

Response to Referee #2 (Dr. Ruth Heindel)

On behalf of my coauthors, I wish to thank Dr. Heindel for her thoughtful comments, and for her supportive assertion that our work will be a “*very valuable contribution to the literature on dust deposition in mountainous regions.*” Here I explain how I will address her comments in revision.

My main comment has to do with making the site variability more apparent in the text, tables, and figures. The site numbering system is not very intuitive, so it was challenging for me to remember which site was which when working through the manuscript. This is especially the case for all of the figures where the sites are numbered from highest to lowest (even though this does not seem to correspond to any site characteristics). I think it would help if the sites could be arranged from east to west (as they are described in the Study Area section), and if the bedrock could somehow be indicated on the figures – this would be especially helpful for Figures 5 and 11.

I agree, the naming convention for the collectors, which is so familiar to me, takes a little getting used to. Obviously the collectors were named/numbered in the order in which they were deployed, which doesn't follow a clean geographic pattern. In Section 1 (Study Area) I introduce the collectors from southeast to northwest, with frequent reference back to Figure 1, because the geographic pattern seems more useful than the sequential numbering. Everywhere else though, it seems best for simplicity and consistency to present the collectors from 11 to 16, which seems like the most neutral approach, since the measured mineralogical and geochemical properties don't always vary geographically in a predictable way. I'll see what I can do about indicating the bedrock type on the figures though; maybe colors or a minor annotation will help make that clearer.

Specific comments:

Line 135: How deep were the soil samples collected? It seems like they were all surface soil samples given the difficulty in sampling soil in this environment, but it would be helpful to state an approximate depth or depth range for the soil samples.

Yes, the soil samples were all taken from shallow depths; I will note this in the methods.

Line 170: The sentence about the two size fractions doesn't make sense, or maybe the sentence is missing a phrase. Make sure that it is clear that the <63um fraction was considered most likely to represent exotic mineral dust.

I will rephrase this to make the approach clearer. Yes, the fine fraction (<63 um) is considered exotic; coarser material is considered local. Both were weighed to calculate fluxes, but only the fine fractions was analyzed further.

Line 183: “composite sample for collector” is a confusing phrase. Rephrase for clarity.

This is a typo; the word “each” is missing. “This process generated a ~6 g composite sample for EACH collector”

Line 193: There is an extra ‘were’ in this sentence.

Easy to fix.

Methods in general: This section contains very detailed analytical methods that could be moved into a supplemental file. Also, in the site description, it would be helpful to include information about known sources of dust in the region.

Deciding how much detail to include in Methods is always a balancing act. This study employed a wide variety of analytical techniques, and I wanted to be clear about the steps that were followed in the field and the laboratory. Different journals have different thresholds for how much method detail should be presented in the article text, and how much should be moved to an appendix or supplement. I will defer to the SOIL editor for their judgement on what, if any, changes we should make to this part of our manuscript.

Wanting to know more about dust sources in the region is intuitive. In a related part of this project, published last month in *Environmental Research Letters*, properties of likely source regions for dust in the year 2020-21 are presented. Now that it has been published, I will explicitly reference that study here.

Lines 343-346: It is unclear which type of samples these values are for. Are you reporting across the dust, soil, and rock samples? Or are these values for one type of sample?

You're right, as written, this is unclear. I will fix this in revision.

Lines 537-552: It might be helpful to show some of the correlations between soil fertility and dust characteristics – like the correlations mentioned with calcium. For me, this would have been more effective than looking back to Table 2.

Thanks for the suggestion. The manuscript has a lot of figures already, and I was trying to not overdo it. In revision I'll explore how to include a visual representation of these relationships.

Figure 1: The site locations are shown with yellow stars, not yellow triangles as the caption states.

Whoops, thanks for noting that!

Table 1: Include the dates of collection or the length of deployments in the table. It would be helpful if Table 1 could capture all of the deployment information written out in Lines 130-134. It would be helpful to visually see how the 22 samples are distributed across sites and seasons.

I can easily add the lengths of the deployments to the table, although they are all nearly the same. As I noted above, I was trying not to have too many figures, but in revision I will explore how I could present the duration of each sampling interval visually.

Figure 4: Is it possible to use a ternary diagram with lighter cross-hatching? Especially when printed at a smaller size, I am worried about the legibility of the points on top of such a dark background.

Thanks for the suggestion, I will try to lighten the background.

Either Table 2 or Figure 5 could be moved to a supplemental file.

Again, the balance of what to include in the text vs. figures and supplement is always a challenge. My instinct is that this table and figure should remain in the main text because they present the primary data from the soil analyses.

Figure 6: It seems like summer21 samples have considerably more illite, kaolinite, and mica compared to the other dust samples. Is this a real difference, and if so, any ideas about why this might be?

It's hard to say; some of the visual distinction (height of the peaks) is related more to the thickness of the sample on the XRD slide: more material = more intense peaks, and for some of the dust samples, there wasn't much to work with (leading to stubby peaks). I think it's safer to use these results to highlight the similarity between dust and soil samples, and their contrast with the bedrock, rather than overinterpreting them as evidence of differences between the dust in various seasons.

Table 4: What does the Dust sample with no date refer to? Is this some kind of composite sample?

These are the 2021-22 samples as noted in Lines 204.

Figure 11: Use "Site" instead of "Collector" along the x-axis?

Sure, I could make the change, or change to Dust Collector.