General comments:

The study of Machguth and Huss (2014) presents a new, computationally efficient method for the automated derivation of glacier centerlines. Such automated methods are highly valuable, as the manual derivation of centerlines is very time-consuming. Compared to previous approaches, the proposed method is implemented differently (e.g., completely grid-based) and includes novel elements (e.g., trade-off functions). The method is applied on a global scale, while previous methods were applied on regional and local scales only. Machguth and Huss (2014) conduct a comprehensive quality analysis of their approach in Greenland and Alaska. This allows them to provide uncertainties for their final glacier length product, which is useful. In addition to deriving and evaluating centerlines/glacier lengths, Machguth and Huss compute area-length scaling relationships for different glacierized regions and analyze the found differences in the scaling parameters. Such a large-scale application was previously impossible due to the lack of accurate length measurements. The presentation of the material is very good: the paper is well-structured, while figures and tables are informative and well readable. In certain places, additional explanations would be helpful (e.g., why did you introduce certain thresholds? why did you use a certain equation?), but I'm aware that this could lengthen the paper too much.

Overall, I recommend that this paper is published with minor changes. Both specific comments and technical corrections are listed below, in page order. Many of the listed points are technical corrections, and the authors can decide to what extent they want to consider them.

p.2491 Title: I would remove the "straightforward". Your method is rather sophisticated. Something like "The length of the glaciers in the world – global application of an automated method for the calculation of glacier center lines" may be an alternative. Although implied by "glaciers in the world", the global can be emphasized, as none of the previous methods have been applied on a global scale.

p.2492, l.5 It would be beneficial to define your use of fully automated in the paper. Strictly speaking, the approach to derive the physical centerlines is not fully automated. As shown in the Greenland quality analysis, a small percentage of the centerlines is erroneous (with errors that are difficult to quantify), no matter the quality of the DEM and outlines. However, regarding the derived lengths, the term "fully automated" seems appropriate because here, you can easily work with uncertainties (as done on p. 2506).

p.2492, l.5 "that relies on" instead of "based on"

p.2492, l.10 "accuracy" instead of "precision"

p.2492, l.14 "Based on our model output, we derive"

p.2492, l.16 "key" instead of "central"?

p.2492, l.25 "Despite being scientifically relevant and easy to communicate " instead of "But despite of being of scientific relevance and easy to communicate"

p.2493, l.3-13. In case of 2D applications (unlike 3D flow modeling), don't the terms "flow line" or "trajectory" per definition refer to the 2D projection of the actual 3D flow line or trajectory? To me, this is somewhat similar to the use of the term glacier area. In a 2D application, area always refers to the projected area, rather than to the actual 3D surface or slope-corrected area. While it is difficult to derive the 3D flow line from measured data, its 2D projection can be approximated to a certain degree, using surface velocity fields or even elevation contours.

Following the explanations of the different uses of the term “glacier length”, what is the definition of glacier length used in the paper? Quality criteria are given later on (p. 2502), but it would be beneficial if you quickly defined the type of line envisaged.

p.2493, l.19 “requirements” instead of “criteria”

p.2493, l.22 delete “needs to”

p.2493, l.23 Delete “Thereby”

p.2494, l.4 “cost grid” instead of “cost grids”

p.2494, l.10 Having exactly one line per glacier branch increases the likelihood of getting the longest centerline. But it also allows to further quantify the glacier geometry (nr of branches, branch order), among various other applications (e.g., tracing disintegrating glacier branches through time).

p.2494, l.14. Here, you could quickly define your use of fully automatic.

p.2494. l. 23. Isn’t the final output one line per glacier (the longest one)? The mentioned set of centerlines is rather an intermediate product that is difficult to use as-is.

p.2494. l. 25-29. Present or past tense throughout the paragraph.

p.2494. l. 27. “Comparing our results to the lengths obtained by Kienholz et al. (2014)” instead of “Comparing our results to Kienholz et al. (2014)”

p.2495. l. 3. Delete “on the example” “tested in a strongly glacierized area”

p.2495. l. 6. Simpler as follows: “…because its 3950 ice bodies represent all possible morphometric glacier types”

p.2495. l. 11. “To the north of the Geikie plateau,”

p.2495. l. 12. “For the East Greenland test site,” with comma

p.2495. l. 13. “spatial” instead of “horizontal”

p.2495. l. 19. “Kienholz et al. (2014), using identical” comma instead of “and”

p.2496. l. 5. Split into two sentences. Something like: “By intersecting all glacier outlines with global DEMs, a local DEM and a glacier mask are obtained for each individual glacier. These DEMs and masks are stored in a projected coordinate system with a resolution between 25 and 200 m (e.g., Huss and Farinotti, 2012)”

p.2496. l. 19. The numbers of inaccurate RGI glacier outlines must make up more than 1% of the total?

