

Main points

This is an interesting and well put-together study. It presents some interesting insights into supraglacial drainage networks on a large number of Swiss glaciers, which must be one of the first such studies that takes advantage of modern remote sensing/photogrammetric approaches. Supraglacial drainage networks on the Greenland Ice Sheet are a popular focus of research, but such networks on valley glaciers are understudied. I thus welcome the efforts of this paper. I would also like to congratulate the authors on their attention to detail. I think I came across just one typo throughout, and the formatting, presentation, writing style and all other such aspects are top class. I very much appreciate the care taken to ensure this. It makes the job of reviewers much easier, and indeed makes the work far more accessible to a readership.

Whilst I see value in the paper and welcome the efforts of the authors, I do have some concerns as follows:

- 1) One of the key issues I have is that I am not 100% certain of the broader aims of the work. The authors very clearly state on lines 91-92 that our ‘aim is to characterise the morphometry of supraglacial channels on mountain glaciers, providing insight into where and why they form’. Whilst this is clear, I would like the authors to go further, and say why this matters – why, glaciologically speaking, should we be doing this? Why is it important for us to gain these new insights? I suspect the authors can address this relatively easily, but I would like to see clear statement as to the value of this work. It’s worth saying that I think a lot of text that could contribute to such a statement already exists in the Introduction, so it’s just a matter of coalescing the key points.
- 2) Perhaps my main concerns are about the subjectivity of the mapping of channels, and the assumption that not seeing channels of a certain size means there are no channels. I don’t believe this is correct. I believe that the approach is more about resolution rather than presence. I go into some detail in my line-by-line comments below, and indeed the authors themselves actually raise this in the very last sentence of the paper! However, I believe this deserves more attention. Please see my comments below.
- 3) Another key concern is about the timing of the analysis. The imagery for the analysis was gathered in the early part of the summer. Lower altitude glaciers in early summer will have more melt and thus more channels than those at higher altitude. This could be the main or even sole driver of the differences observed in channel density. I believe it is dangerous to use a single snapshot in time, particularly when it is this early in the melt season, to assess overall drainage density. I appreciate that the authors are constrained by data availability, but this is an important point that needs careful consideration.

I have a significant number of other comments which I relate to specific locations in the text. These are detailed below.

Line-by-line comments.

Line	Issue
13	It seems odd to state that your investigations explore '<2000 supraglacial channels'. This seems rather vague to me. '<2000 could mean anything from 1 to 1999. Can you be a bit more precise? Are you looking at a few tens, a few hundreds or nearly 2000?
13	I must confess to being quite surprised that only 85 of your studied 285 glaciers have supraglacial channels. What time of year did you carry out your investigations, since I think this would be significant.
34	You state here that glaciers and ice caps 'are anticipated to contribute to sea level rise throughout the 21st century and beyond'. It would be worth stating that they have indeed already been contributing too.
90	With reference to my point above, here you mention that you create an inventory of 'almost 2000 supraglacial channels'. This is a much clearer indication of the numbers involved than the <2000 referred to previously.
162	I'm pretty astonished by the manual effort that must have gone into mapping these channels. This is an impressive feat, so very well done! However, I have a couple of concerns. Firstly, how did you assess and quantify the accuracy of your manual approach? The channels you indicate as being mapped in Figure 2 are quite clear and relatively straightforward to delineate and map I would imagine. However, I would guess that some of the images you were using were less clear and the channels less well-defined. In such circumstances I suspect there's a degree of uncertainty and error in your mapping. How do you quantify this, and can you put some numbers on this?
Figure 2	Following on from the point above, and particularly relating Figure 2, I am curious about how you determine what to include in your delineation. I can definitely identify several channels in part (a) that you do not choose to delineate in part (b). This causes me concern, since it suggests an (inevitable) degree of subjectivity is integral in this study, and there are clear consequences of this when it comes to considering metrics such as drainage density. Some of the channels not mapped by the authors are only just visible as they are quite fine and thus presumably smaller (in parts (c) and (d) for example, there are numerous very small channels, which would be very hard to map, but are worth being aware of). As a result, there is, I guess, a size-threshold element as to which channels are included. However, to me, there are some channels that I would consider to be of similar size (and clarity) to those which have been delineated but which the authors have chosen not to map. I think this issue is of considerable concern, and needs consideration and arguably, more channels need mapping.
218	This concept of the mapping resolution and the fact that you are mapping channels above this threshold, is important. However, in the imagery, it looks to me that there are hazy, grey areas which most likely indicate a dense network of small channels. Whilst you can't map these individually, they are areas of channels and so I wonder if this needs to be considered (particularly in your drainage density calculations).
219	As a consequence of the threshold mapping resolution, I am uneasy about this differentiation between glaciers with and without channels. More accurately, those without are simply those without channels above the threshold mapping resolution. It seems likely to me that they do have supraglacial water flowing in channels, but these are in smaller networks that are not easily identifiable as discrete channels.
221	I am concerned about the observation that all glaciers above 5.6km ² have channels, and the insights being drawn about bigger glaciers having channels. Could it not be simply that bigger glaciers have bigger channels while smaller glaciers have smaller channels. As a result, we don't see the smaller channels as easily (due to the image resolution), and so are swayed into seeing these as lacking channels?

