

General comments:

I thank the authors for implementing my suggested changes and answering my queries. I still have a few comments and questions surrounding the runoff methodology and the new rate of runoff analysis.

Additionally, I still believe the writing could be improved further. I have made numerous suggestions below on where sentences could be rephrased to be clearer. The language used should also be more consistent. The authors interchangeably use varied vocabulary to describe the same thing (e.g., speed-ups vs ice acceleration, velocity transients; subglacial drainage system vs meltwater system, basal system, basal channels). I recommend going through the manuscript to make the writing clearer and to be more consistent as it will greatly help to improve the readability of the manuscript.

Runoff methodology:

The authors state that they calculate runoff for late-season melt events by summing all grid cells in the catchment and then dividing by the number of cells to get the average runoff (not the total runoff for the catchment). However, as mentioned in my initial review, I'd like to clarify that the correct approach is to simply sum the grid cells of the whole catchment which will give the total runoff from that catchment entering the subglacial system below that catchment (assuming all water directly accesses the bed and there is no upstream subglacial influence – see later comments).

Multiple times in the manuscript the authors compare the magnitude of the late-season melt events to that of the early season lake drainage, whilst stating themselves that this is a generalised estimate that ignores any upstream influence (likely substantial). Given that the catchment-based runoff calculation is an underestimate (especially when using the average and not the total), I question whether a direct comparison between the two event types is justified. To improve the robustness of the runoff estimates, the authors could route RACMO using the hydropotential to the subglacial area affected by the North Lake drainages. Due to the large uncertainties in both RACMO and bed topography and the extra work required this isn't essential, but without a more thorough method to calculate the runoff, I recommend removing all comparisons in runoff magnitude between the lake drainage and the late season melt events.

Rate of runoff analysis:

Thank you for adding the rate of runoff analysis to the manuscript. I do wonder if this analysis would be more suited to being in the results with the rest of your runoff analysis?

L484-488: I'm a bit confused what point the authors are trying to make here. It's interesting that there is a positive correlation between ΔR and DOY, which is exactly why late season melt-induced speed-ups are of interest and why they trigger large speed-ups compared to melt events during peak melt season (i.e., because the rapid increase in runoff compared to preceding periods overwhelms the subglacial drainage system). Why does this add a complication?

Additionally, I don't quite follow the authors comment about the rate of change of runoff in Section 4.1: *"Thus, while we agree that changes in the rate of runoff may play a role in controlling the system response (particularly for runoff-driven events), we feel the temporal evolution of the melt system remains a key variable in the overall response of the ice sheet to meltwater forcing."* The rate of runoff (melt, rainfall, lake drainages) is what predominately controls the temporal evolution of the

drainage system (e.g., Schoof 2010; Hoffman et al. 2011, Bartholomew et al. 2011, etc). If you have high sustained melt going into the system, it will get efficient and respond less to melt or lake drainage events. This is why the lake drainages early in the melt season have large dynamic response. I recommend carefully rewriting this section to explain the points made in more detail, whilst also referring to the well-established concepts of subglacial drainage evolution in Greenland.

Section 4.2:

I believe this section still doesn't fit in with the rest of the main manuscript, and complicates the overall story. The influence of bed topography channelling an upstream lake drainage is very specific to this site. It does not fit in with the general inferences of the evolution of the subglacial drainage system through the use of trainset speed-up events presented in the rest of the manuscript. Moreover, it also highlights the flaw in the runoff estimates, that the subglacial drainage system beneath North Lake is well connected to upstream sources. I recommend removing this section to streamline the manuscript and to help present a clearer story.

Specific comments:

Title: Seasonal subglacial drainage system evolution? The authors talk about surface drainage too, but I wonder as the focus is on the inferred evolution of the subglacial drainage system it is worth mentioning this in the title.

L35: ...(GPS) observations of ice motion show that...

L36: Correct van de Wal et al. 2008 reference. I also recommend diversifying references for this bit (e.g., Andrews et al., 2014; Bartholomew et al., 2011)

L38: Delete "the details of". Change "ice-sheet velocity" to "ice velocity"

L39: Add "is often non-linear"

L44: Suggest changing the end of this sentence to something similar to: "...varies throughout the melt season as subglacial drainage transitions from inefficient to efficient systems, modulating basal sliding. + references"

L46: Change "basal" to "ice"

L48: Change "...how the ice sheet responds to..." to "how ice velocities respond to...". Change "ice-sheet sliding" to "basal sliding".

L51: Please add example references for supraglacial lake drainage studies

L52: Supraglacial lakes aren't limited to the western margin, change to/or similar "In the ablation zone of the Greenland Ice Sheet..."

L56: Remove "glacial". Change to "reduces friction between the ice and bedrock.."

L57: Delete "the" from "the lake drainage events...". Delete "these". Change to "...coincide with surface uplift driven by high water pressures in the subglacial drainage system"

L59: I might be being pedantic here, but to me "ice sheet" refers to ice sheet wide processes, whereas lake drainages are local/regional. Perhaps say "ice"?

L62: The added definition is much appreciated here, perhaps change to saturated layer thickness at the ice-bed interface?

L68: Change to “surface uplift”

L71: Change to “subglacial drainage efficiency”

L75: Basal channels more commonly refer to channels under ice shelves. Suggest rephrasing sentence to/or similar: “Ice thickness also plays a role, with subglacial channels under thick ice (define thickness) closing quickly (within hours to days) through ice creep...”

