

Distribution and characteristics of supraglacial channels on mountain glaciers in Valais, Switzerland. Holly Wytiahlowsky et al. 2nd review for TC by Ian Willis

Thank you for the vast number of improvements to the paper following the suggestions by myself but also the other two reviewers. I noticed that many of our comments were similar.

The paper is greatly improved and is closer to being ready to publish in my view. I've been through the paper carefully and have a few remaining general comments and a few more specific detailed comments and questions.

The science is good, and the results are interesting, but my comments and suggested edits are to encourage you to work on articulating the results and implications of your work more carefully, precisely and logically than you do, with the ultimate goal that more people will read it and it will have a better impact. The Discussion was the main part of the original paper that needed improving and you've done a good job in doing so. But it remains the section that'll most benefit from more work.

General points

1. Throughout your paper, it would be clearer (and you could lose a lot of repetition), if you did not continuously tell us that your channels are 'large' or '> 0.5 m wide'. Tell us in your methods that you can only resolve channels above this size and that hereafter you refer to these simply as 'channels'. Then you can delete all subsequent references to '> 0.5 m' or 'large', as we know that when you use the term 'channels' it is an abbreviation for 'large channels > 0.5 m'.

We originally added the mention of our mapping threshold throughout, following previous comments from reviewers that noted that we do not sufficiently address the presence of channels below our threshold. To avoid repetition, we have kept the mention of our mapping threshold when it is first mentioned in each section and removed it afterwards if it is not needed.

2. You use the word 'morphology' and 'morphometry' with respect to channels throughout the paper and it's not clear what you think the difference between these two is. Can you better define these two terms when you first introduce them and then use the correct word thereafter? Or do you see them as the same thing, in which case just use one term consistently.

Amended – We refer to morphology when visually describing channel shape (e.g., sinuous or incised), and morphometry in relation to quantifiable measurements (e.g., length, quantified sinuosity). We now define each term when they are first mentioned (paragraph 2 and 4 of the introduction) and have corrected any instances of where these terms are used incorrectly.

3. There are places in the paper where you're comparing your work to 'ice sheets' but really you're just comparing with the Greenland Ice Sheet. I think you should alter all such sections to refer to the GrIS only and not give the impression that there are vast surface drainage networks on the Antarctic Ice Sheet!

Amended – we have gone through the manuscript and replaced 'ice sheets' with the Greenland Ice Sheet when we are not also mentioning Antarctica. Section 5.3 has now been changed to a 'Comparison between Valais Glaciers and the Greenland Ice Sheet'.

4. Similar to above, there are places in the discussion and conclusions where you refer

generically to 'mountain glaciers' or 'valley glaciers'. You need to decide whether you think your results for the 85 Valais glaciers are universally applicable and can be generalised. Parts of your discussion suggest you do not think this and work is needed to apply your methods to other areas of the world. I would agree with this. In which case you should always refer to 'Valais glaciers' and not imply that your findings are necessarily applicable everywhere.

Amended – we have gone through the discussion and conclusion and replaced 'mountain glaciers' or 'valley glaciers' with Valais glaciers where we are specifically talking about the results from our study area. In some instances, we have left 'valley glacier' in when talking about the types of glaciers in Valais, or when referring to 'mountain glaciers' more broadly.

5. I would encourage you to proofread your work more than you do and have your other authors look over it, to spot and correct grammatical errors. Unfortunately, there were a lot of these, as some of the detailed line by line comments below show.

We have now gone through and corrected any instances of grammatical errors that we could find.

Detailed line by line comments

14. we map 1890 channels (to keep tenses consistent). Amended.

35. repetition of word 'rapidly'. Amended.

48 could say 'with potential to impact the suspended...'. Amended.

54-5. Better English would be "...which has implications for subglacial water pressure, the onset of subglacial channelisation and, in turn, ice motion.". Amended.

72. Better to say "...to have a larger debris cover..." or "...to have a larger coverage of debris". Amended.

81/82. "...high concentrations of channels correlate with ..." or "high concentrations of channels appear to be correlated with...". Amended.

