

## Comments to ESSD-2022-369

### General comments

The study by Fountain et al. is presenting the results of a new glacier inventory for the contiguous United States (without Alaska) as mapped from manual digitizing of orthorectified digital aerial imagery. Independent of my comments below, I want to congratulate the authors to this long overdue update and acknowledge the great effort that is visible here. I have a number of more general comments to a) the terminology, b) the 'layout of the 'paper' and c) the datasets as well as some more specific ones.

Starting with a), I am not very happy with mixing glaciers and perennial snowfields. First, snow fields should not be included in a glacier inventory and second, I think the definition applied here for 'perennial snowfields' is ambiguous. Of course, glaciers can be described as perennial snow (L82), as they originate from snow that survives the melting season over several years, but I think this is not the same as 'perennial snow fields' that are just composed of snow and firn and should thus not be included in a glacier inventory. Things get a bit complicated when ice patches (not moving glacier ice) - that might be completely covered by seasonal snow - are to be included but seasonal snow has to be excluded.

Given that seasonal and perennial snowfields are abundant in this region, that their separation is nearly impossible in many cases, and that the transition of a glacier to an ice patch is gradual, I suggest using a definition that is better suited for this environment. Leigh et al. (2019) have tried to sort this out with a scoring system that can be applied when very high-resolution images are available. I suggest testing it here and re-evaluate the assignment. Currently, a large number of the here assigned 'perennial snowfields' are actually glaciers, e.g. they show bare ice, deformed debris bands, lateral moraines and could be found 'above' units classified as glaciers (and in a few cases its also the other way round, some avalanche deposits in valley floors are classified as glaciers). One example is shown in Figure A10. I think there is no need to assign the class 'Perennial snowfield' to (the two parts of) Freemont glacier. This is still a usual glacier that is actually connected in its lower part (under a thick medial moraine) to the neighbouring Sacagawea Glacier.

I fully acknowledge the difficulties in performing such an assignment and that in many cases a clear assignment might even be impossible, but currently the number of real glaciers that would be removed from the sample when users exclude the perennial snowfield class is rather high and thus worth revisiting. Moreover, in some regions it seems that perennial snowfields (and even glaciers according to Leigh et al. 2019) have not been mapped. Once this is done, please add example images for the various cases in a multi-panel figure so that readers have a chance to follow the decisions. Maybe also a short note on the class 'Buried Ice': I would not use it. Include it with the glacier outline when it looks like glacier ice under debris-cover and leave it when not. None of the dataset users will do the reassignment, but all are aware and will understand that other interpretations might exist. So please decide as an analyst where to place the glacier outline and leave it with this.

Regarding point b), I also have the impression that the current draft reads more like an internal progress report rather than a paper. There is no problem with being short and to the point, but for example a discussion is completely missing, the information included in the attribute table is not presented, glacier characteristics to be included in a glacier inventory (e.g. minimum, mean, maximum and median elevation, or mean slope and aspect) are neither calculated nor presented and visualized and lots of information is listed in the Appendix without provid-

ing a good access (e.g. showing the image footprints) or mapping examples from the various regions with outline overlays to see the decisions taken (also in difficult cases). The text provided in the Appendix comes thus across as rather theoretical descriptors of image conditions and would in this form have a better place in the Supplemental Material. Some of the images in the Appendix, however, should be transferred to the main part and used to illustrate the methods. Please show outline overlays and annotate the images to guide the readers through the decisions made.

The digitizing of the new dataset has in general an excellent quality and is a clear improvement over the currently available datasets. However, as mentioned above, the assignment of 'this is a glacier' and 'this a perennial snowfield' seems a bit arbitrary and inconsistent at times. Moreover, some glaciers (and/or perennial snow fields) are seemingly missing. I have compiled a few examples at the end of this review for illustration and suggest revisiting the assignment of all perennial snowfields to really have all glaciers included in the glacier class. Please add an item Class\_nr with 1 for glaciers and 2 for PS. I would also encourage the authors to calculate topographic information for each glacier entity, provide the data in the attribute table of the data file and add some selected illustrations of the dataset characteristics to the text (e.g. maps, scatterplots, bar charts, tables). A shape file providing image footprints (to see which outlines have been derived from which image) would be a most welcome asset.

