

Grounded ridge detection and characterization along the Alaska Arctic coastline using ICESat-2 surface height retrievals

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2nd version

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Review

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Summary

The authors have done a commendable job of addressing all the comments in my first review as well as those of my co-reviewer, Dr. Lemieux. I am especially impressed with their approach to assigning confidence levels to their grounded ridge detections, which greatly strengthens their interpretations of the spatial distribution of grounded ridges in their study area. In my opinion, this manuscript is very close to ready for publication, but I have outlined a few additional comments below that I feel should be addressed first. As far as possible, I have tried to include clear recommendations with each comment and I believe the authors will find them all simpler to address than those in my first review.

Major Comments

1. Confusing grounded ridge legend (Figures 5-8)

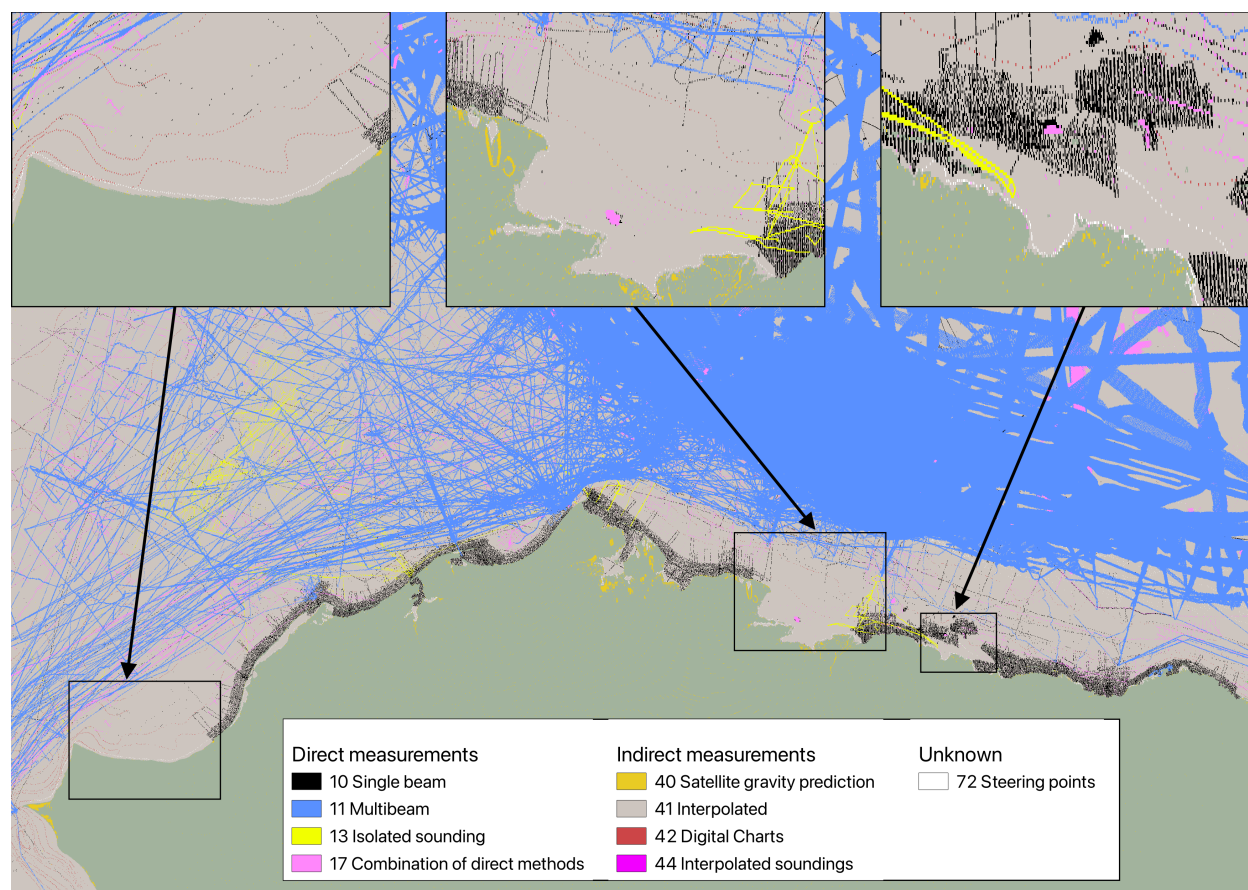
I really like the addition of the colored regions to indicate keel depths derived from different sail height ratios on Figures 5-8, but I find the symbology used to assign confidence and bathymetry data type to each grounded ridge somewhat confusing. First, it took me a little while to understand the meaning of the purple and yellow squares in Figure 5, when neither of these symbols is included in the legend. Reading between the lines, I assume the color of the symbol designates the confidence level, while the shape indicates the nature of the bathymetry data. If so, this should be spelled out clearly. However, as an alternative that might require less explanation, I recommend using separate symbols above and below each ridge to provide this information. For example, you could use a single color-coded symbol above each ridge to indicate confidence and perhaps a letter character below the keel for bathymetry data type. Please also see my associated comment 2 below.

