

Response to Referee 1 on “A Comprehensive Database of Thawing Permafrost Locations Across Alaska”

We would like to thank referee 1 for their helpful comments. We found all comments to be constructive and have addressed all of them (see detailed responses below). As a result of these revisions, we believe that our manuscript is much improved. Below please find a point-by-point explanation of our revisions.

The authors present a comprehensive compilation of evidence for abrupt and non-abrupt permafrost thaw in Alaska, integrating 19,540 locations from 44 diverse sources spanning seven decades. In addition, the authors use the database to evaluate existing permafrost maps and to explore the spatial patterns of the two types of thaw using auxiliary data. Given the significance of abrupt permafrost thaw for both local and global effects, combined with the current lack of regional-scale datasets for land managers, the database represents a unique and valuable contribution that will be useful to a broad audience.

Prior to publication, the following issues must be addressed:

1. Figure quality and consistency needs to be increased (see specific comments below)

We thank the reviewer for this helpful feedback and address these issues specifically in our responses below.

2. Some of the discussion material focused on abrupt thaw impacts should be moved to the introduction or removed

We thank the reviewer for this suggestion and have addressed this specifically in comment #18 below.

3. The available inventory of permafrost thaw features is limited not only by where abrupt thaw is taking place, but also possibly by where investigations are being made. You touch on this point in L367-L372. Can you also comment on how the violation of the assumption of 'random sampling' might affect the results of your statistical tests, and which regions, if any, you think might be overrepresented

We thank the reviewer for this helpful feedback. We added the following clarifying sentences to our discussion:

“Because observations in our database are not randomly sampled, the results of our statistical tests should be interpreted with caution. Sampling is biased toward regions that have had more research activity, resulting in overrepresentation of areas including the Brooks Range, Seward Peninsula, and Arctic tundra lowlands.” Lines 370-373

Specific manuscript comments

1. L66-68 In the beginning of paragraph 2, the contrast to gradual thaw should also be stated in terms of impacts. The comparison of cm/yr (rate of change) vs (duration and impact) for abrupt thaw could be made more commensurate

We thank the reviewer for this suggestion and have added a clause to clarify:

“Unlike gradual thaw, which occurs when the active layer thickens by a few centimeters a year and causes a gradual shift in vegetation and slower, sustained shift in the carbon balance (Harris et al., 1988), abrupt thaw processes initiate within a few decades and cause severe impacts on the surrounding ecosystem (Turetsky et al., 2019; Webb et al., 2025a).” Lines 68-70

2. L86: "events": but items listed in parentheses are landforms/features. Is the 'event' the initiation of these features?

We thank the reviewer for this comment and have changed the word “events” to “features”.
Line 88

3. L116: how were lines converted to points?

We thank the reviewer for this comment and agree that there needs to be clarification regarding how polylines were converted to points. We added a clause to the end of the sentence:

“Given that spatial datasets were often in different formats such as points, polylines, and polygons, we standardized the database by converting all locations to point features based on the centroid of the feature (polygons) or the midpoint of the line (polylines).” Lines 118-119

4. L124: consider rephrasing for clarity: "we have not manually verified each individual feature, but rather the features in the database reflect the accuracy of their source datasets" or something

We thank the reviewer for this comment and have reworded the sentence for improved clarity:

“We did not manually verify each individual feature, and the features in the database reflect the accuracy of their source dataset.” Lines 126-127

5. L125: "lacking validation data of" -> "lack of validation data for"

We thank the reviewer for this comment and have rephrased the sentence. Lines 128-129

6. L127: what are the ongoing opportunities for community feedback?

We thank the reviewer for this comment and agree that this section needs to be more explicit. We have changed this part to read:

“This level of documentation allows the reliability and limitations of the dataset to be evaluated transparently by users. In addition, the open-access and collaborative nature of the database enables community feedback including the identification and correction of errors, duplicates, omissions, or regional gaps, and provides clear opportunities for continued refinement and expansion as new data become available.” Lines 130-133

7. L127: Rather than asserting that it is an effective means, you could state that by providing accuracy, the reliability and limitations of the dataset are provided transparently. Separately, you can comment on community feedback (being specific) and opportunities for continued improvement.

We thank the reviewer for this helpful feedback and agree that we should be more clear and specific in why this database is an effective tool. We changed line 127 to say:

“This level of documentation allows the reliability and limitations of the dataset to be evaluated transparently by users. In addition, the open-access and collaborative nature of the database enables community feedback including the identification and correction of errors, duplicates, omissions, or regional gaps, and provides clear opportunities for continued refinement and expansion as new data become available.” Lines 130-133

8. L146: This section could be reworded for clarity: "We chose not to ... case for all areas"

We thank the reviewer for this very helpful comment. We decided to remove that statement because if permafrost is not thawing abruptly, then by definition, it must be thawing gradually.

9. Figure 1: This figure needs to be cleaned up:

- the resolution of this image should be increased.
- There is a problem with the "intermontane boreal" legend item in 1b
- The titles are redundant - information is in caption and legend.
- the grid lines in the vicinity of the legend are not oriented correctly
- while not essential, an outline of the Alaska state border (for consistency with other figures) and/or a map of neighbouring territories would improve the figure

We thank the reviewer for this very helpful feedback regarding Figure 1. We have increased the figure resolution, fixed the issue with the legend text, removed the redundant tiles, fixed the grid lines, and added an outline of Alaska for improved visualization.

