

Manuscript ID: ESSD-2025-304

Title: Ice front positions for Greenland glaciers (2002–2021): a spatially extensive seasonal record and benchmark dataset for algorithm validation

Dear Baptiste Vandecrux,

Thank you very much for handling our revised manuscript and for passing on the constructive comments from both reviewers. We are grateful for the time and effort invested in this second round of review. We have carefully considered all comments and revised the manuscript, figures, supplementary files, and repository description accordingly.

Below, we summarize the three main revisions made in this revised manuscript, followed by detailed, point-by-point responses to all comments.

- 1. Validation revision:** we re-evaluated the GrTPD comparison with TermPicks and AutoTerm, identified and corrected the causes of unrealistic AMD outliers, and updated the validation methodology, figures, and supplementary files.
- 2. Classification and metadata revision:** we revised the glacier classification framework by separating terminus type from glacier origin and added a metadata field to distinguish GrIS-connected glaciers from local glaciers and ice caps.
- 3. Introduction and presentation revision:** we streamlined the Introduction, corrected citations throughout the manuscript and repository description.

We sincerely appreciate the reviewers' thoughtful feedback and hope that the revised manuscript adequately addresses all remaining concerns.

Best regards,
Xi Lu on behalf of all co-author

Anonymous Referee #1

General comments

I commence the authors for a very thorough revision that significantly improved the manuscript and dataset. While all my previous comments have been addressed, further minor revisions are necessary which are outlined in my detailed comments below.

Response: [We thank the reviewer for the positive evaluation of our revisions and for the further helpful comments provided. We have carefully addressed the remaining points raised below and revised the manuscript accordingly.](#)

Response to specific comments

Abstract

1. Line 23: What does GrTPD stand for? Maybe write it out first and then add the abbreviation in brackets.

Response: The abbreviation has now been defined at its first occurrence in both the Abstract and the Introduction as “Greenland Terminus Position Dataset (GrTPD)”.

Introduction

2. Line 46: Currently, the Enderlin et al., 2014 and Mouginot et al., 2019 citation are the are incorrect as both discuss ice discharge and not frontal ablation. While similar, they are not the same. I would suggest changing “frontal ablation” to “ice discharge”.

Response: We thank the reviewer for this comment. In response to related comments on mass loss, the sentence has been revised to remove the use of “frontal ablation” and to ensure consistency with the cited studies, as shown below.

Text from the revised version

Mass loss from the Greenland Ice Sheet (GrIS), averaged about 280 Gt yr⁻¹ during 2010–2018 (Mouginot et al., 2019; Frederikse et al., 2020), and has increased in recent decades (Otosaka et al., 2023)..

3. Line 96: Add space between “glaciers” and citation.

Response: The space has been added.

4. Line 99: Add space between “adjustment” and citation.

Response: Space added.

5. Line 101: Add space between “variability” and citation.

Response: The space has been added. We also checked the manuscript and corrected the spacing before citations throughout the text.

6. Line 110: Please write out the abbreviation when first used.

Response: The abbreviation has now been written out at its first occurrence.

7. Figure 1: Maybe include in the caption for panel a) what the legend means as it might not be obvious to all readers. Also, include a citation for the Basins as I assume that they are the Mouginot et al., 2019 drainage basins.

Response: The caption of Fig. 1a has been revised to clarify the legend and to include a citation for the drainage basin classification. The colored points representing different glacier types have also been described in the caption.

Text from the revised version

Figure 1: Spatial overview of the glaciers included in this dataset. Central panel (a) shows glacier locations grouped by drainage basin (Rignot and Mouginot, 2012). Colored points indicate the glaciers included in the dataset: marine-terminating

[glaciers \(MT, blue\), land-terminating glaciers \(LT, orange\), and lake-terminating glaciers \(LK, turquoise\). Surrounding maps illustrate \(b–g\) six examples of temporally resolved ice front positions \(color-coded by year\) derived from multi-source imagery.](#)

Data and Methods

8. The numbering of the headlines is not correct in this section – It goes from 2.1 to 2.4 to 2.3 with 2.2 missing.

Response: We apologize for the oversight. This occurred during the reorganization of the Data and Methods section after additional content was added. The subsection numbering has been corrected in the revised manuscript.

9. Line 148: GEEDiT is an abbreviation and should be written out the first time it is used. Also, the citation for GEEDiT (Lea, 2018) is missing.

Response: GEEDiT has now been written out at its first occurrence, and the citation to Lea, (2018) has been added.

