

Interactive comment on “A new method for deriving glacier centerlines applied to glaciers in Alaska and northwest Canada” by C. Kienholz et al.

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Kienholz, Rich, Arendt & Hock MS No.: tc-2013-164 The Cryosphere A new method for deriving glacier centerlines applied to glaciers in Alaska and northwest Canada. Author(s): C. Kienholz et al.

Referee comments by Ian S. Evans

This is a very good paper, automating the generation of centrelines especially for multi-branched glaciers by using various empirical ‘fixes’. It is ambitious, in covering the whole branching system. It solves some of the problems discussed in LeBris and Paul’s 2013 paper (which had a somewhat different objective, a single flow line per glacier).

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The English expression is very good. It is correctly admitted that the paper does not deal with flow lines, although good centrelines will be close to flow lines except at branch junctions (as an aside: ‘central flow lines’ have discontinuities –sideways jumps - at the transverse line where the branches are deemed to have joined: true flow lines continue side by side).

Even the complex, multi-stage algorithm has difficulty with some glaciers: with large glacier complexes, with multi-lobate or asymmetric tongues, and with small apron glaciers – as is honestly discussed. The abstract implies manual adjustments for 12.2% of the Alaskan/Canadian glaciers, but mentions the causes of only $5.5 + 3.5 + 1.4 = 10.4\%$. What of the other 1.8%?

Some decisions could benefit from further justification. For example, why are short branches deleted? Do they tend to be erroneous, or are they just a nuisance?

Some of the Figures (4, 7, 8) are over-reduced. The numbers in 8, especially blue ones, are almost invisible. In 8, the main map has a lot of detail and is difficult to read. Visibility is improved after several steps of on-screen enlargement, but there should be some consideration for those who print out the ‘printer-friendly’ or the initial file. I hope that in the final version, these Figures will be as wide as the captions below them – why not?

The complicated algorithms adopted are robust in coping with currently available DEMs. One hopes that some simplifications may be possible when higher-quality global DEMs, e.g. TanDEM-X, become available (next year?). At least, there should then be fewer cases requiring manual adjustment.

DETAILS P 5191 line 17: delete comma after ‘often’.

P 5196 top: it would be useful to mention the range of r values (max is 1 km; give values for 0.1, 1.0 10.0 and 100.0 km² glaciers) here, not just (max) in Table 1.

5197 line 5 after ‘distance’: insert ‘from any point to its closest edge’

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5198 line 5 : the relationships are exponential, but a and b are 'exponents'.

5199 around line 8: I would like some discussion of WHY unreasonably upslope routes are initially chosen.

5199 line 22 not 'reached': reword.

5200 line 11. This is not clear in Fig.4, possibly because it is so small.

5201 top, and line 16: number of iterations is arbitrary (from your choice of 0.1 steps): I would rather see this discussed in terms of change in b, for which the maximum is 0.5 – that is more 'transferable'.

5201 top, and line 10: ideally there should be discussion here in relation to 'field' checks, i.e. discussion of specific cases. It is alarming that, even after editing and depression-filling, sufficiently large blunders can remain to give large reversed slopes and several successive uphill pixels along the candidate centreline.

5201 line 27: not 'significantly' but 'greatly'! [No significance test here!]

5203 eq.8: From $S=(k - w^2)/w$ it seems that $k_{max} = 650$ m is reached when $S = 500$ km². Is it worth pointing this out? (k_{min} is just over 150 m.)

5204 line 4 'conversion point' is undefined. Should it be 'convergence point'?

5205 line 6 'separated'

5205 lines 6-7 Reword, avoiding 'deceeded'. Presumably this is the opposite of 'exceeded', but it is not found in compact dictionaries, or even in my 1149-page Webster's (admittedly from 1992).

5205 line 21 insert 'lateral' before 'moraines'.

5206 lines 10-14. This suggests possible sub-optimality. Would it be better to perform these necessary adjustments to step 2 BEFORE the first round of step 3?

5209 line 10: divergence on volcanoes: earlier discussion (p. 5208) implied that this

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problem was tackled by outlining the catchment of each tongue before (automatically) generating a head as the highest point for each. Logically, obtaining an appropriate outline should precede definition of start and end points – I would regard this as a matter of editing the inventory.

5209 lines 19-23 9 (and p. 5215 line 9) I doubt if filtering out very low gradients would solve the problem mentioned in line 13. A small, wide apron glacier is likely to have a steep true slope gradient – around 30 degrees - so even a line from a top left high point to a bottom right low point would have a quite steep apparent gradient.

5210 lines 13-16 I prefer to restrict the term nunatak to rock projecting above the surrounding ice. The implications for centrelines of continuous rock slopes over which seracs discharge are quite different – as mentioned here – so it is best to emphasise the distinction by not extending the term nunatak to such slopes.

5210 lines 18-21: this raises the question, why was this simpler approach not adopted?

5211 line 20: insert 'very' before 'large'. [How many glaciers have branches tens of km wide?]

5212 line 21 'use', not 'us'.

5213 line 10 not 'length differences' because these are ratios, l_h/l_l not $l_h - l_l$. '... illustrates contrasts in length...?'

5213 line 14 ... and the mode is around 1.07

In Fig.1, (b) is too small.

In Fig. 4 the centrelines would have more contrast if they were black, or white, rather than yellow on an orange background.

In Fig. 7, the orange and red circles are too similar in colour. Are the centrelines in 7a 'grey'... or black?

In Fig. 8 (and its inset), the centrelines would be clearer if the glaciers were white.

In the Fig. 8 inset, an important glacier left of centre is not given a branch order; it is probably '5'.

In Fig. 9a (and 9b) if the subdivision of bars is intended to show differences between size (area) classes, it fails. 4 histograms each with a horizontal base might show this, but cumulative (quantile) plots on one graph would be better. Such differences are not discussed, however, in the text (pp. 5213-4).

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