

Interactive comment on “Role of discrete recharge from the supraglacial drainage system for modelling of subglacial conduits pattern of Svalbard polythermal glaciers” by Léo Decaux et al.

Anonymous Referee #1

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C1

Review of “Role of discrete recharge from the supraglacial drainage system for modelling of subglacial conduits pattern of Svalbard polythermal glaciers”

General comments

This paper aims to assess the importance of supraglacial hydrology on subglacial water flow. I believe this to be a very important topic in the realm of subglacial hydrology, which could have important implications for other environments including Greenland. The paper presented here, makes use of classical formulations of hydraulic potential to define subglacial water flow paths, then by some mechanism, the model is run with discrete water inputs and a supraglacial hydrology model and the results are compared. It is possible that this simplistic approach could serve as a useful framework to quantify the effects of supraglacial hydrology on the subglacial drainage system. However, the steps that taken to apply the different hydrology distributions to the by means of the hydraulic potential in the subglacial system is not clear to me. Until this is clarified, it is not possible to judge the scientific quality of this work.

Many of the sentences, while mostly comprehensible, are difficult to follow. Some

C2

terminology is misleading, confusing or incorrect. The presentation of some data is very poor and not of the standard of scientific publications (significant figures. . .) Lastly, the manuscript is poorly organized.

It appears that Mr. Decaux is a PhD student. I believe that his advisors must do a more thorough job of preparing this manuscript and guiding Mr. Decaux; it is not the job of reviewers to do this. Should the methods prove to be viable, I believe that the results, when fully described and presented in a logical manner, presented here could be a demonstration of variability in subglacial water flow caused by the different treatments of supraglacial hydrology. The results of the paper could be interesting, however, because of the issues with organization and the lack of clarity in the methods, I do not see how this can be accepted for publication. I hope to have provided some examples and comments, which when applied to the remainder of the manuscript, can improve it in the event of another submission.

Terminology

- **recharge:** This either needs a new word or to be specifically defined. Do you mean seasonal water flux? Would mean seasonal water discharge be better? Discharge sum?
- **discrete recharge/ homogeneous recharge:** I think this is misleading. Homogeneous recharge, to me, seems like putting water equally over the glacier bed. I might suggest the terms with/without supraglacial hydrology. Whatever the terminology, it must be made clear in the introduction/methodology. Sometimes the work **theory** is used, I think a better word would be "test case" or "scenerio"
- **precipitations:** This is not a word. Use precipitation.
- A large point is made of these glaciers being **polythermal**. However, I found it

C3

hard to follow how this fit into the scheme presented here. Discuss the implications of it being a polythermal glacier, including in **Methods** and **Discussion** or only briefly mention in **Study area**.

- **conducts:** I assume you mean "conduit".

Organization

- **Abstract** This needs to be reworked. For improvement, I encourage you to look at resources such as this one: <http://sepwww.stanford.edu/sep/prof/abscrut.html>
- **Introduction** consists of three parts. 1) The background knowledge, broad to specific. 2) The gap in knowledge that the paper will address. 3) Your solution to the knowledge gap. Your work should only be discussed in the last paragraph or two, and should summarize what you will do. The description of your work that takes up most of the introduction here does not belong here.
- **Page 5 Section 3.1.1.** This paragraph is way to long. Try making it just a couple of sentences describing the overall scheme. Put dates, datasets, etc. in the respective subsections. Also make this section 3.1. Consider changing the name of the previous section to **Study sites and datasets** and put the dataset description there. i.e. weather data, imagery.
- I would encourage you to make the **descriptions of experiments** a separate subsection. Its title could be "model runs" or "experiment design".
- **Page 10 Lines 6-8** You present several different K values. However, your results only utilize a few. Either exclude the others, or make the plots/maps available in some kind of supplementary material.

