Response to Reviewer 1

Wytiahlowsky et al. present an extensive analysis of supraglacial channel characteristics for 285 glaciers within the Calais Canton, Switzerland. They manually delineated channels from high-resolution (0.15 m) orthophotos and use these delineations to perform their analysis which included investigating channel characteristics and its relationship to glacier properties. I found the manuscript to be well written and in general easy to follow, with clear and appropriate methodology to support the results and conclusions presented in the manuscript. While supraglacial channel analysis is not necessarily new, the number of channels and individual glaciers characterized in this study is impressive and allows for the understanding of supraglacial hydrology on a regional scale, which is very exciting for the field of glacial hydrology. The results of this work contribute to furthering the scientific understanding of supraglacial hydrology on alpine glaciers while also acting as a point of comparison for future studies of supraglacial channel formation in other alpine environments. My opinion is that this manuscript is suitable for publication in The Cryosphere. Below I have included some general and specific comments for the authors to review. We thank the reviewer for their constructive and encouraging comments and are delighted that they deem our manuscript suitable for publication. We address each point in turn below, with our responses indicated in blue text.

General Comments

-Figure 1: The manuscript would benefit from a overview of the glaciers within the Valais Canton. Currently, a lot of space is used to show the region that is not the study area. I would suggest to highlight the values area (as in panel a) but within a smaller area, then use a majority of the space to delineate and show all of the glaciers in the region (currently indicated by blue). A full view of all the glaciers in the area would allow the authors to then color-code them as (1) glaciers too small to be considered in this study <1km^2 (maybe white or gray to denote they are being excluded or alternatively leave them out due to the small size if they are not visible at the scale chosen), (2) glaciers without channels, and (3) glaciers with channels. Panel B does a good job in showing the large Alestsch glacier, however the debris cover is hard to see in panel C. This may be an artifact of the low-resolution of background imagery for figure 1 in the version of the manuscript submitted for review (I understand .png are often submitted early whereas .pdfs are instead used in the final version, if this is the case this last point can be ignored and I will assume the debris cover will be more apparent in the final version). Finally, if possible under the space limitations, it would be nice if some of the glaciers referenced in subsequent figures could be indicated in some way within Figure 1. This would make it easier to put specific glaciers into context when they are directly named later on in the manuscript. Amended – We have zoomed into Valais Canton on panel A and have colour coded the glaciers to show those with streams (>0.5 m), those without visible streams, those that are snow covered (omitted), and glaciers <0.1 km^2 (omitted). The imagery source has been updated for panels B and C which has increased the quality of the imagery.

-Figure 4. This is a great figure of the delineated channels, however, it would benefit from the inclusion of insets (or sub panels) that include the entire glacier overlaid elevation contours and annotated with the region with channels shown. By including both a glacier-wide view would help top put the streams into the glacier-wide context which is the focus of this work. Amended – We have added sub panels for each panel that show the location of the main panel on the glacier.

I am curious if glacier aspect has a relationship with channel formation. We have added in a sentence in section 4.3 to note that no relationship exists between aspect and drainage density (Kruskal-Wallis test: p = 0.61).

In referring to the two types of crevasses you see (ones that transport meltwater englacially vs. ones that redirect stream flow). The authors state that the crevasse fills with meltwater and overspills along the crevasse trace. This may be true as is seen in Greenland (e.g., Chudley et al., XXXX) but alternatively, the crevasses may have already advected shut, these old crevasses may then act as a preferential flow path as observed in Fig 8 (I see this frequently in Greenland). I would suggest elaborating on this process in the discussion, as a natural question that would arise would be why is the crevasse not hydrofracturing if it completely full of meltwater. While the answer would be the stress regime in such a case (it would suggest the crevasse is old, having advected into a compressional region). Altogether I feel this process deserves some added clarity within the discussion. Amended – We split the paragraph beginning on line 399 in the original version of the manuscript to enable us to expand on the influence of crevasses on meltwater routing.

Specific Comments

Comments regarding figures:

Fig 1: expand the description of the yellow start to include that it is a weather station. Amended – The legend has been relabelled to 'Weather station' and the station name is given in the methods.

Fig 2: Do the arrows indicate ice flow or water flow or both? Stating this in the caption would help clarify. Amended.

Fig 3: The x-axis labels are hard to see, I think all the font sizes in this figure need to be enlarged. The inclusion of the greater than/less than symbols in the x tick marks clutters the text making it even harder to read. I suggest instead including this information in the legend or using bracket notation. Amended – The font size has been increased, and we have changed the location of the x axis ticks to represent the range shown by each bar. We have clarified where we use equal to/greater than in the figure caption.

