Vertical Segmentation of Airborne LiDAR for Select Australian Vegetation Communities

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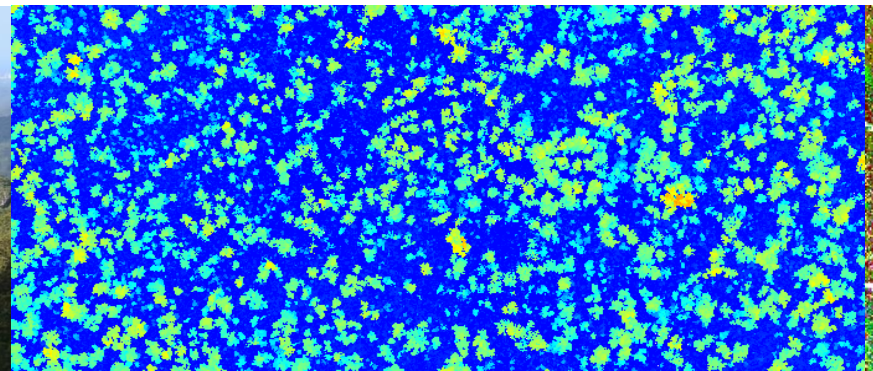
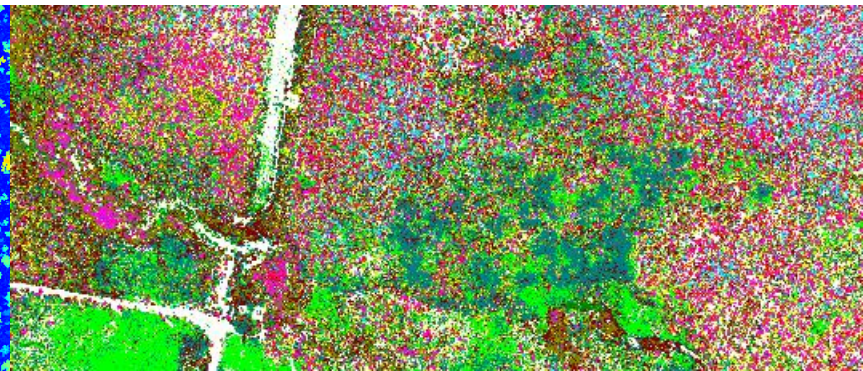
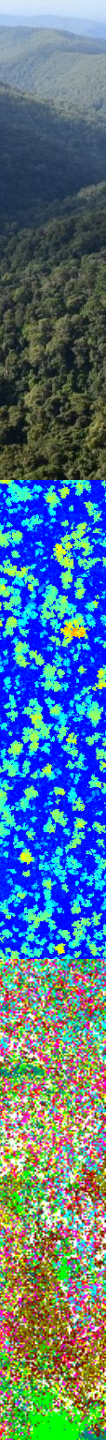
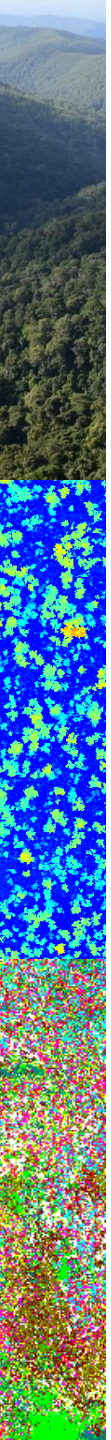






Overview

1. Background & Significance
2. Research Aim & Objectives
3. Study Sites
4. Methodology
5. Results – Vertical Segmentation
6. Results – Point Density Ratios
7. Results – Classification Comparisons
8. Summary



Background – Vertical Vegetation Structure

- Key vegetation classification criteria in Australia
- Difficult to characterise sub-canopy structure
- Critical applications for ecology & vegetation management

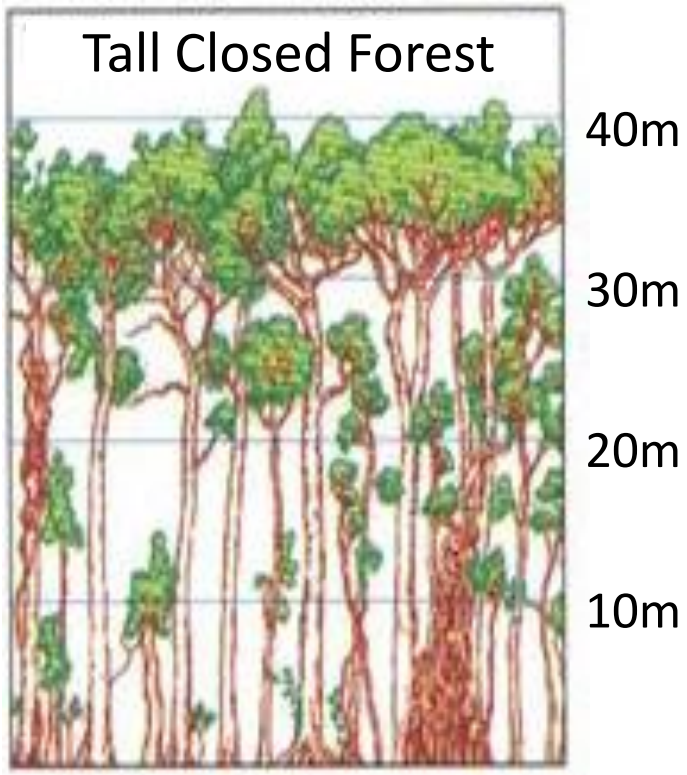
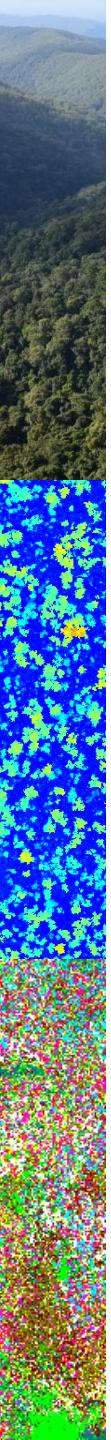


Photo: Applied Ecology



Background – LiDAR

- Light Detection and Ranging (LiDAR)
- Generates a 3D representation of an environment
- Key Types:
  - Airborne Laser Scanner (ALS)
  - Terrestrial Laser Scanner (TLS)
- Established technology for forestry & vegetation management