### **Specific comments**

L1: conterminous or (first n missing) or contiguous (as in L9)?

L26/27: What are the criteria to cite these publications? Not all of them are about stream flow.

L27/29 (and elsewhere): When referring to contemporary glaciers, I would use glacier instead of glacial (see Cogley et al. 2011)

L62/64: I suggest not naming it a report when it should be a paper, maybe use this study.

L67: Please give this part an individual subsection 2.1 (and Uncertainties in L132 to 2.2)

L82: How was the 0.01 km<sup>2</sup> size threshold applied before the digitizing?

L81-87: I suggest applying the classification system suggested by Leigh et al. (2019) to get a better handle on what is a perennial snowfield and what can be named a glacier.

L90: Shaded reliefs are often ambiguous. I suggest using a flow-direction grid to separate glacier complexes into individual entities.

L103: In fact, this IS a huge common problem.

L112 (and elsewhere): Please number all sections in the Supplemental Material and refer here also to this number.

L117: 'once part of the glacier': Couldn't this be checked against the previous inventory?

L132: Please give Uncertainties and individual subsection (2.2)

L142: digitizing

L148-170: As mentioned in the general comments, can you please illustrate with a Figure how these datasets (SFI and NLCF) look like and how the merging was done?

L172: Please add an analysis of glacier characteristics as derived from a DEM

L190: I suggest moving this table to the Supplemental Material and showing in the text only a figure (bar or pie chart). And remove the 'Buried ice' class. Either include or exclude it.

L205: I think also Table 2 has a better home in the supplemental Material. This is background information, there is little that can be learned from it.

L210: Please add a Discussion section

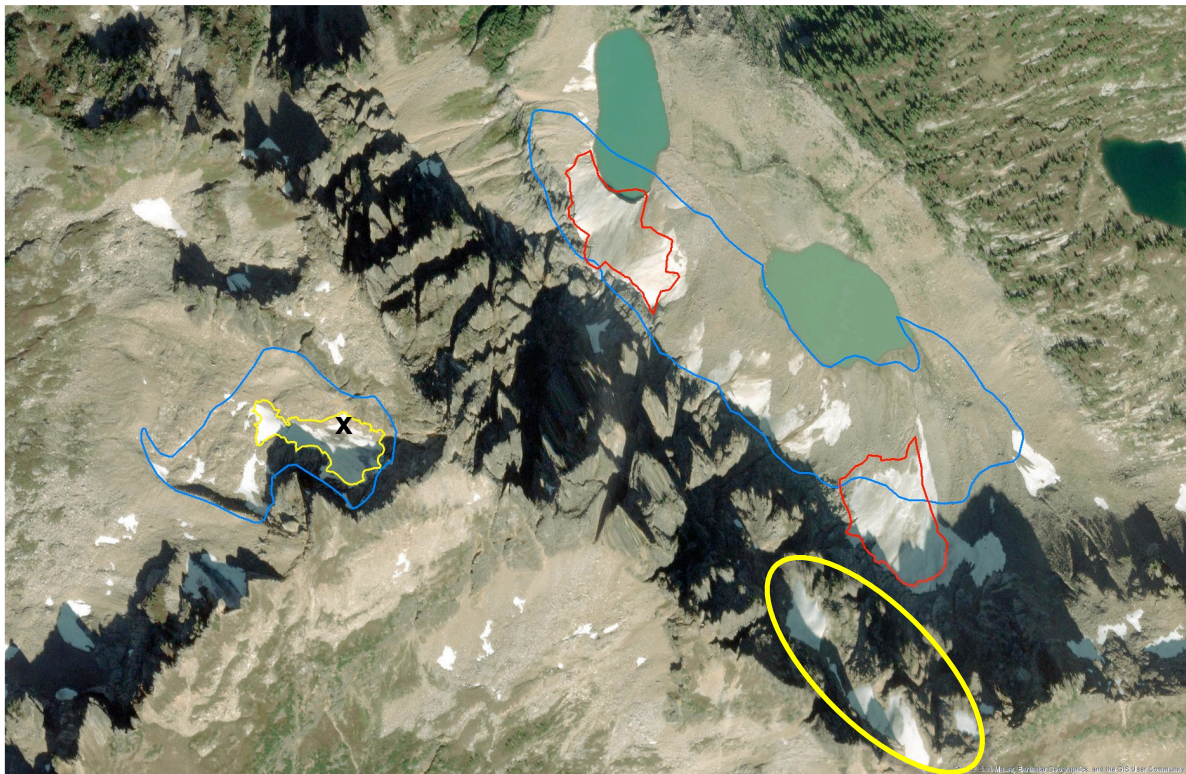
L262: Can you explain here why some of these are perennial snowfields while others are glaciers. It is not entirely clear, in particular not for the large ones.

