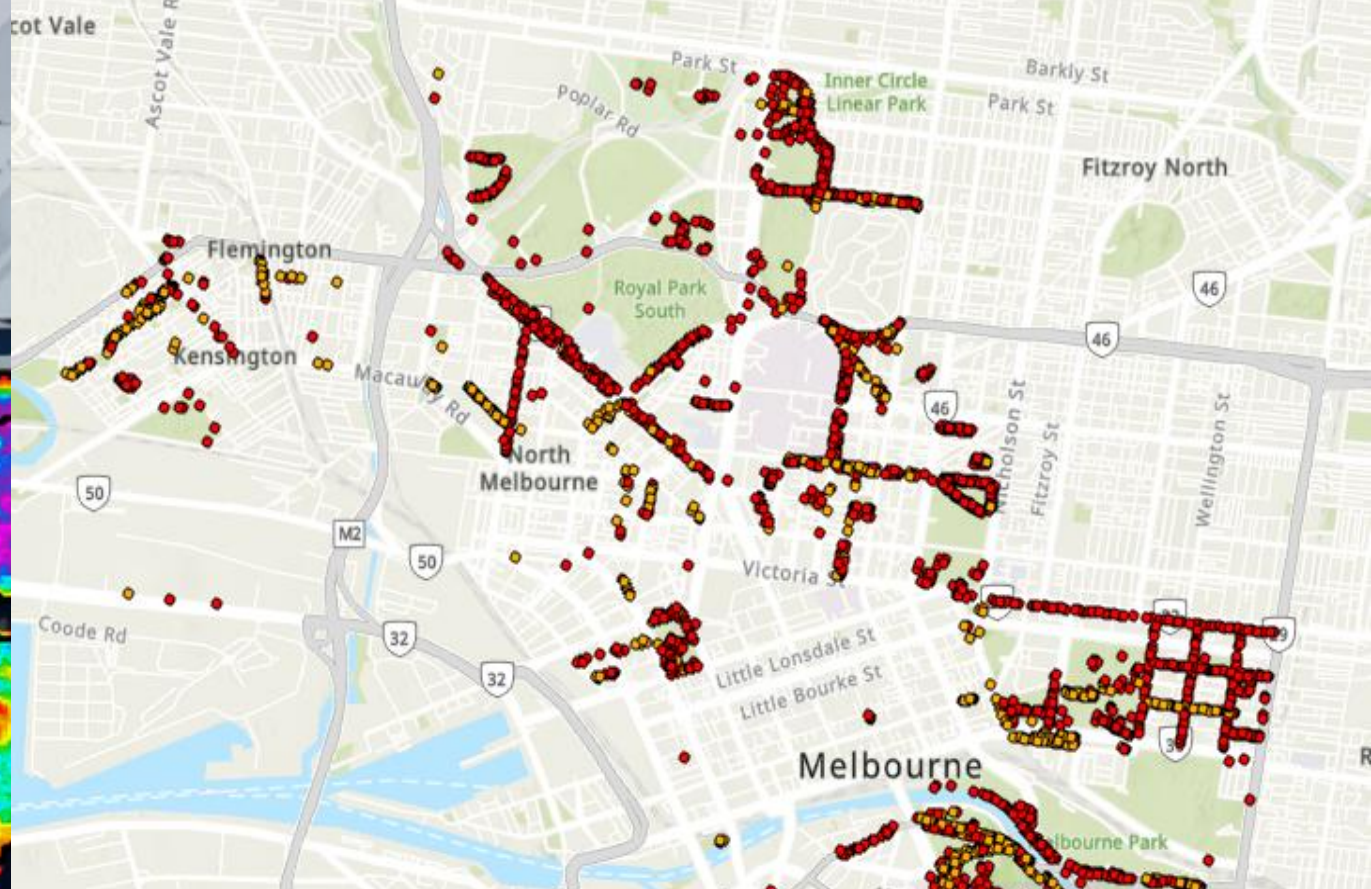
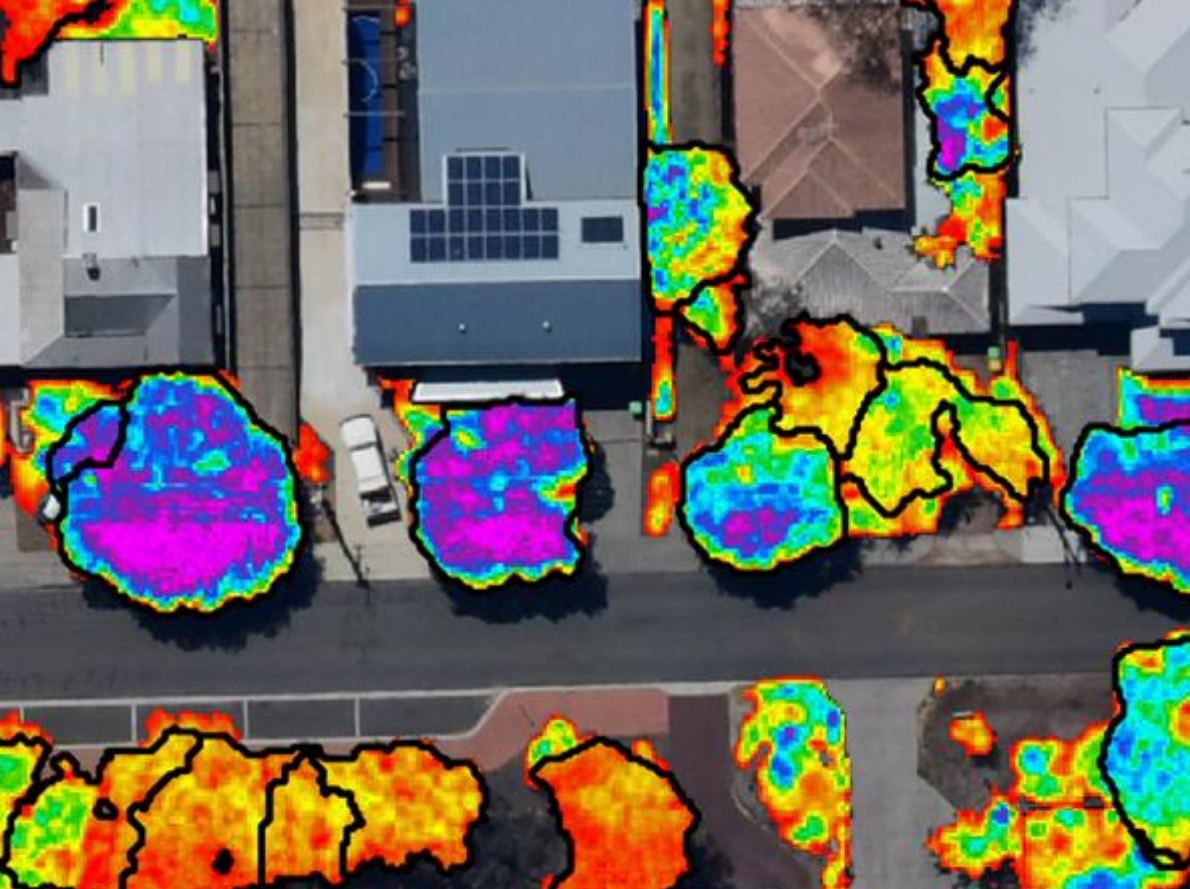




