Response and Changes made to the Manuscript of

"A multi-ice-core, annual-layer-counted Greenland ice-core chronology for the last 3800 years: GICC21"

We made sure to address all comments from the reviewers, from the more technical ones to the more complex ones.

Abstract

The abstract was shortened as a consequence of removing sections about volcanic cooling and the Thera eruption of Santorini.

Introduction

We aimed at improving the introduction to be more informative and comprehensive.

We added the suggested references throughout the introduction.

We added a short description of differences in dating methods, as suggested by RC1.

In Section 1.3. Holocene stratigraphic markers, we added more references about using ammonium peaks for ice core comparison.

In Section 1.4.1, Uncertainty estimates of GICC05 in the Holocene, we provided more information on the GICC05 MCE and the problem of bias.

In Section 1.5. The NS1-2011 timescale, we tried to improve our brief review of the ns1-2011 timescale.

In Section 1.6., The need for a revised and unified Greenland ice-core chronology in the Holocene, we weakened our statement about using all data form Greenland.

Data

We added more information on the resolution of the datasets. We also improved our ice-core data availability section at the end of the MS.

Methods

We created a new supplementary table of the relevant Straticounter settings. The pre-processing of the data was explained more.

We verified the volcanic tie points of GISP2 and included it in our tephra review of Section 4 (where we added a new table of chronostratigraphic markers). We also revised our fine tuning with the new NEEM-SC data by Sigl et al., 2015 and found no issues with our layer counting in this section. We also used black carbon from NEEM and NEEM2011S1 to revise our ammonium match.

The ammonium matching procedure has been explained in a new section added ad hoc. Figure 2 was improved with the aim of highlighting ammonium as a matching tool. We quantified how the ammonium tie points are distributed in the timescale in a dedicated supplementary figure (s10). We used black carbon from NEEM and NEEM2011S1 to revise our ammonium match in order to limit our matching to the tie points that have both ammonium and BC, where possible.

We desist from calling the log-inverted ECM 'pseudo-NH4' as we recognize this name to be misleading.

We clarify the use of Laki as the datum of GICC05 and we add more explanation on the bce/ce conversion to years b2k, which is also added in the timescale supplement.

We aimed at clarifying where we expect we could be biased in our dating process and what precautions we took to avoid it.

Section 3.4 about the correlation study of DYE-3 was moved to the supplementary information to shorten the manuscript even more and to keep a better focus on our methodology.

Section 3.5 (now 3.4), Uncertainty of the GICC21 chronology, was shortened and rewritten to provide a more compact explanation of our uncertainty formula. We removed the redundant tables and figures and presented the new Figure 3 to visualize our statistical tests. We give more explanations about how we reach our formula. We conducted our uncertainty analysis in a continuous fashion, as suggested by RC2. The numerical analysis is reported in the SC supplement and some content was moved to the supplementary information.

Section 4 (Results and Discussion)

Figure 6(now 4) was changed following suggestion by RC2 by splitting it in two panels. We added the GISP2 timescale (Meese et al., 1997) and the DRI_NGRIP2 timescale (McConnell et al., 2018) in our timescale comparison.

We added more information on the DYE-3 400 ka b2k offset in the current figure 6.

We added more information on the timescale comparison and added current table 4 to summarize the chronostratigraphic markers most important for this study and their age according to GICC21.

We edited the section about the comparison to IntCal (now 4.3) by including some of the evidence found in the now-removed section about Thera, e.g. the comparison to tree ring data.

We removed the paragraphs about volcanic cooling and Thera, as we recognize these topics to be out of the scope of the present publication.

Conclusions and Appendix

We shortened this section in response to the removal of the mentioned paragraphs.

Supplement

We verified the Timescale Supplement to contain all relevant information about GICC21. We added a document about the StratiCounter pre-processing.

Ice-core data availability

All data is potentially available to the reader and we describe how to access it. We are encountering delays with Pangaea, hence the data being handled by SOR has been submitted but is not yet available. We reiterate that all datasets can be obtained via communication with SOR or TE.

Kind regards,

Sinnl et al.