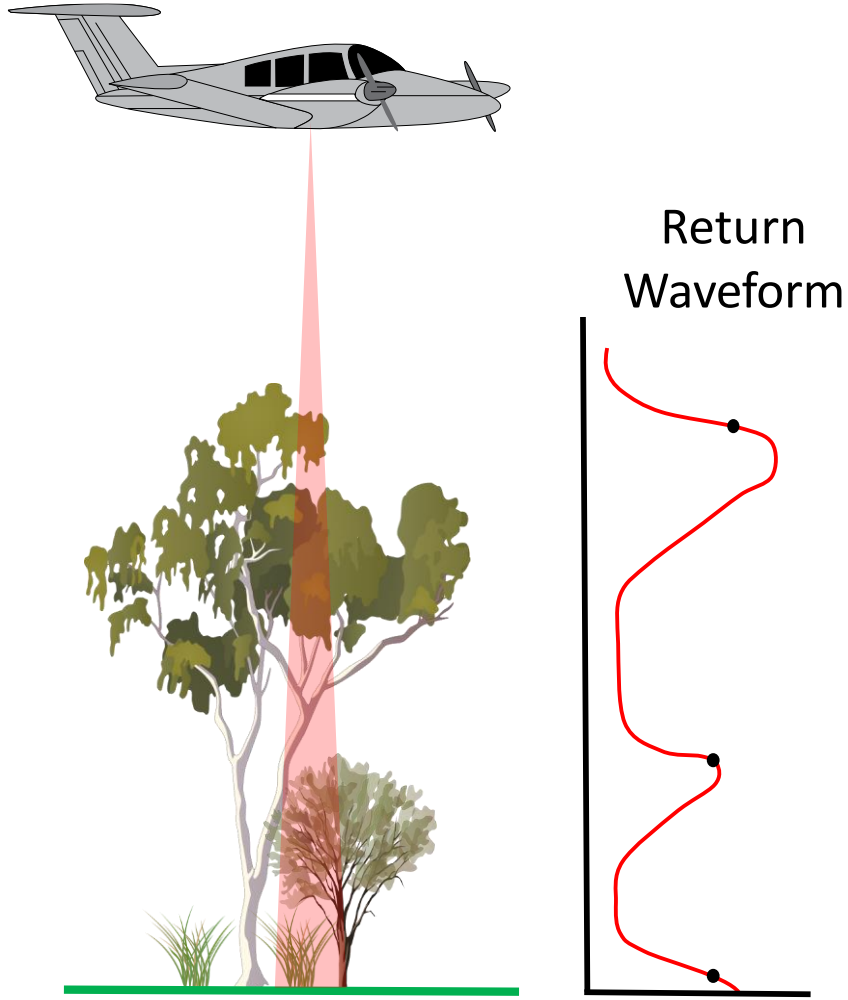
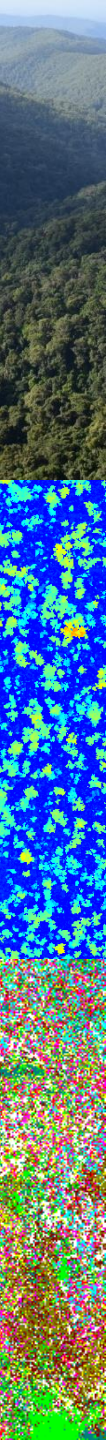


Photo: IAN (graphics)

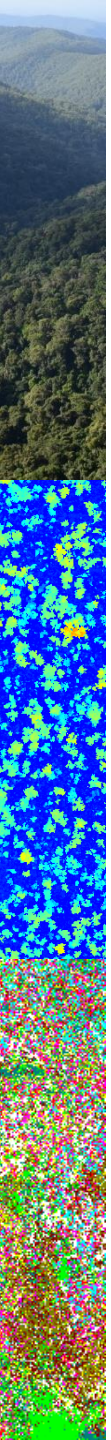


Significance & Research Aim

- High spatial resolution LiDAR & field data increasingly available
- Australian vegetation communities unique & challenging
- Limited studies using ALS data in Australian context

Research Aim

To assess the ability of high spatial resolution LiDAR data to accurately map Australian vegetation communities.



Research Objectives

1. **Gather** and prepare datasets across a range of vegetation structural forms, from low shrubland to tall closed forest

2. **Process** LiDAR datasets to derive point density surfaces

3. **Classify** processed LiDAR datasets to map individual and stand based vegetation features

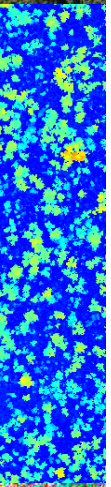
4. **Assess** differences between existing vegetation classifications and vertical point density derived classifications

Sensors & Data

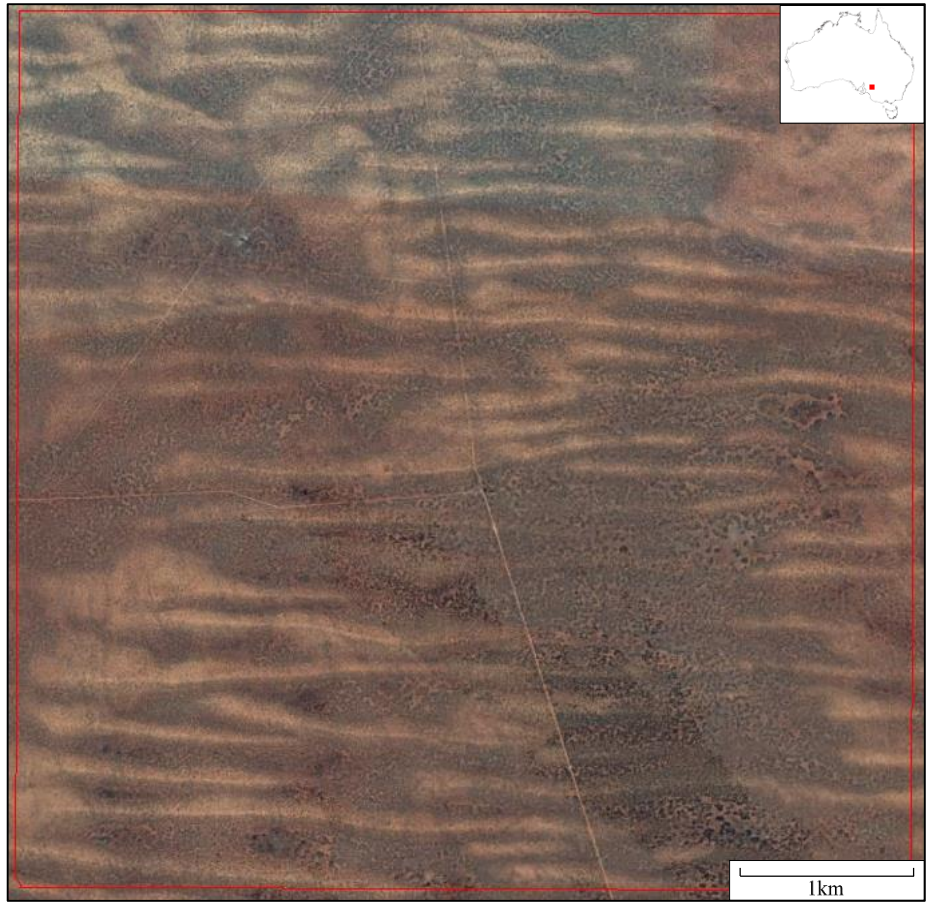
ALS

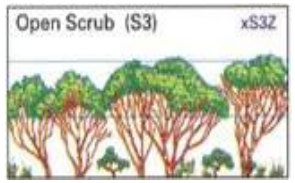
- RIEGL Q560, flown at ~300m on N-S flight-lines
- TERN AusCover data (2012-2013)

Site Name	Point Density	Spacing	Area Covered
Chowilla	54.33 pts/m^2	0.14 m	26 km^2
Litchfield	28.87 pts/m^2	0.19 m	26 km^2
Karawatha	45.16 pts/m^2	0.15 m	13 km^2
Robson Creek	50.68 pts/m^2	0.14 m	26 km^2

