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Earth System Science Data Discussions

Interactive comment on "Rock glaciers of the contiguous United States: GIS inventory and spatial distribution patterns" *by* Gunnar Johnson et al.

Anonymous Referee #2

Received and published: 4 November 2020

"general comments"

The contribution about intact rock glaciers (and fully mantled debris-covered glaciers) presented for (most of?) the contiguous USA is suitable for ESSD, very interesting and timely, as such inventories are much needed. However, a number of limitations of the presented inventory need to be stated clearly and also justified. The current inventory cannot be called a "rock glacier inventory", because it neglects relict rock glaciers but includes debris-covered glaciers. Moreover a classification scheme introduced herein makes a comparison to previous inventories difficult.

"specific comments"

lines 86 ff.: "quickly found no evidence of rock glaciers east of the Rocky Mountain States, therefore we focused our efforts on the 11 westernmost states (AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY)."

Besides using abbreviations for the US states without defining them, this is a statement that cannot be supported easily and needs further discussion. A search for rock glaciers in the Appalachian Mountains will allow you to find literature about potential "sightings": e.g. Putnam & Putnam (2009) reporting about inactive (!) and relict rock glaciers in northern Maine. Please justify why these landforms are excluded in the current inventory.

Lines 95 ff: "Because glaciers and rock glaciers are often co-located. . ."

Is this really always a true statement? In mountainous regions, a glacier will generally form if temperature, etc. allow, but also only if abundant precipitation is available; rock glaciers on the other hand will ask for relatively dryer regions. This aspect should be mentioned and potentially starting in locations where only glaciers are, might not be justified.

Lines 111 ff: "We focused our inventory efforts on identifying rock glaciers that, surficially, appear to contain appreciable internal ice fractions and are presently or were recently flowing downslope. . . . a second major distinction between our rock glacier inventory and classification system and other previous U.S. rock glacier inventory efforts is that we intentionally attempt to exclude relict rock glaciers."

Reading the manuscripts title as well as previous lines, the exclusion of relict rock glaciers is not really expected up to this point. The authors cannot provide a "rock glacier inventory" without relict rock glaciers. There would have to be a different title at least ("intact rock glacier inventory"?). However, I feel there is a general flaw in the approach, as was mentioned by the first referee's comments: on the one hand, a distinction in 3 activity classes is made, but relict rock glaciers are excluded and on the other hand potentially debris-covered glaciers are included without much of a

discussion about uncertainty related to this chosen approach. What kind of inventory is it then and how can it be compared to previous inventories in the USA and other inventories around the world (see the two mentioned inventories of referee #1!)? At least this needs to be mentioned first and then justified somehow (although I have a hard time to come up with a good explanation myself).

Please note also that actually the distribution of relict rock glaciers is especially of interest, as it is a great opportunity to understand climate and paleoclimate evolution. Moreover, from a hydrogeological viewpoint, intact as well as relict rock glaciers are of great interest and neglecting some of them (the relict ones) would make the current inventory only partially useful.

Please refer to e.g. Hayashi et al. (2019: " Alpine hydrogeology: The critical role of groundwater in sourcing the headwaters of the world") and Wagner et al. (2020: "Active rock glaciers as shallow groundwater reservoirs, Austrian Alps") besides Jones et al. (2019b) to appreciate the value of rock glaciers in general (with or without ice being present) for hydrologists, hydrogeologists, ecologists, water resource managers, etc.

Lines 133 ff: "Understandably, there can be some disagreement between analysts regarding rock glacier classification."

Besides the actual classification (about the issue of 3 instead of the usual 2 classes, please refer to reviewer one) shouldn't there be a word or two about the actual issue of delineation of rock glaciers (see e.g. Brardinoni et al., 2019 or Schmid et al., 2015). Moreover, the 3 classes seem to favor active rock glaciers and by neglecting relict rock glaciers, I suppose that quite a number of inactive rock glaciers are "lost" using the approach described herein. E.g. refer to Colucci et al (2019): " Is that a relict rock glacier?".

When considering all the above mentioned limitations with this inventory and by fully agreeing to all the very constructive criticism of the anonymous referee #1 (from the 3rd of November 2020), the actual results of the inventory seem somewhat "biased" to

say the least.

The actual results presented herein are moreover hard to judge, because the available shape file (PSURGI; https://doi.pangaea.de/10.1594/PANGAEA.918585) has no attributes attached to, besides the activity classification scheme (1 to 3). Is it planned to add the related attributes to this data set? Also with this dataset, the title does not include the information that no relict rock glaciers are included and will misguide the potential user of this dataset.

Allow me to jump directly to the Conclusion [as the discussion section about Inventory Accuracy seems to be guided by much confidence and might need some more cautious rewording (refer here to the comments of referee #1)]:

Line 252 ff: "We present the most spatially extensive geospatial rock glacier inventory in the world to date, a powerful tool informing a wide range of research and management applications."

Is this really true? Is this really a complete rock glacier inventory? IMHO there needs to be a clear differentiation between what has been done here and what previous rock glacier inventories tried to achieve. The current state of the PSURGI inventory does not allow a direct comparison to previous inventories, due to the different classification as well as the disregard of relict rock glaciers.

"technical corrections"

Lines 88 ff: "the 11 westernmost states (AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY)" Abbreviations should be explained first time they are used. Not everyone might be familiar with the US states abbreviations.

Figure 1: Class 1, 2 and 3 examples are not ideal, simply because the scale of the examples used is very different (factor 5).

Figure 2: Why not include the Sates boundaries so that the reader less familiar with them can relate to them? Color-coding of the mean (?) elevation of each landform

would allow the reader to appreciate the intact rock glacier distribution.

Figures 3 & 4: box-whisker plots presented here: are the whiskers the 10/90 percentiles or 5/95? Please add this information so that the outliers can be related accordingly.

Figures 5-9: Intact rock glacier density maps would paint a better picture than plotting centroids. Please reconsider the actual value of the current figures 5-9.

Table 1: The inventories by Kellerer-Pirklbauer et al (2012) and Krainer and Ribis (2012) are in the meantime replaced by a consistent rock glacier inventory of Austria (Wagner et al., 2020); see notes of referee #1 about this inventory and the one available for the Balkan Peninsula by Magori et al (2020). Moreover, the table would be of greater value if regions would be mentioned; e.g. Seppi et al. (2012): Eastern Italian Alps (Trentino).

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