

August 17, 2017

Review of bg-2017-140 Spatial variations in snowpack chemistry and isotopic composition of NO_3^- along a nitrogen deposition gradient in West Greenland by Curtis et al.

Dear Dr. Curtis,

Thanks for submitting your scientific results to Biogeosciences. Even though both reviewers and I appreciate the valuable chemical and isotope data from snow packs, I also agree with them that the paper “needs a fair amount of work to be of publishable quality”. **In addition** to the comments of the reviewers, there are two main concerns that I would like to emphasize:

1. The scientific motivation of the study is not clear and specifically, the importance of spatial gradients or not. More relevant background information is needed on this, on potential sources of ions, and on postdepositional processes.
2. The analysis of the data is hard to follow therefore conclusions are not clearly supported. For instance in page 17 “...and nss-SO₄²⁻ (not significant) are greater in coastal snowpack than inland, ...”. If differences are not significant, then they do not exist and cannot be used as argument. Same in the Conclusion section: “However the reverse is true for NH₄⁺ and nss-SO₄²⁻ with significantly higher concentrations in coastal snowpack than inland.”
3. Some of the conclusions are based on correlations that in certain cases are weak (although significant) meaning that other processes are involved. In summary, drawing of conclusion should be based on observations and clearly explained. For instance:
 - a) “While chemistry and deposition show similarities to ice sheet snowpack, stable isotope data show major differences.

What similarities are you referring to, and which set of data are you using to state that?”

b) Page 12. Where is the data for this?
“For non-sea salt sulfate, the pattern of snowpack concentrations is similar to total measured values, with the highest mean concentrations at the coast which are significantly greater than inland, although mean non-sea salt concentrations are all very low (1.0-1.8 $\mu\text{mol L}^{-1}$). Non-sea salt Mg²⁺ is

significantly lower at Kelly Ville than elsewhere, while non- sea salt Ca^{2+} increases significantly from the coast towards the ice sheet, presumably due to wind-blown mineralogenic sources. There are no significant differences for non-sea salt K^{+} and negative values for non-sea salt Na^{+} suggest either non-sea salt sources of Cl^{-} or snowpack losses of Na^{+} , perhaps through preferential elution pathways. ”

Other issues:

4. Page 3. Paragraph 2. “total inorganic nitrogen”. The word total is either redundant if you are measuring all inorganic N species or incorrect since N_2 was not determined.
5. Page 3. Remove double parentheses in ($\delta(15\text{N})$, $\delta(18\text{O})$ and $\Delta(17\text{O})$)
6. Page 3. “We use the strong climatic gradient ” Define
7. Page 6. the common and used scientific notation in the isotope literature is “ $\delta^{15}\text{N}$ ” or “ $\delta^{15}\text{N-NO}_3^{-}$ ”.
8. Table 4. Change “stable isotopes (per mille) ” to isotopic composition (‰)
9. Page 11. “The nutrients NO_3^{-} and PO_4^{3-} show an opposing pattern, with significantly lower concentrations in coastal snowpack than at inland sites and weak, negative correlations with Cl^{-} (NO_3^{-} : $r=-0.392$, $p<0.01$; PO_4^{3-} : $r=-0.277$, $p<0.05$). ”
10. Caption Figure 5. Complete... stable isotope composition of nitrate.
11. There is a great number of non- standard abbreviations such as nss- SO_4^{2-} , ODE’s (What is ODEs by the way?). Please avoid those since they just confuse readers.

I hope you can provide a new version based on the reviews

Yours sincerely

Silvio Pantoja
Associate Editor