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The Cryosphere Discussions

Interactive comment on "Retention and radiative forcing of black carbon in Eastern Sierra Nevada snow" *by* K. M. Sterle et al.

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You need to carefully address the comments of reviewers 1&2. Those of reviewer #1 are particularly important since that reviewer has already reviewed the manuscript previously for GRL. Your responses to that reviewer are not entirely clear and I think that if you pay special attention to the comments of reviewer #2 (and mine, below) that should reasonably address the concerns of both reviewers. The fact that both reviewers have concerns about the number of samples implies that your explanations in the text are not sufficiently clear. Please find ways to improve your explanations and labeling of the figures to remove uncertainties about the figures.

Grammatical note: "data" is plural so, you should say "data were" rather than "data was".

Below are my comments that should also be addressed:

In your Response 4 you describe the collection of grab samples of surface snow. You scraped about 200 g of surface snow from the top 2 cm from 3-5 areas. Is that 200g at each of the areas or total? How did you ensure that the snow samples were from exactly 2 cm (shouldn't that be an approximate depth?). How were these 3-5 areas selected? Why are their only values for five of eight sampling days? What happened to the other three? These samples are the only ones that show a clear trend but they are the most nebulous in terms of sampling rigor.

I find Table 1 confusing since the sample depths used in the analyses for rBC, ions and dust are different. Why didn't you sample soluble ions and dust for the bulk snowpack? How might these differences influence your interpretation of the data? It's really hard to convincingly compare these since they are different sample regions in the snowpack.

Figure 1 shows a great deal of variability in rBC over space and time. Do some of the regions of higher rBC in the snowpit profiles show correlations over time? That is, are there periods of time between snow events where rBC accumulates at the snowpack surface (or increases due to sublimation) and then is buried? I tried going forward in time through the accumulation period and tracking layers but am not able to find anything consistent. During the ablation season there is some consistency for a bottom layer but I'm not sure if it's real. For instance, looking at 30 May, I see a peak in rBC at an approximate height above the soil of 25 cm. I see something similar on 23 May and 17 May. There is a hint of a peak in 10 May and also 29 April but not on 18 April. In fact on 18 April there is essentially zero rBC at 25 cm. As per comment by reviewer #2, you should see if total rBC has changed (integration).

As per the comment from reviewer #2, it is unclear what is happening with the snowpack during the season. If you showed snowpack stratigraphy (density, grain size, layer descriptions) then you might be able to keep track of the buried layers and their corresponding rBC. That would be really interesting since you could show how buried rBC

can affect radiative heating.

Your contention that the soot is flushed out of the snowpack in late May need to be better supported by the data. Please pay special attention to the relevant comment from reviewer #2.

In your conclusions you state that "total snow pack rBC and dust masses increased during the snow accumulation" but you only sampled the top 30 cm of the snowpack for dust so you really don't know that this is the case for dust. Also, your following statements about dust and ions at the surface are not well founded again, because you didn't sample the surface (top 2 cm) for those components.

You need to describe the atmospheric and SNICAR models in the Methods section. The first paragraph of Section 4.3 belongs in the Methods section. You then need to describe the modeling results in the Results section. You should include an error assessment in the Discussion section. For instance, what are the uncertainties in dust properties? Same question for rBC. Please include error bars on radiative forcing estimates.

How could vehicle traffic influence your measurements? Do you mean snowcats? Cars?

The Discussion section should provide quantitative context for concentrations of rBC and dust at the Mammoth Mountain site. How does this site compare with measurements at other locations described in the literature? Why should we care about this site?

You might also have a look at the 1993 PhD dissertation of Nolin "Radiative Heating in Alpine Snow" who measured and modeled light absorbing impurities and their radiative effects in snow at Mammoth Mountain. It's in the UCSB library and Dozier has a copy.

Interactive comment on The Cryosphere Discuss., 6, 2247, 2012.