

# Modelling strata-based forest fuel characteristics change over time using LiDAR technology

by

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Workshop ACT environmental sensing activities  
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# Presentation contents

A woman with blonde hair tied back, wearing a light-colored, patterned, sleeveless dress, stands in a field of dry, golden-brown grass. She is holding a baby in her arms. The background shows rolling hills and mountains under a hazy sky. The overall scene is peaceful and natural.

- My research
- Work so far
- Terrestrial LiDAR instrument test
- Future research
- Acknowledgement

A photograph of a forest. In the foreground, there are several large, vibrant green ferns. Behind them, a dense stand of tall, thin trees with light-colored bark (possibly eucalyptus) rises. The background is slightly blurred, showing more trees and a hint of a sky. The overall lighting is soft, suggesting an overcast day or early morning/late afternoon.

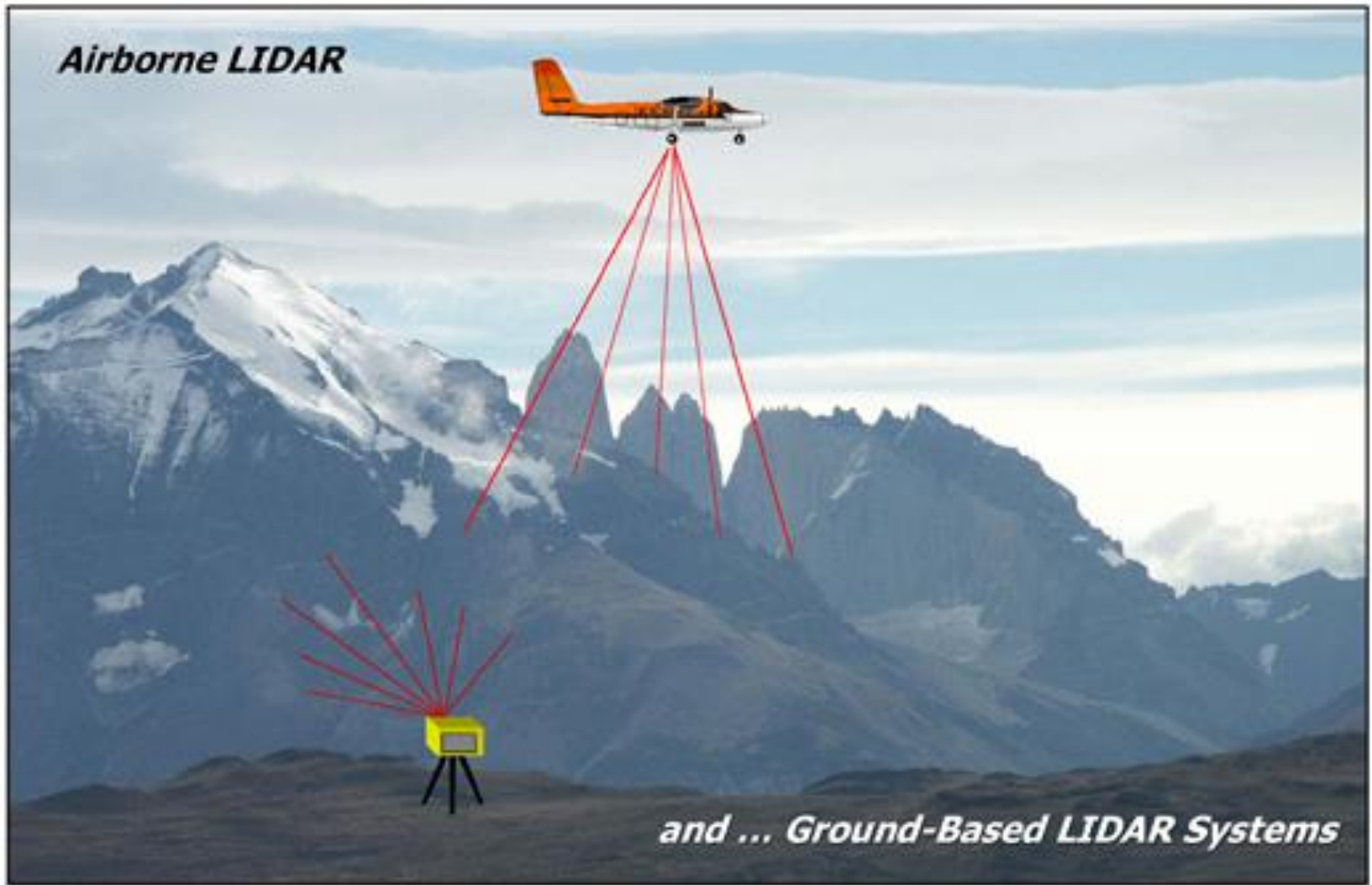
# Linking with BNHCRC Theme and Project: Mapping Bushfire Hazard and Impacts A1

Field work in Lake Eildon and Upper Yarra in  
Feb and Mar

Field work in ACT during the new airborne  
LiDAR campaign

Two study sites in VIC are considered as case  
studies, the developed methods will be  
tested and applied in the ACT project.

# **Merging** airborne LiDAR system with terrestrial LiDAR system for measuring forest fuel structures



# My Research

<b>Aims</b>	<b>Significance</b>	<b>Questions</b>
to measure strata-based forest fuels	integrating airborne LiDAR with terrestrial LiDAR for forest fuel measurements	How to integrate airborne with terrestrial LiDAR?
to model strata-based forest fuel characteristics change over time	understanding forest fuel arrangement and predicting forest fuel hazard change over time	How forest fuel structure characteristics are related to forest age, environmental factors, and vegetation species?
to assess the correlation between overstory and understory fuels change over time	assisting fire management and planning strategy, and in framing bushfire related policies	What are the relationships between overstory and understory fuels characteristics change over time?