p.2497. l. 20. “On calving glaciers, …lies above the actual ELA, ” add two commas

p.2497. l. 23. “picked as a starting point” no s

p.2498. l. 4. “as accurately as the currently applied radius allows” instead of “as well as the currently applied radius allows”. “as well” will be mistaken as “and”

p.2498. l. 17. “Hydrological Flow” H capitalized

p.2498. l. 17. “glacier branches” instead of “glacier tongues”.

p.2499. l. 17. If confluence occurs in the ablation area, the lines might get deflected to the opposite margin of the glacier, due to the convex topography and the increased weight of the slope component. How robust is the approach in dealing with this?

p.2499. l. 18. “narrowing” instead of the “progressively more narrow glacier termini”

p.2499. l. 19. “…down-hill grid cells within the search ring” instead of “…down-hill grid cells” only. Although visible in Fig. 2, it helps to mention in the text that you only consider the cells in the search ring/buffer.

p.2500. l. 7. “Suggestion of glacier endpoints” instead of “Suggesting glacier endpoints”. Alternatively, change title 3.3. from “Implementation of” to “Implementing”

p.2500. l. 15. How effective is this approach in correctly separating marine-/lake-terminating and land-terminating glaciers? While the correct separation is not necessarily required for your centerline application (it is ok to have suggested endpoints for wide, land-terminating glaciers), it is useful for studies that need to distinguish the different glacier types. If your approach works reliably, you have a useful side-product that should be mentioned, e.g., in the Conclusions.

p.2501. l. 14. Can F2 cause the centerlines to lie outside the actual glacier perimeter?

p.2501. l. 15. “high quality” instead of “good quality”

p.2501. l. 16. “result” instead of “results”

p.2501. l. 19. “Calculation of” instead of “Calculating”

p.2502. l.2. It would be of interest to have some kind of sensitivity analysis. For example, how different are the lengths if you set c_0 to 0.5 instead of 0.6? However, given the number of parameters, such an analysis may go beyond the scope of this paper.

p.2502. l.3. “until” instead of “unless”

p.2502. l.15. “Consideration of” instead of “Considering”

p.2502. l.16. Flexibility is needed to deal with inaccuracies, but you might also need some flexibility to deal with rough surfaces that are real, e.g., due to debris cover.

p.2503. l.3. “coarse resolution and possible uphill flow”

p.2503. l.7. “take effect” instead of “takes effect”

p.2503. l.16. “The approach performs well on all glacier types” instead of “ and the approach performs well on all types of glaciers”

p.2504. l.4. “1.02, indicating” instead of “1.02 and indicates”

p.2504. l.11. This supports the interpretation of “fully automatic” given on p. 2. The derivation of the actual centerlines is not fully automatic, but the derivation of the lengths is – if a certain error percentage is considered.

p.2504. l.8. “size classes,” comma

p.2504. l.17. Something like “Evaluation Alaska” might be better.

p.2505. l.16. “tends to cross small polygons more diagonally” instead of “has a tendency to cross small polygons diagonally”.

p.2505. l.18. Is any influence of the debris coverage noticeable? The rough topography in debris-covered areas may also stop centerlines too early.

p.2505. l.26. “By applying the above method” instead of “By applying the method described above”

p.2506. l.16. Period after Antarctic).

p.2506. l.16. delete “with”

p.2507. l.6. characterized instead of integrating.

p.2507. l.17. “show a very similar” instead of “almost show the same”

p.2507. l.25. New sentence: “Both regions…”

p.2508. l.17. “Averaging over perimeters of a few grid cells”. If a smoothed DEM is used (as done on the global scale), such an averaging effect is included?

p.2508. l.21. The relatively coarse spatial resolution of up to 250 m enables a high computational efficiency of the algorithm. Might the coarse spatial resolution (combined with the applied filter functions) yield centerlines that don’t strictly lie within the glacier perimeter? (which can be problematic for certain follow-up applications)

p.2509. l.16 - 23. These explanations also imply that Tables 1 and 2 should be compared with certain care.

p.2509. l.24 -28. Additional commas would improve the reading flow: “comparison,” “DEM,” etc.

p.2510. l.12. The comparison to 4300 interventions is not fully valid because the two approaches do not the yield the same final product (the longest line vs. one line per branch). For example, Kienholz et al. (2014) deleted certain glacier heads manually to reduce the number of lines to one line per branch. Steps to get one line per branch are not part of the approach presented here. “considerable number of manual interventions” could be used instead of the actual number.

p.2512. l.13. Do you also have a data set that distinguishes marine-terminating/lake-terminating from land-terminating glaciers? If so, mention it here.

p.2512. l.17. “methods’” instead of “methods’s”

p.2512. l.23. A few more explanations in this appendix A1 may be beneficial. Why did you use certain equations, why certain thresholds?

p.2513. l.15. t_3 should be t_3a?

p.2513. l.18. t_4 should be t_3b?

p.2520. Increase the size of the figure, if possible.

p.2524. Increase the size of the figure.