91. Discharge is a rate so should say "discharge is a strong control..." [or "volume flow rates are..."]. Amended.

104. '...from glaciers...' plural! Amended.

105-6. "... determining the extent to which surface hydrological characteristics (e.g., channel, channel transport pathways) are uniform between" would be less ambiguous. Amended.

120. "...comparable with Switzerland's as a whole" [Add the apostrophe - it is not comparable with the size of Switzerland!]. Amended.

121. "...and varying crevasse densities..." Amended.

130. "found to contain" => 'containing'. Amended.

175. "has been found to be" => "is". Amended.

There are loads of examples of the above throughout your paper. Do a search for all the words 'found' and see if you can get rid of all the extra words. Amended.

191 remove ref to 'Canton' as you've already established that Valais is a canton. Amended – we have removed 'Canton' in a few places where it is not needed but have kept 'Canton' in for the Abstract, Introduction, Study Area, and for the first mention of it in the Conclusion.

205. delete 'width' or 'wide'. Amended.

217 'was assigned a code based...'. Amended.

218 'The type of channel terminus..'. Amended.

232 "...mapping had been repeated...". Amended.

233 "small enough for us to conclude that the original mapping provided a...". Amended.

234 – add "...and total channel length" to the end of the sentence. Amended.

234-5 "Both sets of mapping also clearly identified how the channels terminate. The primary source of uncertainty here, stems from knowing when to stop mapping up-channel.". Amended.

239. "found to contain" => "that contained". Also, shouldn't you replace "85" with "the" as the number of glaciers with channels is reported as a result on line 280? Amended.

248 "had been used". Amended.

260. Need a colon after 'three classes'. Amended.

263-275. There is a mix of present and past tense throughout this paragraph. Amended.

279 '...glaciers that had an area...' would be less ambiguous. Amended.

280 delete 'were found to'. Amended.

302-3. "and inclusive of the higher one". Amended.

306-314. "Glaciers without large channels (>0.5 m) are more likely to terminate at higher elevations (mean minimum elevation: 2936 m) compared to glaciers with channels (mean minimum elevation: 2797 m), which are often characterised by longer valley glacier tongues. Where glaciers support channels, they are more likely to have a higher maximum elevation (mean max elevation: 3637 m) than glaciers without large channels (mean max elevation: 3555 m). Where channels >0.5 m are present, there is a mean drainage density of 2.4 km/km² and a maximum of 15.2 km/km². The latter was found on the Oberer Theodulgletscher, which is situated on a low slope plateau and has the lowest glacier slope angle in the dataset (13°) (Fig. 3c, Fig. 4a). To summarise, glaciers containing channels are larger, have lower mean slopes, and have a larger portion of their area at lower elevations compared to glaciers without large channels (>0.5 m)." [149 words]

could be improved and shortened to:

"Compared to glaciers without channels, glaciers with channels are more likely to have longer tongues that terminate at lower elevations (mean minimum elevation = 2797 m vs. 2936 m) and have higher maximum elevations (mean max elevation = 3637 m vs. 3555 m). Glaciers with channels have drainage densities ranging between 2.4 km/km² and 15.2 km/km². The latter was found on Oberer Theodulgletscher, which has the lowest glacier slope angle in the dataset (13°) (Fig. 3c, Fig. 4a)." [78 words].

This is just one example of where a verbose writing style could be made more succinct.

Amended – we have taken this suggestion on board with some minor alterations to ensure that the minimum and mean drainage densities are not confused.

317. should say 'top right'. In the Figure, is it possible to remove the white 'gap' in the top right part of (a)? Amended – the white gap related to the edge of the Swiss WMTS layer. We have filled this gap with a colour that is less noticeable.

326. Grammatical problems. This would be better: "Few segments exceed 1,600 m, as the ablation areas of most glaciers are smaller than this." Amended.

328 "~~observed~~". Amended.

340-3. This sentence still needs work. It's not quite right. Amended.

345-6. Wouldn't this be better for this entire sentence: "Qualitative observations suggest that channel distribution and morphology are controlled by glacier structure and topography." Amended.

350 'low' not 'lower'. Amended.

