Earth Observations and Hotspots: Examples from Black Summer

Research Advisory Forum / **2020**

A/Prof. Karin Reinke/ RMIT University
Prof. Simon Jones / RMIT University
Dr Chermelle Engel / RMIT University

@bnhcrc @bnhcrc

bushfire&natural HAZARDSCRC

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

Overview

Challenge: Continuous and timely surveillance of active fire across the Australian continent; old algorithms applied to new data.

Opportunity: Launch of Himawari-8 satellite, providing 10 minute observations.

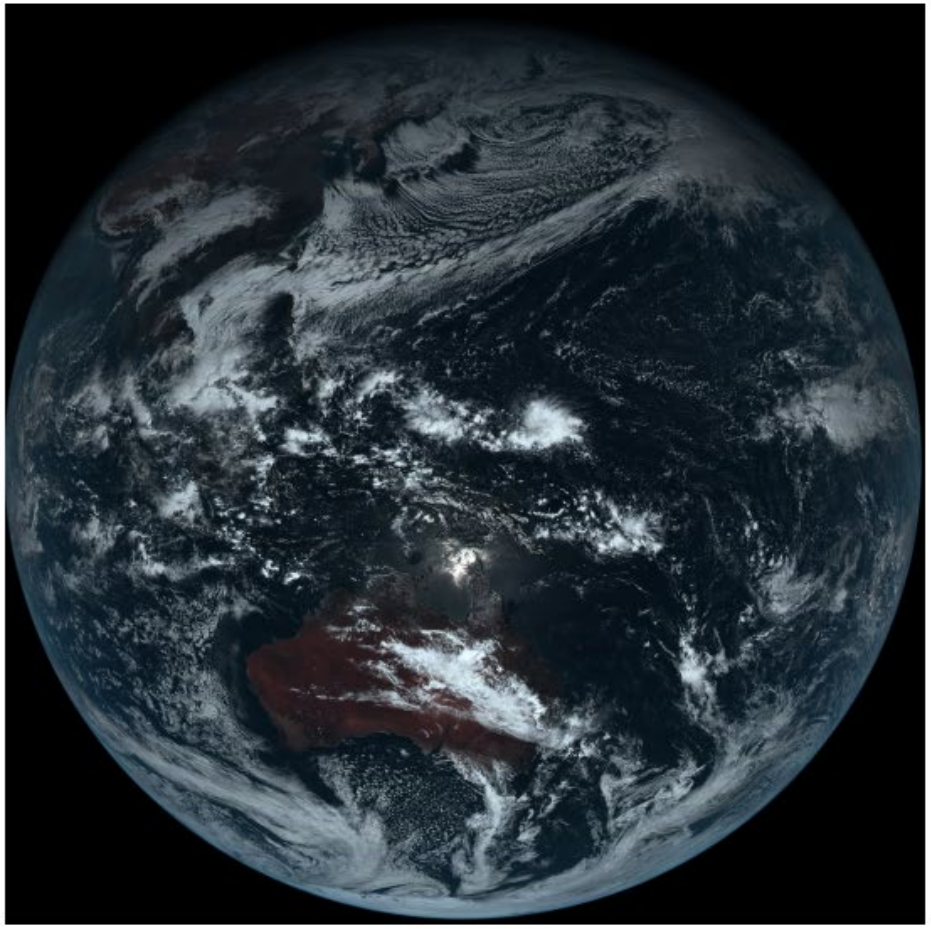
Solution: (1) new fire detection algorithms customised to Australian conditions (ii) computational techniques to deliver near real-time (1-2 minutes) implementation.

Earth Observations for Fire Detection

Polar-Orbiting

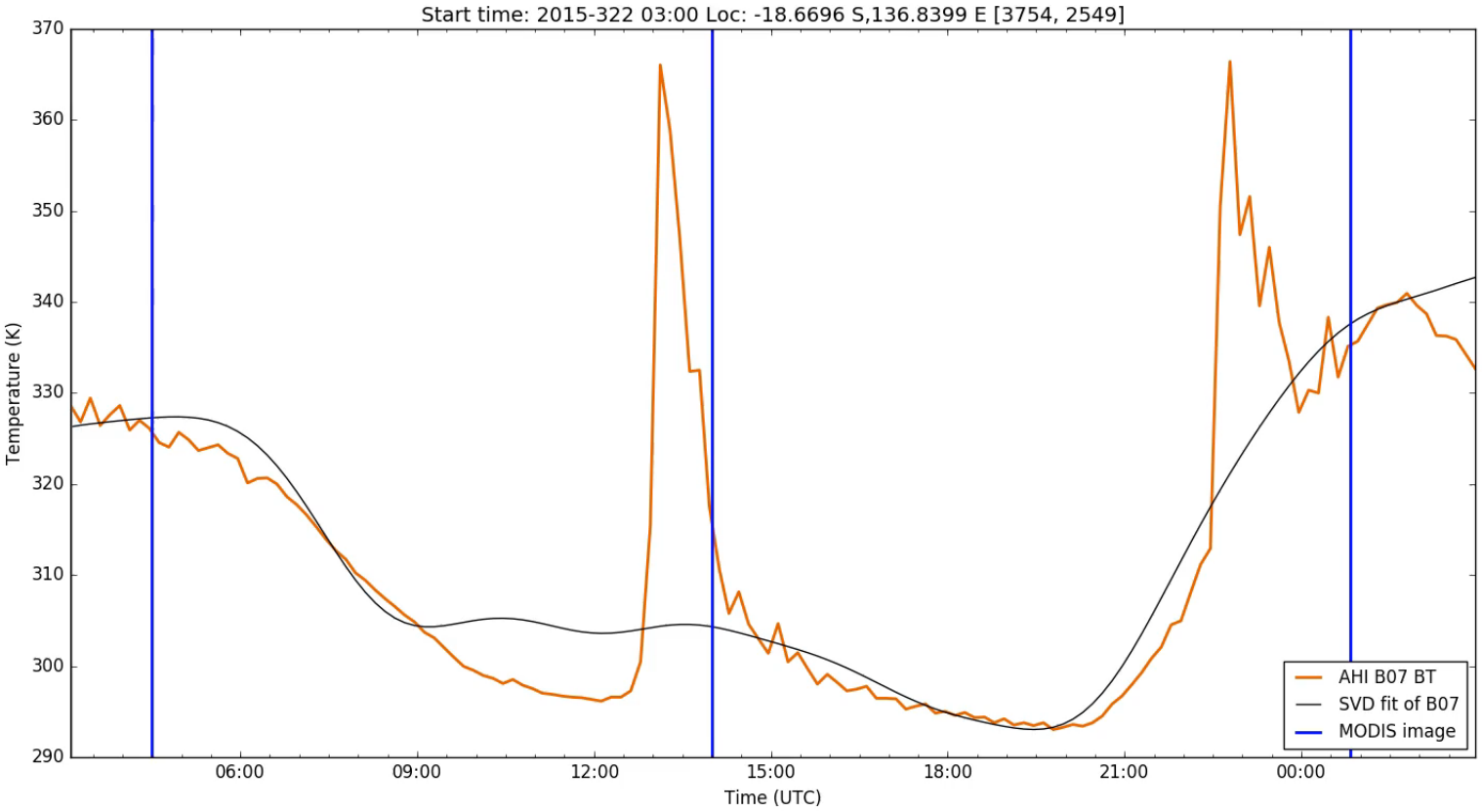
Source: NOAA Science on a Sphere website

