The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2018-200-AC1, 2019

The Cryosphere Discussions

Interactive comment on "New ground ice maps for Canada using a paleogeographic modelling approach" *by* H. Brendan O'Neill et al.

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Received and published: 29 January 2019

Dear Dr. Kanevskiy, Thank you very much for reviewing the paper and for the constructive comments and annotations on the PDF. We have implemented most of the suggested changes from the PDF and addressed all major comments below. We appreciate your time spent on the review, and your input has certainly improved the paper.

1. I recommend to change the title because "a paleogeographic modelling" is only a part of your approach and does not reflect the entire process. Maybe just "a modelling approach"?

We have kept the title as is, as paleogeographic datasets are fundamental to all the models (e.g., the paleovegetation dataset, deglaciation, glacial lake and marine inun-

dation). Many of the conceptual models that form the expert system are paleogeographic in nature.

2. I recommend to clarify some terms and definitions. You often use the term "massive ice and icy sediments" (page 2, line 5; page 4, line 30; page 5 line 15, etc.) to describe tabular massive-ice bodies of either glacier or intrasedimental origin. This approach is common in the permafrost literature (e.g., Heginbottom et al., 1995; Brown et al., 1997; French, 2018) but the term "massive ice" itself is very general. This term covers many types of ground ice (including wedge ice) so I recommend to specify what particular type of massive ice you are talking about.

Yes, we also struggled with what to call this class of ice. The PMC refers to "massive ice" as "extensive sheets", but of course, buried glacial ice may be irregularly shaped, as can bodies produced by segregation/intrusion. We have decided to change the name of this ice class to "relict ice" (e.g., Kokelj et al. 2017), and have clarified in Sect. 2.1 that this ice is either buried glacier ice or intrasedimental ice formed by segregation/intrusion.

3. The term "intrasedimental ice" is also very general (for example, see French, 2007, p. 182) but you apply it only to tabular massive ice bodies

We have removed the "tabular" qualifier so that other shapes of intrasedimental ice are not excluded.

4. When you use the term "segregated ice" (e.g., page 6, line 5), it's better to specify that here you are talking not about massive ice bodies formed by segregated ice but about relatively thin lenses and layers that form cryostructures of the frozen soils

We have added a sentence that we are not referring to larger intrasedimental ice bodies of segregation/injection origin.

5. Page 4, lines 9-11. I cannot see a big difference here: both maps (Heginbottom et al., 1995, and Brown et al., 1997) do not present numerical estimates for massive ice,

pingos, and ice wedges using different symbols for their general distribution (abundant and sparse) instead

The legend of the Brown map does not indicate that the larger ice bodies are not included in the numeric estimates. Either way, perhaps this was the intent. We have removed the related sentences, as we have decided they add unnecessary confusion.

6. Page 4, lines 33-35. Increases in active layer thickness cannot reach 5 m (in such case, it's already permafrost degradation), so I recommend to talk about thermokarst and thaw subsidence to explain why these top 5 m of permafrost are so important.

True – we have changed the wording here to "thaw depth" instead of "active layer thickness".

7. 7. Page 5, lines 8-16. I recommend to rewrite this paragraph. When you describe formation of segregated ice. . .

We have reworked this paragraph to present aggradational ice/the intermediate layer up front, and simplified the text.

8. Page 5, lines 17-21. I recommend to omit or simplify this paragraph: instead of talking about beds of intrasedimental ice, it's more important just to emphasize that here you are talking about relatively thin lenses of segregated ice that form various cryostructures and not about massive ice bodies formed by segregated ice.

We have simplified the paragraph, focusing on the difference in lens thickness and formation setting.

9. I recommend you not to use terms "extensive discontinuous" and "sporadic discontinuous zones." These terms were used in PMC (Heginbottom et al., 1995) but now synonymous terms "discontinuous" and "sporadic" are much more common. Anyway, you use both sets of terms in the same paper, and it doesn't look good – it's always better to be consistent.

We have corrected this issue and updated the nomenclature to "discontinuous" and "sporadic"

10. In your manuscript, you do not describe yedoma in Canada. . .

Since the model considers ice formed since 17 ka, we did not discuss Pleistocene syngenetic permafrost. However, you are right that these deposits are very important given the high ice content. We have added material to this section and suggested incorporating this into future modelling/mapping, as suggested.

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