# Fire Surveillance and Fuel Hazard Mapping

Research advisory forum / **2018**

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bushfire&natural HAZARDSCRC

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

# Research Translation – Fuels3D*

RESEARCH

UTILISATION

**Problem**

Lack reliability of field fuel hazard assessments = poor data quality and low information value.

Fire behavior and fire spread models require quantifiable measures of fuel hazard elements.

Data collection devices such as LiDAR based technologies for quantifying fuel structure on the ground are expensive and sensitive to wind.

**Opportunities**

Bring together off-the-shelf cameras and smartphones with advances in computer vision / photogrammetry.

Suitable for UAV platforms.

**Research Outputs**

6 peer-reviewed journal publications, 3 new publications in review.

VSEA (environment and sustainability) winner.

3 PhD students.

**Solution**

Complements existing fuel hazard assessments.

Uses off-the-shelf cameras and smartphones.

Tool chain from images to 3D point cloud coupled with workflow for extracting fuel layers and calculating quantifiable surface and near-surface fuel structure metrics.

**Benefits**

Cheap, rapid, easy-to-use, repeatable.

Quantifiable metrics per fuel strata.

Adaptable to new research and tech.

**Utilisation Activities**

Two end-user utilisation trials with end-users from across Australia.

In-field, multi-tech case studies across priority landscapes.

**End-User Community**

State land management, and emergency service agencies.

AFAC.

Local councils.

Fire behavior and fire spread modellers.

**What has been achieved?**

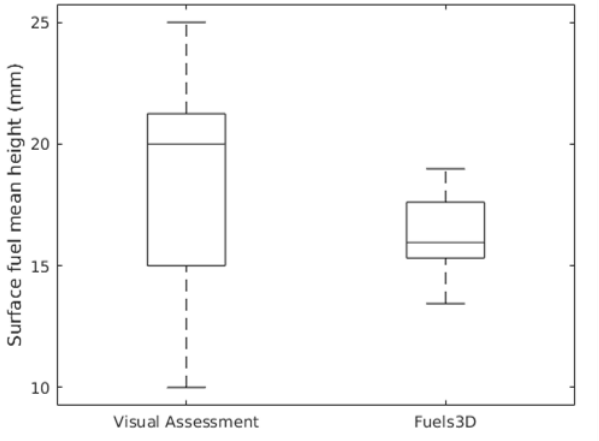
Proof-of-concept and testing.
Accuracy assessment and technology comparison
Bespoke and novel algorithms for extracting fuel layers.
Solution workflow design - hardware and software.

