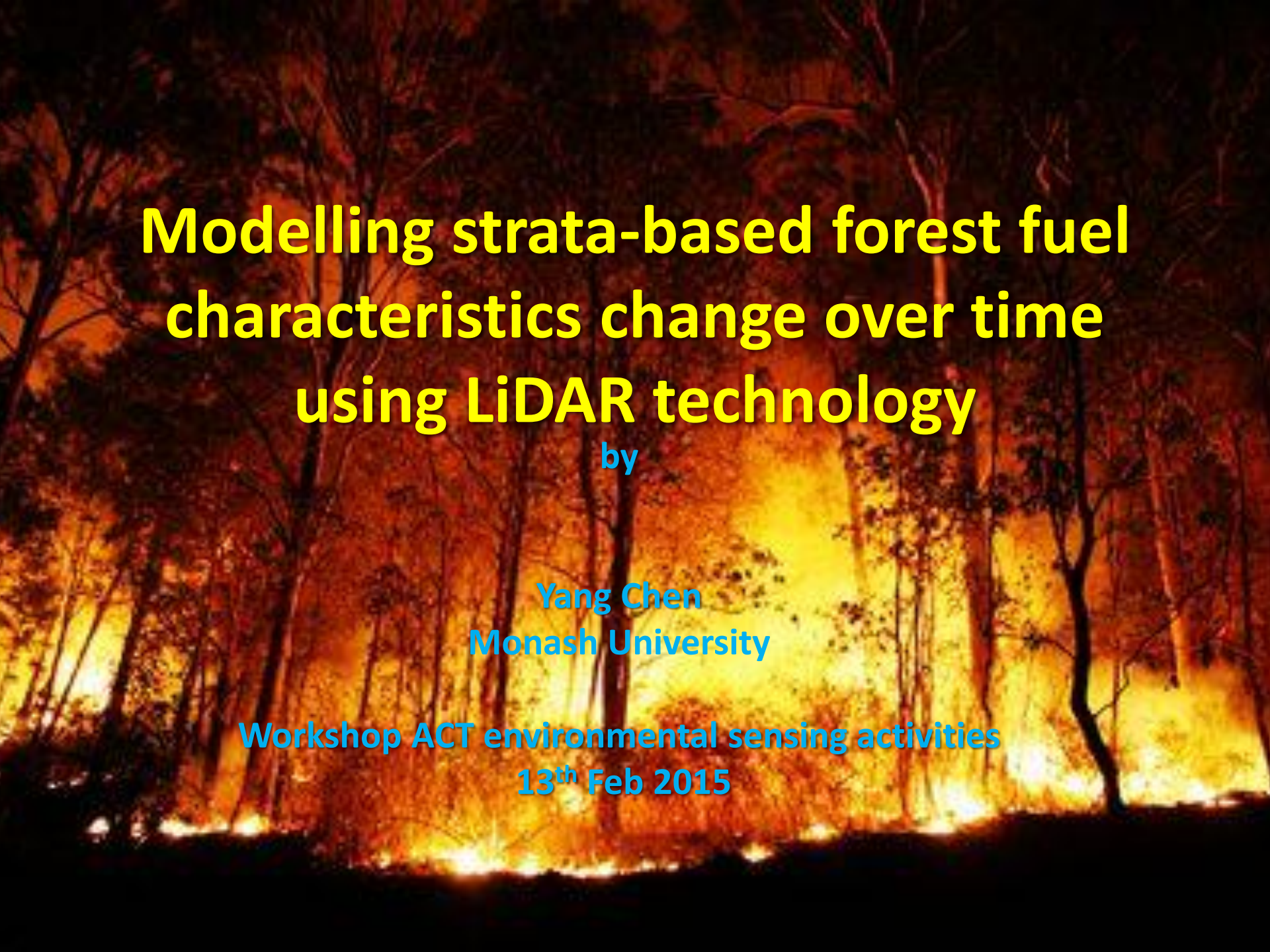


Modelling strata-based forest fuel characteristics change over time using LiDAR technology

