

Integrated Technologies for Wildfire Preparedness and Early Detection



**Bushfire
Research**
Centre of Excellence

Prof. Marta YEBRA

Director Bushfire Research Centre of Excellence, The Australian National University



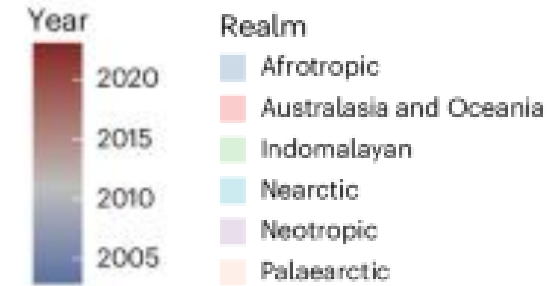


Strong upward trend in extreme fire events

Frequency



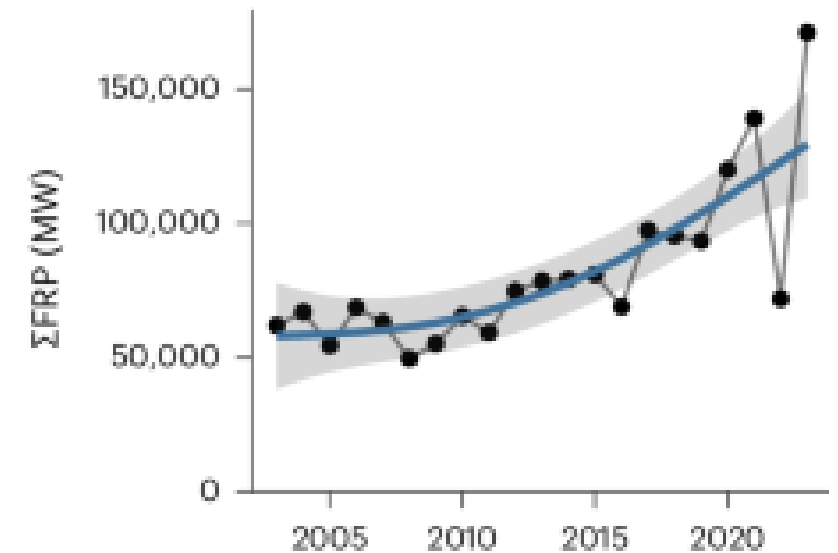
Energetically extreme fires
defined as the top 0.01% for fire radiative power (FRP)
from 2003 to 2023



Intensity

c

Mean of top 20
 Σ FRP events per year



shifts the focus from
reactive firefighting to
proactive ignition management
saving resources, ecosystems and lives

Building a Nervous System for Wildfire Risk Mitigation



Satellite



Scout Drones



Cameras on
Fire Towers



Lighting
detectors



On Ground Sensors



Ecologically sensitive area

Blind spot for tower

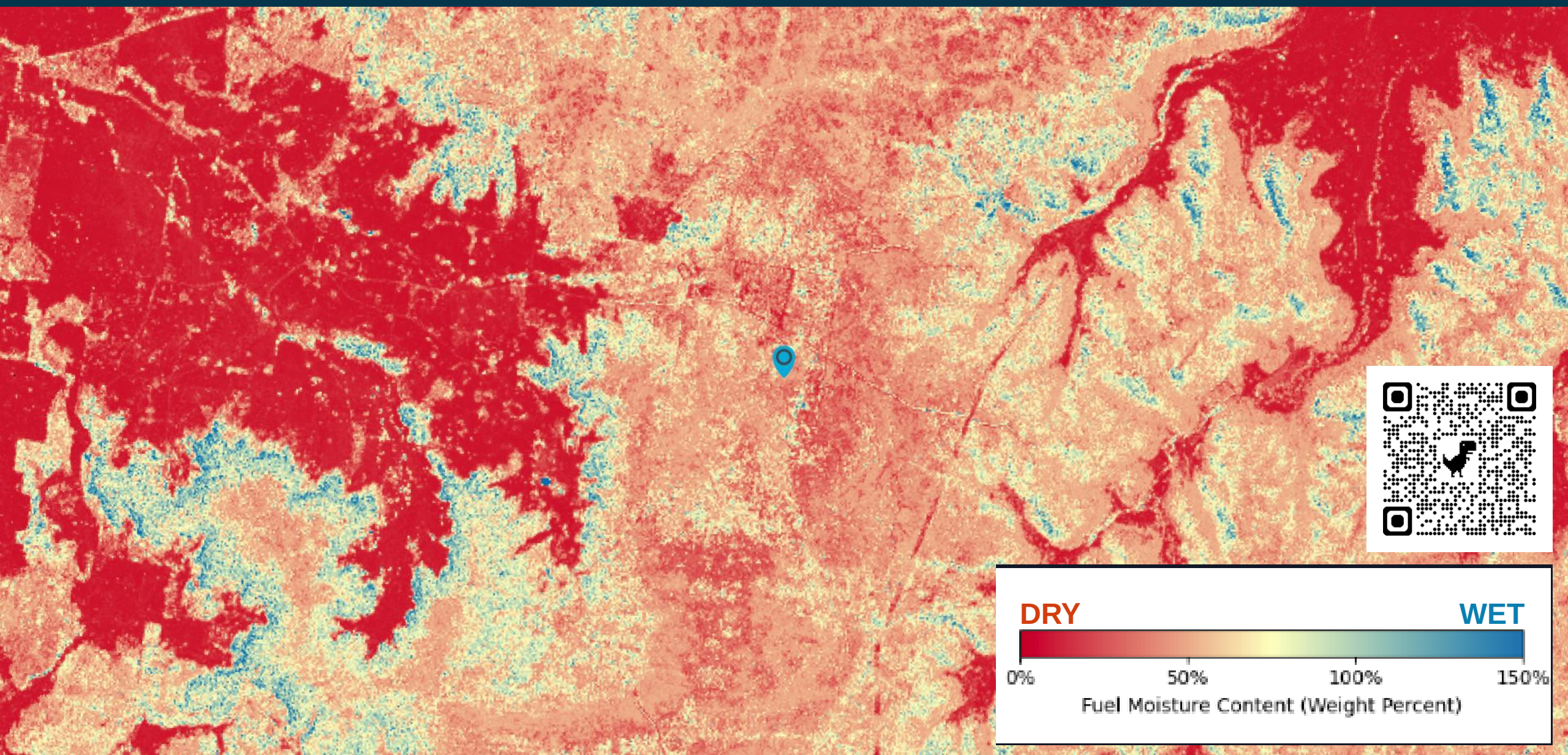
WUI



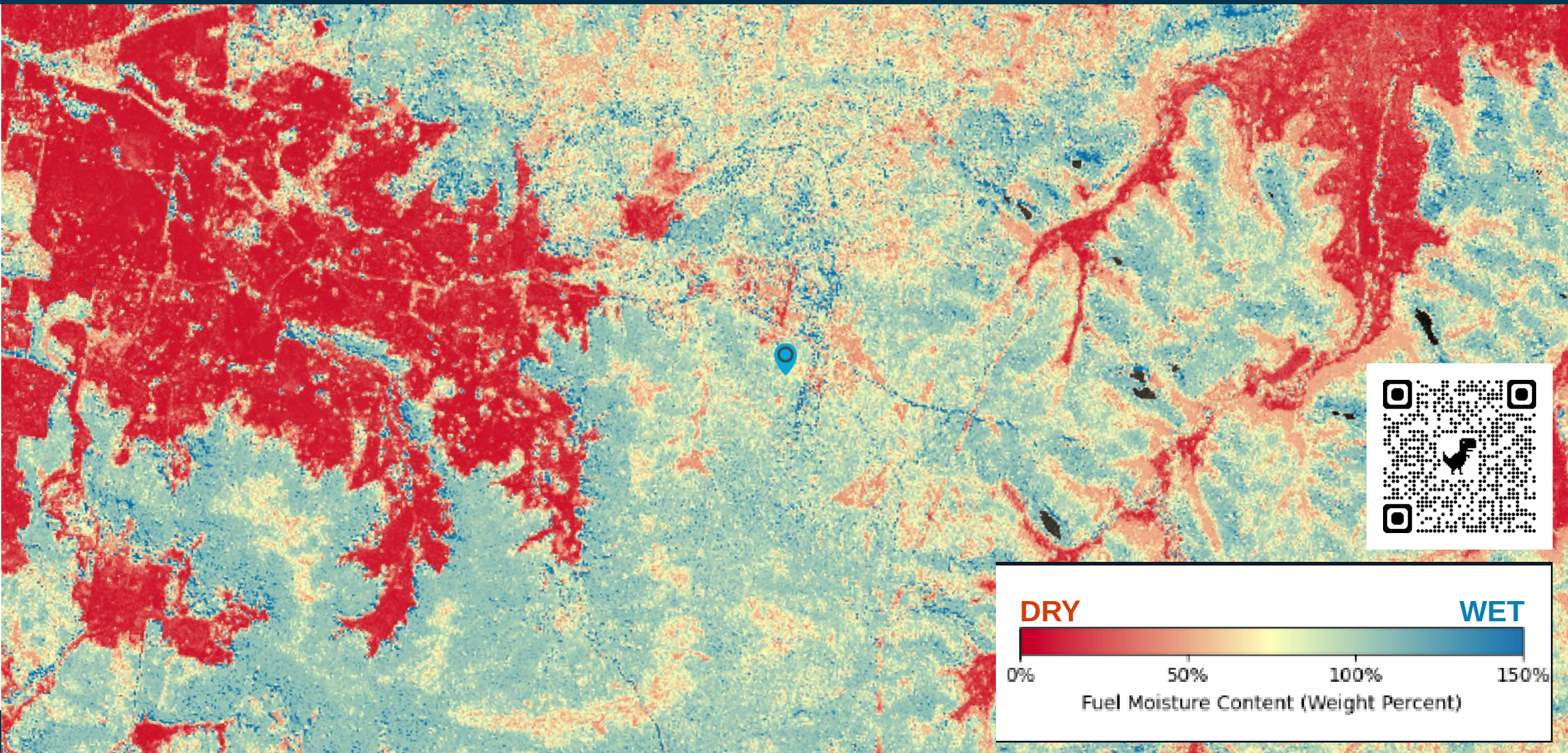
30th Jan 2020, Kain's Flat (New South Wales, Australia)



