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How Low Can it Go: The Mountain Image Analysis Suite

Evaluating the Mountain Image Analysis Suite (MIAS) on low elevation urban landscape images to assess efficacy for quantifying landscape change.

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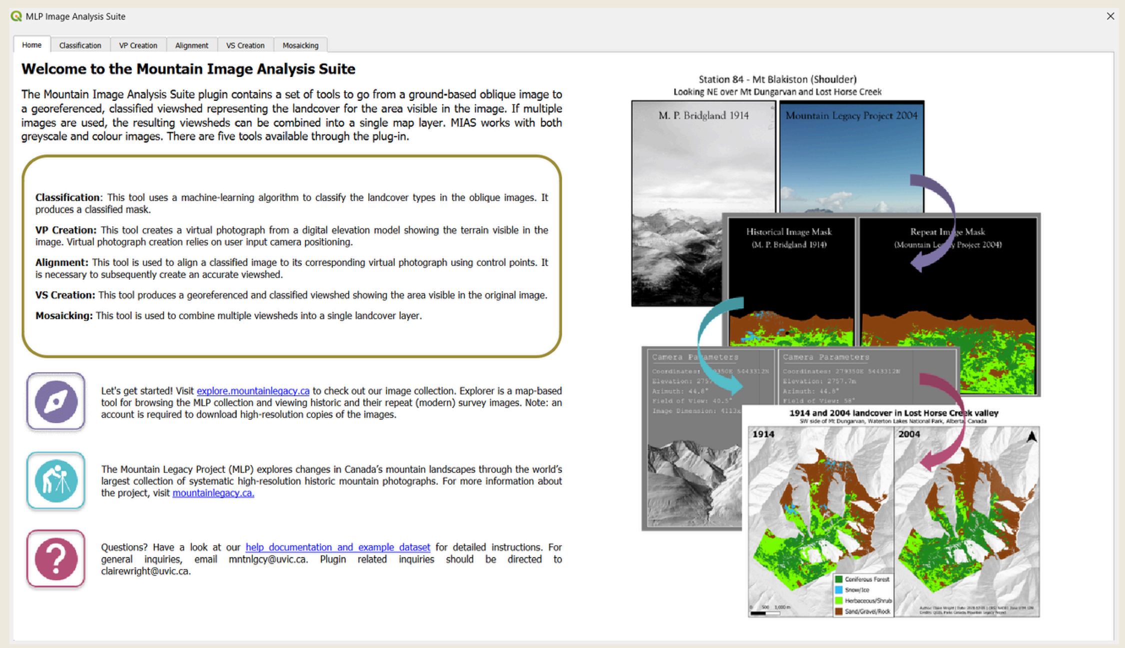
01. Introduction

Repeat photography is the technique of systematically photographing a landscape or focal point over time based on historical reference imagery. This is typically done with *oblique* photographs (taken at an angle to the ground, usually horizontal). The documentation of coordinates, azimuth, lens height and area description allow for a returning photographer to replicate the photograph [1; 2]. Sequential images can then be used to study a range of changes such as glacial retreat, natural disasters, and ecological shifts through time [3].

To assess quantitative landcover change between historic and repeat image pairs, PhD Candidate Claire Wright (UVic's Ecovisualization Studio) developed the Mountain Image Analysis Suite (MIAS) software package. This open source QGIS plugin generates landcover viewsheds from both colour and greyscale imagery, enabling comparison of historic and contemporary landscapes. To date, MIAS has been used primarily within the Mountain Legacy Project (MLP) research group on high alpine imagery.

Questions of the efficacy of MIAS on low elevation image analysis have arisen. Thus, testing the software on low elevation imagery will provide a scope of applicability for MIAS and identify areas where improvements can be made. To do this, MIAS will be tested on two images taken from Pkaals (Mt. Tolmie, Victoria), looking Northeast towards PKOLS (formerly, Mt. Douglas, Victoria).