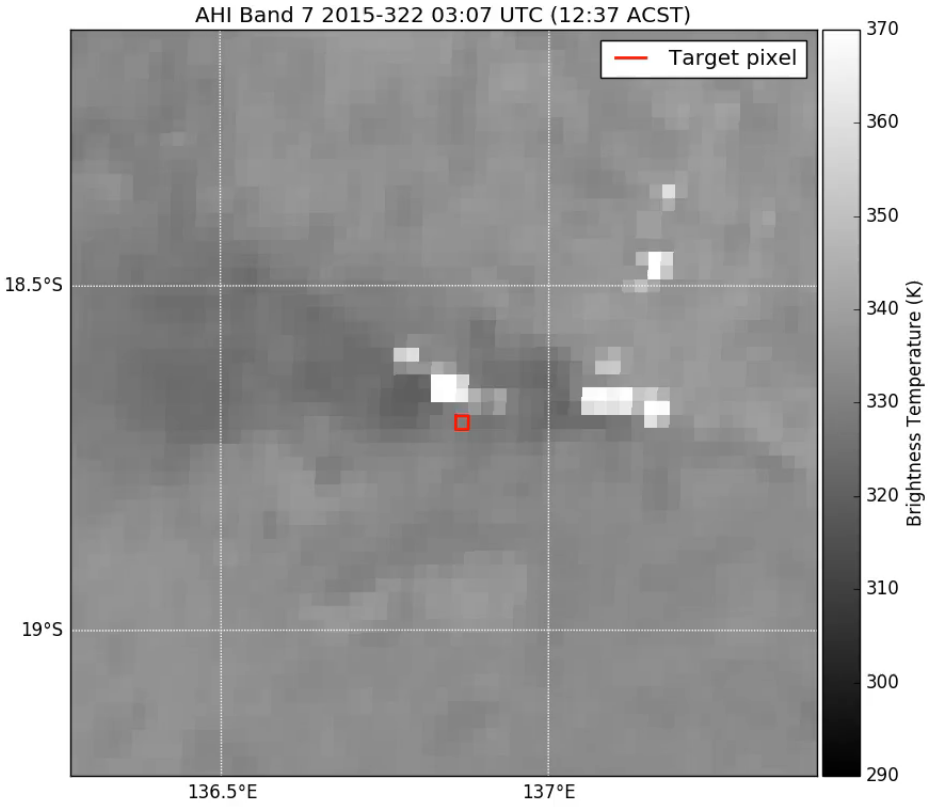
Himawari-8



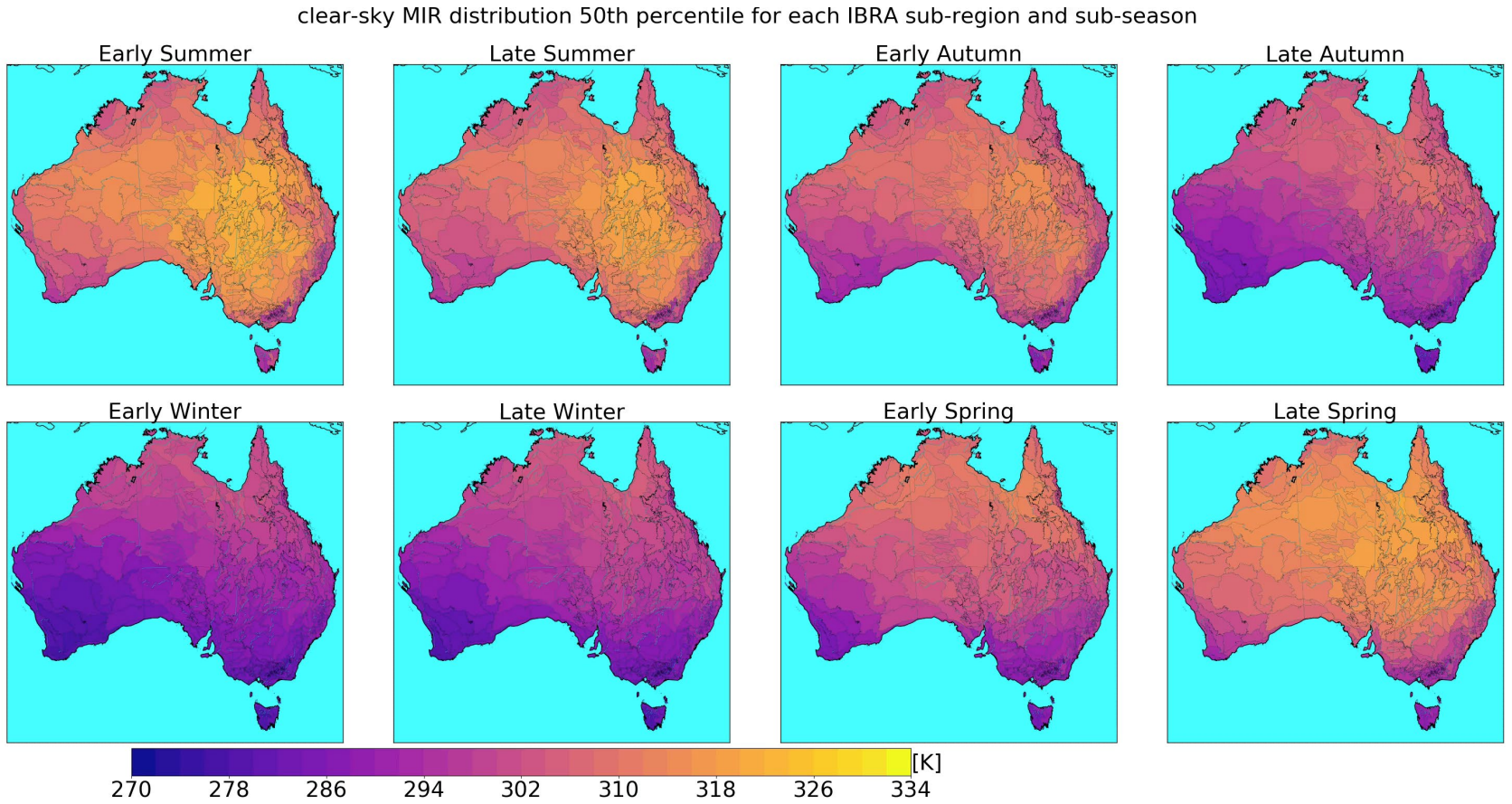
Source: Japan Meteorological Agency website

Earth Observations for Fire Detection





Developing a New Algorithm for Australia



Surface temperatures vary with **time of day**, **season** and **geographical location**.

