General comments

We thank you for seeing the potential of our study and for helping us to improve our mauscript with your objective and constructive comments. We see the need to revise the analyses as well as to shorten and restructure the manuscript and will do so according to your suggestion. We have already addressed some of the points in a similar way in the responses to reviewer 1's comments, but will address your comments again in detail below. Please find our answers in blue in the text.

I highly agree with the opinion of the anonymous referee #1. Because of the high potential of the present paper I would like to add some personal comments helping the authors to improve their paper.

Permafrost studies are currently a hot topic in view of climate change. The authors focus on mountain permafrost, i.e., they want to understand the spatio-temporal change of rock glacier kinematics not only locally (single rock glacier) but on a more regional scale (several rock glacier, e.g., located in a valley or catchment area). The authors want to find out how nearby rock glaciers react (geometrically) to changing environmental conditions, i.e., MAAT, precipitation, snow cover, etc.

Change detection analysis is based on archival aerial photographs and ALS data. The proper processing of these data is not easy and requires a lot of knowledge and experience. I am confident that the data has been processed accordingly.

My mayor concern is on data analysis which has already been addressed by the anonymous referee #1. I'm referring to page 12 where the concept of 3D displacements on rock glaciers is outlined. The authors should clarify the term 3D displacement. To my understanding 3D displacement is a 3D vector describing the dislocation/movement of a point or distinct feature of an object/surface in space (and time). However, the authors of the paper interpret 3D displacement as a distance into a normal direction following the idea of Lague et. al. (2013). Commonly, this algorithm is called M3C2. This algorithm has same advantages, especially in interpreting surface change and its significance. The authors' quantitative analysis of the rock glacier kinematics is based on 2D/horizontal displacements and on volume change. The latter, however, has not been carried out in a fully correct way. Since volumetric change, as implemented in the paper, is based on gridded '3D displacements' (cp. P12L303-304) the obtained volumetric changes are inherently wrong. The authors would have derived a correct result if they had taken (0,0,1) = vertical axis as a reference direction. Due to the specific kinematics (e.g., extending creep internal mass transport) and the geometry (e.g., steep frontal slope) of rock glaciers the obtained volumetric changes are preferably/systematically negative (see Figue 8). I advise the authors to re-evaluate volumetric change. The authors may use M3C2 (properly modified) or a simple difference of digital elevation models (DoD).

First of all, we agree with you that the term 3D displacement is misleading. After reading your comment we understand that the calculation of the volumes by gridding the point cloud based suface elvation changes is subject to a small but systematic error. This has a slight effect on the absolute volumes, but hardly on the relative change of the volumes over time. Therefore, the conclusions derived from the calculations will not change. Nevertheless, we see the need to improve the calculation of the volumes! We will therefore determine the volume via a classic DoD analysis and determine the uncertainty according to Anderson (2019) -

https://doi.org/10.1002/esp.4551 . *In order to avoid confusion and to facilitate comparability with other studies that determine the surface changes of rock glaciers by means of DoD analysis, we will also change the other analysis of surface elevation changes on the basis of DoDs.*

In any case, the authors should include profound error analysis, i.e., significance analysis, for their velocity data (2D, horizontal) and their volumetric change results (1D, vertical, integral value obtained for an area).

We have systematically analysed the errors of flow velocity analysis and surface elevation change analysis on stable areas. The approach to determaine the significance of flow velocities of rock glaciers is published in a peer-reviewed journal (Fey&Krainer 2020). We include this value in all figures and will show the areas below the LoD values in the respective maps in the revised version. In the case of uncertainty analysis of volumes, we will follow Anderson (2019).

The paper will benefit from a more formal structure, such as

We agree that restructuring will bring more clarity and better readability.

Introduction (please clearly specify the research questions),

We will rewrite the introduction as suggested by Reviewer 1 and clarify the research questions. The rewrite will condense the section on general rock glacier characteristics and add a more detailed description of the current status/velocities of rock glaciers.

Study area,

Material (First: aerial photographs and ALS data; Question: What is the reason for not using recent aerial photographs? There is lots of data available at BEV! A comparative analysis would have boosted all results obtained. Second: Supplementary material, such as meteorological data, etc.

We agree that a separation of materials and methods would provide a clearer structure and overview, especially since many different data were used. We will revise the materials and methods section of our manuscript according to your suggestions.

We know the availible BEV data as we have obtained many of the historical aerial photographs here. We decided against using the available more recent BEV aerial photographs because we have collected and/or postprocessed ALS data ourselves that cover more recent study period (2006-2017) and provide the desired information we need to answer our research question.

Methods (photogrammetric mapping, georeferencing, SfM; processing/georeferencing of ALS data; 2D-displacement measurements (orthophoto-orthophoto, orthophoto-hillshade, hillshade-hillshade; software used; precision/accuracy assessment). Question: What is the reason to use hillshades instead of original elevation data?; computation of volumetric change (method, precision/accuracy assessment); Supplementary material (explain data aggregation, etc.)

Since the elevation model of the 1997 dataset has a relatively poor resolution, a calculation of the flow velocity by image correlation with the 2006 ALS dataset in the elevation data was not successful. We state this in the manuscript (P10L241-242). In order to avoid using an additional data type for the determination of the flow velocities, we have also used hillshades for the epochs 2006-2012 and 2012-2017. The calculation of the flow velocity with the help of hillshades is a common procedure that is used in many studies (e.g. Dusik et al. 2015; Bollmann et al. 2015)

Nevertheless, we will restructure the methods section according to your suggestions.

Results (present the results obtained. Maybe, you can find a good way to also aggregate the results)

We will present the strictly factual results in the revised version.

Discussion (discuss the kinematics (movement, volumetric change) of the rock glaciers in a regional context. Is there a correlation in space and time? Interrelate the kinematic information with the supplementary data.)

We will adopt the suggestion for the structure of the disscusion.

Summary (optionally)

Specific comments

The title should reflect the content of the paper. Do you really want to address morphodynamics? Did you mean kinematics? Morphodynamics would imply process understanding.

We will change the title accordingly.

The paper is too long and could benefit from shortening. Maybe, it is not important to discuss each rock glacier in detail. Is there a common response? If not, why?

The restructuring and revision of the introduction, the methods and materials section and the results and disscusion sections will result in the publication being significantly shortened, also because we will keep the results and discussion section more general where appropriate and possible and, for example, delete the special cases section.

Some of the figures are too small and too overloaded and thus they are not readable.

We assume that you are referring mainly to figures 5 and 9. in these figures we will separate the diagrams and maps and make them into two figures. If this takes up too much space, we will move the diagrams of the altitudinal zones to the appendix.

Figure 8: Mean annual volume change (m2) per 100m2 = mean surface height change (cm) !!!

We agree. We will specify the mean surface height change in cm in the revised version.