Australian large area woody vegetation assessment

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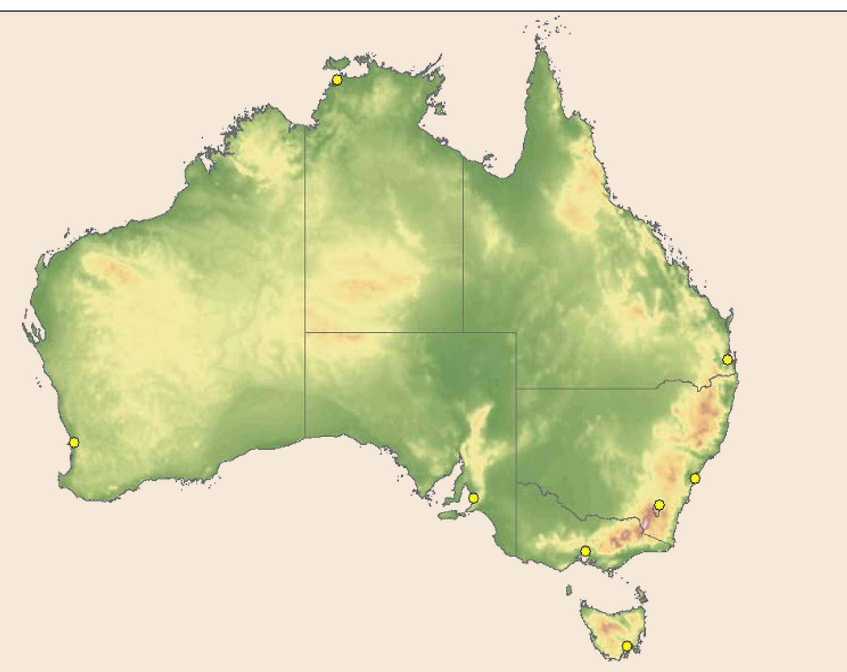


BACKGROUND

State and Commonwealth land management agencies are mandated by law to map and report on Australian native woody vegetation (NWV) condition. Forest attribution relies on the use of remote sensing as field inventory is high-cost and time consuming. Out of the total 125 million of hectares of Australian forest, 92 are dominated by Eucalypt species. Adult eucalypt leaves orientate vertically decreasing the water loss at mid-day, increasing drought tolerance. This erectophile (near vertical) leaf angle distribution (LAD) allows more portion of ground to be seen from above. Therefore, remote sensing of Eucalypt properties remains a scientific challenge due to the orientation and distribution of leaves within the canopy. This work presents the development of operational techniques for the characterisation of Australian woody vegetation systems at different scales.