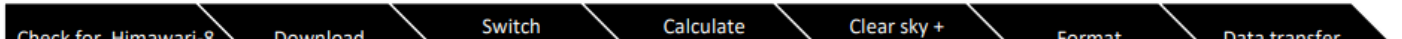
Algorithm varies based on rolling time windows, specific to time of day (ie. every 10 minutes) and geographical region.

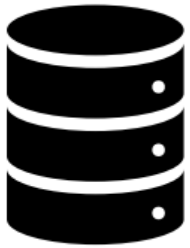
How to deal with **cloud**?

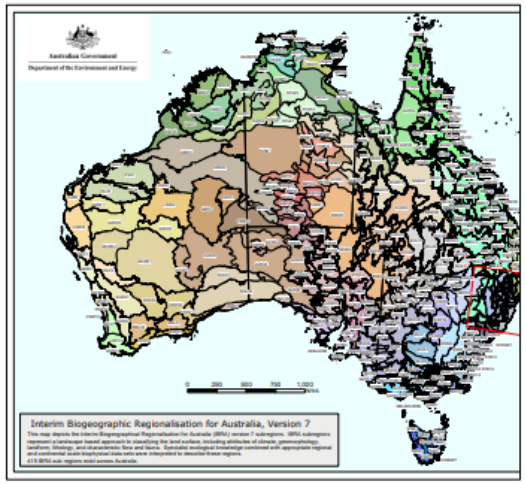
How can we do all of this **quickly**?

Building the Algorithm Solution Workflow

Download 20 mins
Processing < 2 mins







C. B. Engel, S. D. Jones and K. Reinke, 2020 "**A Seasonal-Window Ensemble-Based Thresholding Technique Used to Detect Active Fires in Geostationary Remotely Sensed Data**," in IEEE Transactions on Geoscience and Remote Sensing, doi: 10.1109/TGRS.2020.3018455.

Evaluating the Algorithm

Agreement with operational fire detection products over a including:

- VIIRS hotspots
- MODIS hotspots
- MODIS burnt area hotspots
- other Himawari-8 hotspots (e.g. WF-ABBA)

And, unmatched hotspots compared with MODIS burnt area products to assess likely validity

Operational performance assessed through regional and continental trials

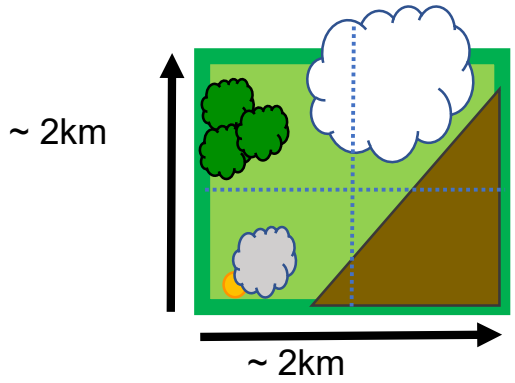
Evaluating the Algorithm

	#detections	#matched	#unmatched	%
BRIGHT/Himawari-8	6398	5881	517	92
MODIS/Aqua	14247	7003	7244	49

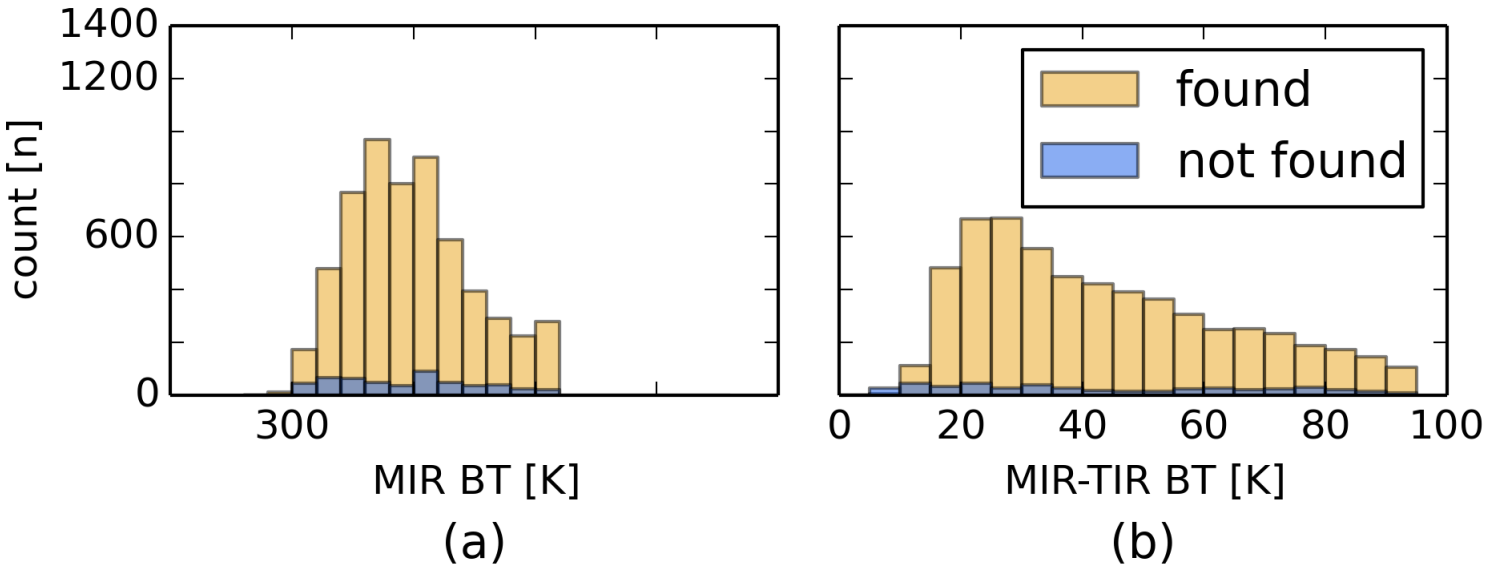
Real-time Trial (NSW/VIC) 15 Mar 2019 to 10 Jan 2020
Co-incident MSTAT/Himawari-8 and MODIS/Aqua* hotspots

