# DISASTER LANDSCAPE ATTRIBUTION, ACTIVE FIRE DETECTION AND HAZARD MAPPING

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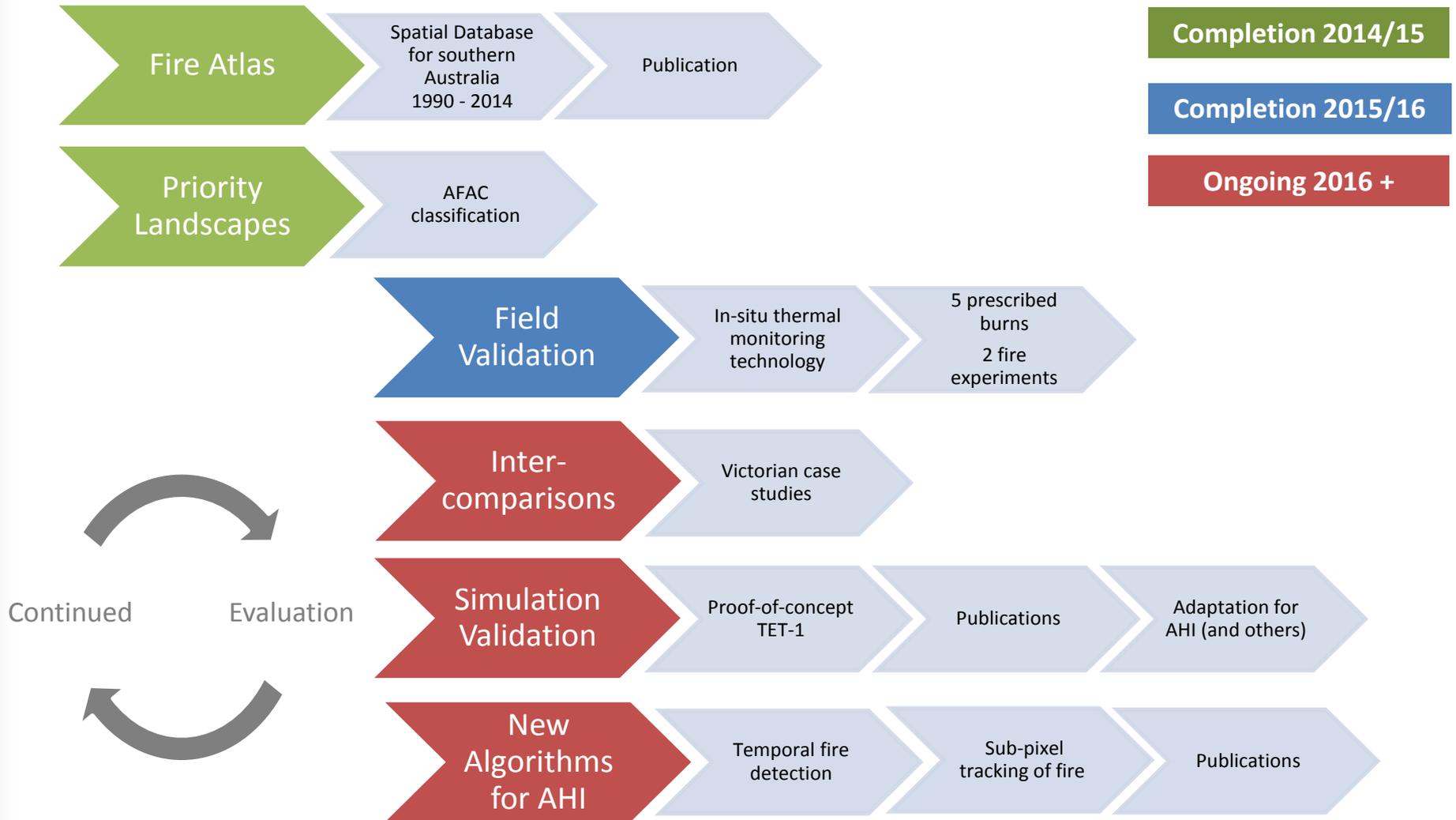
  Dr. Ian Grant, BoM

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# ACTIVE FIRE SUMMARY 2014-2016

**Fire Atlas** → Spatial Database for southern Australia 1990 - 2014 → Publication

**Priority Landscapes** → AFAC classification

**Field Validation** → In-situ thermal monitoring technology → 5 prescribed burns / 2 fire experiments

**Inter-comparisons** → Victorian case studies

**Simulation Validation** → Proof-of-concept TET-1 → Publications → Adaptation for AHI (and others)

**New Algorithms for AHI** → Temporal fire detection → Sub-pixel tracking of fire → Publications

Continued / Evaluation

**Completion 2014/15**

**Completion 2015/16**

**Ongoing 2016 +**

# FIRE ATLAS

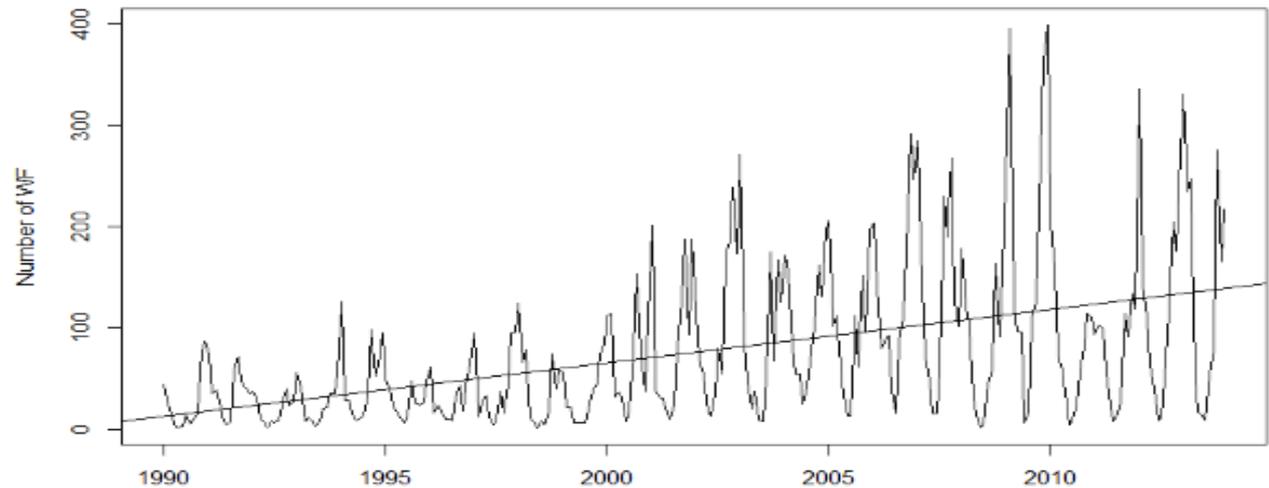Statistical analysis of wildfire incidence:

