Mapping the Vegetation of the Caucasian Ushba Region (Georgia, Russian Federation) as a contribution to an Alpine Club Map

by **Michael Hallett**

This thesis forms part of a team project to produce an Alpine Club map sheet for the Ushba region in Svaneti, Georgia. Classification was carried out using a mixture of remote-sensed image data and relevant literature. Due to the ongoing Covid-19 pandemic throughout 2020 the practicality of a field trip to take measurements was unfeasible. Therefore, accurate references for training data were sourced online in the form of geotagged photos and high-resolution satellite images. For the classification, Landsat-8 and Sentinel-2 satellite images were used along with ERDAS IMAGINE software to produce a classification with three vegetation classes:

1. Mixed High Forest Stands

2. Krummholz

3. Alpine Meadow

Vegetation Zones

Knowledge on the vegetation present within the Ushba region was gained from literature particularly the books by George Nakhutsrishvili[1][2]. From a review of the literature it was possible to recognise up to four vegetation zones characterised by similar vegetation species and existence within defined altitudes. It should also be noted that the impact of hemeroby is high within the Ushba region due to centuries of human presence and interaction.

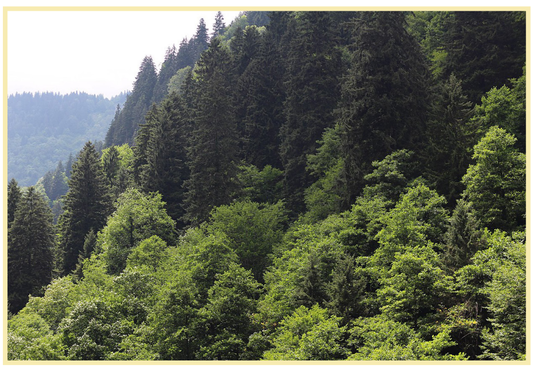

Figure 1 - Image showing a high forest stand environment within Ushba of mixed coniferous and deciduous tree species. [3]

Figure 2 - View of Alpine Grassland with Ushba in the background. [4]

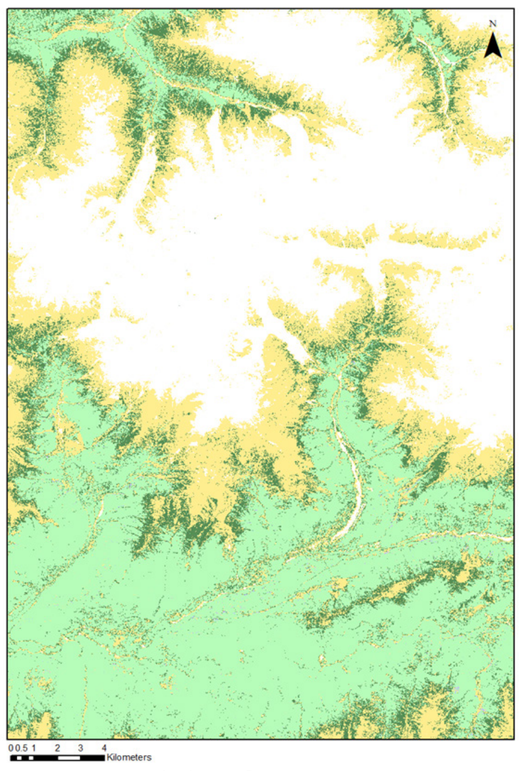

Figure 3 - Final classification output. Mixed high forest stands in light green, Krummholz in dark green and Alpine meadow in yellow.

Data Acquisition

Due to the cancellation of the planned field trip all references for the training areas were sourced online. Where possible a geotagged photo was preferentially used but often the existence of geotagged photos was not sufficient in providing a complete coverage of the entire mapping area.

All satellite data used was completely free and easily accessible from the governmental sites:

- Copernicus Open Access Hub
- USGS Earth Explorer Website

Satellite image scenes were chosen based on their cloud cover percentage with the aim of covering the entire growing season between April 2017 - July 2020.

Method - Work Flow

A hierarchical classification method was used within this study to first extract vegetation from non-vegetation components preceded by the classification of individual vegetation classes. Prior to this the stage image scenes went through several post-processing stages to make sure all data was homogenous and compatible.

ERDAS IMAGINE software was used to carry out the supervised classification - utilising the training areas gained from online sources. The resulting classification can be seen in figure 3.

Outputs

The resulting classification made use of prior knowledge of Alpine Club maps in the determination of the number of classes and their representation. Distinct vegetation boundaries were chosen to provide clear visualisations of where the borders between vegetation classes existed - something which also matches with the format of previous Alpine Club maps.

Colours were kept neutral to allow the vegetation layers to act as the map background and not distract from more important map information such as hiking trails.

As well as the final classification output, time series of both classification and NDVI were generated to show the change in vegetation throughout the growing season and over the last 3 years. Comparisons were also made between the two satellite image sources to prove their compatibility and differences in classifications reached.

Conclusion

The aims of the study were all met despite the mitigating circumstances under the Covid-19 pandemic. A vectorised vegetation layer has been produced which is usable at the suggested map sheet scale of 1:33,000. A confusion matrix and subsequent Kappa calculation gave overall accuracies of 86% and a Kappa value of 0.78 despite the unreliability of using online references for training data. Therefore, the overall result is positive but can certainly be improved in the future with the undertaking of a field trip planned for 2021.

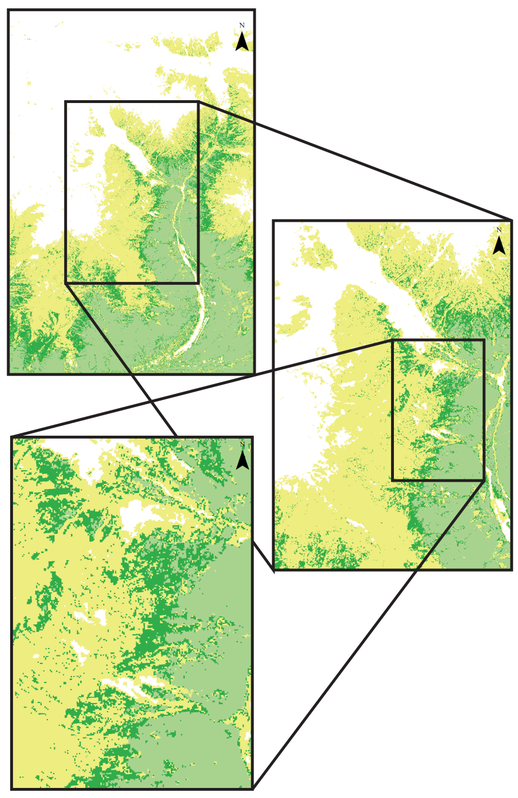

Figure 4 - Close view of the vegetation borders resulting from the classifications. Respective scales of 1:55,000, 1:25,000 and 1:10,000.

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Remote sensing, image classification, vegetation mapping, image analysis.

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