

## CAL/VAL Activities

### AusCover Remote Sensing Facility

Alex Held – AusCover Facility Director  
17 March 2016



*TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.*

# Rationale - Why do we need AusCover Network and Data Coordination in the Future?

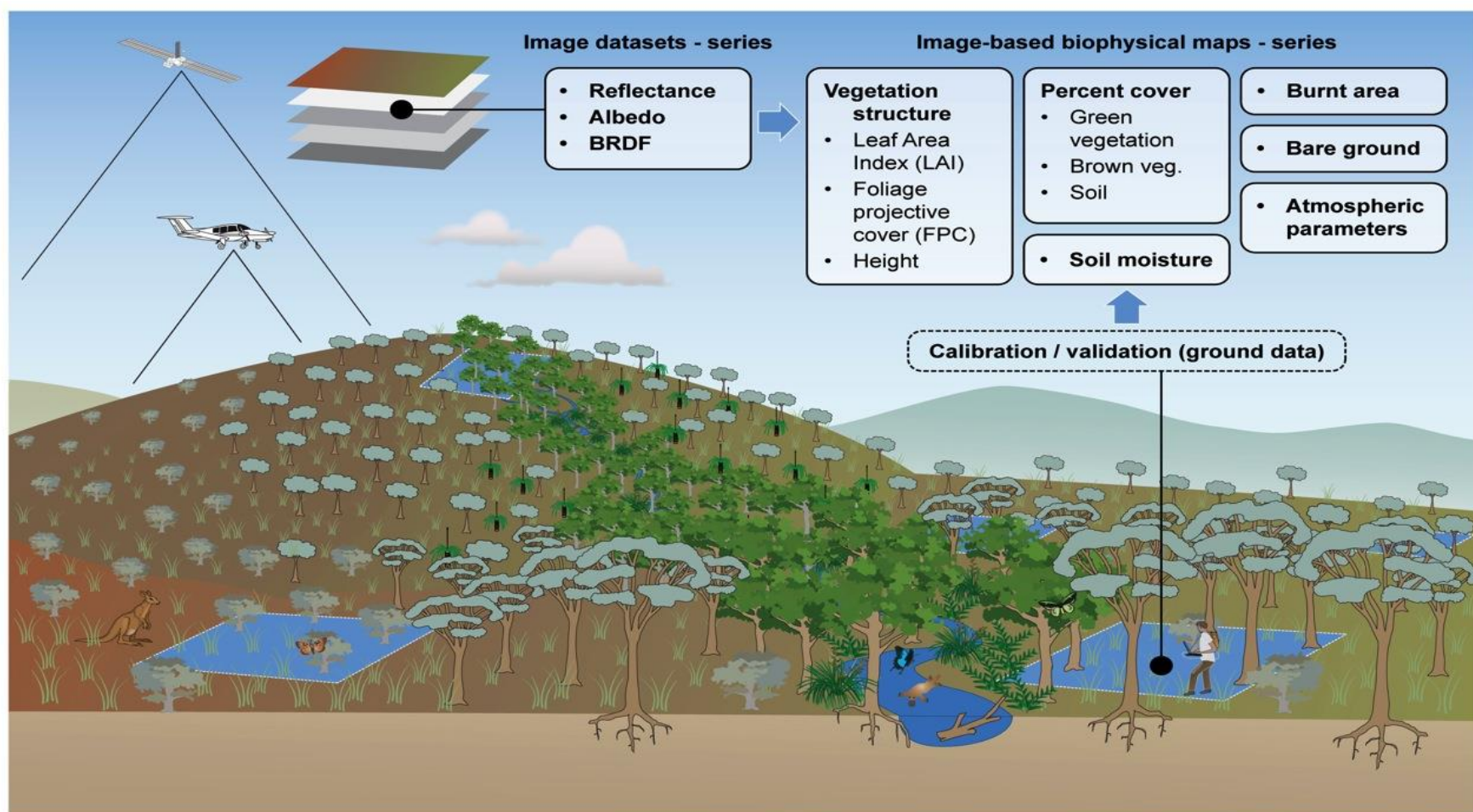
- Australia's land-surface: 7.6 million km<sup>2</sup> ; Population: 24 million
- One of the **largest operational users of EO data** world-wide; 100+ government programs; 10+ satellite stations
- **Highly fragmented use** and management of EO data, across research, state-, and federal agencies
- **Many copies, often hard to access** by NRM users or ecosystem scientists
- EO data needs and **archives growing rapidly** - Few open data storage, delivery options and standards
- **No common field validation standards**





# TERN AusCover Remote Sensing Data Facility

Production and delivery of nationally consistent long-time series of satellite-based biophysical map products and next generation remote sensing research data that is validated for Australian conditions.



# Original Concept: Functional Elements of “Facility”

## Remote Sensing Data Delivery Backbone

- Issues of data formats, interoperability, data-policy,
- Physical storage, efficient delivery to end-users etc.

## Data Production Network

- Nationally-consistent, standard biophysical data products,
- Metadata and technical support documents
- Specialised space-borne, airborne & in-situ research-grade data

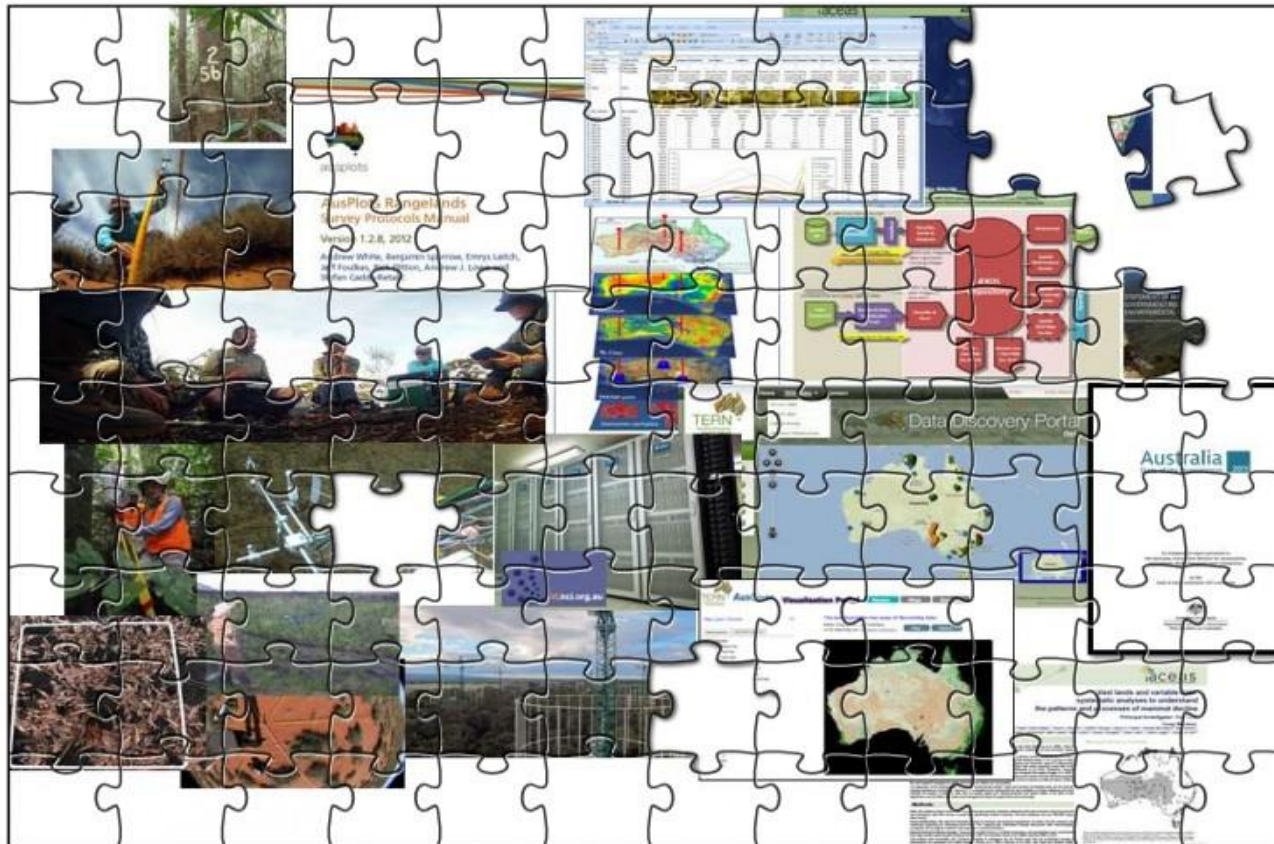
## Ground Validation Program and Instrumentation

- Set national standards & field validation protocols,
- Sites/transects etc.
- International Benchmarking (eg CEOS WGCV LPV)