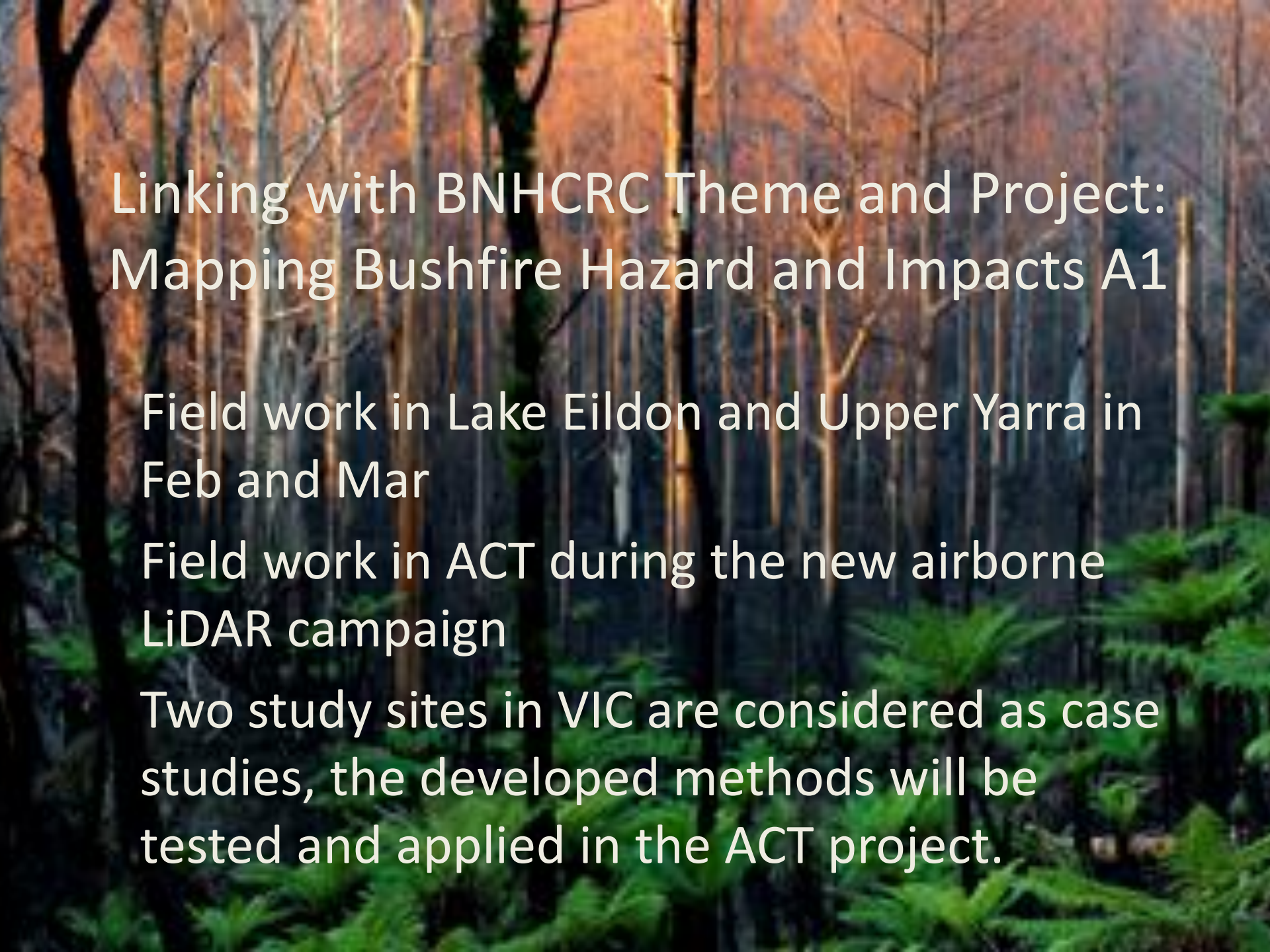
by

Yang Chen
Monash University

Workshop ACT environmental sensing activities
13th Feb 2015

Presentation contents

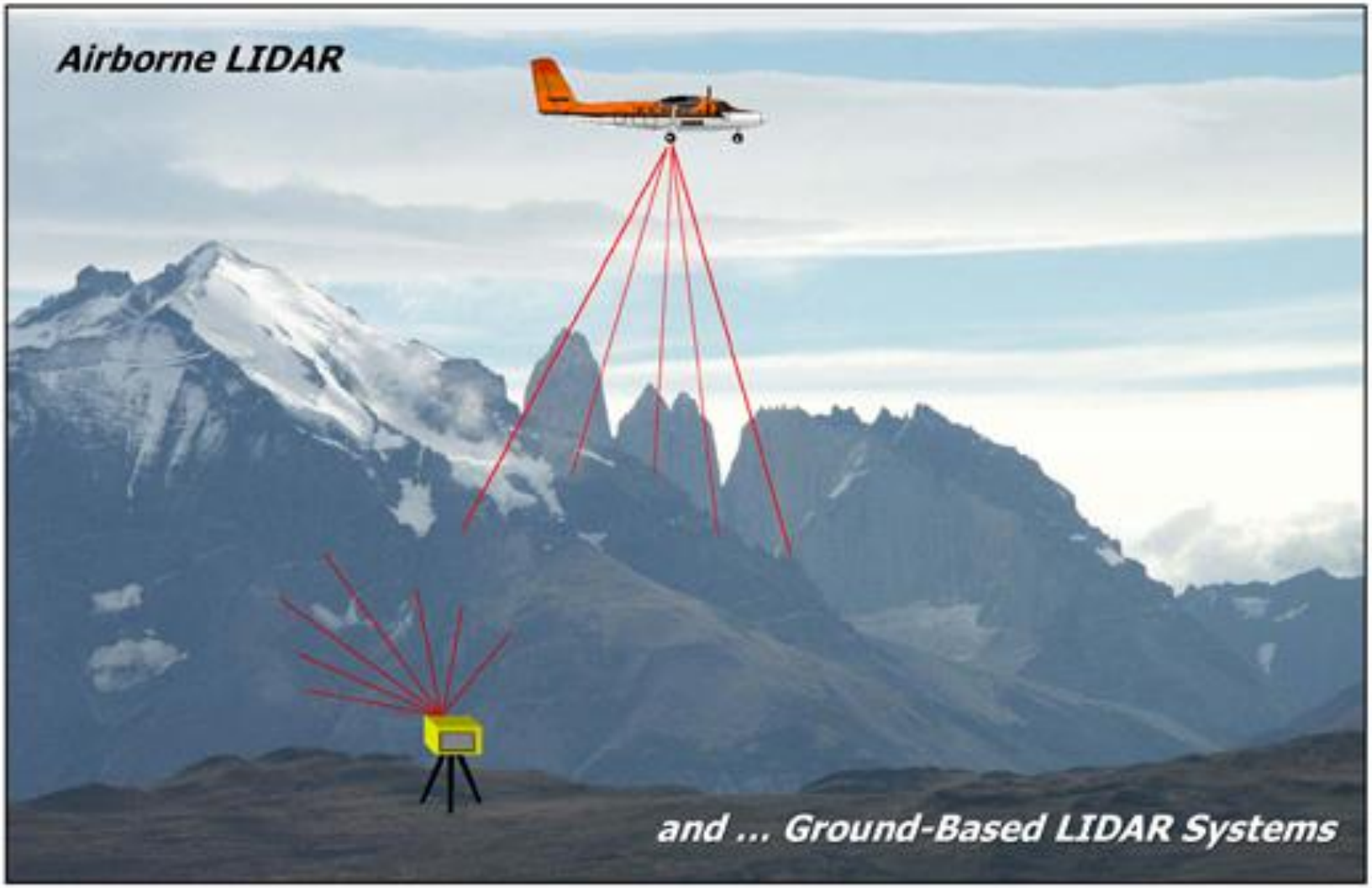
- My research
- Work so far
- Terrestrial LiDAR instrument test
- Future research
- Acknowledgement



