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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Drought-induced biomass burning as a source of black carbon to the Central Himalaya since 1781 CE as reconstructed from the Dasuopu Ice Core" *by* Joel D. Barker et al.

Anonymous Referee #1

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Manuscript review Title: Drought-induced biomass burning as a source of black carbon to the Central Himalaya since 1781 CE as reconstructed from the Dasuopu Ice Core Author(s): Joel D. Barker et al. MS No.: acp-2020-1052 MS Type: Research article

General comments :

The manuscript proposed by Barker and al. presents a new rBC profile reconstructed from the Dasuopu ice core covering the period 1781-1992. After an analysis of this archive using SP2 technic, a spectral analysis of the rBC profile provides an interpreta-

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tion highlighting periods of drought and flooding in the emission regions. If the periods of drought are assimilated to an intensification of biomass fires emitting BC, this result is not confirmed by the contribution of trace metals.

This work upgrades this research theme with at least three significant contributions. First, a new BC record for the Himalayan region, particularly its southern barrier impacted by emissions from the Indian basin, and whose temporal coverage is large enough to include a pre-industrial period. It is however very regrettable that the post-1944 period could not be sampled with sufficient resolution and on a continuous basis for the study of this period where the anthropogenic impact is the strongest. This partially reduces the interest of the work.

The second strong point of this work corresponds to the statistical processing and spectral analysis tool applied to the BC profile. This method provides non-subjective information on the identification of events and trends that should be applied more widely in this community.

The last contribution I would like to highlight concerns the inventory and exploitation of meteorological data and other databases correlated with the results.

I suggest that this work can be accepted for publication with minor revisions and some additional information corresponding to the specific comments.

As a non-English native reviewer, I would not allow myself to make language corrections.

Specific comments :

L.43 : (Sakai and Fujita, 2017) focus on Himalayan glacier, whether precise it in the text, or add additional reference for global glacier.

L.179 : the presentation of the discontinuous sampling of this firn zone is important since it has consequences on the results presented later. It would be appreciated to know more precisely the available zones and to which season they correspond (mon-

soon, dry or intermediate season). One possibility would be to illustrate it with other parameters (water stable isotopes or dust), like done in Fig.3 for deeper sections.

L.192 : If sample were melted in their storage bag before transfer into the tubes, can you estimate the part of BC lost during this procedure as the bags were not sonicated before transfer ?

L.195 : Can you indicate the nebulization efficiency for the CETAC ?

L.201 : Can you indicate the range of concentration for your calibration ?

L.211 : "The record of rBC concentration with depth through the Dasuopu ice core provides a time series of rBC deposition onto Dasuopu glacier over time". Switching from a concentration (g.m-3) profile to a deposition (g.m-2) profile is not as trivial and requires a precise understanding of the deposition and post-deposition processes to reduce a factor of dimension. These aspects do not seem to be addressed at this stage of the study and it is therefore preferable to continue to present these results as concentrations. If I can afford it, it is possible to switch to annual deposition fluxes (g.m-2.y-1) the precise dating is available (m.y-1). "Deposition" is written elsewhere (L.229, . . .), so check them all over the manuscript.

L.284 : "the effect of discontinuously sampling the firn section and its accurate characterization of rBC since 1944 is unknown". This is true, and it has consequences for the discussion of the results obtained during this period of the record. I would suggest, if they are not simply taken out of the discussion, to use them with extreme caution, especially if they are confronted with other continuous sampling periods or similar periods from other sites and glaciers. Figure 2b illustrates the annual flux of rBC. I imagine, for lack of a description, that it is calculated and illustrated only for complete years, without sampling discontinuity. Moreover, for the concentrations and fluxes in Fig. 2a & 2b, since annual values for the period after 1944 are missing, the median value over 5 years is not representative (despite your explanations).

L.297-300 : see previous comment.

L.303 : Not being a specialist of this spectral analysis, you can bring more precisions on the method of identification of the 3 modes at 6, 27 and 512 beyond the simple visual aspect of figure 4b.

L.304-309 : What is the robustness of this analysis on the discontinuous section after 1944 ? Can it be made consistent with the previous zone ? Some border effect as suggested at L.498 ?

L.316 : From Fig. 4e only, I can't identify this shift between positive and negative coefficients at 1877 without further explanations . . . Once this point has been clarified, I appreciate this approach using spectral analysis.

L.365 : As done in Ginot et al (2014) using Lim et al. (2014) information, the impact of melting/freezing rBC loss could be approached to compare with Kaspari data. In any case, it is difficult to compare sites on the basis of the average concentration value obtained since several processes are involved (sources, transport, accumulation, deposition, post deposition . . .). On the other hand, the comparison of trends, increasing factor during anthropisation or particular events remains appropriate.

L.375 : This analysis on the seasonality of the rBC does not bring much new information compared to the referenced results. By using statistical and spectral analysis tools ... that you seem to master, and by compiling the different years, I am convinced that you can deepen this point. A fine analysis of seasonality would strengthen the conclusions on the identification and impact of biomass fires concentrated in one season, while other sources of BC are more temporally distributed over the year.

L.402-415 : BC concentration and snow accumulation are directly linked. Use only annual BC fluxes and snow accumulation for this temporal variation study and their link with climate, emissions . . .

L.530-557 : Concerning correlation between rBC and trace metals, as you point out,

you do not have the right tracers associated with biomass fire to provide meaningful interpretation. However, some inorganic tracers (potassium?) should have been analyzed by ion chromatography at BPRC.

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