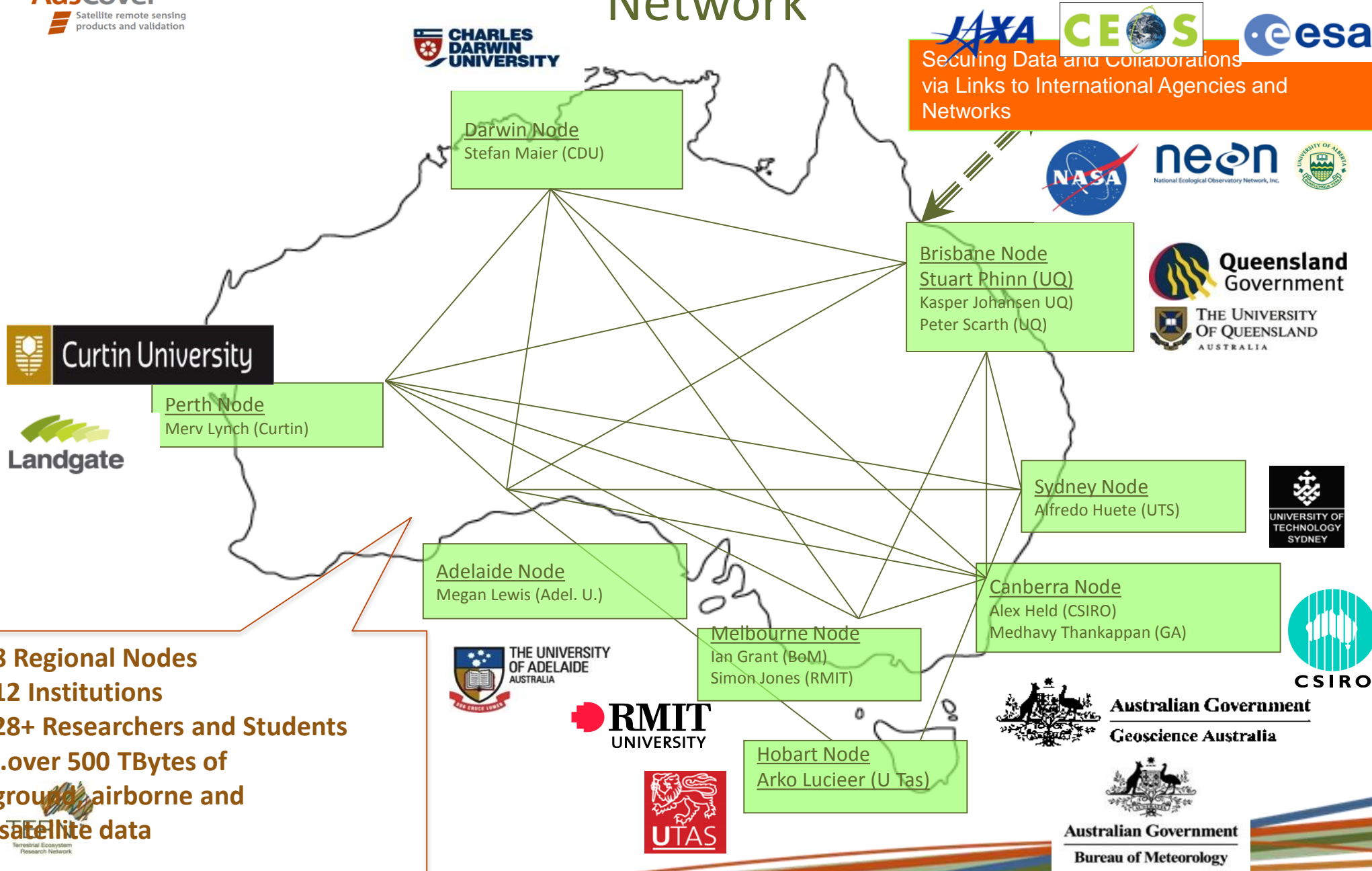


- **AusCover established aligned with TERN Vision**

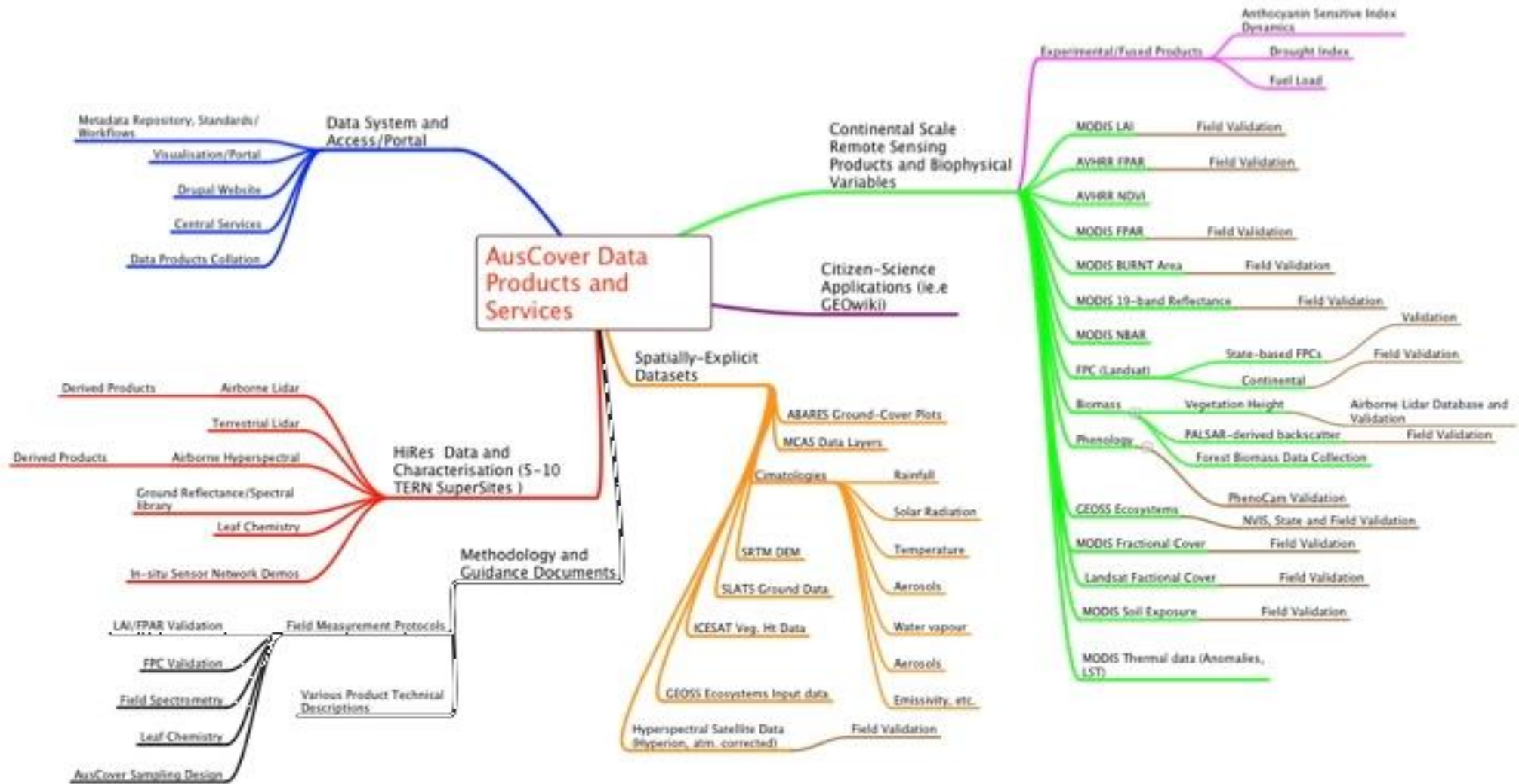
**TERN's Vision** is for an Australian ecosystem science community that has undergone transformational change - from one in which effort is frequently fragmented, duplicative and short-term, to one that is national, networked, and delivering for Australia's future.



# Organisational Elements - AusCover Team & Network



# AusCover Activities and Data Services





# Over 50 Data Products

Data Products List

Theme	Product	Further info (Xwiki)	Data download	Metadata (GeoNetwork)	Visualisation Tool	Status
Land Cover	Fractional cover - Landsat, Joint Remote Sensing Research Program algorithm, Australia coverage					
	Fractional cover - MODIS, CSIRO Land and Water algorithm, Australia coverage					
	Persistent Green-Vegetation Fraction and Wooded Mask - Landsat, Australia coverage					
	Vegetation height - IceSat, Queensland coverage					
	Dynamic Land Cover Dataset - MODIS, Australia coverage					
	Land Cover Type - MODIS, LPDAAC MCD12Q1 mosaic, Australia coverage					
Ecosystem Variables	Vegetation Continuous Fields - MODIS, LPDAAC MOD44B mosaic, Australia coverage					
	Gross Primary Productivity - MODIS, LPDAAC MOD17A2 mosaic, Australia coverage					
	Land Cover Dynamics - MODIS, LPDAAC MCD12Q2 mosaic, Australia coverage					
	Phenology - MODIS, derived from MOD13C2 EVI, Australia coverage					
	Disturbance Index - MODIS, Australia coverage					
	Fractional cover metrics - MODIS, ABARES algorithm, Australia coverage					
- Vegetation Indices	Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) - MODIS, LPDAAC MOD13Q1 mosaic, Australia coverage					
	Enhanced Vegetation Index (EVI) - MODIS, LPDAAC MOD13Q1 mosaic despiked, Australia coverage					
	Normalised Difference Vegetation Index (NDVI) - AVHRR, without atmospheric correction, Australia coverage					
- LAI/FPAR	Leaf Area Index (LAI) and Fraction of Photosynthetically Active Radiation (FPAR) - MODIS, LPDAAC MOD15A2 mosaic, Australia coverage					
	Fraction of Photosynthetically Active Radiation (FPAR) - AVHRR, CSIRO Land and Water algorithm, Australia coverage					
Fire	Burnt Area and Approximate Day of Burn - MODIS, Charles Darwin University algorithm, Australia coverage					
	Fire Frequency - AVHRR, Charles Darwin University algorithm, Australia coverage					
	Thermal Anomalies (Fire Hotspots) - MODIS, LPDAAC MOD14A2 mosaic, Australia coverage					
	Burned Area - MODIS, LPDAAC MCD45A1 mosaic, Australia coverage					
	Burned Area direct broadcast - MODIS, University of Maryland MCD64A1 mosaic, Australia coverage					
	Grassland Curing - MODIS, Bushfire CRC algorithms, Australia and states coverage					
Radiation, Meteorology and Ancillary	Daily Rain Gauge Precipitation (Rainfall) - Gridded, Australia coverage					
	Daily Air Temperature - Gridded, Australia coverage					
	Daily Air Water Vapour Pressure - Gridded, Australia coverage					
	Daily Solar Radiation (Global Horizontal Exposure) - Australia coverage					
	Land Surface Temperature and Emissivity - MODIS, LPDAAC Mx11 mosaic, Australia coverage					
	Day/Night/Difference Land Surface Temperature - MODIS, Australia coverage					
	Digital Elevation Model derivatives - SRTM, Australia coverage					
	Landsat Cloud, Shadow and Water mask - Australia coverage					
Base Satellite Data and Inputs to Satellite						

Fire- Related

Burnt Area and Approximate Day of Burn - MODIS, Charles Darwin University algorithm, Australia coverage

Fire Frequency - AVHRR, Charles Darwin University algorithm, Australia coverage

Thermal Anomalies (Fire Hotspots) - MODIS, LPDAAC MOD14A2 mosaic, Australia coverage

Burned Area - MODIS, LPDAAC MCD45A1 mosaic, Australia coverage

Burned Area direct broadcast - MODIS, University of Maryland MCD64A1 mosaic, Australia coverage

Grassland Curing - MODIS, Bushfire CRC algorithms, Australia and states coverage

Ecosyst... x TERN Data Discovery Portal x TERN - Terrestrial Ecosyst... x Welcome to Geo-Wiki Proj... x Geo-Wiki.org (part 2) - Co... x

rg.au

Sustainable Agricult... Crop Monitor Google Earth Engine SAP (1) Facebook CSIRO Outlook Web Apple Yahoo! Google Maps YouTube Global Forest Observ... Wikipedia

Home TERN data Contact My Favourites My Searches

**TERN**  
Terrestrial Ecosystem  
Research Network

**Data Discovery Portal**

**Delivering open access to Australia's terrestrial ecosystem data**

Search ecosystem data **Search**

**Map Based Search**  
Use our map interface to search for data **Map Search**

**Datasets Included**

Plants & Animals Vegetation Terrestrial ecosystem

Ecological dynamics Fresh water & Estuarine Land surface & Soils

Agriculture Oceans & Coasts Climate

Human-nature interactions Energy, water & gas

**Recently Released**

29-11-2013 - Nimmo High Plains OzFlux Tower Site

29-11-2013 - Calperum Chowilla OzFlux tower site

29-11-2013 - Otway OzFlux tower site

29-11-2013 - Samford Ecological Research Facility OzFlux tower site

29-11-2013 - Tumbarumba OzFlux tower site

**Browse TERN facilities & datasets**

**AusCover** Remote Sensing Data Facility

**OzFlux**

**MSPN** Multi-Scale Plot Network

**ausplots**

TERN - Terrestrial Ecosyst... x Welcome to Geo-Wiki Proj... x Geo-Wiki.org (part 2) - Co... x

ile Agricult... Crop Monitor Google Earth Engine SAP (1) Facebook CSIRO Outlook Web Apple Yahoo! Google Maps YouTube Global Forest Observ...

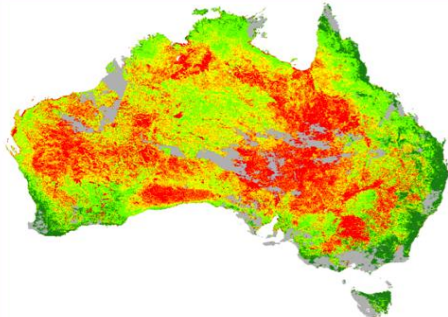
**AusCover**  
Remote Sensing  
Data Facility

Home About Team Data Services Field Validation Contact Us Disclaimer

**GET DATA**

The AusCover facility provides access to remote sensing data and derived products, associated with land-surface characteristics and biophysical variables derived from satellite and airborne imagery. The facility also provides access to a wide, national network of experts in the field, as well as field methodology protocols and in-situ data for use in ecosystem science and natural resources management.