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

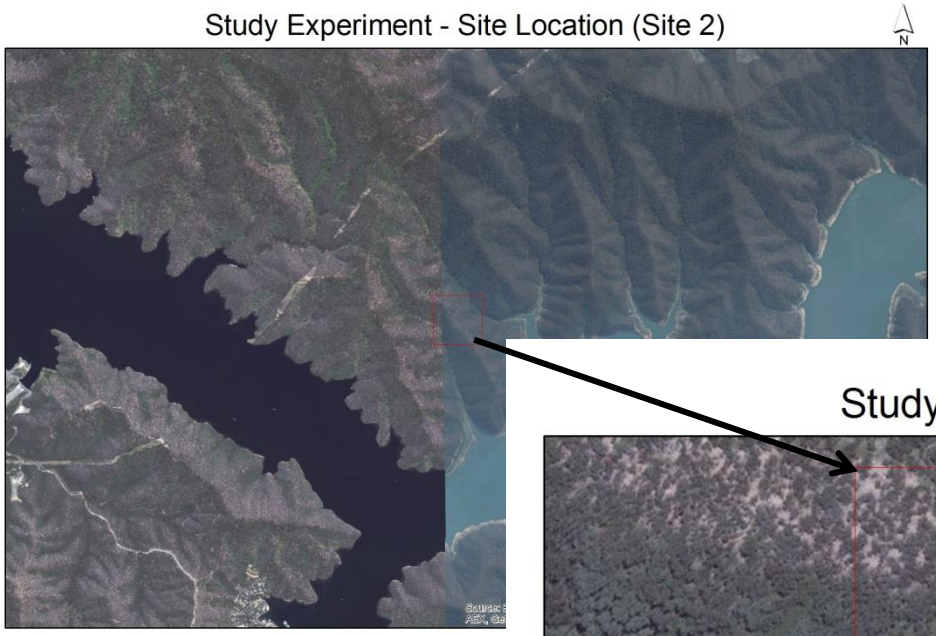


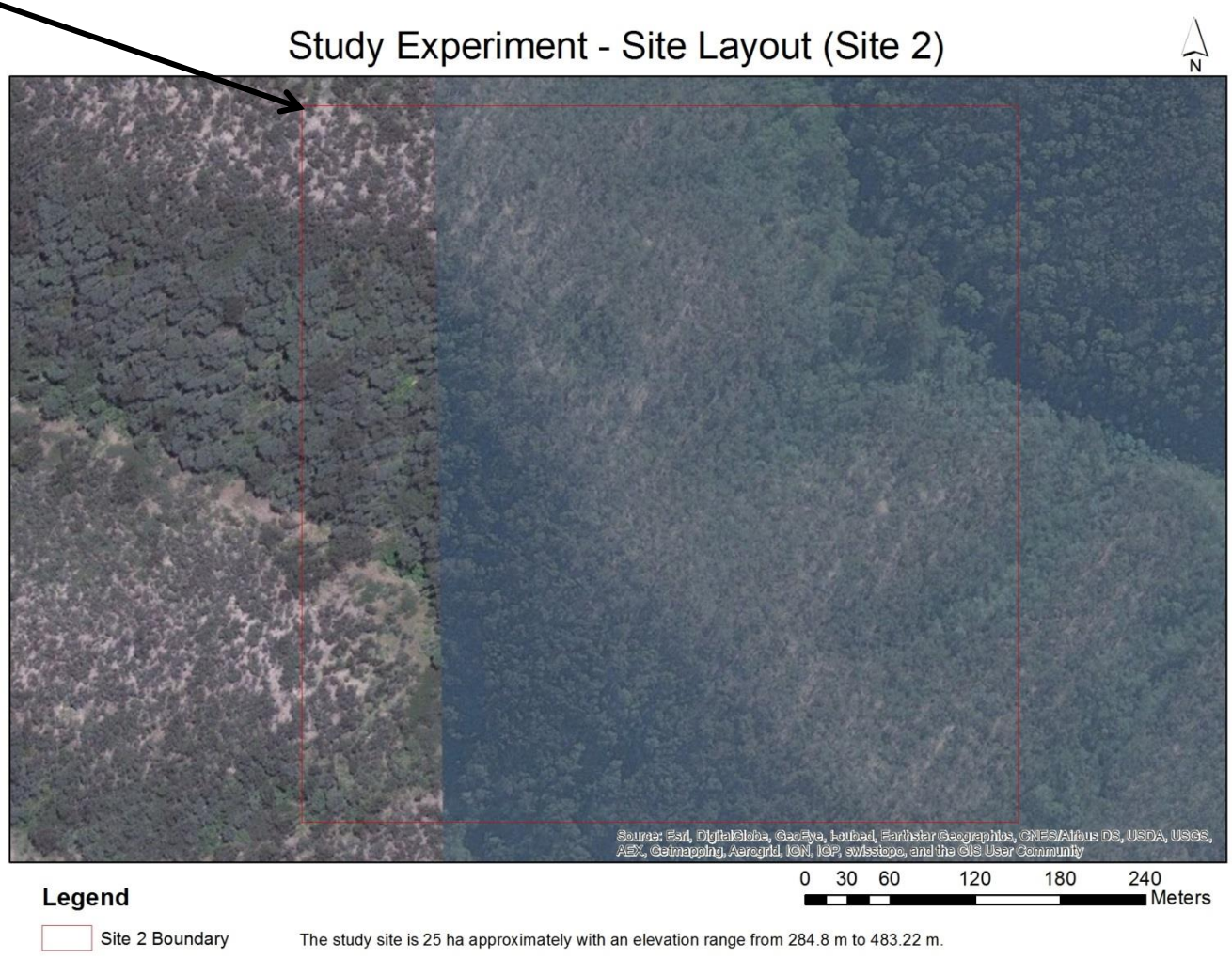
My Research

Aims	Significance	Questions
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?

