

Review of “Insights in a remote cryosphere: A multi method approach to assess permafrost occurrence at the Qugaqie basin, western Nyainqêntanglha Range, Tibetan Plateau” by Johannes Buckel et al.

The authors integrated three distinct methods, including geomorphological mapping, geophysical (ERT) survey, and radar remote sensing, to infer the lower altitudinal limit of permafrost based on periglacial landforms and their surface movements in the remote Qugaqie basin in Tibet. As well-dressed in this manuscript, each method suffers its intrinsic limitations; and their combination makes a strong and convincing case towards a quantitative, detailed, and comprehensive assessment of permafrost occurrence within a basin where no borehole measurements are available. In addition to this success in method integration, I would also commend the authors’ efforts of conducting field mapping and geophysical surveys in this remote and harsh environment. Overall, periglacial geomorphology in Tibet is poorly studied. This work provides a valuable set of observations and datasets, which hopefully will be published and help to generate more interest in studying geomorphology in this area.

However, I would raise a few issues regarding the scientific meanings, the added value of combining three methods, some details of methodology, and clarity in writing. I also provide a long but incomplete list of editorial comments. A careful proofread is needed.

1. Scientific meanings. Even though three research questions are listed in the introduction, it is unclear to me why the authors wanted to assess permafrost occurrence in this particular basin and why we should care. Moreover, what are the implications of the inferred altitude limit of around 5400 m. And how does the limit in this basin compared with other places in Tibet (this comparison is hinted, but not explicitly addressed). Lastly, please define what do you mean by ‘probable permafrost’? Why and what part of your assessment is ‘probable’, not deterministic?

2. The authors explained complementary nature of the three methods very well in the introduction section and beginning of section 3 with figure 2. My question remains in the quantitative interpretation of the elevation (or elevation ranges) as inferred from each method (e.g., lines 26-28 in the abstract, and summarized in the first three bullet points in the conclusion section). Here is a list of related sub-questions.

2a. What was the exact reason to give one single value (namely 5400 m) for the lower limit of ‘probable permafrost’? What about the two proglacial ramparts mapped that are located between 5300 m to 5400 m? Hypothetically, if one doesn’t conduct ERT or InSAR measurements, would it be still reasonable to give an estimate of 5300 m with some uncertainty given?

2b. Quantitatively, what are the added value of the ERT results? Are these localized site surveys critical or supplementary for arriving the 5300 m estimate?

2c. As the InSAR measurements only provide information on surface movement, am I right to interpret that InSAR is marginally supplementary for estimating permafrost occurrence in this study? And it is not very clear what the authors mean by InSAR “allows a **transfer** and an **extrapolation** of our findings about ice occurrence from geophysical measurements to other

periglacial landforms” (Line 84). How exactly did you transfer and extrapolate using the InSAR-measured surface movement?

3a. I wish the authors could provide more details of the geomorphological mapping in section 3.1. In particular, how did you distinguish periglacial landforms that are characteristics of seasonally-frozen ground and permafrost (Line 168)? How did you make use of the DEM and optical imagery to map rock glaciers and protalus ramparts, or were they mapped mainly based on field observations? It might be useful to show optical images/DEM over some of the rock glaciers and protalus ramparts (e.g., next to figure 6 or 9, or as background for figure 10). Why did you need to use optical images from various sources? What are their spatial resolutions? BTW, the Digital Globe, BING, and Google Earth images were mostly likely taken by satellites, therefore not aerial images (Line 165). Is it possible that some landforms were missed and not included in the geomorphological mapping?

3b. It would be helpful if the authors could add a brief description of the roll-along procedure illustrated in figure 5. Table 2 and associated text fit better in section 3.2.

3c. The authors first reported low InSAR coherence in spring and summer (line 239), but later stated as in spring and autumn (line 270). Did I miss anything? And could the authors add some description of the intermittent SBAS approach? Could you also include velocity ranges in Table 3?

Figure 1: I cannot find blue, red, or black arrows in 1A. Label “Namco” should be “Nam Co”

Figure 6: The black rectangle is labeled as Figure 10, but should be Figure 9. The colors for lakes and glaciers are very similar (can set a darker color for lakes). It would be ideal to use an identical set of colors for the landforms in both figures 6 and 9.

Figure 9: (this is a minor visualization issue). InSAR-measured creeping rates show as light yellow in some landforms (e.g the two lowest ramparts and in the middle of some rock glaciers), which are not well distinguishable from the light-yellow elevation mask.

Editorial comments:

No need to capitalize permafrost if it is not at the beginning of a sentence.

L17: play should be plays

L19: at should be in

L50: decrease should be decreased

L55: spell out ERT here, at its first appearance in the text

L56: part should be parts

L61 & L69: at the TP should be on the TP

L79: which should be what

L93: cretaceous should be Cretaceous

L96: In should be On

L97: spell out ISM here at its first appearance in the text

L118: 'the' GLIMS database (can also spell out GLIMS)

L120: then should be than

L128: two-years should be two-year

L152: "derived the from the mean"?

L190: is 'pronival rampart' interchangeable with protalus rampart? If so, it is better to stick with protalus rampart.

L235: changes should be change

L328: "in terms their interpretation in terms of material characteristics"?

L405: are should be is

L408: regimes should be regime

L409: effect should be effects

L410: an should be and?

L410: cower should be cover

L411: delete one 'at'

L412: cause should be because

L418: method should be methods

L431: delete 'the' before this

L466: of should be away

L466: routing should be rooting?

L469: occurence should be occurrence

L472: scalled should be scaled (or large-scale)

L473: probabilities should be probability

L478: insight is a noun

L483: asses should be assess