**Featured Dataset: Grassland Curing Status (Derived From MODIS Data)**



Grassland curing percentage  
Australia  
2013-06-02 to 2013-06-09  
Product 8: Curing ID  
Derived from the MODIS (MOD13) and MODIS (MOD15) data

This dataset is produced by the Australian Bureau of Meteorology and updated monthly.

**Community News**

**AusCover on Facebook**  
Fwd: Post-Doc vacancy for global vegetation modelling Utrecht  
Tue, 04 Feb 2014 07:04:24 +1100

Bit by bit GEO is getting there...Ministers and their reps from 90 countries ju...  
Thu, 23 Jan 2014 14:51:15 +1100

New Sustainable Development INFORMATION portal <http://www.unep.org/>  
Fri, 17 Jan 2014 20:03:31 +1100

Happy 2014! Great examples of value of open data policies! <http://youtu.be/0um...>  
Wed, 01 Jan 2014 09:47:35 +1100

Official Release of v1.0 of Landsat-based Fire Scar Mapping for Queensland - 19...  
Mon, 23 Dec 2013 09:24:13 +1100

Tandem-X Intermediate DEM (DEM): Announcement of Opportunity and Call for Prop...  
Tue, 10 Dec 2013 16:50:16 +1100

**System News**

**News page**  
Delayed production of LPDAAC mosaics  
Fri, 13 Dec 2013 00:29:42 +1100

Issues with some field/site datasets  
Tue, 03 Dec 2013 15:19:41 +1100

[RESOLVED] Issues with data services for some LPDAAC products  
Tue, 03 Dec 2013 15:11:38 +1100


AusCover website gets makeover  
Wed, 17 Jul 2013 09:10:50 +1000

Metadata updates  
Mon, 18 Feb 2013 11:01:41 +1100

**About AusCover**


The AusCover facility provides a national expert network and a data delivery service for provision of Australian biophysical remote sensing data time-series, continental-scale map products, and selected high-resolution datasets over TERN sites.

**Data Products And Activities**



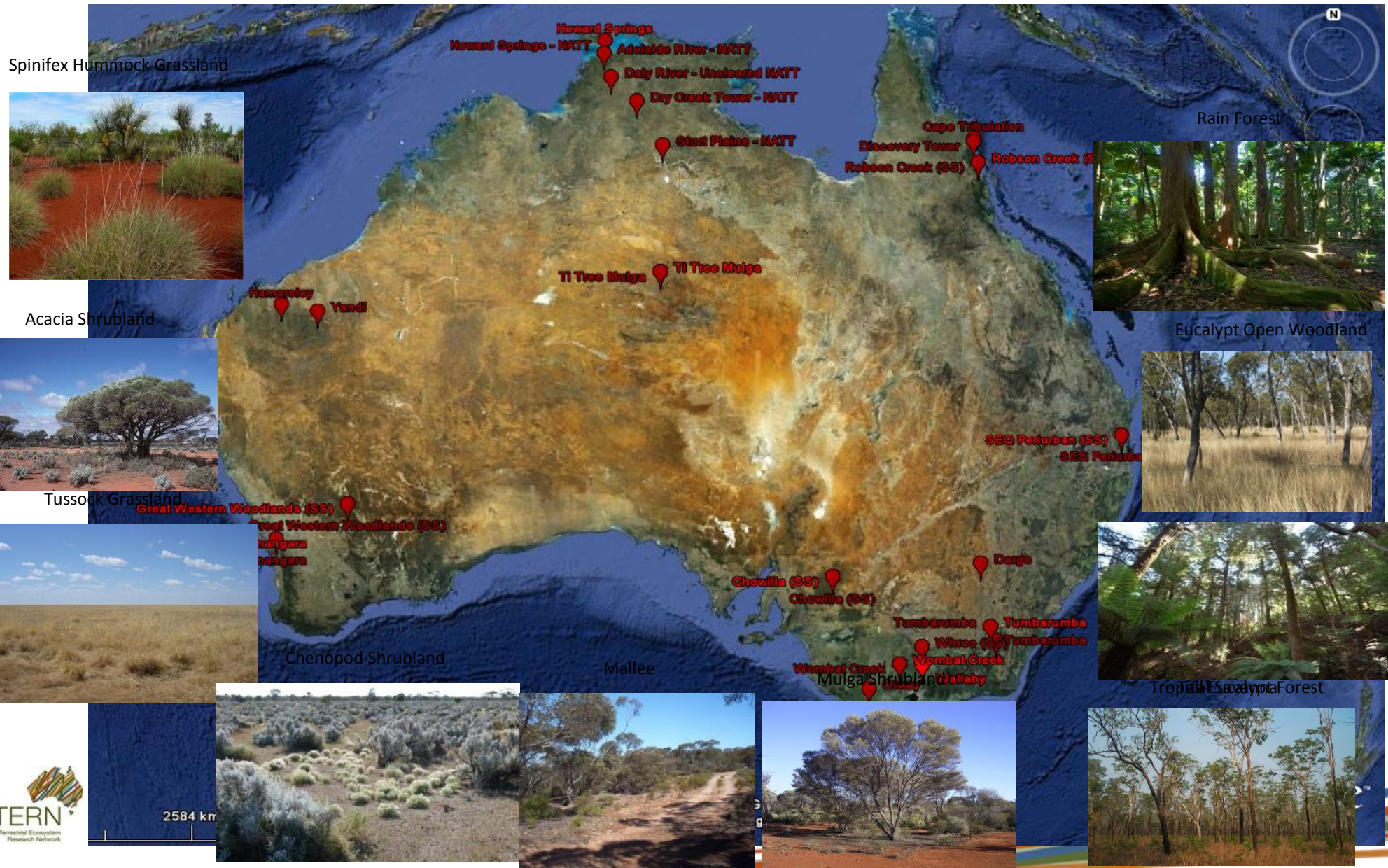
**Calibration / Validation**

Field Sites for calibration and validation of remote sensing data.





# High-Spatial Resolution Remote Sensing Data Collection for Validation and Model Parameter Estimation (across TERN Supersites and other Validation Sites)

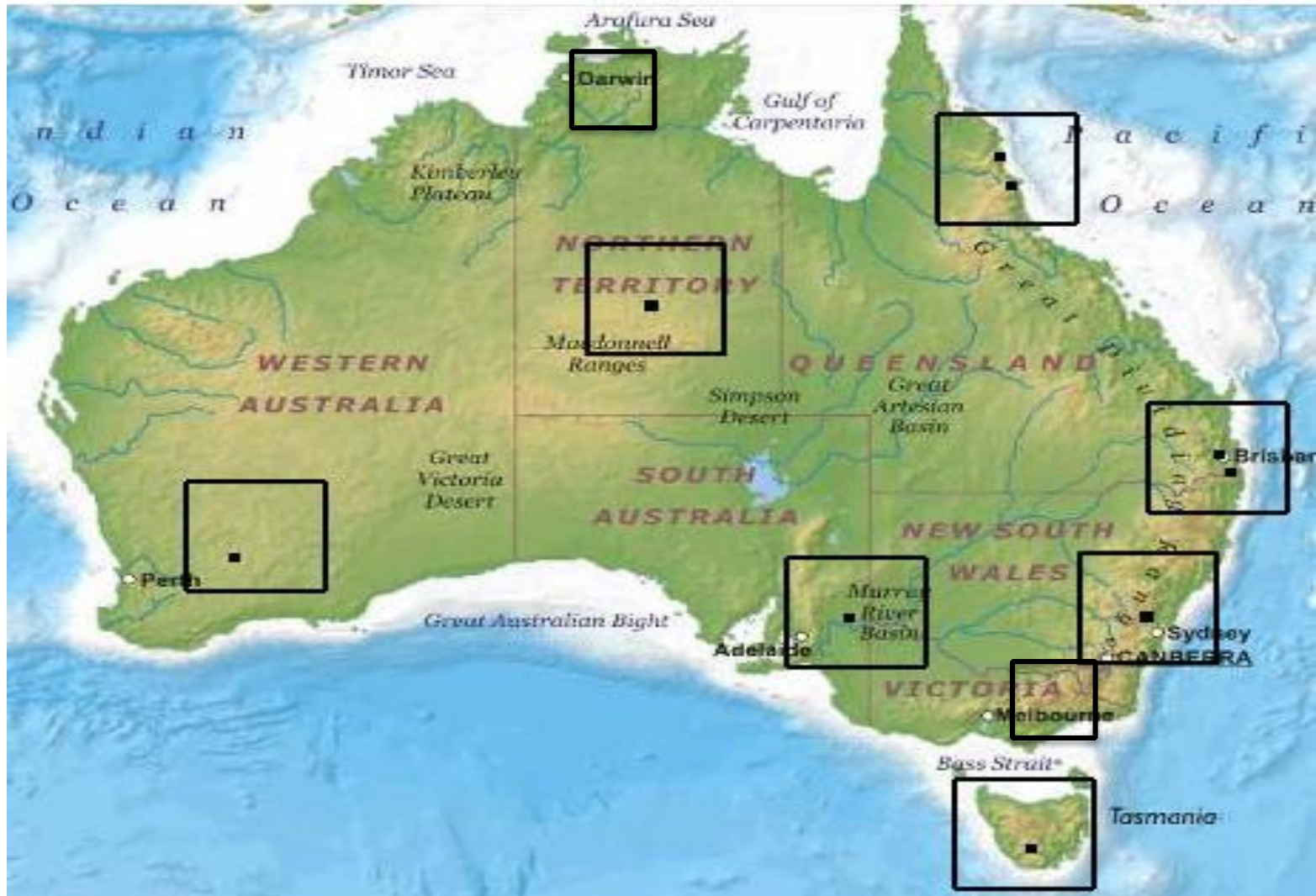




# High-Spatial Resolution Remote Sensing Data Collection

(TERN Supersites and other Validation Sites)

Australia  
Land Area:  
7.5 m sq. Km





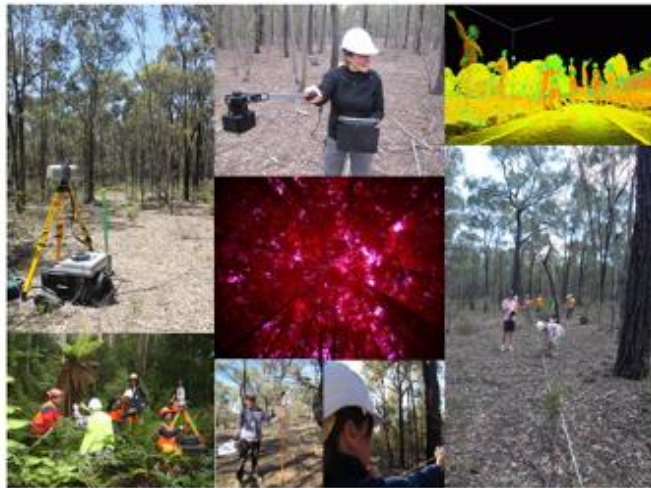
[illegible]



# Field Validation Manual



**AusCover Good Practice Guidelines**  
(A technical handbook supporting calibration and validation activities of remotely sensed data products)



2013



Australian Government  
Australian Bureau of Agricultural and  
Resource Economics and Sciences

