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The Cryosphere Discussions

Interactive comment on "Brief Communication: Outburst floods triggered by periodic drainage of subglacial lakes, Isunguata Sermia, West Greenland" *by* Stephen J. Livingstone et al.

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GENERAL COMMENTS

This paper presents three new observations of subglacial lakes identified from satellite surface elevation data near the margin of a land-terminating section of the western Greenland Ice Sheet. The lakes are small in size, but their location near the ice margin makes them easy study objects for future investigations, compared to subglacial lakes in the interior of the ice sheet. Subglacial lakes have only recently been identified in Greenland, compared to in Antarctica, and therefore there is a potential to study these features in more detail to understand how they interact spatially and temporarily with

the subglacial and proglacial hydrological systems. The paper is well structured and the language is fluent. I recommend publication after minor revision taking into account my general and detailed comments below. I apologize for any misunderstandings and look forward to seeing a revised version of the paper. My main comments and suggestions for improvements are:

1. I find the title does not reflect the paper content in a proper way; it refers to "outbursts floods". There is only one such event documented in Fig. 3. Are similar outburst floods observed for the other two lake drainage events? How common are these kind of flooding observations in satellite data from Isunnguata Sermia? Could the observed event coincide with supraglacial lake drainage events upglacier? Also, there are no drainage data presented to verify the qualitative observations from the satellite image. I would like to see some description of these caveats in the discussion section.

2. Since subglacial lakes are relatively new findings in Greenland, it would be nice with some more review of previous studies in the introduction linked to the discussion. Are the lakes in this study a new type of subglacial lake in Greenland or have they been observed elsewhere?

3. The methods are described shortly at the end of the introduction. I believe not all readers are familiar with these data and methods. Therefore, a methods description could be added in supplements. In this description, a short review on how subglacial lakes have been found in previous studies could be included.

SPECIFIC COMMENTS

Title:

The usage of plural of "outbursts floods" needs to be reflected in the paper. Only one observation of an outburst flood is presented for Lake 2 in Fig. 3. Are there additional satellite images showing outbursts floods for lake 1 and 3? If there is not room for additional figures in the paper, they could be included in supplements. Or the title

could be changed to reflect the content of the paper.

Introduction:

L28: “Shallow hydraulic gradients” sounds confusing to me when referring to water, maybe write “low hydraulic gradients”?

L37: I suggest replacing the word “significant” since it is a statistical term.

L37-39: This sentence holds a lot of information and is a bit unclear to me, e.g. please clarify what you mean with “surface imprints”. Do they not often coincide with subglacial depressions and potential subglacial lakes?

L40-44: Could you add some more review on these findings? Also, you mentioned three types of lakes here. Are the ones described in this paper a new type of lake (marginal lakes that fill over several years)? Please mention in the discussion.

L46: Do you have a reference for the statement “..is thought unlikely. . .” or is it from the references above? If so, please move the references to the end of the sentence.

L47: Add a reference for the Landsat data.

L51: Vertical accuracy?

L52: How were the DSMs corrected against filtered IceSAT data? Did you do this? This sentence is a bit unclear.

L53: Please describe in more detail how NDWI is used. Is there a reference to this method?

L50-55: These sentences describe methods and do not fit very well in the introduction. I suggest to move them to the next section and rename it to “Methods and Observations” or similar. Also, it would be clarifying with a last sentence in the introduction describing the objective and aim of the study.

Discussion:

L91-93: Levett and Russell Glacier have another subglacial drainage catchment than Isunnguata Sermia, so these two are not necessarily connected. Have you checked with other potential sources of subglacial water upglacier, such as supraglacial lake drainage events?

L95: Wrong reference, please correct. The subglacial hydrological analysis was made in the Lindbäck et al. (2015) GRL paper (doi:10.1002/2015GL065393).

L98: “. . .one drainage event _each_ over. . .”

L100: How were the uncertainties ($\pm$) of each lake volume change determined?

L106: “largest and best-constrained _lake_. . .”?

L112-114: I don’t follow this statement “recharge were similar over winter and summer”. February is a winter month, please rephrase the comparison periods. Also, the plot in Fig. 2 for Lake 2 looks steeper in summer 2016 than in winter, suggesting a faster refill in summer. The other two plots do not have high enough temporal resolution in summer to support the statement.

L118: What do you mean with “in close proximity”? Are you referring to other lakes than these three? Please clarify the sentence.

L120: Do you have a reference for this modelling work?

L121: As mentioned earlier. How about supraglacial drainage events upglacier? Can these be ruled out?

L133: One difficulty with future studies of these lakes, is that it is hard to predict when the lakes will drain in the data (almost no observed filling/elevation change before the drainage events in Fig, 2). Any recommendations regarding this?

Conclusions:

L154: As mentioned earlier, I would avoid using the term “significant” for qualitative

data.

Figure 1:

North arrow and spatial reference are missing. I find it difficult to see the color differences, eg. 1 m compared to 10 m change. Also, is it possible to provide exact date for the images used in the subtraction? Makes it easier to reproduce the results.

Figure 2:

Nice figure.

Figure 3:

North arrow and spatial reference are missing. Fig. A: Define IS in the caption. Fig C: Why is the ice green? Fig. D: Why are the lakes blue? Are they masked out or have they lowered 10 m in elevation? Seems unlikely.

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