-   1990 - 2014
-   Increasing in number
-   Increasing in size

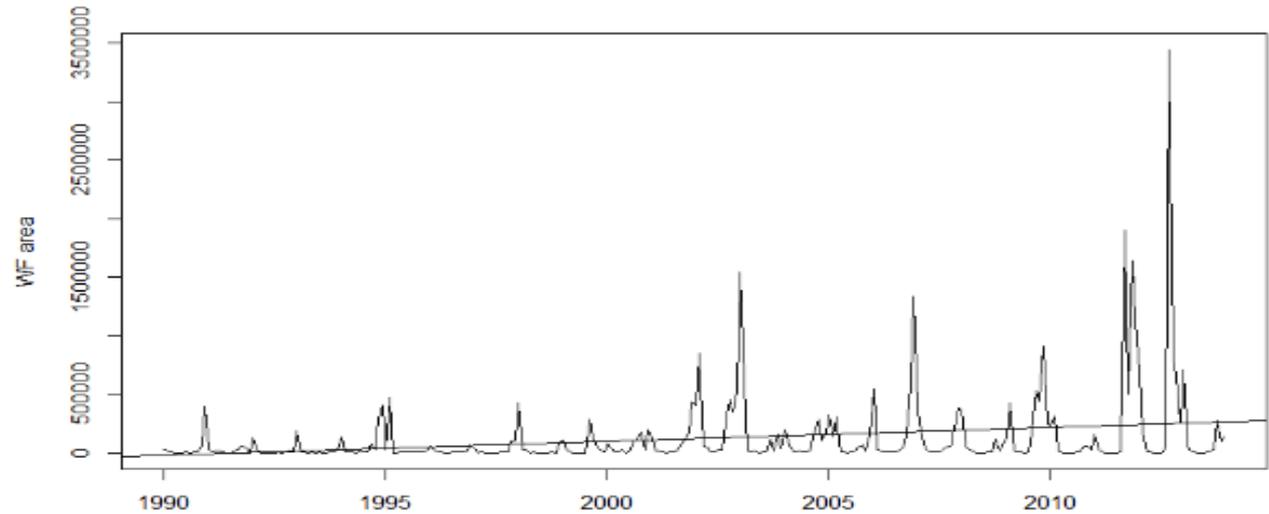Repeated for stratification to states and ecoregions

Temporal windows of peak activity identified
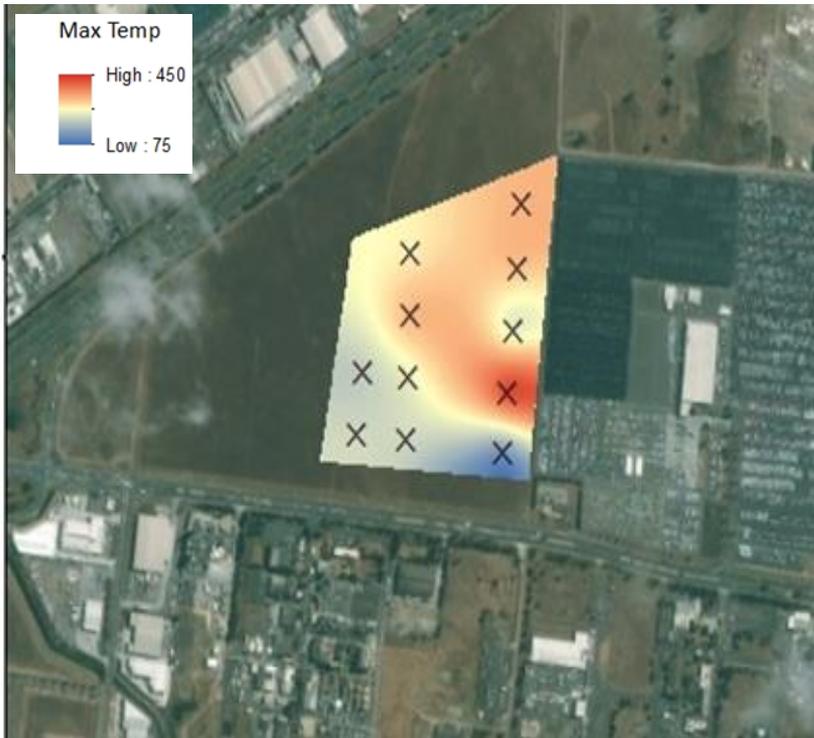
Repeated for prescribed burns

Oliveira, S.; Soto-Berelov, M.; Jones, S. and Reinke, K. **Are wildfires increasing? Reporting the spatial and temporal patterns of fires across southern Australia.** (in review)
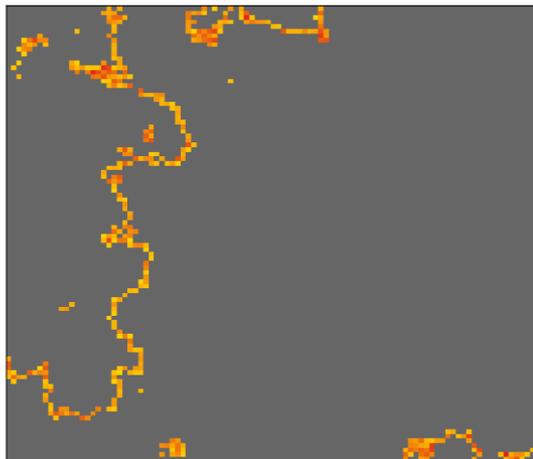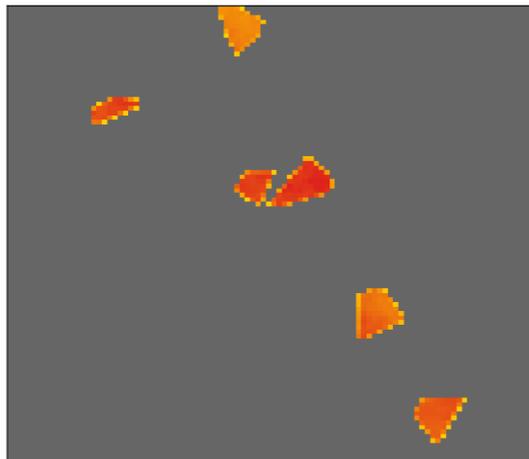
# VALIDATION FOR ACTIVE FIRE DETECTION



