

Re-review of ESSD-2022-238 by Guo et al.

General comments

For the revised version of this submission the authors have tried to implement my suggestions to the extent possible, which is highly appreciated. I compared the new PDF to the former one and recognized that large parts of the text have been rewritten, in part also as a result of the improved dataset. In my view the text is now more to the point, the methodology better explained, the categorisation of different surge-types more consistent and the comparison to other datasets completer and better understandable. Of course, the specific thresholds used for the classification can be discussed, but in my view the authors provide a reasonable starting point. The same applies to the combination of the results from two points in time and with other criteria or studies for the *verified*, *probable* and *possible* assignment. Also here the choices of the authors can be discussed, but it is likely impossible to find a ‘one fits all’ solution. As the authors acknowledge, this study will not be the end of the story, but I think they have done what is currently possible with the datasets available.

I have also checked the revised dataset and think it is much completer and more usable now. The extra effort the authors spent on separating outlines of surging tributaries from often much larger trunk glaciers is highly appreciated. I think this will serve the community much better than currently available datasets and hope this dataset can be integrated in a future update of the new RGI7. Of course, there are now assignments where I would disagree and some glaciers that have obviously surged in the past are not included (e.g. Halong glacier in Tibet described by Wenying (1983) in doi.org/10.3189/S0022143000030306). Hence, also the here presented method (elevation change patterns) has its limitations and further improved and completer results can be obtained when further methods (length and velocity changes) and datasets (literature) are used. As the authors have demonstrated this with a direct comparison to several other datasets, I would leave it with this. The surges that have only be identified in some of these studies are certainly the most interesting, as they will help defining the thresholds needed to distinguish them from other (e.g. just advancing) glaciers.

My most severe objection at this stage is the often wrong English grammar. To get this right, a careful check of the entire text by a native speaker is required. The text is mostly readable, but the wrong grammar is distracting. It seems as if the authors have the usual problems with using ‘a’, ‘the’ and the singular or plural form. In many cases they write it just the wrong way round although there are simple rules that can be applied. For example, one should use ‘the’ when the following is something specific and not use it when it is not (e.g. L113/115 should be ‘the COP30 DEM’ as the COP30 DEM is something specific and L55 should be ‘As for surge-type glaciers, which refers to glaciers that possibly surged ...’ as ‘surge-type glaciers’ are unspecific). But as I am not a native speaker, please give the complete manuscript a check. The points listed below (specific comments) are only a sub-sample. I also suggest to change the wording from ‘surging glacier inventory’ to ‘inventory of surging glaciers’ and to use ‘HMA DEM’ instead of ‘HMA8m DEM’ and ‘NASA DEM’ instead of ‘NASADEM’.

Specific comments

L9: (and elsewhere): ‘... ice flow and inventories of surging glaciers are important for correctly interpreting regional mass balance’

L10: How can an inventory of surging glaciers help ‘assessing glacier-related hazards’? The inventory itself does not indicate anything and even after a hazard has happened, how can the inventory help to assess it? I suggest to remove or explain.

L12: I suggest writing ‘In this study ...’

L16: I suggest writing ‘and 336 probably or possibly surging glaciers’. A ‘surge-like glacier’ can be something very different.

L17 and elsewhere: I suggest writing ‘previous inventories of surging glaciers’

L18: ‘excluding glaciers smaller than’

L20: ‘...uneven. They are ...’

L24: have steeper slopes

L26: ‘those with severe mass loss’

L39: ‘impact the regional mass balance’

L40: investigation and requires to first identify the glacier surges.’

L42/43: insert missing spaces (4 in total)

L444: ‘To support related investigations the distribution of surging glaciers is needed as a starting point.

L45: ‘studying the internal dynamic processes’ For this, also a glacier surge must happen. Just knowing where surges have occurred does not provide anything. I would delete this part or better explain the context.

L45: glacier surges

L48: The Shugar et al. (2021) paper is not related to a surge.

L48: ‘A complete inventory of ...’ Not really. For a hazard assessment you need a hazard. An inventory alone does not help in assessing the hazard nor does it allow to determine where the next hazard will happen.

L51: The ‘normal conditions’ for a surge-type glacier that is not surging is close to being stagnant, at least its lower parts. This is not a good reference to determine flow acceleration. Maybe refer to the usual flow of glaciers that do not surge.

L52: A medial moraine is common to many glaciers, it is not indicative of surge behaviour. Maybe write ‘deformed medial or looped moraines’? As a note, a looped moraine is indicative of a tributary glacier that has surged into a (larger) trunk glacier. In other words, the glacier with the looped moraine is likely not the glacier that surged.

L52: Maybe add ‘shear margins’ to the list?

L55: As for a surge-type glacier, which refers to a glacier

L58: of supraglacial moraine deformation ... To recognize sudden changes

L59: It can also be detected with the change in normalized backscatter from SAR sensors (doi.org/10.5194/tc-15-4901-2021).

L60: The image sources ...are limited, the strong changes in glacier motion might be missed.

L61: I think here you mean: ‘In contrast, the recognition of a specific surface elevation change pattern is a more reliable way to identify surging glaciers, as it will be visible for many years before and after a surge (... , Zhou et al. 2018). Accordingly, its source datasets (DEMs) can satisfy the required spatio-temporal coverage with ... fewer datasets.’

L66: but most effective

L67: ‘as a criterion and to combine this information with other observations if possible ...’