Figures A3, A6 and A9 miss outline overlays. Where is Figure A8?

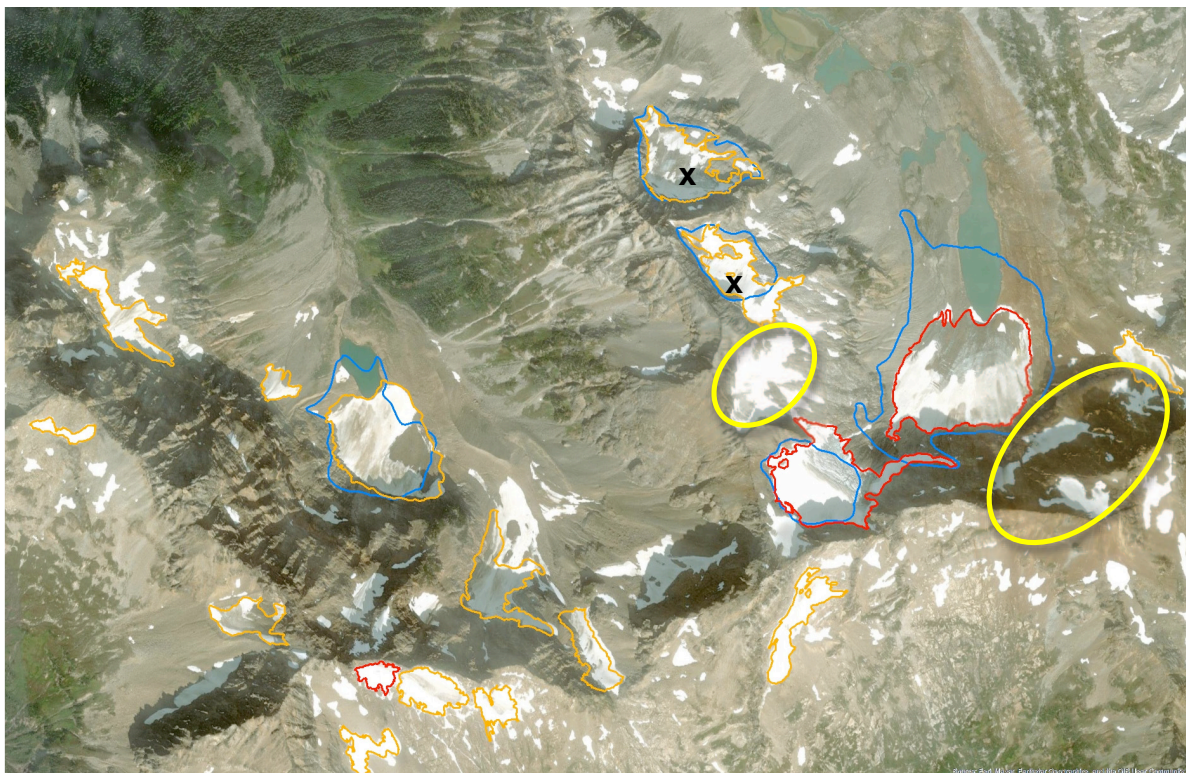
Leigh et al. (2019): <https://doi.org/10.1017/jog.2019.50>