SELECTION OF DESCRIPTORS

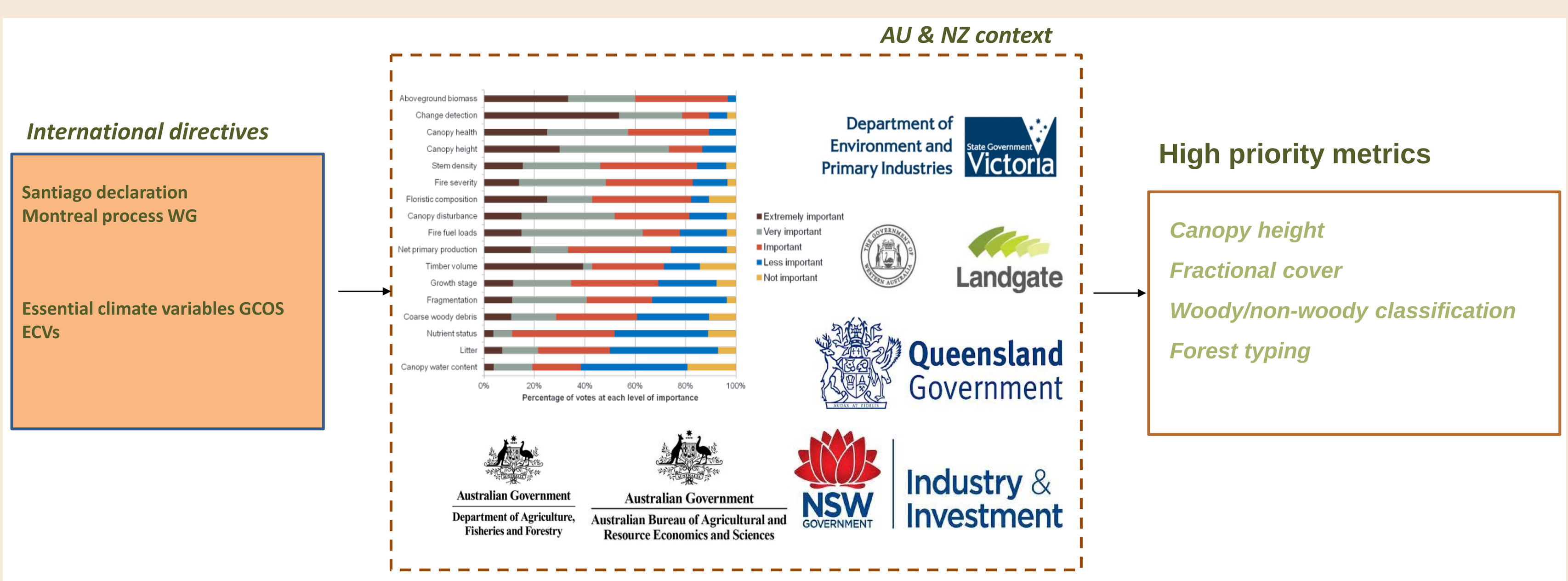


Figure 1. Steps followed for the selection of the descriptors used for woody attribution

A set of descriptive metrics were selected based on international directives and stake holders needs. The procedure consisted of three steps (Figure 1):
- The metric selected for international directives were identified
- A preliminary priority list was created through a survey among Australian and New Zealand stake holders (from education, research and industry sectors).
- Final set of metrics was selected in a workshop held with Australian federal and state agency representatives.

