

The Cryosphere Discuss., referee comment RC2  
<https://doi.org/10.5194/tc-2022-6-RC2>, 2022  
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## Comment on tc-2022-6

Anonymous Referee #2

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Referee comment on "Impact of runoff temporal distribution on ice dynamics" by Basile de Fleurian et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-6-RC2>, 2022

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This study by de Fleurian and colleagues uses a subglacial hydrology model coupled to an ice flow model to test the impact of melt season duration and intensity on ice dynamics, for a Greenland-style idealised land terminating glacier. The presentation of results is very methodical, although quite dense in places. However, I think the wordiness is probably unavoidable to ensure the high level of detail, and the discussion offers a good summary. I only have a few minor comments and recommend that the paper is published after minor revisions.

The meltwater lubrication feedback is one way that meltwater can impact ice dynamics. I realise the focus here is on land terminating glaciers, but in marine terminating glaciers, the subglacial drainage system has been shown to have an impact on frontal ablation (e.g. see Slater et al., 2015, doi: 10.1002/2014GL062494). Perhaps the authors could comment on this somewhere in the introduction or discussion.

The discussion could go further to discuss the potential impact of high frequency variability in melt rate over the season. The fact that the results are so sensitive to the form of the melt season initialisation demonstrates how complicated this problem is to resolve in models. The implications for large-scale projections of Greenland's behaviour (and ultimately contribution to sea level rise) could also be discussed in more detail.

### Minor comments and technical corrections:

L16-19: first couple of sentences of the introduction are a little repetitive – suggest combining into one sentence.

L24: "late 70's" --> "late 1970s"

L43: space needed between subglacial and drainage

L78: probably worth briefly defining effective pressure in this context

L108: First place that ERA5 is mentioned and so needs more of an introduction.

L111: quantify "small volume loss"

L118-122: I'm not sure what the Cryosphere style guide is, but I would change the bullet point symbol to something else

Eqs 5, 6: don't italicise max

Section 2.4: On second reread it makes more sense, but what is the outcome of performing the Wilcoxon signed-rank test? Do you reject ensemble members that are significantly different from the reference? How does this relate to the analysis of the subsequent experiments?

L186-7: Last sentence of this paragraph should be in the next paragraph (about local effects)

L190-200: Could changes in geometry (specifically surface slope) also contribute to the propagation of acceleration upstream over the season? I.e. the initial acceleration at lower elevations causes a steepening of the ice surface just upstream resulting in an increase in driving stress. Perhaps the effect is very small compared to the impact of changes in  $N$ , but we see this diffusive response after retreat events in marine terminating glaciers.

Fig 4: define horizontal black line in caption

L222: bellow --> below

L239: "short melt season" --> should this instead be the "long melt season"?

L243: What is the EPL?

L244-246: It is unclear exactly what is meant by the "overshoot" – specify in which variable, and which figure. Only Fig 5e-f is mentioned here, but I think you are referring to the later summer increase in N to a value above the winter average, shown in Fig 5c only.

Fig 8: I like this figure, although looking at panel a, there appears to be a slight offset in runoff between the reference simulation and the other two simulations that are meant to have a constant runoff (as discussed in section 3.2). Is the offset real and if so why is it there?

Section 3.5: suggest incorporating this section into the discussion.

L379: "The results of our model [experiments/simulations] suggest..."

L397-8: "It must be noted however..." could you clarify this sentence? Perhaps "velocities averaged over the season" or "seasonally averaged velocities" rather than "seasonal velocities".