The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2022-38

Anonymous Referee #1

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-RC1, 2022

Summary:

This is useful study, documenting distribution of peatland permafrost along the Labrador coast of northeastern Canada. The author's undertake a point-based survey of potential peatland permafrost from satellite imagery and then validate survey points with field and aerial surveys to determine areas of "probable, possible, and unlikely" peatland permafrost. The study is worthy of publication with some revisions. Primarily, authors should address: i) the boundaries of the actual study area; ii) rational for using a point-based survey rather than outlining peatland terrain, along with related issues of scale and differentiation between peatland areas; iii) potential to extend and portray distribution of sporadic permafrost based on results of this study. Other discussion points are raised that may be assessed at the discretion of the authors, including: i) perceived abundance of peatland permafrost distribution in Labrador; extent of past permafrost and loss of permafrost relative to present; consideration of defining point-based features as "small, medium, and large" based on a catagorization; age relations of coastal peatlands and permafrost initiation based upon elevation above present sea level; issue of "mis-identification" of permafrost peatlands along the northern section of the study area; correlation between permafrost peatland and terrain other than palsa bogs mapped by ELC; and, discussion of climatic effects related to formation/preservation of peatland permafrost along the Labrador coast and objectives for further study.

Major questions and comments:

Ln 48-49 – "… suggest that peatland permafrost is more abundant along the coast than in the interior". This seems to be an important point. Does this study confirm this suggestion? Does the study adequately cover the interior peatlands, or focus primarily on

the coast? Despite an underestimation of the coastline peatlands, does this study conclude that permafrost is more abundant along the coast than within the interior?

Ln 65 Another important point. To be clear, the study is a point-based inventory. Does this mean that peatland areas are not outlined, and that no coverage of their extent presently exists? In this case, we do not know the individual area or total area of these peatlands.

Figure 4d – does the distribution of peatland permafrost landforms by MAAT say anything about past or present conditions in terms of temperature, for their development? That is to say, why does frequency decrease with cooler MAATs? What is the optimal MAAT for their formation?

Do unlikely peatland permafrost landform areas say anything about past or recent loss of permafrost? Did unlikely areas have permafrost in the past or did they develop without permafrost?

Ln 71 Study Area. What is the actual study area – being that area that is encompassed by this study? This section suggests that the study area is all of Labrador – suggesting that the inventory of wetlands of interest using satellite imagery is to cover all of Labrador. If this is not the case, then a specific section that defines the actual study area is necessary. On a map of Labrador, authors should show the actual area covered by their study, otherwise this is rather misleading as it seems that all of Labrador is the study area and has been examined. Suggest the inclusion of a Section 2.4 entitled "limits of study area" which clearly shows and defines the spatial limit that this survey encompasses. At the same time, some statement on what this implies is important as it appears that the study only identifies and attempts to validate peatland permafrost along the coast of Labrador, but not inland.

Ln 94 Permafrost distribution. This figure should include the outline of the study area within which the surveys were conducted. In this way, readers will be aware of the area in which the study may attempt to validate permafrost distribution. It seems, in fact, that the results of this study should be sufficient, based on observations, to redefine the distribution of permafrost zones along the coastline based on its findings. This could be an added objective and it seems reasonable that if the surveys found permafrost peatlands along the coastline but not inland – that the extent of sporadic permafrost could be extended along the coastline and shown as an additional result in this study. If the authors feel they do not have enough evidence in their study to extend the sporadic zone at present, then they should suggest what else is needed to do so either in the discussion or the conclusion.

Ln 115 Methods. Again, it is important to define the area along the Labrador Sea and Gulf of St. Lawrence coastline that is actually covered by this study. In essence, the study only identifies and attempts to validate peatland permafrost within these areas – not within all

of Labrador. Figure 1 can be used to show contiguous survey areas along coast and can also indicate that inland point features outside of these areas were also investigated.

Ln 115 Methods. The methods section needs to discuss issues of scale. Specifically, how large / how small an area was identified on satellite imagery. Not only the resolution of the imagery, but what is the minimum size of a permafrost peatland that was counted as a peatland complex and, similarly, how large. It seems that this study did not outline peatland permafrost complexes, but simply identified them as point-based features. Does this mean that each feature was contiguous, or does this include multiple features close together. Similarly, how far away does another feature need to be to be counted as a separate feature? As these are indicated only as point features, it is important to provide some methodological constraints on how a feature was included (minimum size) and how it was differentiated from a separate feature (minimum separation distance). It would be very useful it there were also some insight into the size range of these features – even if they were mapped only as point features.

It is not generally clear why a point-based inventory was approached, rather than outlining the potential peatland permafrost terrain units. Perhaps, at least, it could be stated why point-based mapping was undertaking rather than defining polygons and areas.

As a note, it would have been beneficial for the authors to have perhaps differentiated the sizes of the peatland permafrost terrain into a least "small", "medium" and "large" peatland units with some type of catagorization. For example, in Figure S9 it becomes clear that permafrost peatlands are of different sizes, and may benefit from differentiation. In Figure S10 it is not really clear how one peatland unit is differentiate from another as they are shown only as point features and the boundaries of each a not easily to distinguish. Again, a simple differentiation of the size of each in catagorization would have been beneficial.

Ln 208-212 Even though areas were identified only as point features, something about their size should be included. What was minimum size, what was maximum size? Even point features have separation distances, so what was the minimum separation distance between features?

