Obtaining Forest Description for Small-scale Forests Using an Integrated Remote Sensing Approach

Preliminary PhD Findings
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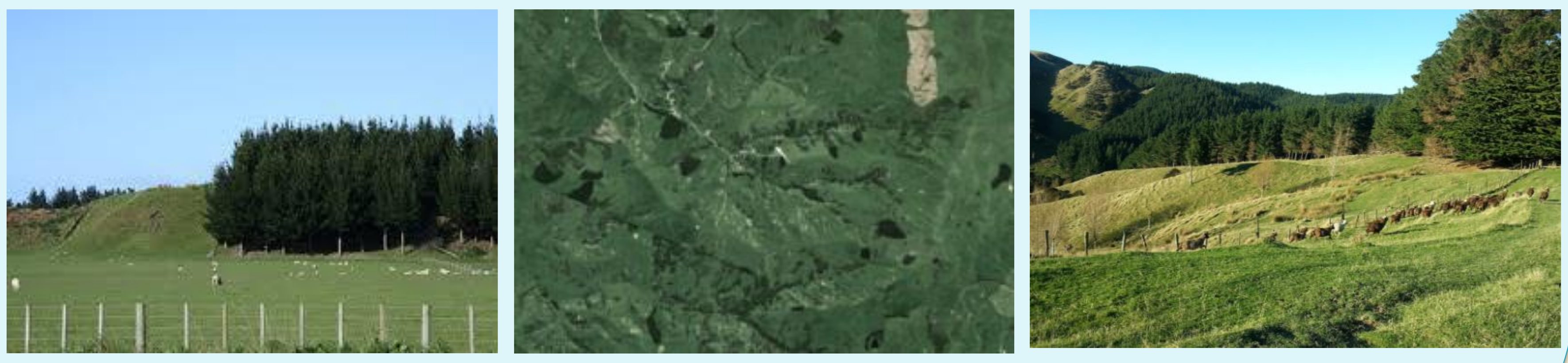
Introduction

New Zealand's plantation forest cover is estimated to be 1.75 million hectares Large-scale owners with more than 1000 hectares own 70% of the area. Their forests are managed professionally with regular area and yield assessment. Small-scale forests occupying 30% of the total plantation area are less well understood as the forest description appears less reliable due to inconsistent area definition and management practices.

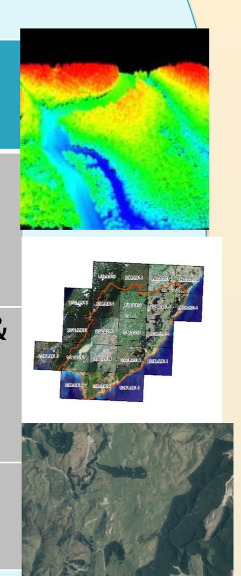
With the advanced development of remote sensing technologies and free or low-cost availability of imagery and LiDAR datasets, the description of small-scale forests could -potentially be enhanced. This research evaluates the possibility of deriving a forest description of small scale-forests using existing remote sensing datasets (airborne LiDAR, RapidEye and aerial photo). The rationale of this research is to improve the understanding of the potential wood supply from small-scale forests without incurring substantial costs for the owners.



Datasets and Study Area

Table 1: Remote sensing datasets

Imagery	Resolution	Acquisition Date	Details
Aerial Photography	0.3m	Dec 2012-Jan 2013	Orthorectified RGB images
RapidEye	5m	Nov 2013-Feb 2014	Bands: Blue, Green, Red, Red Edge & Near Infrared
LiDAR	3.7 points per m²	Jan-Dec 2013	Wall-to-wall coverage