10. Line 152: Add “and” between citation and “were manually downloaded”

Response: Corrected as suggested.

11. Line 152: I am not sure the citation of Rignot and Kanagartnam, 2006 makes sense here. While they are using ASAR in 2004, they are using ERS1/2 for winter 1996 which is not within of the timeframe of the dataset presented here. Consider moving the citation to after the ASRA segment, and please add a citation to the ERS1/2 segment of the sentence.

Response: The citation to Rignot and Kanagaratnam (2006) has been moved to follow the ASAR segment of the sentence, as suggested. In addition, a reference has been added to the ERS-1/2 segment to clarify the applicability of ERS data for glacier terminus delineation. Specifically, we now cite Moon and Joughin (2008), which used ERS-1/2 SAR imagery to extract glacier terminus positions.

Text from the revised version

[These supplementary datasets include Moderate Resolution Imaging Spectroradiometer \(MODIS\) \(Hall et al., 2002\), ENVironmental monitoring SATellite \(ENVISAT\) Advanced Synthetic Aperture Radar \(ASAR\) \(Image Mode, ~8 m\) \(Rignot and Kanagaratnam, 2006\), and European Remote Sensing satellite \(ERS-1/2\) SAR \(Precision Image mode, ~12.5 m\) \(Moon and Joughin, 2008\) and were manually downloaded and processed outside of GEEDiT.](#)

12. Line 166: Change “was” to “were” as you are referring to satellite acquisitions.

Response: Corrected as suggested.

13. Lines 177-178: Consider adding a citation to support the statement that glacier retreat at these glaciers is gradual and linear over monthly timescales.

Response: A citation has been added to support this statement. We now cite Black and Joughin (2023), which presents weekly records of glacier terminus positions and shows that terminus migration typically evolves gradually and approximately linearly over weekly to monthly timescales.

14. Line 196: remove comma before semi colon.

Response: Corrected as suggested.

15. Line 216: Change “terminus” to “termini”.

Response: Corrected as suggested.

16. Line 230: What auxiliary dataset were used?

Response: The auxiliary dataset refers to the glacier classification provided by Bjørk et al. (2015), which was used to identify and categorize peripheral glaciers in addition to the primary reference dataset (the 2021 MEaSURES Greenland Image Mosaic). To avoid ambiguity, the phrase “and auxiliary datasets” has been removed from the sentence, as there is further explanation following it.

17. Figure 2: I am not sure what the box on the right under Quality Assessment is showing – Either include a description in the caption or consider removing it.

Response: We thank the reviewer for this comment. The two boxes under “Quality Assessment” represent different components of the validation framework. The left box summarizes the quantitative comparison method using offset metrics (AMD) at overlapping time steps with existing datasets, while the right box refers to time-series comparisons over the study period and spatial comparisons, focusing on the consistency of terminus variability in terms of magnitude, trends, and timing, using example glaciers from each basin. The corresponding analyses are presented in Section 2.3 (Validation). The figure caption has been revised to clarify this.

Text from the revised version

Figure 2: Workflow of the glacier terminus delineation process. The system integrates multi-source satellite imagery, accessed either directly through GEE or through preprocessing in ENVI, ArcGIS and QGIS. Glacier termini were manually delineated from the imagery. The Quality Assessment stage consists of two components: (i) quantitative comparison with existing datasets using offset metrics AMD to evaluate overall differences and glacier-scale discrepancies at overlapping time steps, and (ii) temporal comparisons over the study period and spatial comparisons for representative glaciers from each basin. The corresponding validation results are presented in Section 2.3.

Validation

18. Line 278: Change “summaries” to “summarize”.

Response: Corrected as suggested.

19. Lines 279 – 280: Repetition of Line 272. Consider removing.
Response: [Removed as suggested.](#)
20. Line 289: Remove “the” before Fig. 3a and c.
Response: [Removed as suggested.](#)
21. Lines 305 -308: The dashed horizontal lines in Fig. 3b and d are very hard to see. Consider choosing a different color. Also, both dashed lines appear to be at 0 so I do not understand how they can emphasize the difference between the two products.
Response: [The figure has been revised to improve clarity, and the dashed lines are now highlighted in red to make it more visible.](#)

We clarify that the purpose of Fig. 3b and d is not to emphasize systematic differences between the products, but rather to illustrate their overall agreement while preserving the distribution of deviations. For most glaciers, the manually delineated (GrTPD, TermPicks) and automatically extracted (AutoTerm) terminus positions are closely aligned, resulting in differences clustered around zero. In a limited number of cases, larger deviations occur where the automated extraction performs less well, leading to more frequent mismatches, while the manual delineations remain more consistent. The figure caption has been updated to better reflect this interpretation. The corresponding section in the manuscript has been revised accordingly.