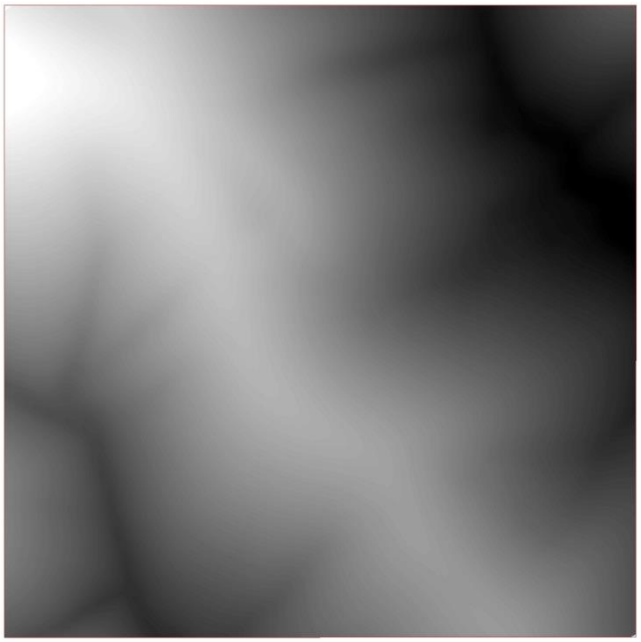

Work so far

Case study – Lake Eildon





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



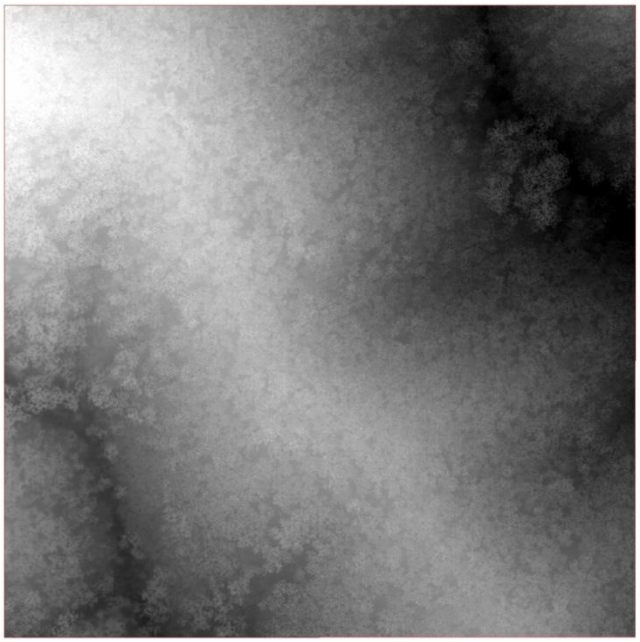
Legend
Site 2 Boundary
High : 483.22
Low : 284.846

DEM resolution : 50 cm by 50 cm

N

0 15 30 60 90 120
Meters

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



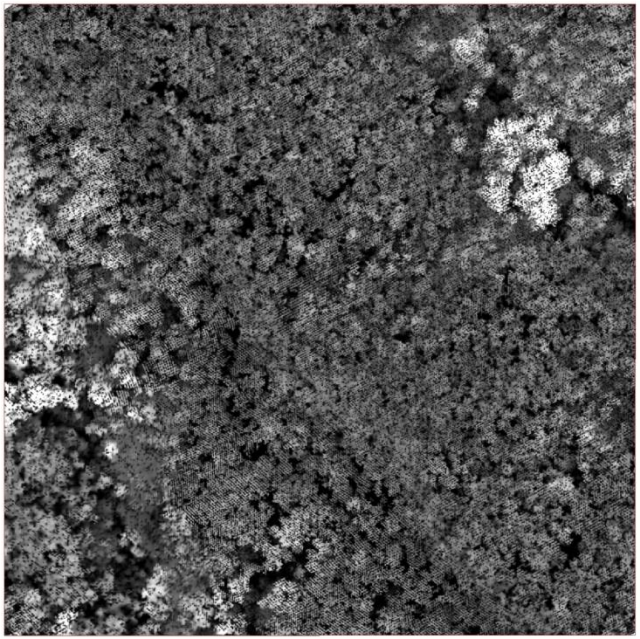
Legend
Site 2 Boundary
High : 503.626
Low : 285.132

DSM resolution : 50 cm by 50 cm

N

0 15 30 60 90 120
Meters

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



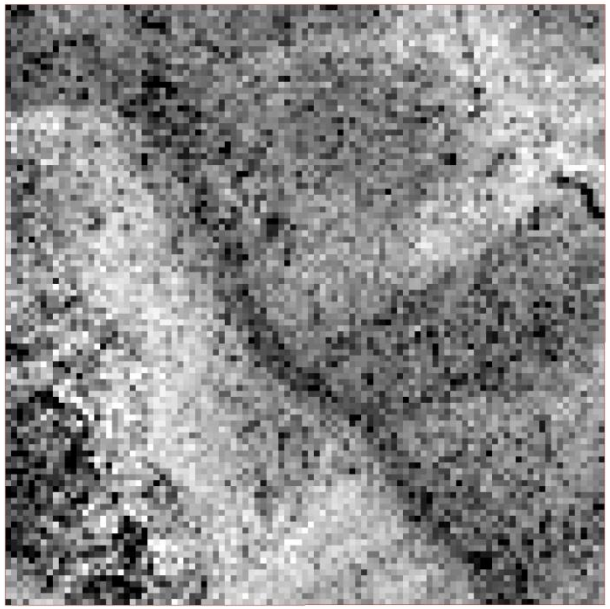
Legend
Site 2 Boundary
High : 50.7751
Low : 0

