RADIATA MANAGEMENT TECHNICAL NOTE

Number: RTN-005
Date: March 2011

Applying Satellite Imagery for Forest Planning

Summary

- Cost-effective options for providing up-to-date information on the status of forest resources to improve planning are important. Due to lower costs and improved technology, attention has recently focussed on the benefits of remote sensing to supplement and improve resource information. Since new opportunities exist to use these technologies, this Technical Note concentrates on the application of high resolution (~5 m) satellite imagery to provide broad area coverage that can be processed to create a number of GIS-ready products to assist forest planners. The images provided are multispectral (five spectral bands) and in a format that can be manipulated to enhance and detect changes in vegetation or land cover. In this context the images can be used in several forestry operations, including; monitoring harvesting and the success of plantation establishment, mapping of wind & snow damage and to delineate forest species and boundaries.

Author: Michael Watt

Introduction

Traditionally the benchmark for mapping and planning in forestry has been aerial photography.
However, recent advances in satellite technology mean that this technology offers a range of benefits to resource managers who require timely information to assist in broad-scale (1: 25 000 scale) planning.

Over the past five years the cost of satellite data has fallen and is now at a level (~$1700[1] NZD/100,000 ha) that provides a cost-effective option for frequent monitoring and updating of forest mapping.

RapidEye is an example of one such satellite. There are currently five identical satellites in orbit which allows daily revisit over many locations.

RapidEye Characteristics

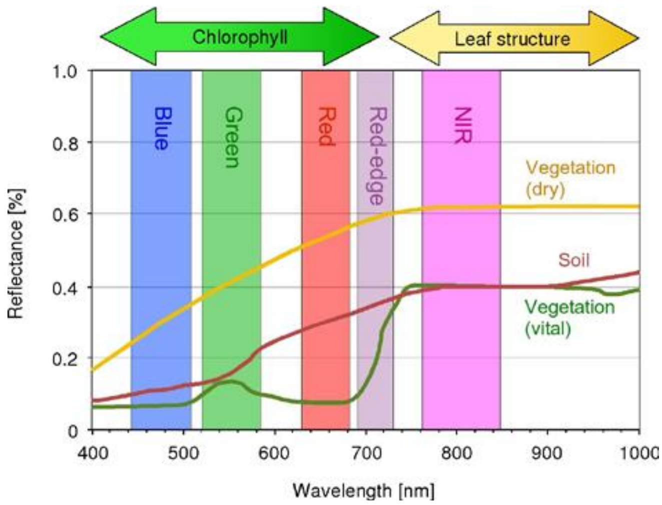
Characteristics of the RapidEye satellite include:

- spatial resolution (~5m);
- multiple spectral bands sensitive to vegetation composition and stress;
- wide data capture 70 x 70 km imaged in one pass and processed and delivered into 25x25 km tiles with <20% cloud cover;
- targeted and daily revisit potential;
- low cost (0.95 Euro/km^2 as at Oct. 15 2010);
- provided ortho-corrected and projected ready for integration into a GIS;
- able to be tasked to capture imagery over specific locations. Minimum order 5000 km^2;and
- national coverage available since October 2010.

The RapidEye sensor measures reflectance across five spectral bands. The visible wavelengths from 400-700 nm are generally referred to as photosynthetically active radiation (PAR) which is the solar radiation used for photosynthesis. As leaves age or become stressed, reflectance increases due to decreasing levels of chlorophyll. The NIR band provides information on the leaf structure as plants become stressed, near-infrared reflectance decreases as a function of cell wall deterioration.

These characteristics allow for discrimination of vegetation types and detection of vegetation stress. The following figure shows the typical spectral profile for vegetation and soil over the five bands.

Further technical details and FAQ are available from *www.**rapideye**.de*



RapidEye has been actively acquiring satellite data since 2010. The coverage as at October 2010 is shown below.