22. Line 331: Add space between CALFIN and citation.
Response: [Added as suggested.](#)
23. Line 340: Add space between “offset” and “(>1km)”.
Response: [Added as suggested.](#)
24. Line 349: change “as the calving” to “at the calving front”.
Response: [Revised as suggested.](#)
25. Line 359: Change “well consistency” to “good consistency”.
Response: [Revised as suggested.](#)

Zenodo repository

26. - In the description, please use citations when referring to other datasets or tools e.g. GEEDiT, TermPicks etc.
Response: [Appropriate citations have been added in the description when referring to existing datasets and tools, including GEEDiT and TermPicks. The repository description has been updated accordingly.](#)
27. - Rename “GrTPD_Centralline.gpkg” to “GrTPD_Centerline.gpkg”
Response: [The filename has been corrected from “GrTPD_Centralline.gpkg” to](#)

“GrTPD_Centerline.gpkg”.

28. - For Glacier ID101 the glacier name is “Spalteglet” which should be changed to Spaltegletsjer.

Response: The glacier name for Glacier ID 101 has been corrected from “Spalteglet” to “Spaltegletsjer”.

Erik Loebel

Thank you for the significant revisions to the manuscript. Please see the general and specific comments regarding this revised manuscript below.

General comments

Introduction

Thank you for the changes. Still, I think the introduction does not do a particularly good job, given that the utility of calving front data is widely acknowledged. In my eyes, it could still use some streamlining and slight restructuring.

The long paragraph describing the need for land-terminating glacier fronts overlooks the fact that, from a mass balance point of view, these glaciers are not as relevant as marine-terminating glaciers due to their much lower velocity, discharge and also variability. This is why they were not the focus in previous datasets and automated extraction methods. I truly appreciate the inclusion of these land-terminating glaciers, but I would frame them as an added benefit of this product rather than a main selling point (looking here at the first sentence in the following paragraph). In fact, I think the introduction could read better without this paragraph (L90 to L109).

I think Table 1 would be more useful if the third column, "temporal resolution," were removed and replaced with calving front count. It might also make sense to include a column indicating the type of sensor used (optical, SAR, or both) to show whether the given dataset had winter coverage.

Please check the citations again. There still seem to be inconsistencies. For example, why is Otosaka et al. (2023) cited for the statement about glacier terminus positions (which is not part of their paper), yet not cited for the statement about mass loss at the beginning? There are also formatting issues, such as missing spaces.

Also, see the specific comments below.

Response: The paragraph discussing land-terminating glaciers (L90–L109) has been removed as suggested. The key points from this paragraph have been incorporated into an earlier paragraph of the introduction, where the inclusion of land-terminating and

lake-terminating glaciers is now presented as an additional benefit of the dataset's multi-type coverage rather than a primary motivation. The text has been revised to clarify that, although these glaciers generally have lower velocities and contribute less to mass loss than marine-terminating glaciers, documenting their terminus variability remains useful for understanding glacier dynamics under ongoing climate warming.

Table 1 has been revised accordingly. The column "temporal resolution" has been retained, as it directly reflects the temporal variability captured by the dataset. In addition, a new column indicating the number of calving front observations has been added to provide complementary information on data density, including repeated delineations from different images at similar or adjacent dates. An additional column indicating the sensor type (optical, SAR, or both) has also been included to clarify whether winter coverage is possible.

The citations throughout the introduction have been reviewed and corrected where necessary, including the use of Otosaka et al. (2023). Formatting issues, such as missing spaces, have also been corrected.

Validation

The additions made regarding validation are highly appreciated and greatly improve the utility of this data product. However, there appear to be inconsistencies in the data supplement and in the corresponding Figure 3. The median AMD between GrTPD and TermPicks/AutoTerm differs immensely in some cases. For GID 102 (Zachariae Isstrom), the median AutoTerm AMD is 940342 km. Many of the AutoTerm extractions for this glacier are incorrect; still, the values are far too high, resulting in Figure 3(d) showing little else.

Examining the data file provided as a supplement reveals more of these inconsistencies. For example, the mean AMD calculated for Rink Glacier (GID1) in regard to AutoTerm is 183 km with a median AMD of 75 m. How is this possible? Differences between GrTPD and TermPicks for GID 89 are in the range of kilometers according to Figure 3b (data for GID 89 is missing in the file, please check), but the calving fronts seem quite close when examined in QGIS. It seems to me that there is a problem with the calculation of this AMD, resulting in some unrealistically high outliers. I really appreciate the efforts here, but these results need to be double-checked and revised.