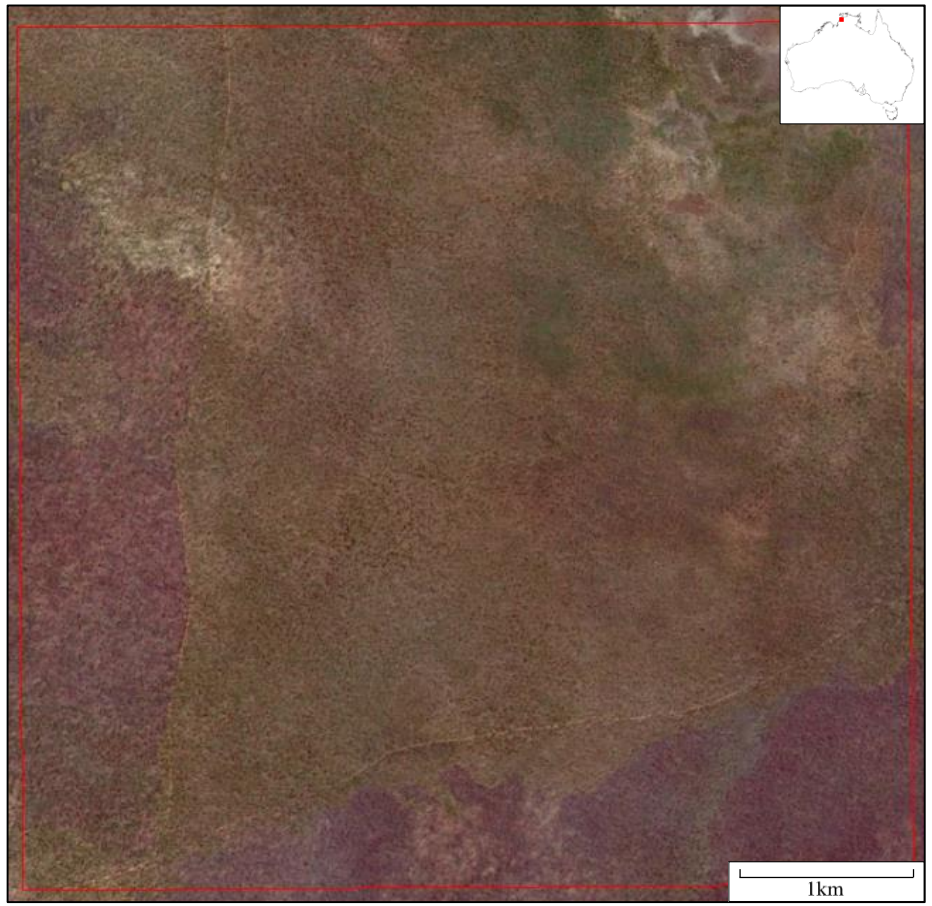


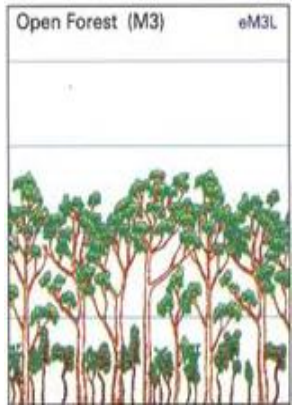
Chowilla (SA) – Mallee Woodland/Scrub

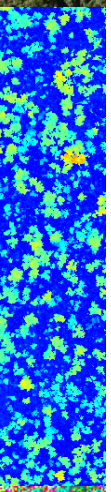




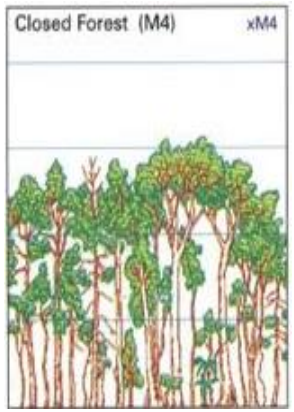
Litchfield (NT) – Tropical Savanna



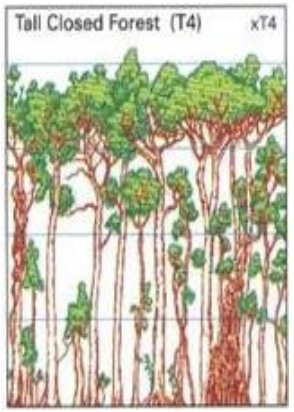


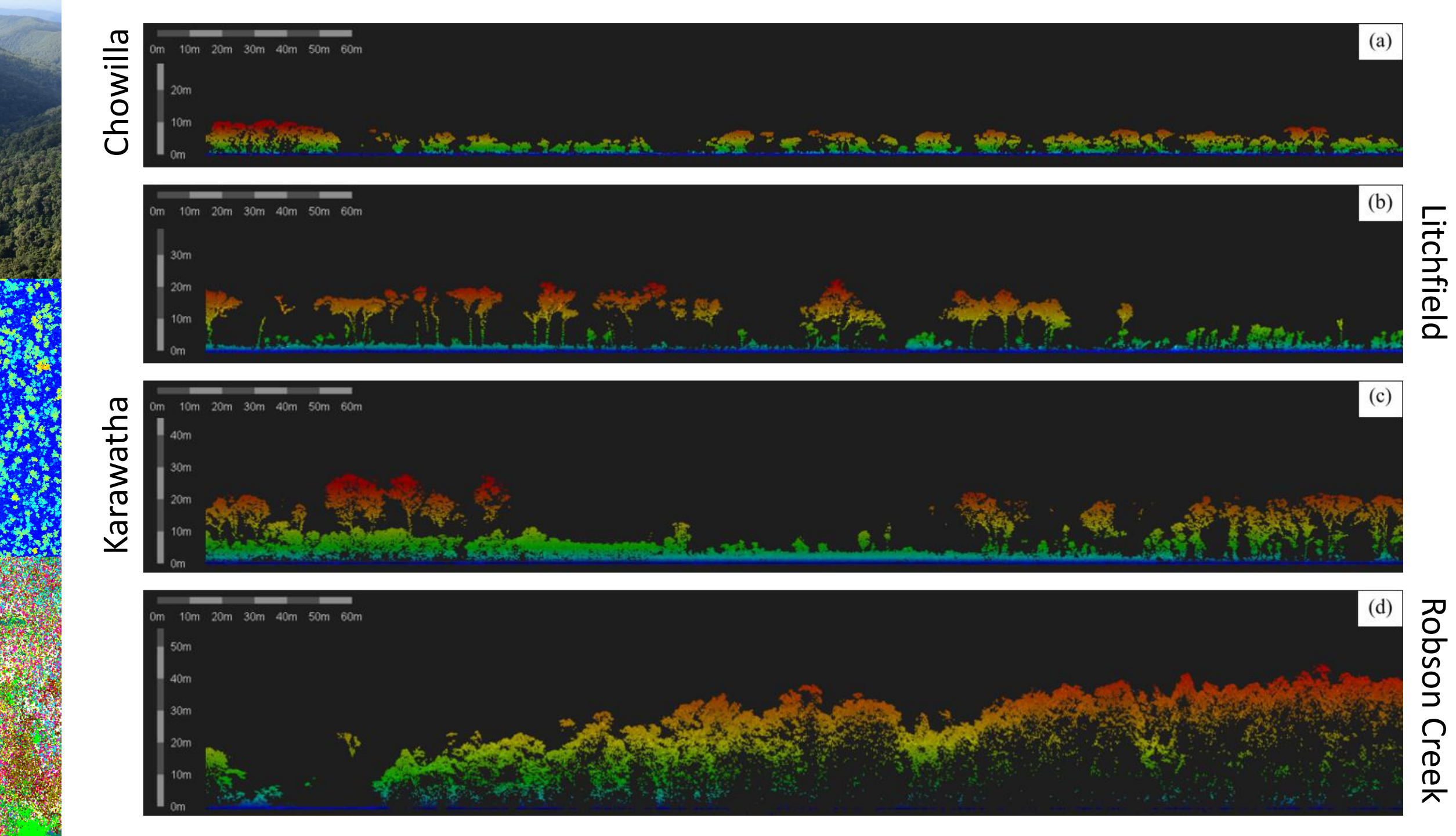


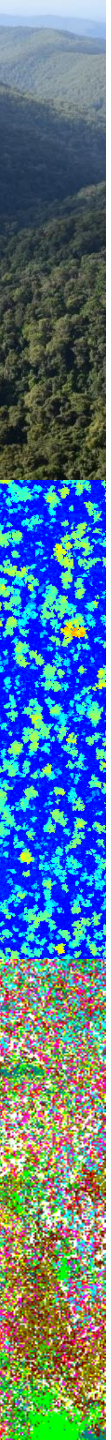
Karawatha (QLD) – Eucalypt Forest



Robson Creek (QLD) – Tropical Rainforest




Chowilla
Karawatha
Litchfield
Robson Creek
(a)
(b)
(c)
(d)
0m 10m 20m 30m 40m 50m 60m
0m
10m
20m
30m
40m
50m