353. This title should come above the previous paragraph as that previous paragraph is exactly on this topic! Amended by changing the following suggestion.

354. This sentence does not capture what this section is about. You're not only investigating links between channel characteristics but also the glacier controls on the channel characteristics. Suggest you adjust the section heading and this sentence so that they match what is being done here. Amended.

359. I'd say 'shallow slopes' as 'lower slopes' could imply slopes at a lower elevation (i.e. opposite of upper slopes). Amended.

362. "lowest slope angles" => 'shallowest slopes'. Amended.

366 I assume this should say 'ice' not 'glaciers'. Amended.

372. 'higher-order channel' not '...channels' 377 'each of which is' singular! Amended.

394-5. Correct the grammar here. Amended.

399. I think Principal Component Analysis should strictly be capitalised (as you've done on lines 424-5). Amended.

404 delete "identified to be". Amended.

435. You need at least a semicolon between "variance" and "instead". Amended.

446-7. What do you mean "are likely to be" You know whether they are or not. Do you mean "tend to be" here? Amended.

451 Comma before 'which' Amended.

454. I'd put a comma after 'meltwater and before 'which'. End the sentence after 'channels' start a new sentence "Conversely, crevasses that have closed..." Amended.

478 and Figure 7. Do you mean 'inception' or do you mean 'interception'? The latter would

seem to make a lot more sense to me. "Inception" refers to the beginning or starting point of something, while "interception" means to stop or capture something that is moving or being passed. You say 'intercepted' on line 481 which seems correct. [Amended – we did mean interception.](#)

486-7 should say "location on a high elevation plateau". You can't say 'higher' as you don't explicitly state what you're comparing it with. Be careful of your use of comparative adjectives. [Amended.](#)

493-4. I'd delete this last sentence as it confuses things. You've already described the balance of glacier surface melt vs channel melt. [Amended.](#)

574 "compared to" => "and". [Amended.](#)

578 "seasonal variation in ice velocity" [or "summer speed up in ice velocity"]. [Amended.](#)

614 "observed to occur" => 'occurring'. [Amended.](#)

614 delete 'We find that' [Amended.](#)

616 Delete 'Our observations find that' [it should say "We find that" or "Our observations show that", but these and all similar phrases used throughout your paper are redundant]. [Amended.](#)

613-630. This discussion on the relationships between certain channel variables on the Valais glaciers (this study), vs. those on high Arctic glaciers reported by St Germain and Moorman and those on glaciers reported by Gulley et al (2009) [location not stated] is impossible for me to follow. I've read it through several times and cannot follow the logic. I'm not convinced the statements are logically connected. I'd encourage a rewrite of this whole paragraph. There is a confusion about what the evidence is supporting the statements. Is everything just based on correlation? This is not the same as causation of course. We need better distinction between correlation and causation and the latter should be linked to physical processes. Line 614 states that slope affects sinuosity which implies causation. You say that wider and more incised channels are more sinuous but where is the evidence for this? You don't measure width or incision. You say that such channels are likely to carry a higher discharge, but what is the evidence / logic / process base of this statement? You suggest it's because St G & M "attribute" higher sinuosity to higher discharge. But on what basis did they do that? All this from lines 614-619 seems poorly reasoned.

Then you state that St G & M find a positive association between channel slope and sinuosity for glaciers in the Arctic. But this is not observed for the temperate glaciers in your study. So, state what is observed. From Fig 5 it's a moderate -ve correlation, right? OK, so we have a discrepancy which needs explaining. Then you state that steeper channel slopes increase channel incision and ref Gulley et al. You should tell us that that study was also for glaciers in the Arctic. On what basis did Gulley et al reach that conclusion? Was it also correlation analysis like you've done? Then you refer to a positive relationship in your study between incision and sinuosity. But where is the evidence for this? Incision is not one of the variables you define in your correlation matrix. So this is just anecdotal evidence, correct? I don't think you can make any meaningful statements about relationships involving incision when you don't show any evidence for incision. On line 624 you state "These channels are likely to continue to evolve inter-annually due to their incised depth." But where is the evidence or what is the process base for this? And how is a statement about what may or may not happen in the future relevant to the discussion here, which is about explaining the present day relationships between channel variables? Then you state "Given this...the relationship between slope and sinuosity represents the conditions under which large channels can form (i.e., flatter, less crevassed regions) rather than the direct impact that slope has on sinuosity." But what do you mean by this? I can't work out how you would

logically deduce that from the previous statements.