Response: We thank the reviewer for the careful examination of the validation results. The inconsistencies identified are valid and have prompted us to thoroughly re-examine both the comparison methodology and the results. Below we address each issue in turn:

(a) Incomplete spatial coverage in TermPicks/AutoTerm

For some glaciers, TermPicks represents the terminus as multiple disconnected segments under the same GID, and at any given date only one segment may be digitised. When our comparison matched lines by GID alone, this could result in comparing our

continuous terminus trace with a partial segment located in a different part of the glacier, even in the other outlet, despite sharing the same GID.

As illustrated in Fig. 1 (example GID 102), TermPicks contains multiple terminus segments from different contributors at a given date (light red line), while our dataset delineates the main outlet front. This mismatch led to artificially large AMD values in the previous comparison. To address this issue, we have revised the comparison criteria by introducing a spatial proximity filter: for line pairs sharing the same GID, only those with midpoint distances less than 5 km are retained. This effectively removes cases where GID matching links geometrically unrelated terminus segments. All remaining large differences have been manually checked to ensure that such mismatches no longer occur.

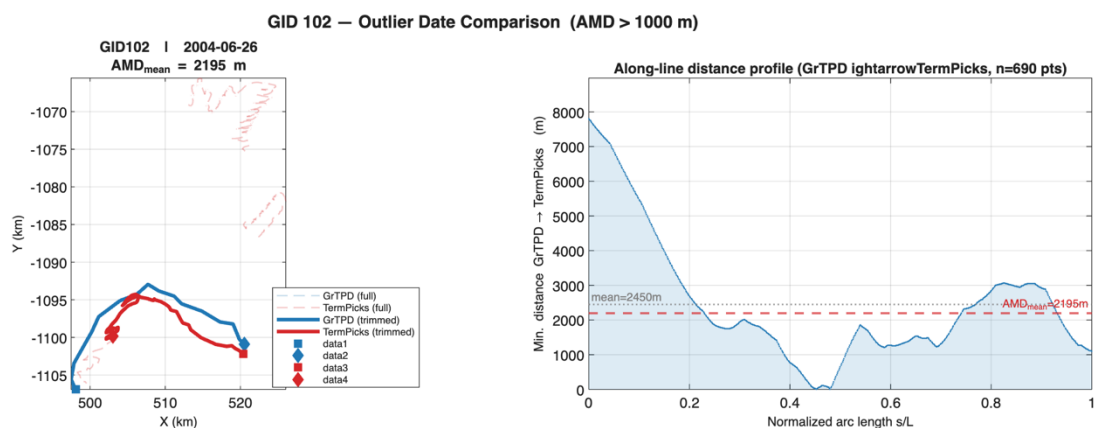


Fig. 1: Comparison between GrTPD and TermPicks for GID 102.

(b) Misaligned line endpoints near rock outcrops:

Even when two terminus traces correspond to the same glacier, they may terminate at different positions (Fig. 2). In the previous calculation, AMD was computed starting from the endpoint of the GrTPD line, which implicitly included differences in line length and artificially inflated the results.

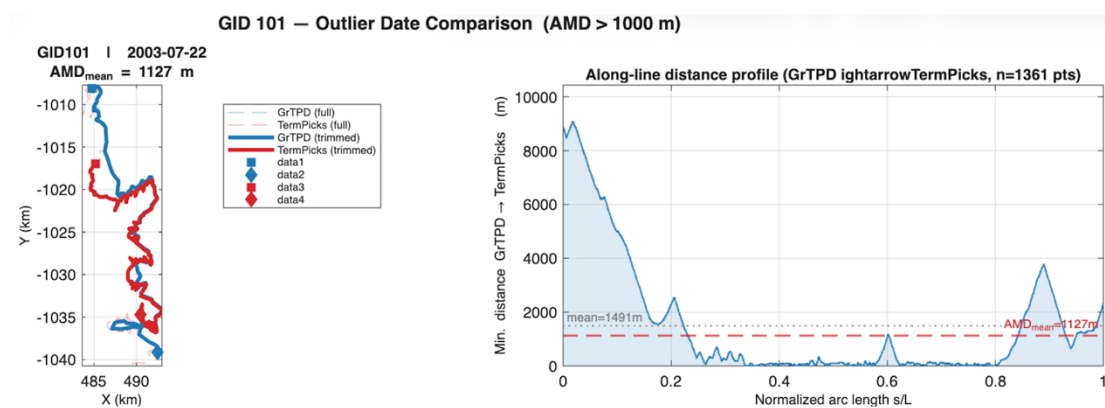


Fig. 2: The nearest point (AMD) to the starting position of the GrTPD terminus (blue square) corresponds to the endpoint of the TermPicks terminus (red square), with a separation distance exceeding 8 km.

