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Interactive comment on "Giant dust particles at Nevado Illimani: a proxy of summertime deep convection over the Bolivian Altiplano" *by* Filipe Gaudie Ley Lindau et al.

Anonymous Referee #2

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Review of Lindau et al 2020 "Giant dust particles at Nevada Illimani: a proxy…." 02 October 2020 The Cryosphere

The authors present a record of ice core geochemistry and particle size data from Nevada Illimani, and ascribe the presence of very large particles to atmospheric convection processes. The correlation between the large particle data and the stable isotope is indeed surprising, and of course I respect the field and laboratory work involved in developing such records. But to me the correlation does not prove that the mechanism previously developed to explain the isotope variability at the site (convection) need necessarily apply to the particle data. I do not feel that any of the explanations

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Discussion paper

provided for the isotope or particle interpretations stand on their own, and the correlation itself is not sufficient for me to accept the particle-convective activity link. I outline my specific concerns below.

Line 70: The authors state that this is the first time giant particles have been addressed in Andean ice. Is this the first time they have been observed, or simply the first time they have been interpreted? If it's the first time they have been observed, why is that? Is there something special about the analysis here, or site, or time period, that would be unique? I cannot recall ever seeing such large particles presented and interpreted at any high elevation or polar ice core site, so some kind of brief literature review would be helpful. Have such particles ever been observed and explained at high elevation observation stations? Any evidence that would corroborate the existing and transport mechanisms would help orient the reader to what might be happening here.

Line 150: The authors assert that any particles larger than 5 microns are of obvious local origin. I have a hard time understanding what is local and what is distant in this geographic context. If local means very close (I.e., within the glacier basin) to the ice core site, then how does a convective mechanism make sense? Local wind stress seems a much likelier scenario. A better location map showing dust sources and some kind of proposed transport pathway would be helpful. And because the focus of the paper is on the giant particles, why not collect mineralogy data on them? It seems logical to compare/contrast the fine and giant particles to establish some basis for local/remote origin.

Lines 200-215: The entire logic of the paper relies on the explanation of the stable isotope signal in terms of convective activity. Yet, the paragraph begins by stating the Andean isotope signal has divergent explanations. Has the convective explanation been explicitly tested at Nevado Illimani? And do the amount effect and convective explanations occur in unison, or are they mutually exclusive? Sentences on modeling and satellite observations are interesting, but it is not clear to me that this has been tested and verified at Illimani with in situ data. Merely stating that you assume convection is

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the dominant control (lines 213-214) is, to me, not sufficient in this case.

Line 216: I would like to see a better statistical treatment of the data throughout the paper. The authors note a “close correspondence” of stable isotopes and giant particles in Fig. 2a. To my eye, the r value must be at least -0.8, which is remarkable in ice core data that normally have a fairly low signal/noise ratio. I don’t understand what the PCA value adds.

Lines 223-225: I don’t understand the relationship among GPP, Ca, and total dust concentration. The correlation between total dust, Ca, and GPP appears poor (statistics would help confirm this), particularly in the dry season. The dry season values are quite variable in dust and Ca, but quite consistent in GPP. What is responsible, and how does it bear on local vs. regional sources?

Lin 279-280: Again, correlation does not mean that the convection hypothesis is confirmed for either isotopes or giant particles.

Line 281: The poor correlations with dry season values may be driven by the single outlier (upper left portion of Fig. 5). I would like to see the r values in Table 2 reported with and without that outlier. I suspect the story may change significantly.

Lines 290-320: I am struggling to understand the link between convective precipitation and the meteorological data. I would think that convective activity is by nature episodic, so how does monthly precipitation data accurately capture this? And how does one then link convective activity to the entrainment of dust? If it’s raining hard from convective activity, how does one get giant particles into the upper atmosphere? And then, without some kind of mechanistic link, I think it is a stretch to conclude that GPP=convective activity=La Nina years.

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