| Reported Fire Start Date and Time | Total or Final Burn Area | Time Difference with Visual Assessment | Time Difference with Hotspot Detection |
|---|---|---|---|
| 12/01/2016 13:45 | 142 ha | 15 mins after | 45 mins after |
| 19/01/2016 14:19 | 104 ha | 11 mins after | 61 mins after |
| 13/01/2016 20:30 | 29 ha | 20 mins before | 10 mins before |
| 01/01/2016 15:21 | 22 ha | 21 mins before | no detection |
| 15/01/2016 15:21 | 15 ha | 21 mins before | no detection |
| 13/01/2016 17:15 | 5 ha | 125 mins after | 145 minutes after |
| 13/01/2016 18:38 | 2 ha | 42 mins after | 44 minutes after |

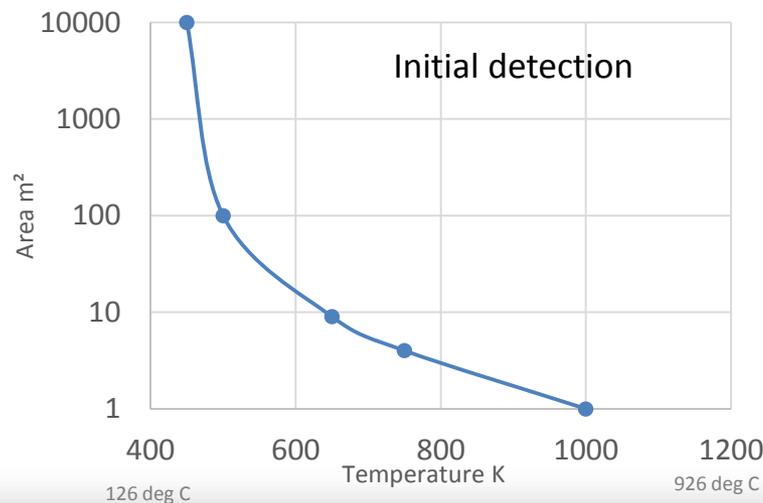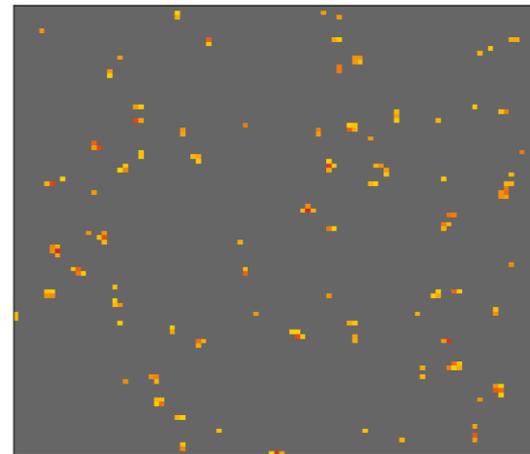# SIMULATION-VALIDATION PROOF OF CONCEPT

