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Comment on nhess-2021-57

Anonymous Referee #1

Referee comment on "Multi-decadal geomorphic changes of a low-angle valley glacier in the East Kunlun Mountains: remote sensing observations and detachment hazard assessment" by Xiaowen Wang et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-57-RC1, 2021

NHESS-2021-57

Progressive advance and runout hazard assessment of a low-angle valley glacier in East Kunlun Mountains from multi-sensor satellite imagery analysis

Wang et al.

This is over large parts a sound and thorough study about the interesting unusual slow surge-type motion of a small glacier on the Tibet Plateau. The manuscript is well written. I recommend publication in NHESS after consideration of the following remarks, some of them substantial.

SUBSTANTIAL COMMENTS

A. The glacier velocities need further work and explanation:

i. I recommend very much to extend the velocity measurements to 2021. There seems to be much continued activity during this period (see also below).

ii. The fact that advance velocities seem larger than surface velocities is puzzling. Your measurement grid is so dense that I don't believe your explanation 2 (L 350 and following) can be right (local underestimation of displacement). I do not understand fully your explanation 1. It could be that the very terminus lowers and slides out. You would have to assess closer if this is able to explain the magnitude of advance observed.

iii. I checked the Planet images you used for the velocities, and I am little convinced by your results. Over 2009-2012, there are large distortions between the images. How did you correct for them? For the other periods it is very difficult to follow features over 2-4 years as they are changing too much. Visually, I manage to follow features in a good way only over 1-year periods. If I compare (visually) 1-year periods, I can well see that only the lowermost part of the tongue well below the lake) is accelerating. You will have to thoroughly redo the velocity measurements, I guess.

B. The authors shortly touch upon permafrost, but not on creeping permafrost landforms. Obu et al. (2019) model mean annual ground temperatures for the glacier tongue area of -4 - -6 deg C. The glacier front has a sharp steep front, reminding of rock glaciers. So, the acceleration of the tongue should also be seen in terms of the dynamics ice-cored moraines and rock glaciers. Both are known to be able to show collapse-like behavior. In particular rock glaciers have recently been shown to accelerate and collapse. This aspect needs to be discussed in the paper.

Obu, J., Westermann, S., Bartsch, A., Berdnikov, N., Christiansen, H. H., Dashtseren, A., Delaloye, R., Elberling, B., Etzelmuller, B., Kholodov, A., Khomutov, A., Kaab, A., Leibman, M. O., Lewkowicz, A. G., Panda, S. K., Romanovsky, V., Way, R. G., Westergaard-Nielsen, A., Wu, T. H., Yamkhin, J., and Zou, D. F.: Northern Hemisphere permafrost map based on TTOP modelling for 2000-2016 at 1 km(2) scale, Earth-Sci Rev, 193, 299-316, https://doi.org/10.1016/j.earscirev.2019.04.023, 2019.

Some random relevant papers on rock glacier acceleration and collapse:

Delaloye, R., Lambiel, C., and Gärtner-Roer, I.: Overview of rock glacier kinematics research in the Swiss Alps: Seasonal rhythm, interannual variations and trends over several decades, Geographica Helvetica, 65, 135-145, https://doi.org/10.5194/gh-65-135-2010, 2010.

Kääb, A., Strozzi, T., Bolch, T., Caduff, R., Trefall, H., Stoffel, M., and Kokarev, A.: Inventory and changes of rock glacier creep speeds in Ile Alatau and Kungöy Ala-Too, northern Tien Shan, since the 1950s, Cryosphere, 15, 927-949, https://doi.org/10.5194/tc-15-927-2021, 2021.

Bodin, X., Krysiecki, J.-M., and Iribarren-Anacona, P.: Recent collapse of rock glaciers: two study cases in the Alps and in the Andes, 12th INTERPRAEVENT, Grenoble, 2012,

Kofler, C, Mair, V, Gruber, S, et al. When do rock glacier fronts fail? Insights from two case studies in South Tyrol (Italian Alps)*Earth Surf. Process. Landforms*. 2021; 1– 17. https://doi.org/10.1002/esp.5099

Kääb, A., Frauenfelder, R., and Roer, I.: On the response of rockglacier creep to surface temperature increase, Global Planet Change, 56, 172-187, https://doi.org/10.1016/j.gloplacha.2006.07.005, 2007.

… and many others that are cited in the above.

SPECIFIC COMMENTS

L 105: To suggest that the lower terminus is a sign of an earlier collapse is quite speculative and should not appear in the study site description. In addition, I doubt you can draw this conclusion. The debris-covered lower part of the glacier might be an ice-cored moraine as there are many found in the region. I cannot see how this feature is so different from the other ice-cored moraines in the region that you can suggest it might be

from a collapse.

L 129: scanned at 7 mm is certainly wrong. 7 micrometres? Please check the USGS pages

Fig. 3 could perhaps go into the Supplement. NHESS readers are less interested in such technical details as they may distract from the hazards aspects. If you agree, move lines 186-193 to the Suppl.

L 196: something wrong with the date 2104/10/18. 2014?

L 202: could be interesting to add the C-band – X- band differences in the Supplement. Did you apply the 2.82 m correction also on the debris-covered lowest part of the glacier? I doubt the penetration will be 2.8 m through a debris layer.

L 233: Why do you stop matching surface displacement in 2019. From a quick check of the Planet archive I see that displacements 2019-2020 and 2020-2021 would be very interesting to describe the instability. I strongly recommend to update the velocities after 2019. I almost consider that mandatory for the purpose of your work.

L 254: the question is if a 40-year continuous development should be called “unstable”.

L 261: the lake *was* not visible …

L 306: Calling a 40-year mass displacement "surge-like" might be open to discussion. How about calling it "… and imply a slow surge-like mass transfer process in the tongue area …"? See above, where I suggest though from checking repeat Planet images that only the lower most part of the tongue is actually accelerating. I would not call that surge-like at all. It seems more a slow landslide of the frontal ice-cored moraine, or similar.

L 341: trebled –> tripled ?

L 342: "unstable"? see above, not sure this is destabilization?

L 350 and following: the two reasons why the advance should be faster than the surface velocities are not convincing to me. This effect is quite unusual and seemingly violates physical laws of flow/creep.

L 411. Section 5.2 is to a large extent methods and results. I recommend to describe the model in the method section, and the model outcome in the results. Only the discussion of the model results (different parameter settings; not whole glacier collapse modelled, etc.) would then come in the discussions.

L 413: changing ice flow direction: do you mean a change over time (I don’t find that in the results) or a change in direction along the glacier (spatial change)?

L 463: … an avalanche from …

END OF REVIEW