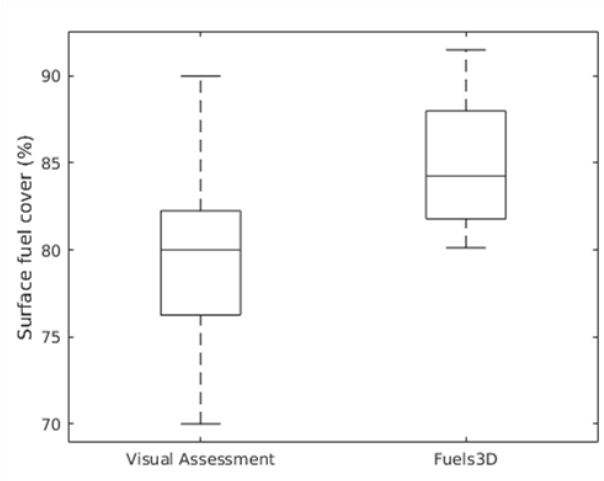
**What next?**

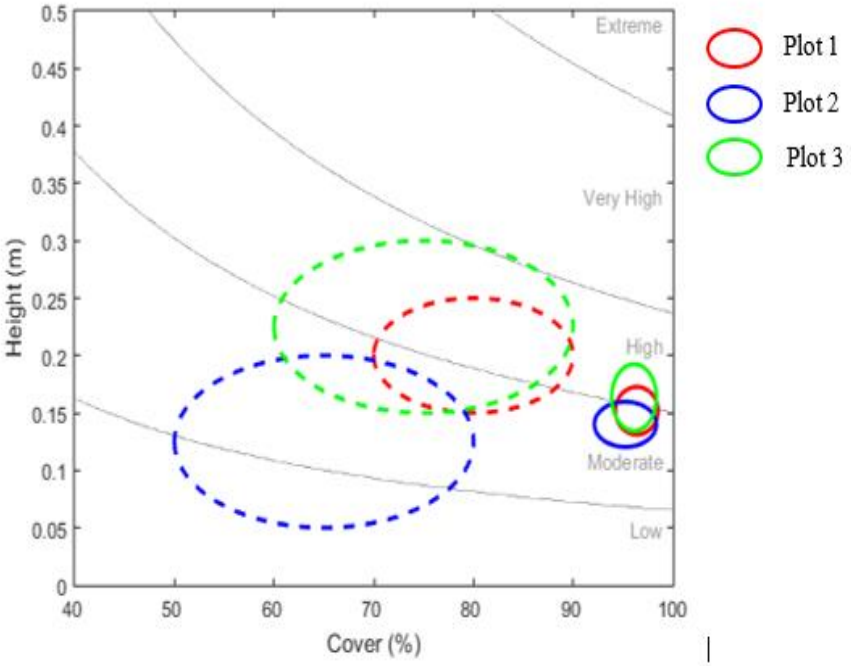
Funding ceases December 2018 (*half project).
Seeking investment for continuation.

