Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2020-8-SC1, 2020

Earth Surface Dynamics Discussions

Interactive comment on "Current glacier recession causes significant rockfall increase: The immediate paraglacial response of deglaciating cirque walls" *by* Ingo Hartmeyer et al.

Jan Beutel

janbeutel@ethz.ch

Received and published: 5 April 2020

This work is an impressive study documenting a laborious long-term study of high-alpine mass wasting (due to glaciation) based on repeat terrestrial laser scans as well as an intimate knowledge of the area studied. The manuscript is pleasant to read and informative, however i have a few questions and comments that would substantially enhance the material presented and sharpen the conclusions drawn out of this work. These are in most cases not requiring extra work to be carried out but rather clarifications and possibly additions of the current manuscript. I will try to elaborate on the basic questions in the following as well as specific and detailed comments in a second

part of this commentary.

(i) Specifically I am lacking a pertinent discussion as to the accuracy and validity of your quantitative analysis presented. in no way do i doubt your figures, but in the form they are presented it remains largely unclear how large or small your errors presented are w.r.t. the state of the art and what this errors depend on. I am especially worried since there is no apparent attempt to validate at least part of the figures presented. is it possible to manually cross check the volumes presented with photographs, site visits, deposits on the glacier surface such as seen in fig 4/KNW and KN?

(ii) Exposition, role of the sun/radiation: I am missing a detailed discussion of the exposition and the role of radiation/shading. can you add into figure 5 at which expositions you actually have rock walls in your portfolio and possibly also how much? You show altitude in great detail (fig 6) but little is shown w.r.t. south/north facing. Also your discussion of agrading/degrading permafrost/active layer is weak and in parts not concise w.r.t. the influence of radiation and the stresses originating from it.

(iii) In section 5 you discuss that groups of rockfall can be observed e.g. near structural weaknesses or in immediate proximity of the glacier surface. It would be very interesting to see this observation also in your evidence. can you point out such weaknesses in the topography/photos? can you point out such hot spots in there as well. Fig 4 only shows the approximate distribution and size of the observations. but if you are really able to bin these into classes and connect them with properties of the environment, you should really show evidence for that. maybe only in the form of a spot check and not a total cumulative analysis but without further backing this claim is hard to make. A more detailed discussion and evidence of fracture/weaknesses existing in the kitzsteinhorn rockwalls would be helpful.

(iv) I am not convinced of the discussion of the randkluft as you present it. to my understanding the key property of such deep reaching voids, typically found at the upper boundaries of glacier cirques (not just in the Alps) is that there is no continuous

physical contact between ice and ground (rock). This means that there is no mass loading with ice or water pressure and the rock surface is largely exposed to air. So in effect the rock walls are "free standing" compared to vertical (or steep) rock parts that are completely encased in ice. Due to this missing mass loading and the missing water pressure the hydraulic regime changes (see e.g. Simon Loew et al Aletsch Glacier etc). Due to the Randkluft reaching deep this is probably the case since a long time - a very long time. Concerning the air and the governing temperature regime i disagree that there is no active layer. It may not be very significant but your claim about ice cover in mid october is not convincing, knowing that mid summer is in the end of june and that there is a lot of running water traversing these rock faces from spring (snowmelt) to fall bringing a lot of thermal energy deep into these rock faces below the glacier surface. I rather think that the active layer (and permafrost) regime is of very different properties (temporal, dimensional as well as thermal) as in free surfaces.

So maybe you can add thermal data to back up your evidence. in a minumum this should be MAAT, MAGST etc. a discussion of north/south, shaded vs. unshaded etc.

Minor comments:

Figure 2: Possibly this figure could be augmented by an even newer picture (end of the study period) to show explicitly the deglaciation that took place during the study period. Also, can you quantify this deglaciation somehow?

Page 6/L 149f: The sentence about rope access is irrelevant for this study. leave it out.

Table 2: Rather than repeating the sales brochure of Riegl please specify the settings used for obtaining your data. The general specs of this instruments are known/accessible through the manufacturer to everyone.

Section 3.2: It would help if you give a short synopsis of the algorithms used (M3C2) and not only list benefits similar as how you briefly explain ICP above.

Availability of the data: Is the LIDAR (airborne and terrestrial) available? or can it be

made available.

Page 7, L 183: In addition, THE...

Section 4.1: - What is the detection limit mentioned? And how is this error determined? can you explain what influences this error (besides the size of the rockfall)? - You mention a theoretical discrepancy w.r.t. the detection. can you please detail here? and besides theory, what does it mean in practice for your study?

Figure 3: What are the two lines? The correlations? Please explain this in detail.

Section 4.2: Errors of +/- 1.5 mˆ3 and 1.3mˆ3 respectively. How sure are you? How did you validate this.

Page 12, L 276: You discuss an event that took place before your campaign. If there is a direct context with the observations during your campaign, please explain and back this up with data and plots. If not leave this out. the discussion here is only of a qualitative nature.

Figure 8: Normally CDF functions are given normalized to 100% and not in absolute numbers. Maybe you can also add the thermal data you have to this plot, although clearly one borehole somewhere else is only of limited use in the discussion (you discuss this somewhere later).

Page 14, L 320: I do not see what hinders debuttressing in this case

---

Interactive comment on Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2020-8, 2020.