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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 #1

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This manuscript presents a shallow ice core record of mineral dust concentration and composition from Illimani, Bolivia, covering the time period 1999 to 2017. Generally, it is well written and structured and mostly scientifically sound (see comments below). The authors propose the relative proportion of giant dust particles as proxy for summer convective activity, which is an interesting new approach. The topic is within the scope of TC and the manuscript deserves publication, after taking into account the comments and suggestions listed in the following.

General comments

The correlation between giant particles and δD, considered as proxy for convection,

is based on the relative mass proportion of giant particles. Considering the fact that determining giant particles in a liquid sample is tricky, because they tend to settle, you need to substantiate the robustness of your results better. Specify if the given mean standard deviation between the two measurements with the coulter counter (lower than 3%) applies also to the giant particles alone. Show examples of the size distributions for the wet and dry season. Since total particle mass concentrations are low during the wet season (when you observe the correlation), the relative mass proportion is the ratio of two small numbers, probably having a large uncertainty. Add uncertainty bars and show in addition the record of mass or number of giant particles for every sample. From the presented data it is unclear if the number or mass of giant particles also has a seasonal or any other variability or not.

Before being lifted up by convection, dust particles need to be mobilized from the ground, which requires strong wind (advection). Have you checked wind speeds in the dust source areas? Dust source areas are located SE of Illimani, whereas humidity in the wet season originates in the Amazon Basin, due to stronger easterly winds and eastward upslope flow (especially enhanced during La Niña conditions). The link between local dust sources and easterly upslope flow is not immediately obvious. Your hypothesis would require large-scale convective processes also affecting the Altiplano. Do you have indications for that? Your precipitation data show the opposite. Hurley et al. (2015, 2016) offer a different hypothesis for depleted stable isotope ratios, i.e. the amount effect is associated with South American cold air incursions, linking synoptic-scale disturbances and monsoon dynamics to tropical ice core δ18O.

Have you considered that as potential explanation for dust mobilization/uplift? How was the attribution to wet and dry season or even DJF, JJA for the ice core values conducted? This is critical and needs to be explained.

Specific comments

Lines 44-45: while moist air advection from the east is suppressed.

L 95: explain ice layer formation

L 110: Give some more details about the standard protocol: how is settling of giant particles prevented, stirring, the mean standard deviation of what?

L 137: LOD: concentration in dust or ice sample?

L 185: Calcium carbonate is also soluble in water (solubility 13 mg/l), and most likely therefore not detected in mineralogical analyses.

L 199: Massive dust deposition – I think this is exaggerated. Have you compared dust concentrations at Illimani with that in other high-alpine ice cores? Are the dust layers visible in the core?

L 500: delete percentage

Fig. 2: Show PC1 separately, in the current figure it is difficult to distinguish δD and GPPms.

Table S2: Give also ice core concentrations for comparison with other publications.

References: Hurley, J. V., et al. (2016), Forward modeling of δ18O in Andean ice cores, Geophysical Research Letters, 43(15), 8178-8188.

Hurley, J. V., et al. (2015), Cold air incursions, δ18O variability, and monsoon dynamics associated with snow days at Quelccaya Ice Cap, Peru, Journal of Geophysical Research, Atmospheres, 120, 7467–7487.

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