# Fuels3D

Understanding the problem



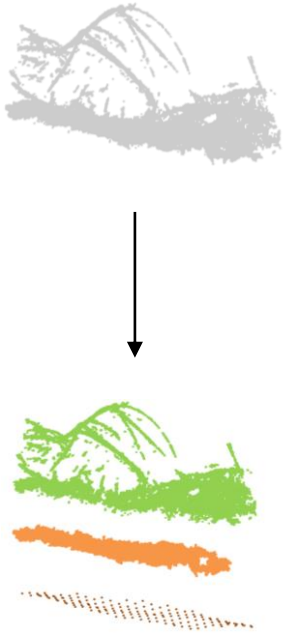
# Fuels3D

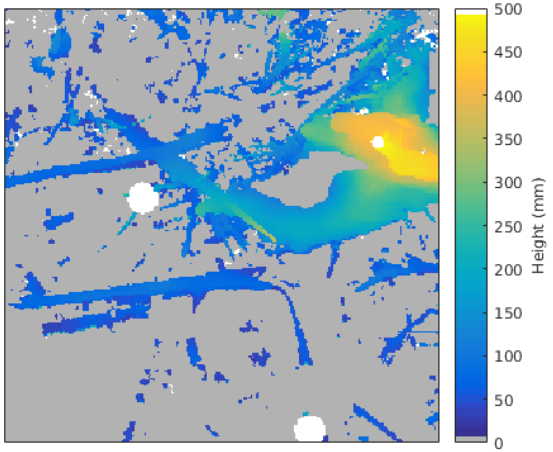
Providing a solution





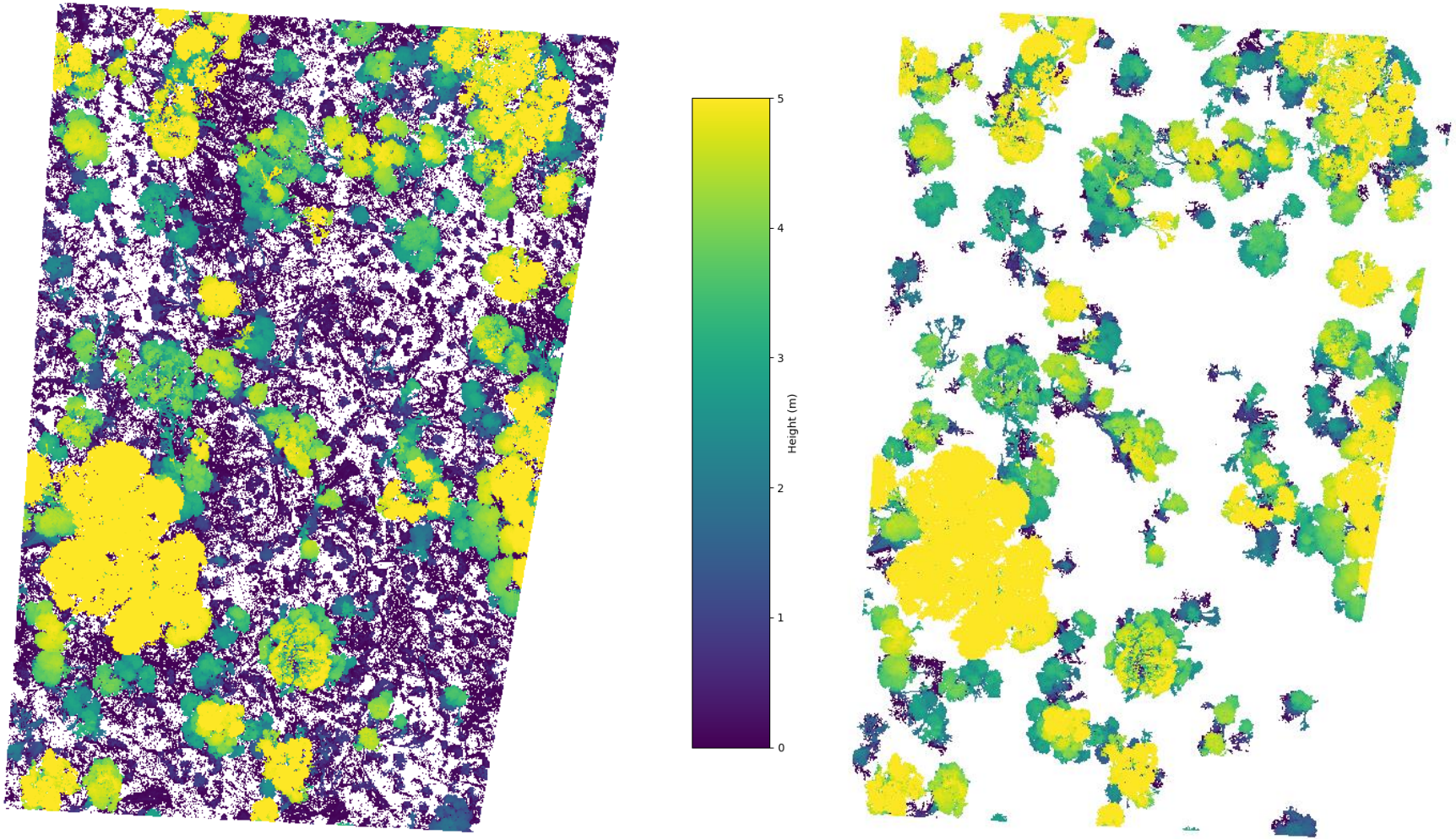
Field image capture → Image transfer (from end-user) → Image matching and scale → 3D point creation → Fuel layer extraction → Calculate fuel metrics and maps → Data transfer of metrics (to end-user)





# Fuels3D

Data outputs



# Fuels3D

Where to next?

- Automating the end-to-end workflow.
- Fuels3D stick: multi-band, multi-camera image capture device.
- Solid state LiDAR.
- UAV mounted or aerial Fuels3D.
- Fuel structure and hazard change mapping, pre and post burn measurement.
- Bark hazard and new metrics for vertical connectivity.
- Protocols for technology limits for data capture under varying environmental (e.g. wind and illumination) conditions.

# Research Translation – Fire Surveillance

RESEARCH

**Problem**

Consistent monitoring and timely detection of fire across the Australian continent.

Polar orbiting satellites have low re-visit frequencies = much of the continent is unobserved for most of the time.

Fire detection algorithms use spatial windows to identify hotspots = mixed pixels, cloud contamination can lead to detection error.