AIRBORNE-BASED ASSESSMENT

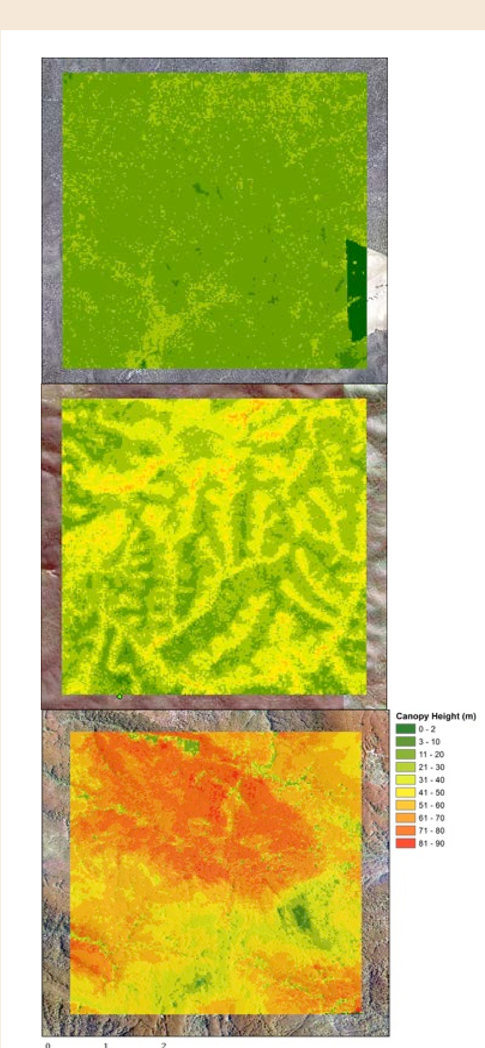


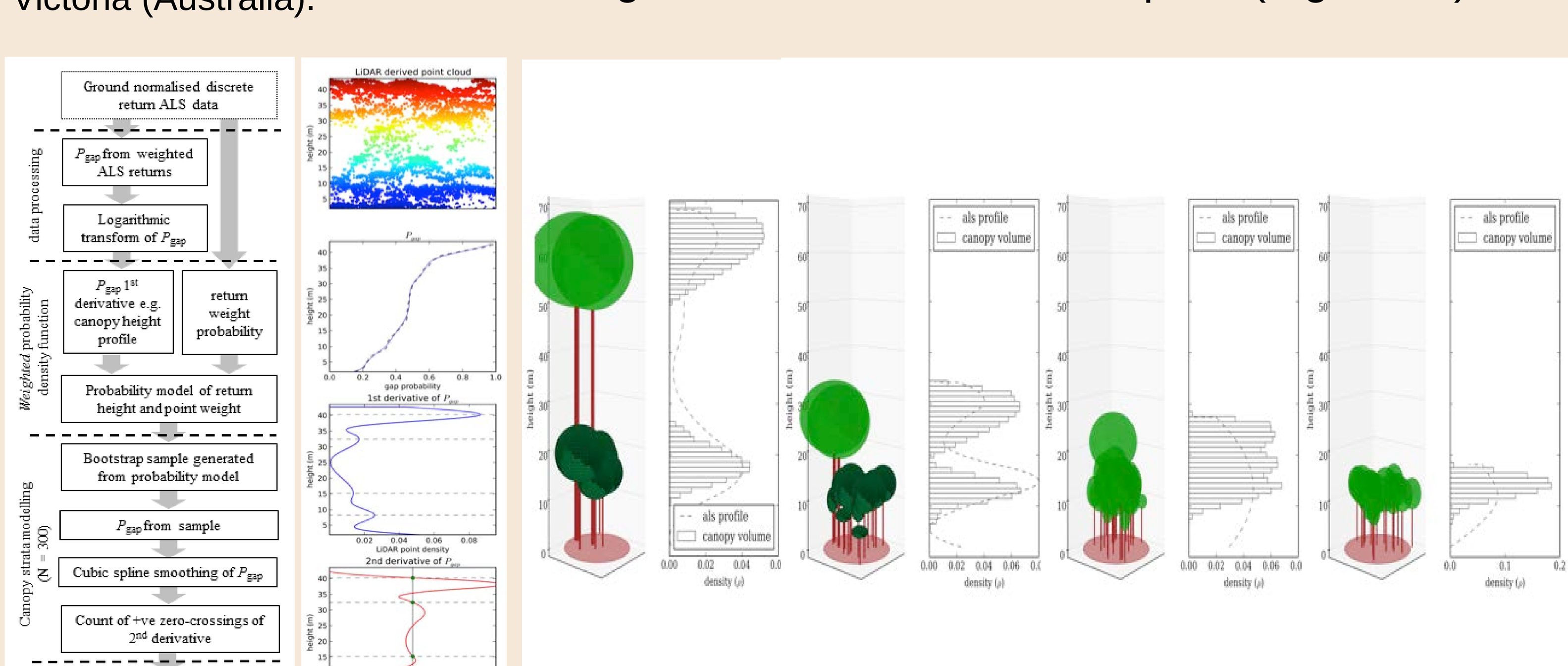
Figure 2. Representation of canopy height derived from ALS for three forest types in Victoria (Australia).

Discrete return airborne laser scanning (Riegl LMS-Q560) was used to derive canopy height and vertical profile.

Canopy dominant height was assessed at 25 m spatial resolution for 5x5 km sites representative of Australian sclerophyll forest (Figure 2). A DTM model was subtracted from total height at each point. The DTM model was calculated as an irregular triangulated network of ground returns rasterised at 1 m2 spatial resolution.

Canopy vertical profile was derived as a proxy of canopy complexity used in biomass and habitat mapping models. The logarithm of ALS discrete return point cloud as function of height (gap probability, Pgap) was smoothed parametrising a cubic spline. Canopy vertical profile and the number of canopy layers were assessed using the first and second derivative of the smoothed gap probability (Figures 3a and 3b).