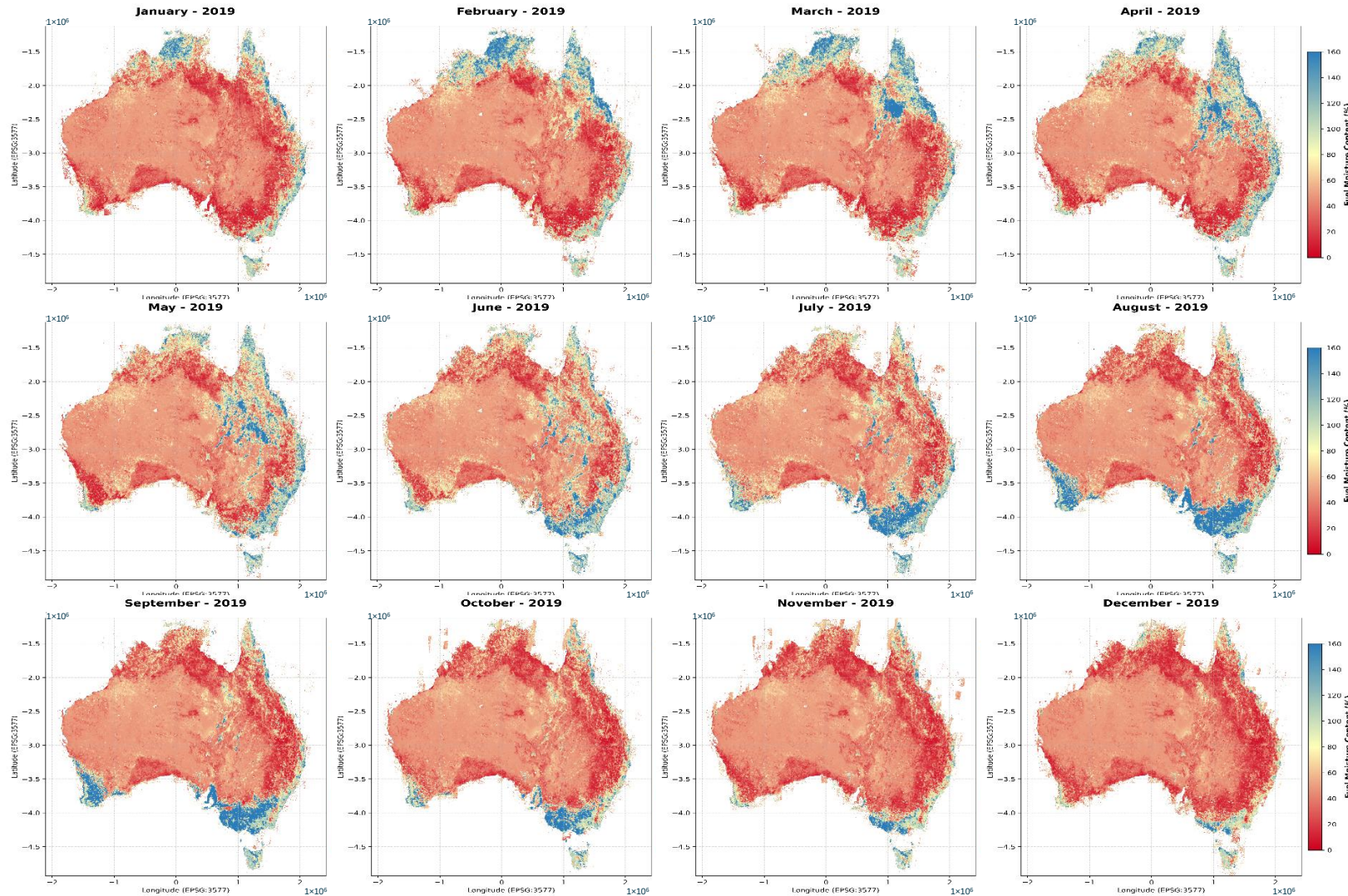
Fuel Moisture Content – 30th Jan 2020, Kain's Flat (NSW)



Fuel Moisture Content – 5 moths earlier ...



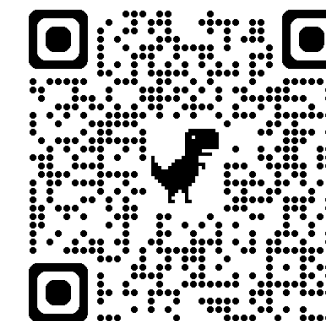
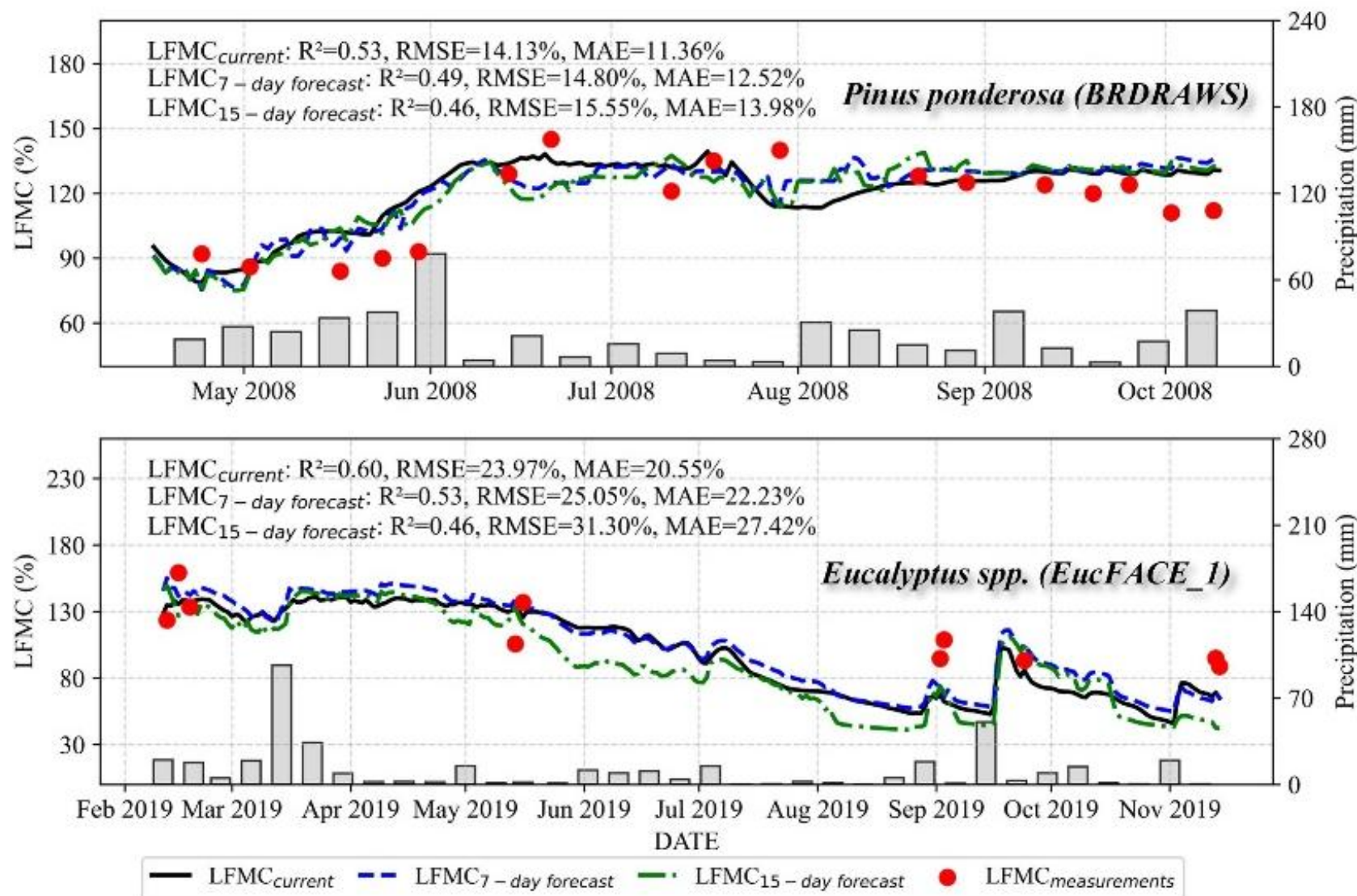
Australian Operational Product → Shared APEC Capability



Wildfire Pilot Dryness

Not every APEC economy
needs to build this capability
from scratch.

Anticipating Flammability: Fuel Moisture Forecasting



OzFuel: Space-Based Fuel Flammability Monitoring

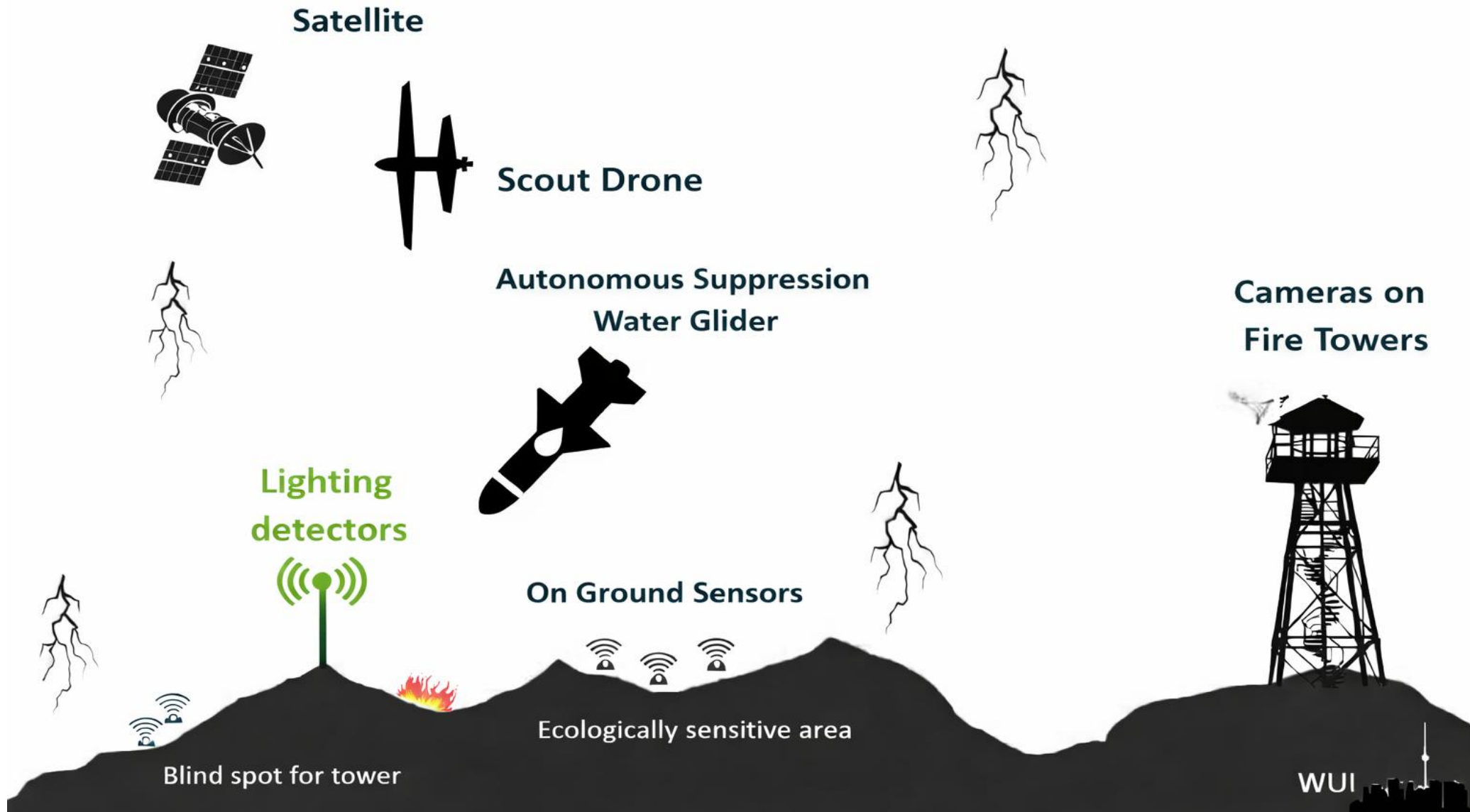


ANU 3D printed engineering model for the OzFuel telescope

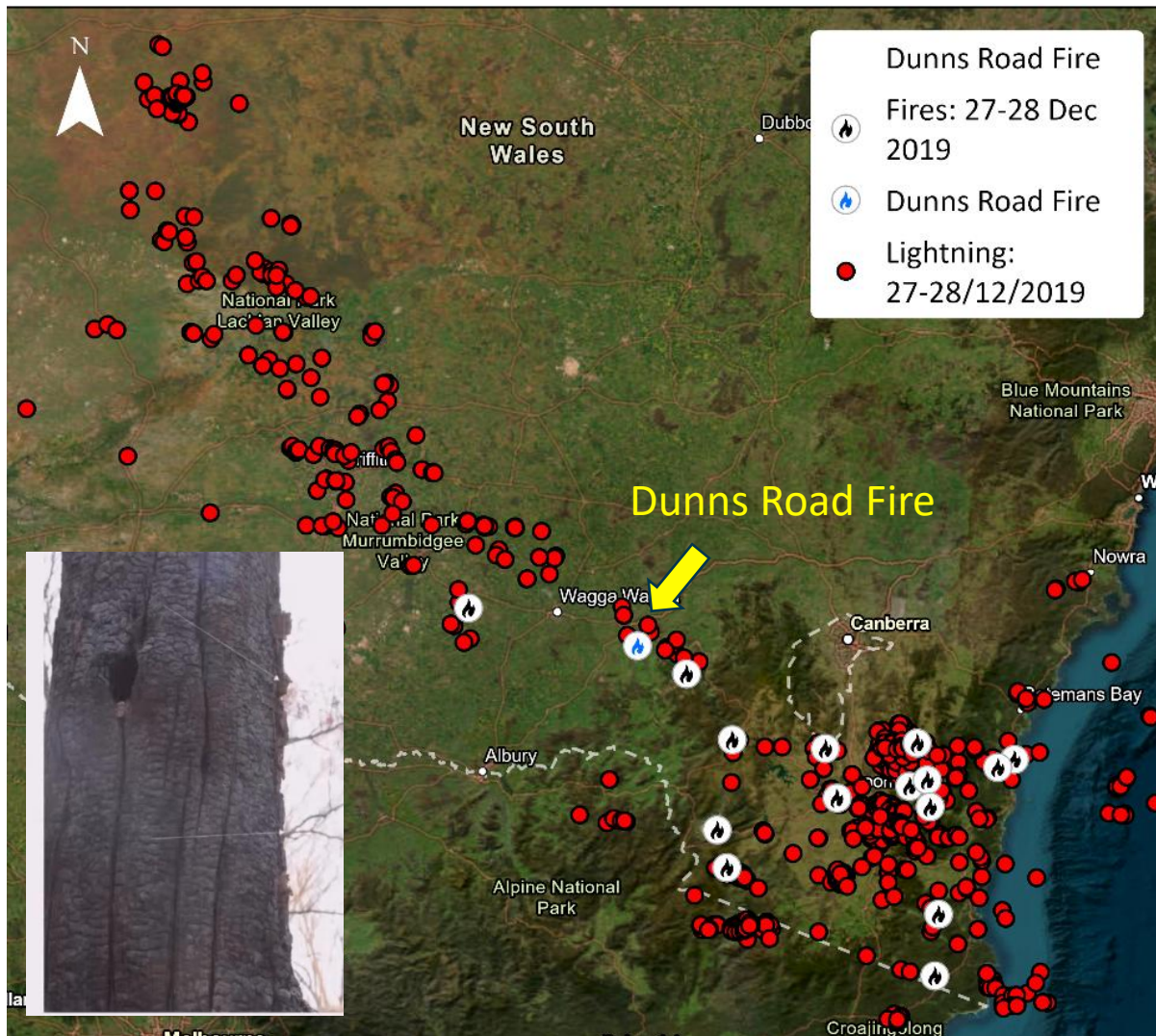
- Next generation of space sensor specifically designed to monitor vegetation flammability
- Complements active fire missions by addressing pre-fire risk



Building a Nervous System for Wildfire Risk Mitigation



The Dunns Road Fire: when a fire starts unseen



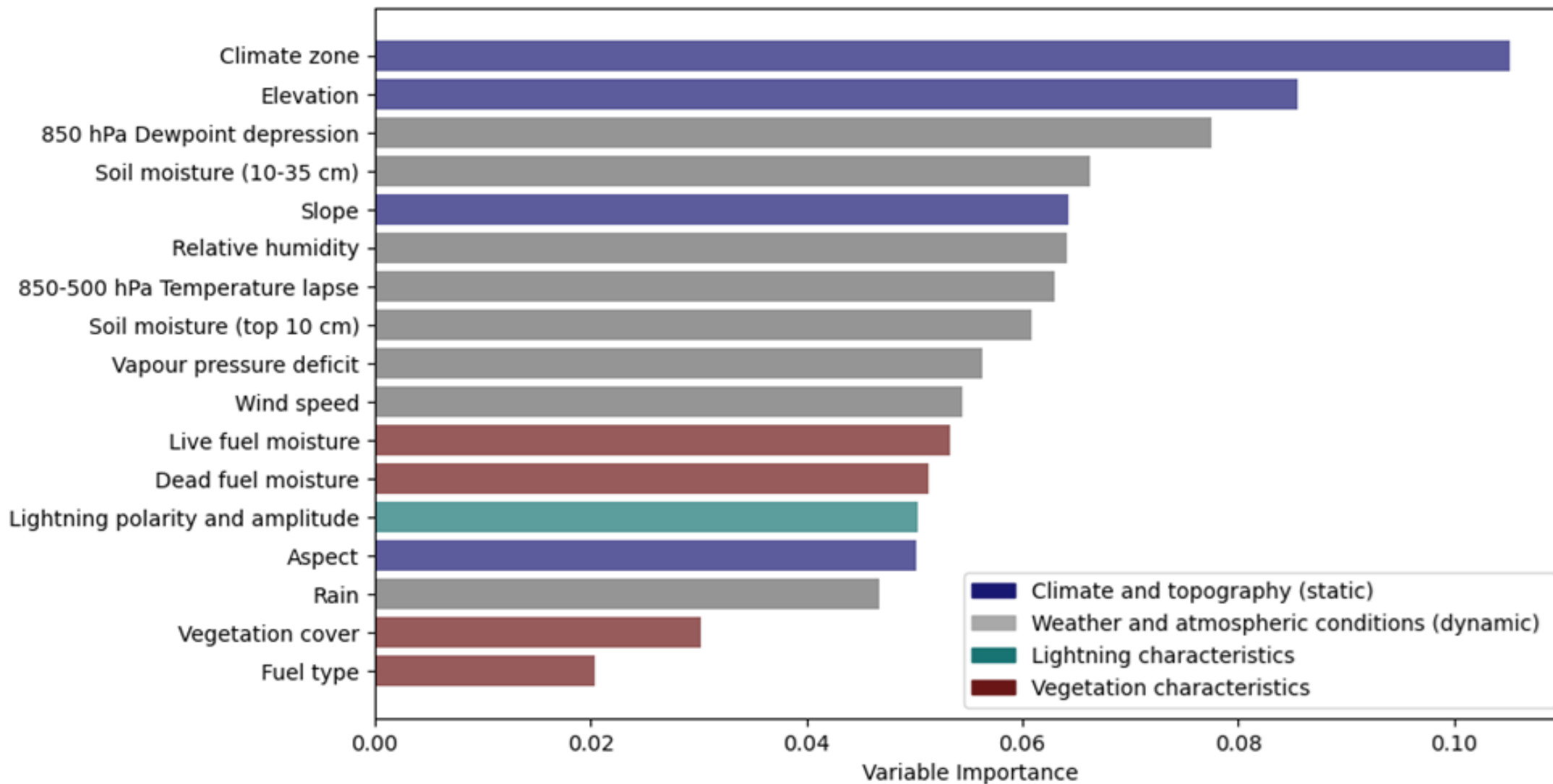
- ~1,000 strikes, 27–28 Dec 2019
- Lightning hit ~11:50 PM, undetected ~12 hrs
- Crews arrived ~1 hr later; fire 3–5 km²

THE FINAL IMPACT

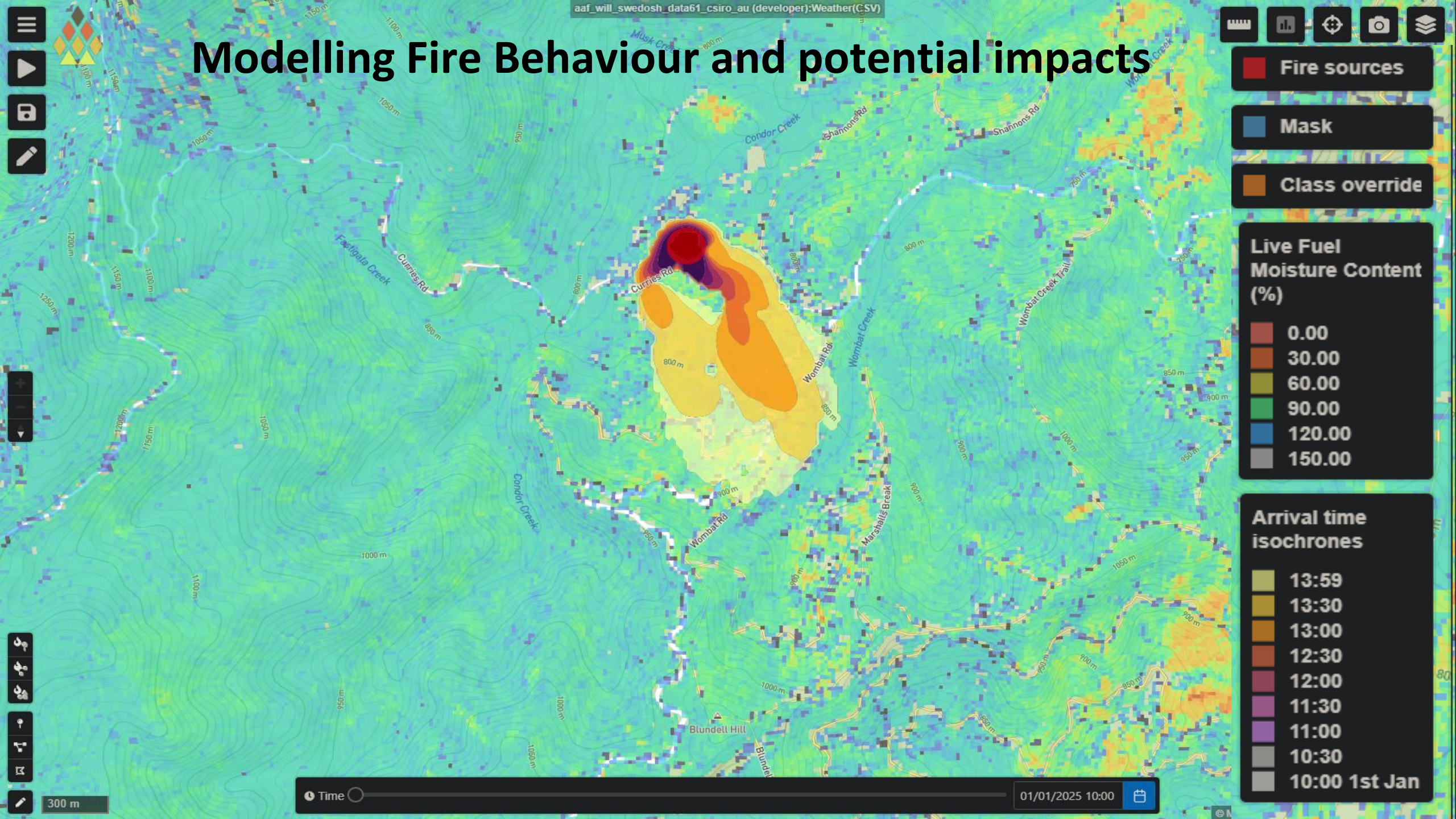
- Burned for 7 weeks
- Consumed 334,000 ha
- Destroyed/ damaged 1,024 structures (186 homes, 27 business)
- \$56 million in damage
- Tragically, one fatality

Tree hit by lightning, with evidence of sap extrusion.
Photo from NSW Coroner's Report via Canberra Times

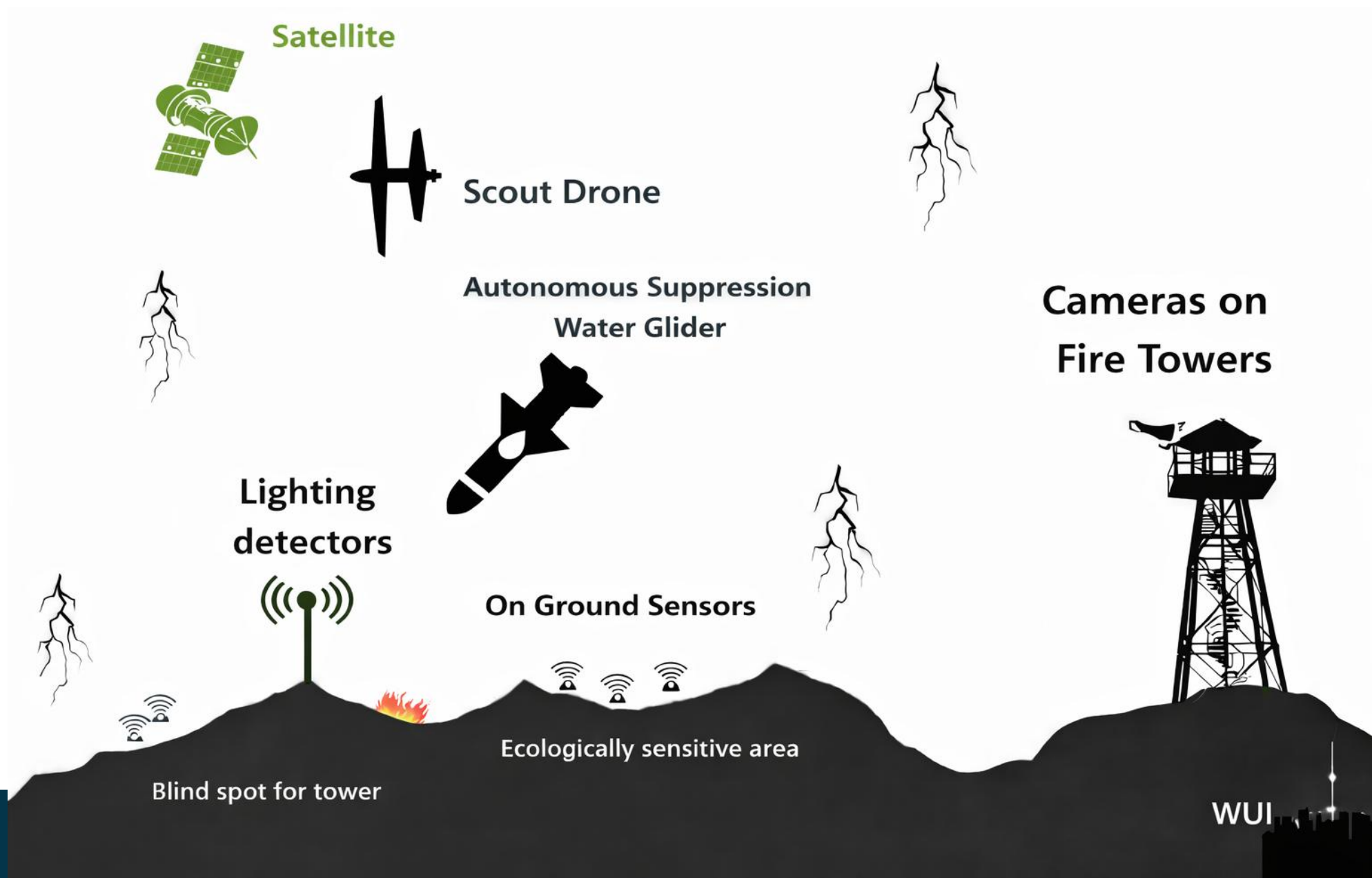
Modelling Lightning-Driven Ignitions



Modelling Fire Behaviour and potential impacts



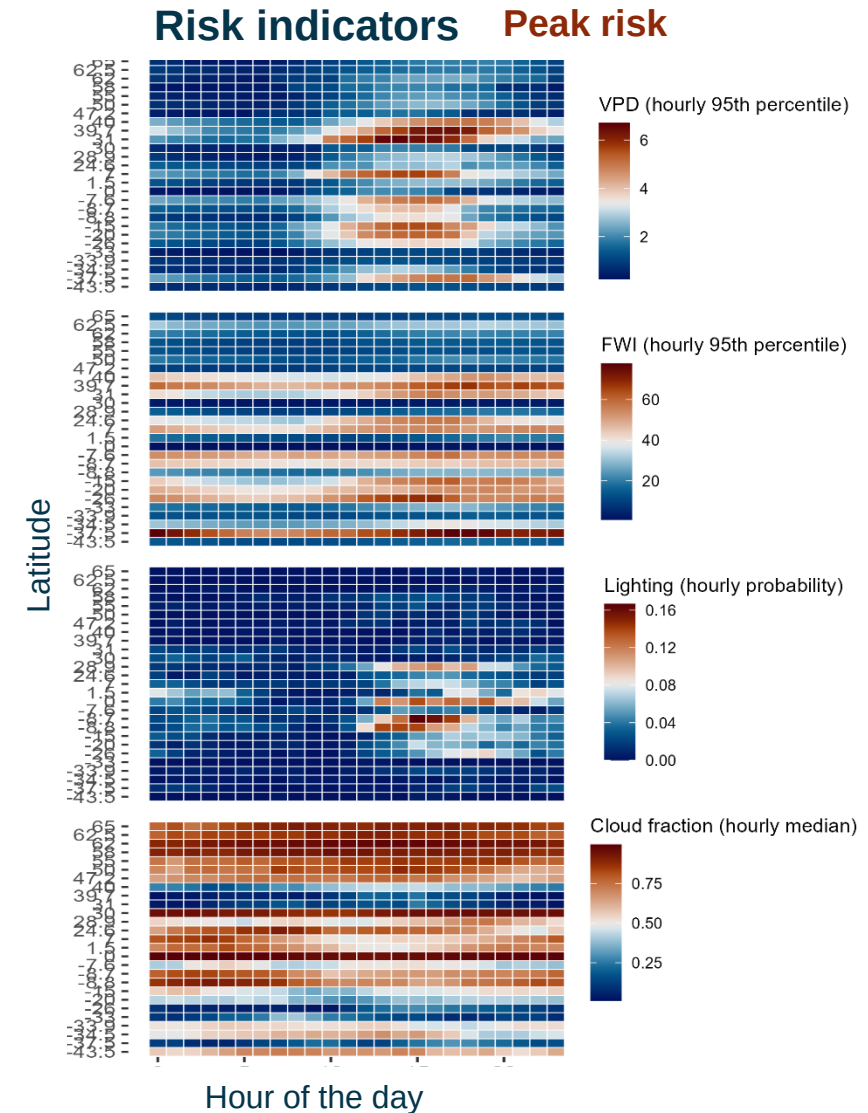
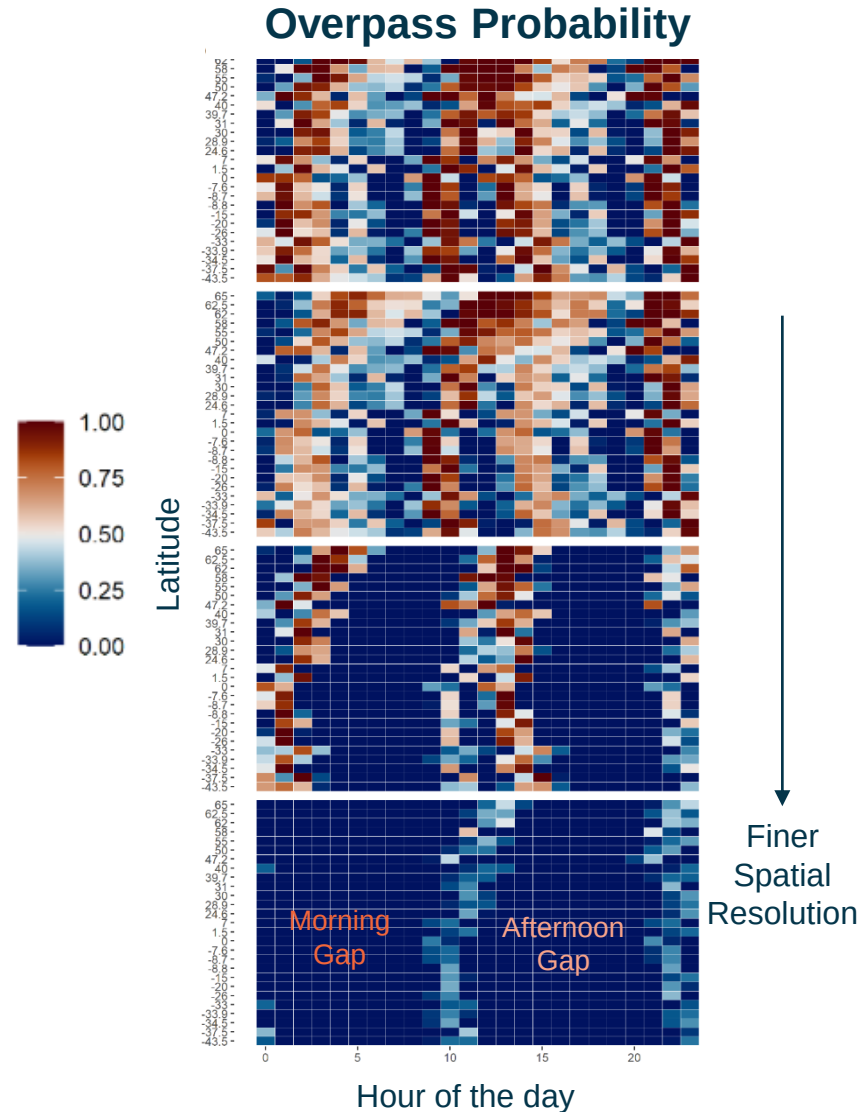
Building a Nervous System for Wildfire Risk Mitigation



