

Earth Surf. Dynam. Discuss., referee comment RC2
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Comment on esurf-2022-6

Anonymous Referee #2

Referee comment on "Transitional rock glaciers at sea level in northern Norway" by
Karianne S. Lilleøren et al., Earth Surf. Dynam. Discuss.,
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This is a very interesting paper showing the complexity in behaviour of rock glaciers appearing relict using cutting edge technology and methods like InSAR analysis, high resolution photogrammetry and topography measurements using UAVs and TLS, geophysical methods (ERT and SRT), thermal monitoring using miniature data loggers and IR camera and long term climatic analysis.

It interprets the rock glacier behaviour in light of the new IPA action group Rock glacier inventories and kinematics and it shows that rock glaciers can register slow movement in spite of very little or even no ice underground. The authors show that this might be determined by other processes like solifluction.

No other paper dealt so far with rock glacier activity in spite of permafrost missing. This paper demonstrates this contradicting situation and suggests that rock glacier movement can occur by other processes than permafrost creep. This is completely new and has not been regulated by IPA action group. However, IPA group indicates that activity of a rock glacier is related to permafrost creep: a moving area (...) *has to represent the downslope movement rate of the rock glacier (permafrost creep) in the area of concern.* So, in the situation of permafrost absence, rock glacier activity in the traditional acceptance should be interpreted with caution and you should discuss this.

2) The paper shows for the first time that rock glaciers can move in spite of MAAT close to 0 and even well above 0 °C. I recommend to discuss more this important finding in relation to other publications showing similar results from marginal permafrost conditions like Serrano et al., 2006 in the Pyrenees and Necăoiu et al., 2016 in the Southern Carpathians. Especially the latter indicates similar rock glaciers dynamics in order of a few cm/year in apparently relict rock glaciers using similar techniques (InSAR).

3) I tend to doubt about the past activity interpretation of Ivarsfjorden rock glacier. This is seen as active only during the cold phases of Holocene and relict in the rest. The 2°C MAAT increase from LIA to the present is used as an argument. For example, Frauenfelder and Käab (2000) indicated a similar offset for the relict rock glaciers to be active in the past but that was relative to the year 2000. In my view once depressed topographically and ground voids filled with fines, it cannot reactivate again in spite of ground permanent refreezing. Permafrost oversaturation with ice (necessary for permafrost creep) is not possible any more as the pore space decreased by debris compaction because of interstitial ice melting. I don't know any paper indicating reactivation of the same rock glacier body that was relict when the climate cooled and the possible mechanisms involved. If you know some, please indicate them to support your interpretation. So far, there were documented new lobes generations overriding old rock glacier body (e.g. Amschwand et al., 2021). However, permafrost might be present in the lower talus slope – upper rock glacier contact and thus to be the case of pseudo relict rock glacier as Kellerer-Pirklbauer (2018) indicated.

Please find more punctual comments on the attached reviewed manuscript.

Please also note the supplement to this comment:

<https://esurf.copernicus.org/preprints/esurf-2022-6/esurf-2022-6-RC2-supplement.pdf>