MODELLING FOREST FUEL TEMPORAL CHANGE USING LIDAR

Yang Chen[1,3], Xuan zhu[1], Marta Yebra[2,3], Nigel Tapper[1], Sarah Harris[1]

[1] School of Earth, Atmosphere and Environment, Faculty of Science, Monash University
[2] Fenner School of Environment and Society, ANU College of Medicine, Biology and Environment, The Australian National University, ACT
[3] Bushfire & Natural Hazards Cooperative Research Center, Melbourne, Australia

The primary option available to reduce fire risks to the community and the environment is through a modification of fuel availability (e.g. fuel reduction burnings). The development of **accurate and reliable methods to quantify forest fuel characteristics** and to understand forest fuel change over time is an ongoing requirement of government, fire authorities and land management agencies. **LiDAR** is proposed to measure **landscape-scale forest fuels** in order to generate a time effective, feasible and objective method for forest fuel hazard assessment.

RESEARCH QUESTIONS

This research aims to answer the following questions:

1. Can LiDAR improve forest fuel structure measurements on a landscape scale?
2. How can airborne LiDAR be integrated with terrestrial LiDAR for a complete canopy profile?
3. How forest fuel hazards are related to forest age and other environmental factors (e.g. weather, topography, and soil type)?

CURRENT FINDINGS

LIDAR BASED FUEL STRUCTURE CLASSIFICATION

LiDAR derived fuel structure classification conventionally involves to classify fuels into groups (surface, near-surface, elevated, and overstorey fuels) according to vertical height ranges (Fig. 3).

However, directly applying the **conventional classification** to the LiDAR point may lead to **misclassification** (fuels >2 m are incorrectly assigned as overstorey fuels; fuels <0.5 m are misclassified as near surface fuels; trunks cannot be separated). These misclassified points need to be reassigned according to the spatial relationship (Fig. 3). To achieve this we develop a **new classification scheme** that follows five steps:

1. Horizontal slicing to separate laser points into groups based on the height interval
2. Reference tree trunks identification (Fig. 1.)
3. Tree trunks assignment
4. Elevated shrubs reassignment
5. Branches and Leaves assignment

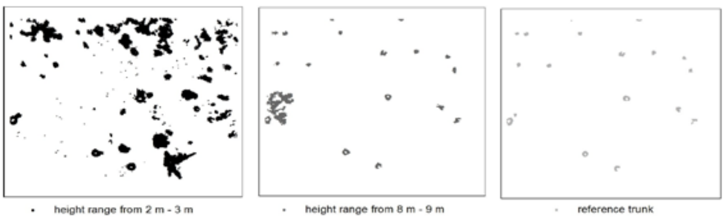

Fig. 1. Reference trunks identification.

A GIS TOOLKIT DEVELOPMENT

We have developed a **GIS-based method to efficiently and objectively assess forest fuel characteristics** as well as to estimate inventory parameters for forest fuel management using two laser scanning systems (tripod-mounted devices and portable devices).

The GIS toolkit supports a five-stage process for an **automatic forest fuel layers classification, forest inventory and fuel hazard estimates** (Fig. 2.)

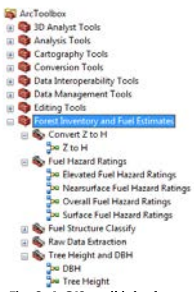

Fig. 2. A GIS toolkit for forest inventory and fuel estimates.

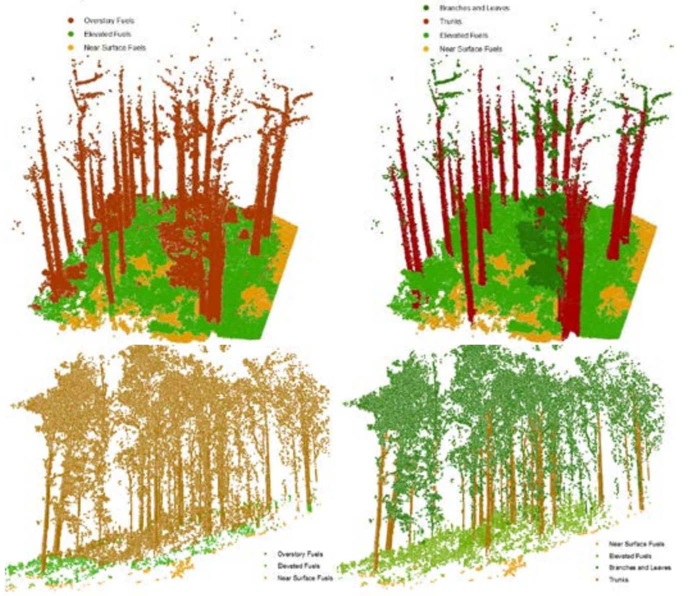

Fig. 3. Fuel strata classification comparison between the conventional (left) and the GIS-based methods (right) using Zebedee (top) and Riegl (bottom) terrestrial LiDAR systems.

Fuel characteristics

After the fuel structure classification, forest fuel characteristics such as **fuel depth and horizontal continuity** can be more accurately and efficiently determined (Fig. 4.).

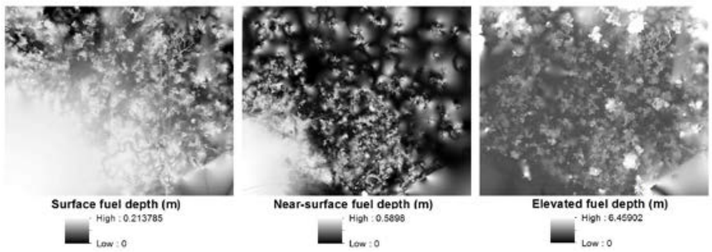

Fig. 4. LiDAR representation of fuel depth.

Tree heights can be estimated by searching for the highest points within a distance of a threshold to the individual tree trunks (maximum radius of crowns). The **Diameter at Breast Height** (DBH) can be estimated by a Hough circle fitting algorithm. **Basal area** (BA) can be estimated based on the calculated DBH.

The preliminary results from our validation analysis using 21 plots scanned in Victoria show that terrestrial LiDAR has high potential to efficiently and objectively preform strata-based forest fuel characteristics. Future work will focused on finalizing the validation of the developed algorithm and address research questions 2 and 3.

END USERS STATEMENT

The application of LiDAR to forest fuel measurement has the potential to improve the quality of data in three ways: 1) to reduce the subjectivity of present methods; 2) to provide spatially-explicit estimates; and 3) to serve as the basis of new landscape-scale fire behaviour prediction systems based on landscape-scale inputs.

Adam Leavesley, ACT Parks and Conservation Service.

ACKNOWLEDGEMENT

Special thanks to BNHCRC for funding this research through a top-up PhD scholarship and to Adam Leavesley, Thomas Jovanovic, Senthuran Arunthavanathan, Dean Yulindra Affandi, Yang Di, Zhan Wang, Saadia Majeed, Yingying Qiao, and Darren Hocking for their field work support.