

Answers to comments in The Cryosphere Discussion of preprint Channelised, distributed, and disconnected: Spatial structure and temporal evolution of the subglacial drainage under a valley glacier in the Yukon

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1 Answers to referee N°2

1.1 General comments

We appreciate your positive comments about our manuscript and the uniqueness of the presented dataset. We were intentionally cautious of not explicitly saying that the dataset is unique and exceptional. However, your comments encourage us to put some of that caution aside. Therefore, we will make some changes to better communicate the uniqueness of the presented dataset to the reader. We will also emphasize the previous publications discussing this dataset and mention that a few follow-up papers are coming relatively soon. In particular, one that explores the effects of the subglacial drainage evolution on surface speed variations.

1.2 Minor remarks

- page 3, line 18: about the winter measurements, if most boreholes display pressure near overburden pressure for several months, one should expect high or even increasing surface velocity? Do you have observation of surface velocity all around the year that show that? May be this link with the surface velocity measurements (as mentioned in 2.1) even if I understand you don't have surface velocity in 2015?

R.

We do have continuous surface velocity records for the whole studied period, including 2015. However, due to the extent of the manuscript we have intentionally left out the analysis of velocity data in the context of the described temporal evolution of the subglacial drainage system. That will be the main focus of a follow-up paper. We will make the rationale explicit in the text and mention that the above paper is in preparation.

- page 3, line 19: which size are expected to be this “water pockets”? The wording make me think to a feature that as similar vertical and horizontal dimensions, whereas I expect more a flat feature? May be “water patches” would be more appropriate here?

R.

We have not explored the question of the shapes of these water pockets. However, we also guess they will have a “flat” aspect ratio. Nevertheless, given that we do not have observations or models to constrain their shape, we want to describe them as a generic water volume embedded into the ice. We will look for better terms than “pocket”, but if we keep the terminology, we will explicitly mention in this section that we do not have constraints on the exact shape and size of these water pockets.

- page 3, line 20: sometime you are using upper case after a colon, sometime not. Here I would said that a starting a new sentence would work better as the second point is at the beginning of a new sentence (even a new paragraph).

R.

We will check the whole manuscript to make sure there is no capitalization after colons, except for proper nouns and acronyms. In this case, we will start a new sentence and remove the paragraph break before describing the second process.

- Figure 1: cases b, c, d are not steady, in comparison to a that can be steady. May be it should be mentioned in the caption. Also, how long do we expect these unsteady situations to last? Give order of magnitude.

R.

Cases b and c could be steady at some timescales if overall heat dissipation within the channel equals ice creep. We will refrain to give estimations of the timescales these configurations could last over, as they are highly dependent on the magnitude of the overburden pressure and other factors. Even d could be stable over long time scales under very shallow ice where ice rheology is elastic. For example, partially filled ice channels can last years at the edge of the glaciers, where streams go in or out of them. However, we will add that a is stable and d is generally unstable.

- page 4, line 3: missing a verb in the last part of the sentence?

R.

We will review the wording.

- page 4, line 12: it is obvious, but may be you should mention here that you are measuring water pressure in these boreholes?

R.

Good point. We will add a mention to the fact that what we are actually measuring in the boreholes is water pressure.

- page 11, line 7: how sensitive are your results to this choice of a 6-day time window?

R.

Following on the responses to referee N°1, we will elaborate by mentioning the results obtained with other time windows and how we decided only to discuss the ones resulting from 6-day time windows, which seem to strike the right balance between reliability and temporal resolution.

- Figure 7, caption: for c, you should mention that f is defined in Figs. 10 and 11.

R.

Very good observation. We will add the suggested mention.

- page 16, line 11: Is that that in winter the pressure is not showing any daily variations and more a monotonic signal? Any suggestion how the connection between the different boreholes could anyway be qualified?

R.

Yes, that is the case, and without diurnal variations, our method does not work, a limitation we acknowledge in the method description. We do not have any good suggestions for detecting hydraulic connection in wintertime, as the only distinguishable features on those records are probably related to mechanical processes. An alternative approach could be based on similarities in hydraulic head. However, an equal hydraulic head between two boreholes would be a very weak proof for the existence of a hydraulic connection. The only approach we have considered (but never implemented) is to develop an active sensor that could vary its volume to create small pressure variations. In a confined volume, such pressure variations should be easy to detect by other sensors hydraulically connected. We will add a mention to this idea in the manuscript.

- page 18, line 20: in this chapter?
R.
 We will replace “in this chapter” by “we will present showing”
- page 20, line 6: a small increase
R.
 We will change “an small increase” by “a small increase”.
- page 22, lines 12-14: don’t really get the point of this isolated paragraph with the surrounding ones.
R.
 It was intended to give context to the following paragraph. However, we acknowledge it seems disconnected; therefore, we will rephrase it and merge it with the following paragraph.
- page 26, line 11: section 2.6
R.
 We will remove the misplaced space within the word “section”
- page 27, line 12: Fig. 5,
R.
 We will replace the misplaced comma by a dot.
- page 32, line 23: resolution of our data?
R.
 We will add the missing “of”
- page 34, line 35: May be you could conclude by a bit of prospective? Which new measurements could allow a better understanding and complement these measurements? Array of seismometers? What more could still be inferred from this existing dataset?
R.
 That is a good suggestion, and it can be combined with the idea of mentioning follow-up papers. We will add a paragraph or two with future work, prospective thoughts and suggestions for new measurements. These paragraphs might also include the mention of the active sensors mentioned above.