A vibrant red and blue parrot, possibly a Red-tailed Tropicbird, is perched on a dark, textured tree branch. The bird has bright red plumage on its head, neck, and body, with blue feathers on its wings. It has a large, pale, hooked beak and dark eyes. The background is a soft, out-of-focus green with circular bokeh light spots, suggesting a forest setting. The text "Work so far" is overlaid in yellow on the bird's head.

**Work so far**

Study Experiment - Site Location (Site 2)



# Case study – Lake Eildon

Study Experiment - Site Layout (Site 2)

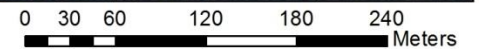


**Legend**

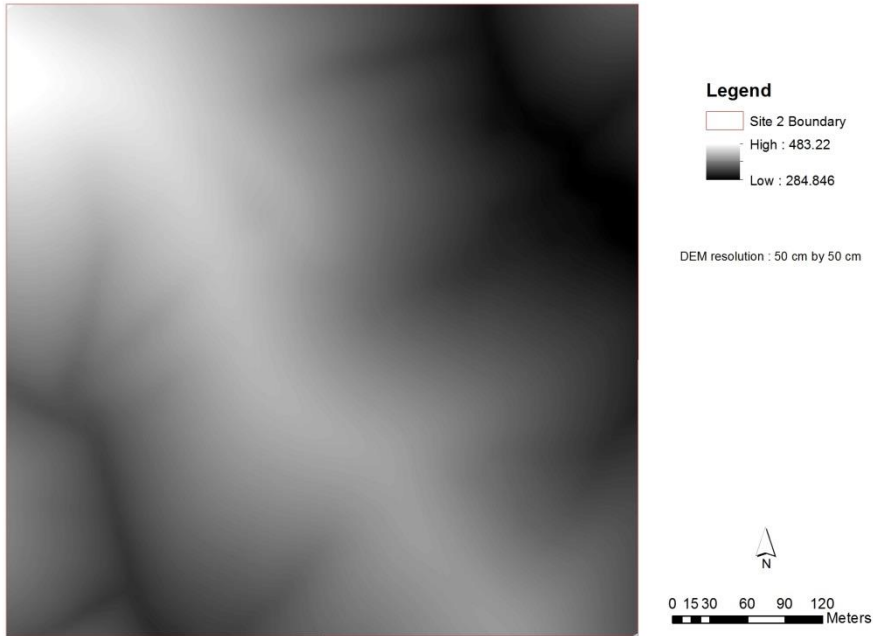
 Site 2 Boundary    The study site 2 is located at Lake Eildon National Park.

**Legend**

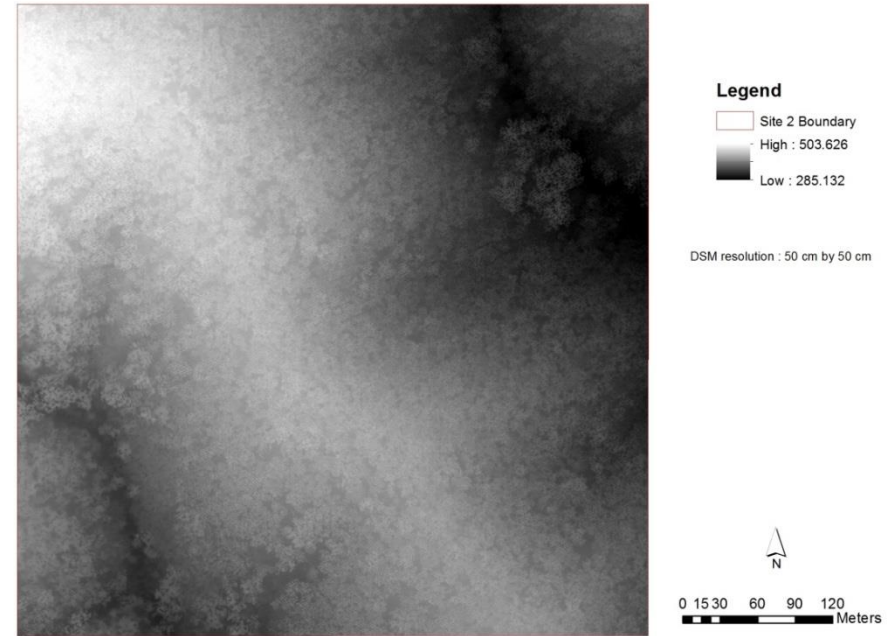
 Site 2 Boundary    The study site is 25 ha approximately with an elevation range from 284.8 m to 483.22 m.