**Remote sensing, artificial intelligence, modelling and user interface tools
can assist in urban forest biosecurity preparedness and response.**


ArborCarbon



22 October 2025

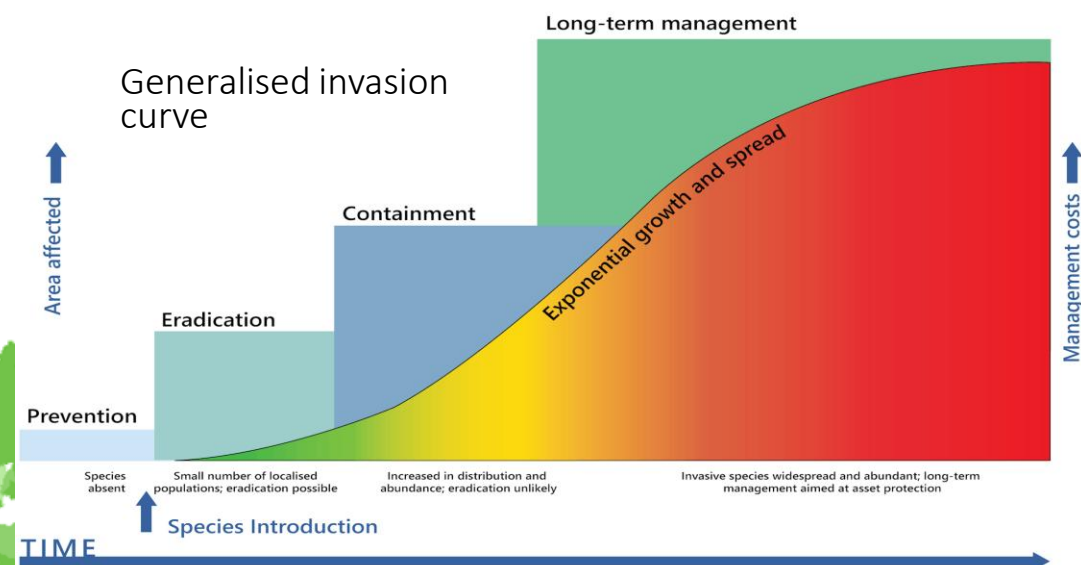
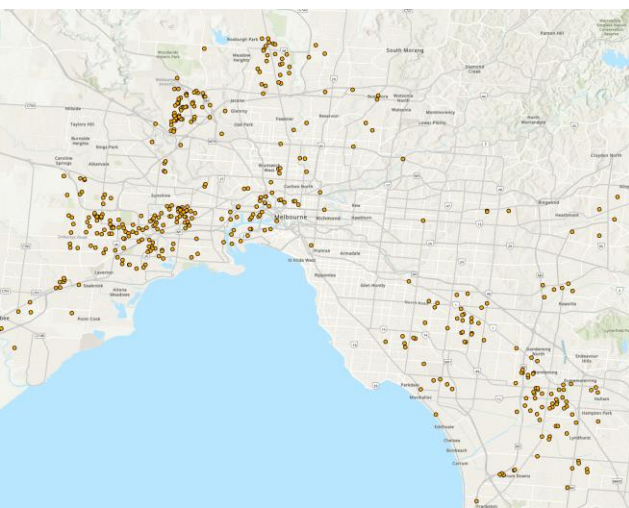
David Smith¹, Dr Paul Barber¹, Naviin Hardy¹, Dr Angus Carnegie²