Methodology

Data Preparation

- Download ALS data (TERN AusCover)
- Preparation using LAStools
- CHM & coverage mapping

Processing

- Vertical segmentation using LAStools
- Point density ratio calculations using QGIS

Classification

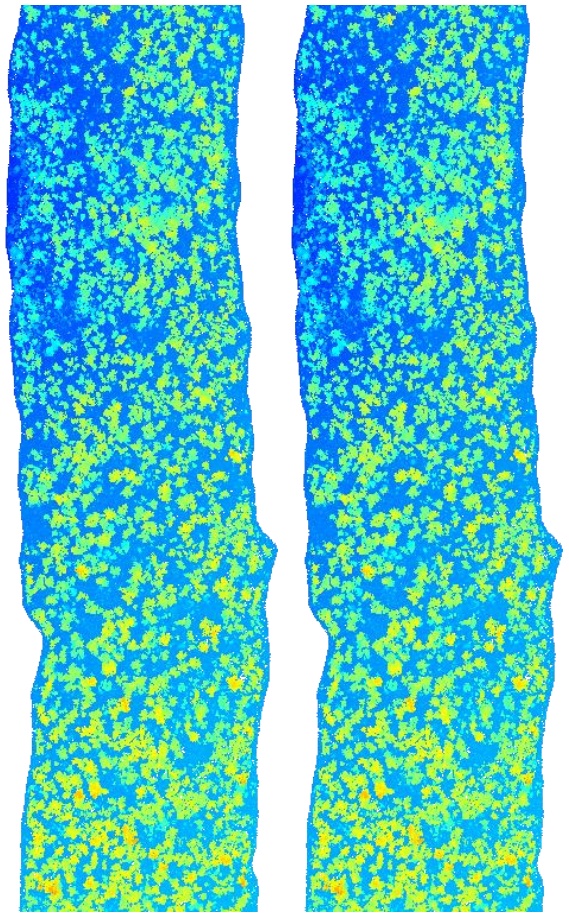
- ISODATA classification of segmented data
- Specht classification using CHM & coverage data