Resolution : 0.5 m by 0.5 m

N

0 15 30 60 90 120
Meters

Study Experiment - Canopy Closure (Site 2)



Legend
- Site 2 Boundary
- High : 1
- Low : 0.0769231

Canopy Closure resolution : 5 m by 5 m

N

0 15 30 60 90 120 Meters

Study Experiment - Elevated Fuel Hazard Assessment (Site 2)

Legend
- Site 2 Boundary
- Low
- Moderate
- High
- Very High
- Extreme

Resolution : 5 m by 5 m

N

0 15 30 60 90 120 Meters

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

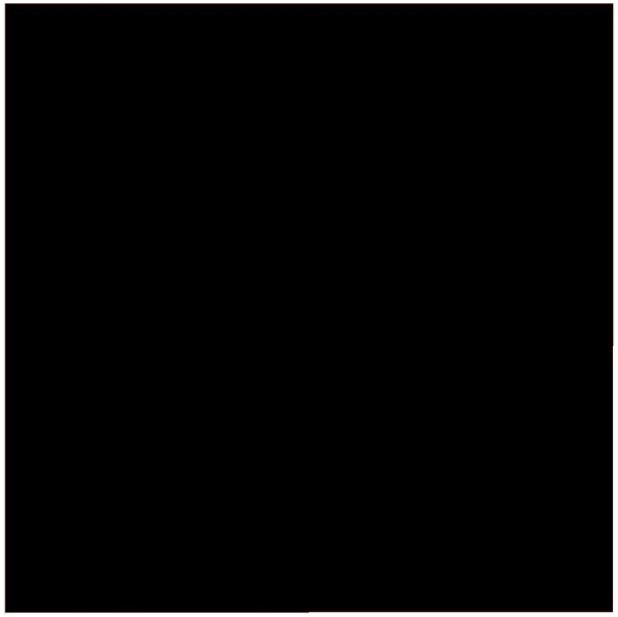
Legend
- Site 2 Boundary
- Low
- Moderate
- High
- Very High
- Extreme

Resolution : 5 m by 5 m

N

0 15 30 60 90 120 Meters

Study Experiment - Surface Fuel Hazard Assessment (Site 2)