(DAY only) Within +- 1 pixel, within +- 10 minutes

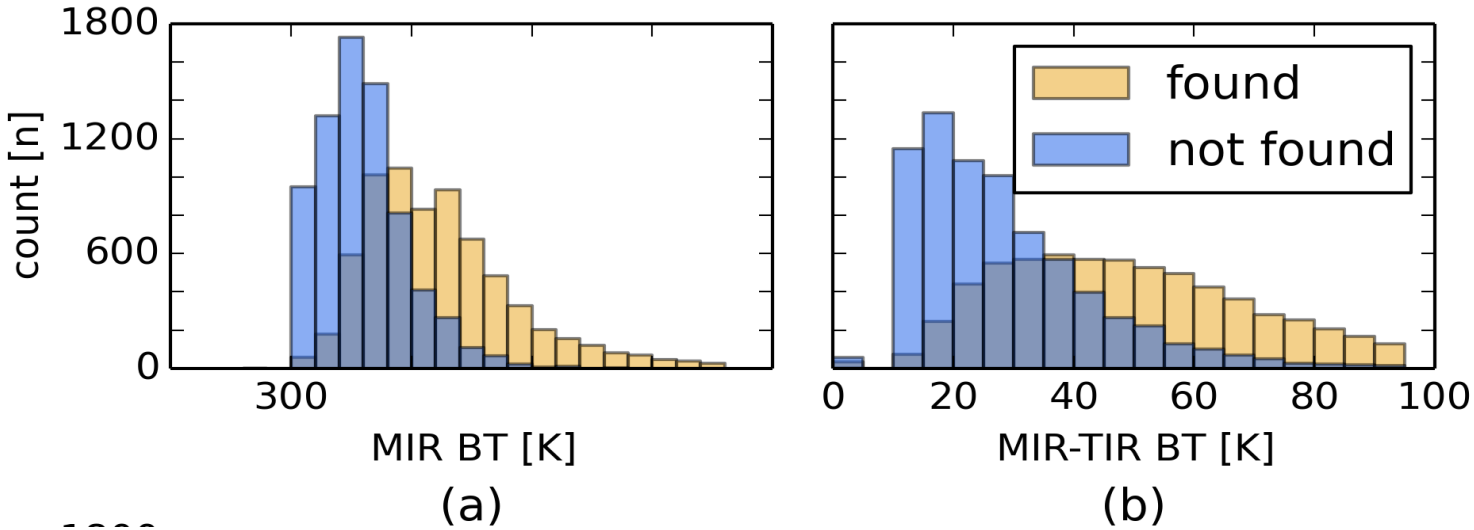
Evaluating the Algorithm



BRIGHT/Himawari-8 matching MODIS/Aqua

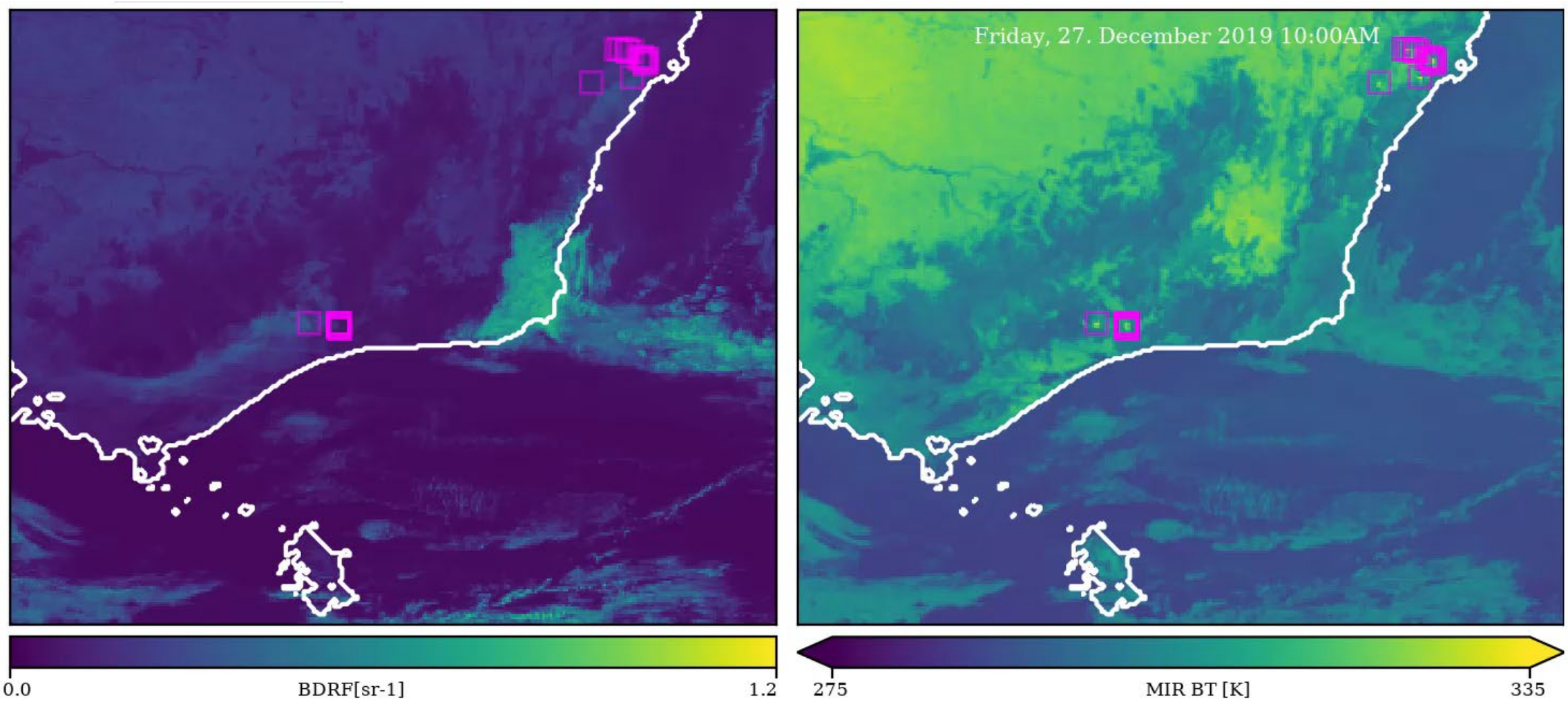


MODIS/Aqua matching BRIGHT/Himawari-8