To address this issue, we revised the AMD calculation method by applying a centre-aligned trimming approach: both lines are trimmed to their common overlapping length, centered on the midpoint of the shorter line. This ensures that the most of spatially overlapping portions of the terminus are compared, improving biases introduced by inconsistent endpoint. The updated comparison results are shown in Fig. 3 in the main text.

A small number of glaciers still exhibit large AMD values. These reflect genuine differences in how datasets represent complex terminus geometries and their evolution:

(c1) Retreat into tributaries

As glaciers retreat upstream, different datasets may digitise different branches or portions of the terminus that evolve from a wider front to narrower upstream sections. These delineations can still fall within the distance threshold (5km) but represent geometrically different parts of the glacier or other glacier (Fig. 3), leading to residual discrepancies. In addition, other datasets (e.g. TermPicks, compiled from multiple contributors) do not always maintain consistent terminus length through time, even when no upstream retreat occurs. These differences in representation can result in large apparent offsets.

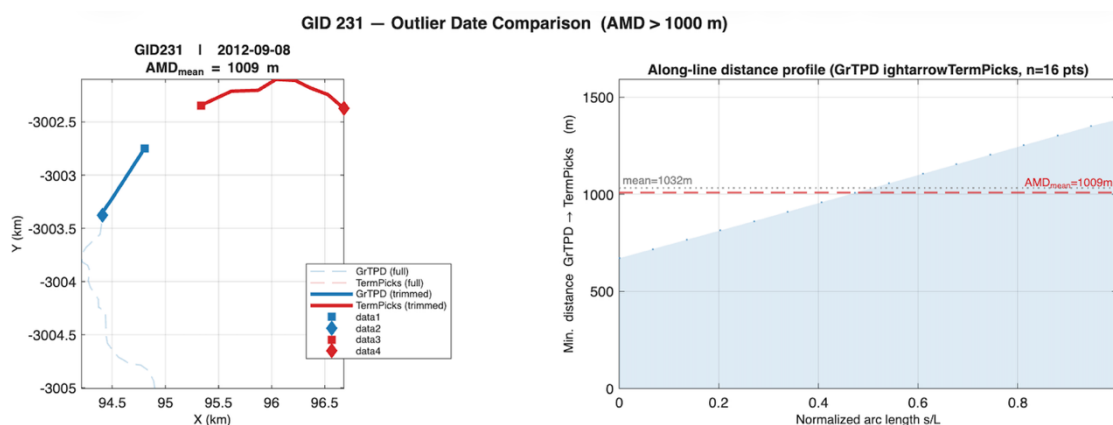


Fig. 3: As GID 231 retreated upstream, the TermPicks delineation diverged toward an adjacent glacier rather than following the upstream of GID 231, resulting in an anomalous deviation.

(c2) Interpretation of calved ice

Differences can also arise from subjective decisions on whether recently calved ice blocks are included as part of the glacier front (Fig. 4), leading to systematic offsets between datasets.

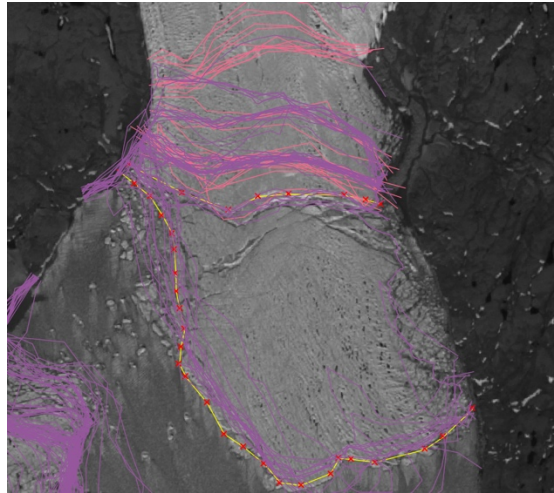


Fig. 4: Comparison between GrTPD and TermPicks for GID 104 on 23 June 2002.

