Comment on tc-2022-38

Steve Kokelj (Referee)

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-RC3, 2022

Summary

In this manuscript, "Significant underestimation of peatland permafrost along the Labrador Sea coastline", the authors have initiated an interesting observational dataset on peatland permafrost distribution for a region with limited data on the nature and extent of permafrost. As such the inventory method and data set provide a useful contribution to the knowledge of permafrost in the study region. The inventory method provides a straightforward point dataset that identifies occurrences of likely peatland permafrost, explores some environmental factors associated with peatland permafrost occurrence, and compares this fine-scale dataset with broadscale depictions of organic terrain, thermokarst, and ground ice distribution. The dataset provides an empirical basis to guide future investigations or to inform potential revisions of broader-scale depictions of thaw-sensitive permafrost and future modeling efforts. The data presented is straightforward and relatively easy to understand and the analyses are useful. There are a number of items that the Authors should consider prior to publication. These amount to minor to moderate revisions and would help improve the clarity and impact of this study. These general comments are provided below followed by a series of detailed items which I hope the Authors will find useful to guide their revisions.

General comments

The Introduction is reasonably effective at framing the study but should be further strengthened by better linking the state of knowledge with clearly articulated research questions or hypotheses. This will help to better frame the content of the paper, and provide clear logic behind the methods and analyses that are implemented. In relation to this point, there is a fair bit of data shown in the Supplementary materials, some of which seem central to the paper, while other figures in the main manuscript host relatively small amounts of information (F1, 2a). Some figure content could be better organized to make more economic use of figure space while highlighting the data that best supports key arguments.

Some minor editorial adjustments and additions to the figures would be helpful to more clearly define the spatial scope of the study. Early in the manuscript, it seemed that the paper developed Labrador-wide datasets, but only later in the manuscript did it become clear that the manuscript was focused on the coastal region as indicated in the title. Also, it would be useful to express whether the inventory was aimed to be exhaustive or whether it is thought to represent a subsample of the total population of the features within the focal area of study.

I think that the paper would also benefit significantly if the point data could be more effectively linked to some spatial characteristics of the peatlands. In this regard, I suggest three points to consider. First, it would be useful to clearly express the rule-base for decisions of how and where researchers dropped points to indicate the presence of a (permafrost) peatland complex. In Figure S9 the points seem to represent discrete features, however, it is less apparent why multiple points are dropped in peatland areas in Figure S10. In relation to this point, I think it would add significant value to the paper if the points could be attributed by a size index describing the peatland. This could be through establishing categories based on the area (discrete/small, basin/medium, landscape/large). Alternatively, or in addition, it would be useful to digitize a random subsample of peatlands to show the size distribution of a sample population. This would better contextualize the point dataset giving the inventory more "depth" and providing a better picture of the areal coverage of permafrost peatlands. This data would also provide the Authors with a solid platform for future analyses. It would be useful to include a table showing the data model describing attributes that were collected by the inventory.

I generally like the comparisons between the data generated by this project and the broad-scale spatial products. I think the comparisons are made in a reasonable manner, despite the difficulty of direct comparison with most of these broad-scale datasets because what they represent can be unclear. Some straightforward quantitative comparisons that show the degree of agreement between empirical permafrost peatland observations and grid cell classifications for the datasets portrayed in Figure 5 or S5 would be useful and should be added to the results section. The implications of these results can remain in the discussion.

Specific Comments.

P1 L10-13. Consider making a clear statement of the general distribution of peatlands across Labrador early in the paper to help frame this study. This added context would help a reader not familiar with the region.

L15 – I think it would be useful to briefly explain what is meant by a wetland and peatland

permafrost complex. Does the area of the landform matter?

L21 – It is not clear why the presence of "frost susceptible sediments" is important for peatland permafrost to form. Is it that peatlands typically develop in flat, poorly drained environments often characterized by lacustrine or glaciolacustrine deposits, which also happen to be frost susceptible?