Canopy height was validated using data collected in the field using a laser ranger (TruPulse). Canopy profile models were validated creating synthetic canopy models using the data collected on 18 plots (Figure 3c).



(a) (b) (c)

Figure 3. Procedure to derive canopy complexity from ALS data (a and b) and its validation (c)

GROUND-BASED ASSESSMENT

The performance of common ground-based methods (low- and high- resolution hemispherical photography, LAI-2200 and TLS) for fractional cover estimation have been compared. To facilitate the comparison, each instrument was set-up using the same reference point on the ground with measurements taken only minutes apart. Care was taken to ensure consistent instrument height and levelling. The results of this study suggest that a level of caution must be taken when using common passive optical techniques as a reference estimate due to the high sensitivity to variable illumination and sky conditions. Plot mean RMSE was within 20% of the HR-DHP(S) reference only for 46% of the cases. When increasing the accuracy threshold to 10% and 5%, the proportion of pair-wise comparisons within those thresholds drops to 24% and 6%, respectively. This is especially relevant as common validation practices often assume negligible uncertainty levels for in- situ reference estimates.
On-going work includes the use of 3D modelling to fully-reconstruct a forest stand and simulate the theoretical performance of each method (Figure 5).

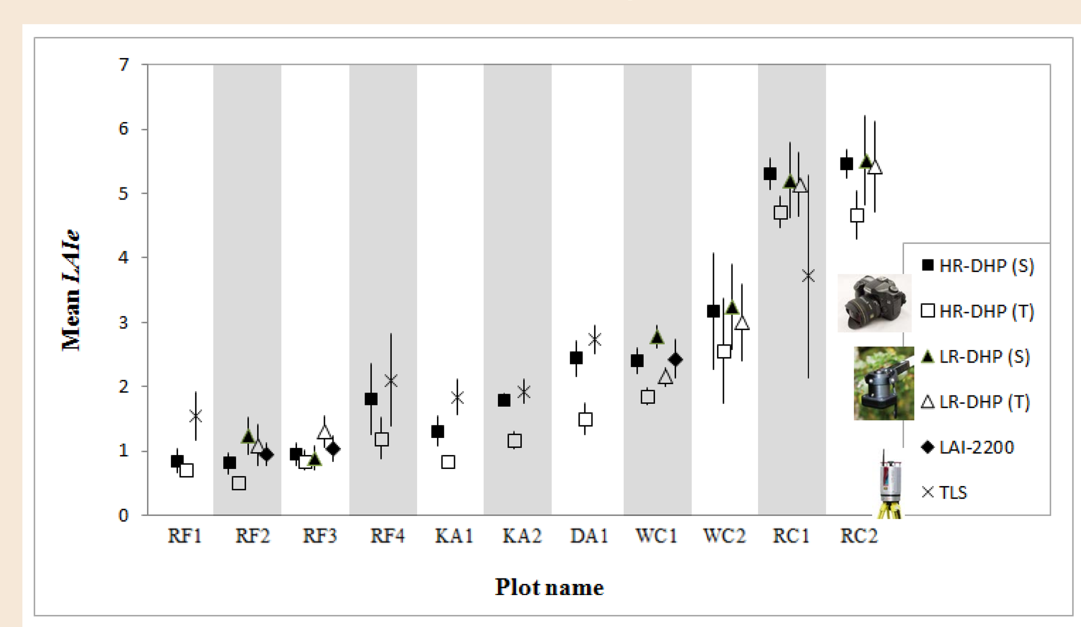


Figure 4. Comparison of effective LAI derived from hemispherical photography, canopy analyser and TLS in 11 study sites located along Eastern Australian coast