SCHOOL OF EARTH  
& ENVIRONMENTAL  
SCIENCES

UNIVERSITY OF  
WOLLONGONG  
FACULTY OF SCIENCE



Curtin University



Australian Government  
Geoscience Australia



THE UNIVERSITY  
OF ADELAIDE  
AUSTRALIA



RMIT University



Queensland Government



University of  
Zurich <sup>UZH</sup>



THE UNIVERSITY  
OF QUEENSLAND  
AUSTRALIA





## TERN AusCover Supersites - Warra Tall Eucalypt, Tasmania - DWEL Laser Scans



**1064 nm**  
-Bright  
leaves  
-Dull trunks



**1556 nm**  
-Darker  
leaves  
-Brighter  
trunks

# TERN AusCover Supersites - Warra Tall Eucalypt, Tasmania

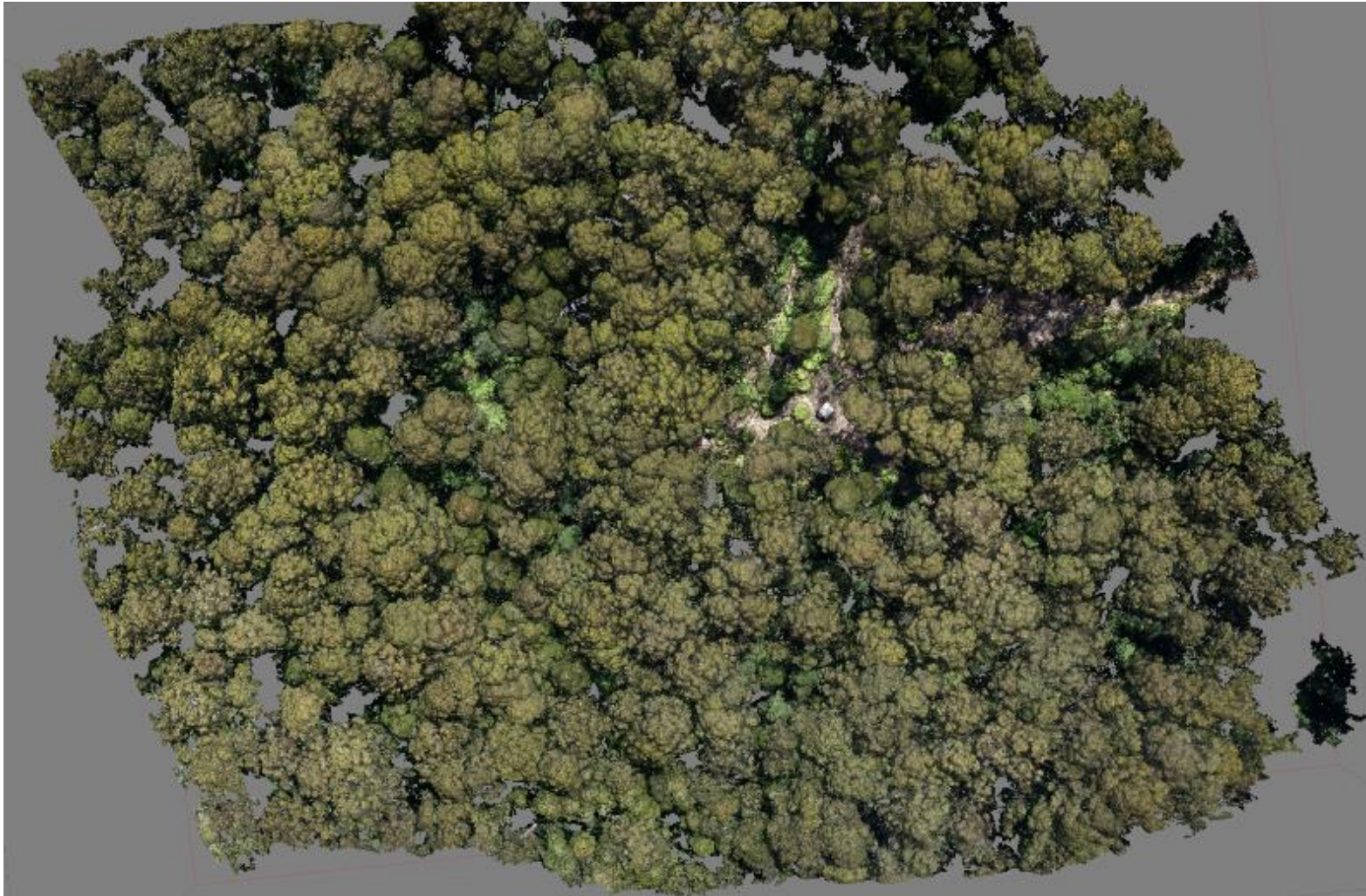
## - DWEL Laser Scans



- Sample DWEL scan from Warra Flux site
- Completely different veg types in Warra – Variability within a forest
- 800m away from the other site