### Image examples (World Imagery layer of the ESRI Basemap)

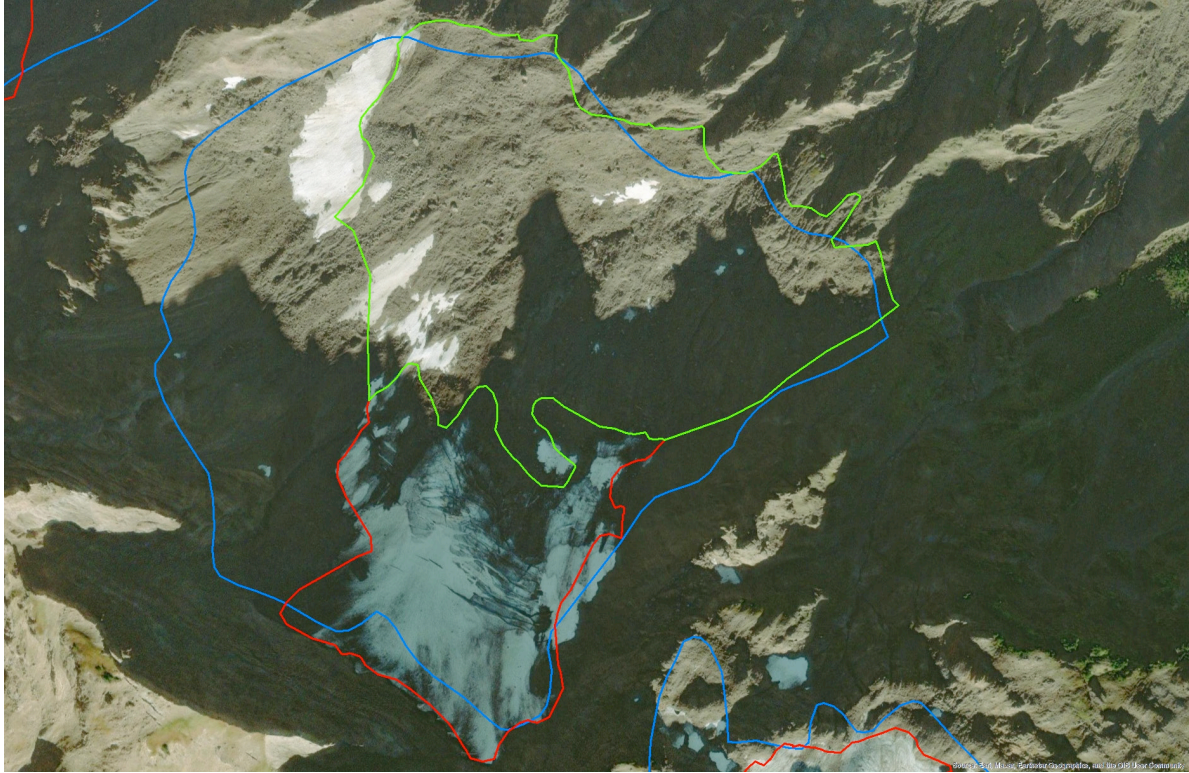
Red: glaciers, yellow/orange: perennial snowfields, green: burried ice, blue: RGI6



