

Dear Editor and Reviewers-

Please find herein an addressal of the various comments and suggested edits for our manuscript. Our **new text is in blue and bolded** and new/edited manuscript text is in **red with quotations**.

**Public justification (visible to the public if the article is accepted and published):**

Since several paragraphs were added to the latest version that have some grammar to be corrected or clarified, please make the following minor changes.

- Throughout document, "earth's" should be "Earth's"

Two changes were made:

First sentence of the abstract:

“Permafrost thaw across Earth’s high latitudes is leading to dramatic changes in vegetation and hydrology.”

First sentence of the Introduction:

“Permafrost is warming and degrading across Earth’s high latitudes”

- Ln 72 "...quantify and monitoring..." should be "...quantify and monitor..."

This has been changed, as suggested, to:

“In this study we focus on how best to quantify and monitor permafrost degradation rather than assess the drivers of change and ecological changes.”

- Ln 92 - Does the journal use the spelling "aeolian" or "eolian"?

Based on this paper:

Amory C, Trouvilliez A, Gallée H, Favier V, Naaim-Bouvet F, Genthon C, Agosta C, Piard L, Bellot H. Comparison between observed and simulated aeolian snow mass fluxes in Adélie Land, East Antarctica. The Cryosphere. 2015 Jul 30;9(4):1373-83

Which has:

“Aeolian snow transport events were correctly reproduced with the right timing and a good temporal resolution at both locations except when the maximum particle height was less than 1 m.”

The journal uses: “aeolian”

We have made this edit to:

“Much of the area has a typical stratigraphic sequence of peat (0.5-1.5 m), aeolian silt (2-3 m), and alluvial sand and gravel (Jorgenson et al., 1999; Brown et al. 2015).”

- Ln 94 - "Excess ice contents in birch forests can be greater than 50% while ice contents in the black spruce stands are typically closer to 20% (Brown et al., 2015; Jorgenson et al., 2001; Jorgenson et al. 2025; Walters et al., 1998). " - change "contents" to "content", and consider modifying the sentence to reflect that it is the permafrost ground you are referring to and not the forests (trees).

We have changed this to:

“Permafrost is mainly epigenetic and formed during downward freezing. Excess ice contents in permafrost below birch forests can be greater than 50% while ice contents in the black spruce stands are typically closer to 20% (Brown et al., 2015; Jorgenson et al., 2001; Jorgenson et al. 2025; Walters et al., 1998).”

- Ln 97, 115, etc - Note where you can use the abbreviation ERT as you have already defined it.

We have changed it in two locations:

“Deep boreholes found permafrost at depths ranging from 7.3 m (Ferrick et al., 2008) to 47 m (Jorgenson et al., 2001), while ERT indicated minimum thicknesses of >20 m were common (Douglas et al., 2015).”

“The period between 2012 and 2020 (when the majority of the field measurements were collected, including repeat ERT) included three of the ten warmest/wettest summers and three of the ten warmest wettest winters in the ~100-year record.”

We have not changed “electrical resistivity tomography” to “ERT” where it is present in section titles, however, please let us know if you wish to make this change. There are two of these instances.

- Ln 158 - "...to be within 3 cm..."

This has been changed, as suggested, to:

“As the soils within the top 3 m were mostly peat and silt, shallow (<1 m) probing typically hit a hard refusal boundary (indicating frozen conditions) for stable permafrost; for these conditions we consider the accuracy to be within 3 cm (given a “soft” mossy and litter-rich ground surface).”

- Line 160 "...to be within 20 cm..."

This has been changed, as suggested, to:

“Occasionally, in partially degrading permafrost near the surface (within 1.5 m) the probe encountered frozen ground with substantial unfrozen water content with refusal gradually becoming harder across a ~20 cm transition zone; we consider the accuracy under these conditions to be within 20 cm.”

- Line 165 - There is quite a bit of new text here, and I am a bit confused as the paragraph leads in with reference to probing, but here switches to thickness of the permafrost/seasonal frost layer. Please have a careful look at this paragraph and revise for clarity.