L78: Delete “These observations highlight the need for further study on the evolution of basal conditions.” Or change “basal conditions”

L81: “ice-sheet speed up” suggests they are occurring over the whole ice sheet. Perhaps delete “ice-sheet”. And same for L82?

L100: Suggest adding “localised lake drainage”. I’m still not entirely convinced you can confidently state that melt and rainfall events are smaller than lake drainage. With melt/rainfall events happening on much larger spatial scales, the increase in subglacial discharge for well-defined outlets will surely be larger than lake drainages. I suggest instead emphasizing the different spatial scales (local vs regional).

L101: Suggest changing to “transient ice velocity response to meltwater inputs...for annual ice motion”. I would suggest refraining/being more careful about the use of “ice-sheet velocities” throughout, with the studies and processes you discuss in this study are all regional/local scales.

L103: Again, remove “ice-sheet”

L108-109: Suggest removing this line, as these two types of events operate on vastly different spatial scales.

L106-120: Good justification for the study, and improved intro to the study site.

L113: Is the site 25 km away from the terminus of Jakobshavn Isbrae, or another glacier?

L113: Change “ice-sheet” to “ice motion”

L139: Suggest rewording 1-sigma errors to 1-standard deviation?

L223: Are you using the daily mean runoff or daily sum runoff from RACMO?

L224: Add “ice surface catchment in which...”

L226: Shouldn’t this be the sum of all grid cells? How many grid cells is the catchment?

L228: Change to/or similar “This is a generalized estimate for the runoff that makes it to the bed directly below the lake, but neglects any upstream sources routed beneath North Lake through the subglacial drainage system”

L235: Change “integrated” to “total”

L254: Again, I don’t think these claims can be made without more thorough methods.

L237: Can you please add a reference for the timescale of North Lake drainage?

L307: pre-melt season winter velocity? Perhaps for consistency just say “background winter velocity”

L332: Change “Discussion section” to “Section 4.”

L332: The analysis on runoff variability will be more suited here, in the results.

L336: Suggest changing “ice sheet response” to “ice velocity response”

L329: It will likely not make much difference, but I do think the effective lake drainage melt supply to the system should be your calculated effective runoff + RACMO runoff of the catchment for that day?

L389: Suggest rephrasing “the sliding behaviour of the Greenland Ice Sheet...” to/or similar “The relationship between ice velocities and surface melt are linked through the evolution of the subglacial drainage system.”

L396: Change “basal hydrologic system” to “subglacial drainage system”

L427: I don’t think you can confidently state it is smaller.

L434-435: I find this sentence confusing, please can it be rephrased?

L436: Change “subglacial meltwater system” to “subglacial drainage system”

L448: What is the maximum, mean or integrated flux? Do you mean runoff?

L450: Change “speed-up response” to “magnitude of speed-up” or similar

L451: Delete “summer”

L452-457: This should be in the methods instead

L445: This sentence adds confusion, with the “state” of the subglacial drainage system during the melt season being almost completely controlled by the runoff magnitude and variability... (e.g., Schoof, 2010; Hoffman et al., 2011 etc)

L450-482: I think this paragraph would be better placed in the results with the other runoff analysis, or possibly replacing the analysis of speed-ups compared to mean, max, etc runoff.

L479: Be careful with the use of “melt events”, as I presume you mean peaks in runoff, which could also be caused by rainfall events?

L484: I suggest rewording to “The correlations between speed-up magnitude, DOY and the rate of change of runoff...”

L485: Change “subglacial drainage state” to subglacial drainage efficiency

L489: I would suggest rewording/removing. RACMO does not underestimate runoff from lake drainages – it doesn’t include them at all.

L496-497: Yes, but it is the preceding runoff characteristics that define the “state” of the subglacial drainage system. And if there were a large runoff event before the early-melt season lake drainage, the velocity response would also change.

L508: Delete “glacial”

L509: Change “ice sheet” to ice

L536: Change “ice-sheet” to “ice”

L542: Confusing sentence, smaller amplitudes in what? Suggest rephrasing “horizontal sliding transients”, surely there are no velocity speed-up events before the lake drainage?

L543: remove “the” ...water filled cavities. And network instead of networks?

L45: Change “velocity transient” to “speed-up”

L547: Change to: early in the melt season.... Change “hydrologic system” to “subglacial drainage system”

L547: Change “the horizontal-velocity increases...” to “Increases in ice velocity associated with...”

L549: Suggest changing “meltwater conduits” to “connections”

L549: More drainages occur? Or is there simply just more active supraglacial hydrology (moulins etc).

L551: I think this sentence could do with being more nuanced and specifying that it increases frictional coupling in the distributed regions adjacent to efficient channels?

L543: Timescale of closure is very dependent on ice thickness

L543: Typo? “dewater cavities”

L555: Change conduits to “connections” or just say moulins

L631: Change “subglacial bed conditions” to subglacial drainage system

L632: Suggest removing “preliminary” considering the wealth of previous papers on this site and many other studies using GPS to infer subglacial drainage evolution in west Greenland.

L645-648: Again, this doesn’t fit with the rest of the conclusion/ story on the manuscript

L915 (Figure 6): Please check axis labels here and throughout (m year⁻¹ should be m year⁻¹). I think mm/day should also be mm w.e. day⁻¹

Figure 1: Check axis labels throughout (m year⁻¹ should be m year⁻¹). How is the annual ice flow direction is indicated?

Figure 4: Correct m year⁻¹