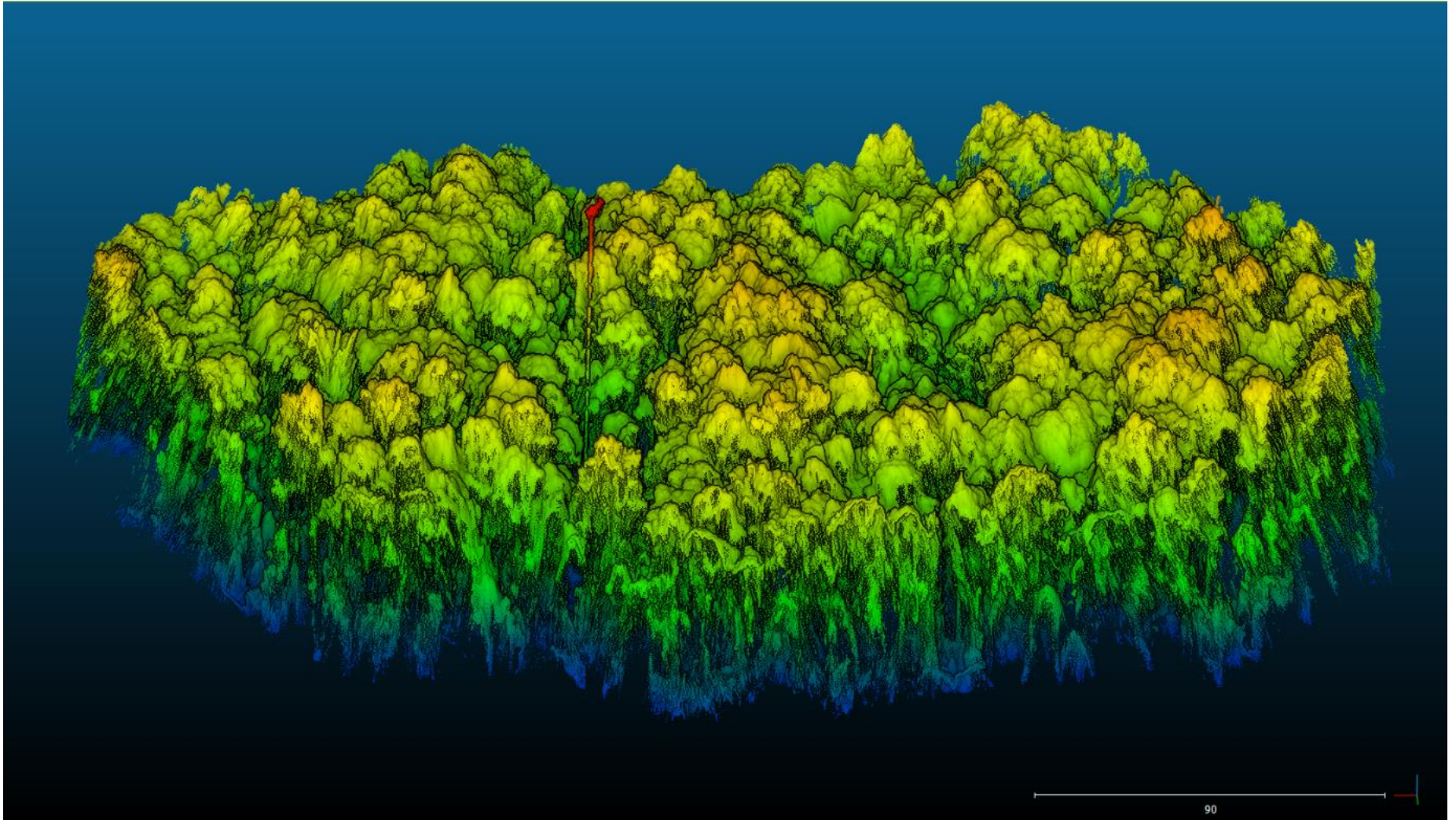


## 3D point cloud from UAV



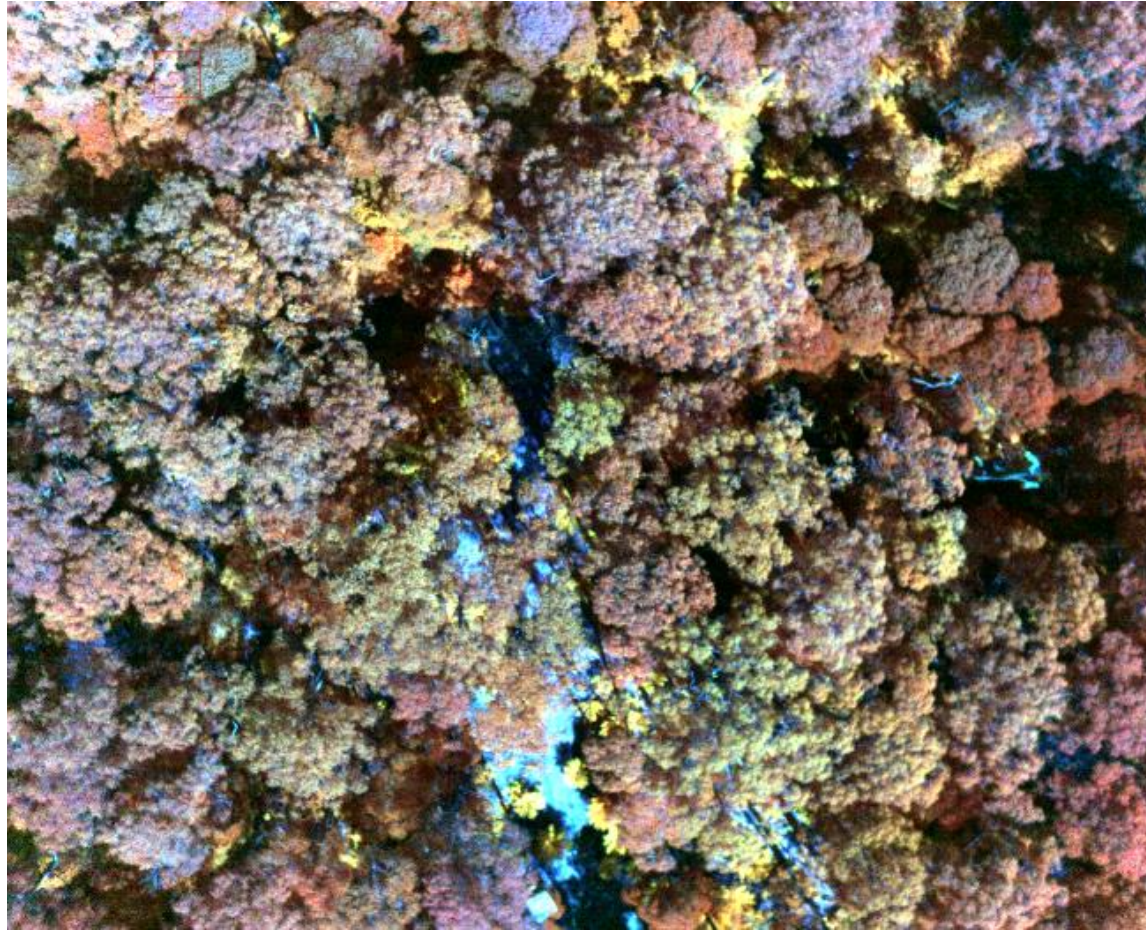


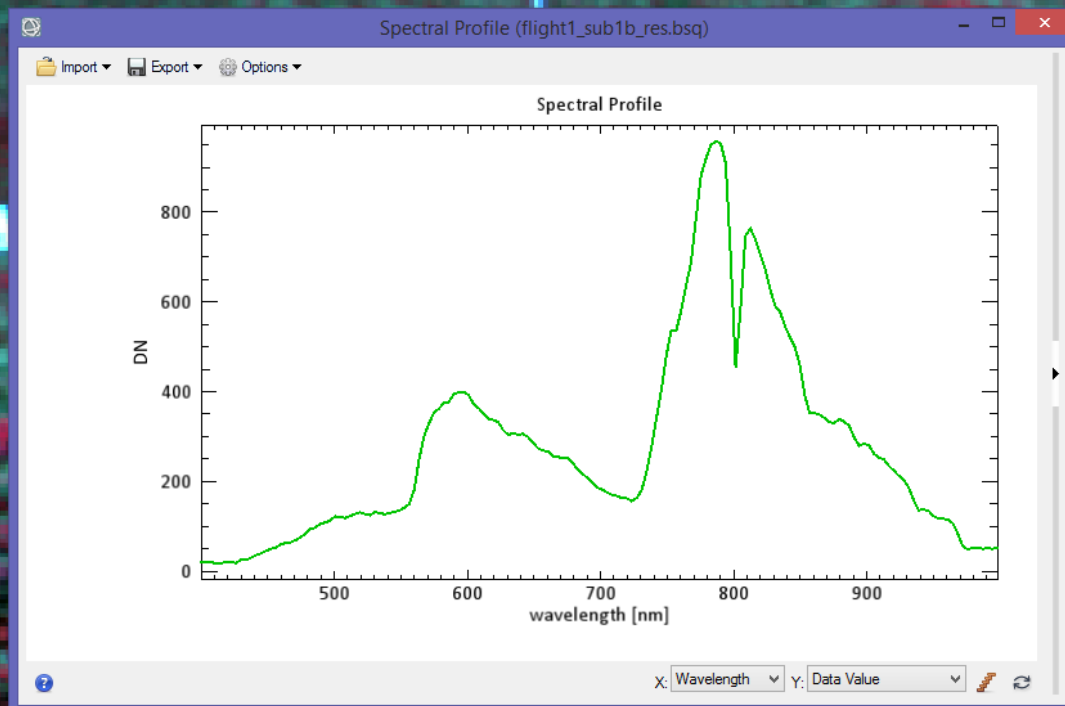
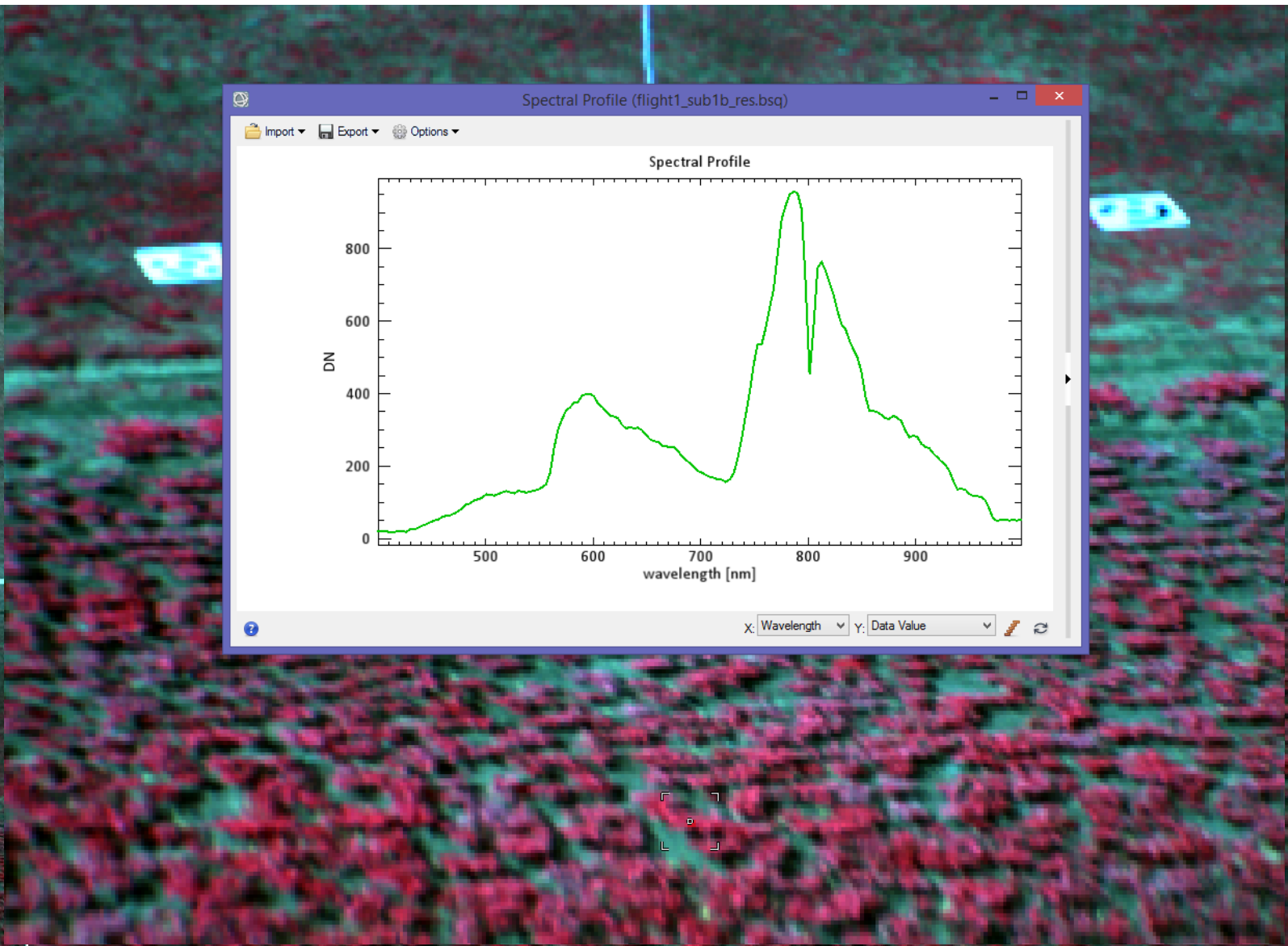
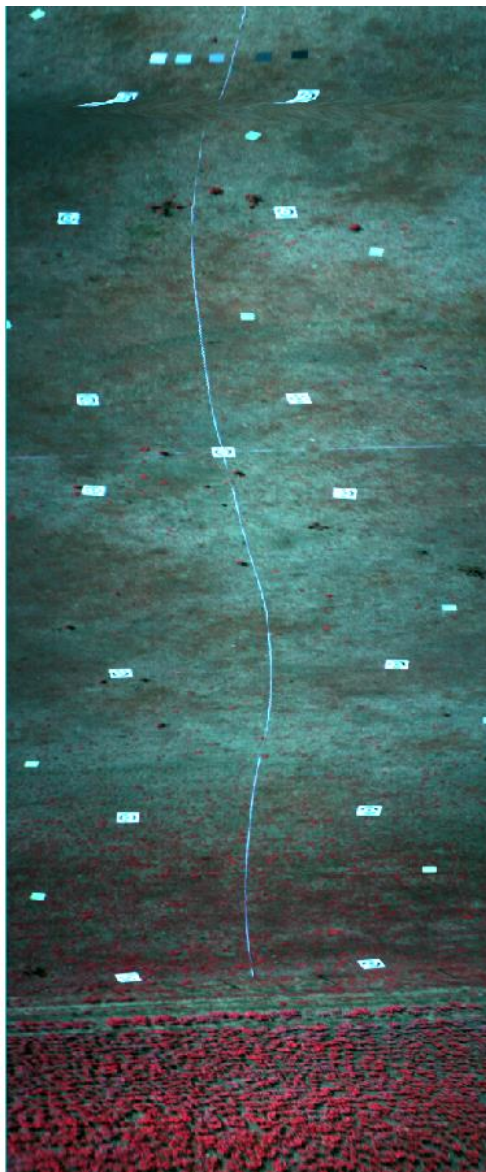
# Canopy height





# Multispectral UAV image of Warra Supersite



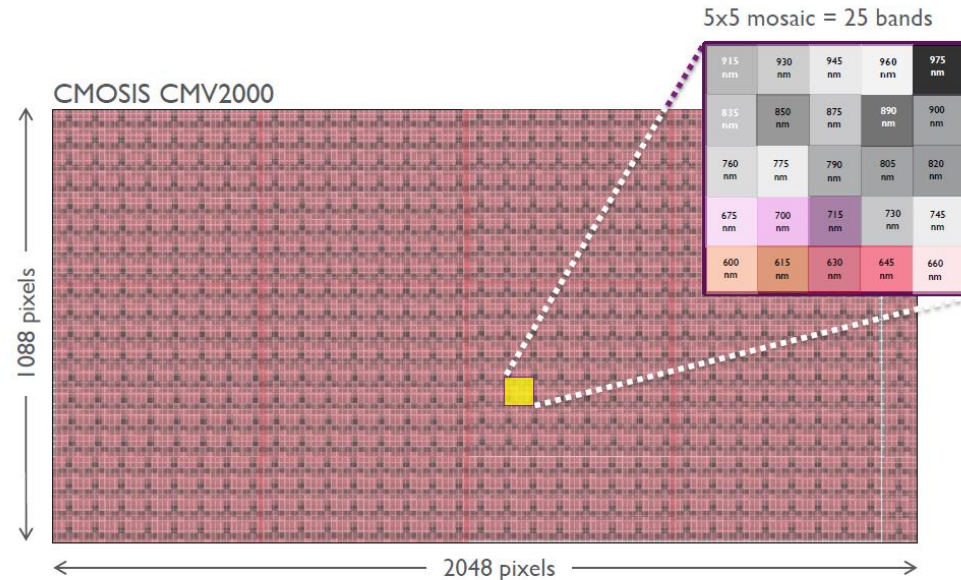
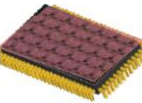




# Hyperspectral snapshot sensor (IMEC)



## SNAPSHOT MOSAIC HSI SENSOR (5X5 NIR)

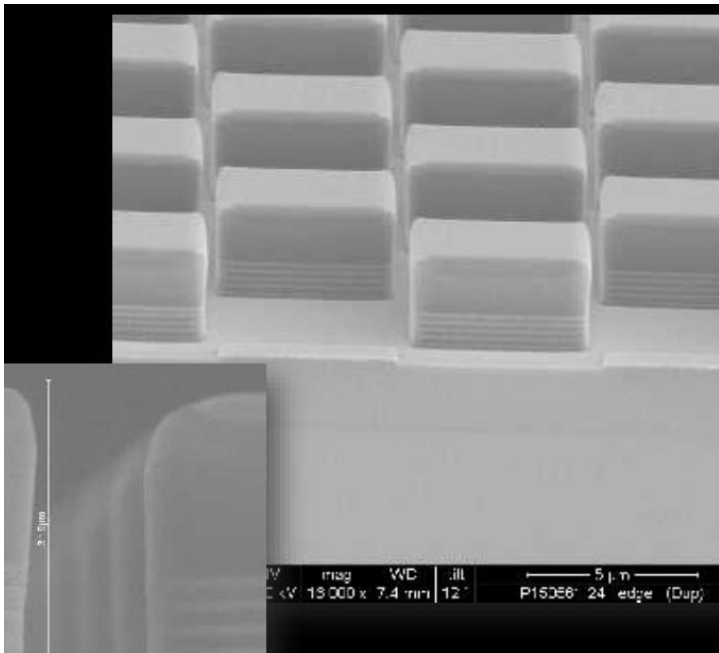


### Key specifications

- **Spectral resolution:** 5x5 mosaic (1 filter / pixel) = 25 bands in 600-1000nm
- **FWHM:** ~ 10-15nm
- **Spatial resolution:** from 410x218 (RAW per band)
- **Speed:** up to 340 data-cubes / s (max sensor limit)