Analysis

- Comparison:
  - ISODATA vs Specht
  - ISODATA vs TLS PAVD

Methodology – Data Preparation

Raw flight lines



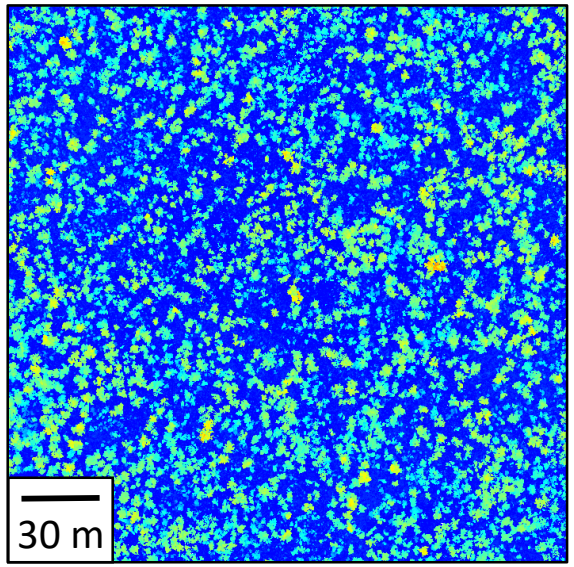
20 m

Merge

Remove outliers

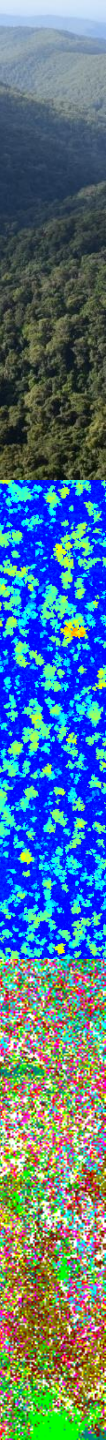
Normalise heights

Pre-processed point cloud tile

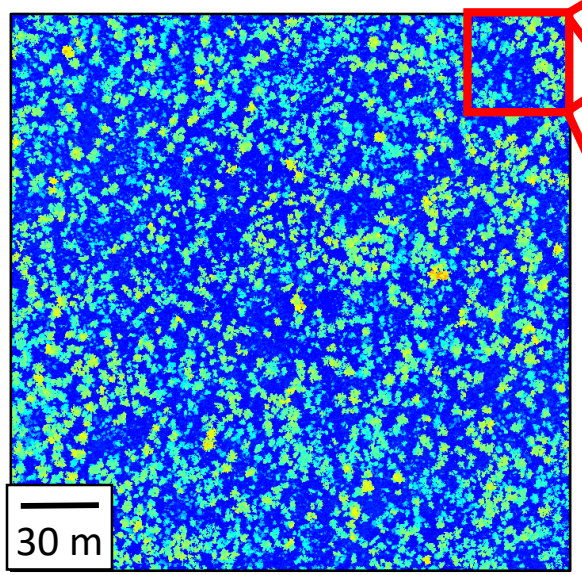


30 m

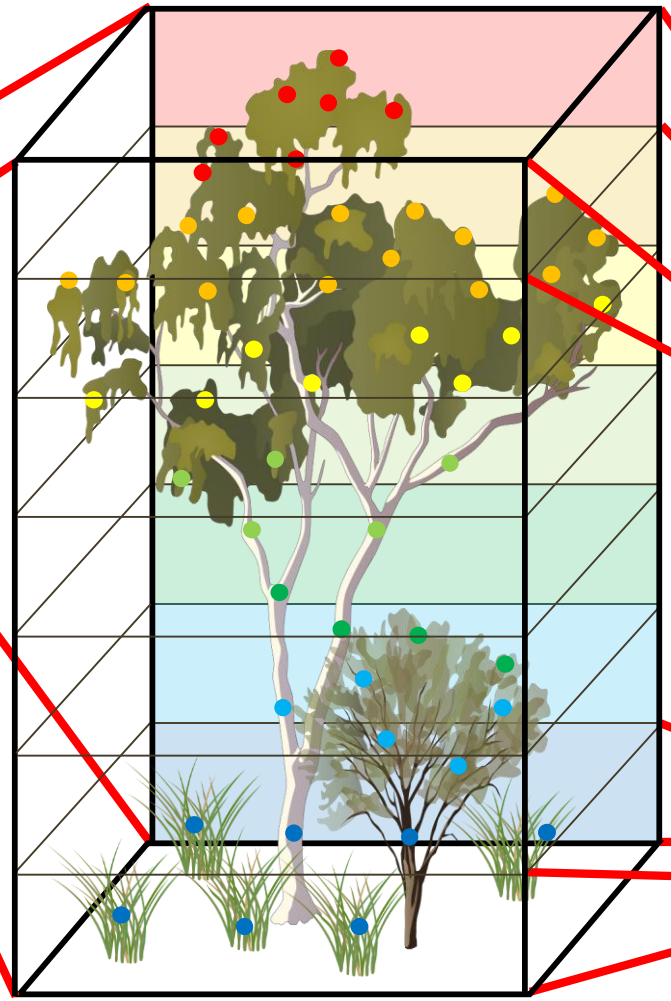
Methodology - Processing



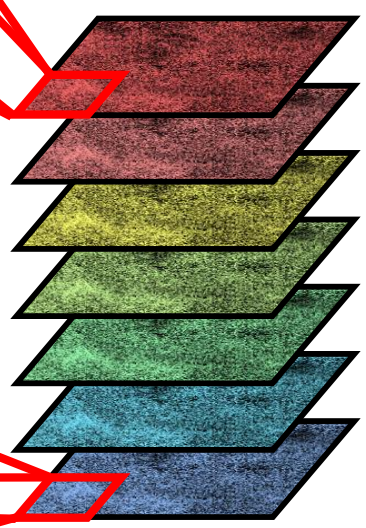
Pre-processed point cloud tile



Segmentation

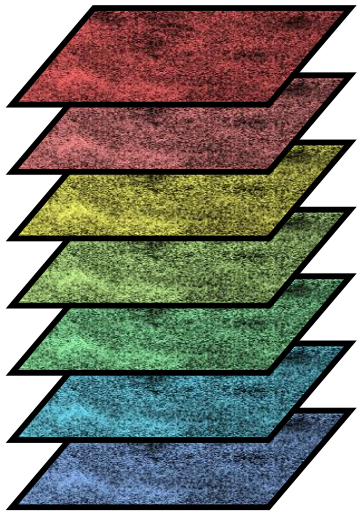


Point Density Rasters

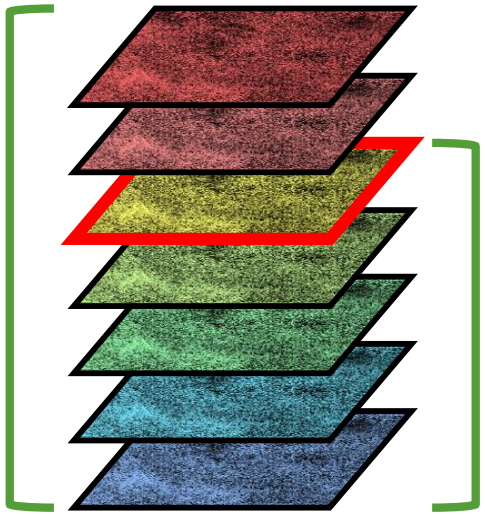


Methodology – Classification & Accuracy

Point Density Rasters



Point Density Ratio Calculation

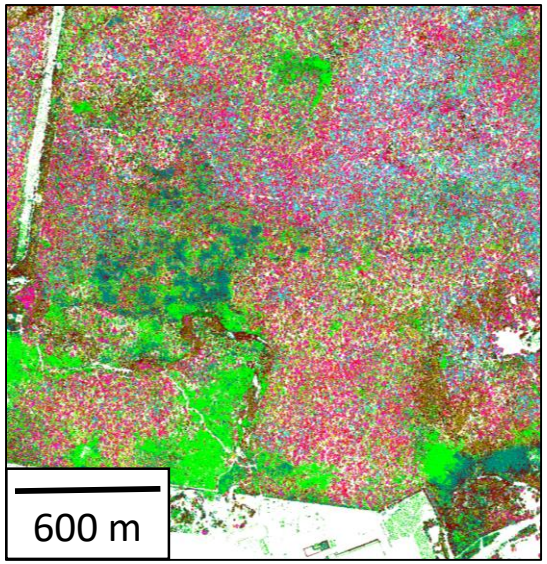


Standard

Adaptive

Clustering Algorithm

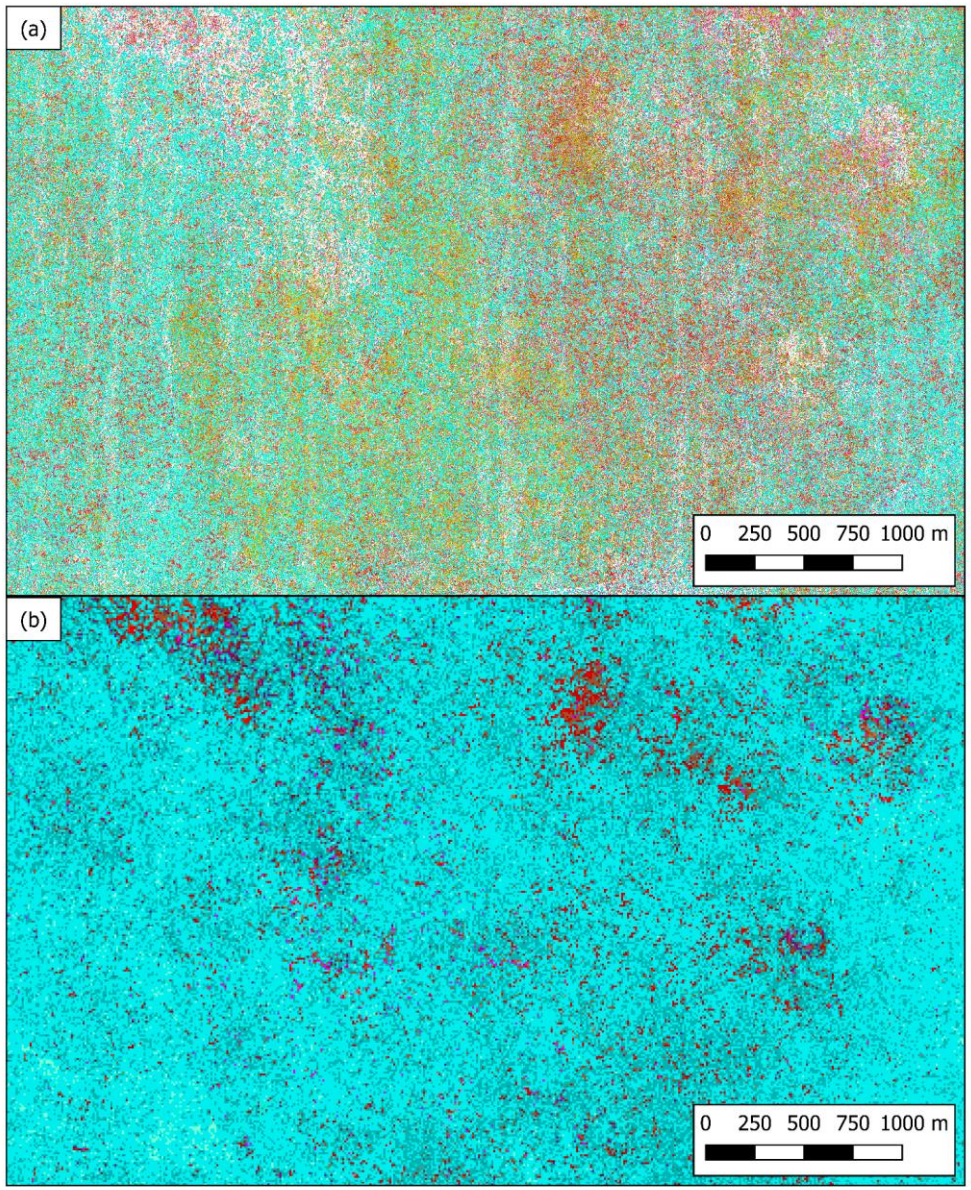
Vegetation Community Classification



Karawatha Segmentation Visualisation

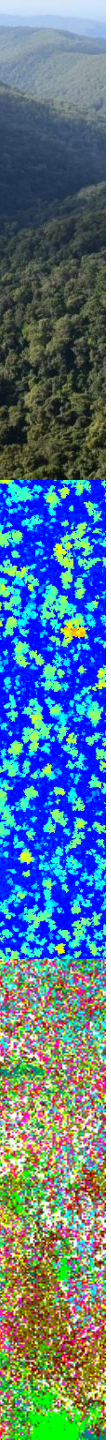
Results – Vertical Segmentation

- Data quality
  - Point densities
  - Vertical & horizontal accuracies
- Spatial resolutions
  - 1 – 2 m^3 segments
- Data size / software capacity
  - RAM limitations
  - LAStools functions



