

Interactive comment on “Imprint of Arctic sea ice cover in North-Greenland ice cores” by Damiano Della Lunga et al.

Anonymous Referee #2

Received and published: 20 January 2020

The authors present new records of bromine and other trace ions from two Greenland ice cores, interpreting these records with respect to sea salt inputs and potential for reconstructing Arctic sea ice cover for the past 7 centuries. The primary metric for sea-ice reconstruction is bromine enrichment (Br_{enr}), a relative measure of bromine excess with respect to sea-salt bromine. The Br_{enr} records are compared to satellite observations for the last few decades, and to a pan-Arctic sea-ice reconstruction by Kinnard et al., for the last centuries. The work is a novel and helpful contribution to the understanding of bromine variability across Greenland and its potential utilisation as a sea-ice proxy. It is important to recognise that the authors present, and interpret, bromide (ion) and not (total) bromine concentrations, as the data were determined by Ion Chromatography. Although there is no specific reason to doubt the accuracy of the

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measurements, very little analytical detail is provided and I will comment on this more below. Despite these shortcomings, the authors are to be commended for their novel and elegant approach to discrimination between open ocean, blowing snow and frost flower sea-salt sources, demonstrated in figure 7. The language is well-structured and understandable but with many minor grammatical errors.

Specific comments:

- It would have been helpful to have MSA included in this work, to complement previous comparisons between sea-ice proxies. If suitable MSA records are available they should be added to the interpretation.
- There are many small spelling and grammatical errors throughout the text. I provide some examples here: p.1 (Artic, trough/through), p.2 (pythoplankton), p.3 (residuals, twice than the one), p.5 (customized), p.6 (Bromin), etc.
- Line 42, A centuries-long record of direct sea-ice observations is available for the north coast of Iceland.
- Line 60, add year to Kinnard citation
- Line 154-6. The authors should provide a reference or observational evidence to support the assertion that bromine explosions occur over multi-year sea ice. The study by Cox & Weeks instead indicates that surface salinity in multiyear sea ice is highly variable on metres-long length scales.
- Section 2.3. The “constrained” distribution of the back-trajectories in Figure 4 does not seem consistent with a 12-day run-time. Were the trajectories filtered for altitude? That is, were they constrained to pass through the Marine Boundary Layer at some point in time, to ensure they are more likely to sample the marine atmosphere? Please check that the run-time for each trajectory was not a shorter period (i.e., 2 or 3 days?) or some other form of data filter was not applied.
- Section 2.5. A typical test for the influence of mirabilite (representing frost flowers) is

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the Na/SO₄ ratio. Any reason why this approach was not adopted for this study?

- Line 318. Generic descriptions such as “a general increase” should be avoided. Please quantify how much and how significant this increase is.
- Table 1. Regarding the methods of analysis, please specify which parameters presented in the manuscript were produced by CFA (i.e., continuous flow analysis techniques such as Ca²⁺, Na⁺, Cl⁻, etc) and/or IC.
- Figures 2 and 3. It is very confusing and incorrect to write Br₂₆ and Br₁₇. Amend the text to something like ‘B₁₇ Br⁻ flux’, etc. Furthermore the rampfit function also allows for error bounds to be applied to any change point. These should be added to the figure and quantified in text. Please consider combining Figures 2 and 3. Also consider including the sodium profiles for each core so the significance of any Sodium flux changes can be evaluated.
- Figure 4. Please ensure that the same geographical field is used in each panel, to make it easier for the reader to evaluate differences.
- Supplementary Methodology. Please quantify the LODs, sample concentration ranges and representative uncertainties for each of the ions presented in the text. From comparing this text and figure S1, it appears that the LoD for Br is 10 to 100% of the sample concentration?
- Figure S5. It is more helpful to plot something like decadal (or multi-decadal) averages, as it is unclear what time period a 20 point smoothing average represents.
- Figure S6. It would be interesting to plot this data together with Figure 5, to demonstrate larger-scale variability and consider other drivers of change in the polar atmosphere (e.g., background acidity, dust levels, etc).

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-215>, 2019.