The Cryosphere

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Discussions

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Interactive comment on "Challenges in predicting Greenland supraglacial lake drainages at the regional scale" *by* Kristin Poinar and Lauren C. Andrews

Anonymous Referee #2

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Supraglacial lake drainage has crucial impacts on surface-to-bed meltwater connection on the Greenland Ice Sheet but remains challenging to quantify. This study uses remote-sensing velocity datasets to constrain the relationship between strain rates and supraglacial lake drainage and to test the hypothesis that transient strain rates drive fast lake drainage. The results show significantly more-extensional background strain rates at moulins associated with fast-draining lakes than at slow-draining or non-draining lake moulins. This study aims to solve an important science question for the Greenland research community. I recommend it for publication with some minor changes.

General comments:

(1) The structure of the paper is basically clear but can be improved. Some suggestions: Section 3.4, this section is short so it may not be necessary to divide it into two sub-sections. Section 3.6, some descriptions belong to methods and should be removed. Section 3.7, the first paragraph of this section belongs to methods and should be removed. The discussion section presents very insightful ideas but the discussion should be based on the results of this study. I think sections "4.2 Prediction of future lake-drainage events" and "4.3 Parameterizing moulins in ice-sheet models" should be more closely related to the main findings of this study. In other words, these two sections should highlight how the findings of this study can help us better answer the two crucial science questions (lake drainage and new generation of ice sheet models) rather than broadly introducing these two science questions. This can be done by slightly modifying some words and expressions.

(2) Significance test is widely used in the study. It may be useful to briefly explain how the test was conducted at different parts of the results.

(3) The paper concludes that "observational progress in understanding lake drainage initiation will rely on field-based tools such as GPS networks and photogrammetry". I think this should be further discussed. A growing availability of high-resolution satellite imagery (e.g. CubeSat and Landsat-9) provide more frequent observations of supraglacial lakes in future and may mitigate the time gap problem.

(4) The study area of this paper is relatively small ($\sim$1600 km2) and most cover low elevations (<1400 m). Will the results obtained in this study be applicable for larger areas? particularly when including high-elevation areas. It will be useful to briefly discuss this point.

Specific comments:

line 16, Smith et al (2015) found nearly all surface meltwater drain into moulins in the ablation zone of the southwestern GrIS rather than in the western GrIS. I think it is necessary to distinguish these two study areas. It is not clear if all meltwater drains

to moulins, particularly at the high-elevation areas of the western GrIS since few river, lake, or moulin maps have been made for this region.

line 18, on diurnal scale too.

line 20, add "." before "Our".

line 28, "basins of specific supraglacial lakes", do "basins" mean the topographic depressions that host lakes or the upstream contributing catchment area to feed lakes?

line 42, supraglacial river gauging, streams are narrow and exhibit small contributing areas.

line 50, Banwell and Sommers are not appropriate to describe "the next generation of ice sheet models".

lines 59-61, this sentence is not easy to follow.

lines 102-103, how to obtain velocity uncertainties?

line 121, panchromatic pixels?

line 232, panchromatic band? Multi-spectral bands have lower spatial resolution (2 m).

line 258, how is p value calculated?

line 266, e3?

line 285, are most of these moulins located in topographic depressions that host lakes?

lines 308-310, how about comparing to Cooley and Christoffersen (2017)?

lines 320-322, how is p value calculated?

line 421, standard deviation 15 days is a very long time because most supraglacial lakes have short lifetime spans. Any implications we can obtain from this long std?

line 428, what does "meaningfully change" mean?

line 591, fix "*Stevens:2015ht".

line 723, "meltwater" rather than "melt" delivery to the bed.

Figure 4, the moulin elevation colors are not clear for the dots, perhaps change into color ramp? Fix "Bamber:2013 gw" in the figure caption.

Figure 8, see the comment for Figure 4.

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