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Interactive comment on "Brief Communication: The Khurdopin glacier surge revisited – extreme flow velocities and formation of a dammed lake in 2017" *by* Jakob F. Steiner et al.

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This paper presents surface elevation change and surface velocity data from before and during the recent surge of Khurdopin Glacier in the Shimshal Valley of Pakistan. These data are used to characterise the surge evolution, calculate mass change, quantify the surge return period, and describe the evolution of an ice-marginal lake. The manuscript is generally well-written and the data contained within are new and interesting. There are a few areas where with only a small amount of further work the manuscript could be improved – these are detailed immediately below – followed by some more minor comments that should provide some more clarity in places.

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1. The key take-home message is currently a bit hidden. It seems to me that the new findings are: 1. that the surge return period appears to be of the order of 20 years (whilst acknowledging that n=2); 2. that surge velocities may be even faster than previously realised – implications for erosion and sediment transport; 3. that there may be a topographic control on this particular surge (but this needs much greater discussion – see following point); 4. that the ice-marginal lake is posing a hazard to local communities. If the abstract and the conclusions could be modified to give the key message much greater prominence the manuscript would have greater impact.

2. The relevance of the steep bed topography at 12-km needs some further discussion/explanation. Is the suggestion that it provides a control on surge dynamics? Or even that it is responsible for the spatial imbalance in flow? Presumably it doesn't provide a bottle-neck to flow (I imagine the opposite if anything)? Is the modelled ice particularly thin above the step and potentially frozen? Some consideration of the possibilities would be a welcome addition.

3. There appear to be many more velocity datasets discussed in the text than presented in the figures. Is there a reason for not showing all of the velocity data? It would really help with visualising the evolution of the surge to have them all (or at least more than the current three) available.

4. The discussion of whether the surge is thermally or hydrologically triggered lacks real evidence so I would suggest toning it down or even removing it. It is likely that both thermal and hydrological processes will be at play as you infer in your own discussion.

5. There needs to be some uncertainty analysis of the dh/dt data. How well co-registered were the DEMs? Showing off-glacier areas of dh/dt data (and velocity data) would help here, as would the distribution of those values. This extra analysis would be a good addition to the Supplementary, with uncertainty shading added to the figures and an error range added to the values stated in the main text.

Minor comments:

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Discussion paper

P1 12: ‘during a surge of the Khurdopin Glacier in 2017.’ (also elsewhere, glacier should be Glacier where you are referring to it by name).

P1 15-16: I’m not sure there is evidence for a surge front in the data you show here?

P1 19-20: do you show these surface observations? It’s difficult for the reader to believe the extra lubrication suggestion without seeing evidence.

P1 26: this is maybe misleading. . . has an increase in frequency been reported? Or just an increase in number? And is that not because we have better and better data? Without repeat datasets (like those presented here) we can’t say for sure whether frequency is increasing or not.

P1. 34-35: what do you mean by ‘understanding regional glacier behaviour’? Is ‘in order to advance knowledge of basal processes, non-steady flow more generally, and erosion and sediment transport in the region’ perhaps a better justification?

P2 3: name the glacier here, and also specify in the next sentence that it’s the Khurdopin lake (not Kyagar) that has previously caused destruction.

P2 8: maybe ‘recent’ is better than ‘novel’ here? Novel implies something a bit different about it.

P2 9: do you actually quantify the mass transfer somewhere? I don’t see it. . .

P2 16: was the ASTER DEM derived by USGS? Or by the authors? In either case, some further information is required about its expected vertical accuracy and how well it performs against the TDX DEM.

P2 22: can you add the value (of mass loss) here?

P2 23: is it subglacially sourced for sure? I’ve always imagined it to be plucked from the spur where the two main tributaries meet.

P2 26-27: is there a reason why you don’t show these finer resolution velocity data?

P2 31: maybe reword to ‘does not always allow the onset, peak and termination of the surge to be accurately identified, the data suggest that. . .’?

P2 32: not sure ‘build-up’ needs italics (here or at line 38)?

P2 32-40 change to past tense here (‘were below. . . and quickly rose. . . increased in 1998. . . and peaked in spring 1999. . . phase lasted until. . . glacier had reached. . . was characterised by. . . velocities had reached. . . had further accelerated’)

P3 7: I’m not sure Figure 3 really supports this statement. . .

P3 9 and 14: if the lowermost 1 km of the glacier is not impacted by the surge is the length change not zero? What is meant by length change here (if not position of the terminus)?

P3 20-21: this is a long section between the commas – consider moving ‘at rates comparable to those of the quiescent phase’ before the first comma

P3 32-38: it should be a short step to calculate the volumes from the DEM data – these values would be a valuable inclusion here.

P4 21: not quite true. The recent Hispar paper (doi:10.3390/rs9090888) by Paul et al. show comparable velocities

P4 25-27: as far as I can tell the Planet imagery did not contribute to the data you present here other than the overview in Figure 3.

Figure 1: some co-ordinates either here or in the text would help readers not familiar with the glacier to locate it.

Figure 3: I’m not sure the wiggles are best described as ‘centrelines’? Are they not the contorted medial moraines that have shifted position?

Supplementary: can you provide the image tile names in each case?

Supplementary: Table S1 should be S2 in second case (and should SRTM be included

here?).

Supplementary: the animation is excellent. Should it not be referred to somewhere in the text (or it may go largely un-noticed. . .)?

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