

The Cryosphere Discuss., referee comment RC2
<https://doi.org/10.5194/tc-2022-38-RC2>, 2022
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Comment on tc-2022-38

Anonymous Referee #2

Referee comment on "Significant underestimation of peatland permafrost along the Labrador Sea coastline in northern Canada" by Yifeng Wang et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-38-RC2>, 2022

General Comments

The manuscript submitted by Wang et al. presents an interesting approach for compiling an inventory of peatland permafrost occurrences along the Labrador coast. The consensus based approach integrates multiple methods including imagery interpretation and field observations. The overall approach is unique compared to other permafrost mapping studies with its utilisation of extensive field validation and the consensus based approach. It could therefore be a model for similar mapping projects elsewhere.

The inventory generated is compared to other studies that have produced maps of permafrost peatlands. The importance of climate and geomorphological influences are discussed and the MS highlights the importance of local-regional scale mapping as well as the integration of field observations. The MS is generally well written and interpretations and conclusions are sound. The paper would be of interest to a wide audience. I have no major concerns and it should be published following some minor revisions. I do have a number of comments and suggestions for the authors' consideration in preparation of the revised MS.

Some consideration of the scale of existing maps of permafrost and peatland distribution compared to the scale of the authors' study is required in the analysis and formulation of the main conclusions regarding adjustment of existing maps for southern Labrador. The maps used for comparison are at a smaller scale (national and circumpolar) than the more local to sub-regional scale mapping presented in the MS. Many of the maps used (or the ones used to develop them) will have minimal mapping units so that the characteristics of smaller units will not be shown on the map. This would be the case for example, with the Heginbottom (1995) which is at a scale of 1:7 million, and to some extent O'Neill et al. (2019) which utilizes similar scale maps in its development. It is therefore not surprising that your results would be a bit different. At a national or circumpolar scale, the 15 km that the authors' suggest the southern permafrost boundary should be extended, is within the precision of these maps. One of the points that could be made is that the application

of national and circumpolar scale maps is not really appropriate for addressing sub-regional to local scale issues including those related to plant and animal habitat or infrastructure scale integrity as has been done in a number of other studies. Although the authors do seem to hint at issues of scale, this aspect could be strengthened in the paper.

The inventory would appear to consist of point observation of frozen peatlands. It is not clear if the area of these features has also been determined. This would be useful for the comparison to existing permafrost and peatland maps which show distribution in terms of areal coverage rather than location of specific occurrence of features. Although the density of peatland complexes likely containing permafrost (number) per 400 km² is shown in figure 3b this is not the same as % areal coverage as shown on other existing maps. This makes it difficult to determine whether the results indicate greater occurrence of frozen peatlands than the maps that are used for comparison in the MS (i.e. comparing apples to oranges). Many of the likely or possible occurrences of peatland permafrost complexes are for example within the sporadic or isolated patches zones shown on the Heginbottom et al. (1995) map which means permafrost is more likely than not to be absent and limited to organic terrain in the case of isolated patches. It is difficult to determine from the results presented whether the map presented in the MS indicates a permafrost distribution that is different from the Heginbottom et al. map. Some further discussion is probably required regarding area of the features identified in the inventory.

I am somewhat curious as to how the maps for comparison in the main paper (figure 5) were chosen especially the circumpolar maps (Hugleius et al. 2020; Olefeldt et al. 2021) rather than some of those included in the supplementary information. Would the larger scale map of Tarnocai et al. (2011) for example (which I believe also includes information on whether peatlands are frozen), be more suitable for comparison in the main paper.

Some clarification on the study area is required. It would seem that the focus is on Labrador (coastal Labrador?) but the authors should clarify if the imagery analysis was done for all of Labrador or only specific areas. Also there appear to be observations outside of Labrador and it is unclear which areas outside of Labrador were included in the imagery analysis. A map clearly showing the area for which imagery analysis was done would therefore be useful. For field-based observations, some information on how sites were chosen beyond accessibility is probably required for the reader to understand whether there is any bias in the site selection and validation.

Additional minor comments are provided below keyed to line number

L2 – Title – would it be better to refer to the “Labrador coast”?

L30-31 – insert “in temperature” between “offset” and “between” (i.e. be clear that the offset is referring to a difference in temperature). You could also add that it is the difference between the frozen and unfrozen thermal properties that is an important factor.