¹ArborCarbon, Pty Ltd, Australia, ²Forest Science, Department of Primary Industries and Regional Development, Parramatta, NSW, Australia

d.smith@arborcarbon.com.au

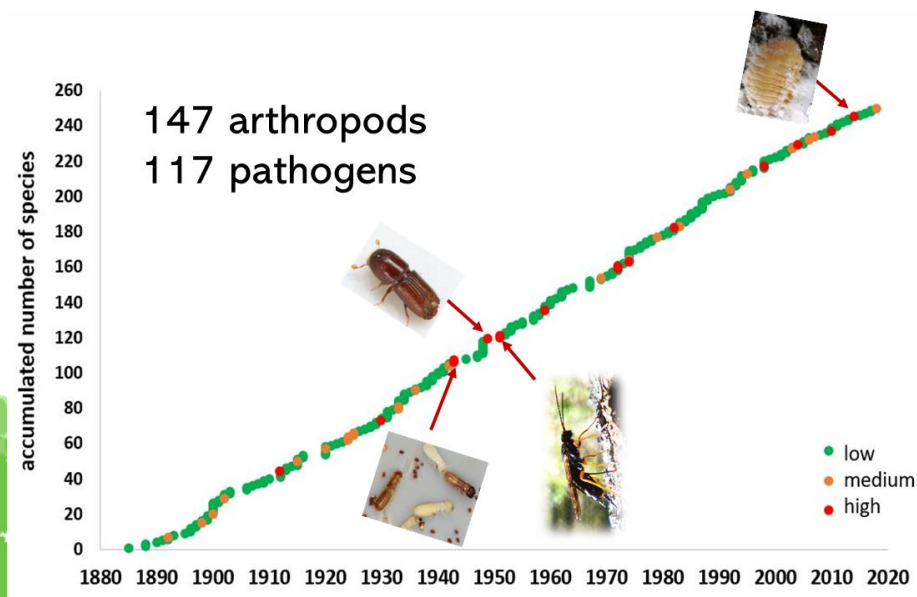
Australian Biosecurity

- In the past, Australia has relied on its geographical isolation to provide a degree of natural protection from exotic threats.
- Rapid transport of imports into Australia have increased the risk of pest/pathogen incursions, now quarantine measures alone are insufficient.
- In forest biosecurity it is important to put in systems that:
 1. Detect & prevent pest introductions early,
 2. Mitigate/eradicate an outbreak if it occurs.



Recent/current Incursions examples

- Monterey Pine Aphid (1997) established
- Tremex Wood Wasp (1998) established
- Fire Ant (Brisbane 2000) under eradication
- Pine nematode (Melbourne 2000) eradicated 2004.
- Pine Longhorned beetle (Melbourne 2000) established
- 'Palm Fusarium Wilt' Canary Island Date Palm 2002
- *Phytophthora siskiyouensis*
- *Phytophthora fallax*
- *Phaeolus schweinitzii* (1990's)
- Myrtle Rust (2010)
- Sycamore Lace Bug (2006)
- Longhorned Beetles (2014)
- **Giant Pine Scale (2014)**
- **Polyphagous shot-hole borer (August 2021)**



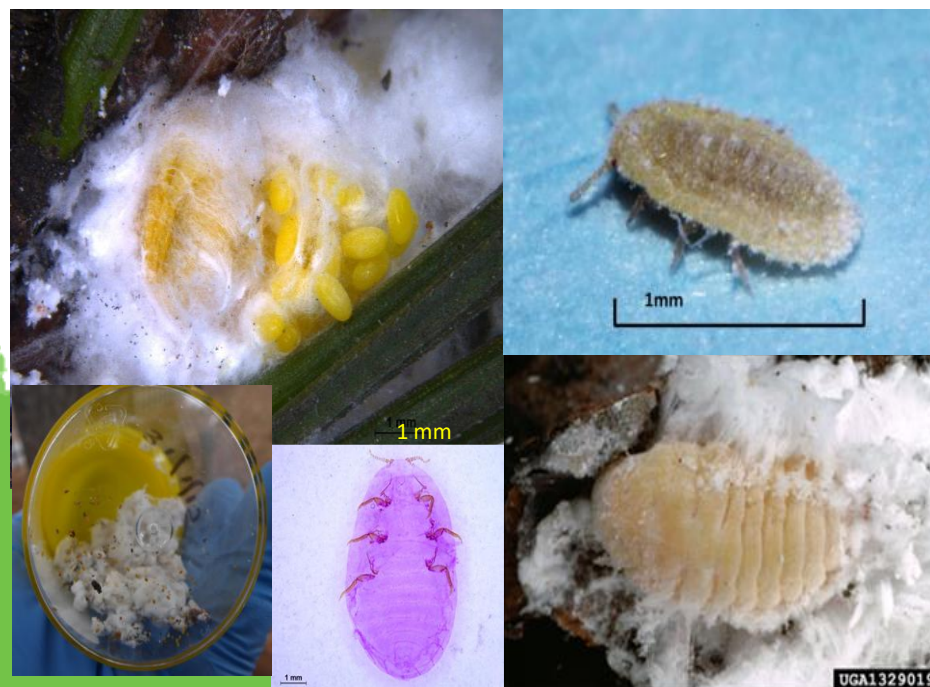
Giant pine scale (*Marchalina hellenica*)