Legend
- Site 2 Boundary
- Low
- Moderate
- High
- Very High
- Extreme

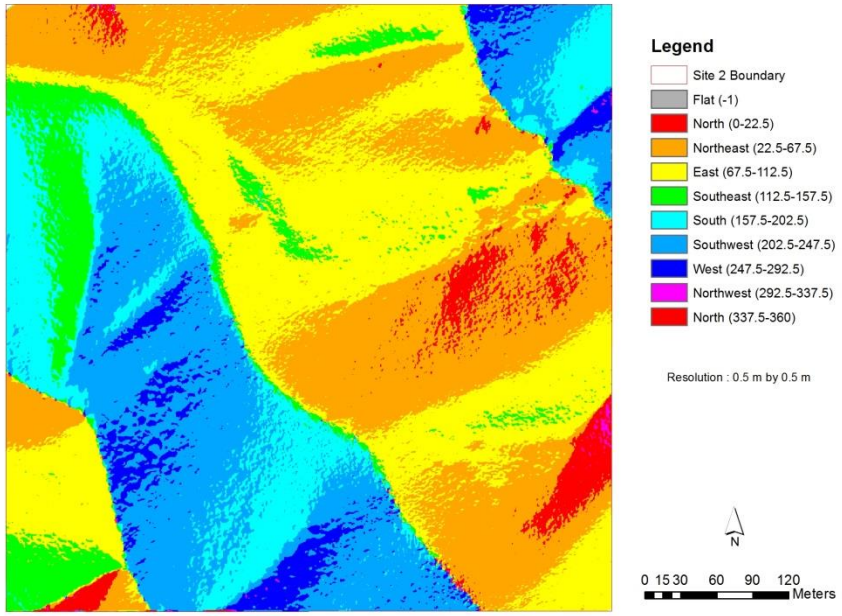
Resolution : 5 m by 5 m

N

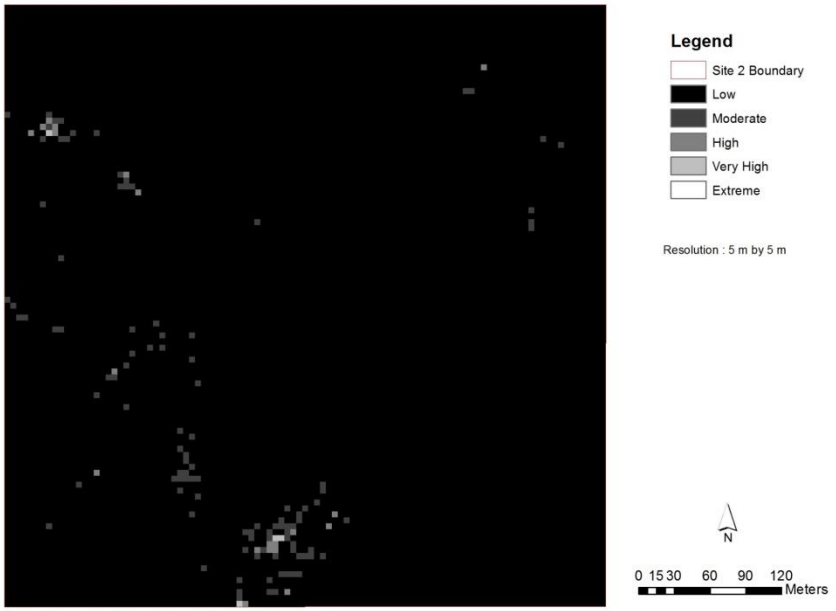
0 15 30 60 90 120 Meters

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

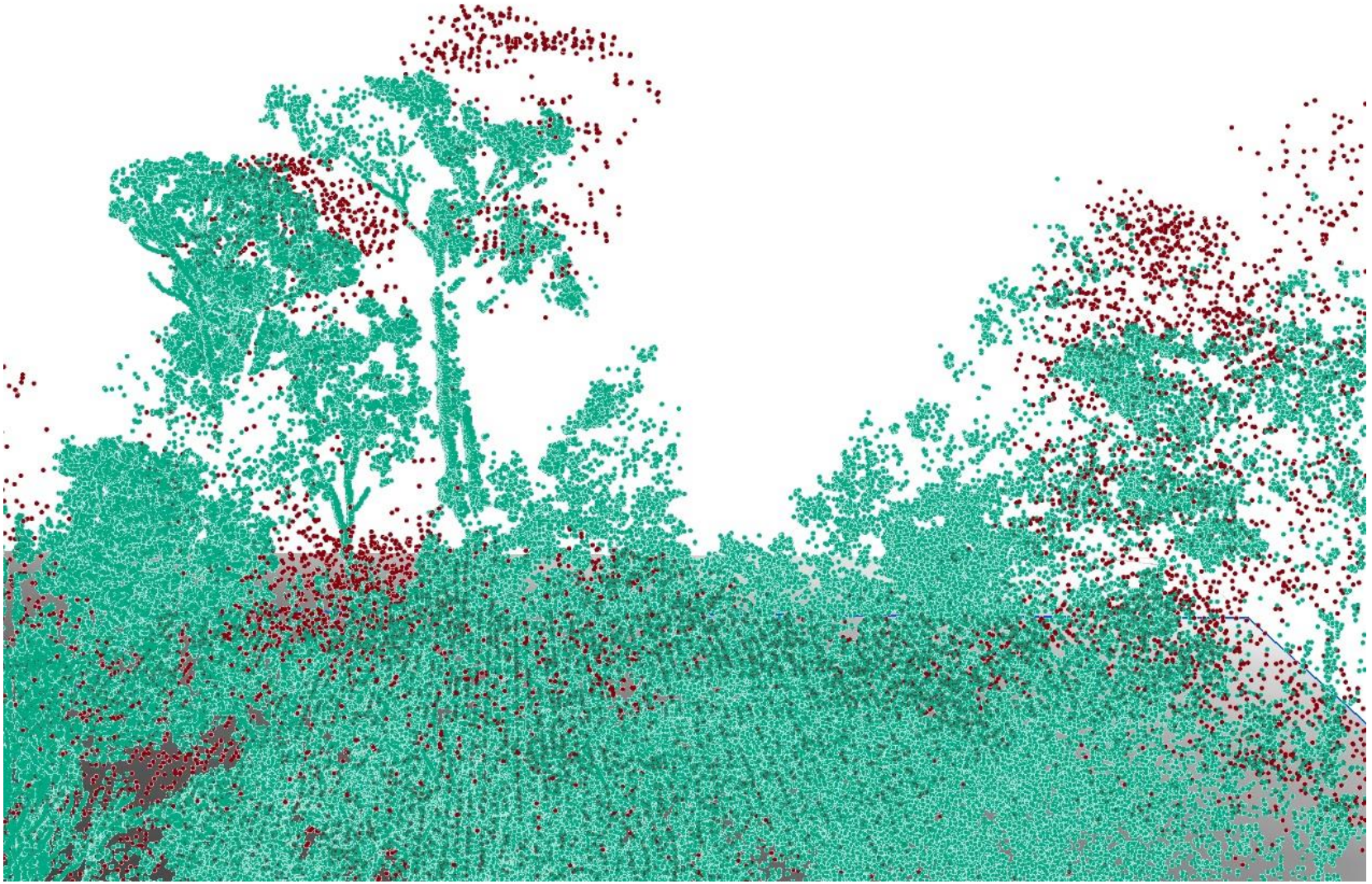
  Horizontal scanning range up to full 360deg
- For our study:

  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

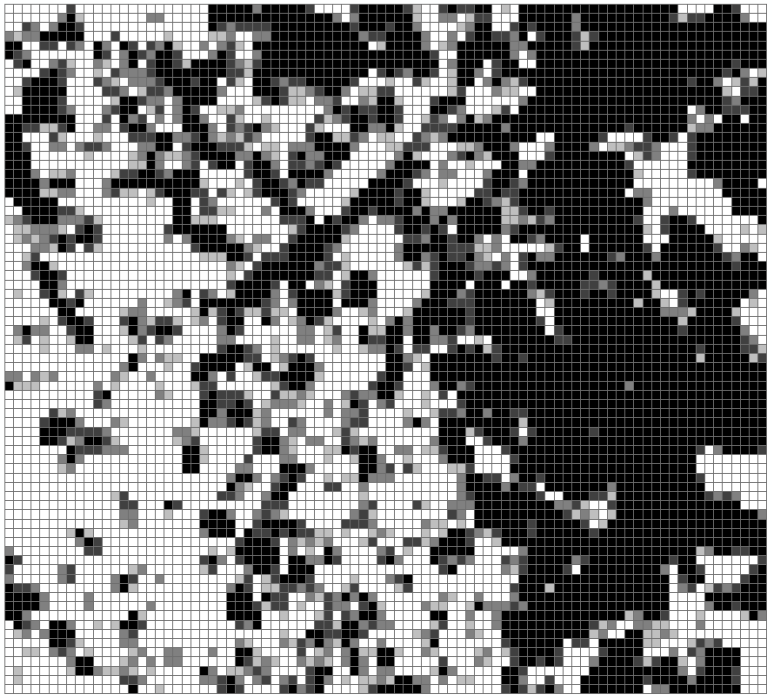
- Terrestrial LiDAR Limitation:

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

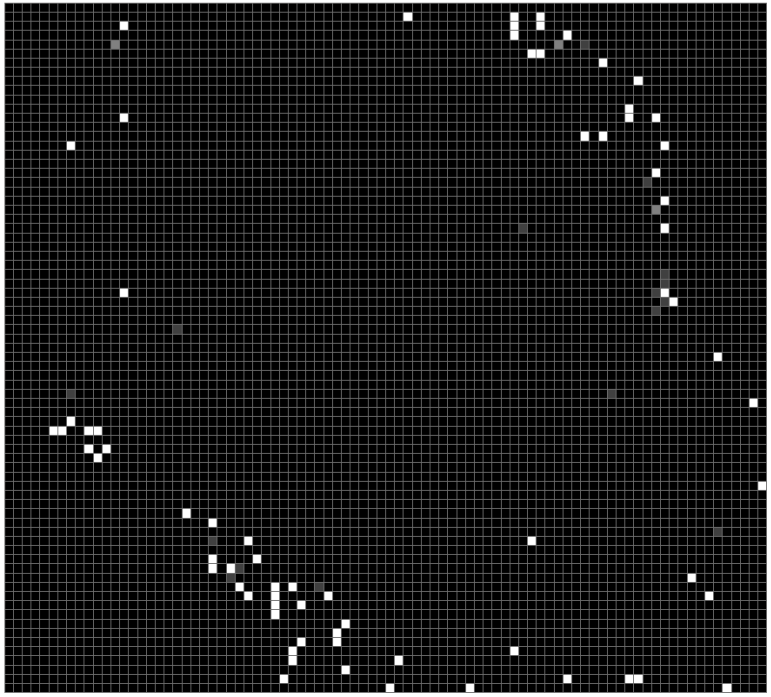
Underestimating canopy heights and overstory vegetation volume

