

## ***Interactive comment on “Supraglacial debris cover assessment in the Caucasus Mountains, 1986-2000-2014” by Levan G. Tielidze et al.***

### **Anonymous Referee #1**

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General comments: A thorough language editing is needed as there are issues and awkwardness in the sentence structure right from the first sentence of the abstract. I will not be pointing out them separately as they are present in almost every other sentence. There are several issues with the methods too as highlighted by Alifu, H. in his interactive comments. In the light of these issues, presently it is really difficult to comment upon the accuracy of the results. Also, how is this a review article as I can see in the manuscript type? It certainly is a research article and not a comprehensive review.

Specific comments: Below I provide some specific recommendations and queries: Abstract The article is about debris cover and therefore it is important to state its relevance properly instead of mentioning it in sweeping terms in both, abstract as well as intro-

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duction. The debris cover is relevant to study not just because of its impact on the glacier ablation but also because it is considered to be a significant part of an efficient sediment transport system (supraglacial, englacial, and subglacial) in cold and high mountains which ultimately affect the overall dynamics, and mass and energy balances of the glacier. Several studies have also reported debris cover's role in promoting the formation of supraglacial lakes. These mentions should come in the abstract and should be more detailed in the introduction along with proper references. Full forms of TM, ETM, SPOT, OLI, ALOS, ASTER etc. are not provided anywhere.

Introduction It is presently fragmented with small and incomplete paragraphs. Many relevant and recent references on debris cover mapping have been overlooked. The last paragraph of the introduction needs to talk about the present study, how is it filling the research gaps, and what is the structure of the paper. Study area Figure 1: The caption is very oddly structured. Usually the (a), (b), (c)... come before their descriptions. Landsat 8 is the correct name and not Landsat L8. P4L6: Spot must be in all capitals.

Data and methods P4L25-29: "...2016 (SPOT) for manual correction of glacier outlines..." which year's outlines? How does using 2016 image to correct the boundaries delineated on past images make sense when 2016 is not even a part of the temporal analysis? Also what was the footprint of the SPOT scene? It needs to be shown in Fig. 1. I am sure that it must have covered very few glaciers than the number that this study is trying to achieve. In that case, modifying the outlines of just a fraction of the total glaciers studied is only going to bring in more inconsistency in the analyses. Paul et al. (2013) statement that "high resolution imagery and manual delineation do not necessarily provide better accuracy, but they certainly provide a better understanding of the difficulties in mapping debris covered glaciers" is a very generalized statement. Glacier mapping results certainly get improved if the manual delineation is performed using high resolution images and of course a lot depends on the interpreter. No matter how much advocacy is presented in favor of semi-automated methods on Landsat or

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ASTER images, manual delineations on high resolution images still provide the best results. Certainly an approach using semi-automated followed by manual modifications is faster and preferable. Particularly, if you want to justify your use of SPOT image, then you should refrain from adding this Paul et al. (2013) sentence here as it is not only an overly sweeping statement but is also contradicting your actions. Why was the Ground Penetrating Radar (GPR) data used and how was it relevant? Also, what was the coverage of the GPR survey and it needs to be marked in fig. 1. P4L30-35: I agree with your choice of ASTER GDEM V2 over SRTM. Please add some references such as “Kääb, A., Treichler, D., Nuth, C., & Berthier, E. (2015). Brief Communication: Contending estimates of 2003–2008 glacier mass balance over the Pamir–Karakoram–Himalaya. *The Cryosphere*, 9(2), 557-564. (<https://www.the-cryosphere.net/9/557/2015/tc-9-557-2015.html>)” which talk about the penetration issues with SRTM DEM. Also provide reference for the DEM accuracy that you have mentioned. Table 1: Are the authors sure that 28/07/2000 scene was free of seasonal snow? I doubt it and I would like to see a screenshot of it with respect to August or September scene of the same year. Section 3.2: Many recent and relevant papers are missing here apart from a flawed description of Alifu et al. (2015) method. “. . .and three different combinations were attempted for OLI imagery 20 (23/08/2013) using either of the two thermal bands as well as an average of both bands: on Landsat 8. . .” What was the result of this exercise and finally which option was used? In any case, spectrally speaking, taking the average of two thermal bands does not make any sense. P6L15-19: I am really confused here. For what exactly the ASTER GDEM was used and why am I again see the mention of another DEM (ALOS) here? Why was there a need to use 2 different DEMs? What is the reported accuracy of ALOS DEM and why should we not suspect that it will also show some snow or ice penetration? Figure 2 is highly confusing. What does the use of Bands 5 and 8 mean here when they are nowhere described within the text?! Removing water bodies and shadows using single bands and not the indices is very unusual and highly doubt the results. P7L1-10 and section 3.4 are actually a part of the discussion and have been wrongly placed here. P9L4-11: Description of the validity

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and use of both, the GPR and SPOT data are vague and unclear.

Results Figure 12: Who did the GPR survey? How was the data processed? Where is the microwave profile? It really seems unconvincing seeing a depth of 220 m in the ablation zone of a mountain glacier!

As I mentioned here, presently the used methods are too vague and confusing to really assess the results and the discussion. I agree that the debris cover has increased but then it is happening almost everywhere. Also, the present conclusion is way too generalized! Of course we need monitoring using high resolution images for all the glaciers and it is not a conclusion which is specific for the study area here. Authors have failed in describing the region-specific needs for performing such a study and its long term implications for the communities.

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