

Earth Surf. Dynam. Discuss., referee comment RC2
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Comment on esurf-2021-10

Oliver Sass (Referee)

Referee comment on "Permafrost in monitored unstable rock slopes in Norway – New insights from temperature and surface velocity measurements, geophysical surveying and ground temperature modelling" by Bernd Etzelmüller et al., Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-10-RC2>, 2021

This is a very interesting and inspiring publication presenting a wealth of data, which work well together to provide a clear and consistent picture of rock slope dynamics influenced by warming permafrost. The paper is well-written and to the point. The figures are very complex and on the whole, there is more data presented than can be "digested" in a standard-length paper. But I understand that the authors like to present all the data together, even if this sometimes makes things confusing for the reader. I recommend the final acceptance of the paper after some minor revisions.

Fig. 1: Add "A" and "B" in the upper left inset

Clarify the relation between upper middle and upper right (took me some time to figure out).

The red circles in these insets are somehow confusing - the caption says that these are climate stations, while the legend says these are warm BTS sites and "met. stations" would be in yellow.

Insets "B" and "C" both are extremely busy, I found it hard to tell where top and bottom of the slope are, and where the landslides actually are. This is partly due to the brownish background, but mainly due to too much information.

line 213/214: six temperature data loggers in total; 3 loggers in the back scarps of Gámanjunni; 2 loggers at Mannen - where is number 6?

line 445: please explain briefly what a "failed rockslide" is

line 446: "delineated by the dotted red line" - I cannot find such a line, do you mean the lilac one?

Figure 9: An RMS error of 19.9% is given. I know well that in areas of high resistivity contrasts, errors are usually quite high. However, 20% is a lot, and it is never discussed how this might affect the validity of the conclusions.

What is more, no RMS errors at all are provided for all the other ERT profiles. Even if the RMS is not the only criterion for the reliability of an ERT section, it needs to be shown and discussed.

Fig. 10 is a good example for the missing error discussion. The odd patterns in profile G-EDY-2 at around 450 m (plateau crest) seem to me to be typical for unrealistic patterns which emerge in an ERT section under the influence of high contrasts and pronounced topography.

The section (C) is not very helpful and seems to cover part of (A) - should be left out.

line 814: "highest velocities and lowest ERT values" - shouldn't it say: highest ERT values?

line 851: "Philips et al. indicate...": WHERE did they find 6000 yr old ice? In the study area? Somewhere completely different?

line 860: "accelerating in the north" - what does this mean? Rephrase

line 866 ff: "can accelerate into the future"

Consider looking at the many publications of Kellerer-Pirklbauer on rock glaciers in the Austrian Alps. Temporary acceleration due to warming of the ice in rock glaciers is quite common, and might be followed by a stop of any movement once the ice has actually melted. This should not be mixed with the behaviour of rock slopes where ice melt can lead to acceleration or collapse.

line 870: Again, rock glacier and rock slope are mixed here. Keep this apart!

line 886: "Increased displacements rates are associated with lower ground temperatures and higher ground resistivity...": This sentence is somewhat misleading. Lower ground temperatures well below zero would probably reduce displacement rates. That's what happened during the Holocene. The velocity increase at lower temperatures at Gámanjunni is due to the fact that areas of subzero temperatures move faster than areas of above-zero temperatures, because there is still ice that can warm up, deform and finally melt. Once the ice has melted, the temperature-displacement relation will probably disappear or reverse.

line 887: Here you give the corresponding explanation to line 886. Make it clearer in the previous sentence that acceleration occurs around the freezing point.

line 893: "The movement mechanism seems to be different for both systems..." (rockslide / rockglacier)

Of course it is different! These are two totally different types of landforms with totally different dynamics.

Typos:

line 252: significantly

line 427: "Cumulative velocities" should be "cumulative displacement"

line 436: purple bares

line 569: considerably

line 605: full stop missing

line 798 and in other places: Kääb!

line 850: delete "a" and the two blanks before

line 881: demonstrate

line 898: full stop missing