Response to Reviewer 1 Comments

Dear Reviewer 1,

Thank you for taking the time to thoroughly review our manuscript and for your constructive feedback. We greatly appreciate your recognition of the value of our research and the positive comments about the paper.

In response to the points raised by Reviewer 1, we have made specific revisions to the manuscript:

Point 1: According to the title, your article is mainly focused on 'accuracy optimization of structure'. The area used to prove the study is 225*253 m^2, and the elevation difference seems to be 15 m (p. 7, line 242). There are two specific questions here.

a. Why did you use DSM as a target for validation? For general use, wouldn't it be better to validate against a general target (objects like trees, buildings, or specific point objects) other than the DSM?

Response 1a: In our study, we analyzed deformation patterns (like doming, bowling or tilting) stemming from the "Structure from Motion" workflow itself, which usually affect the entire processed area and are not easily determined when only looking at point targets like buildings or GCPs. We also used 10 ground control points (GCPs) as additional markers in the landscape to determine the accuracies of the UAV DSMs (see Table 7). For this reason, we also wanted to incorporate an approach which can be used to estimate the deformation for each part of the study site. This area-based approach cannot be achieved through GCPs alone but with an additional DSM dataset such as the lidar-based DSM used in this study. We added the following sentence in lines 399 – 403:

- **"The lidar-based elevation data was selected as the reference dataset because we employed an area-based approach to evaluate deformation patterns in the SfM workflow, necessitating a complementary lidar-based DSM of the whole study site, supplemented by 10 GCPs, for comprehensive accuracy assessment."**

b. When looking at the area and elevation difference, the area does not appear to have a severe elevation difference. Of course, it is not possible to know the irregularities of the area, but how can we say that the area is a proper area to show the validity of this study?

Response 1b: This study was conducted as a preliminary test as part of the UndercoverEisAgenten project were consumer-grade drones are utilized for permafrost monitoring conducted by non-scientist citizens and students. We tried to select a local study site with similar low-relief topography

in order to test our optimized flight designs. Other studies have suggested flat and homogenous terrain as the most challenging terrain for the SfM workflow with high susceptibility to errors (see line 201 - 204).

- Griffiths, D.; Burningham, H. Comparison of pre- and self-calibrated camera calibration models for UAS-derived nadir imagery for a SfM application. Progress in Physical Geography: Earth and Environment 2019, 43, 215–235. https://doi.org/10.1177/0309133318788964.

For these reasons the study site was selected to be challenging for the UAVs while simultaneously providing insights for our future studies. So, if the approach works here in reducing the errors, it should also work in areas with more heterogenous landscape and more topography as these are usually less prone to errors in the first place. The following sentence was added at the end of section 2.2 (lines 348 - 351) to clarify this fact:

- **"The selected study site was deemed appropriate for this investigation, as low-relief and homogeneous landscapes are considered particularly challenging for SfM workflows [41]. The area thus serves as a suitable test environment for UAV-based monitoring procedures."**

Point 2: The authors are using HDM as a means of demonstrating their research achievements. Lidar DTM can be considered true values because that is created by credible organizations, so it can be considered credible data. However, I cannot confirm anything about the accuracy of that data. According to p.13 line 392 the resolution is expressed. But what about height accuracy? Is the accuracy high enough to support the success of this study?

Response 2: Indeed, we forgot to mention the stated accuracies of the lidar-based DTM in this study, which is now added to the sentence in line 399. We added the following part to provide the necessary information from the files' metadata. The sentence was:

- "This dataset is based on lidar elevation data acquired in 2020 and has a resolution of 1 m."

and is now:

- **"This dataset is based on lidar elevation data acquired in 2020 and has a resolution of 1 m with stated XY-accuracy of 0.15 m and Z-accuracy of 0.09".**

The stated lidar-based accuracies are well within the margins of the UAV dataset errors and thus useful in determining the accuracy of the datasets.

We believe that these revisions have improved the clarity and comprehensiveness of our manuscript. We hope that our modifications will meet the approval of the reviewers and editors.

Once again, we thank you for your thoughtful feedback and the opportunity to enhance the quality of our manuscript. We look forward to your positive consideration.

Kind regards,

Marlin M. Mueller et al.