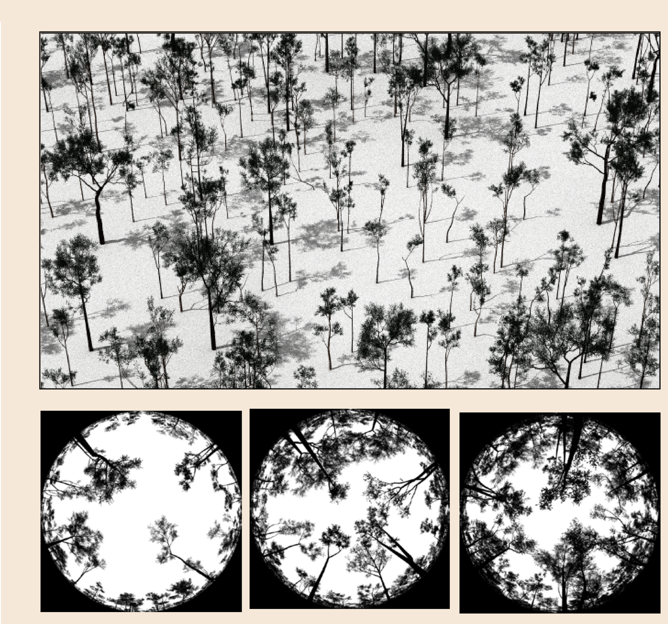


Figure 5. Simulation of a forest stand (above). DHP simulations for 3 stem densities.

SATELLITE-BASED ASSESSMENT

Current work involves creating robust and accurate tools for forest attribution at large scale using satellite sensors. Landsat and some of the new moderate-high resolution satellite sensors offering better spatial resolution and band configuration are being tested. Different band configurations and vegetation indices are being tested as input in classification procedures. Preliminary results suggest decision tree classifiers are more suitable to describe heterogeneous landscapes (Figure 6).

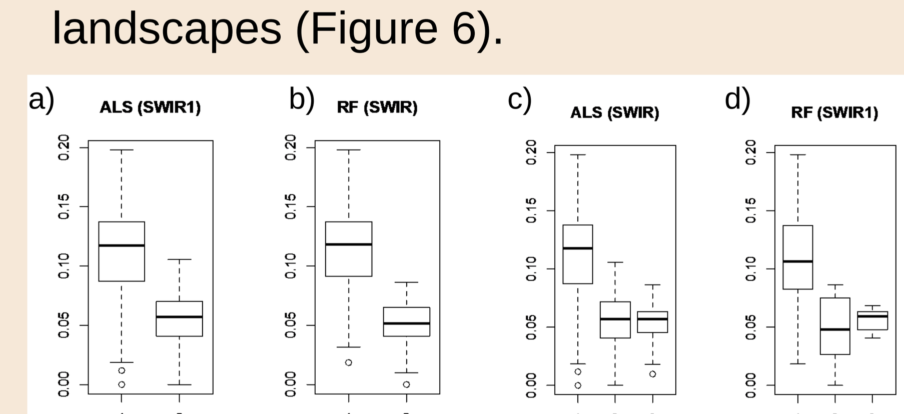


Figure 6. Comparison of the results obtained deriving canopy complexity using ALS (a and c) and a decision tree classifier using satellite imagery (b and d).

More information can be found in:
S Jones, A. Haywood, L. Suárez, P. Wilkes, W. Woodgate, M. Soto-Berelov, A. Mellor, C. Axelsson (2013). Literature review for determining optimal data primitives for characterising Australian woody vegetation and scalable for landscape-level woody vegetation feature generation. CRCSI Project Report, 53 pages, January, 2013. http://www.crcsi.com.au/getattachment/63059502-5159-409b-8643-5aef9aa8f720/Australian-Woody--Vegetation-Landscape--Feature-Ge.aspx

W Woodgate; S D Jones; L Suarez; MI J Hill; J D Armston; P Wilkes; M Soto-Berelov; A Haywood; A Mellor. Variability of ground-based instruments for estimating Leaf Area Index in diverse forest systems. *Agricultural and Forest Meteorology (submitted).*

P Wilkes, S D Jones, L Suarez, A Haywood, A Mellor, W Woodgate, M Soto-Berelov, A K Skidmore. *Remote Sensing of Environment (submitted).*