

## ***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***

**Anonymous Referee #2**

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Glaciers change over the last century, Caucasus Mountains, Georgia, observed by the old topographical maps, Landsat and ASTER satellite imagery

This study presents the quantitative changes in the number and area of the glaciers of Georgia at century scale (1911-2014). The air temperature trends of the high mountain weather stations of Georgia's has also been studied. Overall the glacier change and temperature trend analysis is valuable, particularly in light of enhanced recession rate of glaciers. However, there are many problems with present study. This manuscript requires substantial revision. Many previous studies referred in abstract. There is no need to refer previous studies in abstract. You can mention only previous studies. There is no result (numbers) presented in abstract and general information  
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provided. 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. Also provide significance 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. How generated recent glacier inventory using Landsat TM and ASTER images? What international protocol used for glacier mapping (see Paul et al. 2009)? How identified debris-covered glacier tongue using Landsat images? This needs to be clarified in manuscript. 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. 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. 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. 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.

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.

Other comments P3778, L11: space images or aerial photos. P3779, L11: 'a modern Eurasian glacier to the present moment is not complete' which part of Eurasian

glaciers? Be specific.

P3779, L26: glaciations or glaciers?

P3782, L19: ArcGIS

P3783, L20: Why 0.01 km<sup>2</sup>. Why not 0.02 km<sup>2</sup> as recommended by international standards?

#### References

Bhambri, R. and Bolch, T.: Glacier mapping: a review with special reference to the Indian Himalayas, *Prog. Phys. Geog.*, 33, 672–704, 2009

Bhambri, R., Bolch, T., Chaujar, R., K. and Kulshreshtha, S. C.: Glacier changes in the Garhwal Himalayas, India 1968–2006 based on remote sensing, *J. Glaciol.*, 97, 543–556, 2011

Bolch, T., Yao, T., Kang, S., Buchroithner, M. F., Scherer, D., Maussion, F., Huintjes, E., and Schneider, C.: A glacier inventory for the western Nyainqentanglha Range and the Nam Co Basin, Tibet, and glacier changes 1976–2009, *The Cryosphere*, 4, 419–433, doi:10.5194/tc-4-419-2010, 2010

Paul, F. R., Barry, R. G., Cogley, J. G., Frey, H., Haeberli, W., Ohmura, A., Ommanney, C. S. L., Raup, B., Rivera, A., and Zemp, M.: Recommendations for the compilation of glacier inventory data from digital sources, *Ann. Glaciol.*, 50, 119–126, 2009.

Racoviteanu, A.E., Y. Arnaud, M.W. Williams and J. OrdonÉIJ ez. 2008. Decadal changes in glacier parameters in the Cordillera Blanca, Peru, derived from remote sensing. *J. Glaciol.*, 54(186), 499–510.

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Interactive comment on *The Cryosphere Discuss.*, 9, 3777, 2015.