EGUsphere, referee comment RC1
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Comment on egusphere-2022-671

Anonymous Referee #1

Referee comment on "Permafrost degradation and nitrogen cycling in Arctic rivers: Insights from stable nitrogen isotope studies" by Adam Francis et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-671-RC1, 2022

The authors present a detailed and novel study of nitrogen dynamics within six major Arctic rivers through collection of water samples analyzed for dissolved nitrogen species and nitrogen isotope values. These six rivers span a gradient of permafrost coverage throughout the watershed with the Kolyma having the most continuous permafrost coverage to the Ob which has the least permafrost coverage. Major findings include large inputs of DON and nitrate with isotopically heavy ^{15}N signature due to the Yedoma permafrost thaw zones along the Kolyma. Evidence for permafrost derived DON being recycled to nitrate is presented within this watershed. The authors also present a great data set on seasonal nitrogen dynamics within the six rivers even though the impacts of permafrost degradation could not be shown in this study. Instead, fresh DON from surface runoff and most likely lateral flow through the organic rich top-soils of the watershed supplies the majority of nitrogen within these rivers. The Ob river is presented as one possible future (due to less permafrost coverage) of nitrogen dynamics for the other 5 rivers. Permafrost thaw could be identified with nitrogen isotopes only within small spatial scales due to dilution and vast catchment differences (and their processes) of the main stem rivers. The authors provide detailed discussion of how different types of permafrost thaw impact and watershed characteristics can impact nitrogen and isotopic dynamics.

In general, I would pay close attention to the use of flux and loads throughout the document, particularly with uncited language. Most of the data presented here is concentration (with one figure of flow-normalized concentration).

Figure 1. Potentially add a table of watershed characteristics (including but beyond continuous permafrost coverage) to Figure 1. Perhaps include amount of peatland area, lake coverage, glacial coverage, etc. that is referred to throughout the article. This could also be a supplementary table

Lines 61-64

Is Zhang the original citation here? Or is it

R.O. van Everdigen, Multi-language glossary of permafrost and related ground-ice terms

Definitions (1998), p. 78

I would probably use the van Everdigen reference in place of the Brabets reference. While that definition is included within the Brabets, I don't think it can be attributed to him.

68-77

Seems like there are some citations missing here.

78-90

It would be nice to mention some of the limitations and uncertainties associated with these studies.

Lines 195-196

The authors could remove the last sentence of this paragtraph as they reference the fluid mud stream in line 193.

Line 216- add "the" between capturing and variability

Lines 218-220 It would be good to cite some of the studies regarding the limitations/variability of these discharge records for these rivers

Figure 2- "Continuous" is misspelled on each of the X axes within this figure.

Figure 3-It might be beneficial to add a secondary Y axis or a second panel to better capture the small scale differences referred to in the text (Lines 290-321)

Figure 5-Great figure!

Figure TK I think it would be beneficial to have a conceptual figure the visualizes the how different permafrost conditions and other catchment factors influence the nitrogen cycle, isotope fractionation either at this point or earlier in the article. There is a lot of text within the article that does a great job of describing all of these processes, however, you might be able to significantly reduce the amount of text by referencing a new Figure that visually represents these processes and impacts.

Figure 6- Yukon X axes for both nitrate and discharge differ slightly from all other rivers (or at least the labeling does). I would also include the years of 2003-2018 within the title of this figure. I wonder if spot calculating loads/flux here for DON and NO_3 might provide some interesting insights, especially since the authors

Line 494, I would move the citation of Figure 1 to Line 493 after 'rivers'. As it reads, to me, it suggests that Figure 1 is a nitrogen cycling figure.

Line 550- is this percolation? Or lateral subsurface flow?

Line 616- is this "of riverine nitrogen geochemistry" or on?