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Interactive comment on "The length of the glaciers in the world – a straightforward method for the automated calculation of glacier center lines" *by* H. Machguth and M. Huss

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Manuscript review for The Cryosphere

Title: The length of the glaciers in the world – a straightforward method for the automated calculation of glacier center lines

Authors: H. Machguth and M. Huss

This paper is an important contribution to the field of automated glacier mapping and deriving parameters from glacier inventories such as GLIMS and the Randolph Glacier Inventory (RGI). It comes on the heels of two other recent papers on glacier length,

namely Kienholz, et al. (2014), and Le Bris and Paul (2013). This and Kienholz, et al. (2014) are especially closely related, and this paper refers to the latter and compares the results from both approaches.

As is described in this paper, center lines are useful for a variety of purposes, including glacier flow modeling, automated glacier length change determination, and estimating glacier volume. Glaciers are too numerous to derive center lines manually for large-scale applications, so it is important to have automated methods.

This manuscript generally reads well and describes the method in an understandable fashion. The figures illustrate the method well. I have a few main comments, and then numerous recommendations for small edits. My main comments are:

- Have the authors quantified how important it is to have the glacier outline and DEM be contemporaneous? What errors can result if they are not?

- The center lines generated by this method, at least as shown in Figure 3, seem to be represented by a small number of vertices. Can the algorithm be tuned so that more vertices are produced for smoother center lines?

- The descriptions of the trade-off functions are short enough that they could be in the main text, rather than in an appendix.

- It would be good to state in the introduction something like this: The GLIMS Glacier Database stores center lines for glaciers, and currently contains center lines for about 2300 glaciers. As the RGI is merged into GLIMS, it is expected that center lines from an automated method such as this will be put in the GLIMS database.

- Is the F1 filter the same as, or different from, the Douglas-Peucker algorithm? Why not simply use the D-P algorithm?

- Is there a plan to make the code available to the community?

- It is good to have the comparison with the semi-automated method of Kienholz, et al.

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(2014) in Table 2. It would also be good to show a sample of Kienholz outlines in a figure with outlines from this method, as in Figure 4, for visual comparison.

In summary, I think this paper moves the field of automated glacier mapping forward, and I recommend that it be published once the comments in this review are addressed.

Line-by-line comments (preceded by Page-Line):

2-25: Change to "despite being of scientific relevance and easily communicated ..."

3-5: Change to "because of the link between length and glacier flow"

3-10: Delete "do"

3-12: Change to "...can represent only indirectly the three..."

3-23: Delete "Thereby" and change to "The requirements (ii) to (vi) result from the need to apply the method to ..."

4-4: Delete "a": "minimizing the costs on cost grids"

4-8: Delete "does"

4-11: Delete "actually"

4-15: Delete "Thereby": "We aim at ..."

4-23,24: Change to "...every individual branch of every glacier..."

4-25: Change "was" to "were"

4-27: Change sentence starting with "Eventually" to "We then applied the method to all glaciers..."

5-1: Change heading to "2 Application test sites and input data"

5-2: Change sub-heading to "East Greenland"

5-3: Change "on the example of" to "in"

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5-9: Change "comprises" to "includes"

5-12: Change "the East Greenland" to "this"

5-17: Change sub-heading to "Alaska" (delete "Test site")

5-19: Change "perimeter" to "region"

6-7: Insert semi-colon after "glacier"

8-11: Change "are" to "is"

8-12: What does "suggested" mean? Please clarify.

10-2: Shouldn't the limits of the summation be 1 to 3 (not 0 to 3)?

12-11: Clarify what is meant by "slope glaciations". Please use standard terminology, for example from the "Illustrated GLIMS Glacier Classification Manual", at http://www.glims.org/MapsAndDocs/assets/GLIMS_Glacier-Classification-Manual_V1_2005-02-10.pdf

12-12: It is unclear how the last two criteria are considered only in certain cases, given that this is a fully automated algorithm. Please clarify.

12-19: Change "although objecting the first quality criteria" to "even though the first quality criterion is violated"

13-3: Change "optimization" to "increase"?

13-6: Is it c0 to c2, or c1 to c3? See also comment 10-2.

13-26,27: Change "Model" to "Algorithm".

14-2: Change "masked" to "created" or "compiled"? Meaning is unclear.

15-12: Change "highest" to "best".

17-2: Use "dimensionless" rather than "-".

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17-4,5,6: Rewrite this sentence as "Glaciers with areas of 1 km2, 10 km2, or 100 km2 thus can be expected to have lengths of 2.3 km, 8.2 km, and 29.6 km, respectively.

17-16: Change "canalizing" to "channeling"

17-17: Change "almost show" to "show almost".

18-7: Change "mistaken for" to "taken as"

18-12: Change "here applied settings" to "settings applied here"

18-19: Delete "in future updates"

18-26: Change to "independent of"

19-1: Delete "here".

19-1,2: Change "involve similar possibilities of" to "allow for"

19-3: Change "In view of" to "For"

19-4: Change "Model" to "Algorithm"

19-9: Change "the existing" to "artifacts consisting of"

19-12: Change "oriented" to "reliant". Change "topography" to "topographic".

19-14: Change "any" to "every"

19-16: Change "The laborious" to "Laborious"

19-22: Change "seen" to "that resulted"

19-23: Change "glaciers" to "glacier"

19-28: Add comma after "latter"

20-6: Add comma after "everywhere"

20-7: Change "vicinity of" to "proximity to"

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20-13: Add "on" after "provided"

20-17: Change "delivers" to "produces"

20-18,19: Change "data root" to "data are rooted". Change "involvement of" to "dependence on". Change "Relying on the latter" to "Use of surface slope". Change "is an advantage" to "works well".

20-20: Change "types and more" to "types, and also more".

20-22,23: Delete "on" before "asymmetric" and "ice caps".

20-25: Change "allows more strictly controlling" to "leads to stricter control of"

21-13: Add "from area alone" after "individual glaciers"

21-15: Add comma after "size"

21-24: Change "in-between 60" to "between latitudes of 60"

21-21: Change "is anticipated" to "was achieved"?

22-4: Change "on the example of East Greenland" to "using East Greenland as a test area, and"

22-5: Change "eventually" to "then"

22-15: Restate the four conditions briefly, for the benefit of people reading only the conclusions.

23-23: Change "greatly acknowledge" to "are grateful to"

Table 1 and Table 2 Captions: Change "length ratio of [A] divided by [B]" to "ratio of [A] to [B]", or "[A] divided by [B]".

Table A1 Caption: Change "applied for" to "applied in".

Fig. 2 caption: Change "refers" to "refer", "degree" to degrees", and "kilometer" to

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"kilometers".

Fig. 4: It seems irrelevant to have glacier outlines for two different years in the figure.

Fig. 5: The center line on the large glacier that terminates at about x=655, y=-2260 seems to end in the wrong place. It would be worth adding a short comment about that (whether it is correct as-is or not).

Fig. 6: Please use a color other than yellow, as it's very difficult to see. In the caption, change "inter quartile" to "interquartile"

Fig. 7 caption: Change "inter quartile" to "interquartile"

Fig. 8: For some regions, there must be previously known "longest" glaciers. Do these results agree?

Fig. 9: Include actual data on the graph for at least one region.

End of review

With best regards, Bruce Raup

Interactive comment on The Cryosphere Discuss., 8, 2491, 2014.