Amended – we have rewritten section 5.2. In the rewrite, we have focused on describing our data and then hypothesise reasons for the discrepancy between our data and what St Germain & Moorman (2019) find in the Arctic. We also removed the paragraph focusing on channels on debris-covered glaciers and integrated it with information from the first paragraph. This has helped to streamline the content of paragraph 2 within this section.

651. What do you mean by ‘appearance’ here? Can you just loose that word as the subsequent discussion seems to be about sinuosity only. *Amended.*

652-654. The statement here “Channels that have a proximal debris source and those that run directly through debris cover tend to be more sinuous than channels on clean ice (Fig. 5c)” contradicts the statement in the results on lines 365-8 where you say “We find no noticeable difference in sinuosity between channels on bare ice and those on debris-covered glaciers (Fig. 5c). However, channels proximal to debris ...are more likely to be highly sinuous than channels on bare ice or continuous debris cover”. Which statement is correct?

Amended – both are technically correct; it was just poorly worded. What we were trying to convey is that channels on debris-free ice are slightly less sinuous than those on more continuous debris cover. However, a notable increase in sinuosity is observed for channels in areas with patchy debris cover compared to channels on debris-free ice and continuous debris cover.

654-6. I cannot reconcile this sentence with what is shown in Fig 4d. The sentence states that Fig 4d shows channels on clean glaciers but the non-sinuuous channel in Fig 4d is on the same glacier as the sinuous channel. Are you talking about the two sides of the glacier tongue here?

The straight channel on this glacier is still on a thin strip of exposed ice, confined by debris, rather than flowing directly through debris-cover, which is happening for the channel on the right. However, we have removed this paragraph to avoid unnecessary information and instead integrated some mention of debris cover into the paragraph above.

658-9. This sentence isn’t quite right. It is not the less sinuous channels that are funnelled through areas of bare ice. It is the water that would be funnelled. Or you could say the channels become straighter as they pass through the clean ice area. I don’t see what your explanation for this finding is. Is it to do with the debris cover or is it just to do with the slope? If the clean ice zones of debris-covered glaciers have steeper slopes, then would this create the straighter channels? Or is it from the paragraph 613-30 that you’re ruling out a slope control on sinuosity?

Amended – we have removed this paragraph and integrated key information within the paragraph above.

659-666. This reads like a literature review of previous work. Can you better explain how this work is relevant to your results? Can the processes that are implied with reference to the previous work explain any of your findings relating to the slopes and sinuosity relationships on glaciers or parts of glaciers with different amounts of debris?

Amended – this section has been rewritten.

666-668. This sentence doesn’t seem relevant here. It reads as though it should go in the introduction of a different paper justifying why it’d be useful to assess the effect of debris within supraglacial channels on channel morphometry (which you don’t do in this paper). Or it could go in a future work section of this paper.

Amended – we have removed these sentences.

668-671 doesn't seem relevant at all – I'd personally delete this.

Amended – these sentences have been removed from this paragraph and are now briefly mentioned in the second paragraph of section 5.3.

672-5. You say 'further insight' but further insight into what exactly? How is this sentence relevant to your work?

Amended – we have removed these sentences.

675-677. Could the sentence on lines 666-668 be merged with this and better articulated if you want to end this section with recommendations for future work that stem from the discussion about controls on channel morphometry?

Amended – we have removed these sentences.

714 You need to say "Previous research on surface channel morphology has..." [or some such]. Amended.

714. Just say 'ice sheets' not 'ice sheet settings'. Amended.

717. Need a full stop or semi-colon after 'environments'. Amended.

718. Grammar! Should say 'which are commonly observed'. Also, why not just say "observed on ice sheets"? Amended

718-720. You say 'some glaciers' but is this all but the large glaciers? This would seem logical given what you then say. By 'less interconnected' do you mean 'less dendritic'? You don't been less anastomosing I assume, which is what 'parallel networks' implies. It's just a question of scale as to whether drainage systems can be described as dendritic?

