

Brief communication: Improving botanical monitoring in proglacial areas with high-resolution UAV data

Review by Anonymous 2

We thank the reviewer for their suggestions and comments which we followed to improve the manuscript.

I carefully read the manuscript “Brief communication: Improving botanical monitoring in proglacial areas with high-resolution UAV data.” The manuscript is well prepared and clearly presents the research questions and the workflow adopted to address them. However, the abstract is quite brief and should include some information about the main results.

We modified the abstract to take into account this comment (common to all three reviewers), keeping in mind the 100-word limit:

“Proglacial areas are undergoing rapid ecological and land cover changes as glaciers retreat globally. Unmanned Aerial Vehicles (UAV) are particularly suited for monitoring such complex terrains but vegetation retrievals, such as vegetation cover, have rarely been evaluated against traditional botanical surveys. In this study, we compared the vegetation cover derived from UAV images at various resolutions with vegetation cover measured in situ by experts below the Aneto glacier (Pyrenees). UAV retrievals accurately captured the altitudinal gradient in vegetation cover and the spatial variability between vegetated plots. While increasing image resolution reduced biases, they remained significant in areas with sparse vegetation”

Since the study performs an automatic classification of several land cover classes, it would be useful to provide a confusion matrix to better evaluate the classification performance.

Thank you for this suggestion. We added confusion matrix (Fig. S3 and S4) and the analysis of derived indices:

Methods 2.2.

“The land cover maps were evaluated with a random selection of about 20 points per maps and class for a total of 480 points which class were visually inspected.”

Results 3.1.

“The confusion matrix derived from the evaluation dataset showed the good performance of the classification with F1 score between 0.85 and 0.91 around A1 and 0.71 and 0.77 around A4-6 (Fig. S3 and S4). The classification appeared, thus, more reliable around A1 than A4-6. The increase in resolution had no systematic impact on the classification performance. This is, however, not an independent evaluation of the cover map since the evaluation dataset was obtained through image

interpretation similarly to the training dataset. The main classification error was rocks in shaded area classified as vegetation, especially around the points A4-6.”

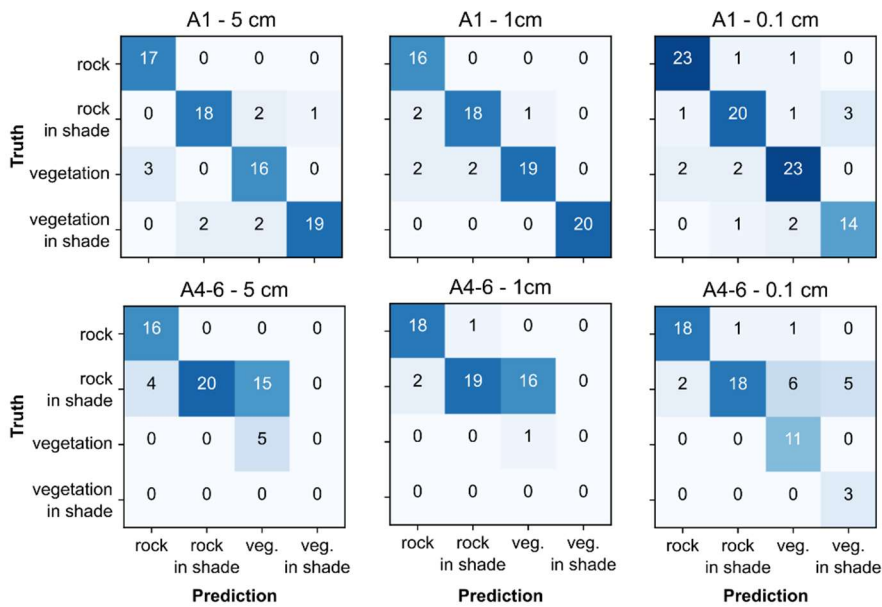


Figure S3. Confusion matrix based on visual interpretation of pixels randomly selected among each set of classification. About 20 pixels per class and set of classification were obtained

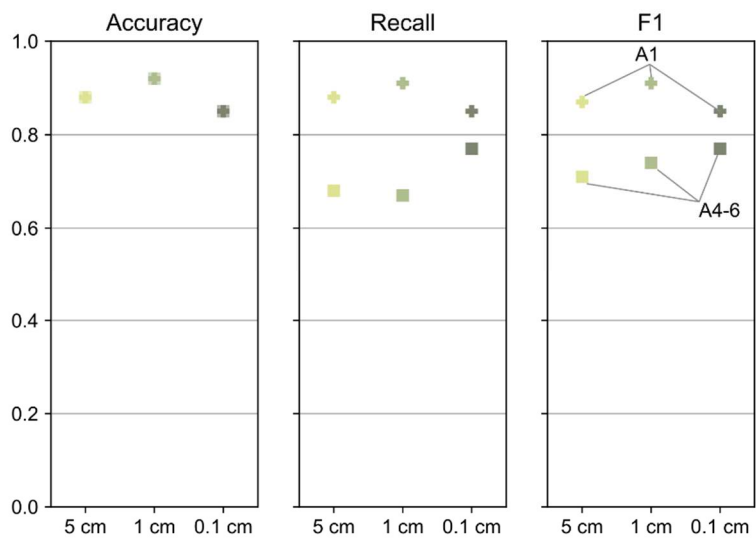


Figure S4. Accuracy, recall and F1-score average across all classes, weighted per the number of pixels in each class.

