Nov 08, 2021

Dear Editor and the reviewer,

Thank all of you very much for taking the time and efforts to review our manuscript, titled with "APCC Data Report I: Black carbon and organic carbon dataset from atmosphere, glaciers, snow cover, precipitation, and lake sediment cores over the Third Pole", that we have submitted to "Earth System Science Data" (MS No.: essd-2021-187). We have considered all comments and suggestions carefully and tried our best to address them and revised the manuscript accordingly. We greatly appreciate all the constructive comments and suggestions that have led to an improvement of the paper, and we hope the revised manuscript is suitable for publication in the journal.

Revisions are made to address the following specific comments.

Our point-by-point responses to the comments are listed below in blue color.

Yours sincerely,

Shichang Kang and Yulan Zhang on behalf of all co-authors

Response to comments:

The paper "APCC Data Report I: Black carbon and organic carbon dataset from atmosphere, glaciers, snow cover, precipitation, and lake sediment cores over the Third Pole" by Kang et al., presents a comprehensive summary of data report regarding the field measurements of black carbon and organic carbon in the Tibetan Plateau, known as the Third Pole. Generally, the paper is clear-written, and the dataset is important to the community for investigating the effect of anthropogenic impacts on the carbon cycle and the potential climate feedback in high elevation regions. I only have a few comments before publications:

Answer: Thank you very much for all the structured comments to improve our manuscript.

- There is a lack of descriptions about the data quality control and what methodology has been used for data processing.

Answer: The data quality for each equipment or parameter reported in this study has been added. The BC and OC data provided in our study are based on the different samples, the processes of

sample collection are according to the standard protocols used. For example, in study by Zhang et al. (2017), for BC and POC in snow samples, we evaluated blank filters for total carbon <1 μg cm^{-2}. For the same filter, multiple measurements showed small relative standard deviations (RSD, <10%), indicating that the data points tended to be close to the mean value, an acceptable filtration (Fig. R1). To test if the filtered meltwater volume contributed to BC measurement error, we filtered the carbon mass concentrations using different volumes. Corresponding relative standard deviations were mostly <30% (Table 1). This implied that our filtration procedure was reasonable. The duplicate snow samples demonstrated the similar concentrations of BC and OC (Fig. R2). We also evaluated the impact of inorganic carbonates interfering with BC measurements at the Laohugou No. 12 glacier, we acidified (N37% HCl) selected filters by fumigation in open glass Petri dishes held in a desiccator for 24 h and subsequently dried at 60 °C for 1 h to remove any remaining HCl. The results from the carbonate acidification and analysis indicated acceptable data quality with a discrepancy <20% (Fig. R3).

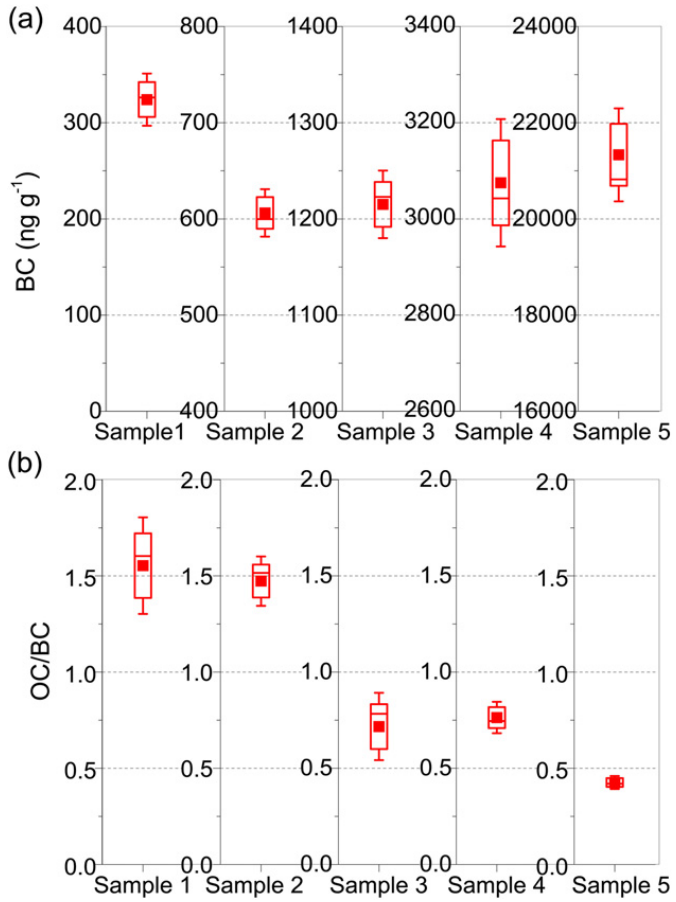

Figure R1 Multiple measurements of (a) BC concentrations and (b) ratios of OC to BC for

selected samples. (Red square represents the mean value.)