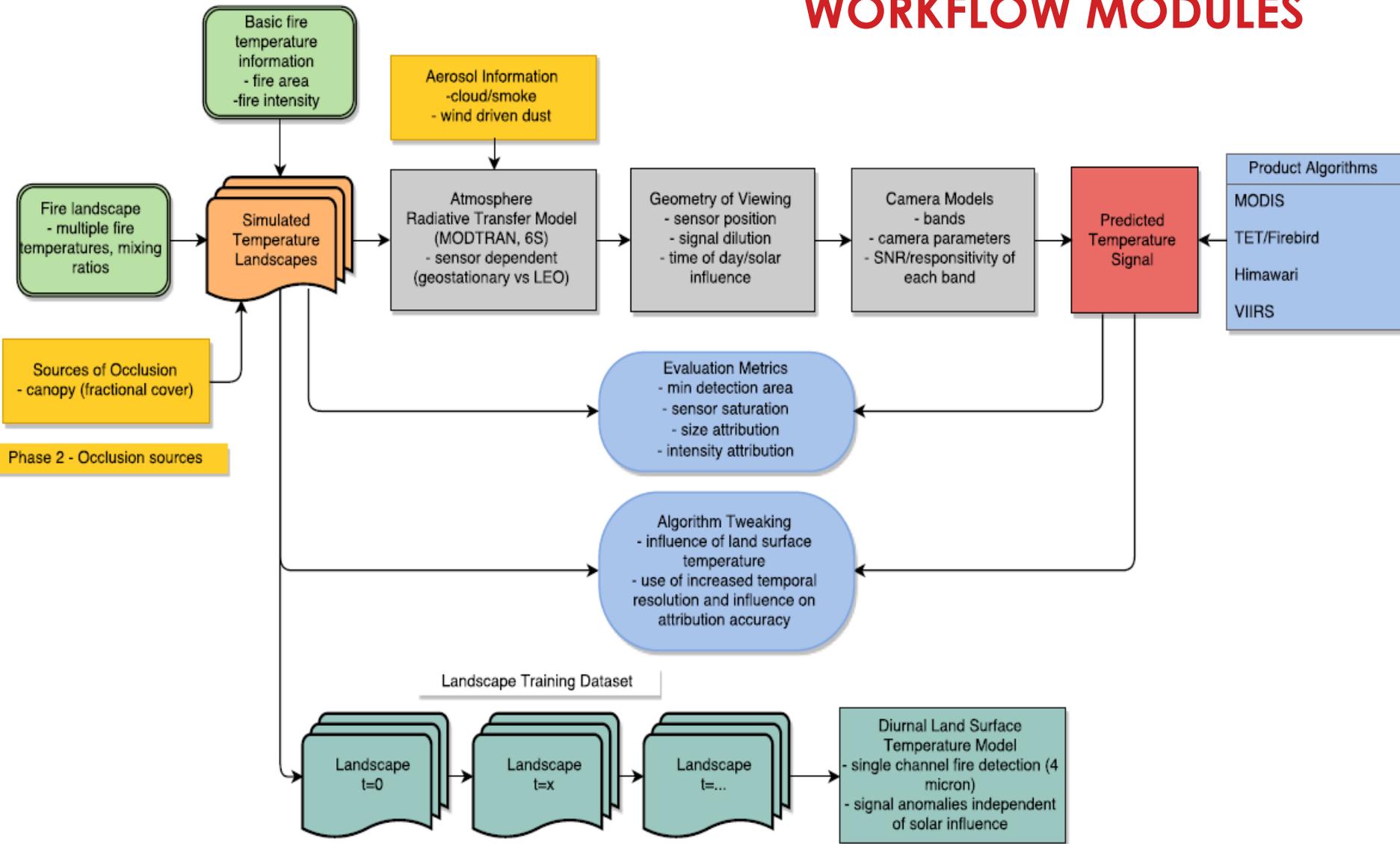Simulated fire front landscape

Simulated fire blocks landscape

Simulated fire spotting landscape



Mitchell, S., Jones, S., Reinke, K., Lorenz, E. and Reulke, R. (2016) **Assessing the utility of the TET-1 hotspot detection and characterization algorithm for determining wildfire size and temperature.** International Journal of Remote Sensing 37 (20) pp. 4731-4747

# WORKFLOW MODULES

# NEW ALGORITHMS FOR FIRE DETECTION



Start time: 2015-322 03:00 Loc: -18.6696 S,136.8399 E [3754, 2549]

AHI Band 7 2015-322 03:07 UTC (12:37 ACST)

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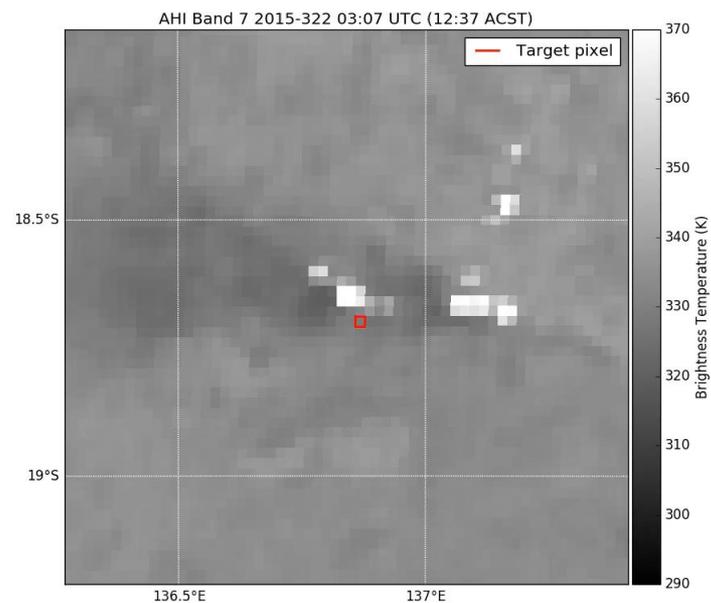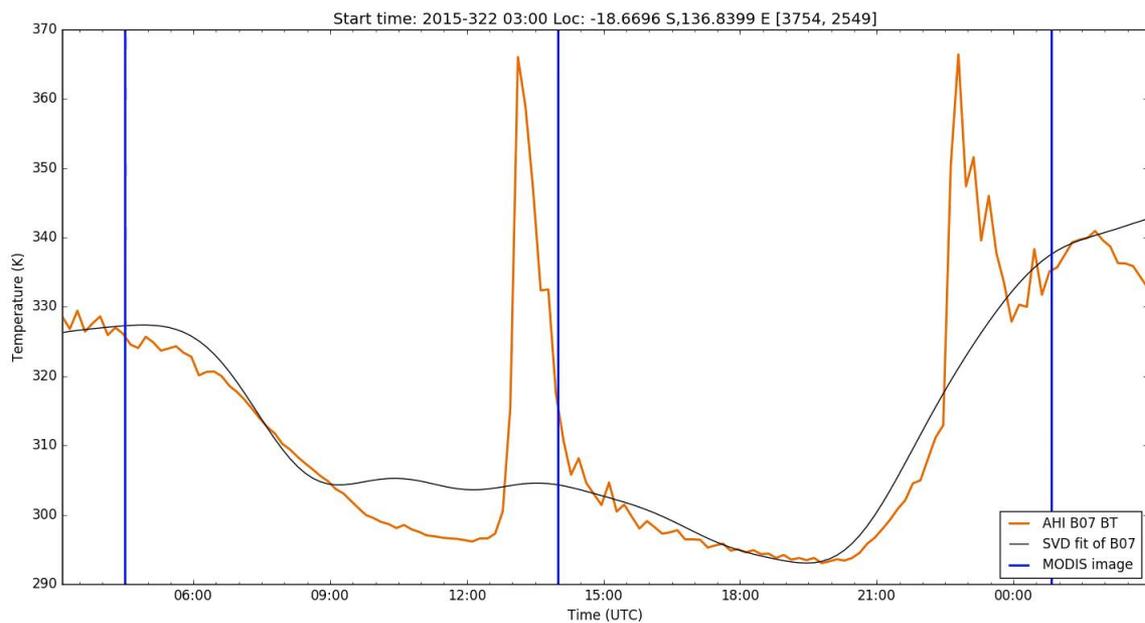
# NEW MULTI-RESOLUTION ALGORITHMS FOR ACTIVE FIRE TRACKING



