

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2021-51

Anonymous Referee #1

Referee comment on "A portable lightweight in situ analysis (LISA) box for ice and snow analysis" by Helle Astrid Kjær et al., The Cryosphere Discuss.,
<https://doi.org/10.5194/tc-2021-51-RC1>, 2021

Summary

This paper presents a small, transportable, in-field continuous flow analysis (CFA) instrument, LISA. Choosing to measure just a few components that should well-record annual layers in Greenland, the authors aim to present improved annual accumulation records by considering spatial variability.

This new instrument is a novel contribution in that it takes CFA methodology, and creates a transportable unit easily operable in-field. CFA is usually part of more complex, permanent (or at least longer-term when rarely in-field) set-ups. The application of LISA is instead to be moved relatively quickly around several sites, geared towards rapidly obtained, possibly high-spatial resolution, annual accumulation records, assessing spatial heterogeneity.

As a first introduction to the new technology, this is a good contribution with potential for wider application. More accurate assessments of accumulation, and hence surface mass balance, contributes to improved scientific knowledge.

Based on these factors, the manuscript is recommended for publication, however this should be following the revisions as below.

Major scientific comments

The comparison of accumulation rates found here to those of other publications is not very

robust and is somewhat unclear in presentation. This is because the other studies offer such a wide variation in timescales covered, many of which do not overlap with the years measured in this study. As Table 1 lays them out, it is too easy to scan across and think them more comparable than they are. Can you please either make this clearer by extending the table to include the dated age range of each average value presented in the others column, or remove this column from the table and include these values only in reference to the discussion in-text?

Related to above, section 4.1 – The sentence on Clausius-Clapeyron should be removed. It is not possible to make a significant conclusion either way on this when comparing these very short, modern accumulation records of this study to other studies of average accumulation over assorted different time periods.

Again on the above but in the conclusions section – these accumulation comparisons shouldn't become one of the main conclusions from the paper. Especially for NEEM, where you actually only have a record for one year of accumulation but start to invoke a positive AO and NOA to explain differences compared to longer average records. Perhaps with further records and more investigation this will be true, but there is not enough to say that here. Please re-focus the conclusions to the successes of the LISA method and application.

Minor scientific comments

Is it possible to rapidly stop core-melt in case of measurement issues to prevent loss of records? Or, if smaller sub-sampling from the waste-line is desired? How is this done? From the photo in Figure 2 I cannot see any way in at the base of the liner to lift the core off the melt head for example. But maybe it is just not visible? Is this the cause of the gaps in the conductivity measurements in Figure 4?

Following on from this, can some explanation be given for Figure 4 for missing portions of data?

Could an estimate of cost for such a LISA set-up be given in the supplementary information? A benefit of such light-weight, transportable systems is often that they are also lower-cost...is this one?

The reporting of melt speed measurement is a little inconsistent – in section 2.1 it is defined as the time taken to measure 3cm of ice. In section 3.1 it is 'Melt speed was registered by measuring the distance from the top of liner down to the top of the snow surface inside the liner about every three cm', which repeats from before but doesn't mention timing the change, and then in section 3.2 it is 'Depth registration was done every approximately 100 seconds and melt speed varied between 2.3 cm/min and 3

cm/min', so this was a slightly different method? Perhaps the method overview could simply state that it is measured by height change of the top of the snow over time, not defining 3cm which wasn't the case for the 2019 campaign, and then in the other sections report in more detail the exact methods. Also decide on whether to report the observed rates for 2017 or remove them for 2019 for consistency.

Technical comments

Text varies between H₂O₂ and H₂O₂. It would be better to use 'hydrogen peroxide' as opposed to 'peroxide' in text since peroxide is a full class of chemicals rather than H₂O₂.

Inconsistent use of American/English spelling in some cases (analysed/analyzed).

P1L10: Suggest either 'Spend enormous amounts' or 'There are enormous costs involved in transporting...'

P1L23: SMB are made

P1L24: but also rely....from past periods

P1L28: fine cores are cheaper

P2L7,16: CFA is defined twice, and is again written in full P3L6, P5L11...I didn't check any further if perhaps you could?

P8L15 °C

P12L15 14th

Section 4.1: 'We note' is repeated four times here and is not needed.

P13L23: highlight that

P13L30: While we

P13L31: section

P14L20: remove 'as stands'

P15L5: remove capitalisation, and should be prolific?

P15L8: constrains repeats