The Benefits of SWIR Imagery for Archaeological Landscape Analysis: A Case Study from Easter Island (Rapa Nui), Chile

Dylan Davis
Binghamton University–SUNY, dsd40@psu.edu

Carl Lipo
Binghamton University–SUNY

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The Benefits of SWIR Imagery for Archaeological Landscape Analysis: A Case Study from Easter Island (Rapa Nui), Chile

Dylan Davis and Carl Lipo, Department of Anthropology, Binghamton University

Introduction

The use of multispectral imagery is particularly effective for mapping the archaeological record of Rapa Nui (Easter Island) due to the island’s lack of vegetation and exposed surficial lithic features. In 2010, Flaws demonstrated that near-infrared (NIR) imagery can be used to identify “lithic mulch” gardens, areas of cultivation that are enhanced through the prehistoric addition of broken bedrock. Here, we evaluate newly available, high-resolution short-wave infrared (SWIR) imagery for its potential to provide additional resolution and discrimination in mapping “lithic mulch” features.

What is Lithic Mulch?

- Lithic mulch is a prehistoric cultivation practice in which broken pieces of bedrock are added to soil.
- On Rapa Nui, mulching increases soil nutrients and moisture to sufficient levels to allow for sweet potato crops.
- Protects crops from prolonged winds, erosion, and temperature variability.
- Covers approximately 76 km² of the island (Booth et al. 2004).
- Key part of Rapa Nui subsistence practice.

Flaws (2010)

- Use of NIR band (760-1050 nm) from WorldView-2 satellite.
- Image analysis using Maximum likelihood classification yields an overall accuracy of lithic mulch identification of 65%.

Methods and Analysis

- WorldView-3 Satellite Imagery (1.24 m NIR, 7.5 m SWIR) analyzed using ENVI 4.7.
- Composite images were created using bands that best displayed lithic mulching for NIR (bands 7, 5 and 3) and SWIR (bands 6, 1, and 4).
- Features were classified using a maximum likelihood classification (MLC).
- Accuracy assessment and z-test conducted to determine statistical significance of the classification differences between the images.

Results of MLC. Comparison shows differences between NIR and SWIR in delineating between bedrock and lithic mulch.

Conclusion

- 7.5 meter resolution SWIR imagery is comparable in its accuracy to 1.2 meter resolution NIR imagery despite its lower pixel resolution.
- SWIR is providing greater success than NIR imagery in distinguishing between natural rock-outcrops and lithic mulch gardens.
- Future work should expand on the progress made here to cover the entire land-area of Rapa Nui, instead of only a small percentage (14.5%) of the island as in this study.
- In the future, if SWIR imagery is released to the public at a higher resolution, it will likely be more accurate than NIR imagery for land-classification and provide greater degrees of discrimination, especially in terms of rock and minerals.

Selected References


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