To reduce uncertainty, we have changed the information on seasonal frost to a separate paragraph and clarified it a little bit:

“Differentiating persistent seasonal frost from very thin permafrost is a challenge, particularly when only frost probe measurements are available (i.e. no boreholes). Here we are confident that frost <30 cm thick at the end of summer is seasonal frost and frost >50 cm thick is permafrost; for in between thicknesses we have low confidence as to whether it is seasonal or permanent frost. In some areas we noted a thin frost layer (30 to 50 cm) to persist for 2 to 3 seasons, and we refer to this as multi-year frost. This multi-year frost is a common problem for

probing ecosystem-driven permafrost in the boreal region.”

- Line 220 - " The average error was 0.093 m..." indicate in this sentence whether you are referring to vertical or other error.

This has been changed to:

“The average vertical elevation error was 0.093 m in the DEM (95<sup>th</sup> percentile) across different ecotypes (Zhang et al., 2023), leading to the propagated error of 0.13 m for the differenced LiDAR DEM.”

- Line 247 - Please check the grammar of this line. "DI thaw depths >100 cm and <120 cm or had increased by >30 cm as a brief transitional stage ..." I think it is poorly phrase, or maybe a word missing after "or".

This was hard to follow for sure. We have changed it to reflect the other location where “degradation-initial” is described:

“DI (thaw depths ~ 1.1 m or had increased by >30 cm as a brief transitional stage) occurred along 36% of the transects.”

Line 250 - remove the , after the ) - In fact, please double check the grammar of this paragraph. I find it difficult to read.

We have edited/clarified a few areas in the paragraph:

“We compiled the repeat surveys of surface topography, water depth, thaw depth, and ancillary subsurface measurements from the four transects to define trends of subsurface thaw and corresponding ground surface settlement between 2012 and 2020 (Figs. 2 and 3). Dates when measurements were collected are included in these Figures. We differentiated trends across each transect into six degradation/aggradation stages (Supplemental Information Table 1). UD (thaw depths remained <100 cm with annual changes <30 cm) occurred along 29% of the transects in 2012 and decreased to 8% by 2020 (Figs. 2 and 3). DI (thaw depths ~ 1.1 m or had increased by >30 cm as a brief transitional stage) occurred along 36% of the transects. DPS (vertically increasing thaw depths >120 cm but not more than ~250-300 cm), increased from 12% to 20% between 2012 and 2020. DPD (thaw depths increased to >250-300 cm) increased from 6 to 16%. Together, these shallow and deep progressive degradation stages indicating top-down thaw of near-surface permafrost increased from 18% to 36% over the 8 year study period. We presume DPD denotes areas with open taliks. DL (lateral thaw bogs and fen margins) increased slightly from 3% to 6%. Regions characterized as DCO occurred under old bogs and fens and presumably had completed degradation through the entire permafrost zone to form through taliks. They increased slightly between 2012 and 2020 from 35% to 44%. We attribute this change, however, due to loss of Repeat-Permafrost-Thin (RPT) and MF (Figs. 2 and 3) near the surface. MF was used to differentiate areas with a thin layer (typically <30 cm) of frozen ground that persisted for 14 years (permafrost is conventionally defined as frost persisting more than 2 years). MF decreased from 7% to 0%.”

Line 374 - " For example, frost probing yields insight into top-down thaw or indicate areas..." should be "indicates".

This has been changed, as suggested, to:

“For example, frost probing yields insight into top-down thaw or indicates areas where near-surface permafrost is aggrading upward but with limited spot measurements.”

Line 377 - "...permafrost at 10s of meters ..." should be "... permafrost at tens of meters..."

This has been changed, as suggested, to:

“ERT can identify the presence/absence of permafrost at 10s tens of meters depth but is not as well suited for survey-level measurements of permafrost bodies whether they are stable or changing.”

Line 378 - The authors added the statement that ERT "...is not as well suited for survey-level measurements of permafrost bodies whether they are stable or changing." Please look carefully at this statement and see if you need to modify it, such as "... .is not as well suited for survey-level measurements of vertical or lateral degradation of permafrost bodies." (assuming this is what you mean).

Thank you for this suggestion. We have changed it but we added “as frost probing”:

“ERT can identify the presence/absence of permafrost at tens of meters depth but is not as well suited as frost probing for survey-level measurements of vertical or lateral degradation of permafrost bodies.”

Also, Make sure all of the Supplemental information mentioned in your MS are present in the Supplemental information. I see only one Table there now.

There are five Figures and two Tables in the SI and they have been uploaded with this most recent version.