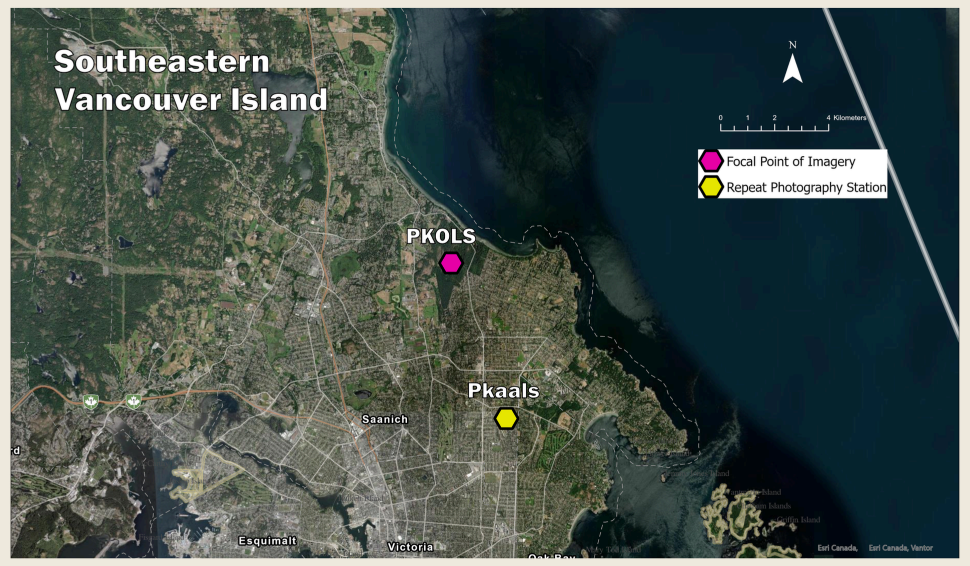


Landing Page for the Mountain Image Analysis Suite in QGIS

02. Objective

To understand how effective MIAS is with low elevation image analysis, and understand limitations and future improvements.

03. Study Area

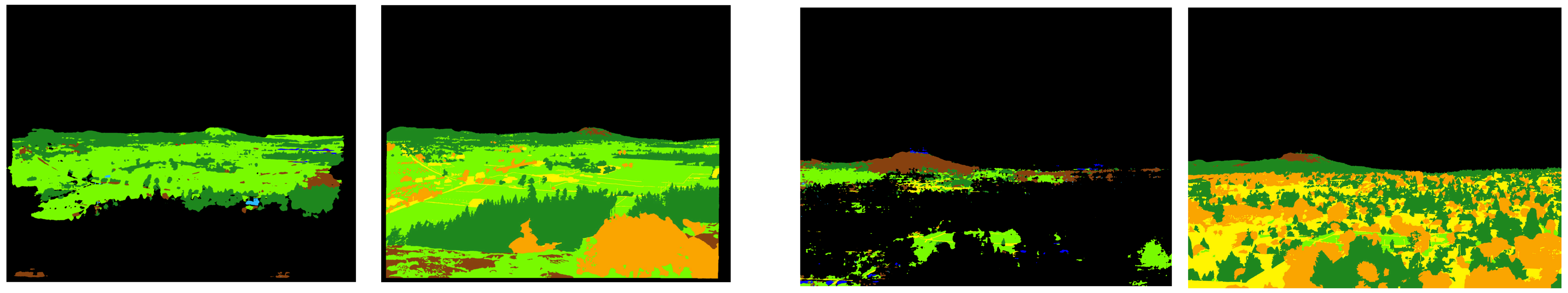


PKOLS and Pkaals in Southeastern Vancouver Island. Basemap sourced from ESRI Canada World Imagery [4].