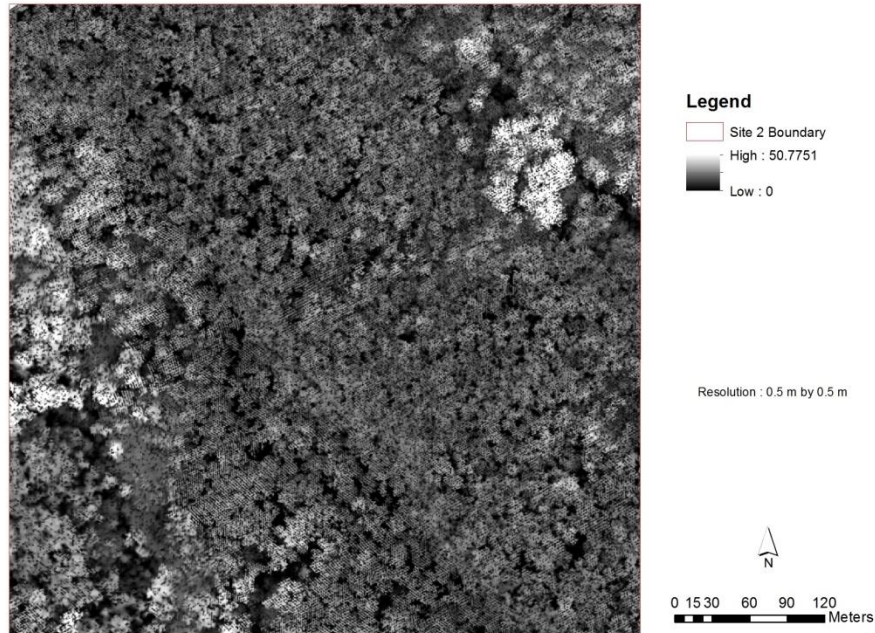
Study Experiment - DEM (Digital Elevation Model) (Site 2)



Study Experiment - DSM (Digital Surface Model) (Site 2)

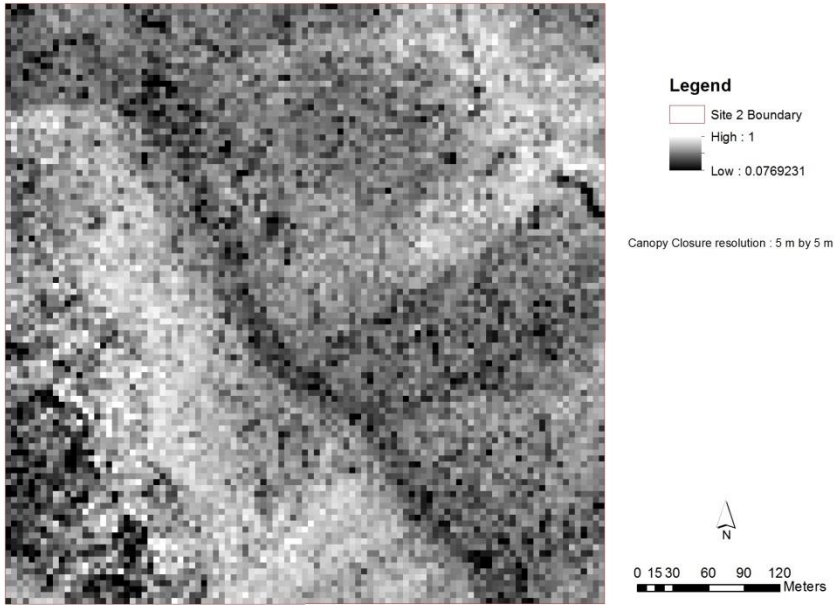


Study Experiment - CHM (Canopy Height Model) (Site 2)