231	I've said it previously, but I am very concerned about the distinction that is being made between glaciers where channels are/aren't present. It's about resolution and not presence to my mind. If glaciers experience melt, unless all surface water immediately enters the englacial region of a glacier, there must be some surface water and to my mind, this must (at least in part) be in the form of channels. I think the distinction is between the size of the channels and not their presence. I would also argue that given your imagery was gathered in mid-July, it is highly likely that the amount of generated melt is not at its maximum, particularly on glaciers at higher elevation. The impact of altitude could be fundamental, since at this point in the melt season, glaciers at lower elevation may well have much more melt occurring than those at higher elevations. This may thus be the driver of there being more, larger, and denser channels on these lower elevation glaciers.
255	It is a little odd that some channels disappear 'below the mapping resolution'. I am assuming you mean that they disappear as they head downglacier, since the phraseology of the various ways channels terminate in this passage implies this. However, I would have imagined that as channels flow downslope, they get bigger (as they carry more water) rather than disappearing under the threshold resolution for mapping.
266	I'm a little uneasy about the statement: 'large channels often occur at the interface between debris-covered and bare ice'. Firstly, what do you mean by 'large'? Do you mean in terms of diameter or length, and what criteria do you use to designate a channel as large? Furthermore, this seems to be quite a significant statement. Like your other metrics, you should quantify this – what proportion occur at such a boundary? Does the statement really hold true, when the channels in Figures 4a, c, d and e do not seem to be controlled by debris presence, and nor do those in Figure 2.
278	In drawing conclusions about the relationship between, for example, sinuosity and slope, I think you need to express some measure of statistical significance so that we know whether these relationships are real.
300-306	I am very uneasy about the statements made here. To simply state, for example, that 'a relationship between drainage density and glacier slope exists' needs statistical support. Looking at the graphs in Figure 5 (particularly e, f and g), I do not see a strong relationship, and so to back up your statements, you need to use some statistics to prove your point.
308	I am not a statistician at all, so can't offer a lot of insight here. However, you make several statements prior to this point regarding relationships in your data, yet it is only here, towards the end of your results, that you directly address statistical relationships. I wonder if things need reordering slightly.
313-314	I come back to my concern raised above, that the relationship between drainage density and glacier altitude. I don't think this is surprising, particularly given the timing of the imagery used to explore drainage density. I feel that this is likely to be the most significant control.
359-360	Whilst I rather like the schematics you provide in Figure 7, there is a degree of conjecture here, particularly in relation to the proposed hydrographs. I'd like it to be made clearer that these are not measured or calculated at all, but rather assumed. Even then, I am wary of them, since in reality, these hydrographs and their shape are strongly influenced by time of year, air temperatures, ease and speed with which channels are formed, diurnal temperature range etc.
369-371	Interesting point, but I'd also point out that higher temperatures will mean more melt is generated and thus there's more water available to incise deeply.
391-393	Need a reference here to support the statement about lake drainage.

399-400	I am very wary of the statement: 'Our dataset provides new insight into meltwater transport across a large range of glaciers, allowing simple inferences to be made about connectivity and lag times'. Your data is all about channel mapping. Water transport and lag times are assumed based on this knowledge, so I would prefer that this is toned down a little.
411	One thing we can't tell is whether the channels you are mapping are currently active. So, it is possible that the crevasse identified in Figure 8 has appeared relatively recently, thus intersecting the channel shown, and halting the flow of water in this channel further downglacier. I don't know how likely this is, but it should at least be considered, alongside the proposed idea that the crevasse is water-filled and thus flowing water overtops it. Without fieldwork observation, we are both speculating, so due caution in the interpretation needs to be exercised.
416-417	Similar to the previous comments, I am wary of the statement: 'the delay between surface melt and proglacial discharge will be larger due to longer pathways and the potential for supraglacial and subglacial storage'. This is true, IF storage takes place. However, you don't know if this is the case. There could be highly efficient englacial/subglacial channels. Again, I think that it needs to be made clearer that these are suggestions rather than based on direct observations.
448	Throughout, you make reference to 'larger' channels, but this is never quantified. What do you mean by larger? Here, for the first time (I think) you indicate that by 'larger' you mean higher discharge. Is this what you have meant throughout? This needs making clear since to me, I had assumed you meant the physical dimensions of the channels. Regardless of what 'larger' means, I do think you need to quantify the criteria somewhat.
480-512	I'm not convinced of the need for this section comparing supraglacial drainage on glaciers and ice-sheets. I feel that the paper is drifting away from its focus a little by including this passage. I'm not suggesting that this section MUST be removed, but rather simply suggesting that its value to the wider paper is not terribly clear, and thus this could be considered.
518-519	Presumably you mean an increase in the SIZE of the ablation area, but when referring to a 'reduction in area for smaller glaciers' you are referring to the entire glacier rather than the ablation area? A bit of clarity needed here.
545	'off the glacier' rather than 'of the glacier'.
557-560	This last statement is the first such mention of the existence of other channels beneath the mapping resolution. I believe this is important (see my earlier comments) and so for it to only appear as the final sentence in the conclusions is rather late. I would prefer to see this discussed earlier, and the importance considered more.