We mean that some glaciers contain large, interconnected networks that exhibit a traditional 'dendritic' pattern, whereas other glaciers contain channels that flow parallel to ice flow and do not merge into one larger channel. We hypothesize that these parallel channels form when there is not a large enough distance for these channels to coalesce or a structural influence. Hence, parallel channels may be more common on smaller glaciers, or in areas where channels don't form until close to the ice margin. We have now rewritten the sentence to provide extra clarity.

723. What are 'flow-stripes'? These have not been mentioned previously so you can't introduce them here in the discussion. Amended – this has been removed.

724 I'd say "both for Valais glaciers and for ice sheets" [note you could say 'Valais glaciers' throughout most parts of your paper to remove a few words and make the sentences flow faster]. Amended.

726-7 I'd say "between ice sheets and Valais glaciers, for example debris may...formation on the latter". Then delete the 'For example' on line 727. You say 'channel formation' here but do you mean that? Or do you mean channel morphology [or morphometry]? Amended.

729. You refer to Rippin et al here but surely you should refer to your work first (and then bring in others' work if it supports your argument)? Otherwise, this is just a literature review.

Amended – we have rewritten the first part of this paragraph, and we now introduce the Rippin paper a little later, after having discussed our work first.

730 You mean 'surface channels' not 'surface melt' here. Your paper is not about melt. Amended.

731 delete 'are observed to'. Amended.

735. If you want a reference for the notion that lakes temporarily store water you could refer to this: <https://tc.copernicus.org/articles/8/1149/2014/tc-8-1149-2014.html>

736. And if you want one for the notion that lakes may refreeze you could use this: <https://www.frontiersin.org/journals/earth-science/articles/10.3389/feart.2017.00058/full>

But actually, if you were to delete lines 734-740 I think your paper would be improved as it remains more focussed on your Valais glaciers.

Amended – we have removed lines 734 to 740.

744. What do you mean by 'will develop'? Delete? Amended.

746 'will depend on the rates of' Amended.

747 I'd say 'associated' not 'subsequent' as higher melt will cause ELA to increase but also through the albedo feedback ELA increase will cause higher melt rates. Amended.

751 should you say 'and a reduction in drainage density'? Not 'or'. Because the example you give of drainage reconfiguration would reduce drainage density. Amended.

756 need a comma after '...evolution' Amended.

757-8. Poor phrasing – you could end the sentence "...future studies should repeat our work in such regions" [or something along those lines]. Actually, your statement isn't quite correct as you do compare your findings to those of others in Arctic settings (St G & M; Gulley et al) although that paragraph did need improving. Amended.

760. Say 'on Valais glaciers'. Your previous sentence correctly noted that you can't necessarily extrapolate from the channels you delineate in your study to all mountain glaciers. Amended.

796 'found to contain' => containing'. Amended.

812. You could clarify that by terminating englacially you mean ending in a crevasse or moulin. Amended.

814 you refer to channels terminating supraglacially or englacially here. By supraglacially I assume you mean those that run off the glacier? Why not make that clear in the sentence above too? So, the sentence above would read:

"...have 80% of its channels run directly off the glacier (terminate supraglacially) while 20% would end in a crevasse or moulin (terminate englacially)." Would that make sense? It seems a little odd to refer to a channel that flows off the glacier as terminating supraglacially. Would 'proglacially' be better? Amended.

816. Refer to your Figure 7 at the end of this sentence. Delete the word 'observed' in the next. Amended.

816. Correct the English. Should say "differ from those in typical ice sheet..." [note plural therefore 'differs' not 'differ']. Amended.

818-20. Your final sentence is poorly articulated and could be stronger. This would be better, but you should decide. Amended – we have used the suggested sentence as it more clearly conveys the information.

