

Dear Editor,

Thank you again for considering our paper for publications, and for your careful reading and suggestions that has improved our manuscript.

Below we have addressed all your concerns, and at the end of this document the questions raised by Referee 1.

I hope you will find this satisfactory.

Sincerely, Karianne S Lilleøren (on behalf of all authors).

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Minor technical corrections: Transitional rock glaciers at sea-level in Northern Norway

Frances Butcher, Associate Editor.

#### **Technical corrections/suggestions**

Line 158: Please refer to the comment on Table 1 by Reviewer 1 - I do not think this has been corrected. The values in line 158 are inconsistent with those in Table 1 - this appears to be a unit error (column title in Table 1 states cm, but values appear to be in m). Please check the text and Table 1 and correct for this and all techniques that appear in Table 1.

*This has been corrected. Sorry that this issue remained from the last revision.*

Line 152: If 'Unmanned Air Vehicle' is not inherent in the name of the UAV product, I encourage the authors to consider using a gender-neutral equivalent term 'Uncrewed Aerial Vehicle'. Note also Air vs Aerial – I believe aerial is the commonly used word.

*Thank you for noticing, this has been corrected.*

Line 255: Is it possible to include absolute displacements in the table to demonstrate the difference between the measurements and the accuracy threshold?

*We have added absolute values to the table below, but kept the document table as is was for now. Maybe this is what you requested? If so, it can be replaced with Table 2 in the document text.*

**Table 2: Vertical and horizontal displacements in yearly rates (cm/year) and absolute values (cm) of different pairs of DEMs and orthophotos from Ivarsfjorden rock glacier. TLS: Terrestrial Laser Scans.**

Period	Vertical displacement		Horizontal displacement	
	Range (Mean) [cm yr <sup>-1</sup> ]	Range (Mean) [cm]	Range (Mean) [cm yr <sup>-1</sup> ]	Range (Mean) [cm]

<b>1975-1982</b>	-30 – 10 (-10)	-210 – 70 (-70)	0 – 2 (1)	0 – 14 (7)	Historical aerial photos
<b>1975-1992</b>	-10 – 0 (-5)	-170 – 0 (-50)	0 – 5 (1)	0 – 85 (17)	
<b>1975-2017</b>	-10 – 0 (-7)	-420 – 0 (-294)	0 – 3 (1)	0 – 126 (42)	
<b>1982-1992</b>	-10 – 20 (-5)	-100 – 200 (-50)	0 – 6 (3)	0 – 60 (30)	
<b>1982-2017</b>	-7 – 5 (-2)	-245 – 175 (-70)	0 – 2 (1)	0 – 70 (35)	
<b>1992-2017</b>	-10 – 10 (-3)	-250 – 250 (-75)	0 – 2 (1)	0 – 50 (25)	
<b>2016-2017</b>	-10 – 5 (0)	-10 – 5 (0)	0 – 3 (2)	0 – 3 (2)	Drone photos
<b>2017-2020</b>	-5 – 2 (-1)	-15 – 6 (-3)	0 – 3 (2)	0 – 9 (6)	TLS

Line 446: It is not clear what ‘current framework conditions’ means. Do you mean ‘in the current framework, conditions are not comparable’?

We have changed the text to your suggestion.

Table 1: See comment on Line 158: should the unit label for column 2 be m (not cm as it is currently).

Yes, this has been changed now.

Table 2: Please add ‘rates’ to the Vertical/Horizontal displacement column titles.

We have added “rates” to the column titles.

#### Figures:

- Please refer to the ESurf guidelines on figures and tables: <https://www.earth-surfacedynamics.net/submission.html#figurestable>. In particular, 'Labels of panels must be included with brackets around letters being lower case (e.g. (a), (b), etc.).'

This has been corrected.

Figure 1:

- Please check the ‘C+D’ label in panel C: should these be D+E?

Sorry, our mistake. This has been corrected.

Figure 2:

- In the first map, the map credit is overlain by image 2. Please refer to the ESurf guidelines on the reproduction and reuse of maps and aerials, and ensure that all figures are compliant.

