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Interactive comment on "Sensitivity of subglacial drainage to water supply distribution at the Kongsfjord basin, Svalbard" *by* Chloé Scholzen et al.

Anonymous Referee #1

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%% General comments

This paper studies the dependence of the subglacial drainage system at the Kongsfjord basin on the characteristics of the supraglacial hydrological system. The implications of this study extend beyond the Kongsfjord basin as the dynamical behaviour of subglacial hydrological systems in general is not well understood. This is a particularly important question near the margins of ice-sheets because the structure of the subglacial drainage system will directly effect the response of the sheet to increased surface melting.

The paper presents 4 experiments; each with a different supraglacial drainage con-

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figuration to supply meltwater into the subglacial drainage system. A general trend between experiments is that more intense meltwater input into the subglacial system will result in more chanelisation; however, not enough to develop long-term efficient subglacial drainage.

It seems like some of the findings are in line with those of Koziol and Arnold 2018 (modelling seasonal meltwater forcing on the velocity of land-terminating margins of the Greenland ice-sheet). In this paper they consider how a subglacial drainage system might contribute to decadal-timescale slowdown of ice in the ablation zone. One theory is that if a more efficient drainage system develops in the summer, the effective pressure throughout the winter will be higher (i.e. the water pressure will be lower), leading to slow down. Your results (figure 3b) seem to suggest that supraglacial-meltwater configurations that produce more efficient drainage (in summer) lead to lower water pressures in winter (as Koziol and Arnold suggest).

You conclude that the resulting subglacial drainage systems that evolve are inefficient. I think here efficiency refers to how the water pressure responds to meltwater input. It seems though (I may be wrong) that the drainage systems are efficient enough to entirely drain the meltwater before the next melt season. Thus, we have the "worst of both worlds" in that the drainage system is inefficient enough for a spike in water pressure at the start of every melt season, but efficient enough to completely drain and revert to it's original (most inefficient) state before the start of the next melt season.

Overall though, without a sustained efficient drainage system, melt added during the summer melt season will drive higher water pressures, which may lead to faster ice-speeds.

I found that, stylistically, this paper was easy to read and well written.

%% Specific comments

A key result is that efficient drainage systems do not develop, which means that the

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summertime water pressures can be large. My question would be how much this depends on the choices of conductivity values?

It was mentioned that these values were chosen to "facilitate chanelisation and maximise the influence of meltwater on subglacial drainage efficiency", where it seems efficiency is inversely related to peak water pressure. This meant taking a sheet conductivity smaller than the literature value, and a channel conductivity larger than the literature value. I can see that this will increase both the channel flux and therefore the channel opening rate. Is it possible that lower conductivity terms could lead to more efficient drainage in the long run? Namely, if higher water pressures are sustained throughout winter, the channels may not full close. It doesn't seem like your simulations predict persistent channels throughout the year. I notice that you do address the idea of "sustained year-round subglacial channels" and why this doesn't happen at the Kongsfjord basin. That is, less overall meltwater input and particularly cold winter temperatures. It may be that I'm completely wrong here, I was just wondering if you had any thoughts on the issue of how strongly connected your results are to your choice of conductivity parameters, and can you be sure that you are "maximising the influence of meltwater on subglacial drainage efficiency"?

A final question that, again I just wonder if you have any thoughts on, is what is the missing ingredient that would produce more efficient drainage systems at the Kongsfjord basin? Is it simply that the meltwater supplied to the subglacial hydrology system is too small, or that the parameter values are insufficient. If, for example, you could choose conductivity values that would give "efficient drainage", are they too far away from the physical values to be plausible?

To summarise my general question is how much of an influence do your parameter choices (hydraulic conductivities) have on the qualitative behaviour of your results?

%% Technical corrections

Line 69) Colon misuse, I think you can just remove it.

Line 70) I think "approximations on" should be something more like "approximations about" or "approximations of".

Line 98) Should be a double hyphen (en dash) between "balance" and "snow".

Line 151) Colon misuse (clause before colon should be independent). I also think semi-colons should be used to separate list items here because there is internal grammar in each of the items (commas).

Line 323) "channels do no align"-> "channels do not align".

Line 434 + 502) Capitalisation of "arctic" (-> "Arctic").

Line 434) "disadvantages chanelization" seems a bit awkward, maybe "inhibits chanelization" or "prevents chanelization" (I think this one is just personal taste so happy for it to be ignored).

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