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Interactive comment on "Representativeness and seasonality of major ion records derived from NEEM firn cores" *by* G. Gfeller et al.

G. Gfeller et al.

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italic: referee 3

bold: Gfeller et al.

Gfeller et al. have assessed the spatial "representativeness" of several major ions commonly found in snow using a suite of snowpits and firn/ice cores from northwestern Greenland. Using complex statistical analysis, the authors identify which species are most likely to reflect the original atmospheric loading/source strength signal on seasonal to interannual timescales when measured in a single record, and which species would require several spatially distributed cores in order to overcome localized post-depositional alteration, most likely wind scouring in this case. The conclusions are

specific to the region of study, though it is suggested that sites with high snow accumulation and calm winds are more likely to preserve representative signals and may not require extensive replicate coring. This work represents a critical, though all too often overlooked, step in interpreting major ion chemistry in ice cores. The analytical methods appear sound and there is careful consideration given to error and the validity of the statistical techniques employed. Importantly, authors consider two possible accumulation scenarios. The manuscript is appropriate for The Cryosphere and written in a clear and concise manner. I recommend publication largely as is and offer several minor comments and suggestions below.

Comments:

It is very interesting that nitrate is one of the most representative ions. As you note, nitrate is vulnerable to post-depositional loss, especially at low accumulation sites, though it may largely be preserved under higher accumulation regimes such as at Summit. Still, it is interesting that conservative species such as calcium and sodium are less representative, at least on the interannual scale. Do you feel comfortable speculating about what accounts for this difference? Calcium and sodium are largely deposited in the colder months, i.e., when wind speed and reworking is greater (you note that the AWS observations are scarce, but you could refer to Section 3.5 in Steffen and Box (2001), Surface climatology of the Greenland ice sheet: Greenland Climate Network 1995-1999, JGR, D24. Conductivity is more representative but also peaks in the colder months, though it may be different since it is a more integrated signal.

This is indeed very interesting. We agree that the representativeness for calcium and sodium is probably lower due to stronger winds during the winter months. Regarding nitrate we could speculate that in addition to being deposited during months with weak winds, the influence of the post-depositional loss might be larger during warmer months, leading to higher representativeness values. We added a sentence on this in the manuscript.

2531(10) and 2552(14): I don't believe decades contain apostrophes (e.g., 1970s) since they are not possessive.

Corrected

Be consistent in your choice of time scale vs. time-scale, inter-annual vs. inter annual, and scenario 2 vs. scenario two (e.g., p2531 and p2545).

Corrected

2549(8): worthwhile?

Corrected

2551(22): Can you clarify "completely obliterated" in this sentence? I read this as the pre-Industrial summer nitrate peak being obscured by the higher, present-day concentrations and distinct seasonality. Is that correct?

That is correct. Corrected.

Interactive comment on The Cryosphere Discuss., 8, 2529, 2014.