



EGUsphere, community comment CC1
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Comment on egusphere-2022-584

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Community comment on "Nitrate isotope investigations reveal future impacts of climate change on nitrogen inputs and cycling in Arctic fjords: Kongsfjorden and Rijpfjorden (Svalbard)" by Marta Santos-Garcia et al., EGU sphere,
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The paper could consider using published seasonal (and multi-year) values of $d_{15}N-NO_3$ and $d_{18}O-NO_3$ in glacial runoff entering Kongsfjord. Linked to this, the paper could also be potentially improved by considering the role of nitrification (which is currently limited to a brief mention in the context of guano). Nitrification has been shown to become the dominant source of NO_3 to glacial runoff in Kongsfjord after mid-July, and the "excess nitrate" it creates seems to be present in a worldwide selection of glaciers. While I am unsure of how this will affect the authors' important assertions about the future nitrogen balance of the two fjords being studied, I think it is really important to demonstrate a full appreciation of the role played by microorganisms in supplementing the nitrate content of runoff whilst glaciers retreat onto land. Two published studies of direct relevance to Kongsfjorden are:

Wynn, P.M., Hodson, A.J., Heaton, T.H. and Chenery, S.R., 2007. Nitrate production beneath a High Arctic glacier, Svalbard. *Chemical geology*, 244(1-2), pp.88-102.

Ansari, A.H., Hodson, A.J., Kaiser, J. and Marca-Bell, A., 2013. Stable isotopic evidence for nitrification and denitrification in a High Arctic glacial ecosystem. *Biogeochemistry*, 113(1), pp.341-357.

The above papers show that the inferred subglacial $d_{15}N-NO_3$ and $d_{18}O-NO_3$ end member signature in the discussion paper is quite different to those observed in glacial rivers. For example, during the main runoff season, subglacial $d_{15}N-NO_3$ was in the range -2 to -7 ‰ (Wynn et al). I am not entirely sure what this means for the discussion paper, but it would be good to see the authors' views on this and I hope it can help the discussion in Section 4.5, where I found sources mentioned that were difficult to understand (moulins?). Putting the strong seasonality of glacial outflow nitrate aside, I wonder whether the authors' inferred subglacial end-member requires more denitrification than is apparent from the published values of subglacial outflow. This might be because the dominant subglacial inputs to Kongsfjord come from far larger glaciers than those studied by Wynn et al and Ansari et al. I find this entirely plausible and also useful, because less denitrification after glacier retreat onto land is also a realistic proposition. It would also be good to question the representativeness of values from the smaller glaciers since they dominate the literature but not the inputs to fjords.

Lastly, a minor point is that N₂ fixation is indeed poorly understood, but it was studied on glaciers in the Kongsfjord region by the publication below. For sure, though, N₂ fixation is not so important

Telling, J., Anesio, A.M., Tranter, M., Irvine-Fynn, T., Hodson, A., Butler, C. and Wadham, J., 2011. Nitrogen fixation on Arctic glaciers, Svalbard. *Journal of Geophysical Research: Biogeosciences*, 116(G3).