

Reply to reviewer's comments

N. Mölg et al.

In the following we reply to the specific and technical comments to the revised version of the manuscript.

Comments Reviewer 1:

- Are acronyms for "TMG", "SBG", etc. really necessary? Perhaps for figures to save space (and then they should be stated in each caption), but given space is not an issue electronically and these only save several letters, I highly suggest avoiding the use of needless acronyms that only reduce readability by having the reader by having to look them up constantly.

Done. Acronyms have been removed throughout the text.

- Figure 4: There doesn't seem to be any statement of comparing to the other glaciers like there was for Figure 3. Add this statement otherwise the reader is left wondering why all these other glaciers are shown. Zmuttgletscher should be the first in the legend and it should also be more pronounced (perhaps a thicker line, black color, or both). The abbreviations are not provided in the caption. It also seems unnecessary to have these glacier name abbreviations only one time in the text (especially for the study area glacier!). I highly recommend providing the full names, which may be possible if the legend is one column. If you still favor abbreviations, then the abbreviations should be stated in the caption. Additionally, "Zmuttgletscher shows a relatively modest retreat..." - this sentence belongs in the text, not in the caption, and then makes sense as to why you add the other glaciers and address the first part of this comment.

Done. We've moved the sentence from the caption to the text, thus the reference to the comparison should be clear. Also, the figure was changed and Zmuttgletscher is now on top (also in the legend) and the lines are black and thicker. There are no more abbreviations in the legend.

- Figure 8: The labels are now acronyms of acronyms. This is very confusing and a bit ridiculous. Just state SBG1, SBG2, TMG1, TMG2 if you're limited for space in the inset figure.

Done as suggested.

- Figure 9: The plot is very misleading as it shows periods of time that are not equidistant; ex. the first one is 16 years and the second is 6 years, but they have the same space between. I would plot the years and then plot the values at the mid-points as this would show the time more accurately. Also, it'd be nice to be able to compare the timing of these changes with the data in Table 3. I would recommend plotting Table 3 as subfigures to Figure 9. This is why having the actual time on the x-axis would be nice as well. This would allow one to see that in 1983-1988, there was also a decrease in debris-covered glacier area.

Figure has been adapted. The table was left outside the figure according to the journals requirements.

- Supplementary table captions should be above tables like the text

Done.

- Supplementary figures 7-16 appear to be the same as Figure 10 - delete these in the supplement (also they should each have a proper caption if they were to remain for some reason)

We've kept them in the supplements because this way the interested reader can study them in detail. We've adapted the captions.

P1, L13 - delete "with decadal"

Done

P1, L16 - "by comparison"

Done

P1, L19 - glacier "has" been quasi-stagnant

Done

P1, L20 - in "the" surface slope

Done

P1, L24 - decreasing glacier dynamics sounds odd. More accurate would be decreasing flux divergence, ice flux, or whatever way the authors would prefer to state this.

Changed to 'decreasing ice flux'

P2, L16 - (iv) "long-term (> decade) glacier-scale studies have mostly..."

Done

P2, L28 - add reference for long response times (>50 years)

Done

P3, L8 - weather "systems"

Done

P3, L9 - change units to m in order to be consistent with the next line of m w.e.

Done

P3, L14 - Zmuttgletscher "has" several independent...

Done

P3, L20 - "mainly fed by TMG and to a lesser extent..."

Done

P4, L6 - our analysis "is" based

Done

P5, L4 - new paragraph seems unnecessary

Done

P5, L8 - using "the Topo-to-Raster tool in ArcGIS."

Done

P5, L13 - "and then georeferenced"

Done

P5, L17 - "the number of images and image quality..."

Done

P5, L28 - ... "(1859), Siegfried map (1879), all available orthophotos, and Swisstop (...) by manual digitization"

Done

P5, L29 - Swisstopo images? maps? stating simply "Swisstopo" sounds odd

Done

P6, L1 - "The time series of maps and orthophotos resulted in glacier area values ..."

Done

P6, L2 - "debris-covered areas" compared to...

Done

P6, L2 - of "these" images

Done

P6, L12 - influence "of" debris cover

Done

P6, L14 - glacier boundary "and" the start and end of the length profile", respectively ..."
Figure 2 - state in the caption that c & d are looking at Tiefmattengletscher to provide the reader with the proper context for looking at the images

Done

P7, L2 - the "long-term elevation change data"

Done

P7, L9 - delete "results of upper transect see Figure 7a" as this is unnecessary

Done

P7, L11 - "However, for debris thicknesses greater than" 20 cm...

Done

P7, L14 - add the time periods used by each station in the parentheses since you provide the elevation and distance from the site. I would also switch the order to be consistent with the text (i.e., close to study site, similar elevation, long period)

Done

P7, L20 - into four "sections" and eleven...

Done

P7, L26 - Between "August 22-24 2017"...