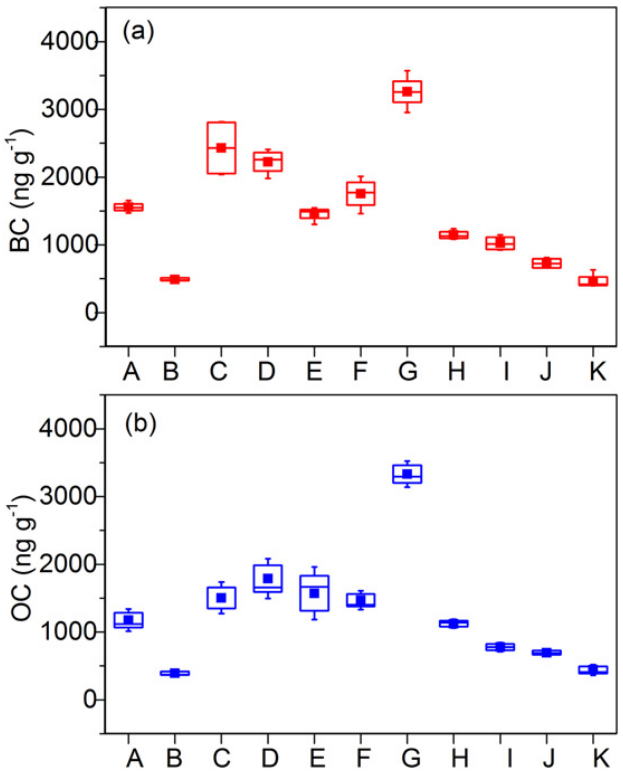

Figure R2 (a) BC and (b) OC concentrations for duplicate snow samples (collected in Aug 2015) filtered with different volumes. (A-K mean the sampling sites on the Laohugou No.12 glacier as shown in Fig. 1b.)

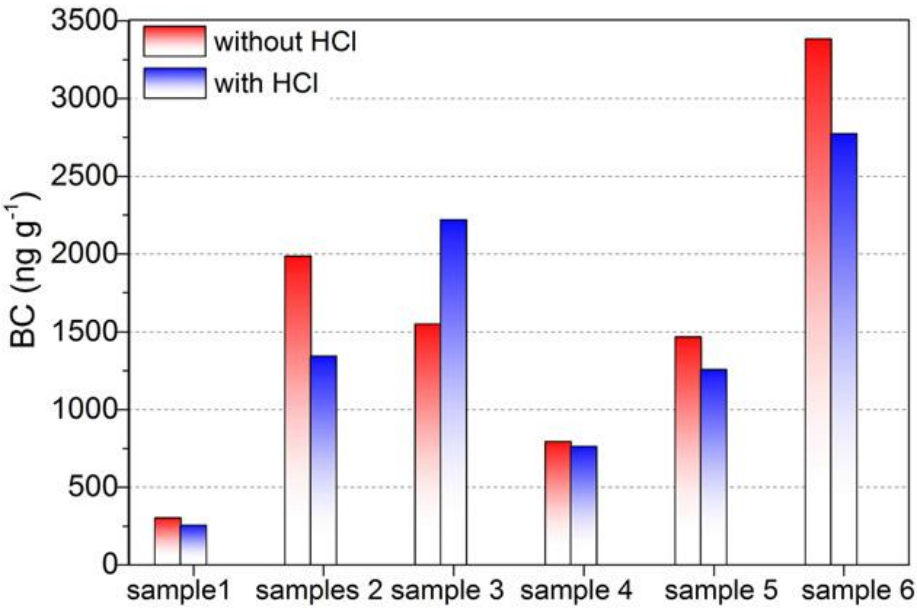

Figure R3 Comparison of BC concentrations measured with and without acidification.

Table 1
BC and OC concentrations (ng g^{-1}) for snow samples collected in August 2015 and the corresponding RSDs (%) filtered with different volumes.