- Detected in Melbourne and Adelaide in Oct 2014.
- A scale insect that originates in Greece and Turkey.
- Poses a threat to plantation industry and urban forests by:
 - reducing yields,
 - impacting health through repeated defoliation.
- The stress imposed makes the trees vulnerable to secondary infestations of other insects and diseases.
e.g. *Ips grandicollis*, *Sirex noctilio*, *Diplodia pinea*



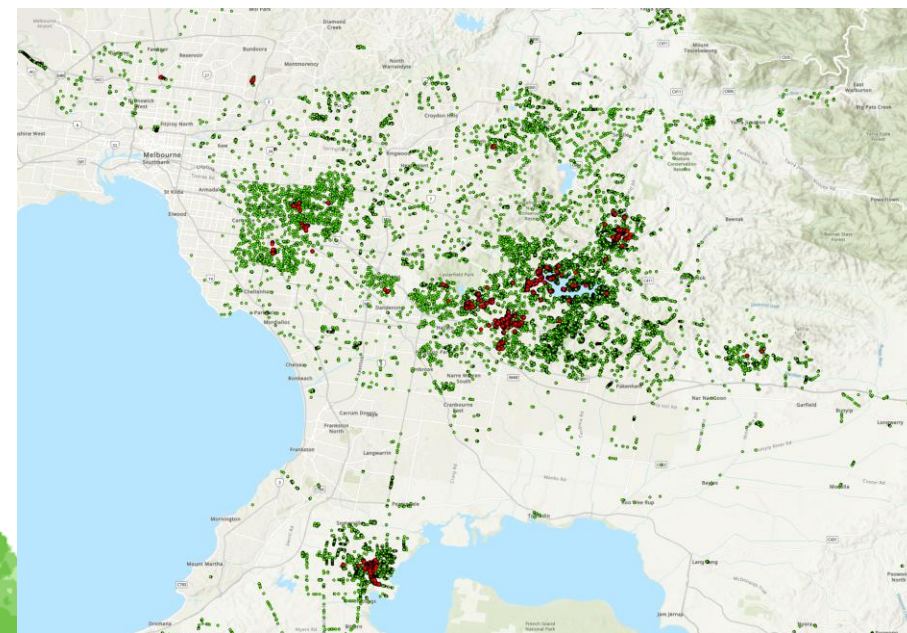
Current GPS 2025

- GPS is being managed in both South Australia and Victoria.
- South Australia is actively surveying and have been eradicating the pest.
- Victoria is undertaking strategic tree removal and surveillance.
- New research funding is continuing to investigate biocontrol options.



Tree sentinel detection and response

- Fast and efficient identification of hosts for early detection and response activities is critical.
- In 2014, GPS was detected in Melbourne, Australia.
- >5400 trees detected with GPS and >70,000 pine trees were mapped manually by hand.
- Detecting pine trees in the landscape was difficult.



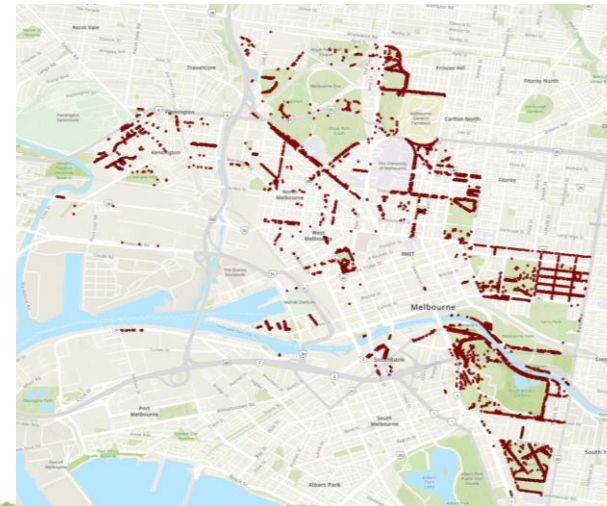
Risks posed tree pests and pathogens to the City of Melbourne Urban Forest.

- 74 pests / pathogens host interactions were investigated
- A georeferenced tree / pest / host interactions database was developed
- Spatial data can now be used for risk analysis and influence planting plans and species diversity.
- Data can also support biosecurity agencies in:
 - early detection monitoring,
 - emergency response.

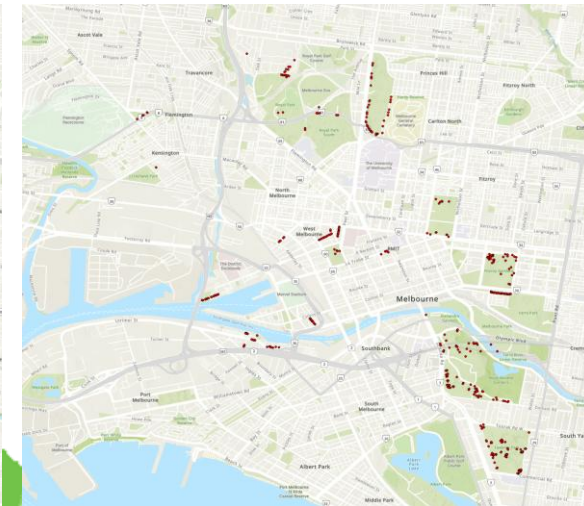
Table 2. Proportion of trees within the City of Melbourne at risk from 30 exotic, established and endemic pathogens.

Scientific Name	Common Name	Emergency priority pest in industry biosecurity plans	Exotic / Established / Endemic	Number of trees at risk	Percentage of trees at risk
<i>Apiognomonia veneta</i> *	Plane anthracnose	No	Established	7534	9.79%
<i>Armillaria heimii</i>	Armillaria root rot	Yes	Exotic	5840	7.59%
<i>Armillaria luteobubalina</i> *	Australian honey fungus	No	Endemic	22131	28.77%
<i>Armillaria mellea</i>	Honey fungus	Yes	Exotic	66717	86.73%
<i>Armillaria ostoyae</i>	Honey fungus	Yes	Exotic	1841	2.39%
<i>Armillaria tabescens</i>	Ringless honey mushroom	Yes	Exotic	32920	42.79%

Emerald Ash Borer



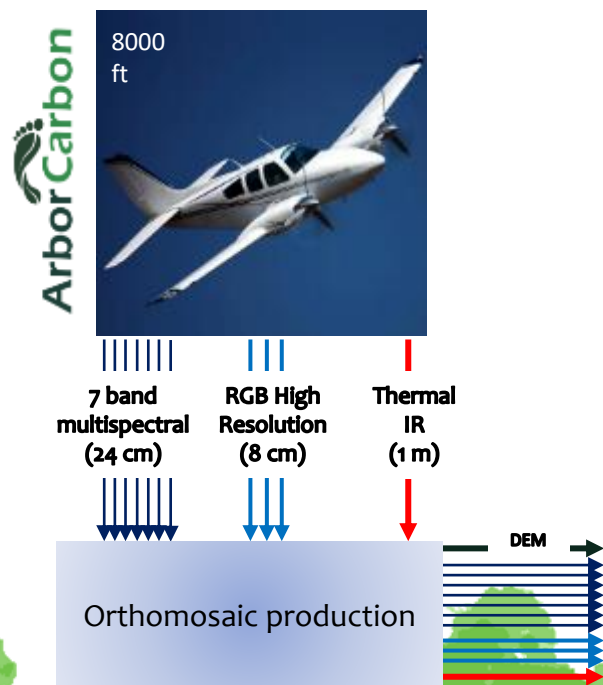
Arthropalus ferus



Urban tree sentinel detection

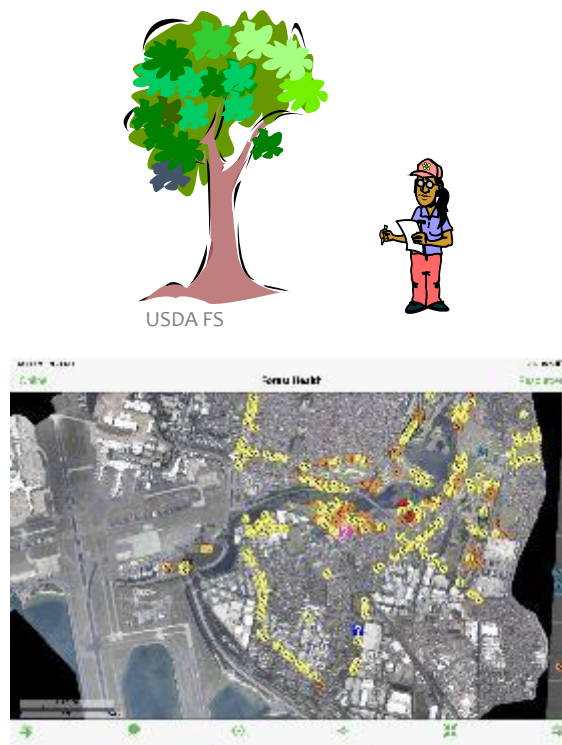
Data captured in 2020/21 over the Bayside Council in Sydney as part of a larger acquisition.

Aerial imagery acquisition



Carnegie et al 2023

Ground validation



Deep learning model



Classification accuracy:

- *Pinus* 92.1%
- *Platanus* 95.2%

Classify Genera & Species



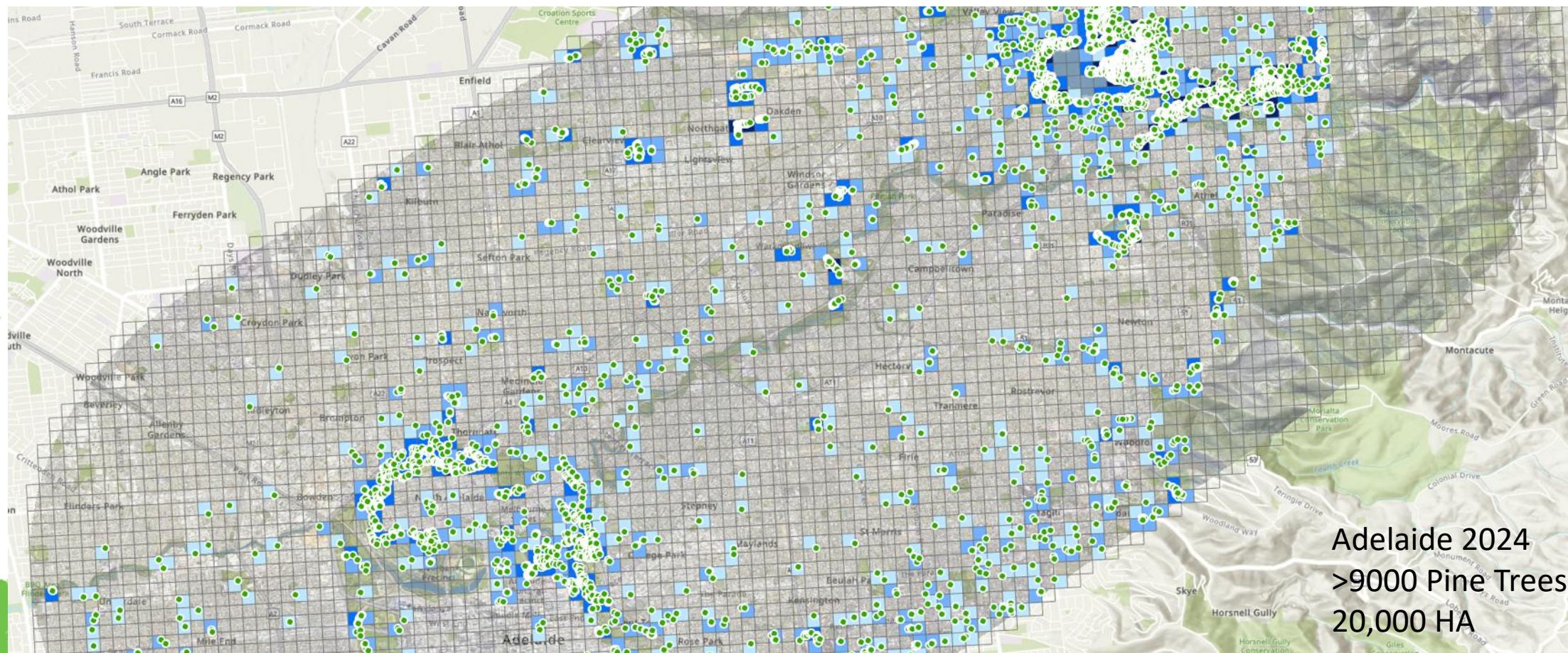
■	Casuarina cunninghamiana
■	Cedrus atlantica
■	Eucalyptus mannifera
■	Eucalyptus melliodora
■	Eucalyptus polyanthemus
■	Fraxinus pennsylvanica
■	Fraxinus velutina
■	Other
■	Pistacia chinensis
■	Prunus cerasifera
■	Pyrus calleryana
■	Quercus cerris
■	Quercus coccinea
■	Quercus lusitanica
■	Quercus palustris
■	Ulmus parvifolia
■	Zelkova serrata



ACT
Government

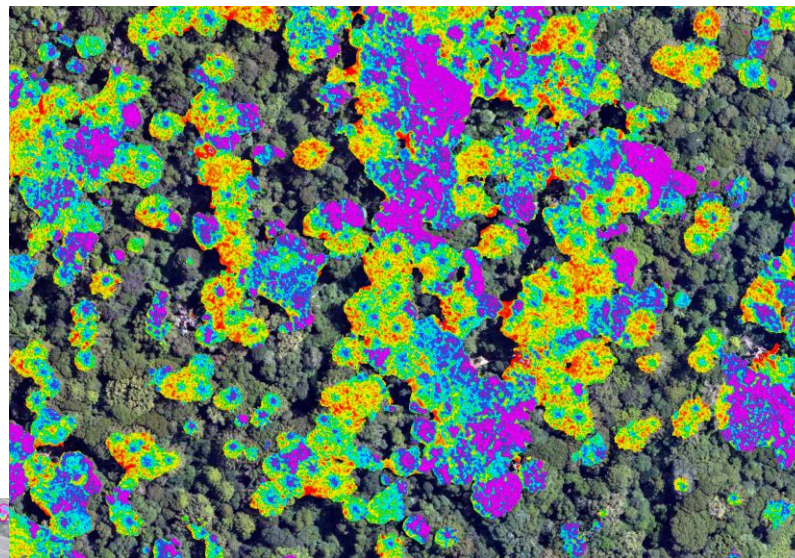
**Benchmarking
Health
>700,000 trees**

Pinus locations and risk of spread

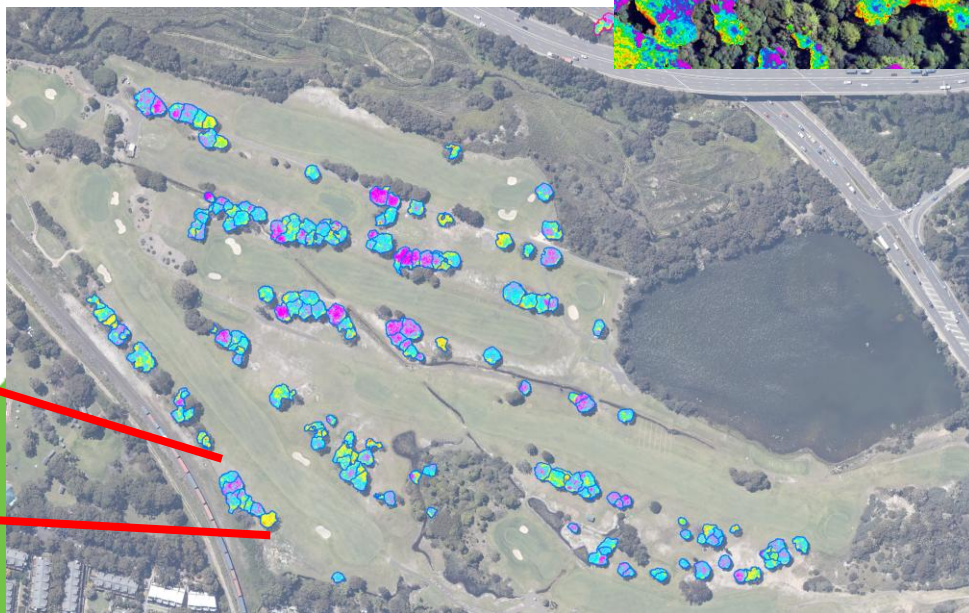


Tree genus detection and crown condition

- Vegetation Condition Index (VCI) is applied to the trees to look for poor crown condition.

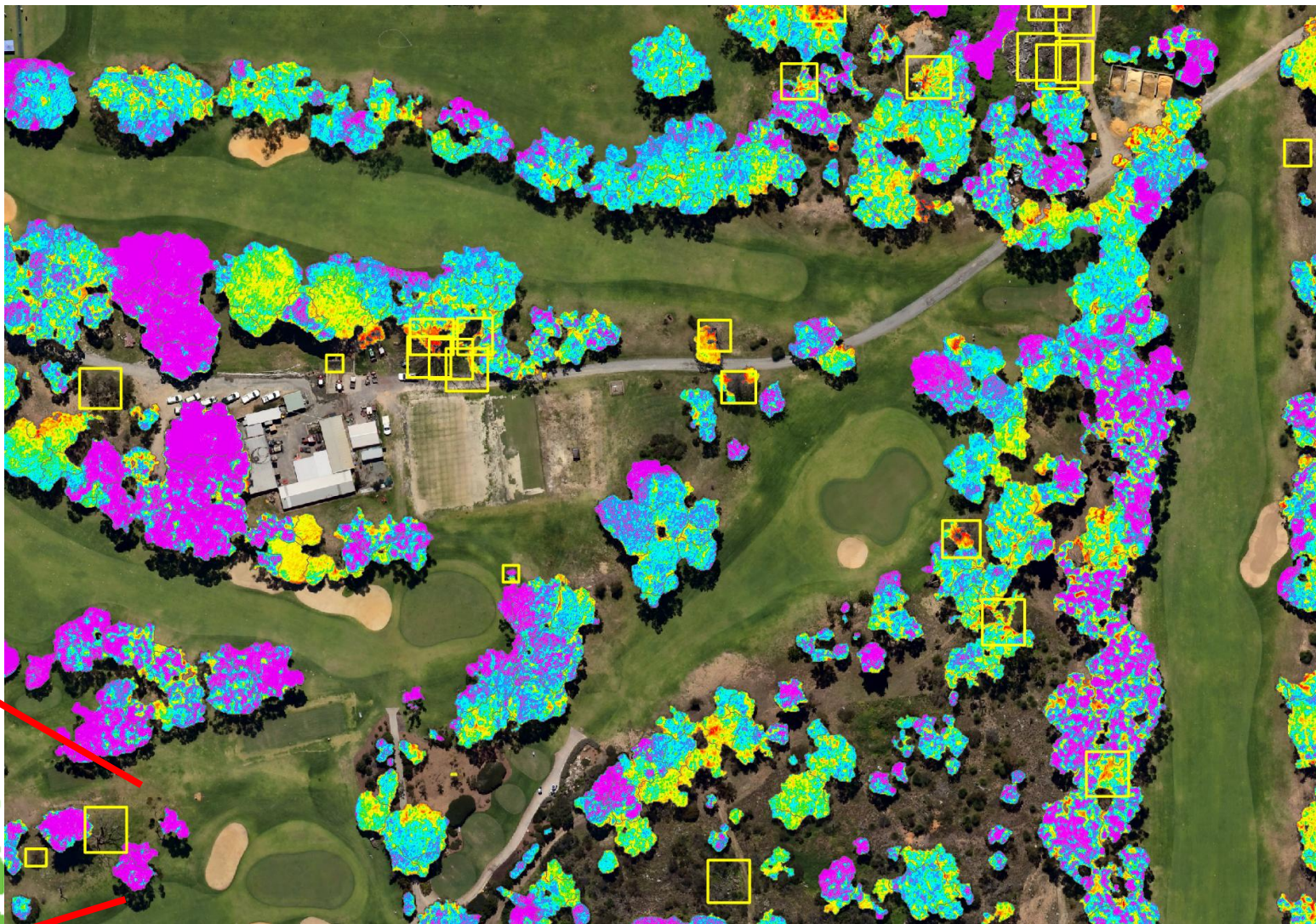
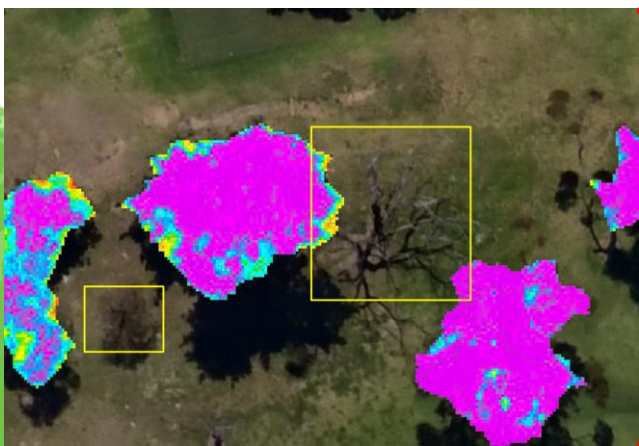


- Purple trees indicate healthy crowns red or yellow are trees in poor health.

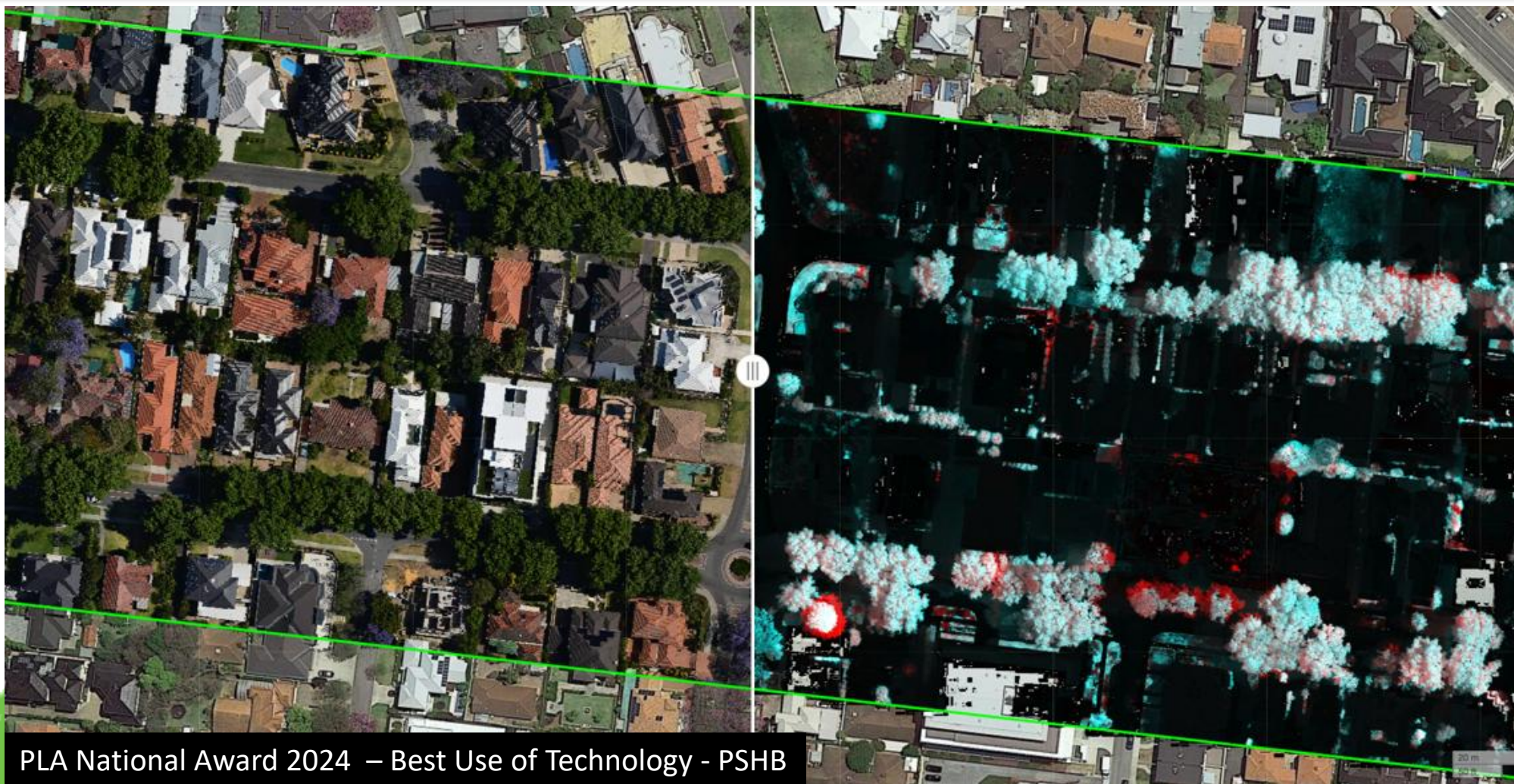


Detection of dead wood & poor crown condition

- Dead wood can be detected within the trees.
- Yellow squares show trees with dead wood. These are correlating with poor crown health.
- Combining these metrics a change detection model has been developed.
- This would be important for surveillance for PSHB.



Annual Change Detection



PLA National Award 2024 – Best Use of Technology - PSHB

Provides early warning and monitors effectiveness of management strategies

Pest/Pathogen ID & Health



Myrtle Rust
Austropuccinia psidii



Giant Pine Scale
Marchalina hellenica



PSHB
Euwallacea fornicatus
Fusarium sp.

Future work underway

- Change detection index to assist with faster more targeted surveillance.
- New indices to identify more tree genera.
- Assessing new council databases to create a wider understand of the risk
- Linkage to tree databases to produce traffic light system to identify trees for monitoring, surveillance and diagnostics.
- Linking tree host / pest list to interception data to refine high risk sites.

Contributors to the presentation.



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Acknowledgements & Questions

Our Team

Adjunct Prof. Paul Barber, Emeritus Prof. Giles Hardy, Dirk Mitchell, Naviin Hardy, Briony Williams, Dr Peter Scott, Matt Ghazi, Jeremy Thomas, Dale Giancono, Isabella Rowe, Christian Delattre, Julian Weber, Ryan Takeda, Gabriele Satta.

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