I would also like to ask the authors for a small clarification regarding the use of optical RGB data. Could the introduction of near-infrared (NIR) data potentially improve the performance of classifications at lower spatial resolutions? Vegetation is highly sensitive to this wavelength, and

many vegetation indices rely on NIR. A short discussion of this aspect could strengthen the manuscript.

We fully agree with this idea and modified the text accordingly:

“More complex vegetation cover retrievals using convolutional neural networks or adding bands derived from topographic information do not seem to guarantee better results (Niederheiser et al., 2021; Zangerl et al., 2022). However, it might be beneficial to include RGB-derived indices or to acquire near-infrared images to derive the NDVI values, as it is an index specific to vegetation (Bayle et al., 2021).”

I also suggest a few minor improvements to the figures:

Figure 1: I suggest adding the dates of the glacier fronts in the legend.

We followed this suggestion:

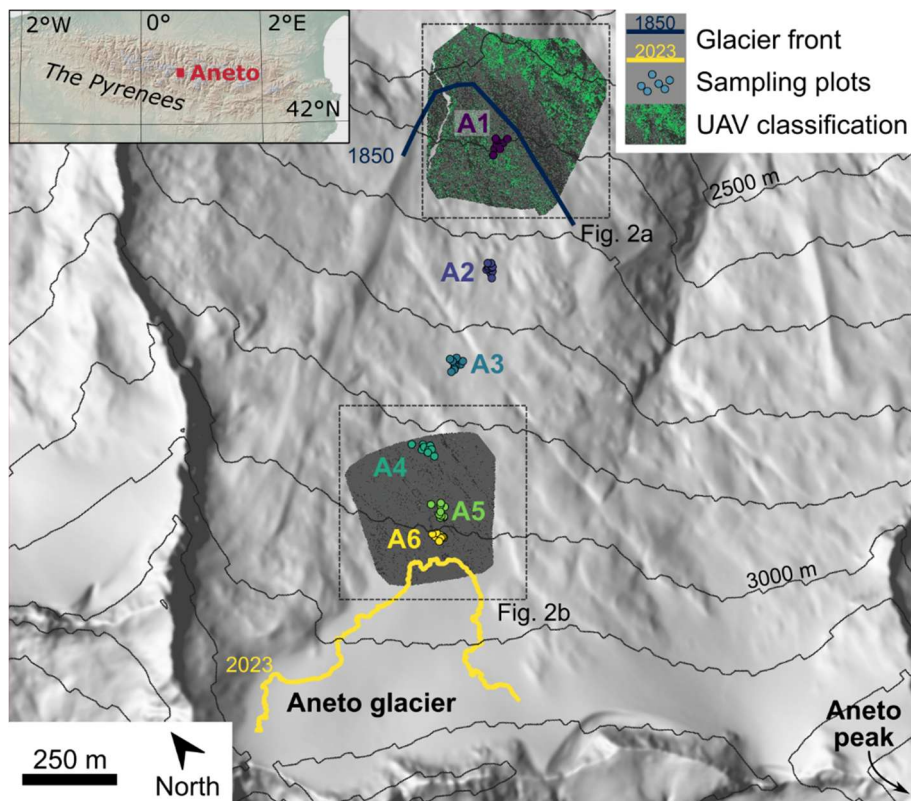
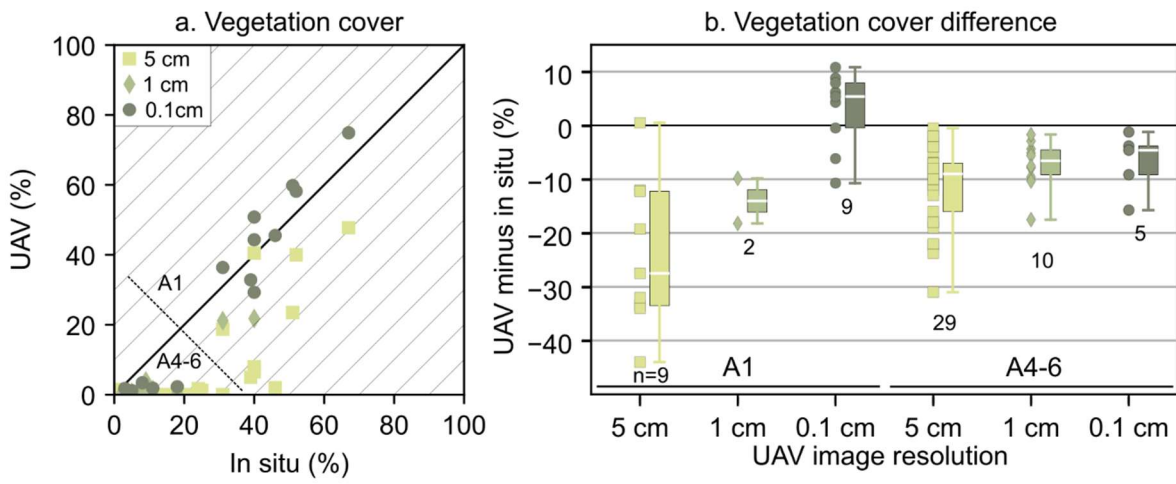


Figure 2 (vegetation cover plot): I suggest adding borders to the symbols to better distinguish the points from area A1 from those belonging to areas A4–A6.

Text and a delimitation line were added on the figure to indicate points from A1 and from A4-A6:



Overall, the article can be accepted after these minor revisions.