, S., Arienzo, M., Chellman, N., Leuenberger, D., Maselli, D., Place, P., Sigl, M., Schüpbach, S., and Flannigan, M.: Boreal fire records in Northern Hemisphere ice cores: A review, *Clim. Past*, 12, 2033-2059, doi:10.5194/cp-12-2033-2016, 2016.

Rubino, M., D'Onofrio, A., Seki, O., and Bendle, J.A., Ice-core records of biomass burning, The Anthropocene Review, vol. 3(2), 140-162, DOI : 10.1177/2053019615605117, 2016.

Grieman, M. M., Aydin, M., Isaksson, E., Schwikowski, M., and Saltzman, E. S.: Aromatic acids in an Arctic ice core from Svalbard: a proxy record of biomass burning, Clim. Past, 14, 637-651, https://doi.org/10.5194/cp-14-637-2018, 2018.

4. The wording is sometimes too vague or unclear, figures are unclear:

I don't understand the meaning of "A new dimension of forest fire activities in the Northern Hemisphere" in the title.

Line 29: what do you mean with "different ice core studies": Please specify from where ?, with which proxy ?, which time period ???

Lines 236 and 239: what are these numbers: concentrations of ammonium ? of levoglucosan ?

Why figure 3 reports levoglucosan only up to 600 ng L^{-1} and Figure 4 only up to 1200 ng L^{-1} while Figure 2 indicates levo as high as 20802 ng L^{-1} ???

Please show satellite data for Siberia as well in Figure 5.

5. Information derived from Back-ward trajectories:

I think you may address more details on the origin of air mass reaching the Aurora site. In the present manuscript you stated at the end of the introduction: "Particularly, 10 day backward trajectory from 1992-2002 showed that southern Alaska can receive air masses from the North Pacific Regions, East Asia, Eastern Russia-Siberia, higher latitudes of Alaskan regions, Japan, and Canadian regions in the troposphere (>300 hPa) (Yasunari and Yamazaki, 2009)."

I here recommend to address the following points (that would need new calculations): (1) focus on the fire season (from June to August), (2) I think 300 hPa is too high (it is the upper troposphere) and 500 hPa (around 5 km elevation) is likely more relevant for the travel of plumes. Also check the sensitivity between 5 and 10 days.

6. Discussion with previous records (section 3.4):

Why do you extensively discuss your organics with ammonium records from 20D (Greenland) ???? This discussion is not very useful since the records were obtained with different proxy and are expected to be influenced by different source regions (Canada for Greenland versus Alaska and may be Siberia for Aurora).

Instead, again please show your own (Aurora) data on ammonium, nitrate, potassium, sulfate etc.

End of the review.