Dear colleague,

Thank you very much for your effort and valuable comments. We have tried to consider every single one of your suggestions – hopefully to your satisfaction.

Best regards

The Authors

Response to reviewer #3

This manuscript aimed to use ICProx algorithm to determine deformations that occurred at a rock glacier. It is an interesting research, but it has a far distance to acceptance. Some of my advices are the following:

(1) The mehtod is presented by this reserach or by other researches. It is not very clear.

We were not sure what you meant by this.

(2) In abstract, the content about this research is limited. Most of the contents are background introduction.

In general, we as Geodesists try to answer the following questions in the abstract:

What is the general problem?

"Current research questions in the field of geomorphology focus on the impact of climate change on several processes causing subsequently natural hazards. Geodetic deformation measurements are a suitable tool to document such geomorphic mechanisms e.g. by capturing a region of interest with terrestrial laser scanners which results in a so-called 3D point cloud."

What is the particular problem?

"The central problem in deformation monitoring is the transformation of 3D point clouds captured at different points in time (epochs) into a stable reference coordinate system. To date, this step has been mostly carried out by usage of artificial targets and/or control points. Several drawbacks are related to this strategy such as the enormous effort to distribute the targets within the area of interest, the required survey by additional geodetic sensors such as total stations or GNSS-receivers as well as the limited extent within the region of interest."

How do we solve the particular problem?

"In this contribution a surface-based registration methodology, termed the iterative closest proximity algorithm (ICProx), that solely uses points as input, similar to the iterative closest point-algorithm (ICP), and hence does not require any artificial targets or extracted geometric primitives, such as planes. The aim of this study was to automatically classify deformations that occurred at a rock glacier, an ice glacier as well as in a rock fall area. For every example two epochs were processed while the ICProx-algorithm's classification accuracy is 70% on average in comparison to reference data."

(3) From the introduction part, I can not found what this research aims to do and why conduct this research?

At the end of the first chapter we state the following: "The most delicate step in this processing chain (linked to deformation monitoring) is the transformation of single epochs into a common reference coordinate system, which is also referred to as registration or matching of point clouds. Erroneous effects that occur in this step have an immediate and systematic impact onto the quantification of deformation. Thus, all conclusions that are drawn based on the generated results are falsified."

We have structured the manuscript in three major parts:

- Section 3: Description of the algorithm
- Section 4: Description of the areas of interest
- Section 5: Discussion of the results

Regarding other research: There is no other algorithm than ours that is capable to automatically identify deformation within unregistered point clouds. Hence, we could not compare to other implementations.

We weren't sure if you were referring to the classification accuracy. If so, we have added the following sentence that explains the cause of this result.

"Hence, an extension has to be implemented that is capable to determine an optimal octree size under consideration of the local topography. This information could also be used to dismiss certain octree cells due to insufficient geometric properties that would **otherwise occur in the algorithm's numerical and visual assessment**."