Results – Point Density Ratios

- Adaptive point density ratios
  - Improved identification of sub-canopy vegetation
- Standard point density ratios
  - Effective for structurally simple vegetation
- Segment point density requirements



Chowilla - Exploratory

CHOWILLA
Exploratory Classification

Coordinate System: GDA94 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

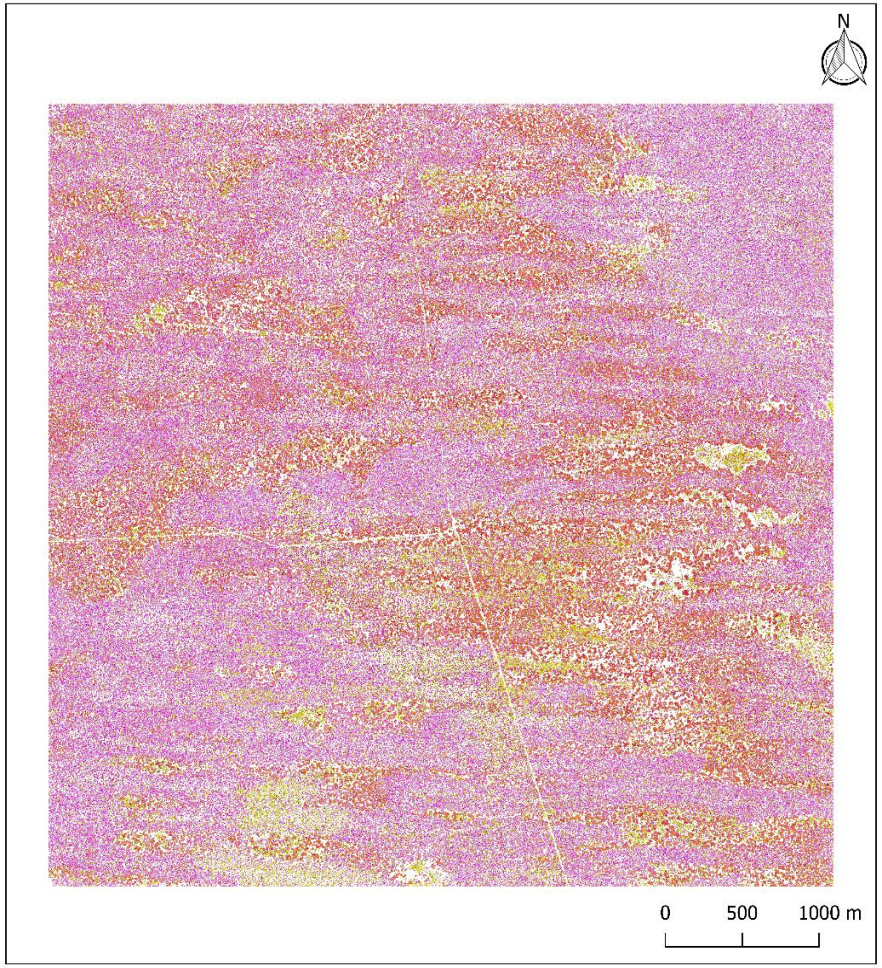
Raw data sourced from TERN AusCover, with processing & analysis using LASTools, QGIS & ENVI

Produced by John Tasker (2017)

Legend

- Unclassified
- Bare ground
- Ground cover
- Open shrub [2m]
- Shrub [2m]
- Shrub [2.5m]
- Open shrub [3m]
- Shrub [3m]
- Shrub [4m]
- Shrub [5m]
- Low Trees [+6m]

Chowilla - Specht



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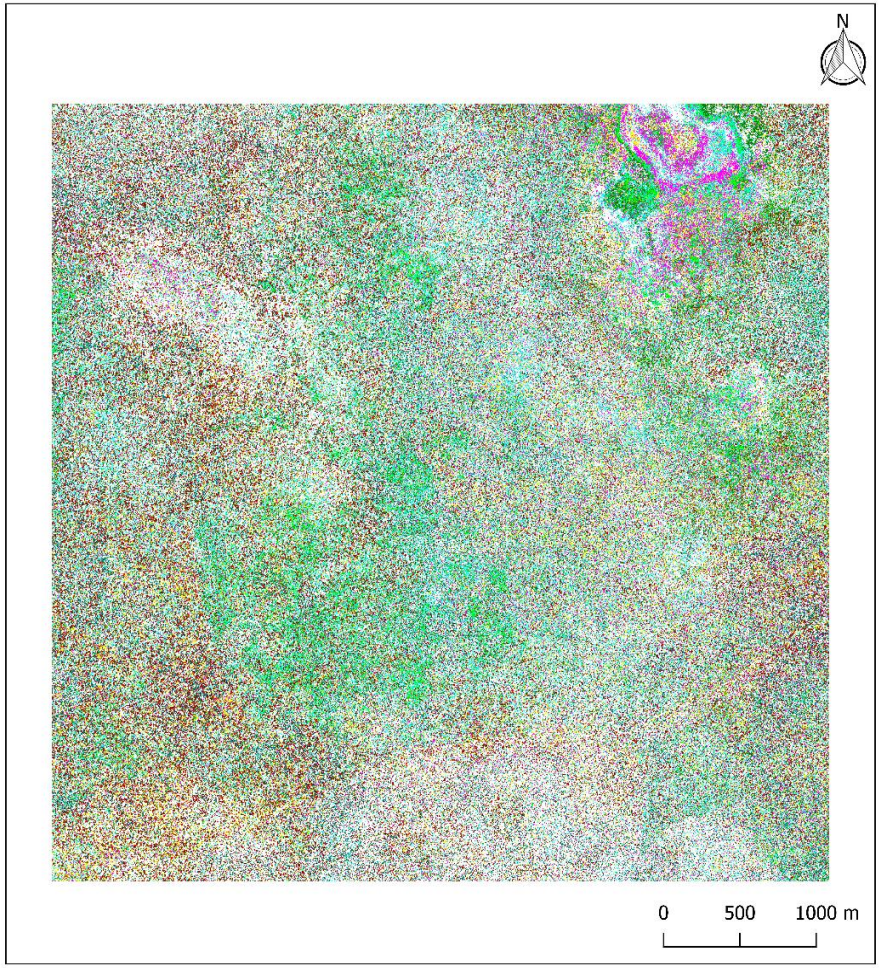
Produced by John Tasker (2017)

Legend

- Unknown
- Bare
- Low open-shrubland
- Tall open-shrubland
- TOS/LOW
- Low open-woodland
- Open-woodland
- Tall open-woodland
- Low shrubland
- Tall shrubland
- TS/LW
- Low woodland
- Woodland
- Tall woodland
- Open-heath
- Open-scrub
- OSC/LOF
- Low open-forest
- Open-forest
- Tall open-forest
- Closed-heath
- Closed-scrub
- CSC/LCF
- Low closed-forest
- Closed-forest
- Tall closed-forest

