Climate of the Past Discussions

Clim. Past Discuss., author comment AC4
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Reply on RC3

Giulia Sinnl et al.

Author comment on "A multi-ice-core, annual-layer-counted Greenland ice-core chronology for the last 3800 years: GICC21" by Giulia Sinnl et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-155-AC4, 2022

Dear Anonymous Referee #3,

Thank you for your positive and detailed review of our manuscript. We hope to have addressed all your comments in the revised manuscript.

We agree that the manuscript ended up being quite long, however GICC21 needs thorough explaining and documentation. In response to your comment and to those by An.Ref.#1 and An.Ref.#2 we have concluded that the manuscript will gain more readability by shortening some parts, in order to refocus the manuscript around the GICC21 timescale, i.e. we intend to cut out the discussion of volcanic cooling and Mediterranean volcanic events (sections 5.2 and 5.3, Appendix A and B, and the relevant parts of abstract and conclusion). We will continue the investigation on these topics in our future work.

In response to your comments:

>>Section 1.3 is important - however please describe more clearly that there is a hierarchy of uniqueness of these tie-points. If a tephra layer in the ice can be geochemically connected to a unique historical eruption (and/or to other dated sites), and if this layer is found and securely uniquely identified in the multiple ice cores, then this tephra layer forms a much more unique signal (and thus securely synchronous tie point) than if the volcanic eruptions are recorded as peaks in SO4, ECM or DEP; the latter peaks are replicated over the core and thus do NOT have unique IDs attached to them. When looked at in isolation, the latter peaks cannot be used as dates, but geochemically ID-ed tephra layers can. Are the shapes of peaks used in tying peaks, and if so, how?

Reply: Thank you for the information, we will clarify this section. The shape of the peaks was certainly used as a matching criterion, we will add that to our description.

>>In the same section, add some more references to tephra layers in ice cores, e.g. Abbott et al. 2021 CP doi:10.5194/cp-17-565-2021. It couldn't hurt to mention in this section already that tephra layer studies have thrown up surprises, in that some acid peaks were previously attributed to the wrong volcanic eruptions (e.g., Plunkett et al. 2021). For a wider context, please also cite Baillie 2008 (doi:10.1029/2008GL034755).

Reply: Thank you for the information. We already acknowledge the erroneous assignment

of peaks in GICC05 later in the MS, however we will add more details here and include more references such as the ones suggested.

>>Lines 29/36, "synchronization/synchronized", please reword to "comparison/compared", as the current wording strongly implies adapting site chronologies by aligning/tuning their supposedly simultaneous peaks. Such tuning removes any independence between chronologies, and thus precludes the subsequent investigation of lead-lag dynamics (perhaps for wider context cite Blaauw 2012 doi:10.1016/j.quascirev.2010.11.012).

Such potential problems about the reliability of different peak identifications and alignments are make it more difficult to properly evaluate the important Figure 2.

Reply: We agree with your rephrasing. Thank you for the suggested citation. Our intention throughout the work has always been to obtain an independent Greenland timescale that can later be used to compare Greenlandic climate to other regions.

>> In Table 2, please outline which tephras have been positively and securely geochemically IDd in which core, and which matches instead rely on e.g. matching ECM peaks. For example, were Laki or Oraefajokull tephras geochemically identified in all of the used ice cores?

Reply: We will review the tephra availability for the cited eruptions. For this work we did not present new tephra data, so our identification of ECM peaks relies on published work. To our knowledge, tephra from Öræfajökull for example was reported only in GRIP (Coulter et al., 2012), not in NorthGRIP or other ice cores.

>>Has the manual fine-tuning, including each decision been documented, quantified and motivated? Will the data be made available, including all high-res raw data and decisions? Could it be an idea to put the data on github, with version control and with information on decisions taken?

Reply: Yes, we did keep track of the fine-tuning details, such as the motivation for each intervention on the layer count. We will evaluate if a GitHub repository would be the best option for storing the manual fine-tuning iterations. As we have replied to An.Ref#2, the ice-core data is for the most part already available, but some records (e.g. EastGRIP CFA) have pending publication processes, for which we refer readers to directly contact the reference authors listed in the Data section. We are evaluating if the normalized and preprocessed data we have used as an input to StratiCounter could be published with a separate DOI in the meantime.

In reply to your more technical comments, we have accepted all of them in our revised manuscript. Comments are only relevant for one of these:

>>Beside Fig. 6, could you also show a Figure of the accumulation rates for each core based on the adapted time-scales? Are all resulting accumulation rates and their variability considered to be realistic?

Reply: We have a figure in the supplement about layer thicknesses that provides a first indication of the accumulation rate history of the ice cores. Accumulation rates require thinning models, which are not in the scope of this work. We will refer readers to the most recent publications about thinning models, in the cores where they are available.

Kind regards,

Sinnl et al.