Figs 3 and 5: I am confused as to what the different colors represent, are they supposed to correspond to something? All of the different colors when one variable is being plotted is confusing. Particularly because different colors are being used in different figures. Note that this comment is only referring to Fig 3c-f, and Fig 5a,b,e-g. Amended – Plots that only show a single variable are now all the same colour.

Fig 5. Including an annotation to each of the subplots with the results from the spearman's rank analysis would be helpful here. Currently the reader has to go back and forth between figures 5 and 6 to interpret the data presented. The x-axis labels in 5d are very hard to read, I would suggest making these larger. Also, the outliers in panels c and d makes it difficult to see the differences between the box and whisker plots. Maybe consider excluding the outliers or a ρ djusting your subplot size/spacing so that the distribution is more clear, particularly in 4c and 5d. Amended – Spearman's correlation values have been added to Figure 5, and the y axis limit has been modified for the box plots.

Fi 7. This is a great figure, however, most of the the text in this figure is too small to read. Also, consider either making the ela dashed line bold or a different color (or both so it is easier to see). Amended – The text size has been increased, and the ELA line thickness has been doubled.

Fig 8: I would suggest adding arrows to indicate meltwater flow direction. Amended – Arrows have been added that indicate the meltwater flow direction, and this has been added into the caption.

Fig A2: all labels are too small to see. Amended.

Manuscript comments:

L63: Here you site WorldView-3 with a ~3.7m resolution, however, this is the short-wave infrared resolution, WorldView-3 has a 31cm panchromatic and a 1.24 m multispectral. Amended.

L127-137: There is a lot of information and numbers in this paragraph that becomes hard to follow, consider removing unnecessary information or making a figure or a table to accompany this information. Amended – We have edited this paragraph to remove some of the unnecessary detail.

L141-142: Explicitly state the channel width the method was successful on and then the channel size in this study area. Amended – we have added additional clarification.

L143: define the abbreviation NDWI_ice before use. Amended.

144: state that you are referring to multispectral here, WV-2 has a 46cm panchromatic resolution. Amended.

Paragraph starting on L332: Reference specific tables and figures within the appendix rather than the appendix as a whole. Amended.

L354: change "…crevassed area of a glacier, restricting the area" to "…crevassed area of a glacier which restricts the area…". As phrased it is unclear if your last clause is referencing the preceding clause or entirety of the sentence (which would not make sense), so I suggest removing the final clause for clarity. Amended.

L356: the end of this sentence is confusing as written. I suggest rephrasing the sentence to read something like "When crevasses are open they can intercept meltwater and…, crevasses that have closed modify small-scale surface topography and meltwater can be routed along the crevasse trace…" or something like that. Amended.

L357: The term "bottom-heavy hypsometries". Amended – Reworded to "a larger portion of their mass at lower elevations".

L316: I think this should be referencing Figure 5e. Amended.

L317: This figure reference may also be incorrect. Amended – this should read Fig. 4a.

L371: change to "in order for channels to form". Amended.

L381: change "/" to "and", also remove "on" in the phrase "on the runoff hydrograph". Amended.

L390: specify lag time here, a lag between what and what? Melt and peak proglacial discharge? If so, state that here. Amended – this has been changed to reflect that it refers to the lag time between melt and peak proglacial discharge.

L393: comma between large and low. Amended.

L394: Break into two sentences, ending the first at the word “melt”. Amended.

L400: Define lag times here as well. Amended.

L400: Here you refer to “main stem segments”, but earlier in the text you referred to stream order. I suggest being consistent with terminology. Amended.

L451: change “/“ to “or”. Amended.

L465: change “additionally” to “The”. Amended.

L467: do you mean on instead of “and” here? Amended.

L470-1: I am not sure if this is true, most debris-covered research has been done in the Himalaya with some in Alaska (e.g., all work by Doug Benn and many others). Amended – The wording has been edited to emphasise that whilst research on debris-covered glaicers has documented and discussed supraglacial channels, little work has looked at the role of sediment within supraglacial channels.

L496: add “on” before meltwater routing. Amended.

L509: mountain glacier environments have glacier lake outburst floods which could cause abrupt acceleration, I would mention this here even though you do not see them in your area. Alternatively, refer to your specific area rather than “mountain glacier environments” more broadly. Amended.