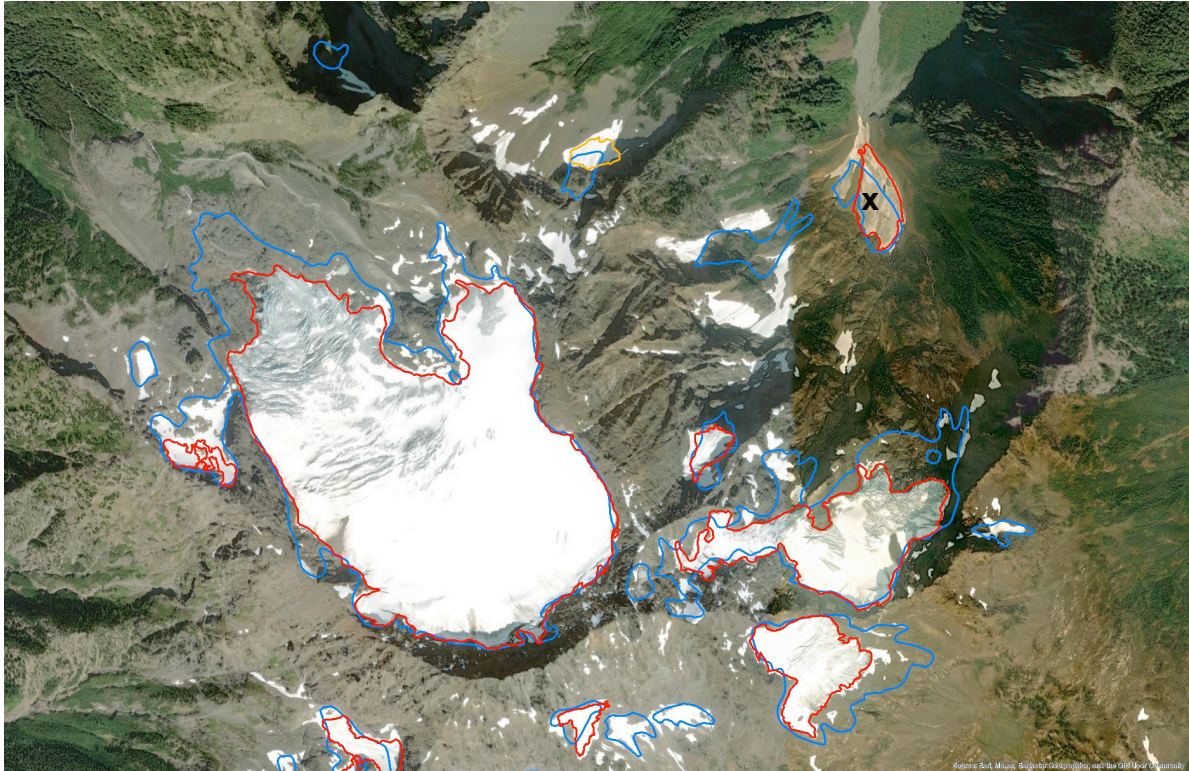
x: this is also a glacier. Circle: these should be included, at least as perennial snowfields. Background image: ESRI.



x: glaciers rather than perennial snowfields, Circles: Missing. Background image: ESRI.



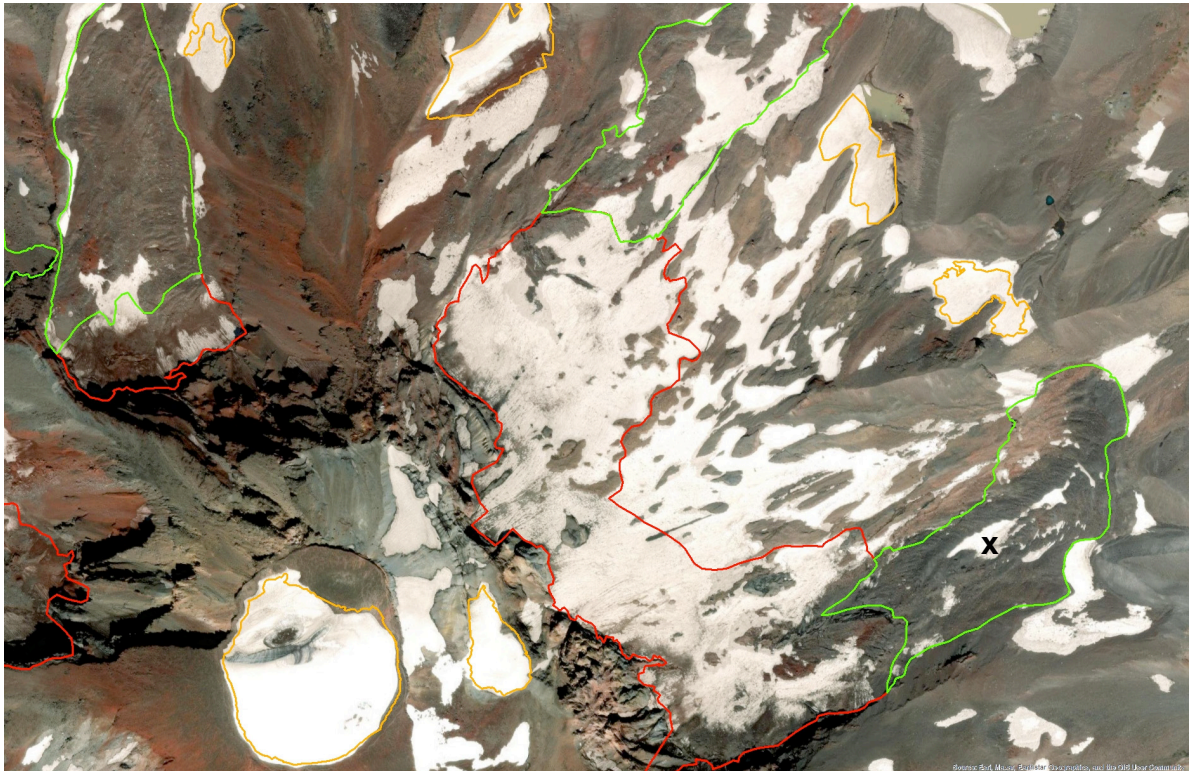
I would not include the green part. Background image: ESRI.