04. Methods

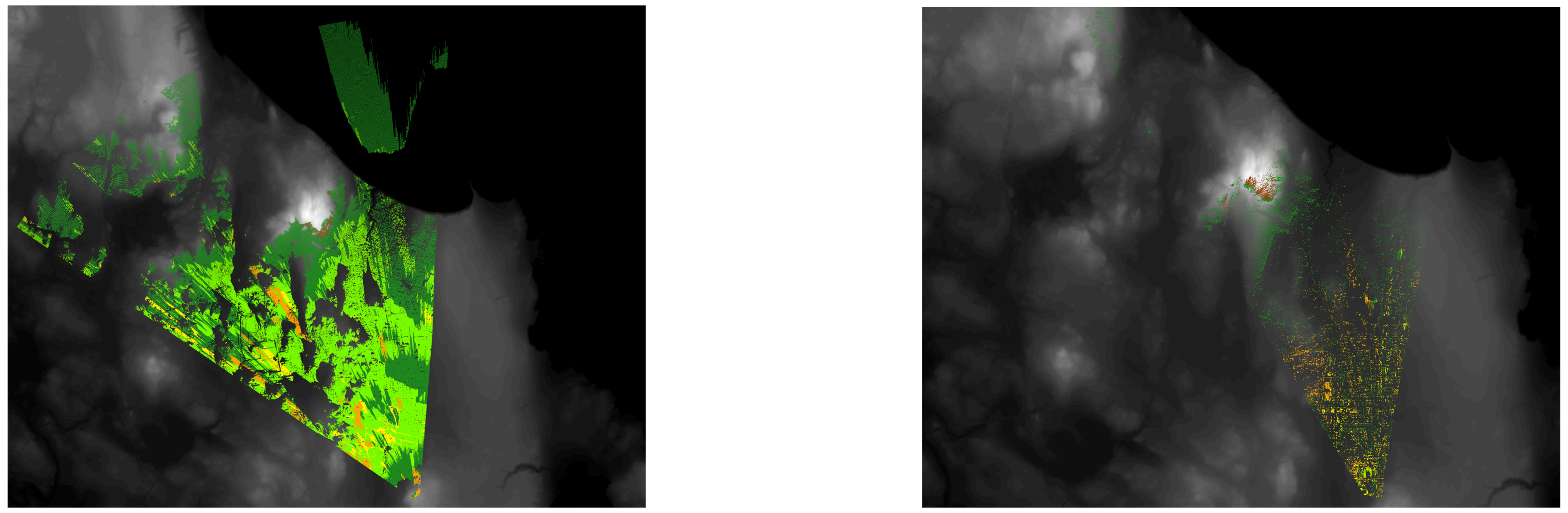
For this study, four of the five steps of MIAS were used, through QGIS. (1) Classification; (2) Virtual Photograph Production; (3) Image Alignment; and (4) Viewshed Creation. Resulting landcover masks were compared to assess how MIAS can be improved to better analyze low elevation imagery. An historic image taken in 1908 by an unknown photographer, and provided to the project by the BC Archives (Left), was chosen to test historic imagery [5]. A repeat image taken in 2022 by C. Laurent was chosen to test colour imagery. This image was provided to the project by the RNS Program, University of Victoria.

Images of interest were identified, particularly those which had a historic image pair.



Landcover masks of images were created in MIAS using the automated deep learning classifier and pretrained models available on the MLP Github (left image in each pair). Landcover masks were manually corrected in Affinity Photo to increase mask accuracy (right image).

Virtual images were created using a 1m digital surface model (DSM) and user-provided camera parameters.Classified masks were aligned to the corresponding virtual photographs using four control points per image



