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The Cryosphere Discussions

Interactive comment on "Linking pollen deposition, snow accumulation and isotopic composition on the Alto dell'Ortles glacier (South Tyrol, Italy) for sub-seasonal dating of a firn temperate core" *by* Daniela Festi et al.

Anonymous Referee #1

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With the manuscript, the authors try to improve their dating method for ice cores proposed in their previous study (Festi et al., 2015, Journal of Glaciology) to achieve core analyses at sub-seasonal time resolution. They also attempted to argue the accuracy of the new dating method in comparison with time change of surface level calculated at the drilling site by a mass balance model. In addition, they tried to interpret the profile of δD values of the core based on their detailed chronology established.

The challenge for high resolution analysis is highly evaluated. However, due to a lack of in-situ observation data, it is difficult to judge the argument in this manuscript. Also,

it seems like that the argument is based only on good results obtained by statistical analysis using the SPSS software. The authors should consider more what the data mean and what statistical techniques mean.

The novelty alone cannot warrant publication of this manuscript. Therefore, I recommend the manuscript not to be published.

Detailed comments:

Section 3.1. High resolution pollen-based timescale: the depth-to-day method

P3, L11: Is the sampling interval of 10 cm appropriate for the sub-seasonal time resolution? The authors need to show its grounds.

P3, L25: The authors mentioned that the onset of flowering may differ by several days. How about the peak season and the end of the season? I think those factors also influence the daily changes of airborne pollen concentration and assemblage.

P3, L32: How long does each 10 cm sample accumulate (accumulation time frame)? I wonder if the authors can compare similarity between daily data from Solda and core samples because of the different time scales.

P4, L6: Does the transportation of airborne pollen depend on the species? I wonder if the pollen composition may be kept until pollen deposition on the glacier.

Section 4.1. Pollen based timescale

The authors need to explain more what each date indicates. I wonder if pollen deposition and snow fall on the glacier do not necessarily occur at the same time. Once melting occurs, how do the authors think about the date of snow and pollen in the core?

For example, significant melting occurred in the summers of 2005 and 2006 based on the model calculation. Then, the surface level of snow was reduced to the level on April 9 and the end of March; respectively, as mentioned on P6 L15-16. Therefore, it should be natural to think the ice core lost those parts when there is no internal accumulation

due to refreezing of percolating water as mentioned by the authors on P4 L25 and P6 L14-16.

On the other hand, pollen grains should be gathered on the boundary of the removed layer. Therefore, the pollen concentration and composition in the layer are disturbed from the original state. Actually, a thin layer containing mixed spring/summer pollen is observed in the core as mentioned on P6 L8. After all, I wonder if deciding the date at detailed level does not make sense with such melting core.

Showing stratigraphy of the core should be helpful for readers' better understanding.

Section 5.1. Comparison of the pollen and modelled timescales

The authors need to discuss the accuracy of layer dating obtained with the EISModel by using observed data, for example, the stake observation or automatic snow depth measurement, event signals of dust storm and volcanic eruption, and etc. Otherwise, the authors cannot insist on the legitimacy of the accuracy of the pollen dating.

The point of argument in the following chapters is unclear. The authors need to revise. Instead of those chapters, the authors should devote pages to the discussion for the concept of dating of snow layers and pollen grains after the post-depositional process, and the accuracy of the pollen dating. The suitable sample thickness for such high-resolution time scale should also be discussed. The sampling intervals of 10 cm in this study may be too thick.

Section 5.2. Melt water effect on the pollen signal

The authors need to clarify more the point of argument in this section. As I have mentioned, I think melting affects the position, concentration and composition of pollen grains and the loss of snow layer. Those post-depositional process should lead to disturb dating of layers in an ice core.

P7 L8: Cite original papers. Those were already mentioned in other papers before the study by Gabrielli et al. (2014).

Section 5.3. The potential of pollen for qualitative climatic reconstruction

I wonder if the authors can be more specific in discussing the analysis results by displaying the data obtained because only abstract conception was mentioned here. The studies in Nakazawa and Fujita (2006, Annals of Glaciology) and Nakazawa et al. (2015, Environmental Earth Sciences) may be useful for the discussion in this chapter.

Section 5.4. Application of the pollen based timescale

The authors need to clarify more the point of argument in this section. As the authors noticed, a good correlation between the mean daily temperature and the measured isotopic composition arises from preservation of seasonal variation of the δD values. Therefore, the effect of re-evaporation or the stable isotope amount effect seems to be small. However, to reconstruct past temperature, the authors need to analyze the data while considering the smoothing of δD values.

Section 6. Conclusions

P9 L11: The timing of local flowering of different plant taxa and of the daily changes in airborne pollen concentration should be changed under climate change. How do the authors overcome this problem without airborne pollen data when applying this method to date deeper ice cores?

Table 1

The dates in 2005 and 2006 are manifestly inconsistent with the EISModel calculation and the authors' arguments. It needs to be explain more.

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