

Earth Surf. Dynam. Discuss., referee comment RC1  
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## Referee Comment on esurf-2022-6

Anonymous Referee #1

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Referee comment on "Transitional rock glaciers at sea level in northern Norway" by  
Karianne S. Lilleøren et al., Earth Surf. Dynam. Discuss.,  
<https://doi.org/10.5194/esurf-2022-6-RC1>, 2022

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### General feedback

I enjoyed reading this interesting manuscript. The complex behavior of degrading rock glaciers in response to climate change can only be decoded in a multi-methodological approach, as you nicely show. The final decision as to whether the landforms are active, inactive/transitional or relict is not an easy one – especially when some results are contradicting. But, you show that it is still important.

Overall, the manuscript is well written and structured. While the methods and results part is totally fine, I have some suggestions to improve the reasoning in the paper (from your motivation to your conclusion). More background on the relation of permafrost occurrence and rock glacier activity should be given in the introduction to better indicate the motivation of this study (you provide this in the discussion, chapter 5.1, but part of the information should be provided earlier). What is the link to the inventory you did in 2011?

You use the term "transitional" or mention "active to relict stages" (e.g. l. 27, l. 430) in reference to the IPA WG. These terms are related to the kinematics, not including the ice content (as e.g. the term "inactive" does, see Barsch 1996). But, you also apply geophysical soundings to find indications for ground ice occurrence. This of course is important to link back to permafrost distribution. Here, some more background will support your argumentation.

The structure of the paper (especially chapter 4 and 5) is very individual and interesting. The different sections could be linked better in some parts (introduction, discussion, and conclusion). For example, the motivation to compare the rock glaciers in Northern Norway to those in Svalbard (analogues) could be mentioned before.

Individual edits are listed below.

### **Introduction:**

l. 34: the name of the author is Vonder Mühl (please correct) and reference is missing in reference list.

l. 41: add more information on geomorphological characteristics of the landforms, as important for the mapping. Any specific characteristics for rock glaciers at sea level (e.g. short lobes)?

l. 52: add link to official document of IPA working group (or the website)

l. 55: definition of an intact rock glacier; so, different to the one given by Barsch?

l. 56: regional analysis; are this selected areas with rock glaciers at sea level? And if, why this selection?

l. 58: where is this information on activity coming from?

The last paragraph of the introduction and the aims of this study, respectively, could be linked to the titles/questions given in the discussion.

### **Setting:**

l. 82: ... the northern areas... "were" (not was)

l. 99 ff: in this paragraph may be mention that the relict rock glaciers are indicators for the former existence of permafrost (as the frost polygons)

### **Methods:**

l. 161/173: complementary geophysical investigations... should be applied in the same conditions (in the same time) as ground conditions may change over time

Method/potential of the thermal camera is not mentioned. Provide some details about the accuracy and give references.

### **Results:**

l. 191: "... fig c))..." close the second bracket

l. 229: rather rock glacier units instead of "rock units"

l. 245: "Fig 5c", A-C are not labelled in Fig. 5

l. 279: "until now", I suggest to give the year (2019)

### **Discussion:**

l. 289: give references to permafrost models

l. 320: "...snow variations" add also "variations in material properties" (block size, etc.)

l. 336: here it would be helpful to interpret the vertical and horizontal deformations independently to differentiate between processes. With the CIAS program you match single blocks at the surface; if you see a consistent flow field, the blocks are for sure not moved by an avalanche or rock fall but by solifluction or permafrost creep.

l. 375: Did you map several lobes on top of each other, this could be a morphological indicator for reactivation phases?

l. 411: "... are probably...?.. because of" do you mean "are low because of..."

l. 420: write "IPA" not "Ipa"

### **Conclusion:**

In this chapter, you could mention the valuable combination of different remote sensing and in-situ methods to better understand dynamic systems. Without the extensive field work or the available remote sensing data on the other hand, you would not be able to draw your conclusions.

l. 436: this point of the problematic complex geomorphological systems of rock glaciers, talus, landslides, and scree in close vicinity is not really elaborated within the paper and should be detailed e.g. in chapter 4.1

Figure 1:

Section A: country names are not readable

Are there different nuances of pink in the permafrost distribution map (it looks like lighter and darker areas)?

Section C: indicate D + E for Ivarsfjorden

Figure 2:

Add the area names to the different map sections

Maps and Photos are too small.

Symbols and lines are hard to differentiate.

Figure 4

A: Legend does not fit to the colour code in the figure. There are no circle symbols (PSI) and field colors (stacking) does not cover the entire range from light yellow to dark red.

Figure 5

A, B, C are not indicated in the Figure (as given in I. 245)

Figure 9

Image B is partly very dark, please improve.

Table 1

Is the accuracy really given in cm? This should be rather meters (e.g. TLS 2-4 cm accuracy)

What is the accuracy of the orthophotos?

Table 2

Very small displacements and mainly in the area of the accuracy. Can you highlight the numbers that are not in the range of the accuracy?