

Interactive comment on “Glaciers change over the last century, Caucasus Mountains, Georgia, observed by the old topographical maps, Landsat and ASTER satellite imagery” by L. G. Tielidze

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Authors express their gratitude to Anonymous Referee #2 for the review and the proposed edition of the manuscript. My answers on the comments you can see below:

"Many previous studies referred in abstract. There is no need to refer previous studies in abstract. You can mention only previous studies".

I didn't referred no one previous study in abstract. It just mentioned, but really it seems, that they referred indeed. I will change it.

"There is no result (numbers) presented in abstract and general information provided".

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I will try to add result (numbers) in abstract.

"Introduction is too short and study area section is bigger than introduction. There is need to mention gap areas in current knowledge of glacier changes in Caucasus Mountains, Georgia in introduction".

I will add some information about current knowledge in introduction. As for study area, It worth to mention that this paper is a first English language scientific work, where dynamics of glaciers of the whole Georgia according to separate gorges and river basins in last century is revised. Accordingly, I assume that information from the section study area has scientific importance and we can't shrink the text.

"Also provide signiiňAcance of glacier change database generated in present study at century scale. Sound background (e.g. contribution by previous studies) is missing in introduction. Therefore, shift (refer) previous studies from the abstract in introduction".

I will try to do this.

"How identiiňAed debris-covered glacier tongue using Landsat images? This needs to be clariiňAed in manuscript".

In the Caucasus, supra-glacial debris cover has a smaller extent than in many glacierized regions, especially Asia (see Stokes et al., 2007; Shahgedanova et al., 2014), and it helped us to obtain even more accurate result. Also every year we have a expeditions almost the all river basins, and using by GPS we are measuring glaciers terminus.

There is also need to perform rigorous statistical test (non-parameter test - Mann-Kendall) to know the significance of air temperature trends. Section on error estimation is missing in manuscript and no uncertainty (+) presented with results.

I will try to do this.

"This study reported number of glaciers increased in recent time (i.e. 2014) as compared to 1911. There is no explanation provided of number increase in results section".

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The explanation and reasons of glacier number increase is presented in discussion section.

"May be surveyors left many glaciers (i.e. small glaciers) on topographic map in 1911 or ?. Careful verification of old maps is needed. If surveyors left to map glaciers on old topographic maps. This information should be mentioned in manuscript".

This information is already mentioned in my manuscript, please see P 3781, L 17-24. Also, to estimate mentioned errors is practically impossible. Podozerkiy's maps are so old that we can't get other, more precise information about glacier outlines.

"There are so many numbers presented in results section. I would suggest to mention important numbers (refer for others table ?) and provides their explanation. The reasons of glacier number increase presented in discussion section. This should be first mention in result section and discuss this issue in discussion. Discussion section is very weak and many issues are not addressed. For example, there is no comparison with previous studies (Russia and other surrounding range) provided in discussion whereas several studies has referred in reference list".

As I have mentioned this paper is a first English language scientific work, where fully is revised dynamics of glaciers of Georgia. So, I assume in a section results work results must be given in detail, I mean according to each river basins and not as a table, because the table does not fully express information given in text. As this section is quite large part of the paper and I think it does not need addition information. As for the comparison with previous studies, I have read almost all papers related to the Caucasus. As those papers does not comprise such large time period (for example: half century or one century), and because I decided not to compare them. But, if it is necessary I will try comparing some data.

"I would suggest to refer and study previous studies on glacier change in other regions (e.g. Bhambri and Bolch 2009, Bhambri et al. 2011, Bolch et al. 2010, Racoviteanu et al. 2008) for improvement of present manuscript".

TCD

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I will try to refer this previous studies.

"Other comments"

"P3778, L11: space images or aerial photos".

I agree.

"P3779, L11: modern Eurasian glacier to the present moment is not complete. which part of Eurasian glaciers? Be specific".

I have used this sentence from the paper Barry, 2006; Khromova et al., 2014, so I am not sure I have right to correct it.

"P3779, L26: glaciations or glaciers?"

You are right, glaciers.

"P3782, L19: ArcGIS"

I will correct it.

P3783, L20: Why 0.01 km². Why not 0.02 km² as recommended by international standards?

Because the area of all small glacier which we digitalized were 0.1km² and not 0.2km². We could not ignore them as such glaciers were more than one.

References

Stokes, C. R., Popovnin, V. V., Aleynikov, A., and Shahgedanova, M. (2007) Recent glacier retreat in the Caucasus Mountains, Russia, and associated changes in supraglacial debris cover and supra/proglacial lake development, *Ann. Glaciol.*, 46, 196–203.

Shahgedanova M., Nosenko G., Kutuzov S., Rototaeva O., and Khromova T. (2014) Deglaciation of the Caucasus Mountains, Russia/Georgia, in the 21st century observed

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