"Compared to the GrIS, drainage networks on Valais glaciers are less developed due to smaller drainage areas and limited distance for channels to merge. Additionally, the down-glacier narrowing of the Valais glaciers further restricts the potential size of their drainage networks."

Reviewer 3 comments

The previous round of revisions by Wytiahlowsky and others has resulted in a much improved manuscript. The authors addressed my comments and concerns adequately and updated figures accordingly. I therefore only have a few comments, upon incorporation and in addressing the other reviewers I would recommend the manuscript for publication in The Cryosphere.

L56-57: Here the authors state that remote sensing techniques have not been applied to mountain environments because of the small channel sizes there, but this is not supported adequately, how big are the channels typically found on mountain glaciers? This should be stated and references given. Currently only satellite resolutions are given which does not mean much if the size of the streams are not given as well.

We do not provide citations or state the size range of channels on mountain glaciers simply because there is a lack of research to provide us with a good figure. The introduction notes this uncertainty as we state "...the majority of channels are **likely** to be... below the resolution of the highest resolution freely-available satellite platforms". Hence, the benefit of this study is that we provide the first large-scale characterization of channels on mountain glaciers.

Previous studies that have documented channels on mountain glaciers are largely focused on a single glacier in higher latitudes (e.g., Norway), hence we cannot confidently provide a quantification of channel size in the introduction.

L57-59: Why would the principles that govern channel formation be different on alpine glaciers than on ice sheets just because large satellite imagery studies have not been conducted? As the authors state, the foundation of glaciology and glacial hydrology was preformed on alpine glaciers, and the mechanisms for supraglacial stream formation are quite well known. Furthermore, I don't think this study is investigating channel inception, rather, channel distribution in different environments (as stated in the following paragraph). This should be revised before publication.

Amended - we agree with the reviewer that this sentence does not best reflect the contributions of this paper and have changed it to state that we do not know whether the characteristics and distribution of channels on ice sheets are comparable to mountain glaciers. We have also provided more reasons why channel characteristics and distribution might differ between ice sheets and mountain glaciers.

L392: What was the size of the ablation area for these large glaciers that had supraglacial streams? Stream presence should be a function of ablation area size, this could be a linear function but should be supported in the text.

Figure 6 shows that there is not a simple linear relationship between ablation area size and drainage density. Our calculations use the snow-free area (i.e. the ablation area at the time of image acquisition) rather than the entire glacier area throughout (see section 3.2) to reflect the area available for channel formation, which likely closely resembles the size of the ablation area. In fact, glacier mean elevation ($\rho = -0.66$, $p = \leq 0.001$) and glacier slope appear to be stronger controls on channel density ($\rho = -0.46$, $p = \leq 0.001$). Hence, a large ablation area

might not contain a high density of channels if the glacier surface is steep (increased meltwater interception from crevasses) or if much of its area is at higher elevations (less surface melt) (see sections 4.4. and 5.1).

L401-402: What was the duration of the melt season in 2020? Another reviewer commended on this but the timing of imagery acquisition within the melt season should be addressed in the manuscript.

We only have monthly temperature data so our ability to provide detailed information on the exact duration of the melt season is limited. However, the average temperature is $> 0^{\circ}\text{C}$ from April to September in 2020 so we have added this information into the methods (section 3.1). This section now provides a better overview of the climatic conditions that affected glaciers in Valais in 2020 (snow cover, temperature, and melt season duration).

L469: The authors addressed my previous comments by adding this text explaining how crevasses can exist while water filled. [Thank you.](#)

L568: the results of this paper do not directly explore how supraglacial drainage networks will change under future warming, consider rephrasing this sentence to as to not imply this is a direct consequence of the work by using “may” or something similar. [Amended – we have changed ‘will’ to ‘may’ to clarify that this statement is speculative.](#)

Minor comments

Figure 1: Does the glacier in panel b have a name? [Amended – the glacier name \(Glacier de Corbassière\) has been added.](#)

Figure 2: The addition of the entire glacier outlines look great. The figure would benefit from an indication of channel flow direction, particularly in areas where the channels deviate from glacier flow direction (particularly in panel e). [Amended – We assume that this refers to figure 4, and water flow direction is now indicated on the figure by small blue arrows. In one instance, the water flow direction is unclear from the DEM and flow direction raster, so we have added a question mark here to avoid overinterpretation.](#)

Fig 8: What is the elevation and coordinates for this photo? An inset like on Figure 2 would be helpful. [Amended – we have added a panel on Figure 8 that shows where the main figure is located on the Oberer Theodulgletscher to provide more context.](#)

L403: The rationale for this statement should be appended to the end of this sentence. [Amended.](#)

L404: state the value for drainage density here.