Litchfield - Exploratory



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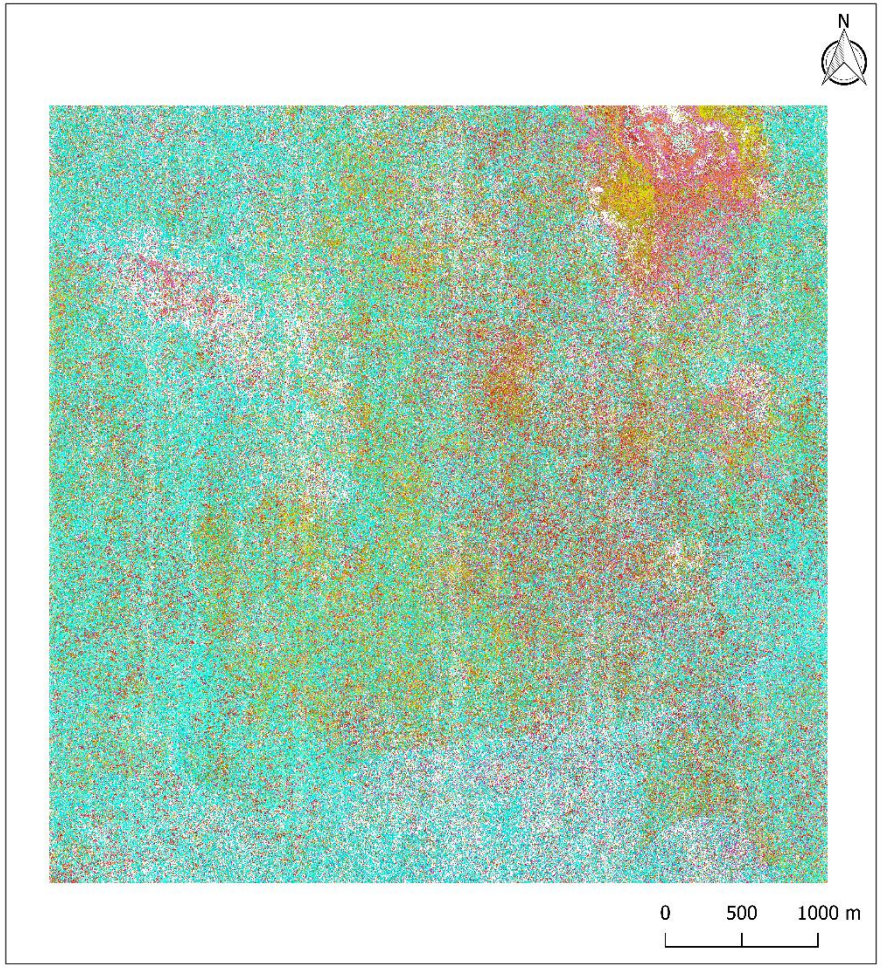
- Unclassified
- Bare ground
- Ground cover
- Open shrub [2m]
- Shrub [2m]
- Shrub [4m]
- Low tree [8m]
- Tree [12m]
- Tree [14m]
- Tall tree [16m]
- Tall tree [17m]

Litchfield - Specht



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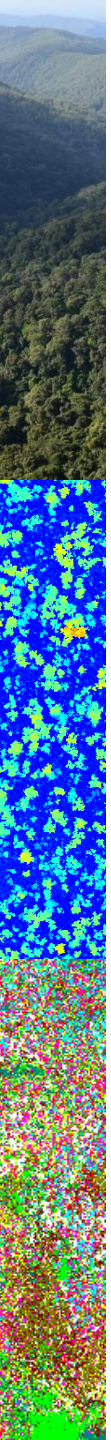

Karawatha - Exploratory

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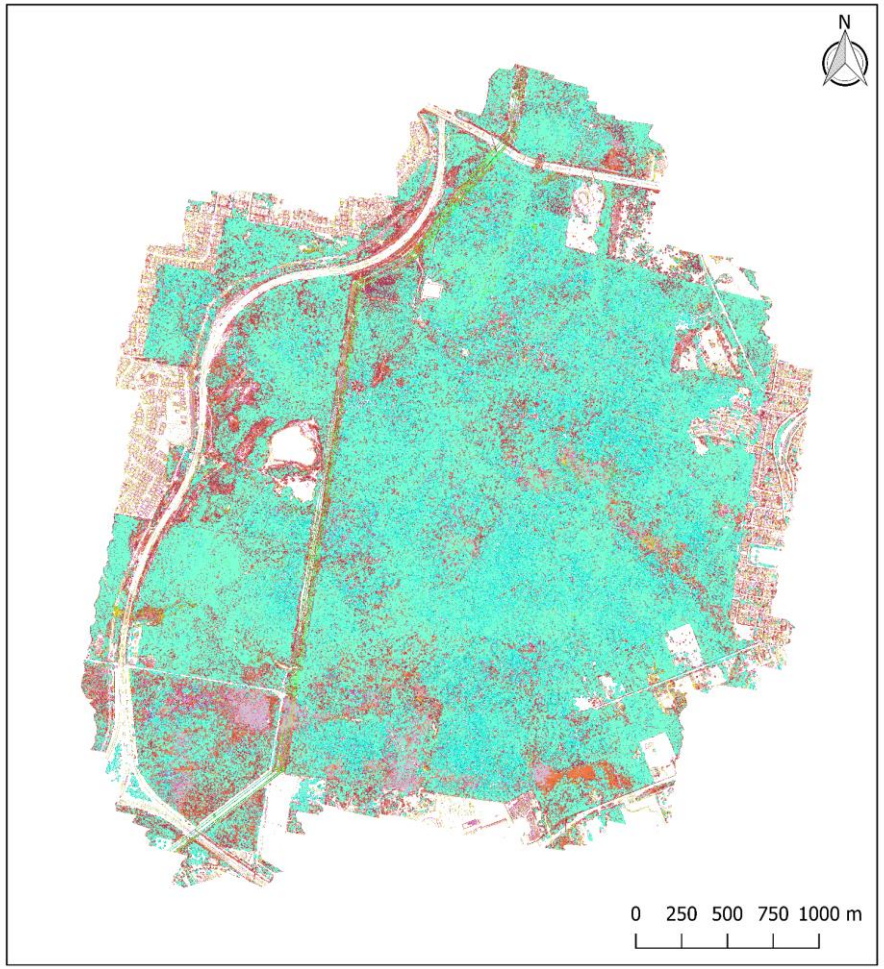
Raw data sourced from TERN AusCover, with processing & analysis using LASTools, QGIS & ENVI

Produced by John Tasker (2017)

Legend

Exploratory Classification
- Unclassified
- Bare ground
- Ground cover
- Low shrub [2m]
- Tall shrub [5m]
- Low tree [8m]
- Low tree [11m]
- Multi-storey [3m & 13m]
- Tall tree [16m]
- Tall tree [18m]
- Tall tree [20m]