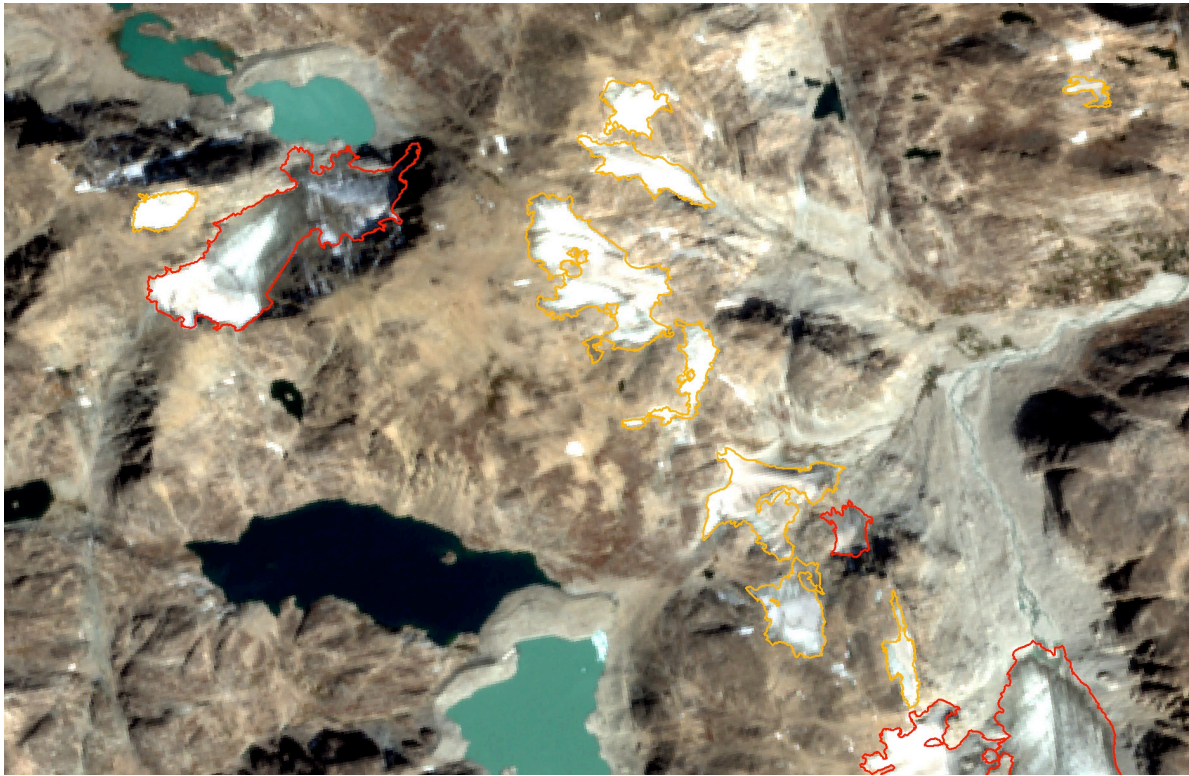
This is an avalanche deposit rather than a glacier. Maybe not even a perennial snowfield? Background image: ESRI.