[1] Imagery is priced at 0.95 euro/km^2

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

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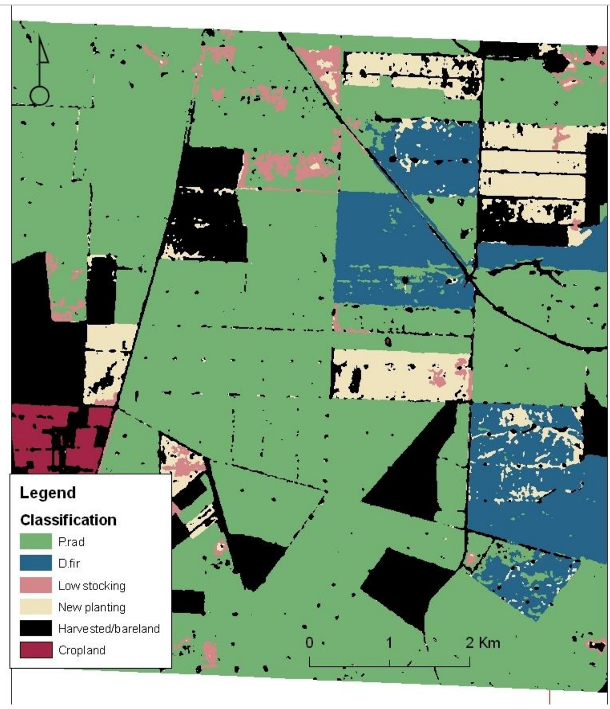
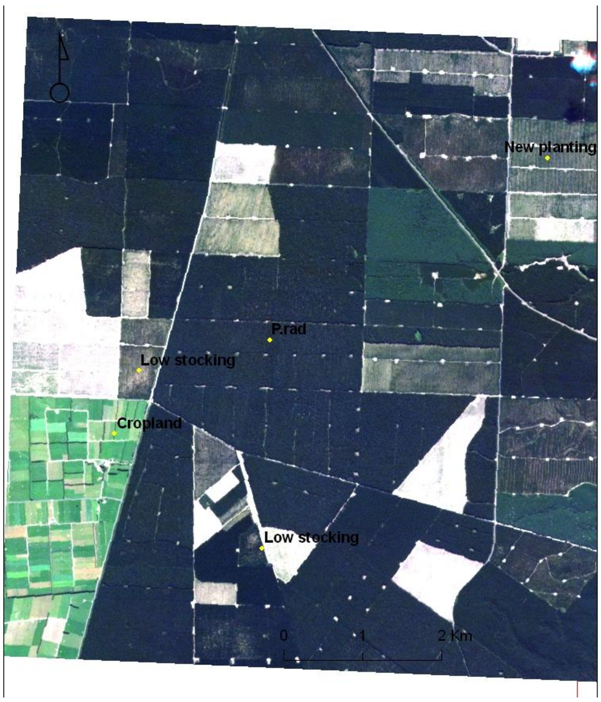


For reference, the coincident image is shown in true colour using the same band combination as conventional aerial photography.



The second image covers the same area, but is displayed as a false colour composite by including the NIR band. This band combination enhances actively growing vegetation and also harvested areas.

Applications

The application of satellite imagery ranges from supplementing existing GIS datasets to providing critical base information. This is especially applicable in newly developed areas or in cases where detailed forest survey information is not available.

The immediate applications of satellite imagery to forestry are identified as:

- operational monitoring - i.e. harvesting and the success of plantation establishment;
- mapping of wind & snow damage and erosion events; and
- delineation of forest species and boundaries.

The following examples illustrate the different applications. The first example shows an automated classification. The classification effectively:

- separates harvested areas and forest species (*Pinus radiata* and Douglas-fir);
- identifies areas of low stocking density due to operations such as thinning, variable establishment or wind damage.

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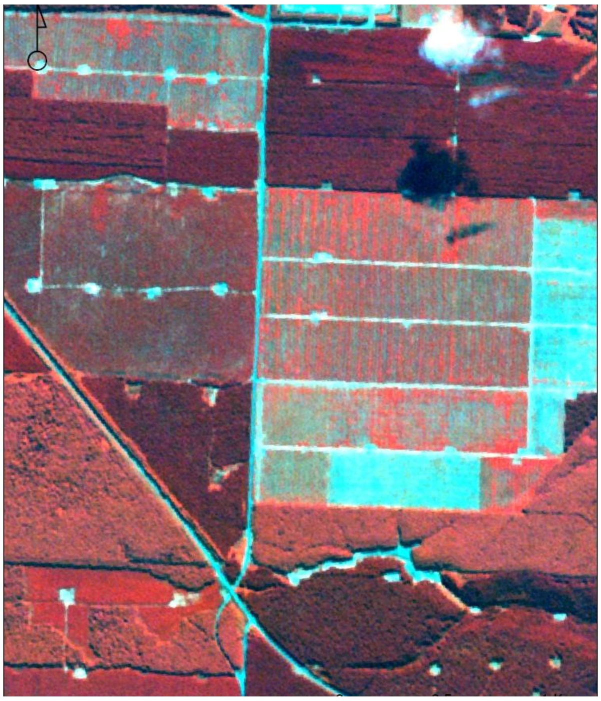
Several techniques exist for highlighting variations in growth. These include the calculation of vegetative indices using different spectral bands. The following two examples show newly established and young plantations. Variations within blocks is quite apparent and can be delineated and mapped to a GIS. This information could be used to identify and target areas of poor establishment.



Potential Application

Forest condition could be monitored through repeat coverage. This would allow for changes in forest area through harvesting to be automatically mapped.

Concluding Comments

The potential application of high resolution satellite imagery as presented depends on the quality of the existing forest description. The examples presented here illustrate how the imagery can be directly integrated into a GIS, analysed and used to update the forest description using semi-automated methods.

Less emphasis has been placed on the spectral characteristics of the imagery, but there is potential to use the imagery to monitor forest health and to automate processing to provide harvest area updates in a GIS format.

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