My second source of confusion is the presence of multiple symbols for each ridge. In Figure 5, this appears to indicate both ridges are identified with both low and medium confidence, but the caption states "These ridge features are characterized as medium confidence grounded ridges". I'm not sure why ridges would be assigned more than one confidence level, but unless there's an aspect to this that I'm missing, I would recommend the authors identify only the highest level.

Lastly, the locations of grounded ridges in the SAR imagery in Figures 6-8 is only marked with purple dots, potentially creating the impression that they are all high confidence features. Instead, you could use the same symbols as those used above each ridge (per my suggestion above) to indicate ridge locations.

2. GEBCO Type Identifier (TID) grid data

I appreciate the authors including an illustration of the GEBCO 2024 TID grid in their response, which shows more shallow water single-beam data than I had known about. Nonetheless, there are still some areas of the coastline within this paper's study region that have few direct observations of bathymetry. In particular, the figure below highlights three areas with very few single beam data and primary reliance on interpolation. I realize this is something of a moot point now that the authors are using a deeper shallow-water cutoff for their analysis, but the figure below also illustrates that there is a greater diversity of data sources in the grounding regions than the 3 types that the authors discuss in their response and in the manuscript. Given this diversity, I recommend adopting GEBCO's categorization scheme and simply distinguishing between grid cells with "direct", "indirect", and "unknown" bathymetry measurements. Per comment 1 above, these could be designated with "d", "i", or "u".



3. Missing details on SAR data products and radiometric processing

This is a somewhat minor point, but since Figures 6-8 provide a color scale bar in dB (see minor comment below), I recommend adding some brief details about the acquisition mode and polarization of the data as well as the processing options applied (e.g., gamma-nought or sigma-nought for backscatter coefficient). The text should also state the source of the Sentinel-1 SAR data (i.e., ESA or ASF, or elsewhere) with appropriate link or DOI.

Minor comments

Figure 1: I like this new figure, but I have two minor comments. First, I feel the reader might benefit from some additional annotations to indicate which ice is mobile and which ice is stationary in each of the sub-diagrams A-D. This could help clarify that the ridge is part of the drifting pack ice in panel B, but is forming at the boundary between the landfast ice and pack ice in panel C. Second, the label for “Shorefast / landfast ice” should extend all the way from the shoreline to the SLIE. In other words, bottom fast ice, grounded ridges, and the shorefast ice extension are all different parts of the shorefast ice.

Figures 6-8: The color scale bar for the SAR imagery indicates a range of 12-22 dB, which I believe is in error. I expect the range should -22 to -12 dB.

Lines 508-510: This statement about differences in the size and number density of ridges in the Chukchi and Beaufort Sea is very interesting, but I feel it requires some additional citation or other support. Is this something the authors found from their own data, or are they describing findings made by others?

Lines 589-591: I agree with your revised description of the impact of sea level variations on sail height and therefore grounded ridge detection. However, I feel the key sentence could use some clarification regarding the direction of sea level change. Here is a suggestion for rewording (strikethrough indicates deleted text and bold indicates new text):

“Assuming the level ice can float independently ~~of the grounded ridges~~, these **positive** variations **in sea level** would increase **lift** the level ice **around the grounded ridge**, thereby **reducing the relative** height ~~relative to~~ **of the** ridge sail height (H_s), recording smaller sail heights than otherwise would be detected and therefore **leading to an underestimating of** keel depths (H_k).”