Karawatha - Specht



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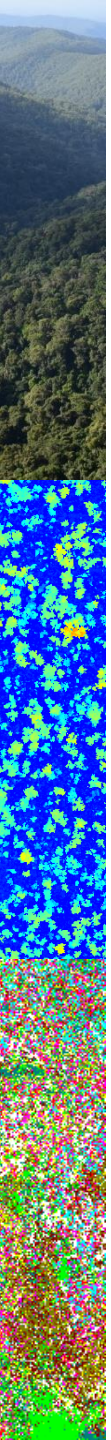
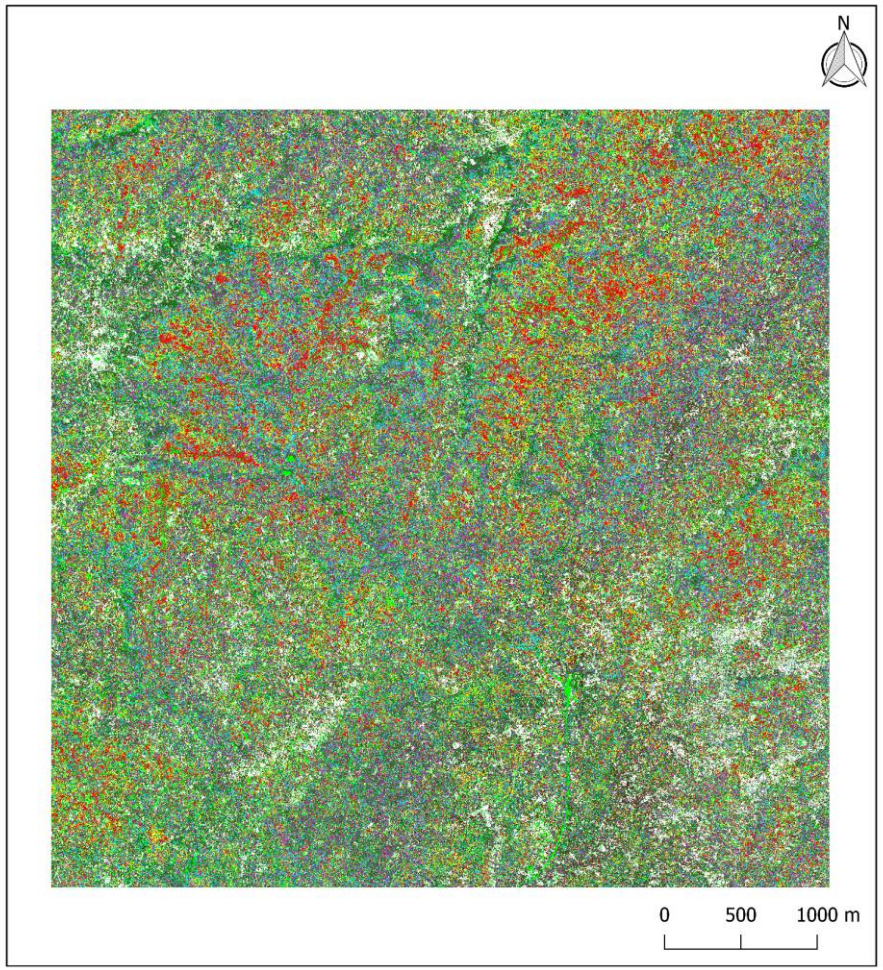


Robson Creek - Exploratory



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Exploratory Classification

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Projection: Transverse Mercator
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Units: Metre

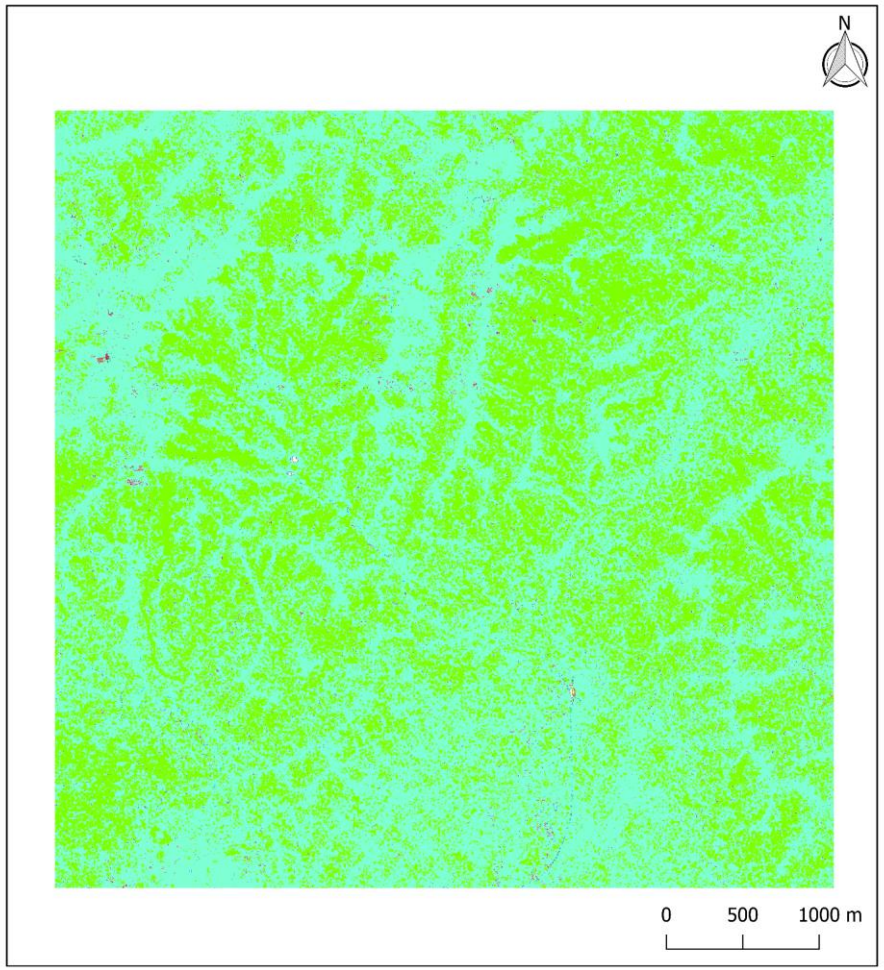
Raw data sourced from TERN AusCover, with processing & analysis using LASTools, QGIS & ENVI

Produced by John Tasker (2017)

Legend

- Unclassified
- Ground cover
- Dense understorey [2m]
- Dense understorey [4m]
- Dense understorey [6m]
- Tree [10m]
- Tree [16m]
- Multi-storey [2 & 22m]
- Tall tree [22m]
- Tall tree [26m]
- Tall tree [32m]

Robson Creek - Specht



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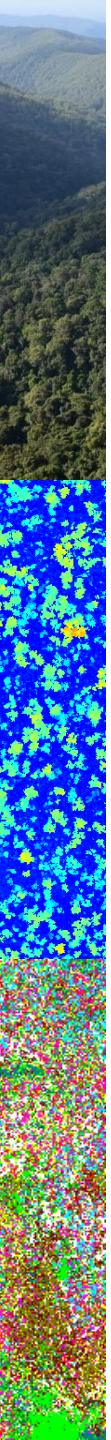
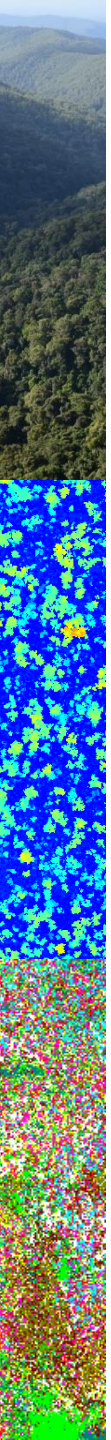


Results – Classification Comparisons

- Exploratory LiDAR-derived classifications
  - Classification of full vegetation structure (ground to canopy)
  - Characterisation of fine structural patterns (1-2 m segments)
- Specht classifications
  - Primarily classified canopy vegetation
  - Overlap class for shrub/trees
- Site-averaged PAVD data
  - Weak similarities (sample site vs whole site)
  - Additional analysis required



Summary

- Vertical segmentation is an applicable method to characterise Australian vegetation communities
  - Fine spatial resolutions
  - Diverse range of vegetation communities
- Point density ratio calculations
  - Standardise ALS point cloud datasets
  - Compensate for canopy return bias
- Further work required to refine methods and processes

QUESTIONS

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