Review of tc-2018-131, Sept. 21, 2018

Characterising the behaviour of surge and non-surge type glaciers in the Kingata Mountains, Eastern Pamir, from 1999 to 2016

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P2, L10: it would also be useful to mention the nearby Karakoram here (which is already described in several of the papers you reference). An added reference to this paper would also be useful:
Gardelle et al. 2012. Slight mass gain of Karakoram glaciers in the early twenty-first century. *Nature Geoscience*, 5, 322-325

P2, L13: clarify the period that the reference to positive mass balance of the eastern Pamir refers to

P4, L14: the distance from Taxkogan meteorological station to the Kingata Mountains is >100 km, so this should be noted

P4, L16: clarify where a 'mean temperature as high as 15°C' is referring to: e.g., over glaciers? At which altitude?

P5, L4: I think that 'high accuracy' is optimistic given the resolution of your imagery; 'good accuracy' would seem to be a better descriptor

P6, L4: state what the 'common reference dataset' was

P6, L10: state which band(s) and resolution were used for the determination of glacial motion; in part, this is needed to understand the pixel size being referred to here

P7, L6: state the averaging distance used for the velocity smoothing, and how blunders were identified in the data

P7, L7: how do you know that the accuracy of manual measurements is within 30 m, and therefore which area changes can be considered significant? There are some useful papers that address this issue directly, such as:

- Hall, D. K., Baa, K. J., Schöner, W., Bindschadler, R. A., and Chien, J. Y. L., 2003: Consideration of the errors inherent in mapping historical glacier positions in Austria from the ground and space (1893–2001). Remote Sensing of Environment, 86: 566–577.
- Paul, F., and 19 others, 2013: On the accuracy of glacier outlines derived from remote-sensing data. Annals of Glaciology, 54(63): 171–182.

P7, L18: be more explicit as to what 'discrete changes in glacial motion' refers to

P8, L9: state what the total glacier area was in 1999 so that the 1.33 km^2 change can be put in perspective

P8, L13: can you be more specific about the duration of the individual surges? A range of 'a few months to several years' is pretty broad

P8, L14: please better describe what the 'clear sign of surge behaviour' was – e.g., how far did the glacier advance over which period? Fig. S1 is too small and too low resolution to make out much meaningful detail (also see specific comments below). Please improve!

P8, L18: please specify the end period for the movement of '100 m/yr since 2007'. Also specify the period that 'termini of advancing glaciers… changed less than 300 m' refers to: my initial assumption was 1999-2016, but in the next sentence you say that remained stable until 2007

P9, L6: I don't understand what 'displacement following the entire glacier' means. It would also be useful to state what the change in glacier length was, in addition to area

P9, L13: change 'truck glacier' to 'trunk glacier'!

P9, L15: to me, W5 looks like a surge-type glacier due to the distorted moraines in lower terminus region in 2000 (in particular it looks as if the tributary to the SE might have recently surged; see Google Earth for high resolution imagery). It would be worthwhile looking through old Landsat imagery to see if this surge was captured, which would prove this definitively. I would therefore argue that the unusual recession of this glacier is primarily due to the quiescent phase of the surge cycle, which would make sense when no other glacier in the KM retreated over the study period.

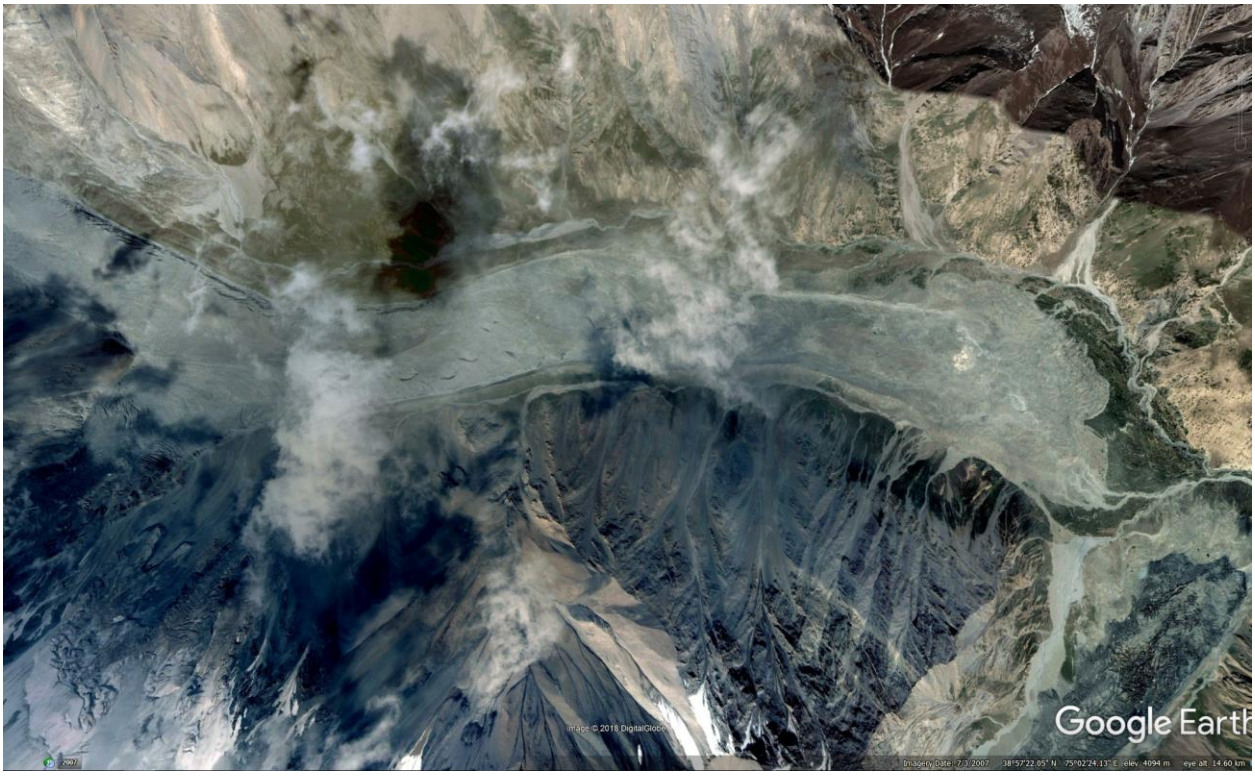
P10, L2: you mean that these glaciers showed no detectable change beyond error limits? This is why the errors need to be better defined in the methods – see comment above for P7, L7