L70: as well as the differing glacier mass balance

L73: ‘2020) and Tien Shan’

L74: inventory of surging glaciers

L75: spatio-temporal coverage

L78: ‘2020), i.e. not all glaciers that surge do also advance.’

L81: long-repetition cycles

L82: surging glaciers

L83: elevation changes

L84: from multiple DEMs

L96: Glacier elevation changes across HMA were found

L98: positive or close to zero changes.
 L106: The NASA DEM serves as
 L107: with a moderate
 L113 of the COP30 DEM
 L115: therefore the COP30 DEM
 L116: of the product
 L119: from very high-resolution
 L132: Why 48 m and not 30 or 60?
 L134: include the most recent surges (Brun et al., ...).'
 L138: detected and removed.
 L141: 'to capture morphological changes.' I suggest inserting here: 'We acknowledge that due to the 30 m spatial resolution not all details of a changed glacier surface are visible.'
 Or something similar.
 L143: from the USGS
 L149: as a template for the inventory of surging glaciers
 L151: by also excluding rock outcrops, seasonal snow and shaded
 L169: such as the polynomial fit ... that were operated
 L172: high-mountain regions
 L173: 'geolocation shift' The method corrects both horizontal and vertical shifts, which one is meant here?
 L189: 'through a Fast-Fourier-Transformation.'
 L192: through a 3-sigma threshold criterion.
 L195: and potentially lead to false values.

L328: glacier area.
 L339: Is it sure that Siachen Glacier surged? In my understanding this is a fast flow glacier such as Baltoro or Biafo that does not really surge.
 L349: in the reference group
 L352ff: please remove 'the' before north, northwest, north east
 L363: in the reference group for comparison,
 L365: of the reference group
 L368: in the reference group
 L371: with glacier area, length and elevation range as these are auto-correlated.
 L372: By contrast, glacier median elevation has little correlation with these parameters.
 L383: tiles
 L390: where surges occur
 L422: our results highlight ... aspects is slightly
 L424/5/9: facing north/towards north/facing north (or 'facing to the north')
 L428: north-east facing glaciers have a higher chance to be surging glaciers
 L445: positive elevation changes, which is known as one part of the 'Pamir-Karakoram-West Kunlun' Anomaly (as a note: the other two parts are advancing glaciers and stable or even decreasing summer temperatures).
 L485: internal glacier surges that did not result in a terminus advance.
 L495: observations after 2000 were used
 L546: Frank Paul
 L729/30: remove capitalization
 L759: '(only glaciers larger 0.4 km² are considered)'
 L773: 'The number and area ratios of surging glaciers for different area classes.'

Figures

- Fig. 1: I suggest making the (a), (b), etc. annotations on the figure a bit larger. Fig. 1c indicates that the KH-9 coverage is a bit incomplete, in particular in the Tien Shan. Can you add somewhere in the text how many surging or surge-type glaciers have thus no elevation change information for the first period?
- Fig. 2: As for Fig. 1, I suggest that you first start with the reference to the figure panel and then describe the contents, i.e. ‘... change maps during (a) 1970s-2000, (b) 2000-2020 and (c) the corresponding surge classification. The subset selected for visualisation is fine but I miss the link to the classification scheme.’ I suggest to annotate panels (a) and (b) with the class derived from the criteria for the glaciers possible. For several of them the assignment to the ‘verified’ class is not very obvious from the elevation difference maps.
- Fig. 3: I suggest using much smaller circles (40% of current size) and more distinct colours to code glacier area (e.g. black, blue, red and yellow). Maybe the sub-regions can be numbered for a quick identification?
- Fig. 4: The dark red used to illustrate the percentages is a bit too dark to see the numbers on top. Please use a lighter colour.
- Fig. 5: I think the panels are too small to see anything and suggest to show all 4 on top of each other with a width close to page width. I also suggest to use more distinct colours, at least for the probable and possible classes. As mentioned for Fig. 2, please move the panel identifier before the text, i.e. ‘identification in (a) the Pamirs, (b) central Tien Shan, ...’
- Fig. 6: Maybe use white for the (a) and (b) annotation, it is a bit difficult to see. As for Fig. 2, I suggest to annotate the ‘Surging glacier’ class in the panel with the result of the classification. When it is not purely the elevation change pattern, please add with an index letter or number (to be explained in the caption) which other criteria have been used.
- Fig. 7: Instead of coloured bars you might use two different shades of grey. Please also add minor tick marks on the y-axis and consider using dotted grid lines for the major tick marks of the y-axis. I also suggest to get the inset-table out of the figure and show (and cite) it as a regular table.
- Fig. 8: Caption: ‘in eight aspect sectors’. As all six panels have an identifier, I suggest repeating it for the column description, e.g. ‘Left column (a) and (d): distribution of ...’
- Fig. 9: Please add minor tick marks on the x-axis and consider using different shades of grey instead of colour for the plots. Caption: use commas as separators ‘... area, (b) elevation range, (c) natural logarithm ...’
- Fig. 10: I suggest filling the foreground dots with a lighter colour or even white to better see the differently sized circles and to add minor tick marks on all x-axes.
- Fig. 11: I suggest using major tick marks every 2 m, insert minor tick marks and dotted major grid lines (or tick marks also at the upper x-axis. Instead of colour, different shades of grey can be used. Please annotate the x-axis with ‘NMAD (m)’ instead of just ‘Meter’.