(c-1) 01:40 UTC

(c-2) 06:00 UTC

(c-3) 01:00 - 06:00 UTC

Wickramasignhe, C.; Jones, S.; Reinke, K. and Wallace, L. **Development of a multi-spatial resolution approach to the surveillance of active fire lines using Himawari-8**. Remote Sensing, New Opportunities and Challenges in Forest Fire Research (in review).
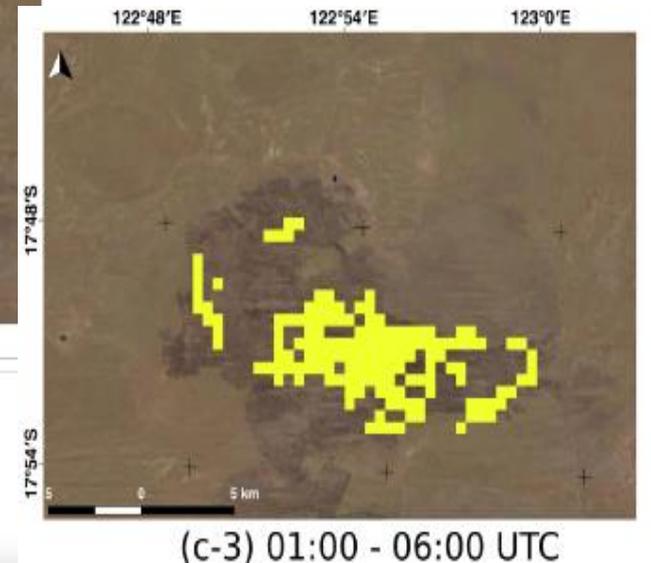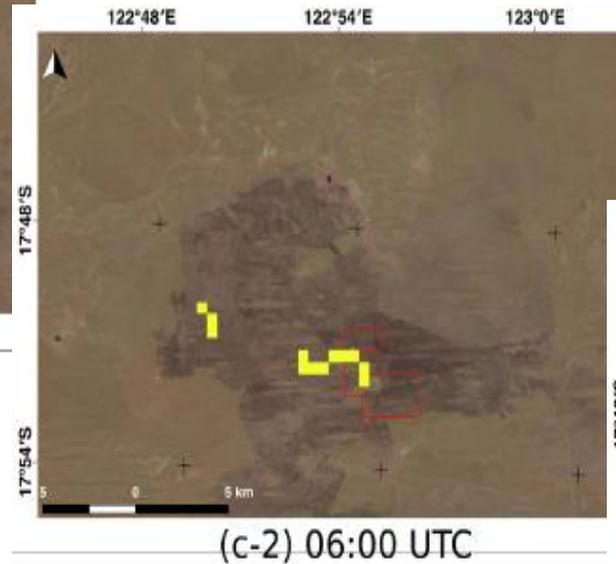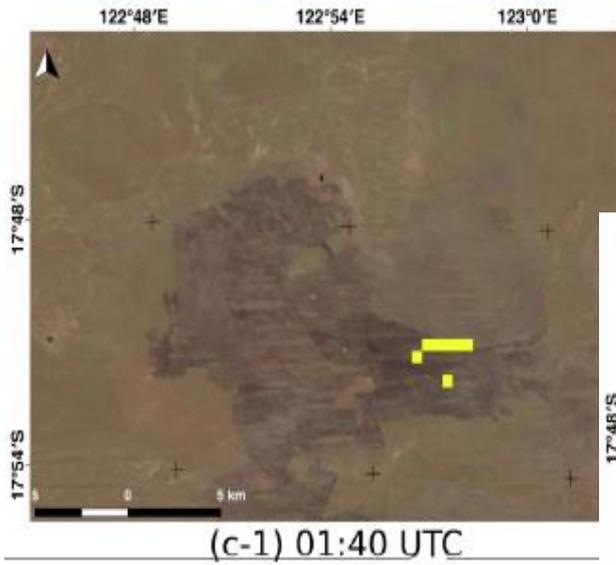
# FUELS3D SUMMARY 2014-2016

**Technology Review**

TLS
Tablet scanner
Camera

Smartphone specifications

**Priority landscapes**

AFAC classification

**Field Validation Phase I**

Image acquisition and sampling protocol testing

Pre and post Burn mapping

Publications

**End User Trials**

Usability and Repeatability

Publication

**Fuels3D**

App development and data workflow

publications

Final suite of fuel hazard metrics

**Field Validation Phase II**

New landscapes and metrics

Continued    Evaluation

**Completion 2014/15**

**Completion 2015/16**

**Ongoing 2016 +**

# SOLUTION REQUIREMENTS

| Criteria | Visual Assessment | Fuels3D | TLS |
|---|---|---|---|
| Easy to use | ✔ | ✔ | ✖ |
| Cheap | ✔ | ✔ | ✖ |
| Rapid | ✔ | ✔ | ✖ |
| Quantifiable | ✖ | ✔ | ✔ |
| Precise (repeatable) | ✖ | ✔ | ✔ |
| Accurate | ✖ | ✔ | ✔ |
| Integrates within existing fire and land management agency protocols and guides | | ✔ | ✔ |

# WHAT IS FUELS3D?

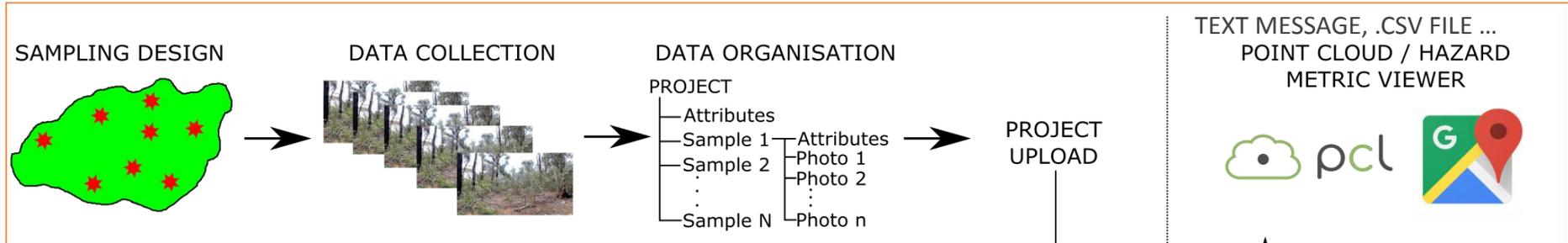Fuels3D is an Android **app** that enables and manages image capture in the field.