P10, L6: it would be useful to include a figure that shows Landsat images of these stable glaciers to prove that they haven't changed, and so that the velocity profiles in Fig. 7 can be understood in relation to conditions on the ground. This could be a supplementary figure if there isn't space in the main text.

P10, L18: remember to include reference to Figure S1 in this section (e.g., for E10, W8).

P11, L3: I have to admit that I was pretty unconvinced that some of these glaciers were surge-type based on the low resolution images provided in Fig. 8. So I went to Google Earth and used the 'historical imagery' time slider to find a large number of excellent, high resolution images that cover your glaciers of interest. Using these, it is much easier to prove that surges occurred – for example, see screen captures on the next page for glacier E12, which show a dramatic change in surface crevassing between 2007 and 2011. Similarly, the changes for glaciers E13 and W13 in Google Earth are much clearer than shown in Fig. 8. The Google Earth images also help to correct what appear to be some misinterpretations in your figures, such as the label for the 'Stable glacier terminus' for glacier E7 in Fig. 8, which appears to be ~2 km north of the actual terminus (I'm also unconvinced whether E7 is actually a surge-type glacier based on Google Earth).

So I believe that you need to go back through the analyses for all 28 glaciers in your study and using the high resolution Google Earth imagery (perhaps also Bing Aerial: https://www.bing.com/maps) to supplement the Landsat and ASTER data you already use. This would make your interpretations for some glaciers much stronger, while potentially correcting misinterpretations on others. This would also enable a better description of the features indicative of surges, such as changes in crevassing, terminus advance, looped moraines, potholes, etc. (could list these in a table for each glacier).



Glacier E12 from Google Earth: 2007 vs. 2011: I'm now convinced that it surged!

P12, L1: I expect that some of these interpretations might need to be updated after analysis of the Google Earth imagery

P12, L20: please provide an indication of how many (and exactly which) of these glaciers have not previously been identified as surge-type in other databases

P13, L10: change 'velocity initiated' to 'velocity event initiated'

P13, L16: reference to Hewitt's discussion of thermal vs. hydrological causes (and potential role of trunk-tributary interactions) of the surges of nearby Karakoram glaciers would be useful to include here:
Hewitt, K., 2007: Tributary glacier surges: an exceptional concentration at Panmah Glacier, Karakoram Himalaya. *Journal of Glaciology*, 53: 181–188.

P14, L6: when you look at the high resolution Google Earth imagery I don't believe that all the termini were unaffected by the surges

P14, L12: what does 'and so on' refer to exactly?

P15, L1: reference to Copland et al. (2011) would seem to be useful here, as they talk about Karakoram surge periodicity in detail:
Copland, L., Sylvestre, T., Bishop, M.P., Shroder, J.F., Seong, Y.B. Owen, L.A., Bush, A. and Kamp, U. 2011. Expanded and recently increased glacier surging in the Karakoram. Arctic, Antarctic, and Alpine Research, 43(4), 503-516.

P15, L21: I think that it would be more realistic to say 'surge events *likely* remain undiscovered'

P16, L5: based on my earlier comment, I'm not convinced that you did see any receding glaciers; I think that your only retreating glacier (W5) is the result of a quiescent phase after a surge.

P17, L9: the statement that 'KM glaciers on the northeastern slopes are also in a period of rapid recession' seems to directly contradict what you just said and what you show in Fig. 2: i.e., that every glacier on the northeastern slopes is either stable or surge-type. With no evidence to back up your statement I think that you should therefore delete it.

P29, Fig. 4: I find the use of the white lines a bit confusing as the same terminus outline from a particular date is solid in the first part of each image, but dashed in the second part. It would be easier to follow if you used a consistent colour over time; e.g., blue for all early outlines, white for all recent outlines. Same comment applies to Figs. 6 & 8.

P32, Fig. 8: indicate what the white and red lines indicate in the caption

P34, Fig. 10: what do the letters a to g indicate?
P36, Table 1: state the year that the values refer to for 'area' and 'debris cover', and the period that the column 'area changed' refers to. And why are area and debris cover values not provided for 3 of the glaciers listed in the table?

Figure S1: this image quality is pretty low – perhaps it has suffered from compression in conversion to a PDF (size of the entire PDF file is only 147 kb). Can you therefore produce this figure at much higher resolution? There is also no need to make the figure so small; the luxury of having a supplementary section is that you have lots of available space, so I would prefer to see the images for each glacier made much larger (e.g., use the full page width for W8, E9, etc.). Also please indicate what the dotted and dashed lines indicate.