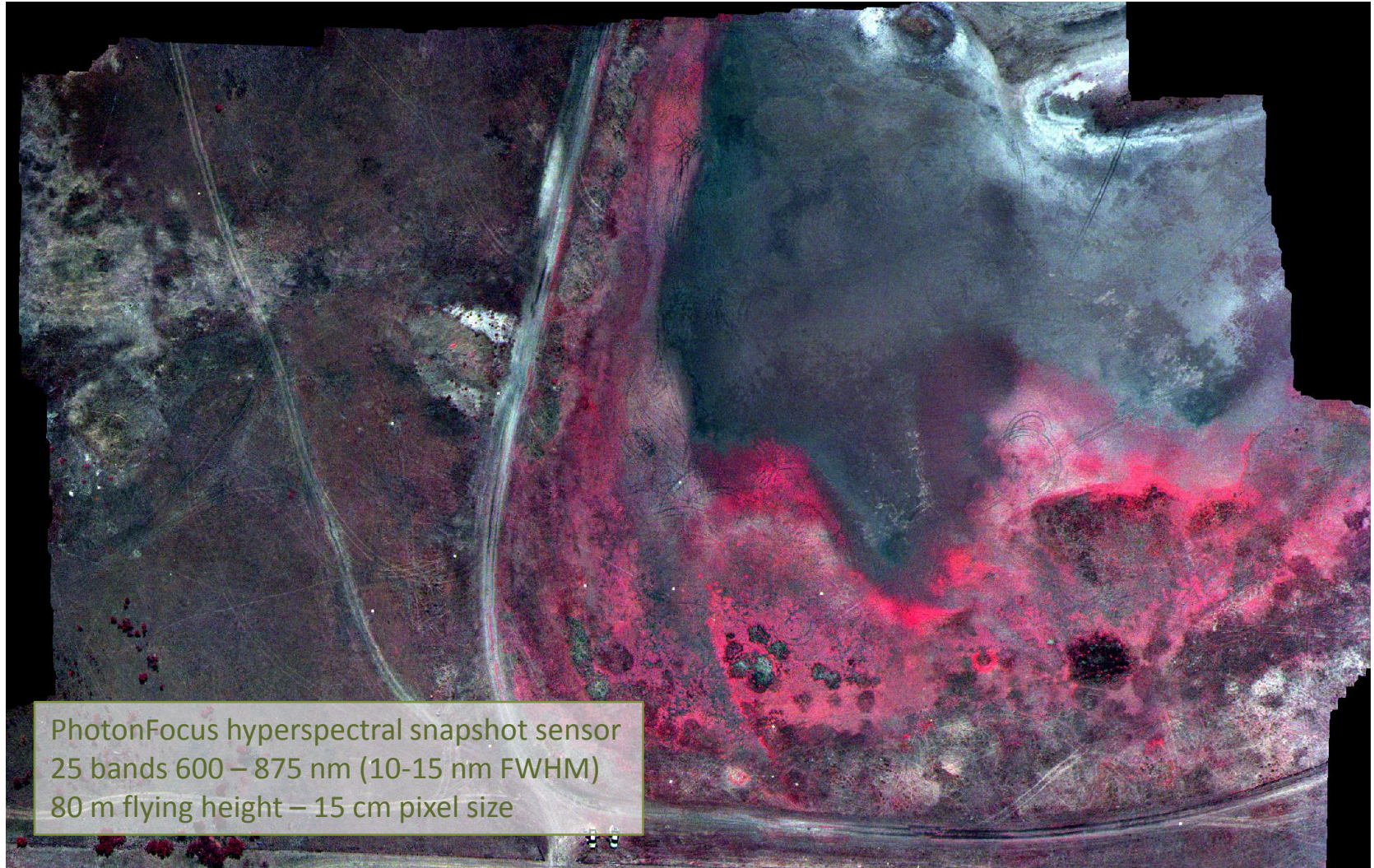


Source: IMEC and PhotonFocus



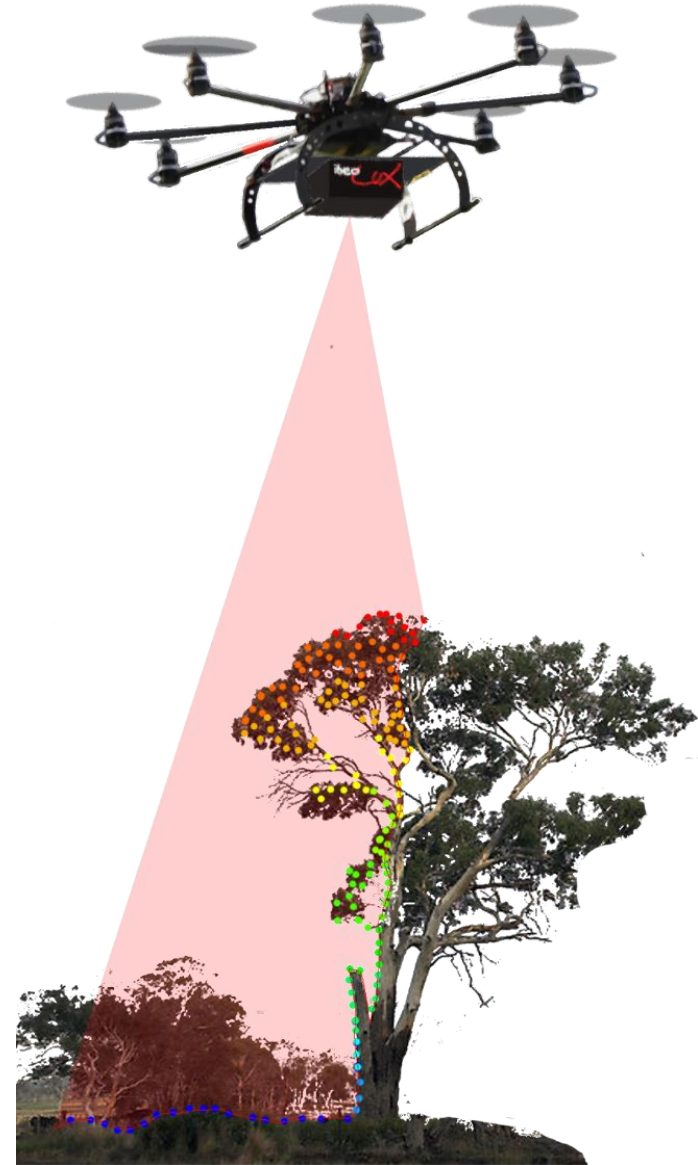
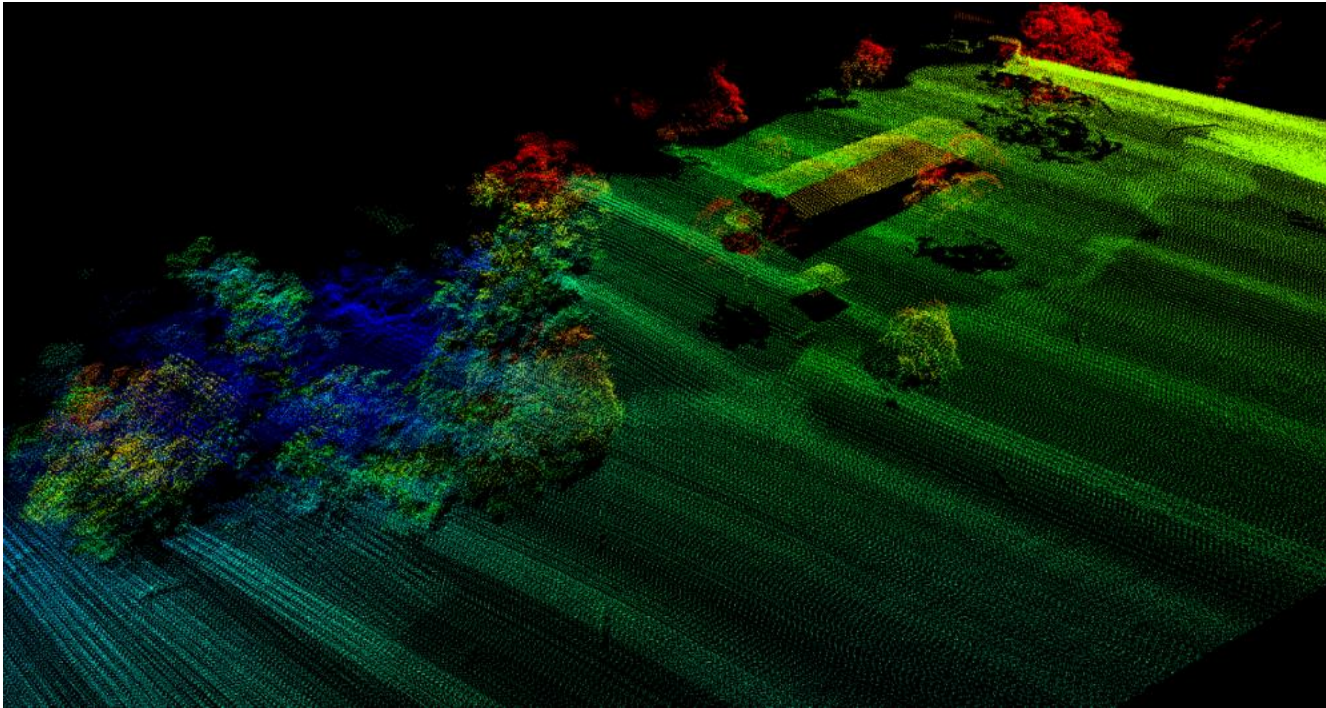


