# Reply on RC1

Helene M. Hoffmann et al.

Author comment on "The ST22 chronology for the Skytrain Ice Rise ice core – Part 1: A stratigraphic chronology of the last 2000 years" by Helene M. Hoffmann et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2022-28-AC1, 2022

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**Replies to reviewer comments in italic**

In this paper by Hoffmann and co-authors a chronology for the last two millennia is proposed for the Skytrain Ice Rise ice core. The chronology was built via annual layers counting with the aid of selected accurate age markers to be used as tie points (volcanic eruptions, tritium peak and peculiar features in the methane profile).

*Thank you for your review and your valuable input. As stated in the paper, we used the absolute age markers as main age indicators and only interpolated in between them via annual layer counting. We added a short paragraph to clarify this at the beginning of the section about layer identification L227-230 revised manuscript*

Surprisingly, some of the major volcanic eruptions of the last millennium were not clearly recorded in the sulfate profile but the authors were able to spot these eruptions via S isotopic composition. While the analytical approach is adequate to retrieve several important information from the ice (including the used tie points), I'm not fully convinced of the reliability of the annual layer attribution. In particular, it looks like the counting of layers, as reported in figure 6, is not straightforward and clear-cut. I can see in this figure (especially for the deeper section) several grey bars which are not corresponding to minima or maxima in the chemical markers. I suppose that this is partially due to the thinning of ice layers at this depth and to the limited resolution of the analytical methods. In figure 6b, the sodium profile is certainly misleading, showing just a few clear peaks with respect to many annual layers counted in this section. It's clear that along this section just the calcium profile was used due to its high resolution, but, as an example I would have picked different peaks and, despite a similar pattern in the $Ca^{2+}$ profile, the two sections 140.0 - 140.5 and 140.5 – 141.0 show 3 layers and only 1 layer respectively. About figure 6, I think that not all the layers are consistent since, sometimes the layer has been marked on a $Ca^{2+}$ maximum (141.5 m) and other times on minima. I would recommend to the authors to better highlight the seasonal pattern in a new figure. For example they could remove those markers that are not useful to the counting purpose (i.e. I can't see any clear seasonal pattern in the MSA or $SO_4^{2-}/Na^+$ ratio of figure 6a).

*We agree that the layer identification does not look straight forward and was indeed challenging. Regarding some obvious mismatches in the markers of the layers in Fig. 6, we found that an old, not finally depth corrected CFA dataset was displayed in the back. We updated and revised Fig. 6 respectively and also changed both shown depth intervals*

*to 22-25 m and 137-140m, because these section proved to be much more representative for the overall variability of the layer thickness. We decided not to take out the MSA and $SO_4^{2-}/Na^+$ ratios in Fig. 6a to illustrate the difficulties in the layer identification process.*

As concerning the CFA section, the reference used for the FIC analysis describes a method for the determination of cations but not for the anions. In particular, I think that it would be a precious information how MSA was measured using a FIC method. A short description with further details about this method should be added (also as supplementary information). How did the two FIC systems work? I guess they were operating alternately so that there is no complete overlap between the samples used for cations and anions determination, but this point should be clarified since the sentence in lines 72-73 is not easily comprehensible.

*MSA has been analysed using the BAS FIC system before, we added a respective reference. We also extended the description and tried to better explain how the cation and anion system work together. The cation and the anion system sample parallel from the same depth of the core. Paragraph added L71-L76 revised manuscript*

The authors measured nitrate by FIC but they did not use this marker to look for a seasonal pattern. At coastal sites, where the accumulation rate is relatively high, nitrate can be used for dating purposes. I would suggest to the authors to try this approach to corroborate the annual layers identification or, if they did it, to write that this marker was not useful in the construction of the chronology.

*Yes, nitrate was measured, but also with the rather low-resolution FIC system and at very low intensities. We therefore decided that it had no advantage over the MSA and did not consider it for layer counting. A respective paragraph was added L246-L249 revised manuscript.*

Minor comments:

Line 20 and 119: remove brackets for the reference (e.g. MacFarling Meure…)

*Corrected*

Line 138: I would prefer "introduction system"

*Changed*

Line 149: change "repeat" into "repeated"

*Changed*

Line 197: I would prefer "way" in the place of "fashion", but I'm not a native English speaker thus, feel free to accept or refuse this change.

*Not changed*

Line 205: I would add "… (Table C1) and are shown by the dashed lines in Figure 5."

*Changed and added*

Line 297: change to "(from -40 to -5 yBP)"

*Changed*

Fig. 5 and 7: add y or yr to the title of the x-axis

*Adapted and changed*

SO4 is not correct. The authors should replace it with $SO_4^{2-}$ in the manuscript, captions, tables and axis titles.

*Changed throughout the manuscript*