Ln 280-285. Discussion regarding distribution of permafrost peatland complexes is intriguing, and also opens up additional discussion. Where are data showing which peatland complexes lie below marine limit, and which are above? This is alluded to but not shown. The issue of deglacial history and marine recession history are relevant here, in terms of defining the oldest terrestrial age surface in the study area and, thus, oldest peatlands. It appears that deglaciation of the region was from as early as 11 ka BP, along the coastline and then younger moving inland to about 7 ka BP. At the same time, marine recession was occurring in the southern areas along the coastline. Presumably, along the coastline at certain elevations deglaciation and marine recession were the earliest, and these are the oldest peatlands. So – are the oldest peatlands generally also the ones with likely permafrost? Are they thickest, do they have the most syngenetic ground ice? It

would be useful to tie the history of marine recession and deglaciation into this discussion a bot more. At present, this is portion of the discussion very limited and is worthy of further consideration.

Ln 287-299. Again, there seems to be more to say here when speculating on the history of peatland intiation ages within the study area – which most of these products/datasets do not take into consideration (and presently, the authors do not either). Admittedly, few peatland initiation ages exist in the region, though theoretically the youngest may be constrained to near the coast. The authors might consider referring to the following articles as a starting points on understanding peatland ages in the region and their possible influence on permafrost peatland distribution:

Gorham, E., Lehman, C., Dyke, A., Janssens, J. and Dyke, L., 2007. Temporal and spatial aspects of peatland initiation following deglaciation in North America. Quaternary Science Reviews, 26(3-4), pp.300-311.

And:

Dyke, A.S., Giroux, D. and Robertson, L., 2004. Paleovegetation Maps of Northern North America, 18 000 to 1 000 BP. Geological Survey of Canada.

Ln312-313: It seems that this study could go a step further by outlining the proposed extension of sporadic permafrost based on their results. Providing an additional Figure 7 with proposed areas of sporadic permafrost would be a useful addition and seems reasonable based on the extent of the study and the results.

Ln330-333: This may warrant an additional sentence or two for clarification. What is the basis for mis-identification based on? For example, most maps in Fig S5 show greater abundance of wetland or peatland areas in the south than in the north. Is it the absence of mapped peatlands along the coastline in these inventories that leads author's to suggest that their identified areas here may not be peatland permafrost, but instead lithalsa's? Or did field visits (Fig. 2) along the northern coastline confirm that these were lithalsa's or in fact peatland permafrost? In general, the absence of peatlands shown in Fig. S5 suggests that either there are few peatlands here, or they are too small to be mapped at that scale.

Figure 6. Reference source for this map seems odd "audio tape?". Whereas it is interesting to show palsa bogs mapped by ELC here, were there other terrain types related to peatlands that were mapped too? There seems to be a good agreement between the mapped palsa bogs and peatland permafrost, but what were other areas mapped as? Were these peatland areas that did not contain permafrost or other terrain types? Could be discussed in text if not in figure itself.

This study seems almost purposefully vague about existing weather and climatic conditions occurring within the areas of identified permafrost peatland terrain. Given the adherence of these areas to the Labrador coastline, it is indeed interesting to speculate to what extent a maritime climate influences the distribution of permafrost across the study area. The authors allude to conditions of fog, cloud cover, snowpack and wind being potential factors in their distribution. Presumably, these factors are being examined in site-specific studies. The authors could elaborate somewhat further, in the discussion, and most certainly in the conclusion, for the need to investigate local climatic conditions that may support the presence of permafrost in these areas. In a way, this is similar to the examination of the role of inversions in some mountainous environments for sustaining permafrost. It would be suitable for the authors to provide some insight into the intent and value of local studies to understand the distribution of contemporary permafrost further. In addition, such work could aid in more accurately determining extent of sporadic permafrost along this maritime area.

Figure S3. Not sure that depicting only locations of non-peatland permafrost locations is useful. Perhaps better to include both those that did as well as those that did not.

Minor Edits:

Suggest adding “northeastern Canada” to the end of the title

Ln 12 Change “maps” to “depictions”

Ln 21 Ditto

Ln 27 consider replacing “perennially frozen ground” with “permafrost”

Ln 41 delete “they”

Ln 43 consider replacing “have suggested that peatland permafrost is present” with “have depicted peatland permafrost as present”

Ln 46 change “is” to “are”

Ln 58 change “have been” to “are”

Ln 60 change “and no” to “with no”

Ln 60 change “efforts have been completed” to “effort completed”

Ln 75 provide location of coldest MAAT (-11.9C) and warmest MAAT (+1.5C) for context and, if possible, so locations on Figure 1.

Ln 73-78. Unless provided elsewhere, indicate proportion of snowfall versus rainfall and range in total precipitation.

Ln 87 How can glacial till be deposited following retreat of the Laurentide Ice Sheet, except by another glacial/glaciation? Explain, rephrase or delete.

Ln 96 Try to keep spelling of words like “archaeological” and “paleogeographic” consistent. Decide on preferred spelling and use it throughout.

Ln 141 change “that exceeded” to “exceeding”

Ln 177-178. Change “wetland complex by wetland complex” to “WOI” if appropriate.

Ln 188 Change “was” to “were”.

Ln 189 Delete “of WOIs”

Ln 191 Delete “that was”

Ln 251 95 % - remove space.

Ln 262 Delete “In this, study, we demonstrated that”. Start sentence with “Peatland permafrost …”. Reference Figure 4b at end of sentence.

Ln 265 Provide reference to a figure as supporting evidence.

Ln 535 Reference seems incomplete. Nordicana D?

Ln 538-539 Reference incomplete.