Biogeosciences Discussions

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Comment on bg-2021-277

Anonymous Referee #1

Referee comment on "Fire in lichen-rich subarctic tundra changes carbon and nitrogen cycling between ecosystem compartments but has minor effects on stocks" by Ramona J. Heim et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-277-RC1, 2022

This study presents an analysis of post-fire carbon (C) and nitrogen (N) dynamics using a chronosequence of tundra ecosystems in western Siberia. Results show minimal effects of fire on above and belowground nutrient pools, with the primary effect related to lichen declines and bryophyte increases post-fire. The research is well designed with appropriate analyses, and the manuscript makes an important contribution to the increasingly important topic of tundra fires for a region that is not well documented in the English language literature. Several aspects related to the framing and interpretation of the work may help to improve manuscript. Congratulations overall on a nice study.

Framing this work as contradictory to Mack et al (2011) doesn't seem entirely correct to me and raises a couple of important issues to consider. The paper by Mack estimates combustion losses one year post fire by using proxies to reconstruct the organic soil layer. In the absence of such data, the present study has a slightly less complete picture of soil C losses. The data provide good information on changes in C concentration, but I wonder if the depth increments are comparable. For example, could it be the case that 0-5cm in the burnt sites corresponds to 10-15cm in the unburned sites? These things are OK, but some more details and nuanced discussion would help. For example, what are the soils like at these sites, is there a well developed organic layer? Would such combustion losses be possible, or are soils a less important fuel source in these systems? Note that Loranty et al (2014) report organic soil depth in this context, and that Jones et al (2013) also document organic soil accumulation after fire. If these sites have different soils it may be worth highlighting this and considering what this means for geographic variability in tundra fire impacts on biogeochemical cycling.

Related to these points, the results or discussion don't really mention depth differences for the soils, particularly regarding the 13C results. Could there be differences related to belowground biomass (root) dynamics? Alternatively, could differences in permafrost thaw depths or temperatures explain any of these differences? Here again I think some site specific context would be helpful - could results from your other studies at these sites (e.g. soil temperature or thaw depth) help interpret these results? A map and/or photos of the study sites could be helpful as well.

This may be more personal preference, but I think the structure of the manuscript could be improved. Subheadings seem to be used instead of paragraph breaks. The Introduction should be broken into several paragraphs to help highlight main aspects of the topic. Conversely, there are places where the subheadings seem excessive - for example section 3.2 could be a paragraph or two. Presenting these results in a bit more detail and narratively linking them can help provide a more comprehensive overview for the reader.

L30: Perhaps start a new paragraph when switching from C to N.

L40: New paragraph?

L186: This discussion begins to address some of my points above. Note the study by Loranty et al had ~10cm organic soil layer relative to ~21cm reported by Mack et al., and in both cases the boundary between organic and mineral horizons is generally well defined. It would be interesting to know how the sites in this study compare, and whether differences in soil types between depth layers (i.e. 0-5cm, 5-30cm affect bulk density and nutrient concentrations.

Jones, B.M., Breen, A.L., Gaglioti, B.V., Mann, D.H., Rocha, A.V., Grosse, G., Arp, C.D., Kunz, M.L. and Walker, D.A., 2013. Identification of unrecognized tundra fire events on the north slope of Alaska. *Journal of Geophysical Research: Biogeosciences*, *118*(3), pp.1334-1344.