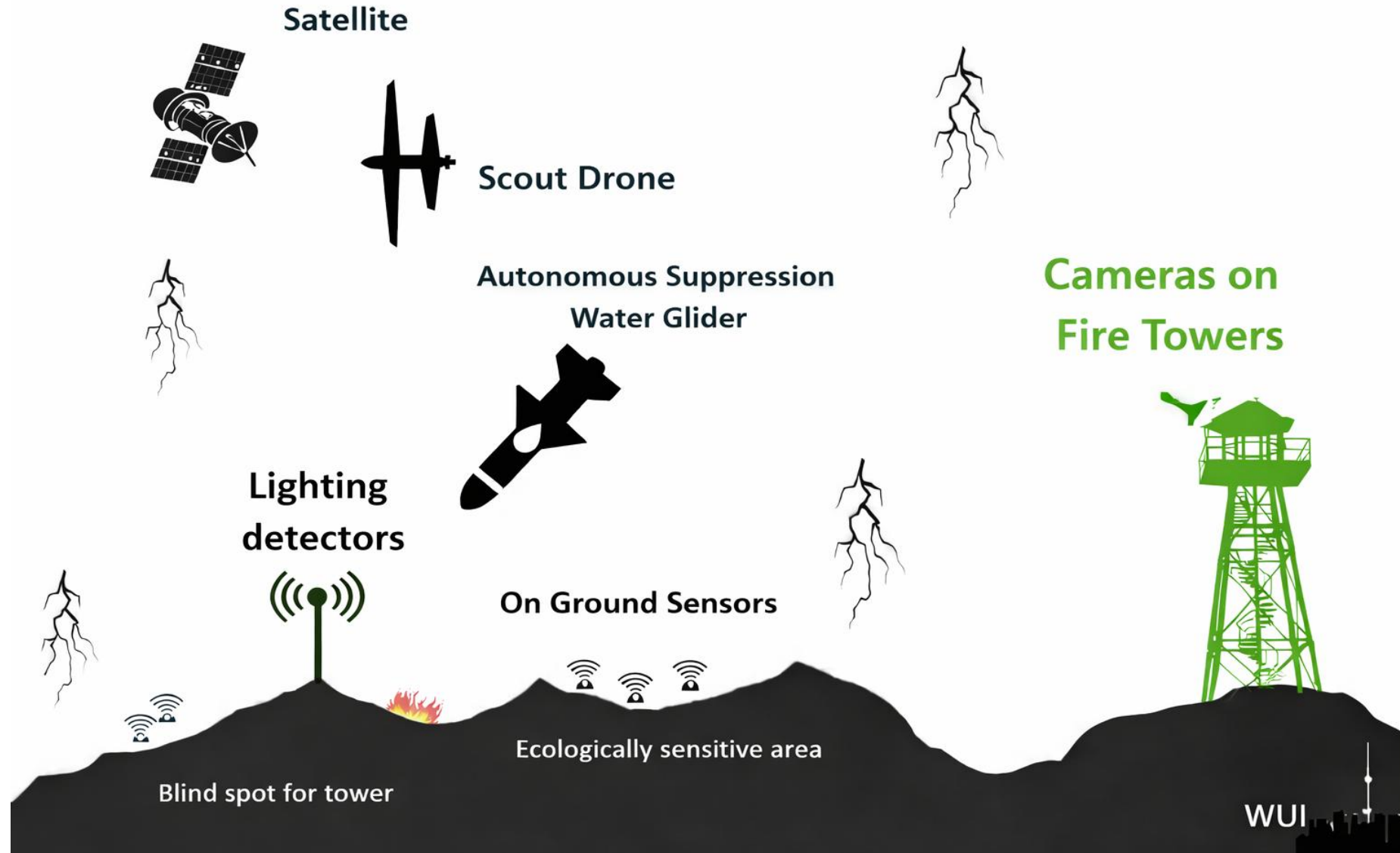
Satellite based Fire Monitoring Gap

Analysis of civil LEO and GEO satellites for 2024 across 29 locations

- Coverage gaps increase toward lower latitudes and finer resolutions
- Late-afternoon satellite coverage coincides with elevated fire-weather indicators
- Complementary observing systems are needed to bridge temporal gaps



Building a Nervous System for Wildfire Risk Mitigation

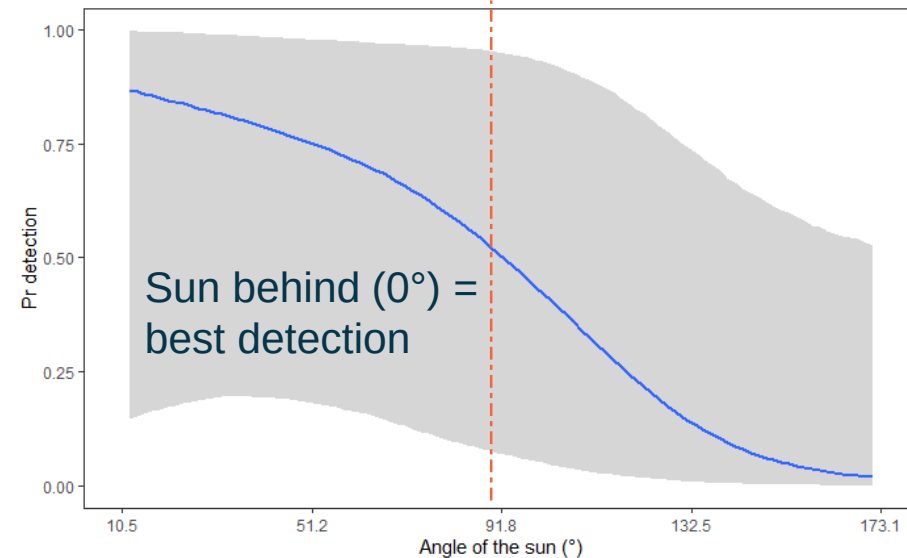
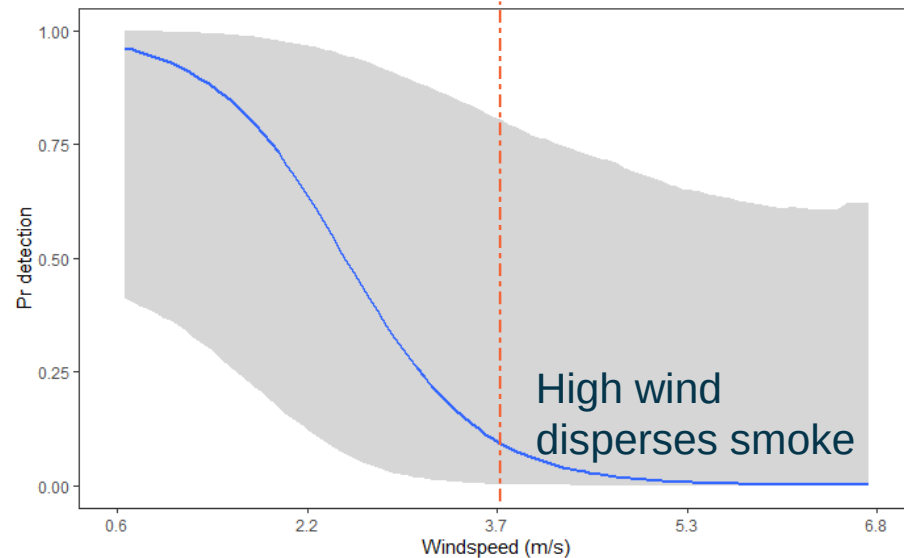
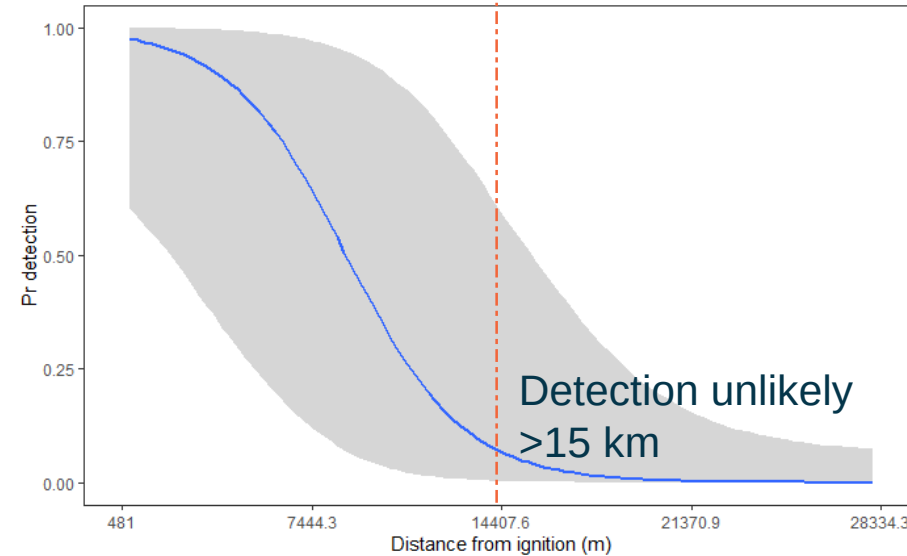
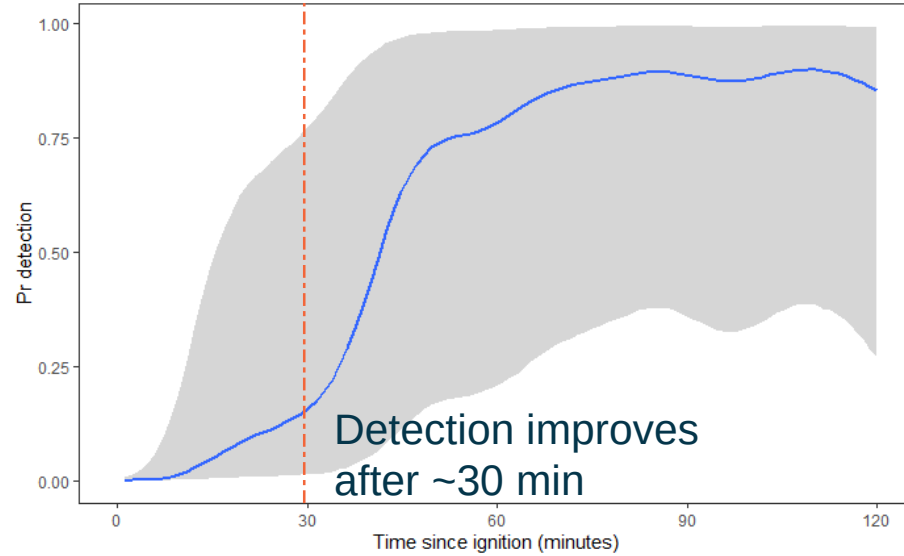




Yan et al. 2022

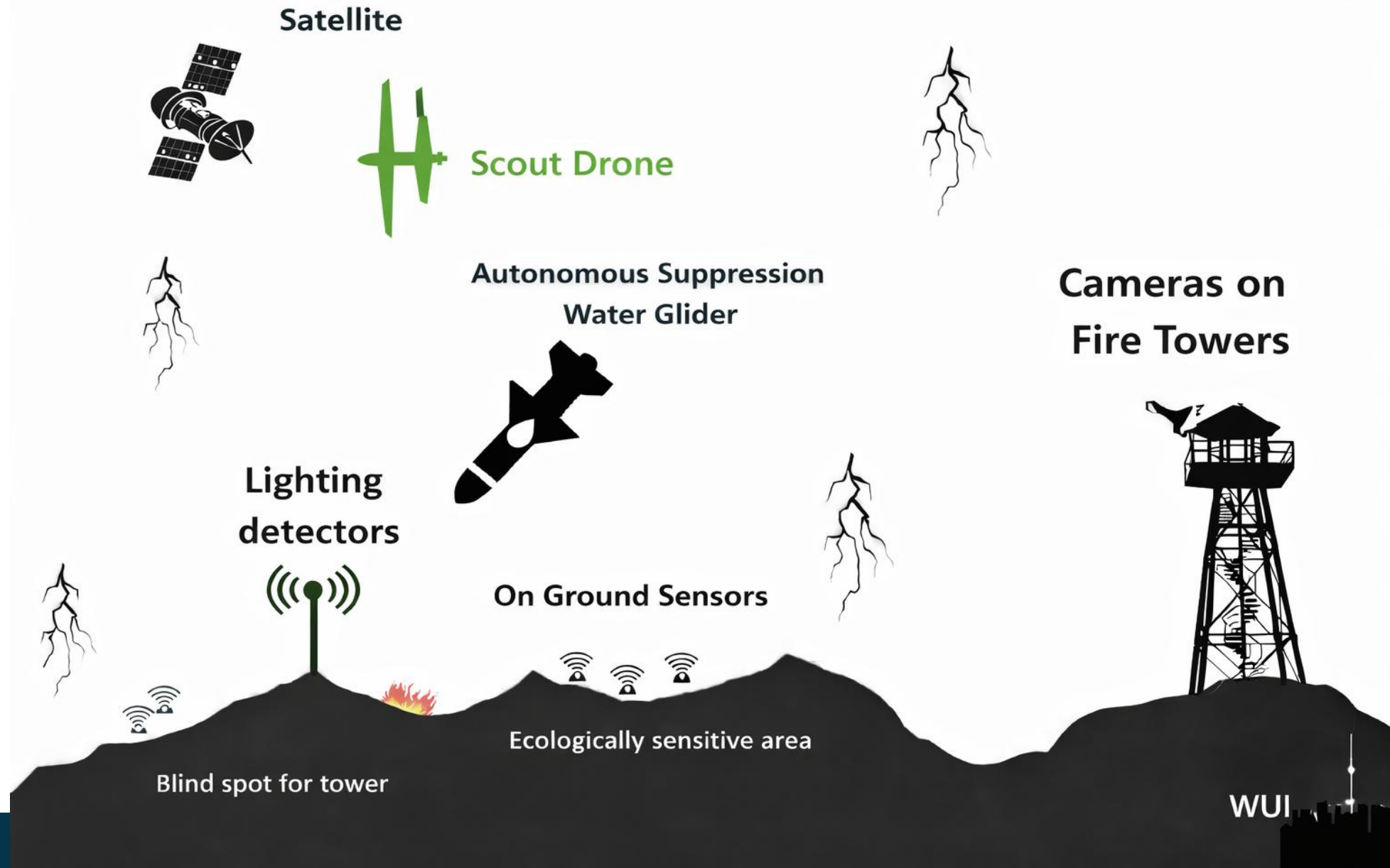


Camera early detection is sensitive to conditions

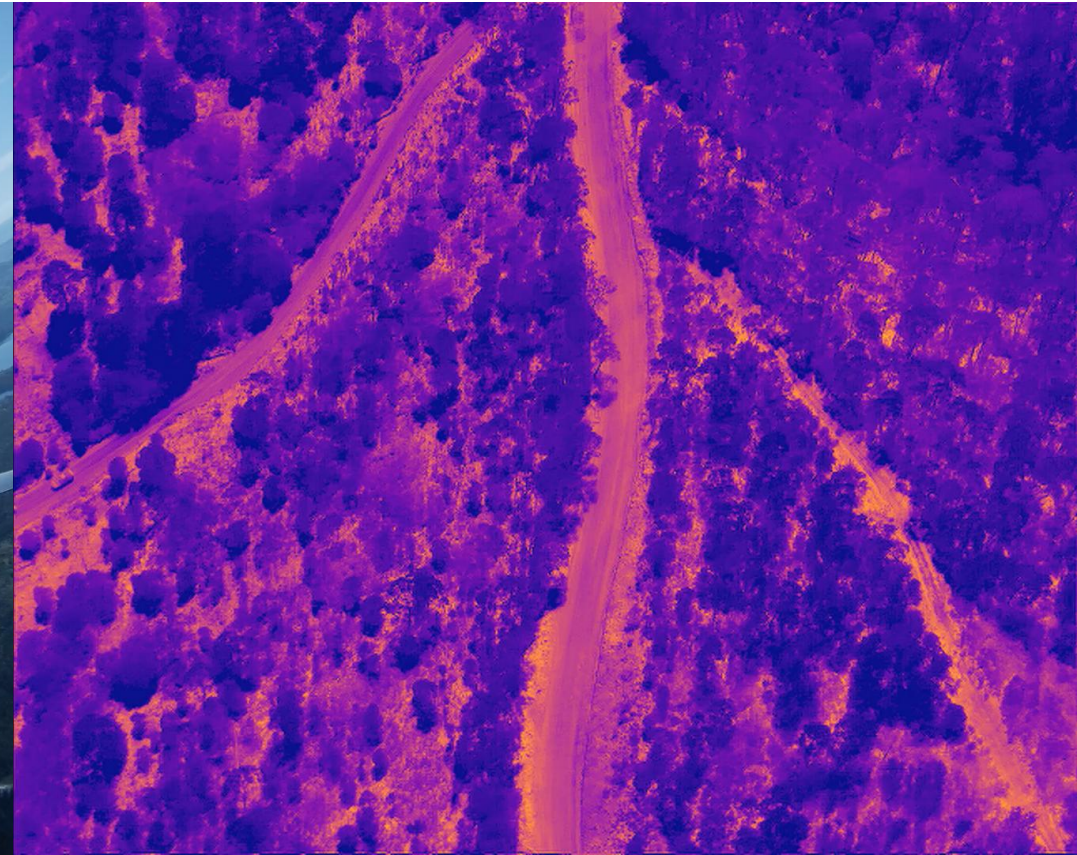


of smoke plume at burning energy
detection efficacy."