Consider that total peatland counts are not the best way to highlight the relative importance of the phenomenon over a geographical area. While the totals have value in comparing permafrost vs non-permafrost peatlands, reporting the data as a frequency density (count/unit area) is more useful to understand the relative importance of the phenomenon, it can be portrayed spatially, and it can be compared more readily with data from other regions.

L28. Suggested modification. Add "in the form of" palsas (peat mounds…)

L28-29. Suggested modification for the definition of peat plateau. "variable-sized fields of frozen peat elevated above the general surface of the peatland"

P2L44-51. This narrative is good, but it would also be useful to describe the distribution of peatlands in Labrador (and the coast) to better contextualize the study. There are some nice maps in the supplement but those don't get introduced until much later in the paper. If peatland distribution was integrated into a map earlier in the main manuscript it would help contextualize the discussion from L44-51.

P2-3L64-65. It would be useful to more clearly indicate the spatial scope of the study. It is implied in P2 L63-65 but should be clarified and shown in Figure 1.

P3L66. Overall, the introduction is well-constructed and the need for research into peatland permafrost is apparent. Still, the final paragraph could be improved by clarifying the research questions or main hypotheses.

2.2 Physical environment

L86-93. To support this text it would be useful to show the relative proportion of different terrain types in one of the maps.

2.3 Permafrost distribution

P4L95-109.

I find this section to be well-written and informative. It highlights data gaps and provides a nice context for your study. Some of this narrative could be situated in the introduction section to help establish the relevance of your work and to frame clear research questions.

3. Methods

It would be useful to define the study area up front and show it in a figure early in the main manuscript.

It would be useful to elaborate on the description of Peatland permafrost complexes in the study area with reference to figures early on. On P7 L149-154 you could clarify that variation in elevation was used to assess permafrost presence.

P7. Upon inspecting some of the supplementary materials the Authors should clarify what comprises a WOI, or a point. Was there a rule base that indicates how a researcher identified a discrete "complex", and when one vs. two points were dropped? For example, the identification of discrete wetlands seems clear on FS9, but the distinction is less obvious on FS10.

P8. With respect to utilizing the DJI Mini 2 as explained in the methods, I would caution promoting a "best practice" since Canadian regulations require maintaining a visual line of sight.

 Source: https://www.gazette.gc.ca/rp-pr/p2/2019/2019-01-09/html/sor-dors11-eng.html

Visual line of sight see 901.11; also see definitions of VLOS.

Figure S3. It would be useful to show all of the survey points and the flight line.

3.3 Validation: It would be useful to describe the data model that guided the collection of

the inventory information.

Figure 2. Please indicate the study area that bounded the extent of the inventory. Also, please adjust the contrast of the "Not Permafrost Peatland" symbol to improve their visibility.

4. Results

P9 L208-211. Section 4.1 is very brief without much supporting analyses or graphics. Consider integrating this section with the next section.

Supplement Sect. S3. Can the Authors indicate all of the points showing the different WOI categories?

The data in Figure 4 is good and the descriptions are clear. Consider paired plots that normalize the distribution against available terrain within that class. Also, it would be interesting to see a plot of the distribution of peatlands without evidence of permafrost.

5. Discussion

P14 L278. Permafrost peatlands can also develop in flat sandy areas so that while ice segregation is commonly associated with peatland permafrost it is not a prerequisite. Here I would also suggest referencing the primary literature to support this point rather than a national-scale rule-based model.

P15-17. Figure 5 and S5 host a large amount of spatial data and the Discussion narrative compares and contrasts this study with modeled outputs of related variables. Systematic comparisons of these data sets should be presented as results and the implications can then be addressed more qualitatively in the Discussion. The comparisons are interesting and should be expressed as a study objective given that Figures 5, and S5 present 13 maps with significant amounts of data aimed at comparing new results from this study with existing mapping data.

6. Conclusions

To reiterate a previous point, I think it is also helpful to present results as a count per area because reporting total numbers of peatland occurrences does not provide a great sense of their spatial coverage or regional importance. Furthermore, counts that are not contextualized by total study area are difficult to compare with other datasets.