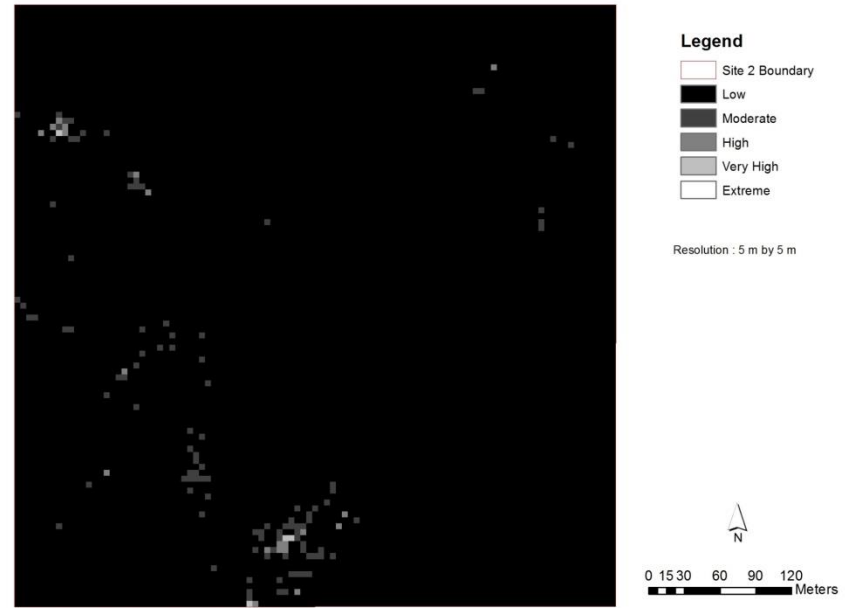




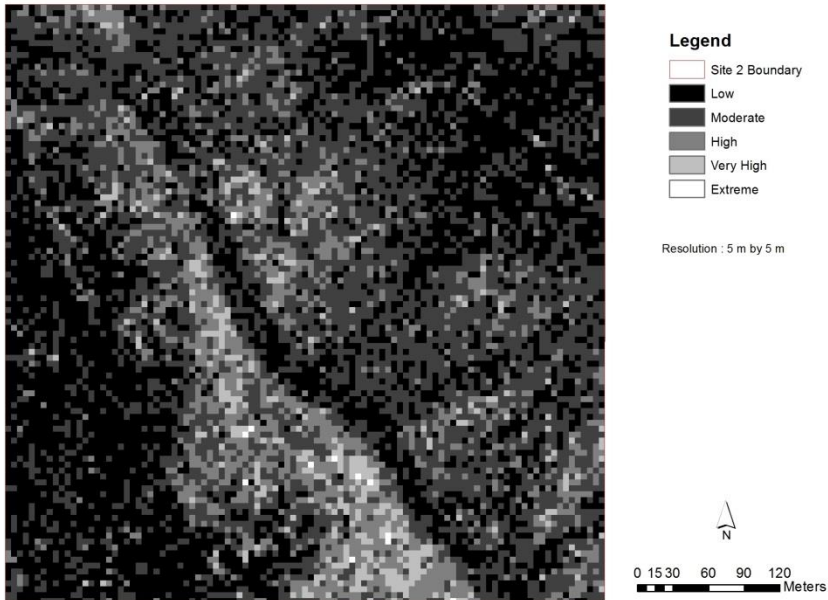
Study Experiment - Canopy Closure (Site 2)



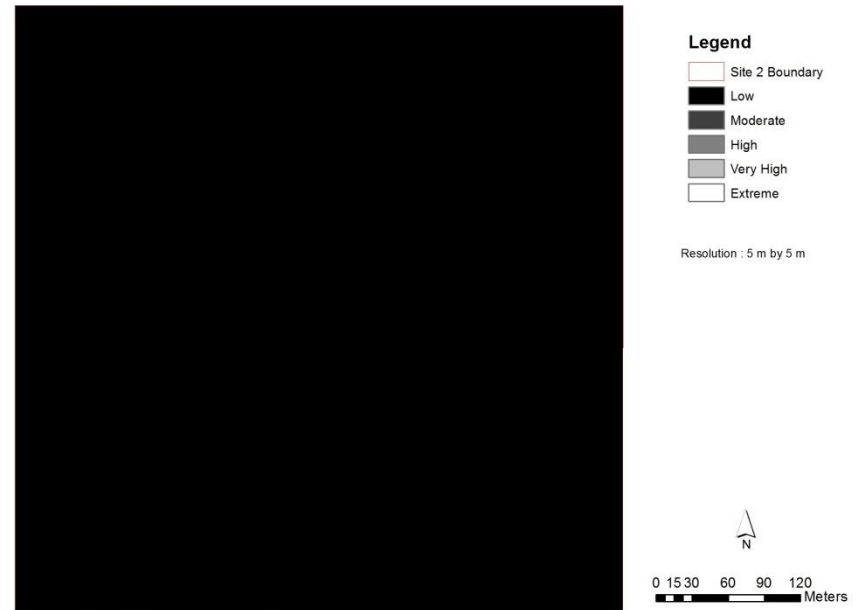
Study Experiment - Elevated Fuel Hazard Assessment (Site 2)



Study Experiment - Near-surface Fuel Hazard Assessment (Site 2)

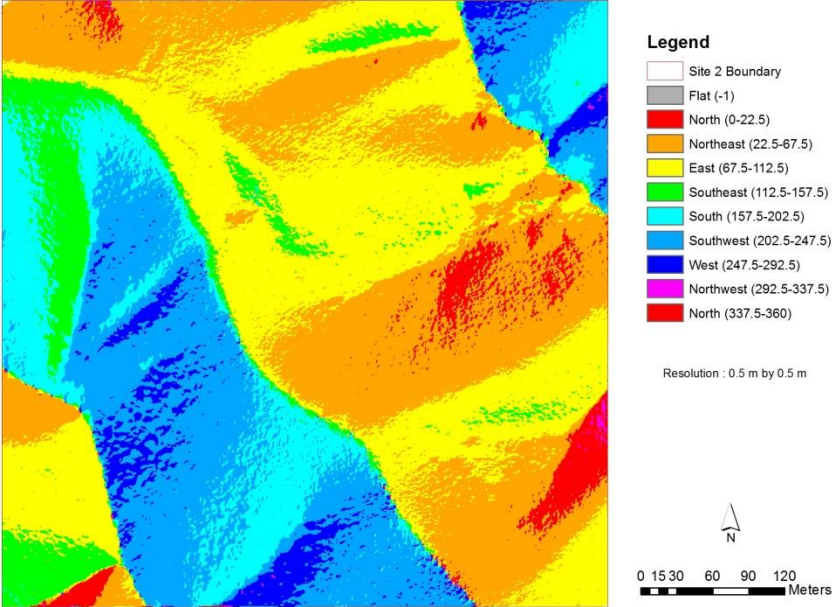


Study Experiment - Surface Fuel Hazard Assessment (Site 2)