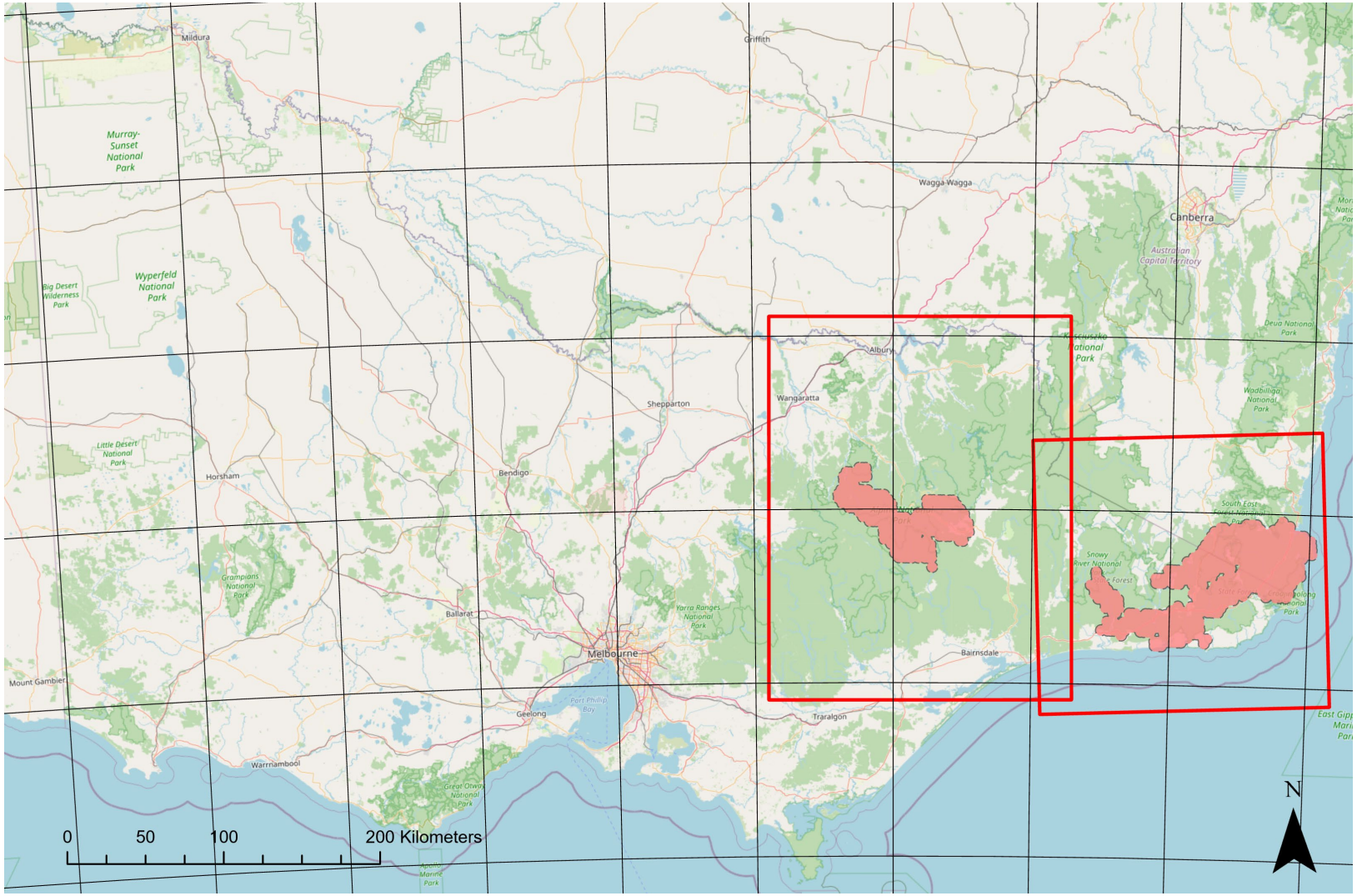


Demonstration of the BRIGHT algorithm during the Black Summer Fires of 2019/2020

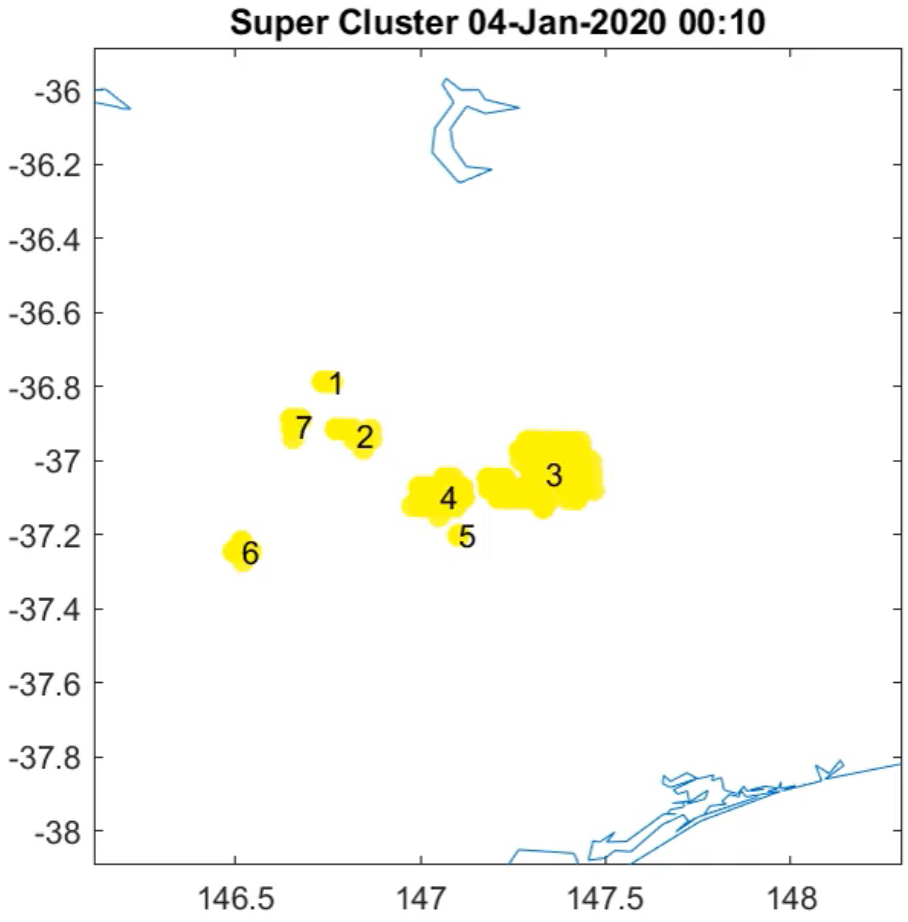
Black Summer: example BRIGHT hotspot detections