Airborne VS Riegl

Airborne LiDAR



Terrestrial LiDAR

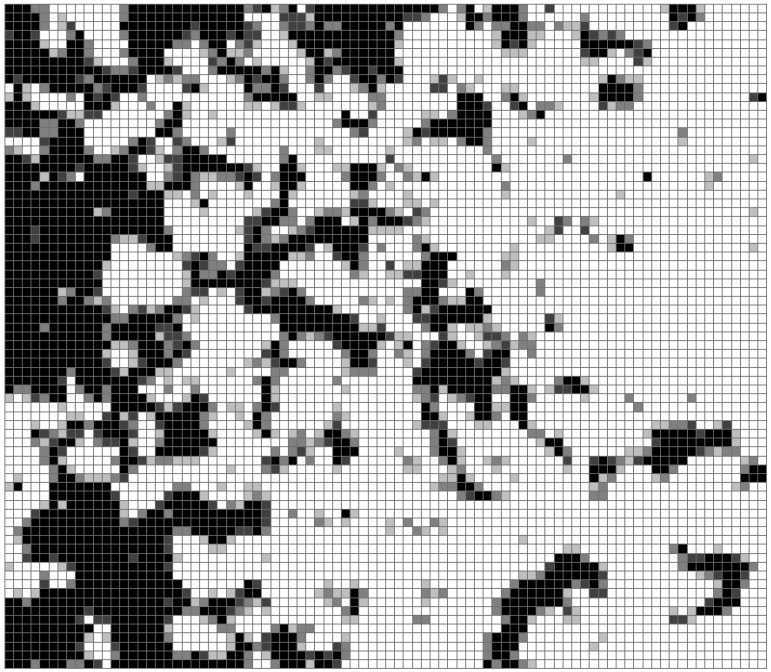


Surface
Litter cover

0 - 0.6
0.6 - 0.8
0.8 - 0.9
0.9 - 0.95
0.95 - 1

Airborne VS Riegl

Airborne LiDAR



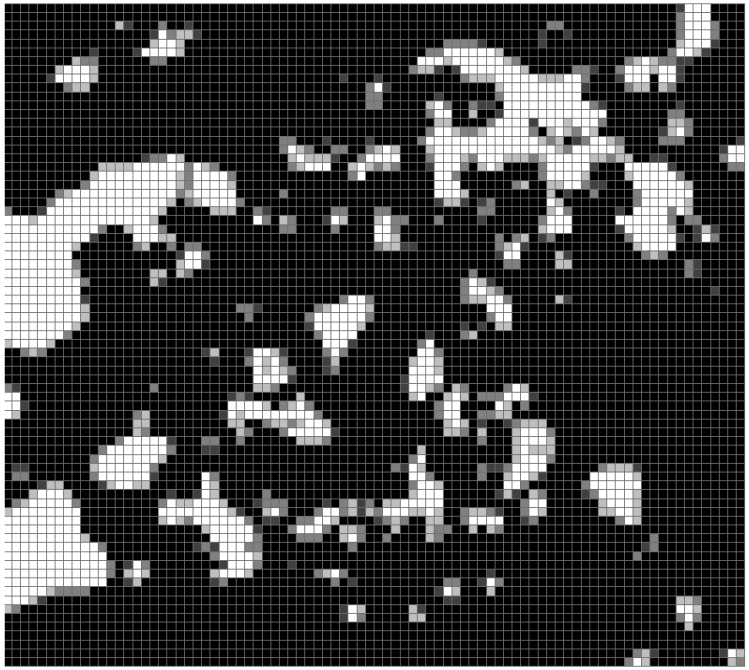
Terrestrial LiDAR

Near-surface plant cover

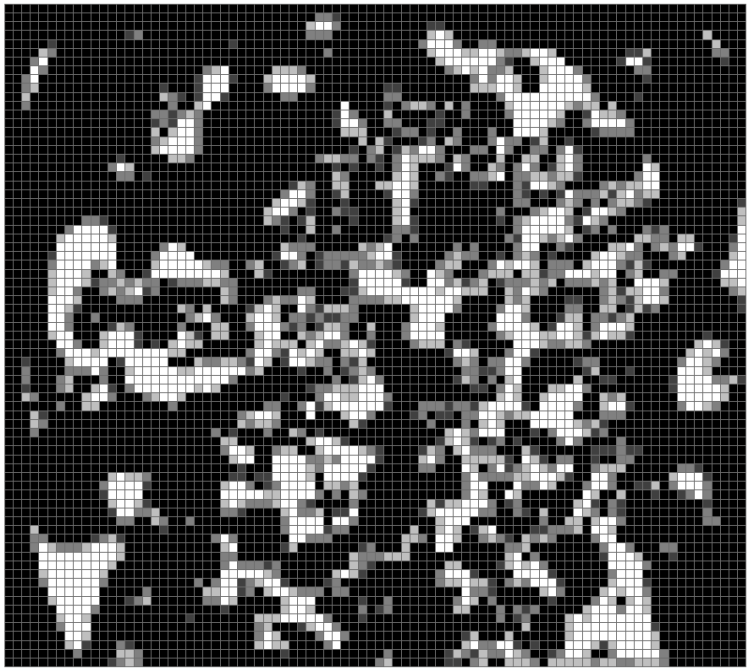
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1

Airborne VS Riegl

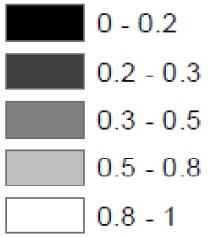
Airborne LiDAR



Terrestrial LiDAR

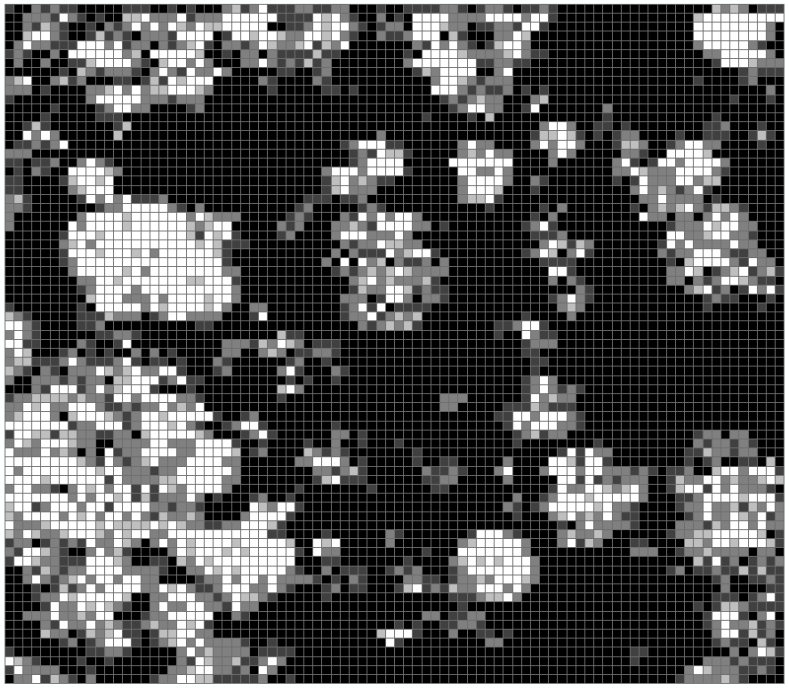


Elevated plant cover

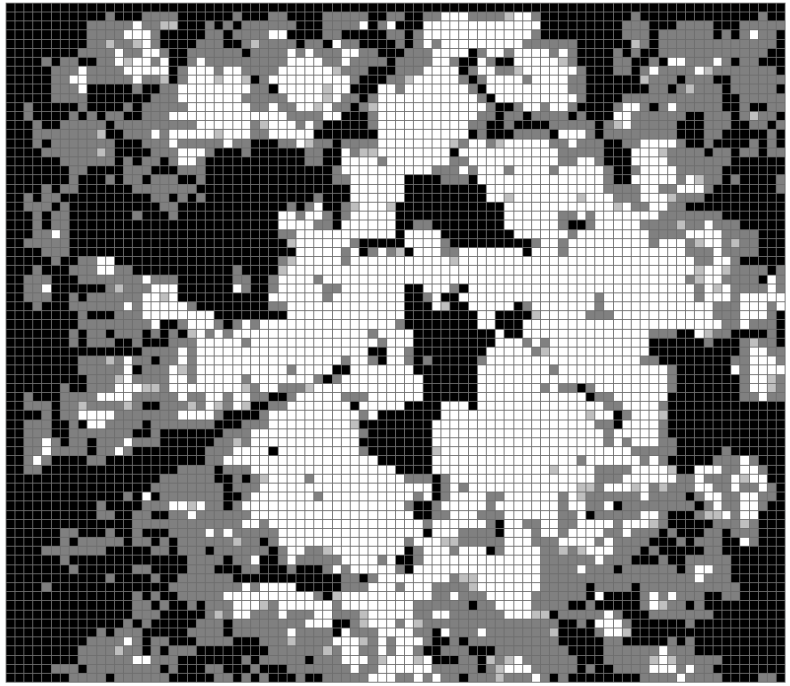


Airborne VS Riegl

Airborne LiDAR



Terrestrial LiDAR



Overstory plant cover

- 0 - 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.9 - 0.9
- 0.9 - 1

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.

- Yang Chen