(c3) AutoTerm-specific artefacts

AutoTerm exhibits a higher frequency of large-AMD outliers compared to TermPicks. In some cases, the automated extraction produces geometrically unrealistic terminus lines (e.g. extending inland or crossing fjord walls), resulting in large AMD values even after trimming (Fig. 5). These reflect limitations of the automated method rather than errors in GrTPD.

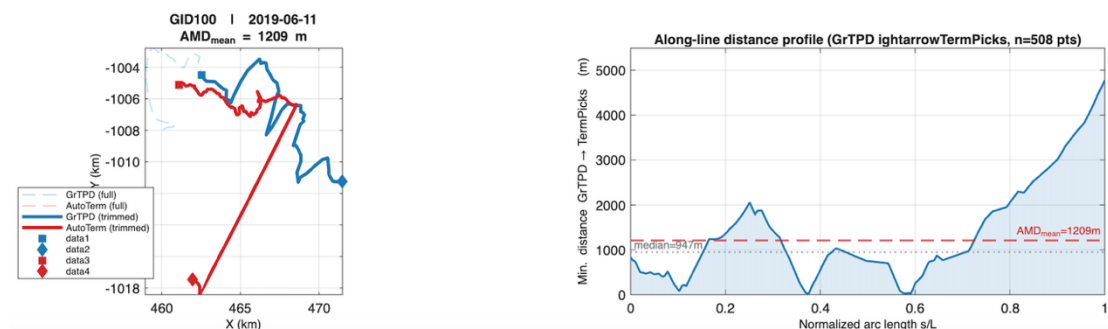


Fig. 5: Comparison between GrTPD and AutoTerm for GID 100.

We have verified that GID 89 is present in the GrTPD.gpkg file. The absence from the supplementary CSV table was due to no matching dates being found between GrTPD and TermPicks for this glacier.

Examples images (Fig. 4-8)

In L419 the authors state that “the temporally dense sampling illustrated in selected examples does not represent the sampling characteristics of the entire dataset”. This raises the question for me of what the utility of these figures is at all. This is particularly relevant since they take up a lot of space in the manuscript. Perhaps it would make sense to only display one or two (actually representative) time series and include the rest in the supplement. The same applies to Figure 10, which does not seem to add much.

Response: We thank the reviewer for this helpful suggestion. We acknowledge that these figures occupy substantial space in the manuscript. They were intentionally included to provide basin-scale comparisons, with one example glacier from each of the six major basins, using well-studied glaciers to illustrate terminus variability across Greenland. These figures correspond to the spatial and temporal comparison component of the validation framework (right box in Fig. 2), focusing on the consistency of terminus variability in terms of magnitude, trends, and timing. They present detailed spatial overlays and time-series comparisons of terminus positions to further evaluate the consistency of temporal variations among datasets.

We note that some of these glaciers have relatively dense temporal sampling due to better data availability. The statement in L419 was intended to clarify that such sampling density is not representative of the entire dataset, as temporal resolution varies depending on image availability for each glacier.

Regarding Figure 10, this figure is intended to demonstrate the applicability of the dataset for capturing glacier dynamics. In particular, it highlights lake-terminating glaciers, which have not been systematically delineated in previous datasets, and illustrates the potential of this dataset for analyzing their temporal dynamics.

Response to specific comments

1. L16: Calving fronts are definitely a key indicator of ice-ocean interaction. I wouldn't include atmosphere here.

Response: We thank the reviewer for this comment. While calving fronts primarily reflect ice–ocean interactions, we note that surface runoff can also influence frontal ablation through its role in driving submarine melting (Cowton et al., 2018). A reference has been added to clarify this point.

2. L18: To my understanding calving fronts do not play a critical role for quantifying dynamic mass loss. Discharge is typically calculated using upstream flux gates.

Response: Both altimetry-based approaches and traditional input–output estimates typically rely on fixed ice masks or flux gates, which may not fully capture mass changes associated with terminus retreat and evolving ice margins (Greene et al., 2024). As a result, mass loss near glacier termini may be underestimated, in some cases by as much as 20% (Greene et al., 2024). Our intention here is therefore to emphasize that temporally resolved calving front observations provide valuable complementary information for understanding glacier dynamics and improving the representation of margin changes in such assessments.

3. L22: Akronym needs introduction.

Response: As also noted by Reviewer 1, the acronym has now been introduced as “Greenland Terminus Position Dataset (GrTPD)” at its first occurrence. The full name has also been added at the first occurrence in the main text.

