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Interactive comment on "Significant mass loss in the accumulation area of the Adamello glacier indicated by the chronology of a 46 m ice core" *by* Daniela Festi et al.

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General comments

Festi et al. present chronological information for a 46 m temperate ice core drilled at Pian di Neve, Adamello glacier. The ice core was dated through a novel combination of pollen and refractory black carbon analyses alongside with radiometric dating by 210Pb and already existing 137Cs horizons. By this means, the authors are able to constrain the age of the surface at the time of drilling, which remained unknown due to existing evidence of prolonged negative mass balance at the site. This is addressing an

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issue of broad relevance to ongoing and future drilling efforts aiming to recover valuable environmental and climatic records at sites that already undergo ice loss at the surface due to persisting warming conditions. I find the manuscript interesting, well-written and suitable for The Cryosphere. I also have a few comments and suggestions on how to improve the manuscript.

I find the new approach to constrain the surface age and to derive an average value for the former net snow accumulation to be the key deliverable of the manuscript. This is of interest not only for the dating of ice cores but provides also important overlap with glaciological investigations at the site, in particular regarding the mass balance reconstruction. This latter point certainly provides additional value to the manuscript and should deserve some more emphasis. Possible additions could be made to the discussion part and in the abstract. For instance, the new evidence for a surface dating to 1995 presented here appears to be nicely consistent with the mass balance investigation by Ranzi et al. (2010), which shows a persistent negative net mass balance since 1995 (one exception 2001). In their Table 1, Ranzi et al. (2010) also provide seasonal information on mass balance that may be interesting to take into account with regards to the pollen seasonal signal. It may also be worth pointing out that such point mass balance reconstructions have particular value as they have been shown to reflect changes in climate better than total mass balance or terminus fluctuation (Vincent et al., 2017). Relatedly, it has also been shown that point mass balance changes can reveal clear regional consistencies, which is interesting to note in the framework of the comparison with Ortles and Silvretta (lines 234).

Specific comments

To aid a better comparison with the existing glaciological datasets, Figure 1 should contain a better map of the drilling area, including at least some topographical detail and preferably contour lines. At present, very little can be learned about the position of the drilling site. For instance, it seems like several catchment areas may exist for the deeper ice core sections.

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The glaciological setting also concerns another important aspect: It is stated that the core was drilled at the location of greatest ice thickness (line 73). It was not possible for me to verify this statement, however. The seismic campaign of Picotti et al. (2017) focused on one profile. The ground-penetrating radar survey seems to originate in Frassoni et al. (2001), but in spite of making a serious effort, I was unable to retrieve this paper. Ideally an ice thickness map could be added to Figure 1.

The ice thickness information could also aid in section 4.1 concerned with an age extrapolation to bedrock. The results are interpreted here basically as reconnaissance for a potential new drilling effort targeting to reach bedrock. I appreciate that the authors openly state that the use of the Dansgaard-Johnsen (D-J) model serves to make merely a crude estimate (line 259). This is not just due to the constraints located only in the upper third depth range, however. Here the clarification of additional points helps to put the inferred maximum age range into context: First, regarding the assumption that the ice is frozen to bedrock – how likely is this given the present evidence? Second, it is reported that the ice thickness value was determined by ground-penetrating radar, but this could have been via seismics instead? (line 251, citing Picotti et al., 2017). Regardless, the ice thickness value will have considerable uncertainty and the calculated dating function is typically sensitive to this. Therefore, a simple sensitivity study using the maximum vs minimum in ice thickness range would provide a more realistic insight regarding the age range expected from this estimation. This could be added as an illustration to Figure 5, which shows a 95% confidence interval but lacks detail on how this was derived.

Technical comments

Line 21: "... mass loss affecting this glacier even in the accumulation zone". Since mass loss is persistent today, it might be better to say "former accumulation zone", including at other instances in the text.

Line 21: "we show that it is possible to obtain a reliable timescale for such a temperate

glacier". This has been shown before. I would suggest to emphasize more the novelty of this work in the abstract, specifically regarding the combination of pollen and rBC and the resulting constraints for the surface age.

Line 27: Maybe say "regional scale"?

Line 33: See comment on accumulation zone above.

Line 37: This is of course very important. Maybe use one of the following citations here to back up this statement?

Line 81: "wet conditions" – what do you mean? What kind of problem stopped the drilling?

Line 142: Could the striking synchronicity between pollen maxima and rBC be quantified somehow, e.g. through a correlation measure? Out of curiosity, can you make out different regimes if the two datasets are used in a scatterplot? This could help to detect, for instance, anomalously high pollen or rBC values.

Figure 2: Personally I would find a zoom-in into a smaller depth interval of added value here.

Line 230: Delete "over the past years"

Line 279: I suggest to rephrase this statement considering that the results comprise pollen and rBC and the upper 46 m. It remains to be shown if a climatic and environmental signal, e.g. in the chemical impurities and stable water isotopes is preserved at the site, including the deep ice layers.

References

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