Sampling site	BC Mean	BC RSD%	OC Mean	OC RSD%
A	1556	4.81	1177	18.53
B	489	4.56	391	10.99
C	2379	16.63	1504	22.96
D	2226	8.31	1787	21.97
E	1457	7.32	1571	32.88
F	1754	13.14	1470	12.62
G	3259	7.76	3332	7.79
H	1146	5.99	1123	7.69
I	1024	10.67	778	11.50
J	728	10.68	696	8.64
K	464	23.97	442	23.55

For WSOC in snow and ice, the detection limit of the analyzer was low at 4 μg L^{-1}, while the precision and average WSOC concentrations of the blanks were ± 5% and 4 ± 2 μg L^{-1}, respectively, demonstrating that contamination during the pre-treatment and analysis processing of these samples was weak (Hu et al., 2021).

For real-time eBC observations, when calculating eBC concentrations, it is therefore possible to eliminate the "loading effect" with the loading compensation parameter k, which allows extrapolation to zero loading, and the accurate ambient BC concentration is obtained (Drinovec et al., 2015). Previous studies have evaluated the real-time compensation algorithm of dual-spot Aethalometer model AE-33 and indicated that AE-33 agreed well with the post-processed loading effect compensated data obtained using earlier Aethalometer models and other filter based absorption photometer (Chen et al., 2018; Drinovec et al., 2015).

The rBC concentrations from ice cores are likely to be systematically underestimated due to the following: 1) Samples were stored in the liquid phase after melting, and prior findings indicate that storage in the liquid phase can result in as great as 80% reduction in measured BC concentrations (Wendl et al., 2014). This reduction is hypothesized to be caused by rBC particles sticking onto the container wall during storage in the liquid phase, or rBC particles agglomerating beyond the size range at which particles are nebulized (Wendl et al., 2014; Kaspari et al., 2014). 2) The nebulization efficiency is size dependent, with large (>500 nm)

and small (<200-250 nm) BC particles nebulized with lower efficiency than mid-sized particles (Wendl et al., 2014; Schwarz et al., 2012). Nevertheless, because we focus on the temporal variation of rBC from ice core for the historical records rather than on absolute concentrations, the systematic underestimation of rBC does not affect the historical change trends.

For BC in lake sediments, the repeated measurement of BC in a few lake sediments (n=5) were to ensure reproducibility of measurements, which reported as relative percentage deviation was better than 8%. Standard reference material (marine sediments, NIST SRM-1941b) was also analyzed to assess the accuracy of measurements. It indicated an average accuracy of 5.5% for the measurements of BC in lake sediments in this study (Neupane et al., 2019).

As suggested, we have added the related information for the data quality control.

References:

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Drinovec, L., Mocnik, G., Zotter, P., Prévôt, A. S. H., Ruckstuhl, C., Coz, E., Rupakheti, M., Sciare, J., Müller, T., Wiedensohler, A., and Hansen, A. D. A.: The “dual-spot” Aethalometer: an improved measurement of aerosol black carbon with realtime loading compensation. Atmos. Meas. Tech., 8, 1965–1979, doi: 10.5194/amt-8-1965-2015, 015.

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Zhang, Y., Kang, S., Li, C., Gao, T., Cong, Z., Sprenger, M., Liu, Y., Li, X., Guo, J., Sillanpaa, M., Wang, K., Chen, J., Li, Y., and Sun, S.: Characteristics of black carbon in snow from Laohugou No. 12 glacier on the northern Tibetan Plateau, Sci. Total Environ., 607, 1237–1249, doi: 10.1016/j.scitotenv.2017.07.100, 2017b.

- The manuscript lacks discussions about the scientific aspects of this dataset. I understand this is a data description paper but the manuscript in the current form looks more like a technical report, rather than a data paper. I notice there are several plots adapted from previous studies based on this dataset. So it would be necessary to summarize the findings based on this dataset. This would help the readers to understand the importance of this dataset and leverage its key scientific implications.

Answer: The journal's requirements stated that: *Articles in the data section may pertain to the planning, instrumentation, and execution of experiments or collection of data.* ***Any interpretation of data is outside the scope of regular articles****. Articles on methods describe nontrivial statistical and other methods employed (e.g. to filter, normalize, or convert raw data to primary published data) as well as nontrivial instrumentation or operational methods. Any comparison to other methods is beyond the scope of regular articles.* Therefore, we focused on the data report, not focusing on the results. Also, as suggested, we have added the brief discussion on the data and their scientific aspects in each section (at the end of each sub-section).

Specific comments:

Line 390: strike through text

Answer: Revised.

Line 518: It's not necessary to mention 'which is of great importance to scientific communities worldwide' as it has been addressed in the introduction.

Answer: Agree and deleted.