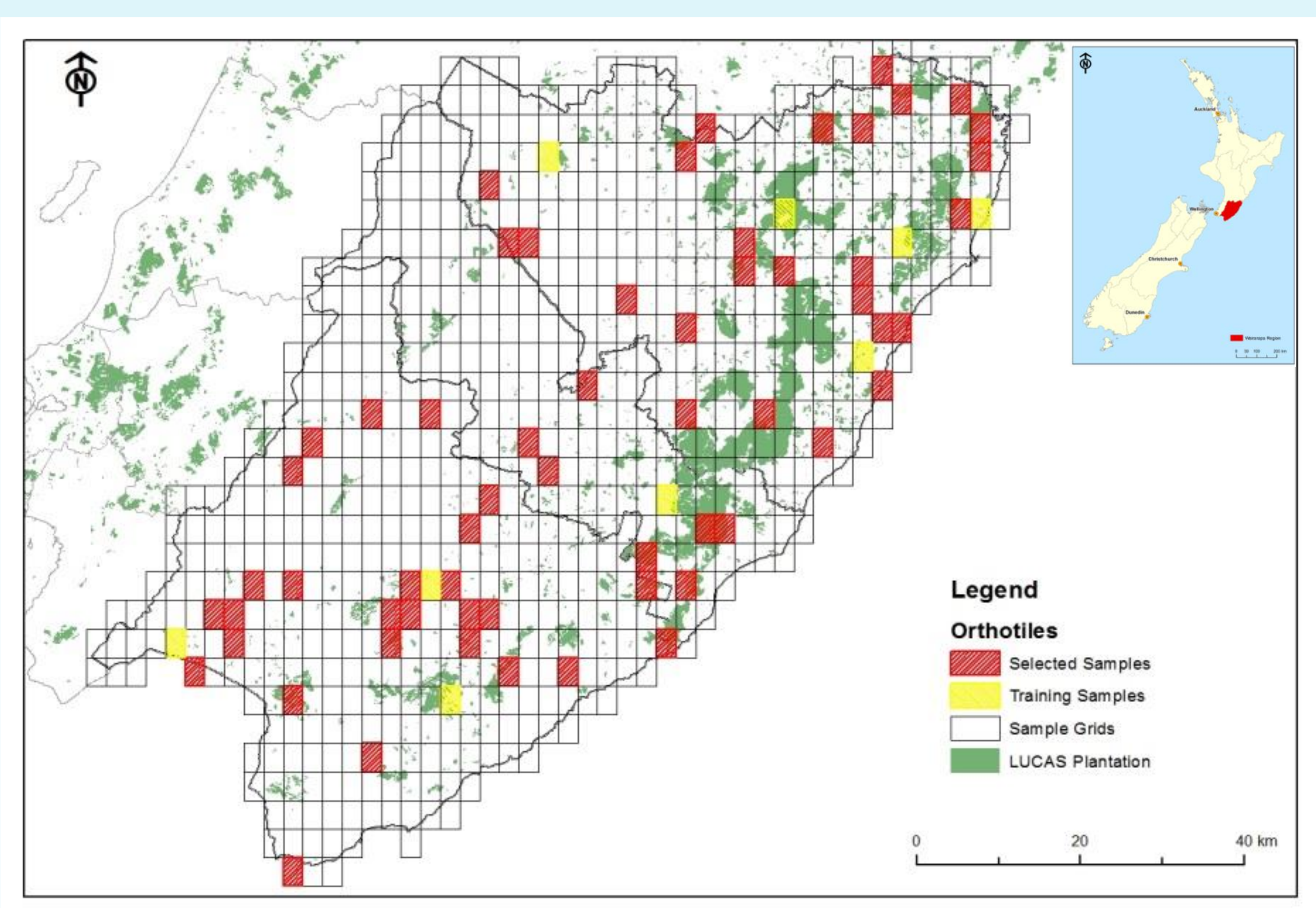


Figure 1: Study area and stratified random selection of grids

The study area is the Wairarapa Region, which is located at the south-eastern corner of the North Island of New Zealand (Figure 1). It is estimated in the region 50 % of the plantations are owned by small-scale forest owners.

Ground based plot data (diameter and height) were collected in May 2013. In total 125 plots covering forest age 9 to 33 were measured. This information is used to verify yield estimation from remote sensing data.

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Methodology

Area Assessment

To map the net stocked plantation areas in the Wairarapa region, sample grids (3.6km x 2.4km) were overlaid over the region. Nine grids from each forest class were randomly selected to develop the mapping approach.

Plantation areas manually digitised from aerial photos were treated as the reference areas. An Object-based classification approach is developed to map plantation area using RapidEye and LiDAR derived features and metrics OBIA classification was undertaken on RapidEye and LiDAR data independently and this was followed by fusing the datasets for anther OBIA classification. In total 270 randomly located points were used to conduct classification accuracy assessment, where the forest mapped for each point was compared with the reference areas. The plantation areas mapped were then compared with the "reference" representation of plantations to determine the most accurate technique.

