Point-by-point response, Review I - Bretwood Higman

Reviewer Comments
Author response
Changes made in manuscript

Overall this seems like a useful step forward in characterizing the distribution of hazardous materials sites in Alaska, and the meshing of OSM data with other data sets is clever. Some minor revisions, especially to make the figures more clear, would benefit the paper (see comments in the attached pdf.)

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Abstract, line 2: decreased rather than "a loss"
Thank you for recommending this. We changed the wording accordingly.
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Introduction: It would be good to note somewhere that impacts of permafrost degradation can sometimes be in downstream areas - e.g. from mass wasting or increased river sedimentation or erosion.
We agree that this is valuable information and added a section on this matter.

Page 2, line 34:

Some of these processes such as thaw slumps have impacts not just locally but even far away in downstream areas as sediments, solubles, and organic matter are eroded from thaw features and may follow different trajectories of transport, biogeochemical processing, and sedimentation depending on environmental conditions (Lamhonwah et al., 2016; Keskitalo et al., 2021; Kokelj et al., 2013) and can also impact ecosystems in these downstream areas (Levenstein et al., 2020).

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Line 23: Presumably there is warming prior to this time-period too, even if the citation does not explore that.

Thank you for pointing this out. For this statement we relied on the Global Terrestrial Network for Permafrost, of which most of the boreholes were established during the International Polar Year (2007-09). The earliest borehole setups - at least for Alaska - are from the 1970s (Biskaborn et al., 2019; Smith et al., 2022). We adapted the sentence accordingly - pointing out the data basis - and added information on modeled permafrost evolution.

Page 2, line 23:

These increasing air temperatures led to a warming and thawing of permafrost since the 1980s, as borehole measurements across the Arctic demonstrate (Biskaborn et al., 2019; Smith et al., 2022). Modeling studies indicate that the initiation of permafrost warming can be traced back to as early as 1900 (Langer et al., 2024).

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Line 32: I would also include deep-seated bedrock landslides - I think this might be one of the better citations to support that: https://doi.org/10.3389/feart.2020.00293

We agree that the previously mentioned land surface changes were mainly focused on tundra lowlands. Looking at the entire state of Alaska, mountainous regions must be included. We adapted the enumeration to include rock avalanches, inserted the suggested reference and added an Alaskan study, which used GERALDINE to detect rock avalanches.

Page 2, line 29: Numerous studies demonstrate intensifying land surface changes in the permafrost region which encompass for example processes such as thaw slumping (e.g. Runge et al., 2022; Ramage et al., 2017; Leibman et al., 2021), the development of thermokarst ponds and lakes (e.g. Muster et al., 2017; Jones et al., 2011), thermo-erosional gullying (e.g. Fortier et al., 2007; Godin et al., 2012), ice wedge degradation (e.g. Liljedahl et al., 2016; Jorgenson et al., 2006) and rock avalanches in mountainous regions (e.g. Bessette-Kirton and Coe, 2020; Smith et al., 2023) all pointing to an increasing loss in ground stability.

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Figure 1: Use more intuitive boundaries that are more usefully distributed - perhaps < 100, 100-1000, 1000-10,000, and >10,000

Also the smallest symbol is essentially invisible on the map. Perhaps make the smallest size larger, and use a dark stroke with a light fill to create contrast against all backgrounds.

Yes, thank you. We changed the scale to the proposed boundaries and agree that it is more intuitive than the former one, which was based on the data's statistics (quantile and median values). We also increased the size of the smallest symbol.

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Line 79: Provide in per square kilometer units for SI consistency.

Thank you for pointing this out. We agree that it is important to stay consistent. We now provide the population density in square kilometers and keep the square mile details in parentheses as a reference for readers more used to the imperial system:

Page 4, line 83: With a population of over 733,000 inhabitants and a land area of approx. 1.7 million km2 (The Information Architects of Encyclopaedia Britannica, 2023), it is also the least densely populated state in the U.S., with a population density of 0.5 people per square kilometer (1.3 people per square mile), compared to the rest of the U.S. with a density of 35.9 per square kilometer (93 people per square mile) (Department of Labor and Workforce Development, 2020; World Bank, 2024).”

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Line 85: I don't know this word. Would "includes" work?

Yes, thank you, “includes” works well. We changed it accordingly.

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Figure 2: I am not sure this necessitates a large figure like this. If critical, it might be relegated to an appendix or supplement.

Thank you for the suggestion. We agree that the figure is better placed in the appendix. We moved it accordingly (Figure A1).

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Figure 3: These two colors are too similar, especially for colorblind readers (like me.) Simply making the value of the building color darker would likely solve the problem.

Thank you for making us aware of this color issue. We adapted the figure (now Figure 2) using color-vision deficiency friendly color maps by Crameri [https://zenodo.org/records/8035877].

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Figure 4: I think this is too many layers for a single map - some are difficult to distinguish. For instance, while the ARCADE watershed boundaries are clear against the dark color for continuous permafrost, it gets lost in some of the lighter colors. Consider making several smaller maps with simpler symbology and fewer distinctions - perhaps it would be useful to have each one show the contaminated sites, but against different backdrops. One for permafrost, one for watersheds, and one for the IS & HI data.

We agree that some layers are hard to distinguish and followed your recommendation to split them in several single maps: The figure (now Figure 3) includes subfigures showing the contaminated sites against a) the backdrop of permafrost zones, subfigure b) blended with the infrastructure data, and c) in the foreground of the watersheds. Thank you for this suggestion.

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Figure 7: The scale bar does not add information - the specific values are labeled on the colors.

We agree that the color bar doesn't add any information. We removed it (Figure 6).

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