<https://www.earth-surface-dynamics.net/submission.html#figurestable>

We have moved the image accordingly.

- The blue square would benefit from a 'Fig 3' label within the image.

Fig. 3 has been added to the image.

Figure 4:

- The text in these panels is small - I suggest enlarging it, and particularly the legend text. If necessary, the legend could be included below the respective images to allow the text to be larger.

We have increased the panels and text.

- Basemap images require credit line.

We have also added the credit line for the background orthophotos.

Figure 6:

- Please run the figures through the Coblis colour blindness checker to ensure that figures are accessible, in line with ESurf guidelines: <https://www.earth-surfacedynamics.net/submission.html#figurestable>

<https://www.color-blindness.com/coblis-color-blindness-simulator/>

We have run the figure through this color blindness tool, thank you so much for pointing at this. To my understanding, this figure is accessible for all the simulated color blindness tests.

- The X referred to in the caption is missing from the image.

The X is now back in the figure.

Figure 7:

- Could the unit of temperature anomaly be moved to the same line as the text?

Yes, it has been moved to the text line.

#### **Typographical/grammatical corrections:**

**All of the following corrections have been changed.**

Line 22-23: are no longer permafrost and ground ice > is no longer permafrost or ground ice

Line 32: at least two > for at least two

Line 57: we have had > we had

Line 68: investigate is missing first 'i'.

Line 99: in outer > in the outer

Line 134: Is 'Norway' needed here?

Line 141: Is capitalisation required for 'Stacking'?

Line 161: Delete second occurrence of '(correlation image analysis software)'

Line 180: Put 'ice, water, air and rock' in parentheses.

Line 238: Delete nested parentheses in Malmstrom and Palmer citation.

Line 265: Raise > raising.

Line 366: TLS' > TLSs (apostrophe not appropriate here).

Line 326: in Southern > in the southern.

Line 327-326: Missing close bracket.

Line 335: Interpreted compacted > interpreted as compacted

Line 340: This would be better as: 'The GST monitoring clearly showed annual average temperatures above...'

Line 342: variation > variations

Line 359: than > to

Line 359: facts > fact

Line 360: other processes than > processes other than

Line 365: one information among > one piece of information among

Line 370: they almost exclusively are found > they are almost exclusively found.

Line 394: such e.g. suggested > such as is suggested, for example, for...

Line 425: to footslope landforms > for footslope landforms

Line 426-427: 'Liestøl (1961) acknowledges that the "talus terraces" at numerous locations resemble rock glaciers, and would indeed fall into the present-day rock glacier definition.' Needs 'they' before 'would'. Otherwise it reads as if Liestøl himself acknowledges the features do indeed fall into the present-day definition.

Line 794: are the relict shorelines > the relict shorelines

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Comments from Referee 1.

Dear Referee 1,

Thank you for your comments and suggestions. We have addressed your points below, and I am sorry for those that remained from the last version of the manuscript.

I hope this is satisfactory.

Sincerely, Karianne S Lilleøren (on behalf of all authors)

- 1) In the paragraph where you give some details on the thermal camera (line 225 in the track-change version of the manuscript), it is still not clear what "systematically" means. Did you measure the front only once or repeatedly? Every year? What about the weather conditions and their influences?

L194 and L297: We took pictures one day in September, 2018. This day was unusually hot, and we felt gusts of cold air escaping the front of the rock glacier. I should probably exclude the word "systematically", since this was only performed one year.

The text has been changed to (L195ff): "(...) we investigated the rock glacier front using a thermal camera (Teledyne FLIR C3) measuring infrared radiation. On one day in September 2018, we took ca. 20 pictures distributed along the front, with a 1 m distance between the camera and the object."

- 2) Figure 1: in the permafrost map it still looks like two different pinkish colors (one for possible and one for probable permafrost?).

This was two colors in the previous version of the manuscript, but in this version there is only one purple color. It may be the background map that disturbs the visibility a little.

- 3) Figure 8: following the figure caption, the labeling was not adapted in the figure (A for the temperature plot, ... D for the overview image).

Thank you for noticing, this has now been corrected.