**Opportunities**

Himawari-8 provides 10 minute observations across the entire Australian continent.

**Research Outputs**

10 peer-reviewed journal publications, 2 new publications in review.

2 PhD students, 1 Masters student.

**Solution**

New paradigms to fire detection algorithms by using:
1. geographically and seasonally varying thresholds
2. tracking individual pixels against expected brightness values
3. utilizing the red channel to improve resolution.

(note: 1 of 3 solutions developed in the project)

**Benefits**

Faster and improved detection accuracy.

Scaleable processing for NRT reporting.

Relieve resources for remotearea monitoring.

**Utilisation Activities**

Planning near-real time trials.

Validation and inter-comparison.

**End-User Community**

Emergency services.

Geoscience Australia.

Bureau of Meteorology.

The Community.

UTILISATION

**What has been achieved?**

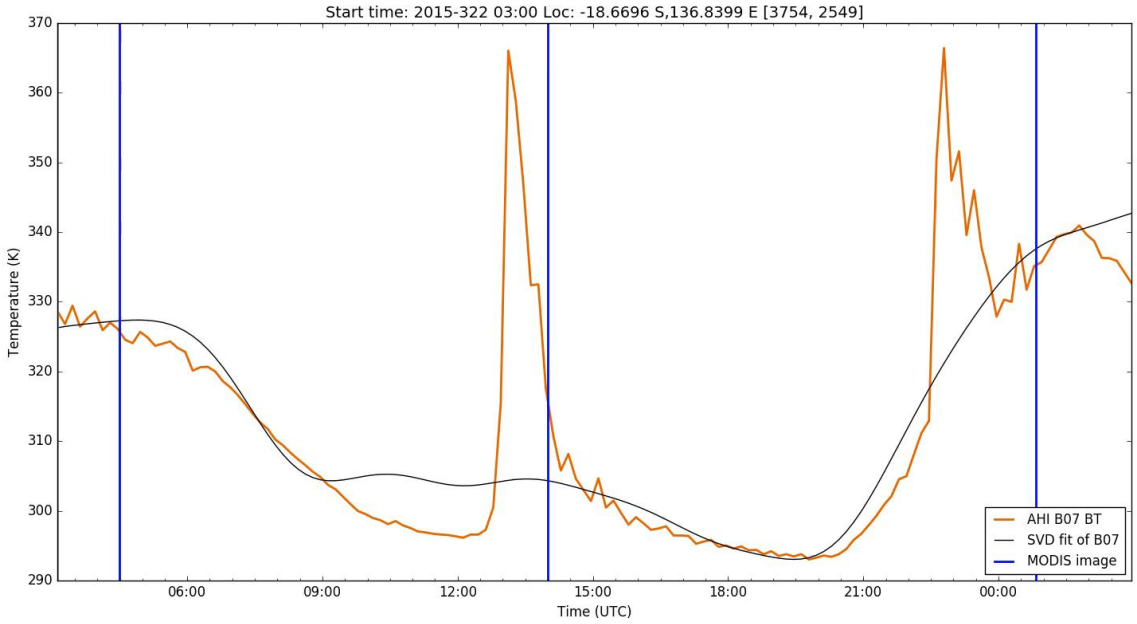
Three independent algorithms for fire surveillance developed. Inter-comparison with MODIS, VIIRS and WF-ABB/AHI hotspots for all algorithms.