4. L24: What does seasonally targeted mean?
Response: Here, “seasonally targeted” refers to the goal of delineating glacier terminus positions at seasonal resolution. Whenever suitable imagery is available, a seasonal terminus position is delineated. The term is used because consistent seasonal coverage cannot always be achieved due to variations in data availability.
5. L29: What is the office name? I can't find it in the files.
Response: Here, “office name” refers to the official name of the glacier. This corresponds to the GlacierNam field in the attribute table, and the text has been revised to clarify this in the manuscript.
6. L42: Consider using more concise language, such as adding IMBIE numbers for ice mass loss or rankings for sea level contribution.
Response: The sentence has been revised to include quantitative estimates of Greenland Ice Sheet mass loss, as suggested, providing a more concise description of its contribution to global sea-level rise.

Text from the revised version

Mass loss from the Greenland Ice Sheet (GrIS), averaged about 280 Gt yr⁻¹ during 2010–2018 (Mouginot et al., 2019; Frederikse et al., 2020), and has increased in recent decades (Otosaka et al., 2023).

7. L66: I recommend removing this because this dataset does not address the issue (nor does it have to).
Response: The sentence referring to uneven spatial coverage has been removed as suggested. The paragraph has been revised to focus on the value of large manually delineated datasets and their applications in glacier mass-loss estimation and calving-dynamics studies.

Text from the revised version

For example, the TermPicks dataset (Goliber et al., 2022) integrates more than 39,000 manually delineated calving front traces contributed by multiple researchers, substantially enhancing data accessibility and enabling large-scale historical analyses. This extensive compilation demonstrates the value of large observational datasets for improving estimates of glacier mass loss and for studies of calving dynamics and glacier evolution (Greene et al., 2024).

8. L73: "Strong potential" seems like an understatement when you consider that ML is used to derive the largest datasets for Greenland, Antarctica, and Svalbard.
Response: The sentence has been revised to better reflect the established role of machine learning and deep learning approaches in generating large-scale glacier terminus datasets.

Text from the revised version

Machine learning and deep learning approaches have become powerful tools for extracting glacier termini from large remote sensing archives, enabling the generation of large-scale datasets and efficient monitoring of terminus variability at ice-sheet and multi-basin scales

9. L79: What is performance transferability?

Response: Performance transferability here refers to the ability of automated terminus-detection models trained in one region or under specific imaging conditions to maintain reliable performance when applied to different glaciers, regions, or sensor types.

10. L83: Does "for example" refer to the previous sentence? If so, it does not fit very well.

Response: The transition has been revised by replacing "For example" with "In addition" to improve the logical flow of the paragraph.

11. L86: The increase in extracted calving fronts between CALFIN and AutoTerm is mostly due to the multi-sensor approach of AutoTerm (whereas CALFIN is only using Landsat).

Response: We agree that the use of a multi-sensor approach in AutoTerm plays an important role in increasing the number of extracted calving fronts by improving data availability compared to Landsat-only approaches such as CALFIN. However, we also note that the size and diversity of the training dataset contributes to this increase. In particular, CALFIN is trained on 1,872 images, whereas AutoTerm incorporates over 39,000 manually delineated terminus traces from the TermPicks dataset. As noted by Zhang et al. (2023) in the Conclusions section, a large volume of manually picked terminus traces was converted into training data, allowing the model to better handle diverse conditions in large datasets.

12. L90: I don't agree with this argument. Automated methods did not focus on marine-terminating glaciers because no other data was available. In fact, many studies created their own reference data. The focus on marine-terminating glaciers was primarily driven by their high variability and importance in ice dynamic mass loss.

Response: Following the suggestion, the paragraph containing this argument has been removed from the revised manuscript.

13. L100: Is this accelerated in frontal retreat reported on in all three references?

Response: We thank the reviewer for this comment. We acknowledge that the cited studies do not all explicitly report accelerated frontal retreat. The sentence has therefore been revised to more accurately reflect both the processes described in these references and our intended meaning, emphasizing notable variability in the near-terminus region, even in regions previously considered relatively stable. These include processes such as thinning, short-term velocity acceleration, and longer-term deceleration.

14. Figure 1: Why are there glaciers outside of the ice sheet mask that are not indicated as peripheral?

Response: The classification of glacier origin in this study follows Bjørk et al. (2015). In the revised manuscript, peripheral glaciers are no longer explicitly labeled on the map. Instead, glaciers are classified primarily by their terminus type (marine-, land-, or lake-terminating).

