

Interactive comment on “Seasonal and elevational variations of black carbon and dust in snow and ice in the Solu-Khumbu, Nepal and estimated radiative forcings” by S. Kaspari et al.

Anonymous Referee #3

Received and published: 12 February 2014

This manuscript presents a small dataset of snow and ice samples taken from crevasse profiles and snowpits along an elevation gradient in Nepal and analysed for black carbon concentration.

Because of the very limited dataset, issues linked with sample preservation and analytical uncertainty, and the application of an existing radiative model with large uncertainties in the adaptation to the site, I do not consider this manuscript to produce sufficient new information to be suitable for ACP. I would recommend to publish the dataset in the ESSD journal which is well suited for reporting this type of data (<http://www.earth-system-science-data.net>).

C12123

The authors report issues linked with sample preservation, a topic that could be introduced early in the manuscript. They propose explanations for the elevation gradient in relationship with deposition and postdeposition processes, and estimate the impact of black carbon on snow albedo, with respect to the impact of other impurities.

The introduction would benefit from a specific focus on the area of interest (High Asia) and background about the structure of observed climate trends (e.g. seasonal and elevation patterns in temperature trends) and glacier mass balance changes.

It would also be very helpful for the non specialist to report the issues linked with the preservation of snow samples, and the coherency (or not) in-between different studies with respect to the accuracy and standardization of measurements. I also recommend to report the state of the art with respect to the seasonal deposition patterns and their causes. A key gap of this study is obviously the lack of direct, in situ albedo measurements, and this could be introduced somewhere.

Section 2 (site description) lacks any justification of the choice of the target glacier (Mera glacier). Was it chosen because of its proximity to the atmospheric observatory where BC measurements have been performed (Yasunari et al, 2010) ? What are the specificities of this glacier : recent mass balance changes, local climate trends, sources of aerosols ? It is expected to be representative of a larger area ?

The methods which are described page 33497 should be critically compared to the methods used for earlier studies discussed in the introduction. The uncertainties associated with the data (end of section 2) should be summarized (what can and cannot be done with these datasets if they are lower limit values).

In section 3, page 33500, the meteorological background is described in the somehow simplistic way. It would be useful to cite recent works on this aspect, such as a recent overview about the origin of moisture (Yao et al, Rev. Geophysics, 2013) and the residence time of moisture (Gao Jing et al, EPSL, 2013) (albeit these works are focused on water isotopes, they include an investigation of moisture sources and residence

C12124

time, including satellite OLR information on convective activity).

Albedo (page 33502). Do I understand well that this paragraph (lines 5-11) is based on visual inspection of photographs ? How valid is this methodology ?

Albedo calculation (page 33503-33504) : how has the SNICAR model been validated with respect to the interplay of snow properties and black carbon and other aerosols ? Is it well adapted for the case study ? What are the main sources of uncertainties ?

More generally, what is the relevance of a calculation of local, punctual radiative forcing, considering the seasonal, elevation and areas which would be impacted by such processes? Wouldn't an estimate of surface snow albedo changes as a function of black carbon and total aerosol load be more useful ? Specifically, for the high elevation glacier sites, what is the seasonal aspect of the mass balance, a feature which could be critical for the proposed mechanism by which impurities would remain exposed ? It seems to be that it is feasible to have information on the frequency of e.g. spring/summer snowfall and therefore assess the duration of surface snow exposure time.

Page 33507, the authors have a very general discussion which is an extrapolation of their findings for the whole area, discussing the distribution of snow coverage as a function of elevation. This extrapolation would first require confirmation of the patterns observed from this very limited dataset through other profiles and through different seasons. A cross-discussion with respect to the elevation range where negative spring summer mass balance can be identified would also be relevant. The discussion of impacts of albedo changes for other glacier areas does not seem fully relevant here (33508).

Finally, many aspects of the abstract and discussion/conclusion are very general considerations which bring no clear new finding. I would suggest to make a much shorter manuscript, more clearly focused on the limitations and new findings emerging from this limited dataset, rather than trying to extrapolate these results for a much broader area. An interesting point lies in the overlap between the radiative effects of dust and

C12125

black carbon, and therefore the need to have more accurate measurements along snow profiles.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 33491, 2013.

C12126