**3D point clouds** are generated utilising **computer vision** and **photogrammetry** techniques.

From these 3D point clouds, **scale** is added and decision rules are programmed to calculate **quantifiable surface and near-surface fuel hazard metrics**.
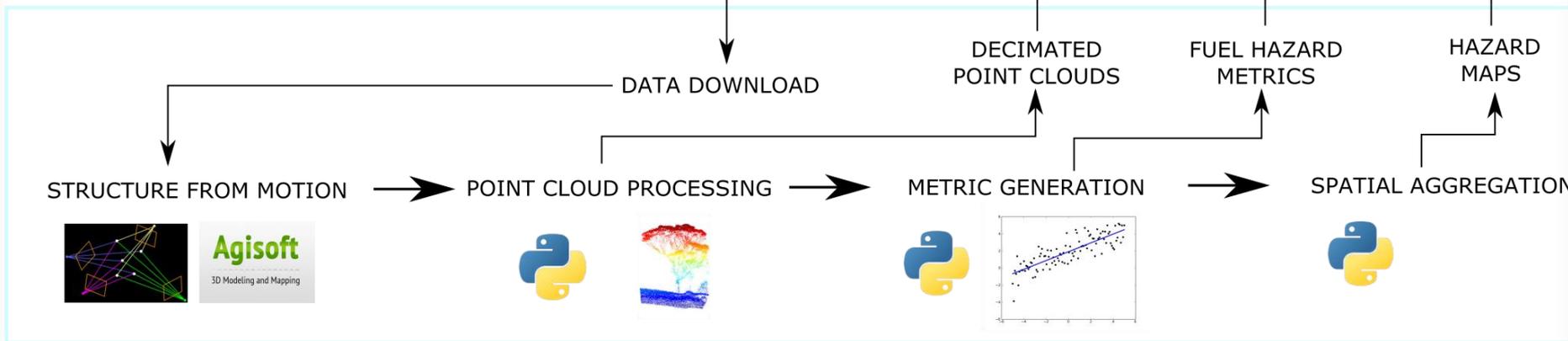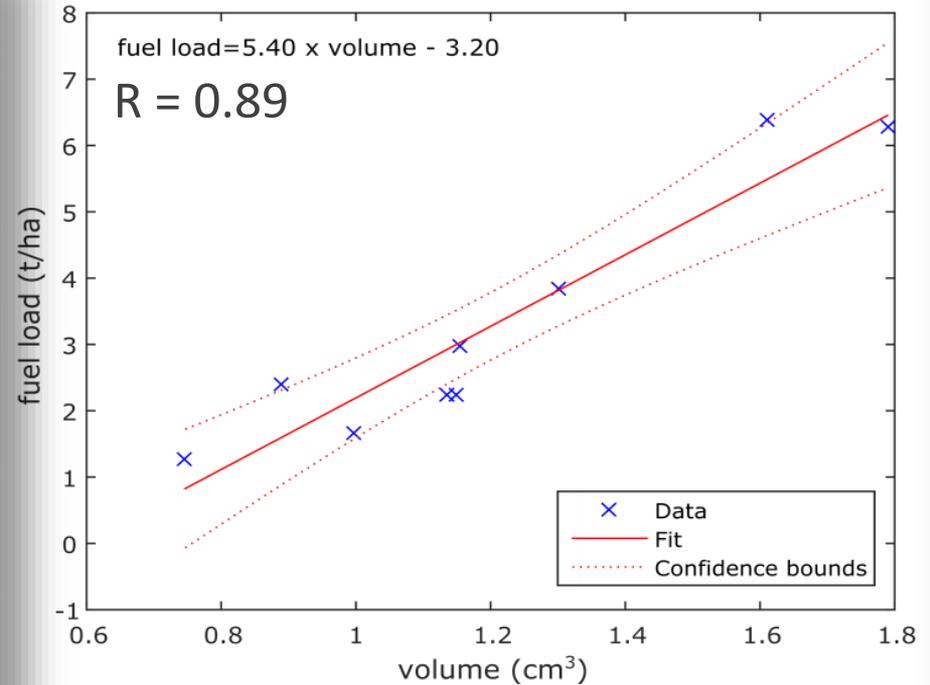
Wallace, L.; Hally, B.; Reinke, K. and Jones, S. (2016) **Leveraging smartphone technology for assessing fuel hazard in fire prone landscapes**. Proceedings for the 5th International Fire Behaviour and Fuels Conference, April 2016, Melbourne, Australia.

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# OVERVIEW FUELS 3D WORK FLOW

**USER/SMARTPHONE SEGMENT**

SAMPLING DESIGN → DATA COLLECTION → DATA ORGANISATION → PROJECT UPLOAD

PROJECT
- Attributes
- Sample 1 — Attributes, Photo 1, Photo 2, ... Photo n
- Sample 2
- ...
- Sample N

TEXT MESSAGE, .CSV FILE ...
POINT CLOUD / HAZARD
METRIC VIEWER

**CLOUD/CENTRAL PC SEGMENT**

Dropbox

DATA PUSH

DATABASE

DATA DOWNLOAD

DECIMATED POINT CLOUDS    FUEL HAZARD METRICS    HAZARD MAPS

STRUCTURE FROM MOTION → POINT CLOUD PROCESSING → METRIC GENERATION → SPATIAL AGGREGATION

Agisoft
3D Modeling and Mapping

# FIELD VALIDATION



fuel load=5.40 x volume - 3.20

R = 0.89
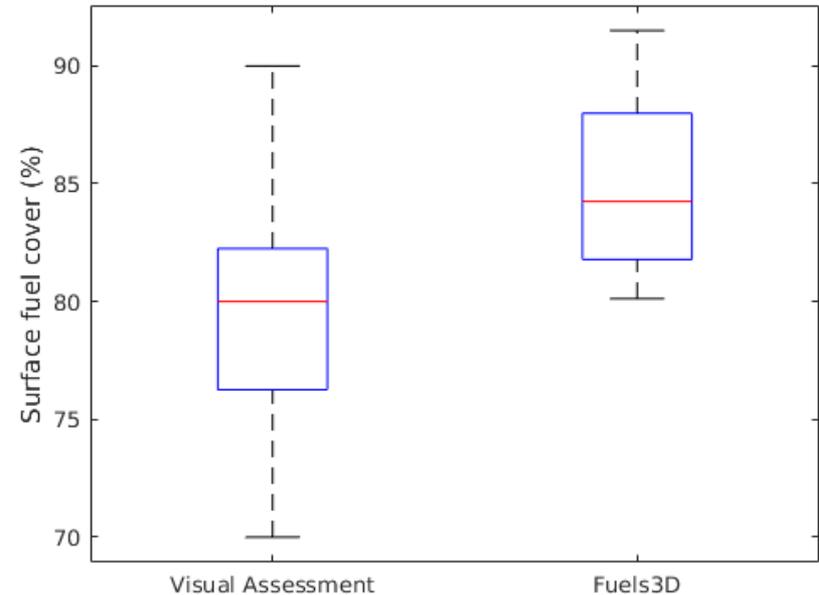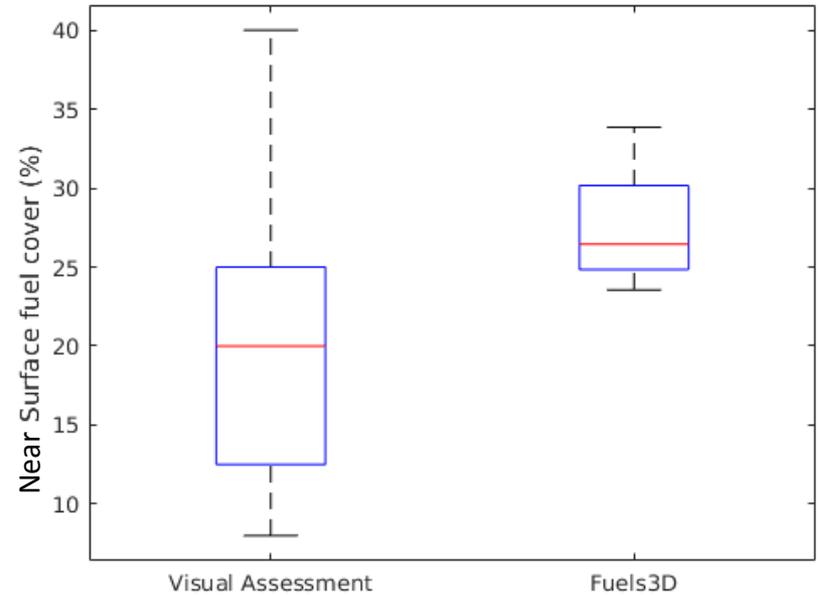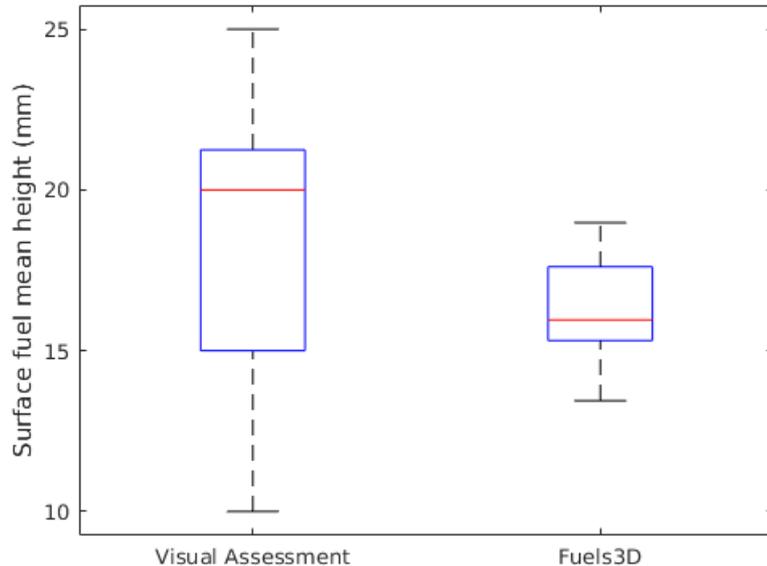
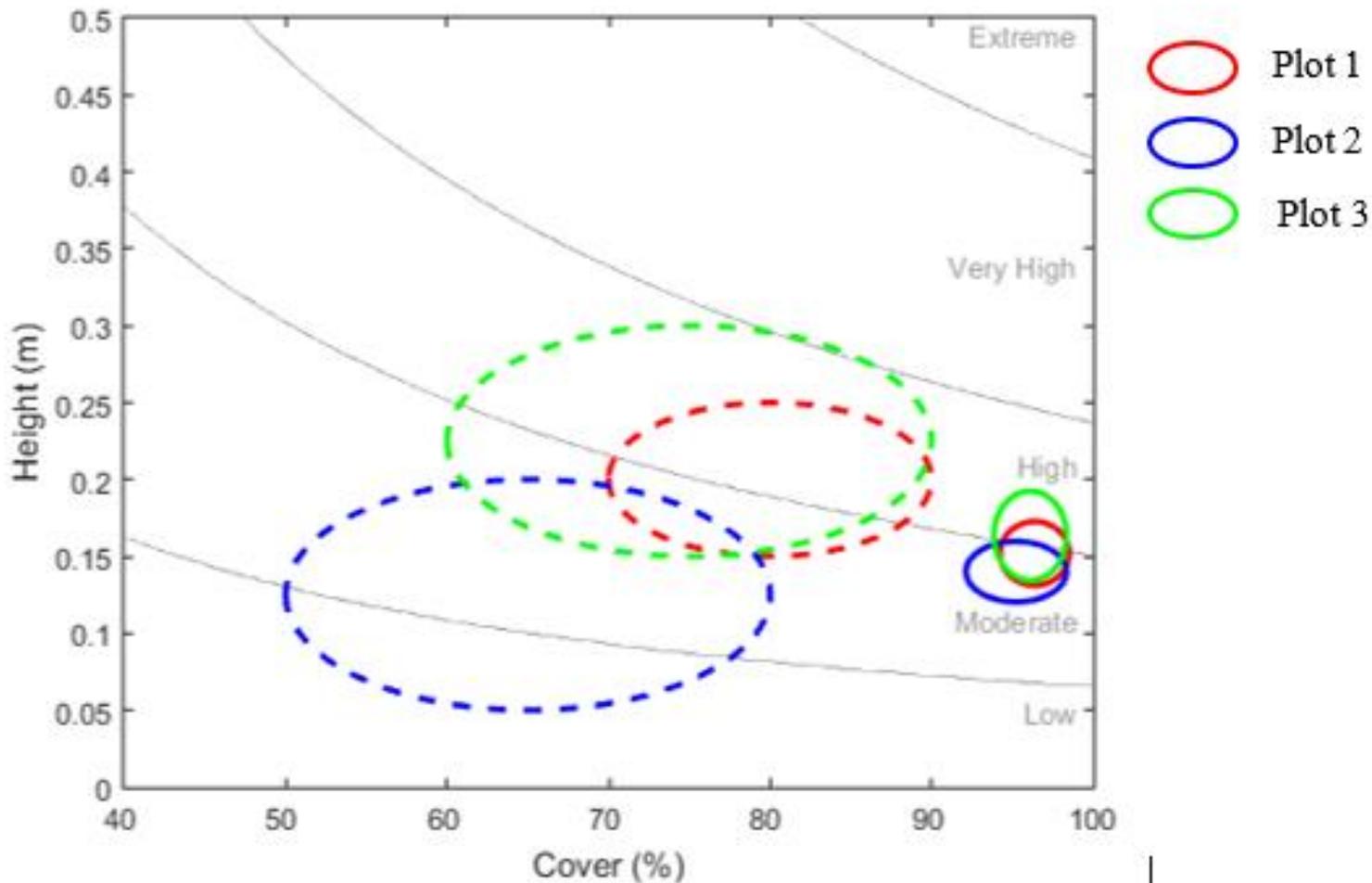# FUELS3D IN ACTION