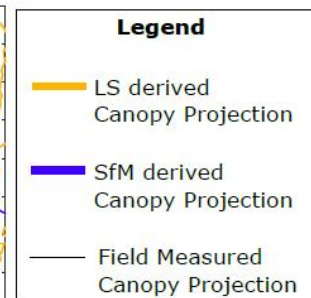
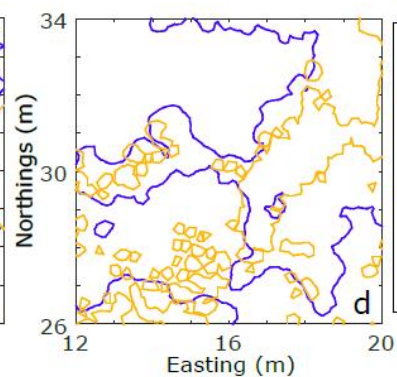
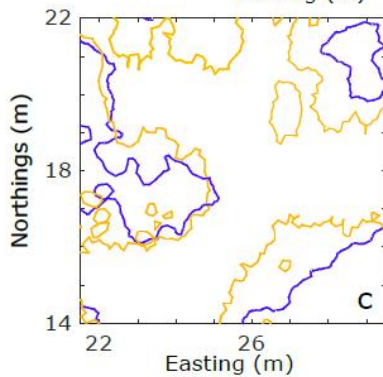
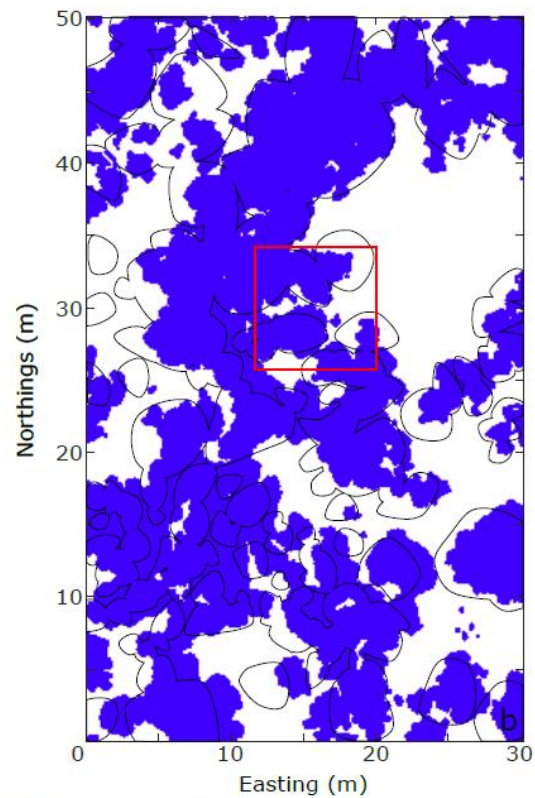
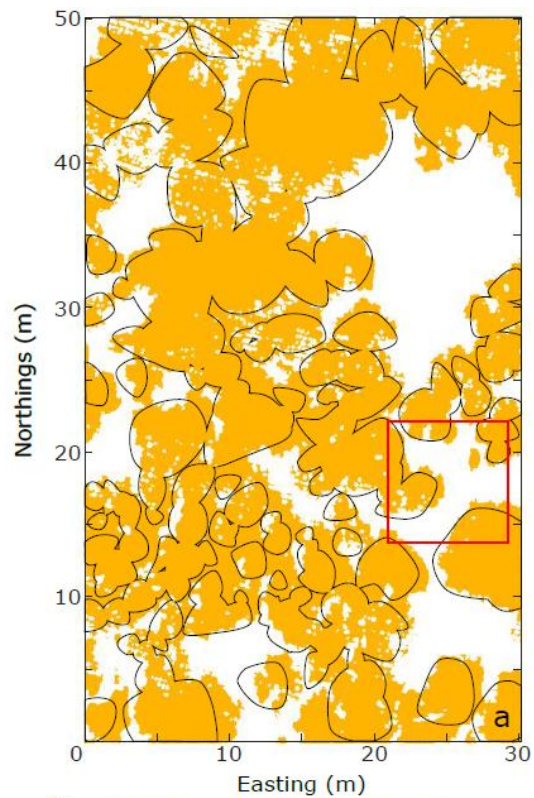
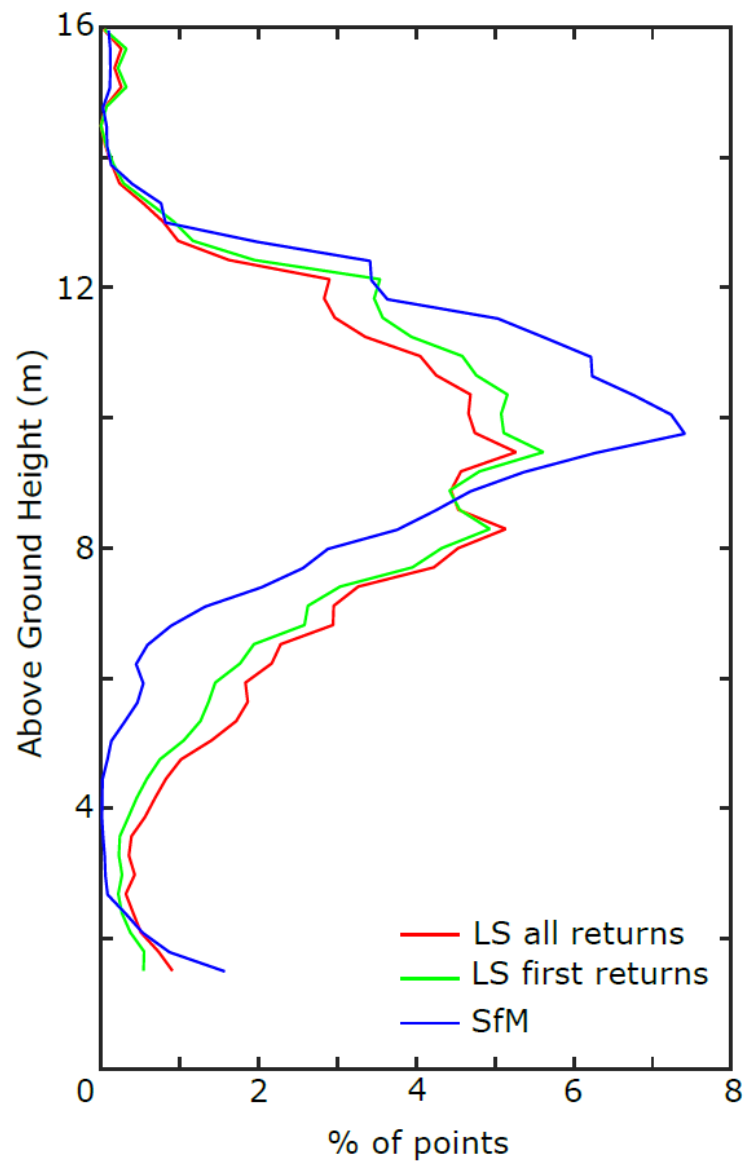
# Native grasslands Tasmanian Midlands





# UAS LiDAR







Dual antenna, dual frequency GNSS: 2 – 4 cm position, 0.15° heading

“Devourer” X8 heavy-lift multi-rotor

Intel NUC data logger

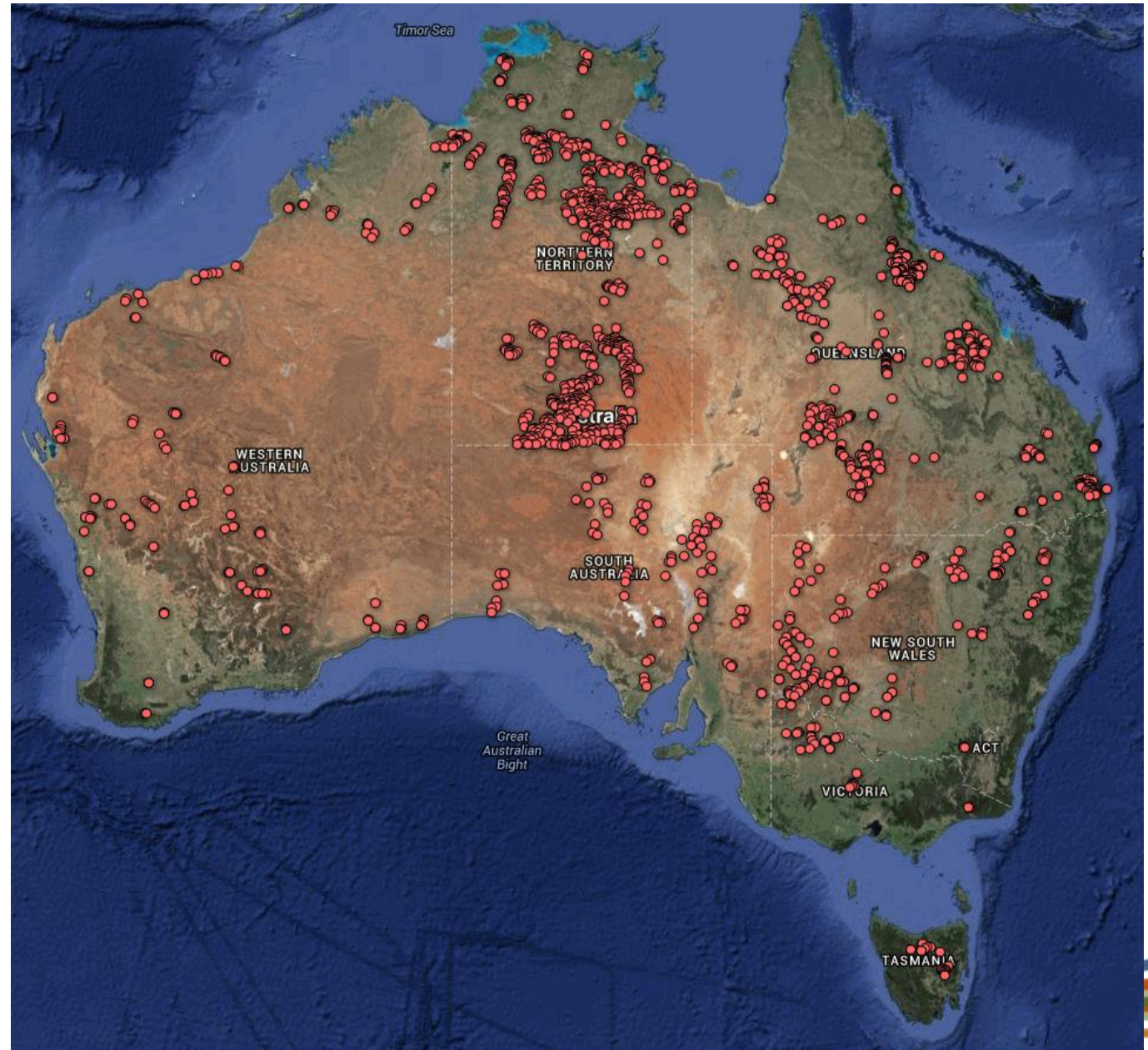


- ▶ \$7999
- ▶ Dual Returns
- ▶ 830 grams
- ▶ 16 Channels
- ▶ 100m Range
- ▶ 300,000 Points per Second
- ▶ 360° Horizontal FOV
- ▶  $\pm 15^\circ$  Vertical FOV