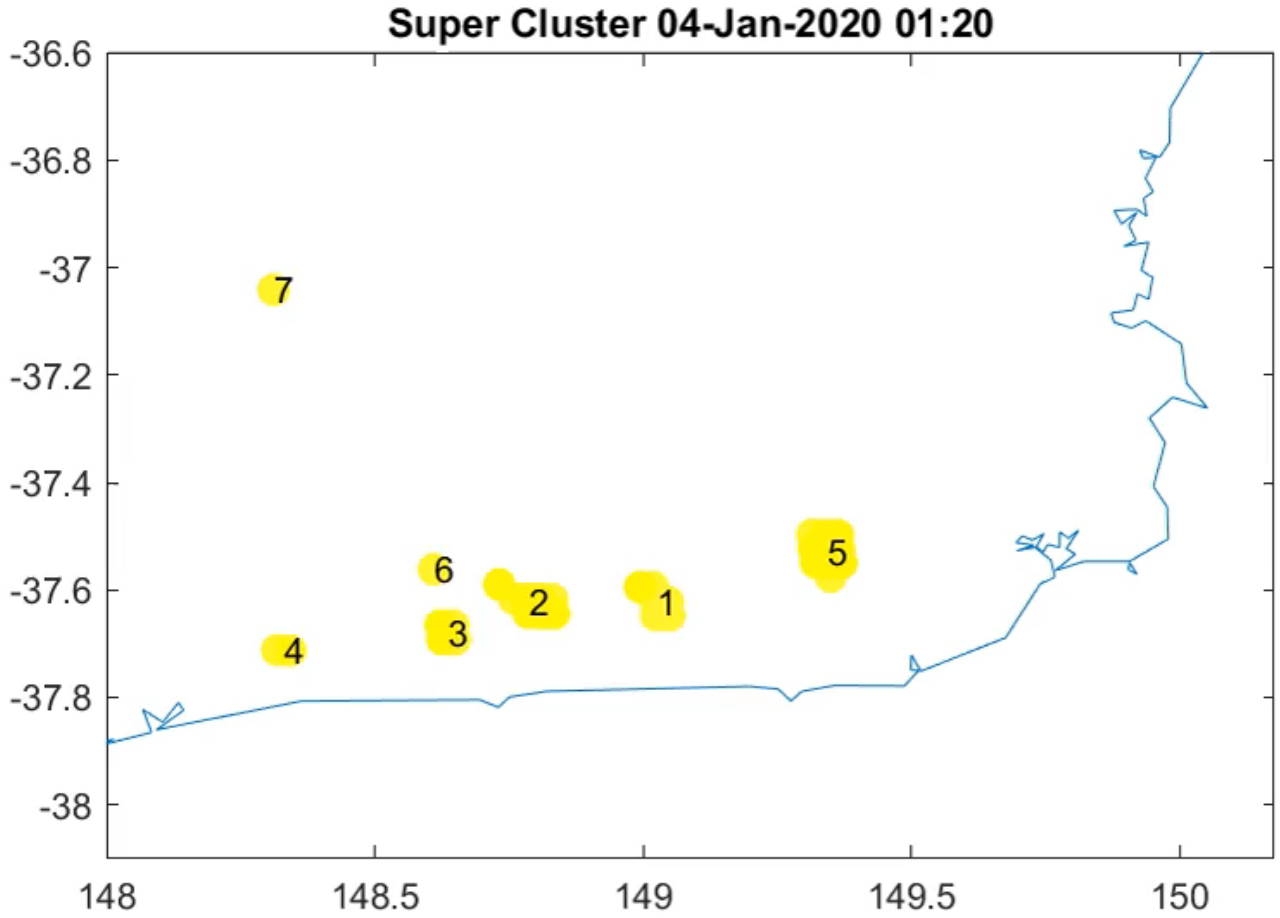


Black Summer: BRIGHT hotspot secondary products

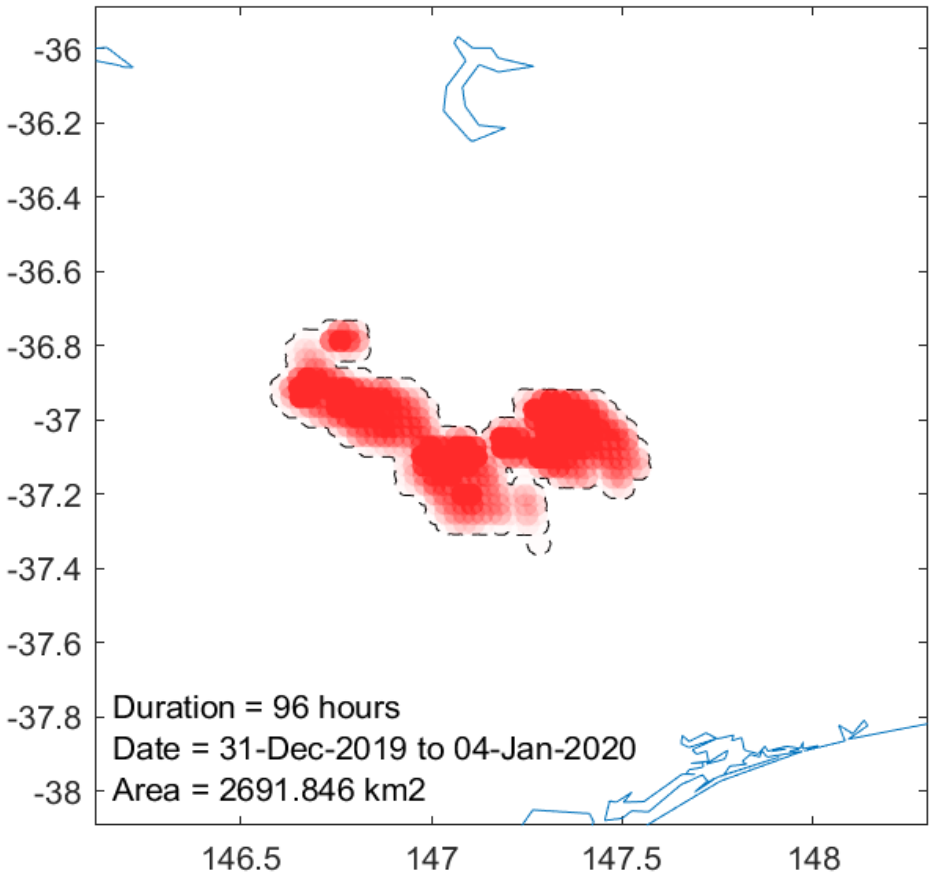


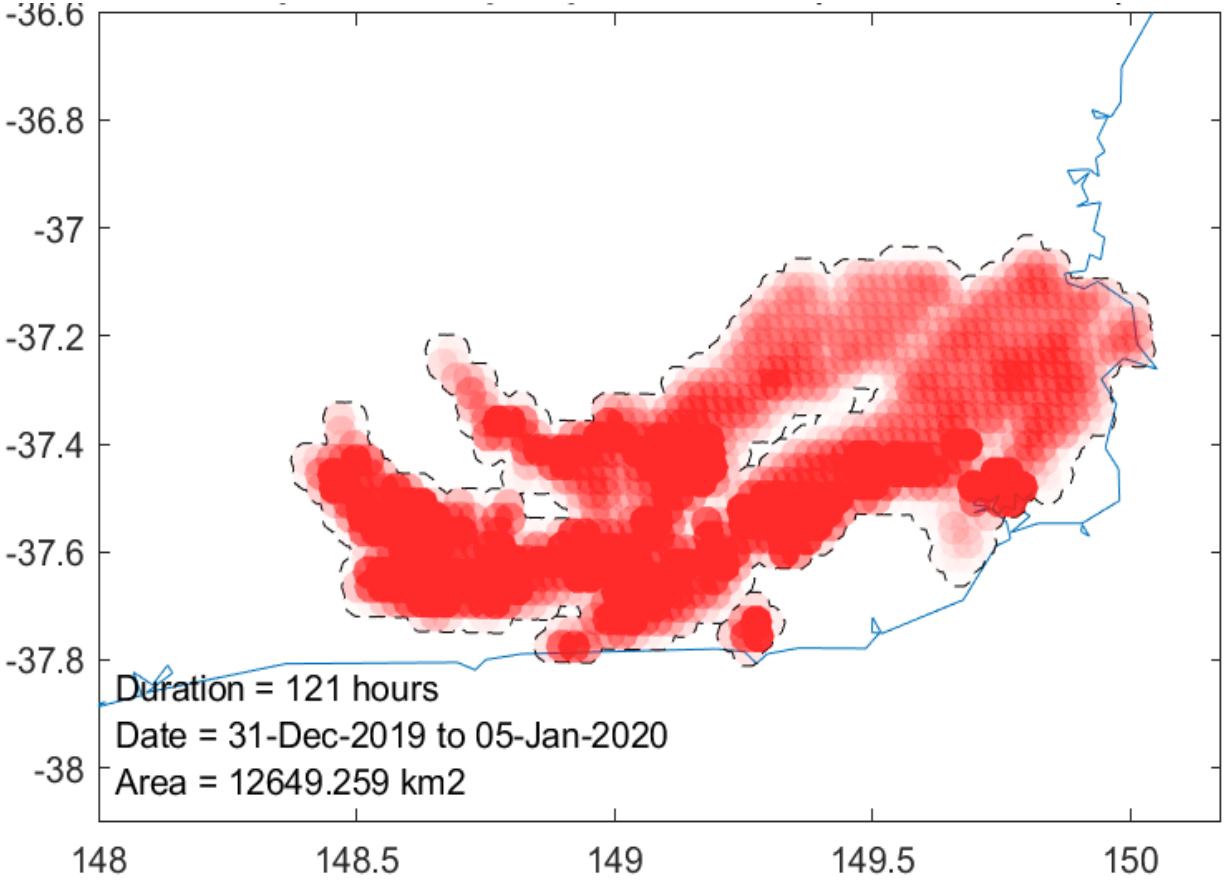
Black Summer: example BRIGHT hotspot clustering





