Monitoring revegetation success using multi-temporal multi-spectral data acquired by Unmanned Aircraft Systems

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Abstract:

The imminent closure of the Ranger uranium mine site (NT) has highlighted a need for a monitoring program that can detect changes in ecosystem condition in a manner relevant to mine closure criteria. Monitoring aspects of rehabilitation, such as revegetation, requires the assessment, over time, of biophysical indicators including: tree stem and canopy density; proportional ground cover (vegetative and bare ground); tree height; and vegetation rigour and health. Coincidently, the impact of landscape disturbances such as fire, weeds and cyclones also needs to be monitored. Unmanned aerial systems (UAS) technologies can capture data to measure these indicators at suitable temporal scales (frequency) and within an appropriate spatial sampling resolution.

The Environmental Research Institute of the Supervising Scientist (***eriss***) is establishing a program using UAS technology for the monitoring of revegetation on mine sites. The recent rehabilitation and revegetation works at the former Jabiluka uranium mine site provided a research opportunity for testing the development and implementation of such a monitoring program. Between April 2014 and October 2015, seven flights were undertaken using a fixed wing UAV to capture multispectral (RGB and NIR) imagery over the mine site (figure 1). Imagery was pre-processed, including corrections for sensor noise and lens distortion. Images were mosaicked and georeferenced in photogrammetry software using Structure from Motion techniques. Radiometric calibration was conducted using pseudo invariant targets. Data analysis included the creation of spectral band ratios and the development of a ruleset for object-based image analysis. Results indicate that changes can be detected at the individual plant level, including growth, mortality and the recruitment of volunteers. Changes in the proportional area of green cover over the time series can also be detected.

The acquisition of a dataset of this spatial and temporal scale has provided valuable information not only on changes in ground cover but also on how to optimise the data acquisition itself, including the timing of captures, flight line spacings and ground control points. These are all important factors to consider when implementing an operational

monitoring scheme. Finally, we highlight the strengths and challenges of using such technology for routine monitoring.

Figure 1. The Supervising Scientist's Swampfox UAV, DE-01.