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Interactive comment on "GERALDINE (Google earth Engine supRaglAciaL Debris INput dEtector) – A new Tool for Identifying and Monitoring Supraglacial Landslide Inputs" *by* William D. Smith et al.

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In this study the authors develop a powerful new tool to identify supraglacial landslides. They present the tool, as well as demonstrate how it can work and the value of it by identifying two previously unknown landslide debris events. This is an exciting development, and valuable to capturing these events where evidence of them is often lost quickly on the landscape, and yet they are important debris sources. I enjoyed reading the paper and I really enjoyed thinking about what may be possible using the tool. I have some questions and suggestions for the authors, but all of these points are minor.

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Overall, great work on this.

1) It could be worthwhile to put the size of landslide deposits that you can identify in more context with the size of glaciers that you can reliably search over and/or something about the size distribution of glaciers around the world. You don't have to answer this but it made me curious: over what proportion of the total number of glaciers would be possible to detect a rock avalanche of the size that you search, assuming that an event occurred? Is this the same as the base number of glaciers with debris mentioned, which was 4.4% of 215,547 glaciers worldwide?

And, the abstract mentions >2km2 area but around line 43 the mention is volume. It would be helpful to relate these together and also indicate how volumes are estimated. With respect to the events it may also help to explain why these are referred to as 'high magnitude' - is this your designation?

2) Another question is if this tool could detect smaller-scale events. Is it that any smaller events are not considered rock avalanches and/or that they cannot be detected? (I thought that "rock avalanches" were defined being >1Mm3, but I could be wrong about that)

What about rock avalanche events on already heavily debris-covered glacier surfaces - would those be detectable?

3) It could also be worthwhile putting the need / value of this tool in context with the total number of rock avalanches of this scale that have been found to date. Was the validation set of 48 known events chosen to span as many regions as possible, or are these all of the events that have been catalogued to date? More context on the likelihood to find additional, unidentified events would be helpful. Another way to expand on that could be to illustrate just how labor intensive it would be to search the Landsat archive manually. What is the range of repeat times of Landsat? This would also help put in context the two new events that you did identify.

Related to this point: I may have missed it, but how computationally and user-labor intensive is applying this tool. It sounds well beyond the scope of what a team like yours could do, but how far from possible would it be to search all glaciers where events may have occurred for the past 37 years? Is the challenge on the GEE computation side or on the validation side? When the latest RGI outlines come out is this something that could be done?

It may be your goal to let the curiosity of the users take over here, but are there some outcomes you think this makes possible in the short term and would advocate for (or may be doing yourselves?). Not having a sense of how intensive the process is, I was left to wonder the scope of study that may be reasonable to undertake - maybe in the conclusions you could indicate something about studies that seem worthwhile? For example, is this best applied to target regions of a certain size and/ or over target timeframes of a certain duration?

In the supplement it was mentioned that you compared to a Planet image. Is there anything that can be said about the future of applying this tool to other image sets? I understand that Planet images are not openly available, but is Landsat the only archive that makes sense to use? Is there anything to say about coordinating Landsat-based results with other image sets, or does that just need to be taken on a glacier-by-glacier basis? This would be important to at least mention, but doesn't take away from the achievement of getting this to work for Landsat data.

4) This is a subtle point, but it seemed like one that was done deliberately in the text so wanted to raise my reaction. The title (and acronym for the tool) uses "identifying" to describe what is done by the tool. And, the tool is referred to as a "detector". However, typically the text refers to what the tool provides as "highlighting" new events. It is only after user evaluation that they are "identified". If this was deliberate then I would check for complete consistency and maybe say that directly somewhere. I suggest that identify (or detect) is a reasonable term for what the tool does, and then the user confirms or validates that finding - but, any word choices you prefer will work as long as explained

clearly and used consistently. (Pay particular attention to this in the conclusion where the language seems to be mixed.)

Another subtle point on language is if all “supraglacial landslide inputs” are the same as “rock avalanches”? And, assuming that debris inputs are also the same thing? I would be check over to be clear and consistent.

Specific points:

It may be worth mentioning in the main text that updates to RGI can be readily accommodated. I have seen at least one announcement that RGI v7.0 has a release target by the end of 2020. This is indicated in the supplement but not stated directly (but maybe it is obvious).

Line 35: Consider referring to point (i) as glaciological and climatological controls?

Line 55: “rapidly transported away from source areas” - in addition to rapid sequestration, which is I think the point focused on in the sentence following the one where this is mentioned, is there a citation about how runout extent of the event is different when deposited primarily on ice?

Line 60: Why use the term “censoring” here?

Line 108: I would change this from “present day” since the RGI v6.0 was published in 2014 and likely stops with digitized outlines before then

Line 153: I’m not sure I understand the point that “GERALDINE is in effect standardised with this global supraglacial cover map” - it would be help to expand on this point

Line 185: I had to read this sentence a few times. Maybe stating this in terms of candidate events (instead of outputs) or being clear that identification step is the one that the user executes and that GERALDINE only presents candidates? (See point above, as I’m advocating for a particular language choice, just that it is a bit more clear and consistent)

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Line 211: Is introducing the acronym SLC necessary? It is only used once (I think). In general there are a lot of acronyms (see comment below on Figure 1)

Line 255: Am I understanding this right that GERALDINE could not detect multiple landslide deposits in about the same spot but at different times? This may never (or only rarely) occur, but I wasn't sure if that was the point this sentence was trying to make. Or, something else about how the "user will have already determined the date of these earlier supraglacial landslides"

Section 3.3 - it seems like it would be worth mentioning that you can do this in the abstract. That would also help expand on the "monitoring" side of the tool's name up front

Line 285: What are the current methods that GERALDINE outperforms? Manual inspection of individual images?

- Very very minor, but I also found that the original (and widely cited) paper by Ostrem has his last name typically spelled with a slashed O but in the original paper it is given with an umlaut. From my reading of this it may have been an older alphabet choice and that these are the same (https://en.wikipedia.org/wiki/%C3%96; https://en.wikipedia.org/wiki/Danish_and_Norwegian_alphabet). I just wanted to point out that the community overwhelmingly cites this paper with the author's name using a slashed O. And, subsequent work by Gunnar Ostrem uses the slashed O.

Figure 1: I would consider giving all these acronyms in the caption. Also, the second to last step isn't quite clear - what is "both" here?

Figure 2: This figure made me look back to the text to make sure if I understood that the maximum debris extent would merge the evolution of the event. I think that is true, regardless of the search timeframe (and somewhat dependent on the Landsat image separation). This would mean that to track the debris transport you would first find that an event occurred and then go back and look through all images to characterize how

it evolved - this is all a user step, right? I'm thinking of your Lituya Mountain example: if you instead ran GERALDINE for the timeframe of 2012-2014 you would get one maximum extent and then you would have to notice that the event occurred in 2012 and was still visible in 2013 and 2014 frames. This is still great since it is relatively little work to analyze around a particular event compared to finding the event in the first place. Right? I think some more context on how many events may exist and how laborious it is search individual frames may help put this in context. And, you could say a bit more about this workflow in Section 3.3, since what is said around line 260 isn't quite clear how that connects to what is shown in Figure 2 (if at all).

Supplement:

- Section 4.0 first paragraph should be "complementary" instead of "complimentary"

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