

Review of “Proglacial lakes elevation glacier surface velocities in the Himalayan Region” (tcd-2021-90) by Jan Pronk and others

Summary

The authors undertake an analysis of velocity differences between lake and land terminating Himalayan glaciers. The authors show that lake terminating glaciers are associated with faster ablation-zone speeds than their land terminating counterparts. They then analyze other glacier metrics (e.g, orientation, slope, debris cover) and employ a numerical flow model to aid in the interpretation of their observations. I commend the authors for undertaking such an extensive study that presents some very interesting findings, but find two significant flaws (outlined in “main comments”) that must be addressed before the manuscript is ready for publication. I therefore recommend the manuscript undergo major revision.

Main comments

1) The language is somewhat stilted in places, with awkward sentence structure and many imprecise/vague statements. The manuscript clarity could benefit from a close read with attention to improving sentence flow and increasing precision and concision. I found much of the writing very dense and difficult to digest and/or follow.

2) You explore covariance of terminus type and several glacier characteristics (orientation, slope, debris cover, etc.). However, it seems that ice thickness differences between the two groups is a very important confounding variable that is not closely considered. As you mention in the text, the lake and land-terminating glaciers have differences in slope, area, and debris cover characteristics, which suggests they would also have difference in ice thickness. If lake terminating glaciers tend to be thicker than land terminating glaciers, this could underlie a substantial fraction of the observed velocity difference between groups. The fact that velocities are close near the ELA suggests that there might not be a gross mismatch, but variations in the distribution of ice thickness between land and lake terminating glaciers could explain the observed velocity differences. This potential complication must be directly addressed. A compelling way to do this would be to utilize the Farinotti 2019 ice thickness product to estimate near terminus ice thickness between these two groups. The fact that calving glaciers do not need ice thickness to go to zero at the terminus is one reason to suspect that lake-terminating glaciers could be thicker, and, hence, faster flowing here. Without investigating this link, you cannot make a casual claim that proglacial lakes cause the observed velocity difference (as is stated in your title), only that the difference exists.

Minor comments

L10: the term appears as “proglacial” in the title and “pro-glacial” here. Please be consistent with one use (I think the non-hyphenated version is preferable).

L15: substantially more heterogeneity than what?

L16: effects > affects

L16: it is not clear what you are saying affects half of clean ice glaciers. Dynamic thinning? Terminal velocity heterogeneity?

L41: do you mean “to cause” dynamic thinning?

L54: what do you mean by “rapidly evolving environments”? Vague term that makes the meaning of this clause uncertain.

L55: what is partially decoupled from climate? The transition from land to lake terminating? The

Fig 1: I would suggest using the term “excluded” rather than “uncovered” because of “uncovered” sometimes being used synonymously with “clean” or “debris-free” in a debris covered glacier context.

L100: A reference like Anderson & Anderson, 2016 seems relevant here. Link: <https://doi.org/10.5194/tc-10-1105-2016>

L138: “The maximum number of image pairs separated by one year was selected for the month of November, as this month is associated with low cloud cover and a relatively high snow line.” – It is unclear what you mean by this. Where is a “maximum number” coming from this analysis? Are you saying you’re using November as an end-of-year date?

Sec 3.1.2 & Table 2 - we need more detail about what velocity fields represent? Rather than just “effective date”, it would be useful to know the date of the first and second images used for each correlation. Or at least the midpoint date and the time span between the two images used. Otherwise we don’t know if we are seeing annual velocities, seasonal velocities, or some combination. Perhaps this could be visualized as a plot showing the temporal distribution of image pairs for each footprint?

L146-148: does the off-glacier used for estimating coregistration error have a similar aspect & slope distribution as the studied glaciers? If not (e.g., steep glaciers & flat area for uncertainty estimate), this error estimate may not be accurate.

L290-291: I am a little confused by this because it seems like basal friction and effective pressure should depend on each other (not be independent as stated). For example, a bed with lower effective pressure will be more slippery (lower friction). Can you better justify this statement or better describe what this experiment is meant to test? If you’re not changing sliding rates (through reduced basal traction) by altering lake level, then what exactly are you doing?

L292: exponent in A_s is not superscripted.

Sec 4.1: How does the absence/presence of debris cover affect velocity uncertainty? Are there systematic differences in debris cover between lake & land terminating glaciers?

Sec 4.2: it seems like the most relevant thing here is whether there are systematic differences between mismatch land & lake terminating glaciers between your estimates & those in ITS_LIVE. If all of your velocities are faster than ITS_LIVE, that doesn't seem like that big of an issue because your study focuses on differences between these groups and is less concerned with absolute accuracy of speeds. However, there would be a problem if lake terminating glaciers are systematically fast biased and land terminating glaciers are slow biased. This analysis should be undertaken.

Table 5: I think you mean ± 4.1 for lake terminating slope (written as 41).

L392: Do you mean "concurrently, IF a large fraction..."? Or are you saying that this is true?

L473: I think you mean 1 km, not 1 km²?

L517: This sentence is fairly awkward and it is hard to determine what you are trying to say.