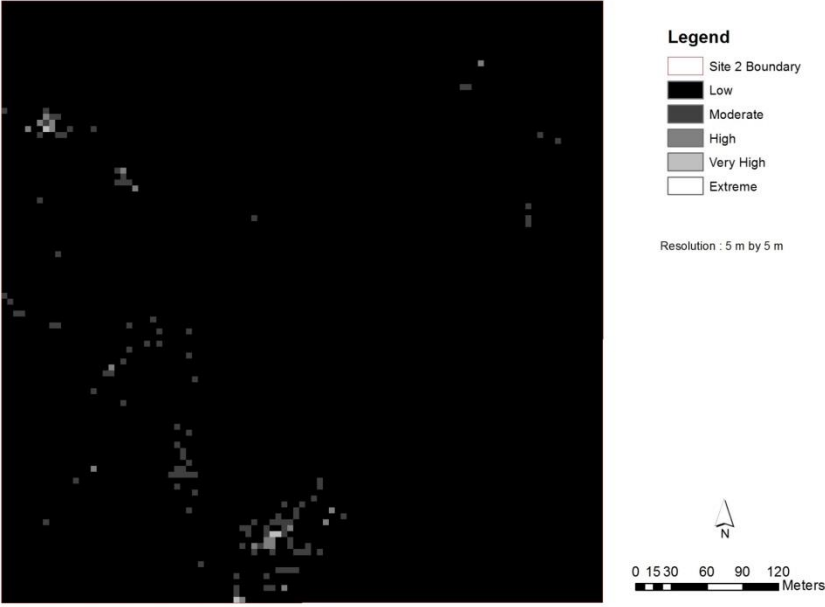


# Elevated fuel hazard ratings are highly related to aspect

Study Experiment - Aspect Map (Site 2)



Study Experiment - Elevated Fuel Hazard Assessment (Site 2)