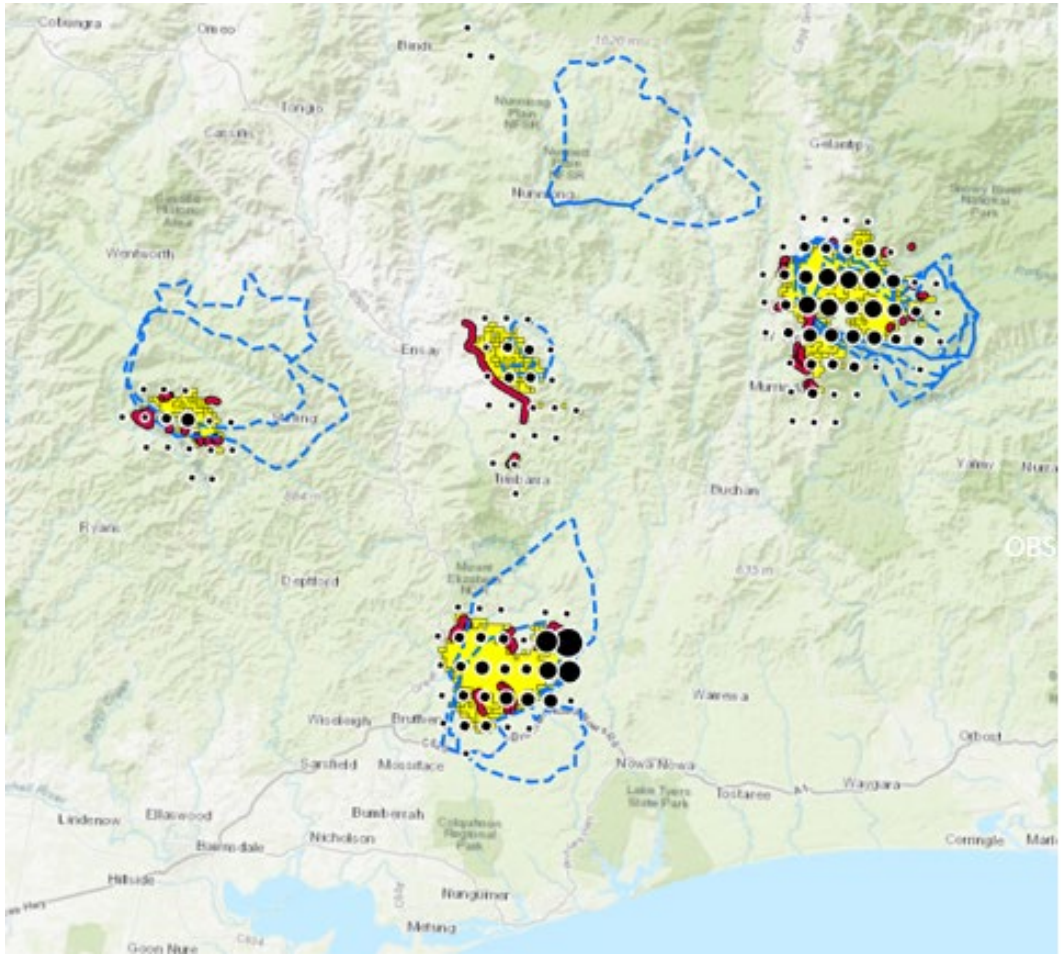
Black Summer: example BRIGHT hotspot persistence





Black Summer: example BRIGHT utilisation

"On days of extreme weather, and with no other data source available, we rely heavily on satellite hotspots, so having the RMIT Himawari8 data coming in in under 30 minutes changed the way we mapped fire and helped us to plan evacuations and provide public warnings with more lead time."