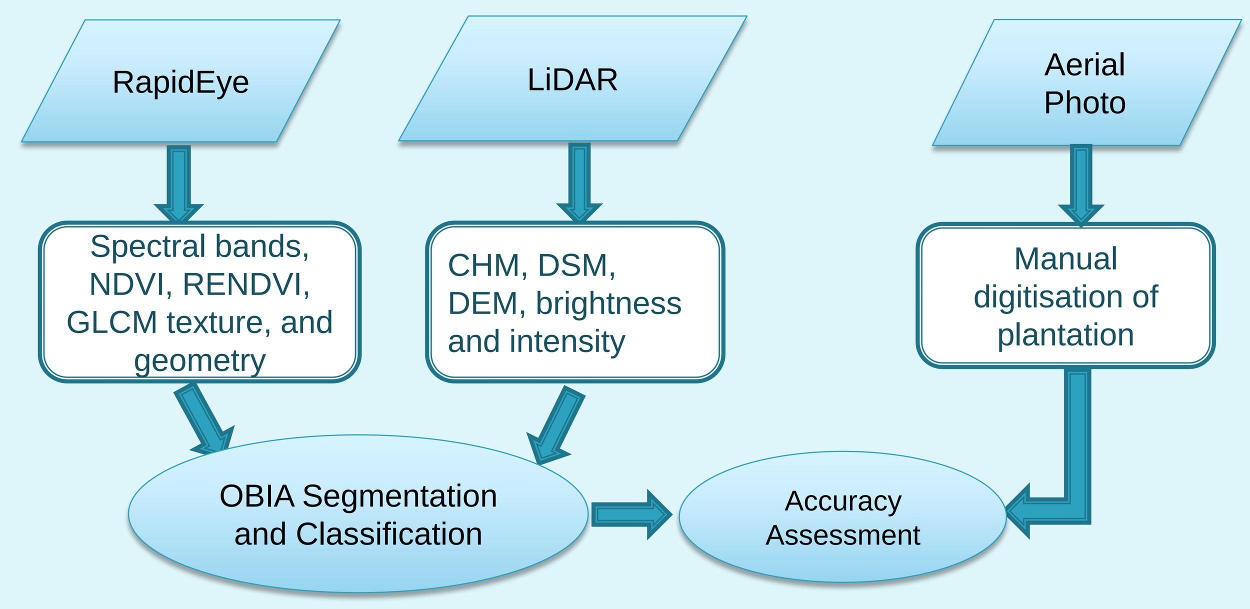
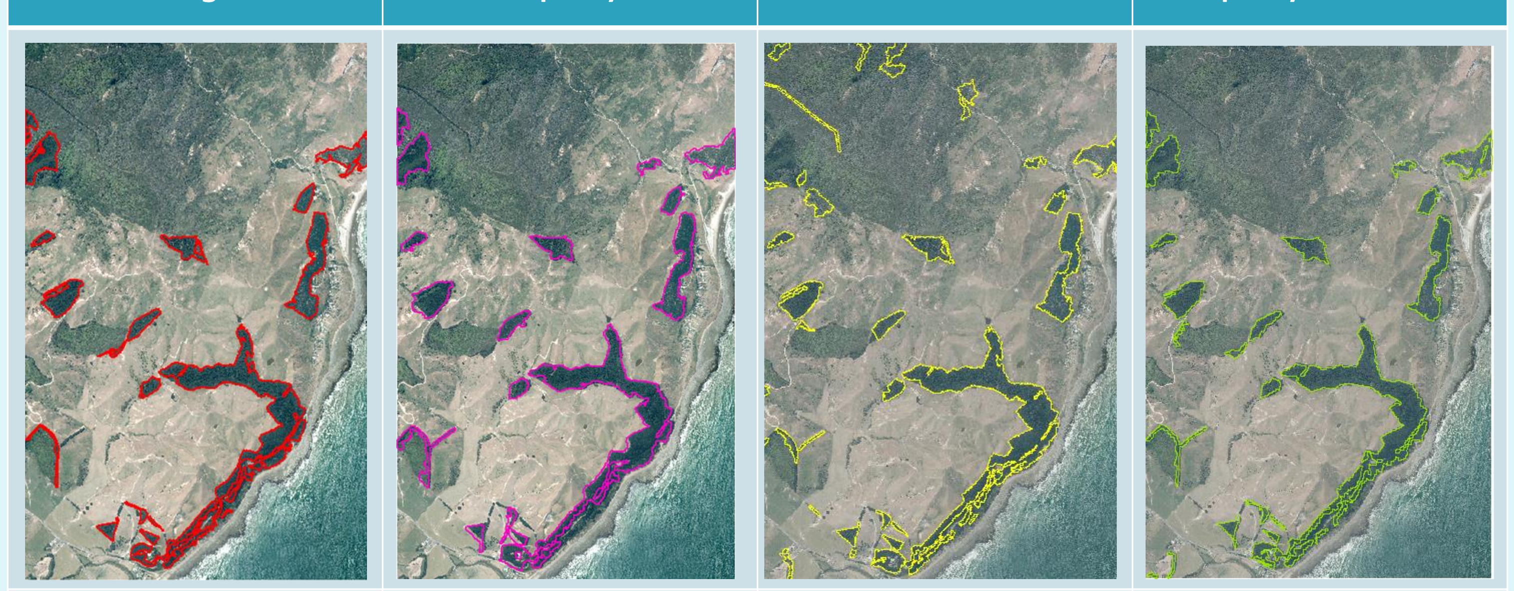


Figure 2: Plantation Mapping Flowchart

Results



Manual Digitisation	RapidEye	LiDAR	RapidEye + LiDAR
Area: 63.2 ha	67.9 ha	70.7 ha	65.2 ha
Accuracy: 100%	93%	87%	95%

Figure 3: Plantation mapped in one of the sample grids

Using only LiDAR surfaces produces lower accuracy in mapping the plantation areas (87%), whereas RapidEye alone produce good mapping accuracy (93%). The combined sensor produced the highest accuracy of 95%. Additionally, heavy forest class covered areas appear easier to map as the accuracy is higher than medium and low forest cover percentage.

Based on classification of representative samples, the approach developed using both RapidEye and LiDAR surfaces is potentially useful for delineating net stocked plantation areas.

Further Steps

Yield Estimation

Use integrated datasets to model forest attributes: Age class, stocking, height, basal area and volume based on empirical relationship derived between measured ground plot data and remote sensing inputs.

Additionally both parametric and non-parametric models for each forest attribute will be evaluated based on R^2 , RMSE and bias to determine the best modelling approach for each forest attribute.

Reference:

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