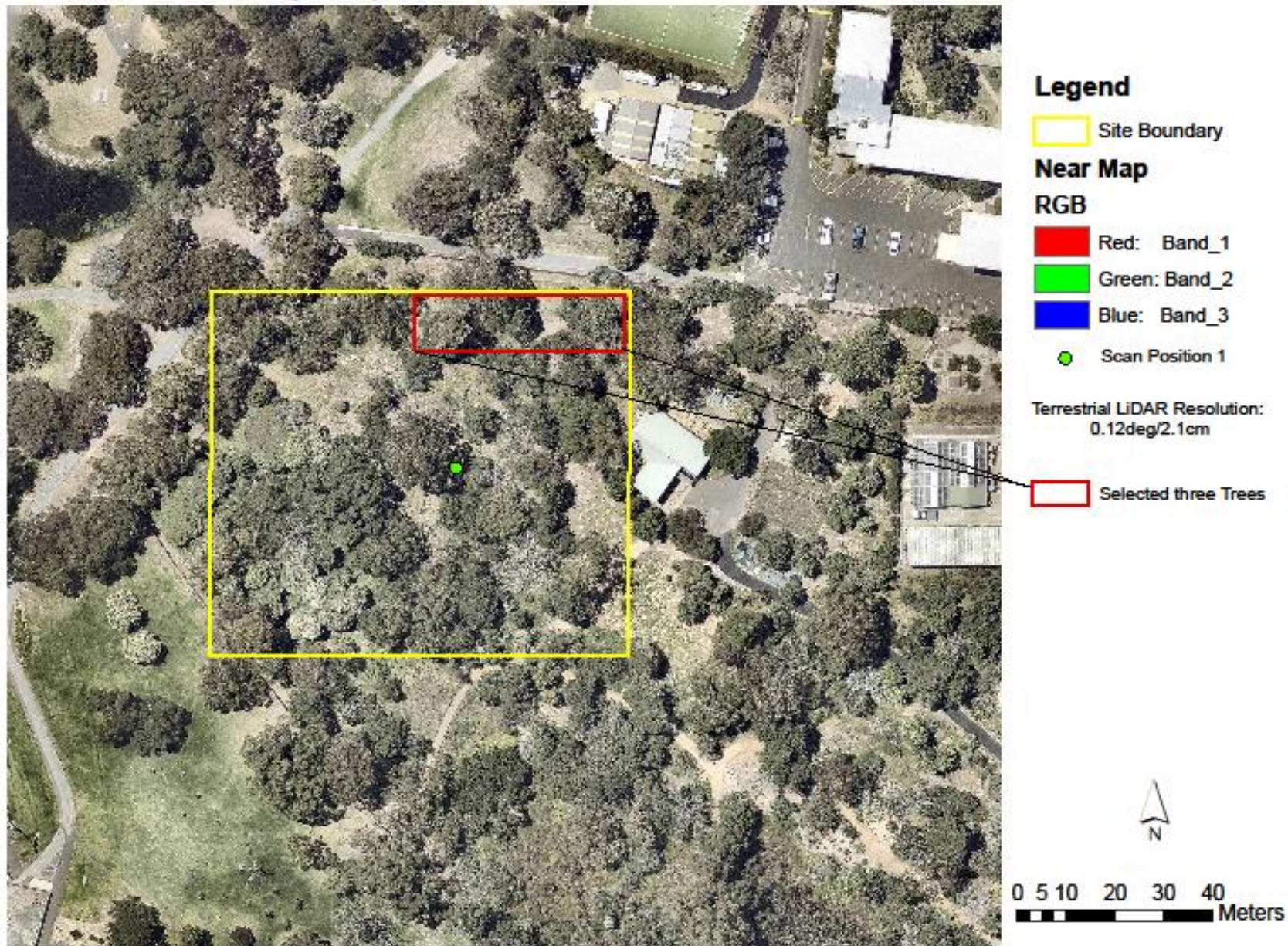
# Terrestrial LiDAR instrument test

## Riegl z420i

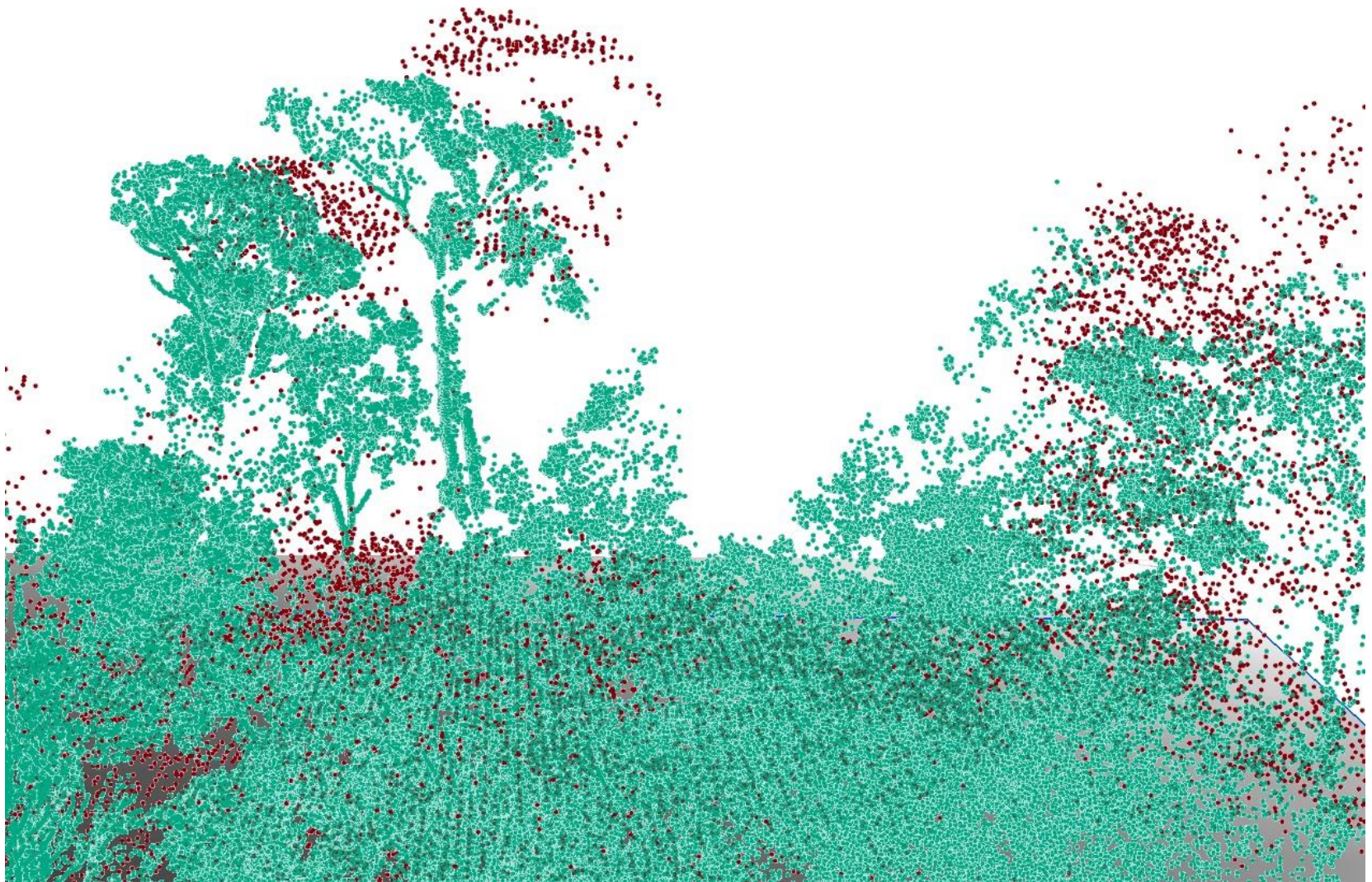
- Vertical scanning range **up to 80deg**  
Horizontal scanning range **up to full 360deg**
- For our study:  
Accuracy using Panorama: **0.12deg/0.021m**  
One scan: **5mins**



# Study Experiment at Jock Marshall Reserve



# Integrated LiDAR vegetation profile



# Some thoughts after the test

- Airborne LiDAR Limitation:

Penetrating canopy

Extracting accurate information about understory fuels

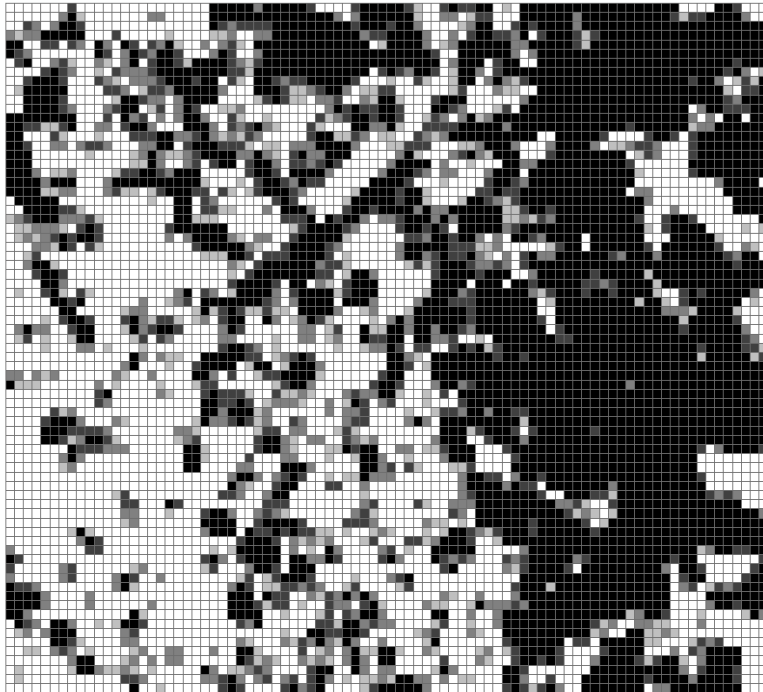
- Terrestrial LiDAR Limitation:

Scanning scales (vertical heights, horizontal distance, and zenith angle)

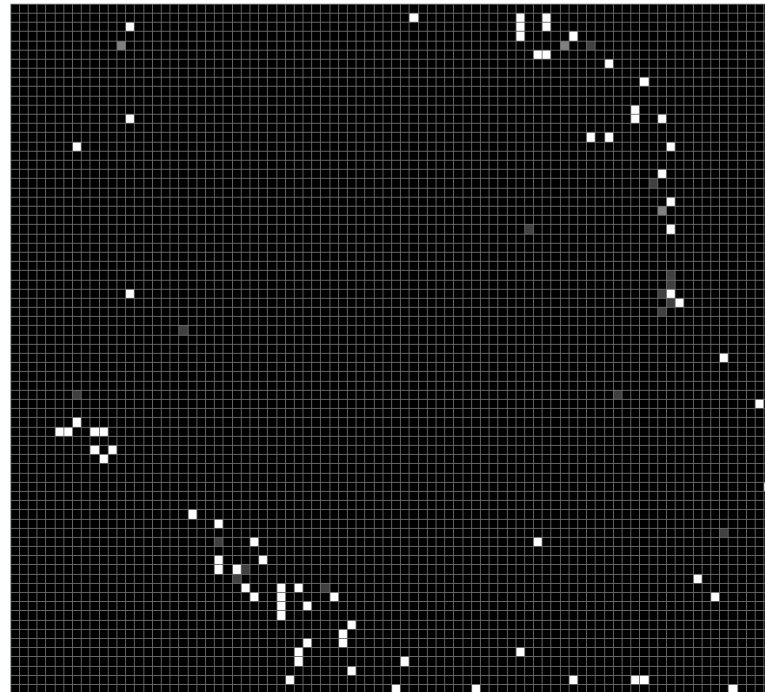
Underestimating canopy heights and overstory vegetation volume

# Airborne VS Riegl

Airborne LiDAR



Terrestrial LiDAR

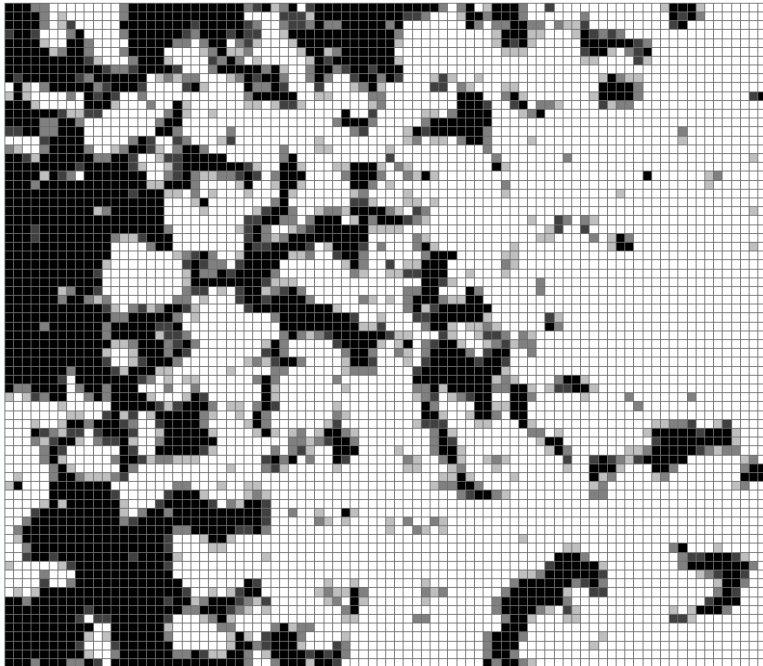


Surface  
Litter cover



# Airborne VS Riegl

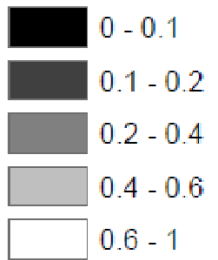
Airborne LiDAR



Terrestrial LiDAR



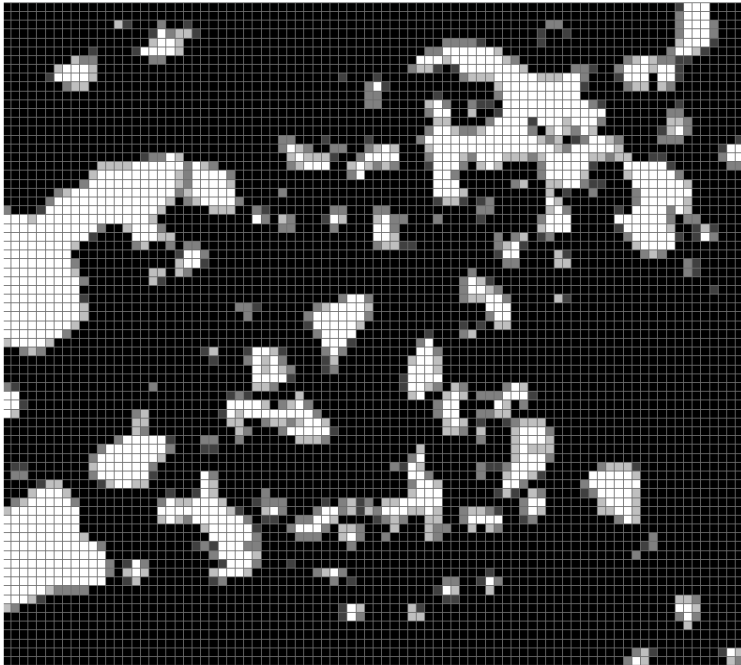
Near-surface  
plant cover





# Airborne VS Riegl

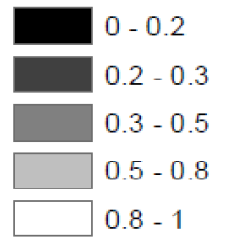
**Airborne LIDAR**



**Terrestrial LIDAR**

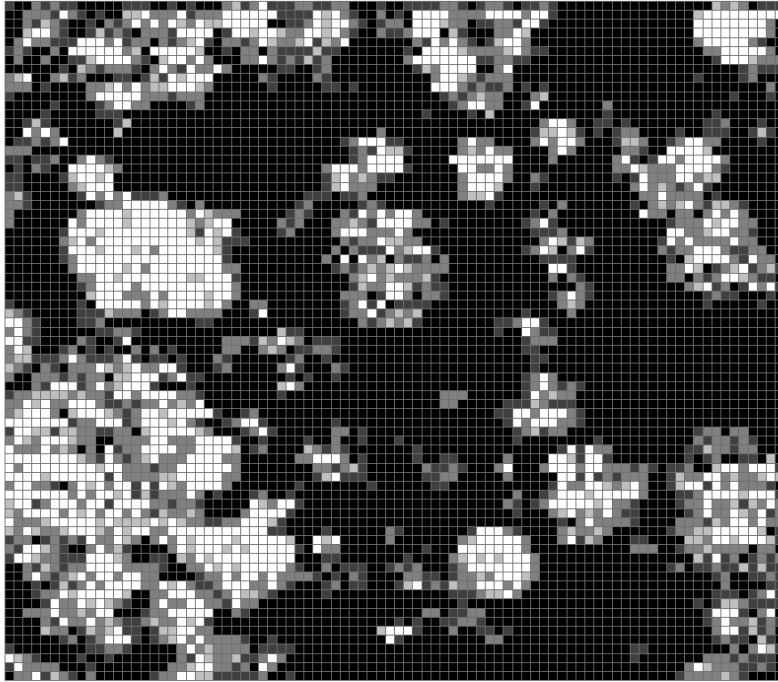


Elevated  
plant cover

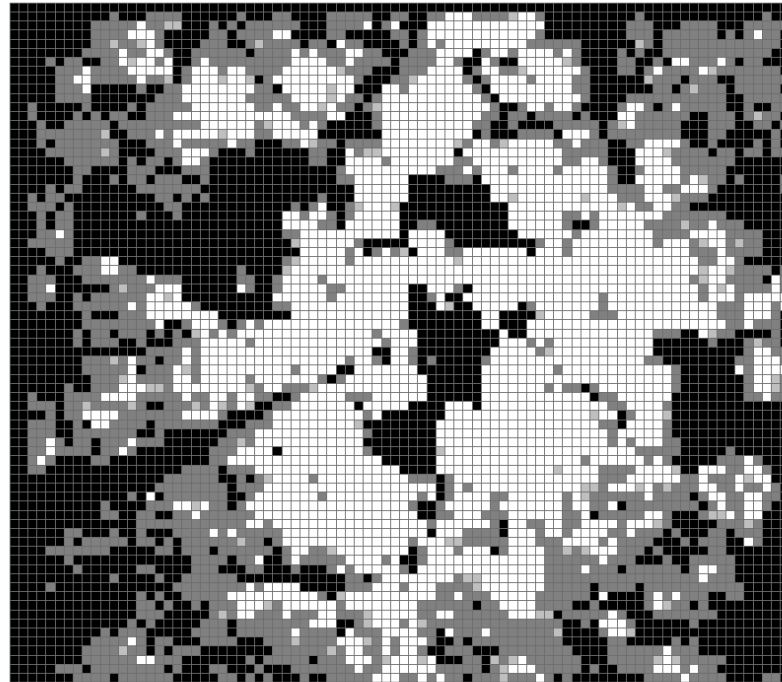


# Airborne VS Riegl

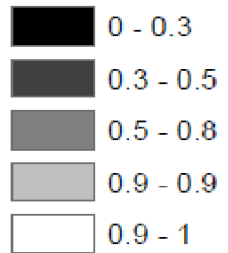
Airborne LiDAR



Terrestrial LiDAR



Overstory  
plant cover



# Future research

- Data collection: terrestrial LiDAR data (Riegl and Zebedee) and ground truthing data in ACT and VIC
- Mapping fuel structure characteristics using the terrestrial LiDAR data
- Merging both LiDAR systems
- Assessing fuels at sites of different forest ages for modeling forest fuel structure change over time
- Predicting forest fuel hazard scores and ratings for fire management (e.g. fuel reduction burning)

# Acknowledgement

- Thank you to Dr Xuan Zhu, Prof Nigel Tapper, Dr Marta Yebra, Dr Musa Kilinc, Dr Sarah Harris for their kind guidance and encouragement.
- Thank you to everyone.

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