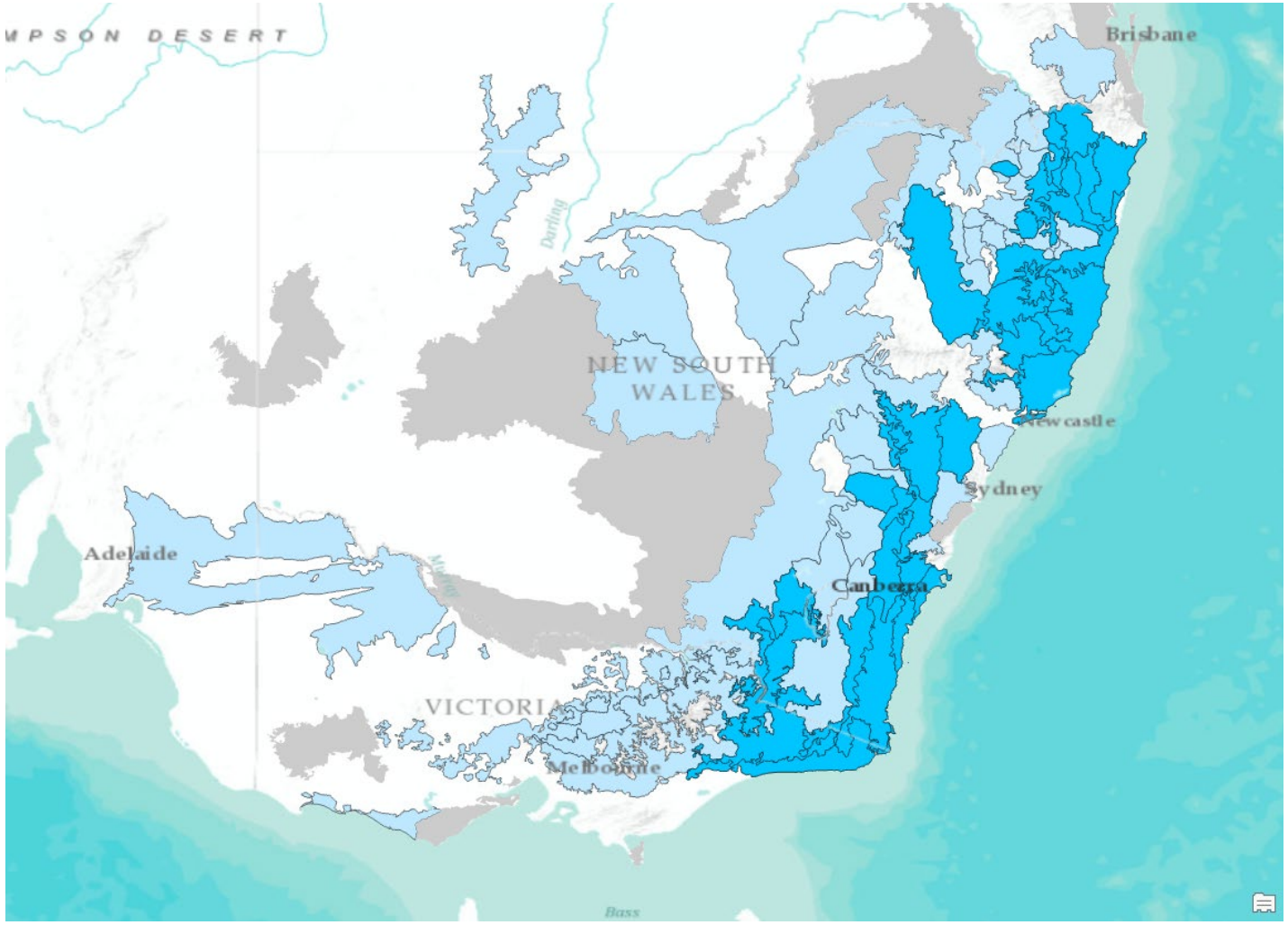


Black Summer: example BRIGHT performance

False detections
comparing BRIGHT to MODIS burnt area.

Nov 2019 – Feb 2020

- ≤1% false detections
- ≤5% false detections
- ≤ 100 DETECTIONS

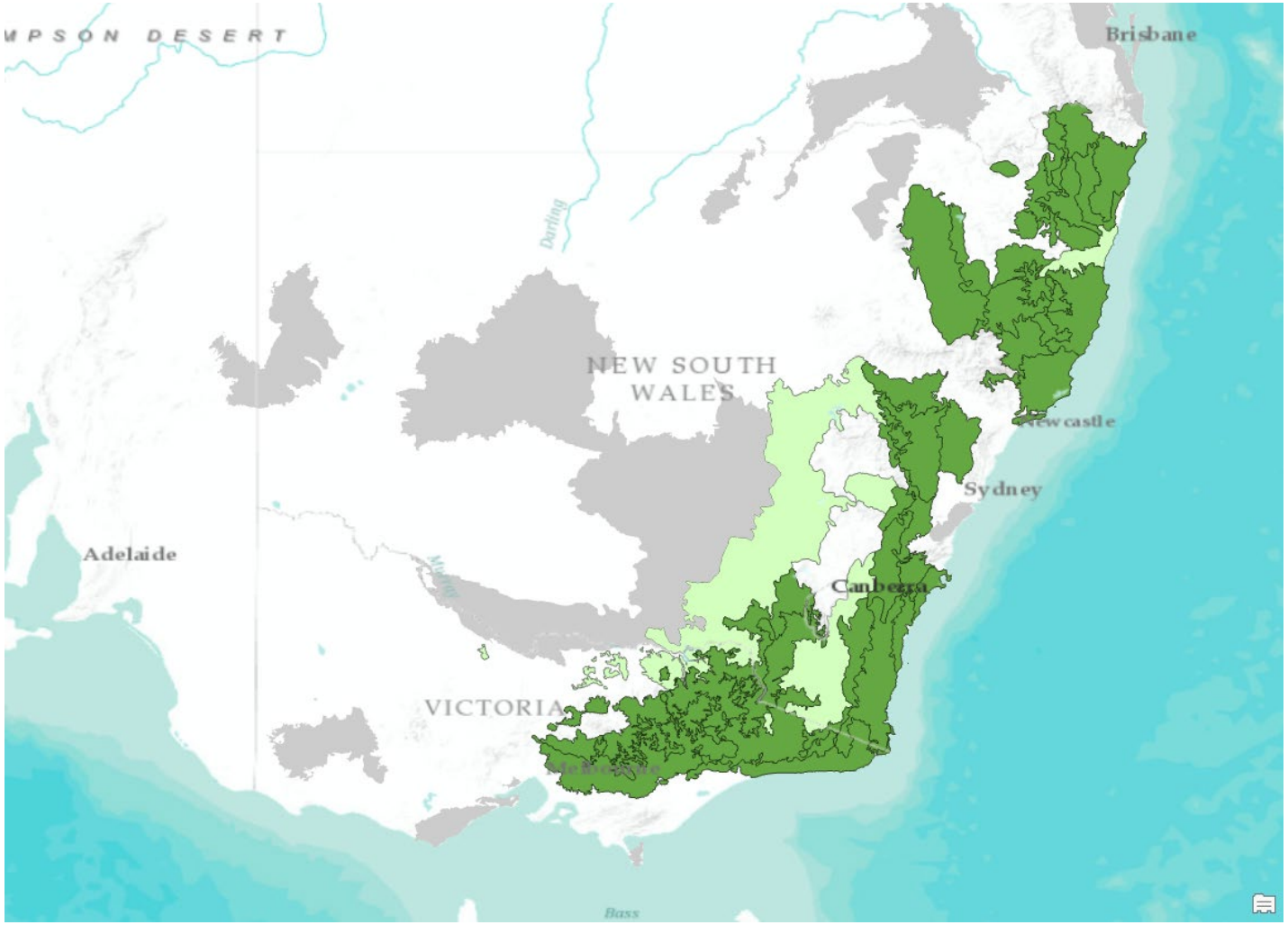


Black Summer: example BRIGHT performance

False detections
comparing BRIGHT to MODIS burnt area.

Nov 2019 – Feb 2020

- ≤1% missed detections
- ≤5% missed detections
- ≤ 100 DETECTIONS



Project Achievements and Next Steps

Awards

- 2017 and 2018 Asian Conference of Remote Sensing best presentation

Research Outputs

- 11 associated peer-reviewed publications
- 1 manuscript in preparation
- 2 PhD and 1 Masters completions

Utilisation Outputs

- 3 new algorithms
- Code to deliver hotspots in near-real time without need for cloud-masks
- NSW and Victorian live trial over 2019/2020 Summer
- National live trial commenced October 2020
- Solution implemented on research grade servers and in parallel implemented on an AWS instance

Near real-time algorithm and validation manuscript in preparation.

Algorithm improvements in response to end-user feedback from trial

Development of ancillary data products.

Preparation of code for handover to hosting agency.

Thank You

Acknowledgements

Stuart Matthews / NSW RFS
Naomi Withers / VIC DELWP
Steve Salathiel / VIC DELWP

And representatives from Victoria DELWP, New South Wales RFS, South Australia DEWNR, Western Australia DFES, Queensland QFES, Tasmania Parks + DPIPWE , NT DENR, and ACT ESA who are participating in the current BRIGHT hotspots national trial.

For further information contact karin.reinke@rmit.edu.au

@bnhcrc @bnhcrc

bushfire&natural HAZARDSCRC
Australian Government Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme