

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2020-342

Anonymous Referee #1

Referee comment on "Reconstruction of annual accumulation rate on firn, synchronising H₂O₂ concentration data with an estimated temperature record" by Jandy M. Travassos et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-342-RC1>, 2021

Review of

Reconstruction of annual accumulation rate on firn synchronizing H₂O₂ concentration data with an estimated temperature record

By Travassos and others

Summary

This study uses optimization procedures to match and therewith date a 133 m firn/ice core record from Detroit Plateau on the Antarctic Peninsula, using a combination of hydrogen peroxide concentrations from the core and seasonally resolved temperature records from four nearby meteorological stations. The precise dating allows making an estimate of the firn thinning rate with depth and the reconstruction of the original layer thickness. When combined with a density profile this leads to annual accumulation rates. The quantitative result is a stable (over an 11-year period) high accumulation rate of 2.5 m w.e. per year.

General assessment

The paper is clear and concisely written and the methods are clearly explained. The figures are of good quality. The originality of the science is good, although after reading one is left with the impression that a lot of effort went into obtaining a key result (accumulation) that would also have been obtained by simple layer counting. The added

value is the objectivity of the method, at the price of having to use a proxy for insolation, i.e. temperature, to perform the warping. To enhance impact, see the final major comment below.

Major comments

I. 34: "surficial atmospheric temperature alone as a proxy for the solar irradiation" Why would the temperature be a good proxy for insolation? It is well known that the seasonal cycle in temperature lags that of insolation, especially in regions where horizontal advection is important and when open seas are nearby. Moreover, sea ice cover may influence the seasonality, depending on wind direction and time of year. Please provide more evidence that the used temperature record lines up well with (top-of-atmosphere) insolation, and how discarding the Bellingshausen record makes a difference. Another useful addition might be to select subsets of the four stations to study the dependency of the final result on station selection, and compare what happens if e.g. simple time series of top of atmosphere insolation is selected as a counter of the passing of the years.

Further to the above: what potential role does precipitation seasonality play in influencing the signal? And how sensitive are your results to the filtering applied to both time series?

An important outcome of this work is not only the average accumulation rate but also the interannual accumulation variability, which is very large (Fig. 5). To enhance the impact of the paper I would like to see a direct comparison of the annual accumulation time series as obtained from this study and as obtained from simple layer counting, as often done in glaciology.

Minor and textual comments

I. 19: The H₂O₂ -> Hydrogen peroxide (H₂O₂)

I. 19: "surficial and atmospheric" Do you refer to H₂O₂ or solar radiation? Unclear what you mean here, please reformulate

I. 26: Can it be briefly explained why the concentration ratios differ by an order of magnitude between atmosphere and snow? What about the diffusion of the signal in the

ice core?

l. 29: Plateau Detroit -> Detroit Plateau (throughout, please)

l. 34: surficial atmospheric temperature alone as a proxy for the solar irradiation -> near-surface (2 m) atmospheric temperature alone as a proxy for the solar irradiation

l. 68: "conductivity measurements on ice cores down to 20m had a modal value of 40.4 μ S/cm" What is the added value of this information?

l. 75: "along the 98m of ice cores" Earlier, ice core length was 133 m, with intact ice until 109.3 m/ Where is this number coming from?

l. 84: "the first 100m" See above.

l. 94: "We have considered 95 only the maximum daily temperature reading at each station" Why? When was the reading taken at the station with one reading per day?

l. 96: ", using a conservative lapse rate for the decreasing of temperature with altitude of $-0.55^{\circ}\text{C}/100\text{m}$ " Since you have a good estimate of the annual mean surface temperature at Detroit Plateau (being the 10 m firn temperature, assuming no meltwater refreezing), you can estimate the temperature lapse rate yourself, neglecting the temperature difference between surface and 2 m.

l. 155: Begin this line with a small introductory remark, e.g.: "The analysis proceeds as follows: "

l. 164: Typo "increasing"

l. 196: Typo "As ice sheet"

l. 216: Why was an 11-year moving average chosen?

I. 222: Although both accumulation estimates are close, they still differ by more than 10%. Is this within the range of expectations?

I. 234: Typo "equals"

I. 238: Add "of" between "Peninsula" and "0.8"