10. Figure 2: The resolution of this image should be increased, or converted to a vector format.

We thank the reviewer for this suggestion and have increased the resolution of Figure 2.

11. Sec. 3.3: There appears to be significant spatial structure in Figure 4, suggesting that the mapping 'errors' may represent a systematic bias rather than random mapping resolution mismatch. Can you comment on where these discrepancies tend to occur and how that information could be used to better interpret the maps.

We thank the reviewer for highlighting this discrepancy. We added clarification sentences to results section 3.3:

“The spatial distribution of ice-dependent abrupt thaw events in areas classified as having low ground ice content is not uniform across Alaska, with most of the discrepancies being in the Seward peninsula, northern tundra, and parts of interior Alaska. Because the abrupt thaw processes used in this analysis require substantial ice content to develop, these results highlight the potential limitations of existing ground ice datasets for accurately representing permafrost vulnerability at the local scale.” Lines 291-295

To explain why this spatial clustering may exist, we added context to the discussion:

“The spatial clustering of apparent misclassifications suggests that localized ice-rich deposits may not always be resolved in regional maps. These discrepancies may rise from sub-grid heterogeneity, including ice-wedge polygon terrain, or from thermokarst legacy landscapes where thaw features formed when ground ice content was higher in the past.” Lines 348-350

12. Figure 3: histogram titles are redundant. Information is in axes and caption. Change axis label from 'elevation' to 'relative elevation'

We thank the reviewer for this comment. We gave both panels a shared legend, removed the titles, and changed axis label “Elevation” to “Relative Elevation”.

13. Figure 5 & caption: Rather than call the left hand colour blue/green, please use a colour with a less ambiguous name.

- clarify in figure caption that agreement is based on your aggregated high-mid class

- figure title is unnecessary

We thank the reviewer for these helpful suggestions to improve Figure 5. We condensed the figure into one panel, clarified that agreement is based on our aggregation of moderate and high ground ice classes, increased figure resolution, clarified the color palette, and removed the figure title.

14. Figure 6 caption: typo "independent"

We thank the reviewer for catching the typo and have corrected this error.

15. Figure 6: Text titles are redundant (e.g. "Non-ice-dependent abrupt thaw proecesses")

We thank the reviewer for this comment and agree that the text titles are redundant. We changed the "non-ice-dependent abrupt thaw processes" category to "Other" and specified that this includes other abrupt thaw processes and gradual thaw processes in the figure caption to improve clarity.

16. Figure 6: for greater visual clarity, consider reducing the marker point size in this and other maps.

We thank the reviewer for this helpful suggestion. We collapsed figure 6 into one panel, reduced the point size, and changed the outline of the Yedoma domain to black for improved visibility.

17. L347: "three military training lands in the U.S. Army Fort Wainwright " is this correct?

We thank the reviewer for this helpful comment and agree that the wording is confusing. This was the wording used in the original source (Jorgenson et al. (2025)), but we replaced "the U.S. Army Fort Wainwright" with "interior Alaska" to reduce ambiguity. Line 360

18. L353-364: this could be tightened up. L353-358 in particular is more suitable for the introduction.

We thank the reviewer for this insight. We acknowledge that these talking points are already addressed in the introduction and have removed them entirely for a more succinct discussion section.

Comments on dataset and repository:

1. versioning of dataset: consider including v2.0.0 or v2 in paper title, it is easy to miss in the abstract.

We thank the reviewer for this very helpful comment and have added Version 2.0.0 to the title of the manuscript.

2. I would strongly recommend using tagged commits in git (you could also put version number in a file) instead of separate directories for versioning. Similarly, using a generic name for your files (e.g. Alaska_Permafrost_Thaw_Database.csv) will make it easier to maintain workflows as more contributions are added and the version number changes. Your scripts could then read the version file to embed the version into the geojson, if necessary.

We thank the reviewer for this very helpful suggestion and have updated our GitHub repository to use tagged commits in git instead of separate directories for versioning. We also used a more generic file name (Alaska_Permafrost_Thaw_Database.csv) for easier workflows. Instead of keeping a separate directory for each version, old versions of the database can be found in the release history.

3. In the two csv files, be consistent with column naming (e.g. DataSourceType vs DtSrcTy) and with style (e.g. all in lowercase_with_underscores / snake_case or all with FirstLetterCapitalized / PascalCase). It will make it easier for people to use the dataset.

We thank the reviewer for this comment and, in accordance with comment 5 below, decided to merge both csv files into one, removing any column naming inconsistencies.

4. Add a unique identifier for each feature: FeatureName may not be unique as more data are added.

We thank the reviewer for this suggestion and have added a unique ID number for each feature. These are listed under the UniqueID column.

5. There appear to be duplicated columns between the two csv files (Thaw_Database and Topographic_Variables). Why not just merge these into a single file?

We thank the reviewer for this comment and have merged all the data into one file.

6. The topographic variables file does not seem to be mentioned in the paper. If multiple files are included in the dataset, please ensure the directory tree is well described.

We thank the reviewer for the extremely helpful comments regarding database structure on GitHub. We combined the topographic variables into the main database file to prevent confusion and have incorporated all the repository formatting suggestions above. We believe these edits have greatly improved the usability and organization of our GitHub repository.