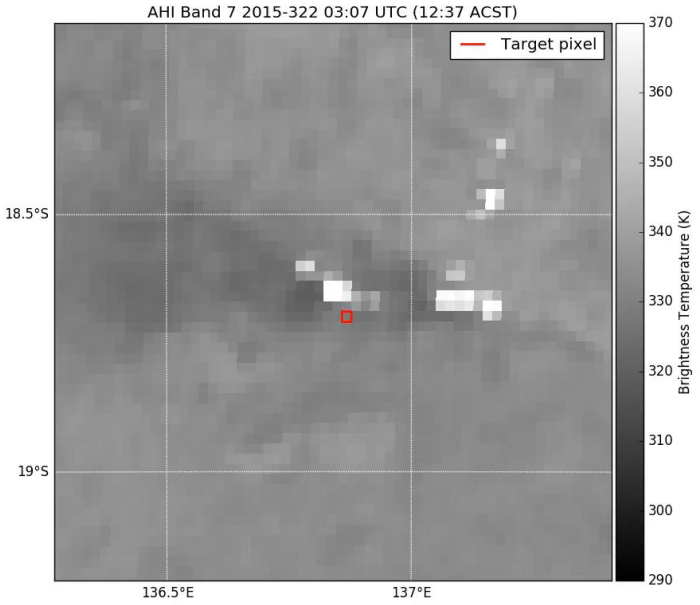
**What next?**

Utilisation trial and review commencing Feb 2019 with the NSW Rural Fire Service and supported by the Bureau of Meteorology.