C4

- I found quite a few **Results** presented in the **Discussion** section. This is a big issue with this paper. Separating these topics can be difficult. This needs to be reorganized and consider if combining the sections could be a good idea.
- **Supraglacial drainage system evolution.** This section has some interesting little facts, however, I don't see how it is coherent to the overall story of the paper (and I am not entirely sure what the greater story is). Either find a way to make it relevant, or excluded it.
- **Page 13 Lines 1-12** These descriptions of K should be condensed and added to methods.
- **Page 13 Lines 13-15** Where are these caves discussed? How are caves **better represented with a discrete water recharge**? This needs to be clearer
- **Page 17 Lines 10** Discuss why this is important to your work.
- **Page 17 Lines 12-13, Lines 27-29** I believe most people would believe amounts of water to be a result as opposed to something to be discussed. Also what to the + and - stand for? What are the uncertainties? Standard deviations? Model errors? Variability in the input data? You present the water discharge quantity in confidence to the m^3 . That seems like an overly precise measurement to me. This is not how numbers in are represented in science, look into significant figures .
- **Page 17-18** You repeatedly talk about outflow observations. What kind of data is this? Another paper (then cite)? if not, you need to make section in your **Methods/Study area** to describe how this data was collected. This shows that your model can somehow be verified (a very good thing...). Making a point of describing this will strengthen your conclusion.
- **Page 18 Lines 26** underestimated not under-estimating.

C5

- **Page 20** I think you could probably end your paper on a stronger note by highlighting the difference between the two situations.

Scientific Comments

- **Page 2 Lines 1-6** Why is subglacial hydrology important? Sliding? subglacial sediment transport? ice marginal lake drainages?
- Form **Page 2 Line 7 to Page 3 Line 10** This needs to be rewritten, omitting what is done in your experiment, and using the formulation above.
- **Page 2 Lines 33** Many have worked on the role on non-uniform water input on subglacial hydrology, these include Werder et. al. (2013), Hewitt (2013), Poinar et al., (2015).
- **Methodology, Spatialized water runoff calculation** Shorten to "Spatially distributed runoff estimation". More importantly, it is not clear how this is done. Do you use a T-index model? Do you prescribe the discharge with an elevational gradient/hypsometry? This needs a better explanation.
- **Page 8 Line 17.** Where does the bed DEM come from?
- **Methodology** You need a section detailing how the Q_h is coupled to the subglacial model. The whole paper relies on this, and it is not evident to me what was done. This is one reason why I don't find the paper to be publishable. There might be some hints in the list of model scenarios, but I am not sure. I believe this coupling should have its own subsection.
- **Page 10 Lines 1-2** No. Röthlisberger 1972 and Weertman 1972, discuss englacial water flow, not surface water flow. Also this paragraph moves around

C6

quite a bit. I recommend finding a linear line of reasoning for your choices in K and then present that.

- **Page 17 Lines 7-9** There has been plenty of work examining moulins, if you choose to discuss them, then add citations.
- **Page 18 Lines 12-14** How do you know that water does not penetrate the cold glacier ice? Do you have field observations? or did you read about this in a paper (which you then NEED to cite)?
- **Page 19 Lines 20-23** How does subglacial hydrology differ between tidewater and land-terminating glaciers? How do tidewater glaciers become more crevassed? This sections need more citations and should go in the discussion section. Poinar et al., (2015) discusses the implications of surface hydrology and moulins. It would be nice to put this work in relation to that research.
- **Page 19 Lines 24-28** Here it seems like you are trying to discuss the future of the subglacial drainage system, with the moving moulins due to the flow of ice. However, as Fischer et al. (2005) point out surface elevation changes (do to increased melt/glacier retreat) also will affect the location of the subglacial drainage system. This is another point worth mentioning looking toward the future.

Figures

- I do not think that the coordinate system used in necessary to mention.
- **Figure 1** Mass balance, not Masse balance. Also adding some interpreted flow-lines will help the reader orient themselves.

C7

- **Figures 7 and 8** What are the different columns? Mention this in the caption. Also I find the UTM markers a bit distracting and not necessary. These should be removed.

C8