[This paragraph speculates how drainage density is likely to vary between glacier types; hence, we do not provide values for drainage densities. Additionally, this sentence mentions cirque-type glaciers, for which including a value might be misleading because we have little understanding of their surface hydrology. This is because most of their channels are likely to fall below the resolution of our mapping.](#)

L423: a citation should be added here. [This sentence hypothesises the effect that climatic warming will have on channel formation/density, which has not been researched outside of the GrIS \(e.g., Leeson et al. 2015\). Hence, we do not include a citation because we have no definitive answer, but we do include a citation \(Marston, 1983\) in the previous sentence which states how channels form \(i.e., incision vs surface lowering\) which provides the basis for our speculation.](#)

L436: change “is also likely to” to “will likely”. [Amended.](#)

L440: I would suggested adding a citation to Mejia et al., 2022 (GRL), while this work focuses in Greenland it provides direct observations of delays/prolonged supraglacial/englacial/subglacial residence time when supraglacial streams are routed en/subglacially.

We have added a reference to this sentence that discusses the storage of meltwater within glacial systems, but have instead chosen a reference that refers to mountain glaciers (Clason et al., 2015), which is more comparable to Valais glaciers.

L441: change “glacial system” to “glacial drainage systems”. Amended.

L443: comma auger supraglacially. Amended.

L454: do you mean the peak has a lower amplitude? Amended – the sentence has been made clearer to note that we mean lower amplitude.

L458: change positions to “drainage systems”. Amended.

L460: location-> presence. Amended.

L484: If there are sediment laden beds there, this should be said so explicitly and cited. This sentence refers to a study that has modelled the excavation rates of subglacial sediment from beneath a glacier, hence we do not have observations to support this from our dataset. We instead use this study to theorise the effect that channel termini locations have on the amount of subglacially derived sediment entering into proglacial rivers.

L548: what is a flow stripe? A medial moraine? A flow-stripe (or longitudinal foliation) is an elongated structure on the glacier surface formed by ice flow and has different mechanisms of formation to a medial moraine. We have now removed this example as it was mentioned in relation to the Chen et al. (2024) paper but is confusing as it is not a feature we note elsewhere in the paper.

L562: consider adding citations to Andrews et al., 2018 and Mejia et al., 2021. We have removed this section following a suggestion to improve the focus of the paper.

Andrews, L. C., Hoffman, M. J., Neumann, T. A., Catania, G. A., Lüthi, M. P., Hawley, R. L., Schild, K. M., Ryser, C., & Morriss, B. F. (2018). Seasonal Evolution of the Subglacial Hydrologic System Modified by Supraglacial Lake Drainage in Western Greenland. *Journal of Geophysical Research : Earth Surface*, 123(6), 1479–1496.
<https://doi.org/10.1029/2017JF004585>

Mejia, J. Z., Gulley, J. D., Trunz, C., Covington, M. D., Bartholomaeus, T. C., Xie, S., & Dixon, T. H. (2021). Isolated Cavities Dominate Greenland Ice Sheet Dynamic Response to Lake Drainage. *Geophysical Research Letters*, 48(19). <https://doi.org/10.1029/2021GL094762>

Mejia, J. Z., Gulley, J., Trunz, C., Covington, M. D., Bartholomaeus, T. C., Breithaupt, C. I., Xie, S., & Dixon, T. H. (2022). Moulin density controls the timing of peak pressurization within the Greenland Ice Sheet’s subglacial drainage system. *Geophysical Research Letters*, 49, 1–13.
<https://doi.org/https://doi.org/10.1002/essoar.10511864.1>