

Review of the manuscript entitled “Channelised, distributed, and disconnected: Spatial structure and temporal evolution of the subglacial drainage under a valley glacier in the Yukon”, by Rada and Schoof.

1 General comments

This study by Rada and Schoof describes a new method to study the evolution of the subglacial drainage system of a small mountain glacier through the analysis of a large number of pressure records. The authors first present in great details the processing framework that is used to identify cluster of related pressure records and the evolution of these clusters through time. They then present the results of their analysis for the year 2015 when the pressure record was covering the largest part of the glacier for an extensive period of time.

I found the description of the processing framework to be very clear and well written, each step was carefully described and it would be easy from this work to implement this process to a new dataset. The authors made a good use of the supplementary material to present the alternative methods that were discarded which gives a good overview of the superiority of the methods that are presented in the main manuscript. After this great presentation of the methods, I was a bit disappointed by the results and discussion part of the manuscript. I however think that this is more due to the structure of the result and discussion section rather than from the content of those parts of the paper. I find that the conclusion of the study are not as clear as they should be and that some reformatting could help with that. In the Result part, the structure of the different subsection does not seem to be the most logical to me, for example, the spatially averaged pressure trends are discussed both in Figure 10 and 17 in two different section, I feel that the first sub-section on the evolution of the subglacial drainage system should focus either on the evolution of the pressure records or the spatial distribution of the subglacial drainage system. As it is know the mix between both spatial and pressure evolution makes the results harder to read in my opinion. Some grouping of results also do not seem completely logical to me, for example in section 3.2 I would rather see only the analysis on diffusion while it

seems to me that the two-dimensional nature of the drainage system would fit better in section 3.3. The Discussion part presents a lot of interesting points, and I feel that a short conclusion with the major takeaways at the end of each section will help to point out the main findings of the study and clarify the results of the study.

Bellow are a few more suggestion and questions on the manuscript in general

1. Regarding the length of the time window, I wonder if using several different time windows with different length would yield more information when comparing their results in term of clustering?
2. I feel that the discussion between correlated and anti-correlated series should be made clearer earlier in the manuscript. The process itself is well illustrated in Figure 1, but I feel that the author are missing an opportunity to clarify their workflow when they introduce the equation for the absolute Euclidian distance where the reason for the use of this specific formulation could be reiterated.
3. At some point in the manuscript, I was not sure if Pressure was designating water pressure or effective pressure, which is a major issue when describing increase or lowering of the pressure. I urge the authors to use either effective pressure or water pressure throughout the manuscript which would help with readability.
4. On the spatial distribution of the disconnected regions, I was wondering if they were appearing consistently in the same region for the different years, and if that is the case, are there any velocity records that they can be compared against?

2 Specific comments

Bellow is a list of more specific and technical comments throughout the manuscript given with line (L) and page (P) numbers:

- L14-P1: “diffusivity” has a typo.
- L7-P2: The references here all refer to ice-sheets velocity, given the fact that the present study treats of a mountain glacier, references pertaining to this type of glaciers might be better suited.
- L17-P2: “OBP” is defined here but used only once in the text, perhaps it should be omitted and only described in the caption of Figure 1.
- L28-P2: The citation of models here is strange, perhaps adding an “e.g” with a shorter list, or a review paper such as de Fleurian et al. (2018); Flowers (2015) would be better suited here.

- L18-P3: “water pressure” should be stated here, or effective pressure (see comment 3 above).
- Fig 1: Colourblind readers might struggle with the colorscheme of the arrows, perhaps something more contrasted would fit better (gradient of blue to red with black for overburden). In the caption of the figure OBP should be described.
- L8-P5: It should be “not” not “nor”.
- L27-P5: the recent paper from Doyle et al. (2021) could be cited here too.
- Equation 2: There is an extraneous right parenthesis.
- L8-P13: It would be nice to have a quick description of the shapes of the pressure record for each cluster here.
- L13-P14: The colour coding for correlated and anti-correlated subclusters could be re-iterated here.
- Equation 4: Subscript i is used both for time and the number of valid sample M_i which should be fixed.
- Figure 10: I think that clarifying between effective or water pressure is needed in the labels here and in other figures.
- Figure 10: I expect that the light blue shading is darker when there is snow cover but that should be clarified
- L4-P19: It should be specified that “the formation of a well developed subglacial drainage system, something that does not occur every year” on this specific site.
- L5-P20: I have a hard time identifying individual borehole records on Figure 10, perhaps splitting panel a with correlated and anti-correlated borehole in a different panel would help?
- L6-P20: It should be “a” not “an”.
- L8-P20: The sentence starting on this line is hard to read and should be rephrased.
- L15-P20: “through time”.
- L33-P20: Perhaps “in the study area” should be added here.
- L15-P23: I add to look for the meaning of “straddle” perhaps “intersect” would be better, or am I missing some of the subtleties of the wording?

- L6-P24: There could be a reference to the section where the probability were introduced here.
- L11-P26: Typo in “section”.
- L15-P30: “might be able”, “be” is missing.
- L24-P30: I am not sure why the discussion on creep that is made bellow is not stated here.
- L11-P32: It should be “boreholes”.
- L16-P32: The sentence starting on this line is unclear and should be rephrased.
- L23-P32: “resolution of our data”, “of” is missing.
- L31-P32: Shouldn’t it be “assigns”.
- Sup-L33-P2: “reproduce” in place of “reproducing”.
- Sup-L34-P2: RIG should be defined here.
- Sup-L7-P3: EOF should be defined here.
- Sup-L8-P3: SOMs should be defined here.
- Equation S7 to 9: Shouldn’t it be a_i in place of a_1 ?
- Sup-L6-P14: “mechanical”.

References

- de Fleurian, B., Werder, M. A., Beyer, S., Brinkerhoff, D. J., Delaney, I., Dow, C. F., Downs, J., Gagliardini, O., Hoffman, M. J., Hooke, R. L., Seguinot, J., and Sommers, A. N. (2018). SHMIP The subglacial hydrology model intercomparison Project. *J. Glaciol.*, page 1–20.
- Doyle, S. H., Hubbard, B., Christoffersen, P., Law, R., Hewitt, D. R., Neufeld, J. A., Schoonman, C. M., Chudley, T. R., and Bougamont, M. (2021). Water flow through sediments and at the ice-sediment interface beneath sermeq kujalleq (store glacier), greenland. *Journal of Glaciology*, page 1–20.
- Flowers, G. E. (2015). Modelling water flow under glaciers and ice sheets. *Proc. R. Soc. A*, 471(2176):1–41.