# Fire Surveillance

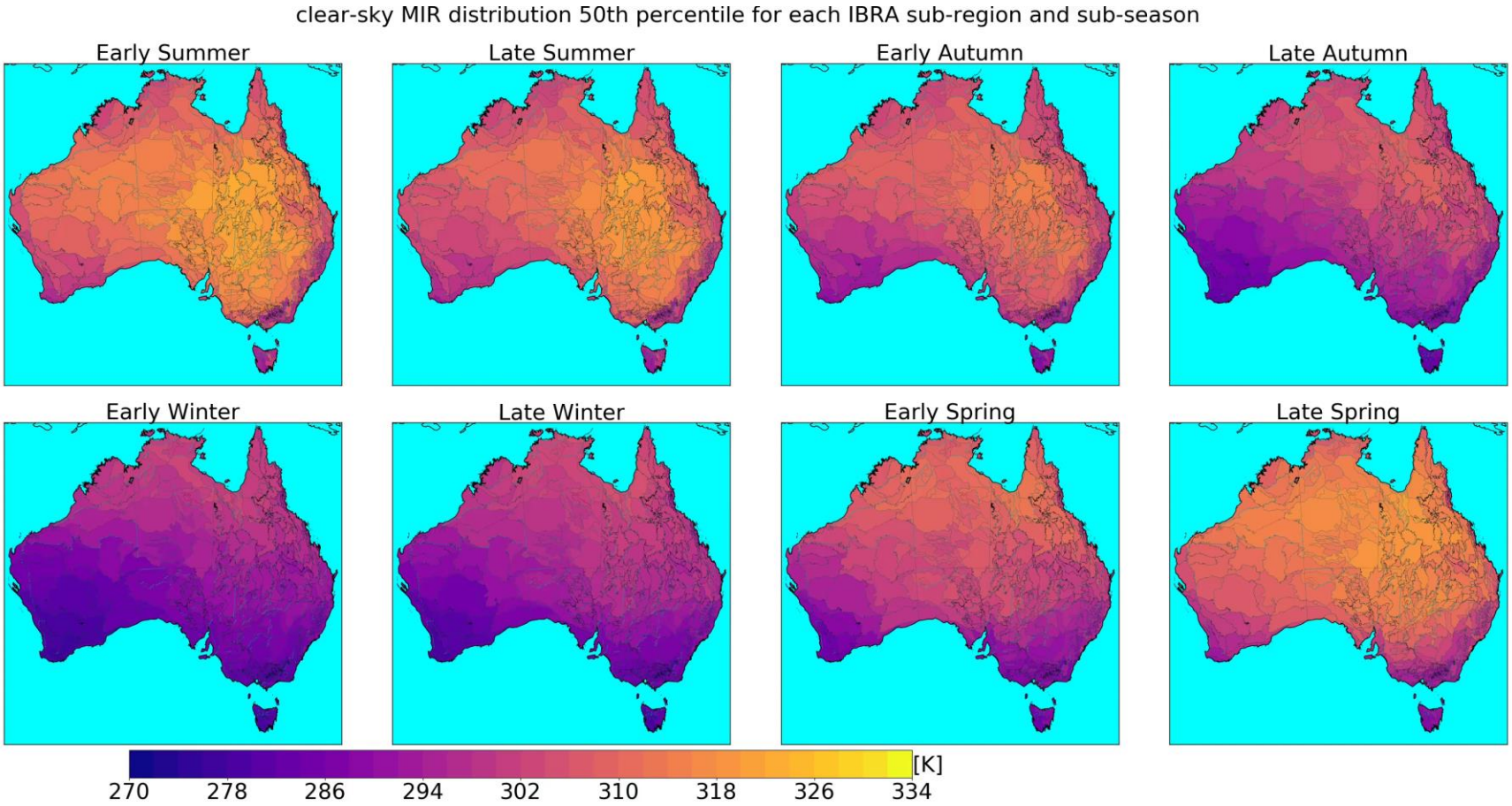
Understanding the problem



# Fire Surveillance

Understanding the problem



# Fire Surveillance

Providing a solution

Himawari-8 image NRT acquisition

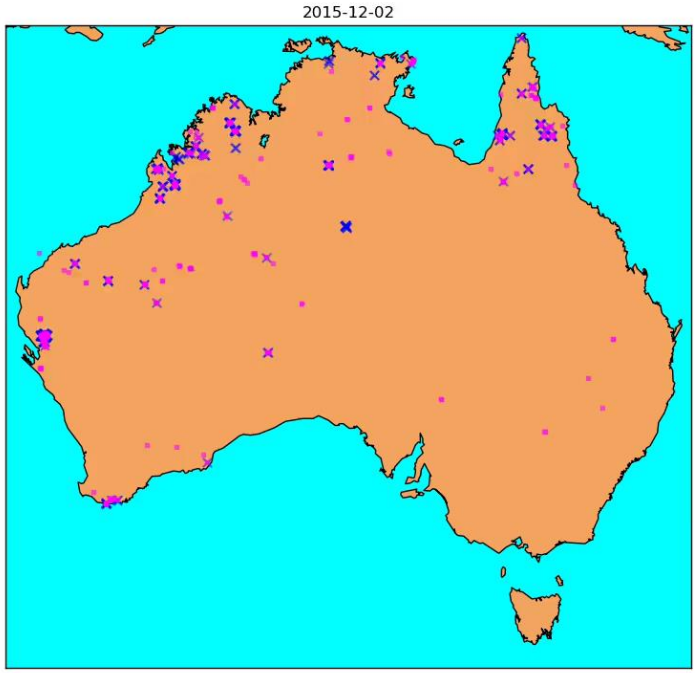
Multi-band

2 week rolling window training data

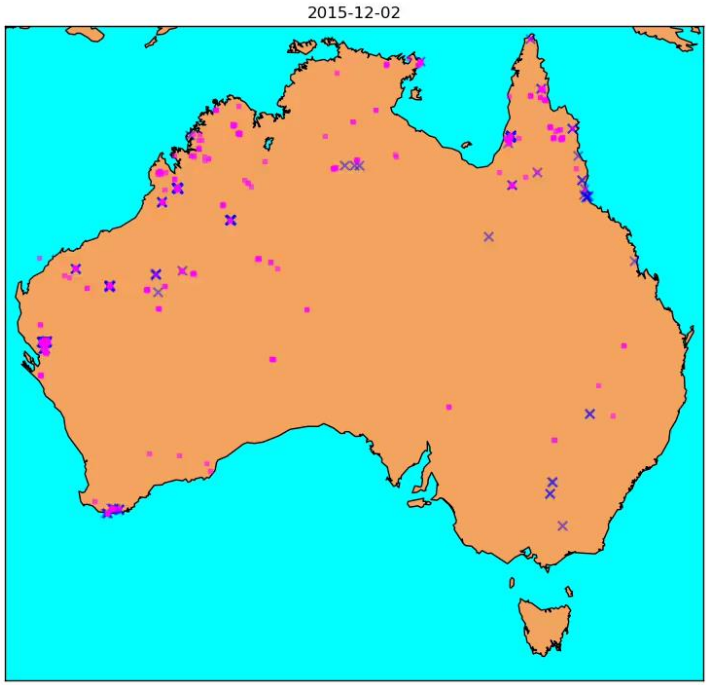
Statistically determined clear-sky observations

