

Interactive comment on “NGRIP temperature reconstruction from 10 to 120 kyr b2k” by P. Kindler et al.

Anonymous Referee #2

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Kindler et al. completed Greenland temperature reconstruction for a full interglacial cycle (10-120kyr) using d15N in trapped air in NGRIP ice core, combining published and new data. The reconstructed temperature record is an important contribution for the paleo-climate community. In addition, the application of d15N paleo-thermometry through the entire glacial cycle allowed them to reveal important insights on the relationship between temperature and d18O of ice as well as accumulation rate. Especially, alpha reconstruction and relation to obliquity are interesting and novel. The authors also looked into some technical issues of the calculation of temperature from d15N, which is also an important contribution. The paper is certainly relevant for Climate of the Past, but the paper is still quite rough and needs major revision before publication.

General comments: The organization of the paper lacks in balance and focus. Many

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of the sentences are very difficult to read. From the way of writing, it seems that many of the findings are already being made in earlier studies. Therefore, it is important to clarify and emphasize what are the added values from the current analyses. The introduction contains very general description of the glacial climate, which is not discussed in the later section and so not relevant for the current paper. It should be deleted or moved to later discussion if relevant discussions are made. Then, the introduction should be rewritten to introduce materials about issues discussed in the main body of the paper.

Specific comments: P4100-P4104: Current introduction contains too general information but lacks necessary information. As this paper bases upon many earlier studies of NGRIP d15N studies, more information on these papers and important issues should be described in introduction. Some materials about general glacial climate should be moved into discussion section and integrate them with your analyses.

P4104, Line 19: The methodological issue is one of the main themes of the paper. Therefore, the current issues and problems in d15N temperature calculation should be described concisely in introduction.

P4105, Line 10: Put references after “ occurs below the LID”.

Line 14: Insert “ during surface warming” after “at the bottom of the firn”.

Line 21: Temperature in firn does not become truly uniform owing to constant climate fluctuation and geothermal influence.

Line 23: You need to define delta age and delta depth.

P4106

Line 14: Why is the Holocene temperature not reconstructed, although you have data? This needs explanation.

Line15: Please explain what are “bags”.

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Line 16-20: It is not clear. Please rephrase.

P4107

Line 7-10: It is not clear. Please rephrase.

Line 16: Why did you use 200 year? It seems longer than normal smoothing. Please explain. This will affect reconstruction of the magnitudes of temperature changes significantly.

Line 20: You adjust temperature and accumulation rate to fit d15N and delta age. How much are temperature and accumulation rate independent? Would it be possible to fit observed and modeled d15N and delta age by only adjusting temperature? If oxygen isotopes don't capture temperature signals, can you still reconstruct temperature from this method? Changing alpha and beta basically assumes that oxygen isotopes capture temperature signals with the relationship changing with time, but in some cases oxygen isotopes may be totally independently changing with temperature.

Line 25: Also specify time step.

P4108

Line 27-29: It is not clear.

P4109

Line 14: Is it possible to estimate the uncertainties of the reconstructed temperatures for the entire period by comparing observed and modeled d15N?

Line 20: "had to" is awkward. Just say "specified". Also change "had to" in other sentences.

P4110

Line 10-26: Difficult to follow. Please rephrase sentences.

P4112

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Line 21: What is "linear relationship"? This paragraph is not clear. Please rephrase it.

P4113

Line 26: "the cold state" needs more explanation. "On the other hand,..." is not clear to me.

Line 27: "increasing length" Do you want to say "increasing amount"? This sentence is not clear. Please rephrase.

P4115:

Line 10: if the 200 yr spline is appropriate, you should say your temperature reconstruction is for multi-centennial scale temperature variation. However, the magnitude of smoothing should also depend on the temperature and accumulation rate. So, ideally you need to change the smoothing function or age distribution with time.

Line 9: "closely follow obliquity" is not accurate as it has only three cycles and third cycle does not show a good agreement. It is possible that it is just a coincidence. So, it is important to calculate correlation coefficients with confidence interval considering autocorrelation.

P4123:

Line 6: the Holocene is not part of the reconstruction.

Line 9: Write uncertainties of temperature reconstruction.

P4135:

Fig. 1. The difference between red and green is not clear. You better use different period to illustrate improvements after each step?

Fig. 2 It is too small. As this is the main figure of this paper, this should be bigger and well-illustrated. You may want to use different figure number for b, c, d.

Temperature reconstructions by earlier studies should also be plotted together with this

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reconstruction to illustrate difference and robustness.

"Technical corrections" Readability need to be checked thoroughly after the next revision.

References: There are numbers after each reference. What are these?

Interactive comment on Clim. Past Discuss., 9, 4099, 2013.