L34 – “assessment of thermokarst....” Is probably better and more inclusive.

L50 – O’Neill et al is a national scale map and is based on integration of a national scale surficial map which will not show local scale distribution of peatlands or other organic terrain.

L60 – There is the peatland map and database which I believe is at least partly based on air photo interpretation of Tarnocai et al. (cited in Supplemental Information).

L275-277 – Way and Lewkowicz (2018) includes ground temperature measurements in Labrador and the thermal offsets for various terrain types. Could you be more quantitative and use these results to strengthen the point you are trying to make regarding importance of thermal offset. James et al. 2013 ERL also discusses the importance of thermal offset in persistence of permafrost in organic terrain.

L278-285 (also figure 4) – With respect to associations with elevation, it might be more important to consider whether the area is above or below the marine limit rather than the elevation itself. Given the marine limit varies with latitude, as described in section 2.2, it would make sense to consider the location with respect to the marine limit. For sites below the marine limit, wouldn’t the time since emergence be a factor as it would influence age of peatland and also length of time over which ground freezing occurs.

L287-299 – Reference is made to model predictions. It might be better to refer to simulations which would be more inclusive as the various studies mentioned use various approaches including compilation/synthesis of existing information.

L298 – The surficial deposits are a key factor influencing drainage and accumulation of organic matter as well as formation of segregated ice. You might consider association of peatland permafrost with surficial deposits as has been done for other parameters in figure 4.

L309-310 - Obu et al. (2019) map represents equilibrium conditions so it doesn’t adequately consider past climate history which is important as you have mentioned in the discussion. Permafrost occurrence will be underestimated, especially in the southern portion of the permafrost zone.

L319 – You need to consider the scale of the maps to which you are comparing your results. Heginbottom et al. is a national scale map and is much at a much smaller scale than your study – 15 km on the national scale mapping is likely within the precision of the map.

References

A number of the citations are incomplete and missing information should be added.

L400-401 – Is this a conference presentation with abstract? Provide the conference details and abstract if that is the case

L404-405 – Incomplete citation. Is this an unpublished report?

L406 – Unpublished report, conference presentation? Provide details.

L413-414 – This is NRC Internal Report No. 82 with 1956 publication date.

L415-416 – Incomplete. This is NRC Technical Paper 449

L432 – Is this correct. Seems like an odd reference for a land survey

L434 – van Everdingen is the editor. Also, you should indicate this is an International Permafrost Association publication of the Terminology Working Group

L441 – Is this from the Quaternary Geology of Canada and Greenland. Add missing citation info.

L442 – This is Map 1880A and it should have a doi number (check GEOSCAN <https://geoscan.nrcan.gc.ca/>)

L453 Missing information. This is from the National Atlas (5th Edition) Geomatics Canada series number MCR 4177. It also has a doi number (check GEOSCAN

<https://geoscan.nrcan.gc.ca/>)

L535 – Is this the database for the inventory (at Nordicana D?) – There should be additional information including doi number.

L538-539 – Is this a conference presentation/abstract, unpublished report? Provide additional information.

Supplemental Information

Figure S3 – Why only show where permafrost is not present based on 2013-17 study? It would be more useful to also include where permafrost was present during the 2013-17 study.

Figure S5 – I believe Tarnocai et al. (2011) also indicates whether peatland is frozen or unfrozen. Wouldn't it be useful to show this on the map?

Figure S8 – How useful is this comparison given Obu et al. map is based on an equilibrium permafrost distribution and past climate conditions are not considered? Since permafrost aggradation in this region likely occurred under a colder climate than present, the Obu et al. map will underestimate the permafrost occurrence.

Supplemental References

Some citations are incomplete

L71-72 – Heginbottom et al. – see earlier comment

L86-88 – More information about these publications should be provided. Is the NRCan Land cover map the one described below (it might also be from National Atlas 6th Edition reference outline series 6409).

Canada's land cover; Latifovic, R. Natural Resources Canada, General Information Product 119e, (ed. version 2015), 2019, 1 sheet, <https://doi.org/10.4095/315659>

L100-101 – Missing info for Tarnocai et al. This is Geological Survey of Canada Open File 6561 and has a doi number – check GEOSCAN