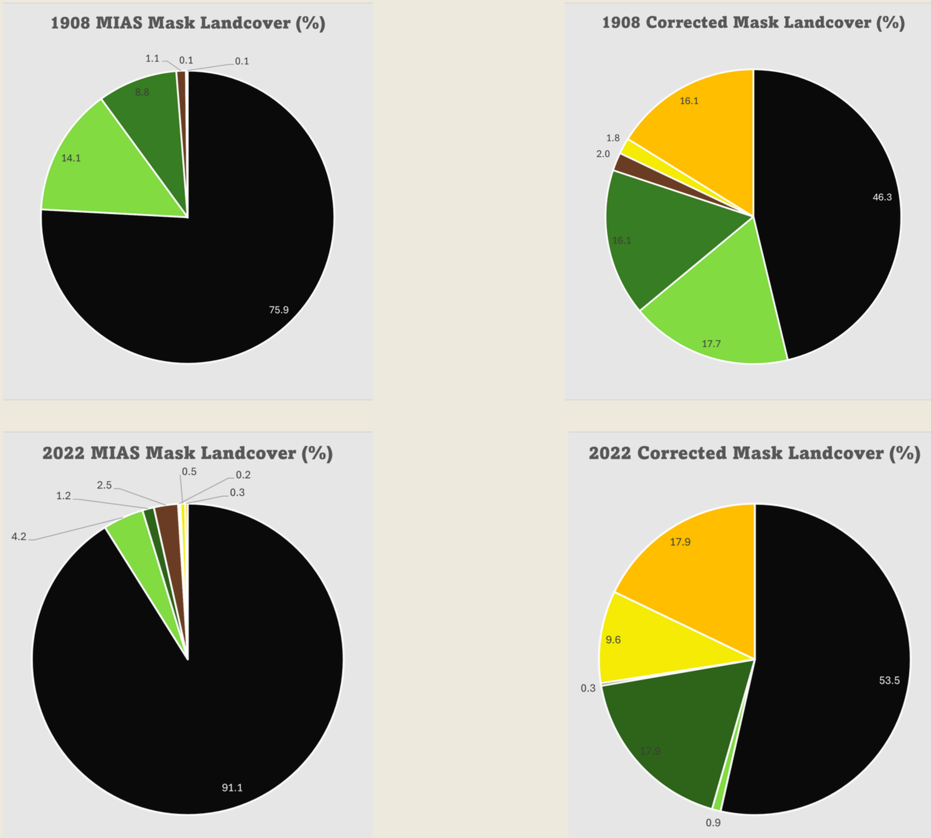
Corrected landcover masks were georeferenced and layered against the digital terrain model (DTM, left) and DSM (right) to create a viewshed (partial map) of the land classifications of the region.

Coniferous Forest | Broadleaf/Mixedwood Forest | Herbaceous/Shrubland | Rock/Barren Ground | Water | Recently Disturbed | Snow/Ice | Built Environment

05. Results and Discussion

Although MIAS was created with the intention of landcover mapping of high elevation imagery, it can be adapted for low elevation imagery with some limitations.

- Further training of the landcover classification model with low elevation imagery is needed to produce classifications without extensive manual corrections.
- MIAS tended to overproduce Not Categorized pixels (black), while underproducing coniferous forest (dark green), broadleaf mixed forest (orange), and built environment (yellow).



- Large trees in the foreground create shadows in imagery, posing issues with detailed land classification. To achieve a full viewshed, multiple images from differing angles should be mosaicked together.
- Foreground vegetation may also change (growth, re-planting, etc.) in the interval between image acquisition and DSM/DTM LiDAR scan, causing misclassification.
- The classification scale used in this study does not apply well to the georeferencing stage, thus a less detailed mask should be used for classification (i.e. classifying the city as build environment rather than outlining individual trees).
- During viewshed creation, the DSM is more accurate for highly detailed masks, whereas the DTM is more accurate with images with a general classification scheme or less vegetation.
- With the increase in aerial imagery, landcover maps with higher accuracy can be created for most areas at low elevations. This plugin is primarily useful for looking at historic imagery before aerial imagery was available, or highly topographic terrain which can favour oblique over aerial imagery.

06. Conclusion

MIAS shows potential for quantifying landcover change in low elevation landscapes, when there is limited tree cover or general classifications are applied to the landscape. With additional training it is likely that the landcover model will produce stronger results. The virtual photograph feature of MIAS may be useful in synthesizing imagery at low elevations, but creating exact repeats of imagery is difficult. MIAS has advanced capacity for quantifying change using high resolution, high elevation oblique images. My work has shown that these software tools hold promise for a wider range of applications, well beyond the Mountain Legacy Project.

References

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