Statistical thresholding for fire activity

Hotspot products



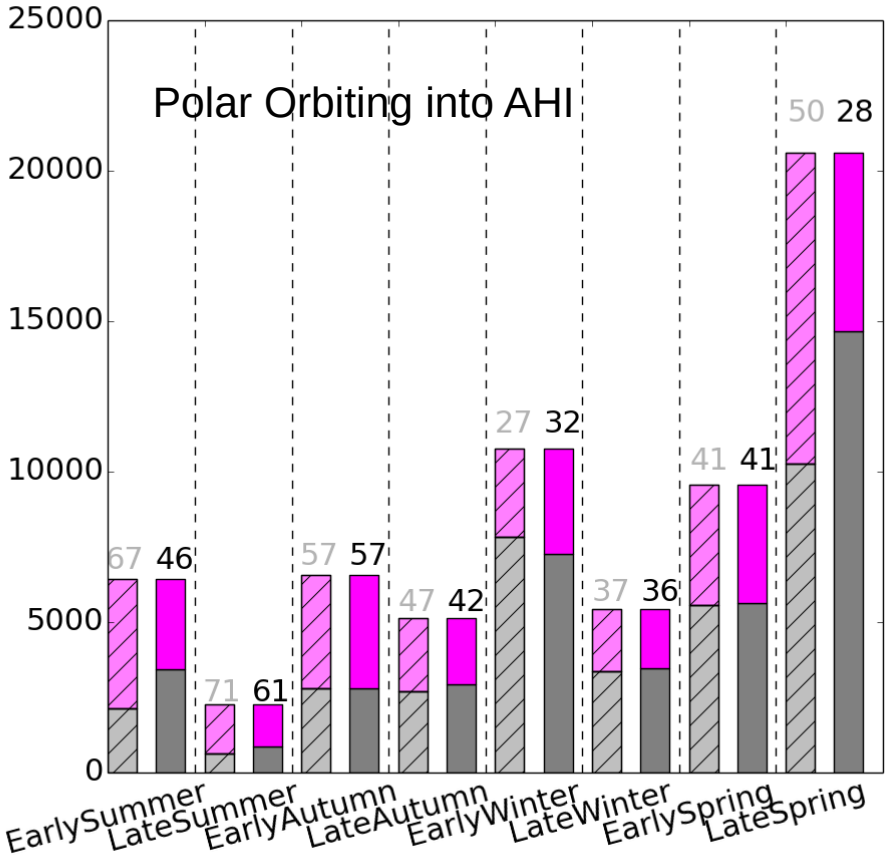

New AHI algorithm for Australia

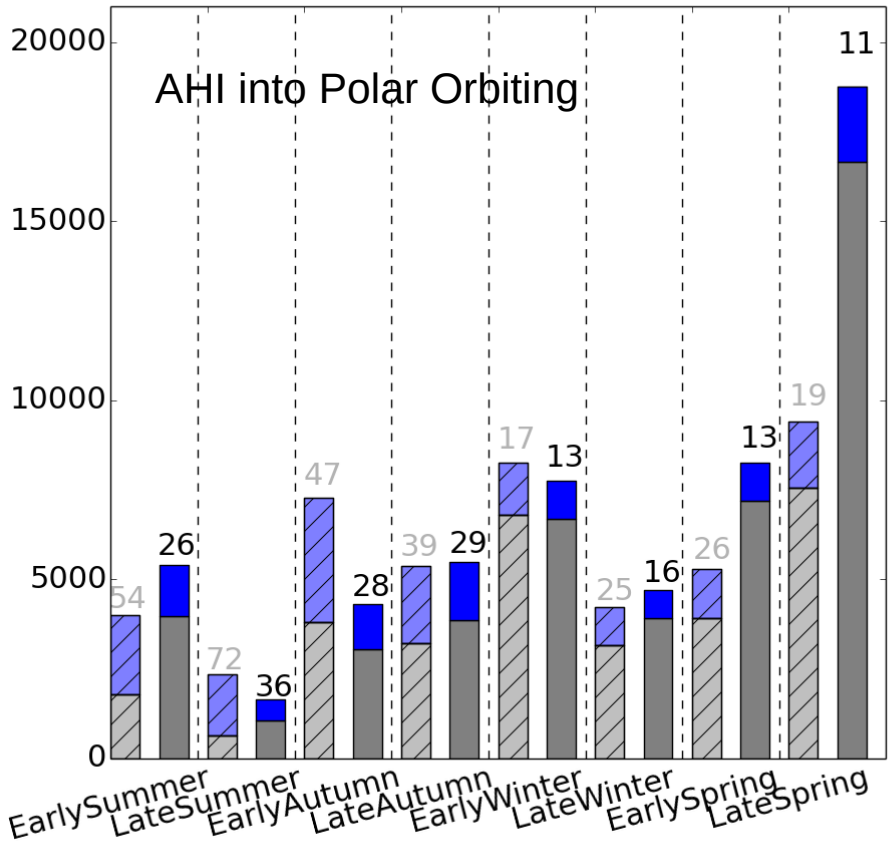



WF-ABBA for Australia

# Fire Surveillance

Evaluating the solution



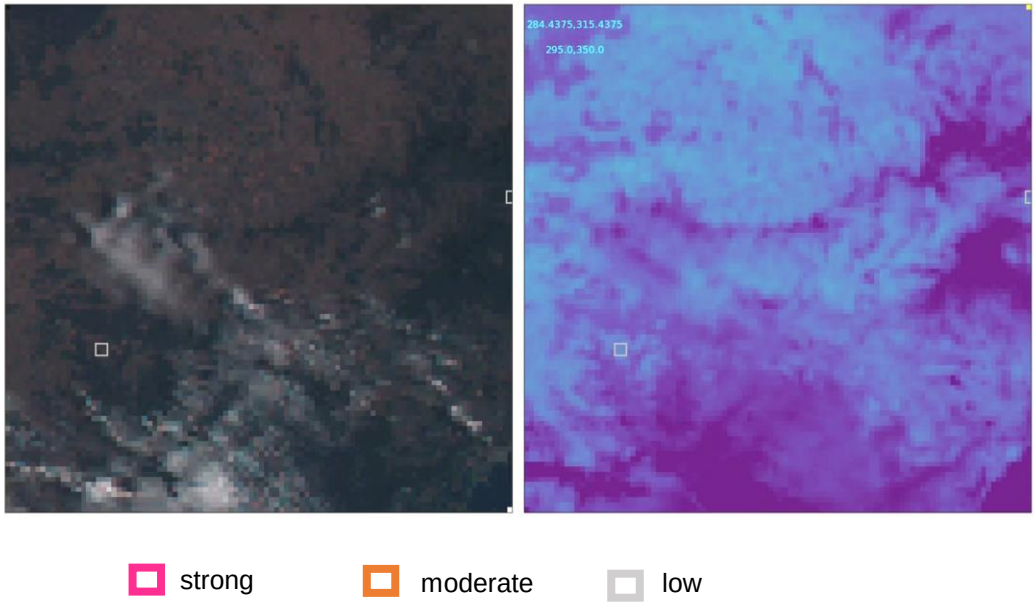




AHI/WFABBA

AHI/IBRA

# Fire Surveillance

Where to next?




- Comparison of first detection times from AHI-IBRA hotspot detections versus trip zero incident reports. (When and where do these occur?)
- Tweaking and continual improvement of the algorithm?
- Stretching algorithms to new applications.
- Detection strength or hotspot confidence intervals.

# End-User Perspective

Dr. Stuart Matthews
New South Wales, Rural Fire Service