

Interactive comment on “Grounding and Calving Cycle of Mertz Ice Tongue Revealed by Shallow Mertz Bank” by X. Wang et al.

Anonymous Referee #1

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This paper uses altimetry and bathymetry data to map changes in the grounded area of the Mertz ice tongue during the early-to-mid 2000s. They use the surface heights of lightly-grounded icebergs to estimate the firn air content for the ice tongue, and use this, geoid-corrected altimetry measurements, and a bathymetry map of the ice shelf, to map the difference between the bottom of the ice shelf, at hydrostatic equilibrium, and the sea bed for different time periods. Areas where these maps show the (hydrostatic) ice bottom below the seabed are treated as grounded. The authors find that the northwest flank of MIT (Mertz Ice Tongue) was grounded during 2002-08, and that the grounding increased between 11/2004 and 12/2006. They propose that the MIT would have calved because of increasing grounding extent even if the tongue had not been hit by an iceberg. The authors also examine the rate of change in the area of MIT, and estimate an interval between subsequent tongue calving events of 70 years.

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A quick summary of this review is that this manuscript needs a great deal of editing and extensive revision before it is ready for publication. I have presented some of my thoughts about what needs to be fixed, but the writing is of uneven quality and my comments about the reliability of interpolated data should (in my opinion) lead to substantial changes in the text and figures. With this in mind, I have not gone to the effort of editing the paper in detail, and hope that the authors can do so themselves.

A major problem in this manuscript is the lack of bathymetry data under the MIT. Data are scattered, at varying density, seaward of the ice front, and the bathymetry maps appear to resolve the seaward extent of the Mertz Bank, but under the tongue the maps are entirely based on interpolated values. This makes the maps in figure 5 and the statistics in table 2 hard to believe except at the very edge of MIT where the altimetry and bathymetry more or less coincide. The conclusions of the paper are largely independent of the data everywhere except in the area where the data are credible, which makes me wonder why the authors chose to show the mapped elevation-difference values in the areas for which they have no data. The authors should make a clear distinction between results derived from measurements and results derived from interpolated values, and the relative expected accuracies of each.

A second problem is that the methods are difficult to interpret, in large part because the report cited as “Wang 2014” is not readily available online, and the paper “Wang et al 2014” appears to describe a method for estimating freeboard change, rather than the absolute freeboard used in the present study. A good deal of the material in this paper is based on a technique in that report, described briefly in section 3.1(126-135). This paper should include a full description of the technique. In particular, it is not clear from the description how the relocation step works or what it is supposed to accomplish, or how the surface slope relates to errors in this relocation (line 241). I would also have liked to see a justification for the kriging interpolation between ICESAT profiles; the grounding features appear to be small compared to the gaps between ICESAT tracks, which makes me suspect that the krigged freeboard values may not provide a good

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indication of grounding.

The authors should also be clear about the tidal values used in the freeboard study. Are the altimetry values corrected for tides? What is the “lowest sea level” mentioned at 155, and elsewhere? Is it derived from a tide model, or is it the lowest observed sea level? Is the tide model on the ICESAT product used, or is a different tide model used? What are the errors involved in each part of this?

The English in the manuscript needs improvement. A few idioms are used throughout that are confusing or distracting. “Inversed” should be “inverted.” “Area-changing rate” should just be “area rate.” “Least-square” should be “least-squares.” Activities in the current study should be in present tense, citations to the literature should be in past tense.

The FAC calculation (3.2) has some nice features, but needs to be described in more detail. How is the least-squares inversion carried out? What are the error sources?

160-177- is the extensive discussion of other methods of calculating the FAC german to this study? This section would be clearer if much of this were omitted.

222-229- this paragraph should be in the introductory part of section 3.2, not after the calculations have been presented.

247: Where are the interpolation errors for freeboard and bathymetry?

254- 50 times the average slope is still a very small number (0.6 degrees). A better estimate of the error due to crevassing would be to directly incorporate the crevasse depth into the calculation- thus, instead of $v \cdot \text{slope_error}$ (~ 12 m) the contribution would be closer to 50 m.

256-62: Why do we need to consider the freeboard stable (or not stable?) It appears that only static estimates of freeboard are used here (derived from single ICESAT campaigns) - so why does it matter that there would be a change (or not) in the freeboard?

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257 “annual changing rate of freeboard” should be “annual rate of freeboard change” or “freeboard rate”

273: What is the significance of Edif < 34 m? Based on 263-268, this would indicate “not extremely confidently identified as ungrounded.” Wouldn’t a better statistic be Edif < -34, or “Extremely confidently identified as ungrounded?”

280: Again: Do you mean “less than -17 m?”

291-293: Reporting Edif within the tongue is a problem, since the bathymetry is not known there. You might report changes along the margin, but the statistics reported here don’t seem to mean anything.

302 Combine the first two sentences, which form a joint conclusion: “. However,” should be “, and that”

325 (and elsewhere) “Area-expanding trend” should be “area rate” or “rate of area change”

367-78: The significance of this paragraph is not clear. Ice-berg scouring is not discussed elsewhere in the paper, so the scientific question addressed by this paragraph needs more introduction.

577- “is used in figure 6”– this appears not to be true.

589: “closed” – should this be “closest?”

594: The legend here is not consistent with the caption.

606: It is hard to distinguish the outline from the “grounding part.” The choice of colors (yellow on yellow) is not good.

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