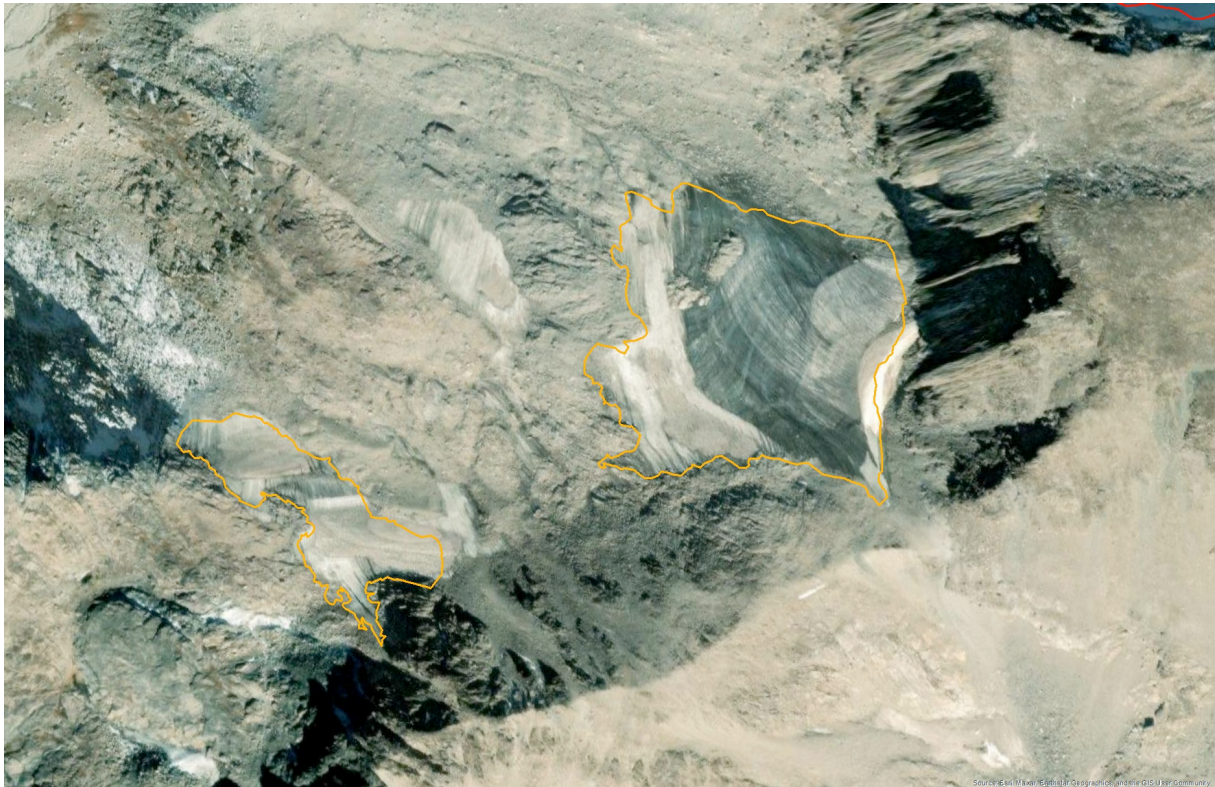
Where is the debris covered part (yellow circle), why is this (x) not a perennial snowfield. Background image: ESRI.



The orange outlines should be glaciers rather than perennial snowfields. x looks like a rock glacier. Background image: ESRI.



The orange outlines (larger polygons) should be glaciers rather than perennial snowfields. Background image: Copernicus Sentinel-2 2020



The orange outlines should be glaciers rather than perennial snowfields. Background image: ESRI.