To retain information on glacier origin, an additional metadata field (Type) has been introduced to distinguish between ice sheet-connected glaciers (GrIS) and local glaciers and ice caps (LGIC) following Bjørk et al. (2015). The figure and associated description have been updated accordingly.

15. L119: Is there a reference for the NunaGIS geographic map?

Response: We thank the reviewer for this comment. Although the NunaGIS map has been widely used in previous studies (e.g. Bjørk et al., 2015), it was not explicitly cited in the original manuscript.

16. L125: Peripheral glaciers can be marine-, land-, or lake-terminating. Lake-terminating glaciers are a type of marine-terminating glacier. peripheral glaciers can also be ...

Response: We thank the reviewer for this comment. In this version, peripheral glaciers have been classified by their terminus type (marine-, land-, or lake-terminating), while a separate metadata category is used to distinguish between ice sheet-connected and local glaciers and ice caps, to keep the classification scheme clear and consistent.

We note that lake-terminating glaciers are treated here as a distinct category rather than a subset of marine-terminating glaciers. This distinction is made because lake-terminating and marine-terminating glaciers differ in several key aspects, including water density, circulation processes (e.g. thermally driven convection in lakes versus thermohaline circulation in fjords), and their connection to broader ocean forcing. In addition, they often differ in scale and geometry. A recent study submitted to The Cryosphere also highlights these differences <https://egusphere.copernicus.org/preprints/2025/egusphere-2025-5733/>.

17. Table 2: The primary data provider for the Sentinel missions is Copernicus, not ESA.

Response: This has been corrected. The data provider for the Sentinel missions is now listed as Copernicus.

18. Also, see the suggested citation guidelines from the USGS, ESA, NASA, and CDSE websites.

Response: We have reviewed the recommended citation guidelines from the USGS, ESA, NASA, and Copernicus Data Space Ecosystem (CDSE) websites and

updated the data-source attributions where appropriate.

19. L177: "Over monthly timescales, terminus migration at these glaciers is generally gradual and approximately linear". Please add a reference for this.

Response: A reference has been added to support this statement. We now cite Black and Joughin (2023), which presents weekly records of glacier terminus positions and shows that terminus migration typically evolves gradually and approximately linearly over weekly to monthly timescales.

20. L181: Reference for arctic DEM.

Response: Reference has been added.

21. L185: Why is EPSG:4326 used instead of a polar stereographic projection, such as EPSG:3413?

Response: The dataset was not deliberately projected to a specific coordinate system; rather, EPSG:4326 (WGS84 geographic coordinates) was adopted as a common reference to unify all imagery and derived products. This ensures consistency across data sources with different native projections and facilitates straightforward use in most GIS and web-based visualization platforms.

22. L243: I disagree. The validation in this paper also shows this. The maximum accuracy (i.e. the best possible manual delineation) may correspond to the resolution of the source image.

Response: We thank the reviewer for this comment and agree with this point. The original sentence has been removed to avoid ambiguity, and the text has been revised to describe potential sources of uncertainty more clearly.

23. L264: Since AutoTerm was trained using TermPicks data, I would remove the "independent".

Response: Removed as suggested.

24. L303: greenland-wide?

Response: The wording has been revised to clarify that the analysis refers to the distribution across all glaciers in Greenland rather than within individual glaciers.

25. L512: Once again, I don't see calving fronts as essential for quantifying ice mass loss. The three methods we are currently using do not critically depend on calving fronts.

Response: We thank the reviewer for this comment. Similar to our response to Comment 2, we agree that existing approaches for estimating ice mass loss do not critically depend on calving front observations. However, such approaches generally do not explicitly account for the influence of evolving glacier termini on mass loss.

Our intention is therefore not to suggest that calving front data are required for current mass balance estimates, but rather to emphasize that temporally resolved calving front records provide important information for understanding glacier dynamics and terminus evolution. These data can help to better constrain dynamic processes associated with frontal change, improve the representation of boundary conditions in predictive models, and offer additional context for interpreting uncertainties and potential contributions of terminus-driven changes to ice mass loss.

26. L528: Are the centerlines included in the data? I might have overlooked them.

Response: Yes, the centerlines are included in the dataset. They are provided as a separate GPKG file, which is available within the same Zenodo repository.

Reference

Cowton, T. R., Sole, A. J., Nienow, P. W., Slater, D. A., and Christoffersen, P.: Linear response of east Greenland's tidewater glaciers to ocean/atmosphere warming, *Proceedings of the National Academy of Sciences*, 115, 7907-7912, [10.1073/pnas.1801769115](https://doi.org/10.1073/pnas.1801769115), 2018.

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