

Dear Editor,

We thank Reviewer 1 for their detailed comments. This last round of edits has helped with many details in the manuscript.

The reviewer's comments are in bold, our response is in normal font and quotations from the new text are in italic font.

Best regards,

Ian Delaney on behalf of all authors

General Comments

The revised manuscript is improved and, while the multivariate nature of the analysis prevents the main findings from being expressed as clearly and succinctly as I would consider ideal, I have no substantial issues. As well as a few very minor comments below, I have two more general suggestions.

- **First, many of the Figures still need attention in terms of consistent font and case, use of colours (especially font on a coloured background), and accurate and consistent labelling and captioning.**

This comment point to the careful and detailed examination by the reviewer and we are very grateful for this. In addition to making the changes detailed below in the specific comments, we have carefully examined each of the figures to ensure they are consistent and match the text and caption.

- **Second, the point made in lines 17 – 19 of the Abstract is still a bit bland. If possible, I would rather make an explicit point that (since sediment transport capacity and competence are more variable, and therefore include higher peaks, for a given discharge in subglacial settings) former subglacial discharge reconstructed from the texture of remnant 'flood' deposits may well be far too high. Perhaps this could even be quantified and presented as a headline figure (peak tau is 1M higher in ICESHEET subglacial than subaerial in Fig. 2g, no?). Or just note this as 'For example...'**

We thank the reviewer for this comment. While we understand and are very grateful for the reviewer's recommendations, we have only slightly modified the text by removing the referenced lines and changing the following sentence. *The implications of these findings help to evaluate sediment discharge from glaciers with different hydro-climatic forcings and establish sources of variability in the sediment export-water discharge relationships.* The implications of this study could be used to interpret sediment transport during flooding events, as proposed by the reviewer. However, we are hesitant to mention this directly in the abstract as it remains uncertain if such deposits would be indicative of subaerial sediment transport conditions once the water leaves the glacier or subglacial ones.

In response to the part of the comment referring to larger difference in subglacial compared to subaerial sediment transport capacity, we have added the following sentence to the second to last paragraph of Section 6.2. *In addition to greater variability, larger sediment transport capacity in subglacial systems compared to subaerial ones (Figure 2) could cause sediment deposition at the glacier margin in the transition from pressurized to open channel flow (Perolo et al., 2018; Mancini et al., 2023; Delaney et al., 2024).*

Specific Comments

- **Fig 1** Fill and font colours don't work very well; axis legend capitalization is inconsistent with elsewhere

variables in black remain constant with short variations in water discharge, where as variables in color change.

- **Fig. 1 caption** 'Sketch of...'

Done.

- **57** 'Yet, continually evolving channel size can...' Incidentally, I'd check all uses of 'evolve/evolving' through the ms and look to replace some with 'change/changing' (e.g., I would use changing here [and e.g., line 154]).

The matter is fixed. We have kept all references to "evolving channel size" in the text given the rational in the previous version, whereby channel size depend on antecedent conditions (i.e. Equation 3). However, other uses of "evolving" have been changed.

- **95** I would replace 'upon' with 'on'. Check elsewhere too.

We believe that the use of "upon" here is appropriate.

- **109** Italicise 'n'?

Done.

- **136** Delete 'the' (twice) as both are names/proper nouns.

Done.

- **139** Delete 'thickness'

Done.

- **Fig. 2 caption** Last line doesn't make sense (but the grey band along e – h does need explanation).

Done. We have also removed the gray bands associated with the heatwave.

- **205** '...occurs because diurnal...'. In fact, I think I'd combine to "...increase in correlation (Figure 4), reflecting the reduced diurnal variability"

The text now reads:

Smoothing water discharge over periods longer than one day causes a substantial increase in rank correlation (Figure 4), removing diurnal variations (Figures S1-S14). Even with the variations removed, correlations in sediment transport characteristics in ICESHEET remain higher than ALPINE, which has more water discharge variations even when smoothed compared to ICESHEET (Figure S1-S14).

- **Fig. 3** Axis legend capitalization

Done.

- **Fig. 3 caption** 'Relationships between...' Also, insert a space between '15' and 'min' Y axis I'd note that the axis is logarithmic (here and elsewhere). The issue arises because there are no intermediate ticks here and only two major markers so the reader does not know whether the axis scale is normal or log. Maybe just insert minor tick marks (as is done, albeit variably, elsewhere).

We have addressed the first two comments. However, the Y-axis is normal scale, not log, so we do not see the issue.

- **208-9** This sentence is really difficult to follow...

Text now reads *The second numerical experiment aims to compare the variability between the subglacial and subaerial sediment transport capacities. To do this, model outputs from both systems are forced with a range of channel shapes, friction factors, and water discharge variability.*

- **212** '... higher ... than...' (not '... higher ... compared to...' (elsewhere too)

Done.

- **Figure 5** There are 9 dots on each plot but only 8 values noted in the caption (2 d missing from the latter?) Comma missing after '6 hr' in the caption too.

Thank you for the careful read. the 2 d period was missing. Comma added.

- **226** '... shear stress, which can...'

Done.

- **227** '... stress, but...'

Done.

- **Figure 6 caption** I'm pretty sure 'left' and 'right' are the wrong way around here... Also, '... show the range...'

Done.

- **321** '... transport capacity and water discharge...'

Done.

- **330** 'The last of these can remain relatively stable over years...'

Done.

- **333** '... likely largely represents...' (?)

Done.

- **362-3** '... melt is too short for the channel to reach steady state' needs rewriting. Maybe '... when high-frequency variability in melt rate is too great for...'

Changed to: *especially during severe rain or melt where melt water input timescales are too*

- **366** 'Thus, fluctuations in discharge...'

Done.

- **369** '... these variations in sediment transport capacity are far larger than those...'

Done.

- **374** '... or the threshold at which...'

Done.

- **287** Delete 'exists'

Done.

- **389** Replace 'as' with 'because'

Done.

- **400** Replace ‘its’ with ‘channel’

Done.

- **406 and 417** I’d remove reference to objectives and begin with ‘We established the conditions under which...’ etc

Given the explicit statement of goals and objectives in the introduction, we would like to keep this reference to the objectives of the study.

- **408** ‘... and an ice sheet...’

Done.

- **410** ‘... a variable relationship exists between water discharge and ...’

Done.

- **411** I’d delete ‘potentially’

Done.

- **412** ‘... even when those records are smoothed...’

Done.

- **418** It is not clear what variables are higher than what else.

Done.

- **420** ‘... variations, as in the...’

Done.

References

- Delaney, I., Werder, M., Felix, D., Albayrak, I., Boes, R., and Farinotti, D. (2024). Controls on Sediment Transport From a Glacierized Catchment in the Swiss Alps Established Through Inverse Modeling of Geomorphic Processes. *Water Resources Research*, 60(4):e2023WR035589.
- Mancini, D., Dietze, M., Müller, T., Jenkin, M., Miesen, F., Roncoroni, M., Nicholas, A., and Lane, S. (2023). Filtering of the Signal of Sediment Export From a Glacier by Its Proglacial Forefield. *Geophysical Research Letters*, 50(21):e2023GL106082. e2023GL106082 2023GL106082.
- Perolo, P., Bakker, M., Gabbud, C., Moradi, G., Rennie, C., and Lane, S. (2018). Subglacial sediment production and snout marginal ice uplift during the late ablation season of a temperate valley glacier. *Earth Surface Processes and Landforms*, 0:1–68.