Building a Nervous System for Wildfire Risk Mitigation



Drone on a Beyond Visual Line of Sign (BVLOS) mission

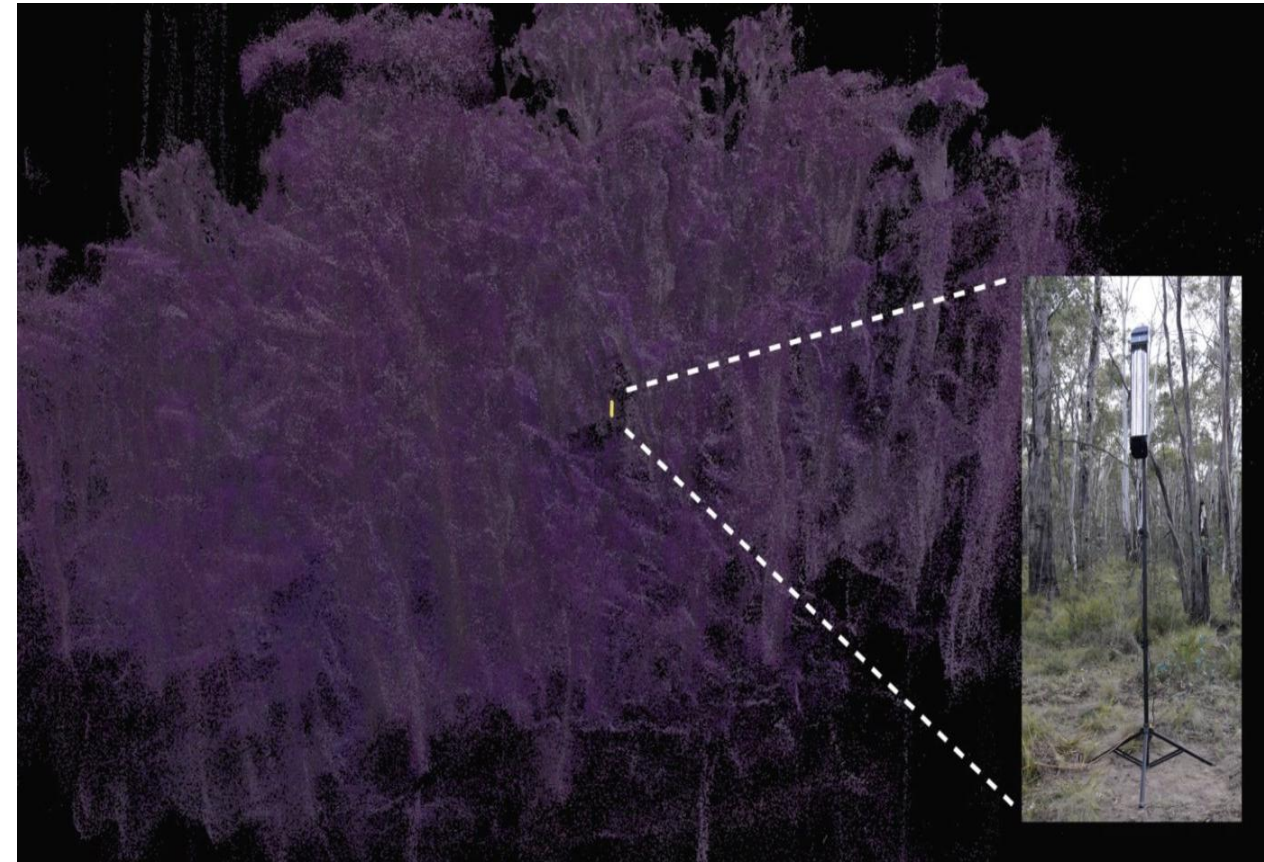


BVLOS operation detecting and confirming a controlled ignition source

Drone: 3D reconstruction of the surrounding fuel



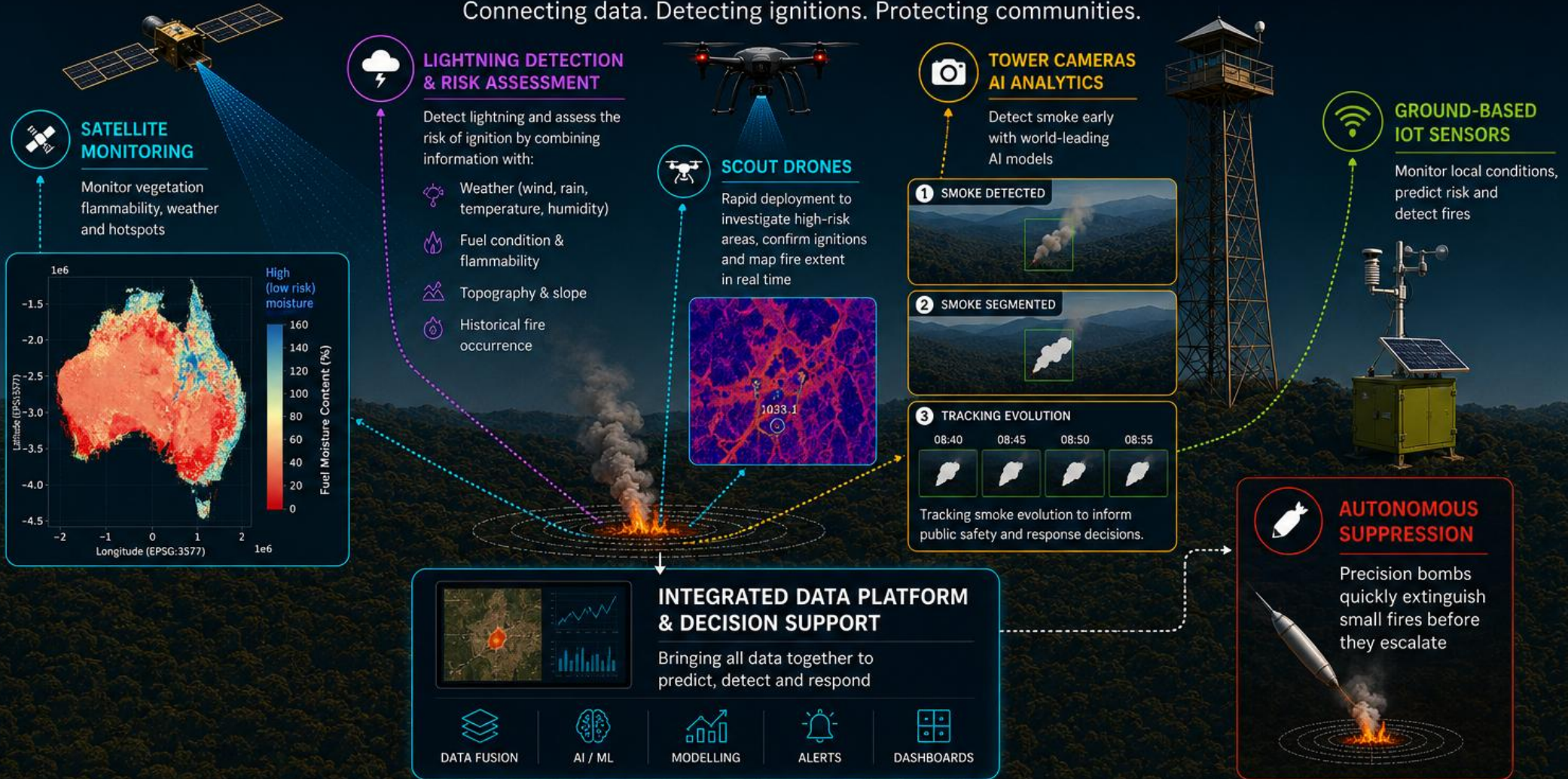
DAY



NIGHT

AN INTEGRATED, INTELLIGENT BUSHFIRE DETECTION AND RESPONSE SYSTEM

Connecting data. Detecting ignitions. Protecting communities.



PROMOTE INNOVATION
Foster new ideas and technologies that drive better outcomes.



INDEPENDENT EVALUATION & BENCHMARKING
Provide trusted, impartial assessment and performance benchmarking.



OUR PRINCIPLES

COLLABORATE & ENGAGE
Work with partners, communities and industry to deliver real-world impact.



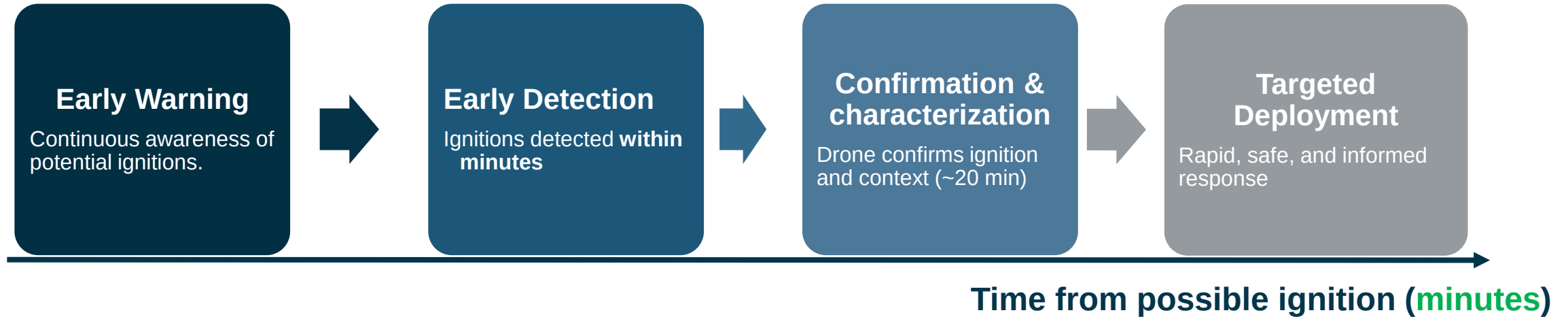
SHAPE STANDARDS & POLICY
Advocate for and influence standards and regulations in bushfire management.



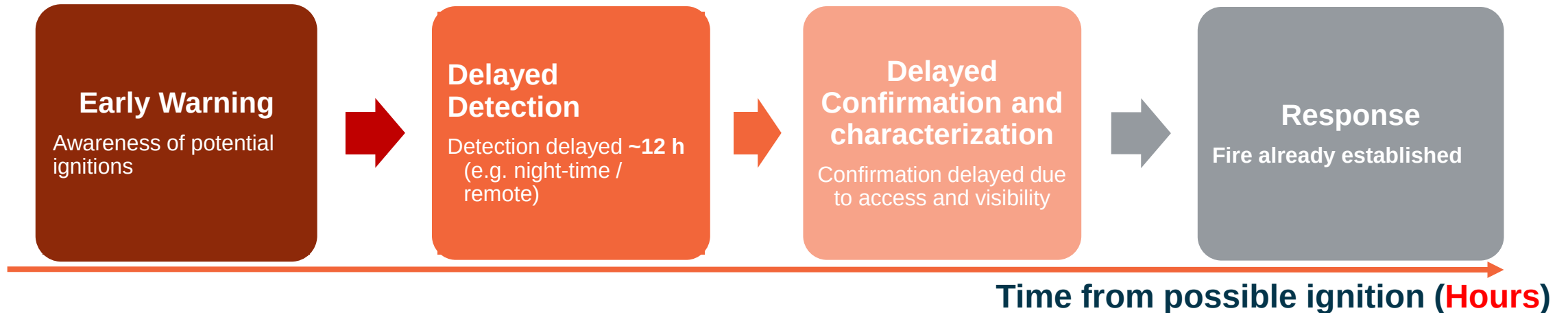
SHARE KNOWLEDGE OPENLY
Support innovation through open IP and knowledge sharing.

Integrated system: minutes rather than hours

Demo of autonomous technologies



Under current operational constraints of crewed aircraft



The real gap is not innovation. It is adoption



Building the pathway to integrated systems

Research

Universities
Research Organization
Start-ups & Innovators

Access, Integration & Trust

Break data & algorithm silos
Make technologies work together
Know what works, when, and where
Test under real fire conditions
Enable shared standards for decisions

Operational System

Emergency services
Utilities
Land managers
Forestry industry
Insurers

From innovation → to integrate capability

What this means for APEC members economies?

- **Share what can be shared:** Satellite data, validation frameworks, standards, algorithms and knowledge don't necessarily need to be recreated by every economy.
- **Adapt what must be local:** Fuel types, fire regimes, infrastructure, operational procedures and institutional capacity vary enormously across APEC.
- **Build systems, not technology silos:** Investment should connect preparedness, ignition intelligence, detection and response.
- The goal is not more data. **The goal is more time to act.**

Thank you

Contact Us

Prof Marta Yebra

Director, Bushfire Research Centre of
Excellence

Email: marta.yebra@anu.edu.au

Phone: +61-2-612 54107

LinkedIn:

- Marta Yebra
- Bushfire Research Centre of Excellence

Learn more:

