

Interactive comment on “Black carbon and mineral dust in snow cover on the Third Pole” by Yulan Zhang et al.

Anonymous Referee #2

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This manuscript presents results from snow sampling, laboratory analysis, and related modeling efforts for the presence and impact of light absorbing impurities in the Tibetan Plateau region. Although the manuscript is not wrong in stating more measurements are valuable in constraining our understanding of the spatial and temporal variability of light absorbing particulates, the techniques presented in this paper are unclear and as written does not contribute to the state of knowledge of light absorbing particulates in snow. Major changes are needed before this paper can be reviewed again for publication.

I will not, at the point, do line by line corrections because they are numerous. The authors need to revisit the writing in each section for editing and to clarify their justification, methods, and results. Particularly, snow sampling and automatic weather

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stations need to be described in significantly more detail.

My first and foremost concern is that samples were collected in November and December, and yet they are attempting to quantify the impacts of light absorbing particulates on melt. This does not make sense to me and if I misunderstood this it is because it is not made clear in the manuscript. Although the sample collection timing may be after the summer monsoon, these samples do not represent the impurities that are present during the ablation season- and therefore it is inappropriate to use these values to quantify reduction in snowpack duration. Particularly for dust, which tends to deposit in the spring when source regions dry out (peak radiative forcing by dust in snow is observed from MODIS imagery over the Himalayan region in April and May).

The backtrajectory footprint modeling was also very unclear to me, how the model runs were carried out needs to be described better, but it is unclear to me why the model runs were only completed for the winter. And were they run continuously? Typically particulates are deposited in episodic events so running it continuously does not inform the source region, it just informs of the regional synoptics. I suggest seeing Skiles et al., 2015 (Hydrological Processes) for how that study produced and described back-trajectory footprints.

The albedo measurements need to be better described. And how was snow effective grain radius retrieved? This should be an optically equivalent grain size, not an observable grain size. If an effective/optical grain size was used, the retrieval should be described. If observed grain sizes were used, the large error introduced by this (see Painter et al., 2007 in Journal of Glaciology) needs to be mentioned.

Estimates of changes in snow cover duration should be removed or significant more detail and justification needs to be made for the timing of sample collection. Section 3.3 and 3.4 are generally confusing- was shortwave radiation (uplooking and downlooking pyranometers) actually measured? This analysis seems far too simplified. Furthermore, the discussion of snow depth is misleading. This is a straightforward energy

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balance calculation, so less snow will melt faster than more snow for an equal amount of forcing- this is basic mass balance. So snow depth does not itself play an important role in the reduction of snow cover by particulates. This is a mixing up of forcing and state functions.

The citations are also outdated or incorrect in many cases, and I suggest the authors revisit these.

I take issue with the use of the 'Third Pole' term, this is not universally recognized and is somewhat politicized, why not just use Tibetan Plateau or High Mountain Asia? Also light absorbing impurity is an outdated term, the community has moved toward the use of light absorbing particulates. Also mineral dust and the acronym MD are confusing- you can simply say dust- which needs no acronym. Similarly, please be consistent in terminology, for example, albedo and reflectance are not the same thing.

Uncertainties in modeling are not only due to lack of observations, and increasing our number of sampling points alone will not reduce our model uncertainty. To state this is misleading.

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