Done

P7, L27 - replace "today's" terminus with the year. Many years from now "today's" terminus will not be accurate. I would suggest this for each use of "today" in the text

Done

P8, L10 - specify "9b"

Done

P8, L15 - A glacier's elevation change gradient is typically inclined towards ... - this sentence is very confusing to read. Please clarify. The gradient is a number, so inclining a number doesn't make sense.

Done

P8, L35 - accounted for "due to a" lack of such data

Done

P9, L6 - delete "negative at"

Done

P9, L8 - Zmuttgletscher "had less" mass loss

Done

P9, L8 - add citation for Swiss mean

Done

P10, L14 - delete ~12.9% of the entire glacier area, and move this to the next line, so it reads "resulting in an increase in percent debris cover from ~12.9% to 31.8±0.06% of the glacier area from ~1850 to 2013." Also, add error for the 12.9% if able to do so, since you show it for the 2013 image.

Done

P10, L21 - and "now is" close to the foot...

Done

P11, L8 - from "less than" 5 cm to "greater than" 70 cm

Done

P11, L16 - seven "week" period

Done

P11, L17 - if stating "Ostrem-like" behavior then should add reference to the Ostrem study here

Done

P12, L6 - The "middle" section ... - this is then consistent with term middle in Figure 8

Done

P12, L20 - delete "and more"

Done

P13, L21 - The use of "on average" with all the years sounds like it's setting up an average for the time period, only to realize that it's meant for spatial average; hence, I would recommend

something along the lines of "Since 1879, the average thinning over the ablation area has been 104.7...". Although even here, I would suggest putting the value in m/yr because 104 m is a lot but it lacks the context to be able to compare it to all the other thinning rates mentioned in this paragraph.

Done

P15, L7 - delete "rather"

Done

P15, L18 - which "provide" a clear picture

Done

P15, L30 - delete "in our case"

Done

P16, L31 - develop "a" more negative mass balance

Done

P17, L9 - delete "points"

We are still convinced that the 'points' are actually correct. Removing them would leave the reader confused as to whether the change is in % relative to the former area or absolute % change.

P18, L10 - Table S15 doesn't exist

Changed

P21, L28 - Recommend changing Owen to "O." to be consistent with the other acknowledgements

Done.

Comments reviewer 2:

P1 L13: There is something missing near 'with decadal ...'

Done

P3 L10: 15 km distant -> distance

Left as is. Distant should be correct.

P4 L6: Our analyses are based

Done

P6 L3: West -> west

Done

P7 L25: Please also mention the actual visually determined threshold here.

Done.

P7 L25: Not very clear from the pdf whether there is a split, but consider splitting paragraph after 'water surfaces' ?

Done

P11 F6: Nice!

Thanks!

P13 L26: Relationship -> relationship -> although I would prefer just 'relation'.

Done

P13 L27: ...show a trend to stronger thinning... Vague to me, can this be rephrased?

Done

P15 L14: investigation priod -> study period

Done

P16 L32: 0.8-1 -> 0.8-1.0

Done

P17 S5.3. I am still bit baffled about the need for percentage points, but OK.

Left as is.

P17 L11: Paper by Teun van Woerkom is no longer in discussions and has been published now. <https://doi.org/10.5194/esurf-7-411-2019>

Included

Comments Editor

The contribution of 1.5 days of radar interferometry measurement is so negligible to your story that it could be skipped. To really focus the paper and not distract the reader.

We are of the opinion that this piece of information should be kept in the paper, since it is the only distributed information about glacier velocity, even from three points in time.

Technical corrections.

Table 1. Dh not defined yet (I think)

Done

5.23. Maybe remind here the date of the reference DEM to which all others are coregistered.

Done

7.19 too large rather than too big. (I think).

Done

8.30 Does not really make sense to have a section 3.6.1 if you do not have 3.6.2.

Done

Table 2. Even if you write "annual" I think it is good for clarity that the unit in the table is set to m/yr. To avoid any mis-understanding.

Done

Do your glacier-wide mass balance agrees with the one from Fischer et al., TC, 2015 when cumulated over a similar period? It would be a nice sanity check.

Yes it does: -0.54 (ours from 77-2010) vs. -0.65 (theirs, 80-2010)

Figure 7. The last sentence of the caption appears to be incomplete.

Done

16.32. Minus sign missing in front of the mass balance.

Done

18.10. Not clear why you say “comparatively high” here and then provide the example of Findeleng. where the area loss is even larger.

Changed to ‘low’

19.14. The same statement applies I think to Argentière Glacier in the French Alps (see Vincent, C., Soruco, A., Six, D. and Le Meur, E.: Glacier thickening and decay analysis from 50 years of glaciological observations performed on Glacier d’Argentière, Mont Blanc area, France, Ann. Glaciol., 50(50), 73–79, doi:10.3189/172756409787769500, 2009.)

Included

20.19. I had a hard time tracking back the 5% contribution of ice cliff to the glacier-wide mass balance. Better explain how you calculated this 5% value (if not already done)

Done

20.25 and 20.29 are mostly repetitions.

Left as is