Pre and post burn
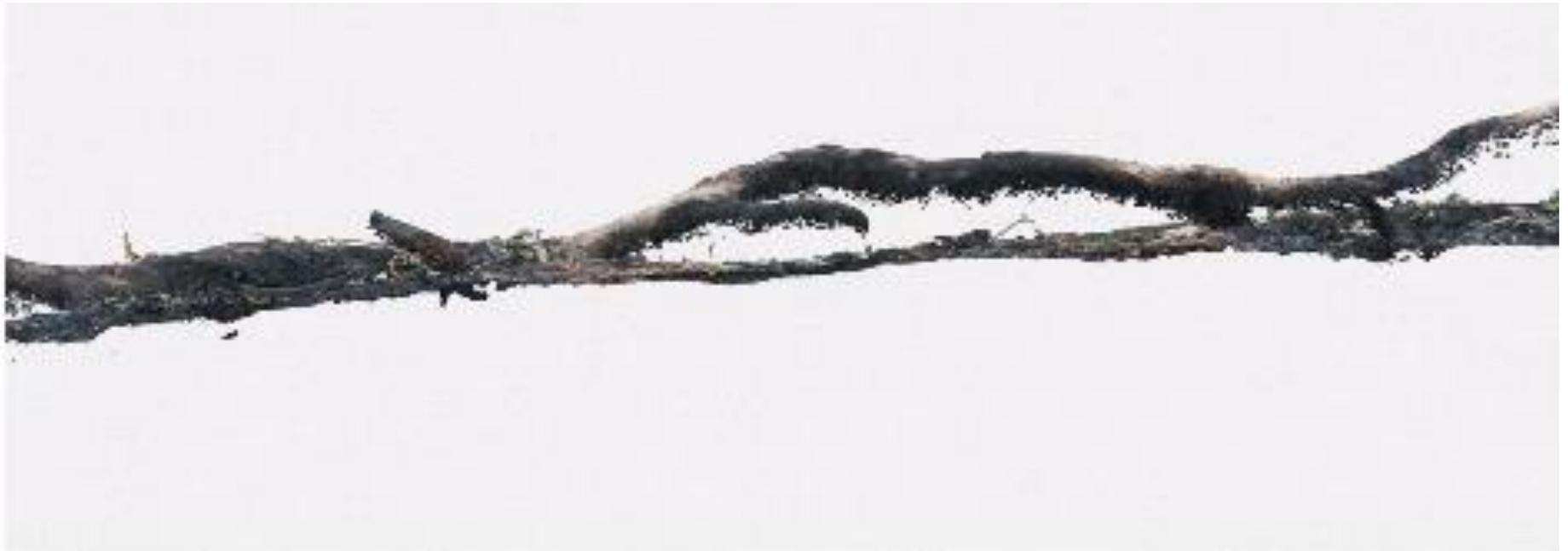
# USER TRIALS

20 end-users from Victorian, SA and ACT land management agencies participated in trial over 3 sites in eastern Melbourne.

# USER TRIALS

Variation in Surface Fuel Metrics and Fuel Hazard Scores



Spits, C.; Wallace, L. and Reinke, K. **A comparison of visually assessed surface and near-surface fuel hazard attributes and image-based point clouds**. International Journal of Wildland Fire (in prep).

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# END-USER ACKNOWLEDGEMENTS FOR 2016

John Bally, Bureau of Meteorology

David Hudson, Geoscience Australia

David Nicholls, Country Fire Authority, Victoria
Danni Martin, Country Fire Authority, Victoria
Rachel Bessell, Country Fire Authority, Victoria

Tim Sanders, Melbourne Water, Victoria

Adam Damen, Department of Environment, Land, Water and Planning, Victoria
Naomi Withers, Department of Environment, Land, Water and Planning, Victoria
Nick Bauer, Department of Environment, Land, Water and Planning, Victoria

Simeon Telfer,  Department of Environment, Water and Natural Resources, South Australia
Simon Wicks, Department of Environment, Water and Natural Resources, South Australia

Tony Scherl, Parks and Conservation Service, ACT
Stephen Wilkes, Parks and Conservation Service, ACT
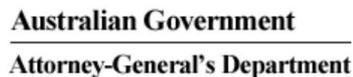
# END-USER REPRESENTATIVES

Active Fire Mapping:

Mark Edwards – Geoscience Australia

Fuels3D:

Simeon Telfer – DEWNR(South Australia)

# QUESTIONS

Thank you