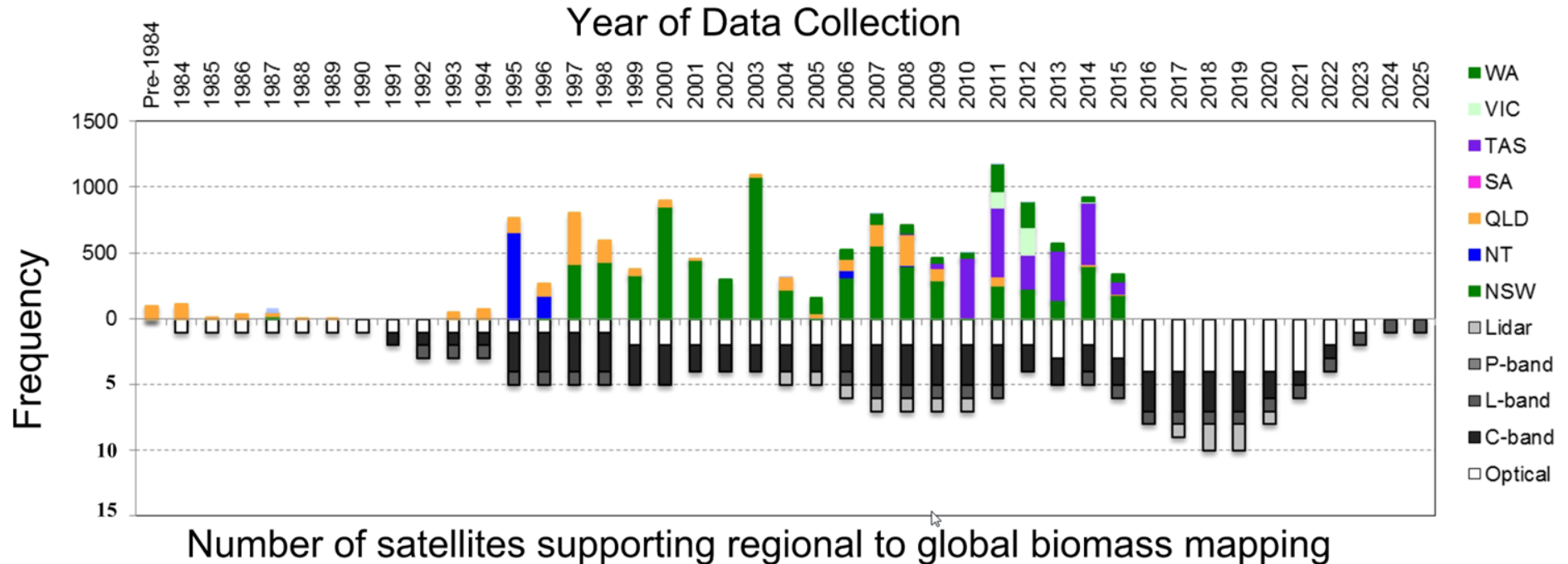
# Fractional cover field sites

- ~2500 field sites across Australia
- > 800 sites post Landsat 8





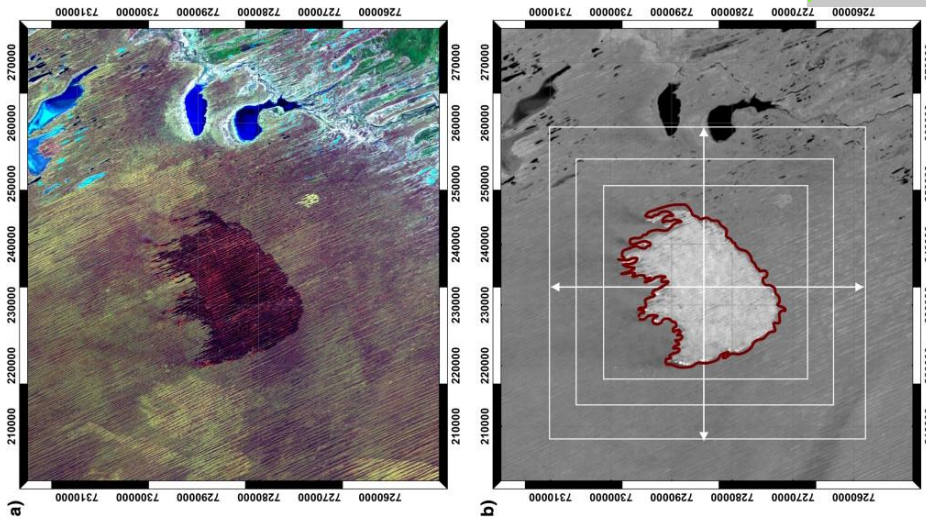
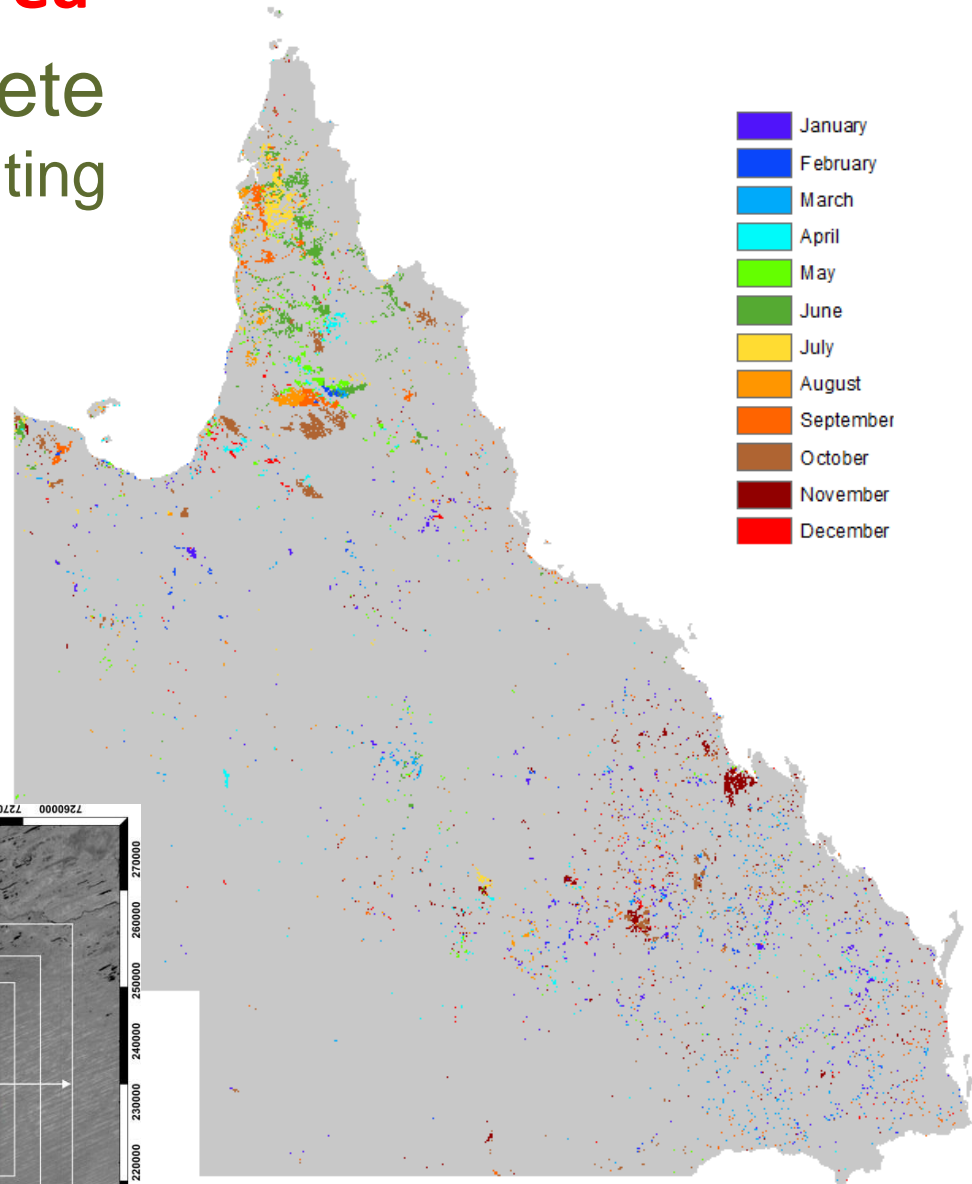
# Future data needs for earth observation CAL/VAL



Optical	C-band	L-band	P-band	Spaceborne lidar
Landsat-7	ERS-1 SAR	JERS-1 SAR	BIOMASS	ICESAT GLAS
Landsat-8	ERS-2 SAR	ALOS PALSAR		ICESAT-2
Sentinel-2	RADARSAT-1	ALOS-2 PALSAR-2		GEDI ON ISS
	RADARSAT-2	SAOCOM CONAE		
	Sentinel-1	NISAR		

# Landsat Burnt Area

- Queensland complete
  - Requires manual editing
- Testing ongoing in:
  - NT
  - Western Australia
  - South Africa



1988

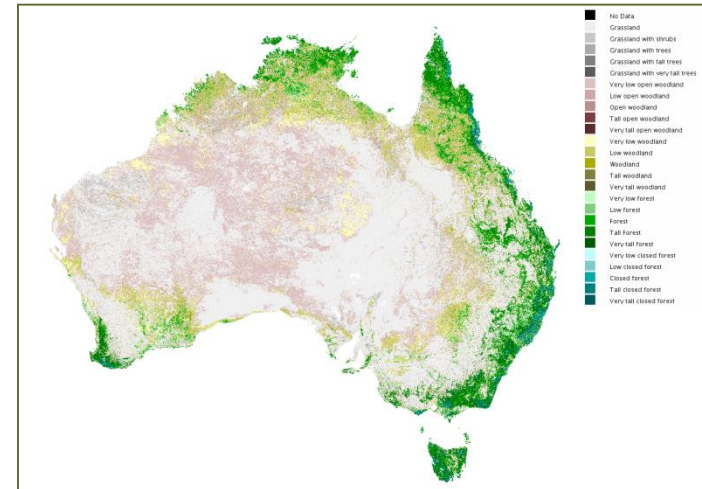




# Biomass and Structural Map, Australia

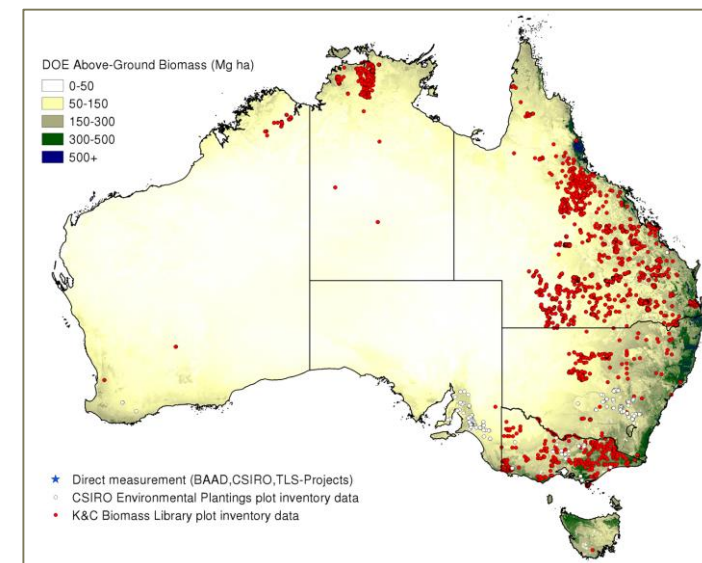
- Structural classification

- Paper submitted to IGARSS 2015 on the structural classification for Australia; oral presentation in July
- Near final version of paper on structural classification using ICESAT, ALOS PALSAR and Landsat sensor data (for RSE)
  - For ILCP
- Key interest within GEOBON in relation to the structural classification for Australia.
  - Request to make available
- Drafting paper for full structural classification (for RSE)



- Biomass

- Meeting with CSIRO (Keryn Paul) aimed at recalculating biomass estimates and measures of uncertainty.
- Report submitted to JAXA in support of the PI agreements.
- Need to aim to generate biomass map by:
  - K&C meeting, Tokyo, October
  - GLOB\_Biomass meeting in Jena, January.
- Paper submitted to Current Forest Reports on approaches to biomass mapping across large areas
- Draft paper on biomass library to be prepared for July/August
- Awaiting outcome of the ARC Linkage project
- Important to download quota of the ALOS-2 imagery



# Vineyards – CSIRO Digital Viticulture

- Scanning of two vineyards in South Australia using 4 different laser scanners

- DWEL
- CBL
- Zebedee
- GRover





**DWEL** – laser scan of T5REP1 Minimal Prune vines

- Image not filtered yet and brightness levels not adjusted, this will happen in the next round of processing



1064nm



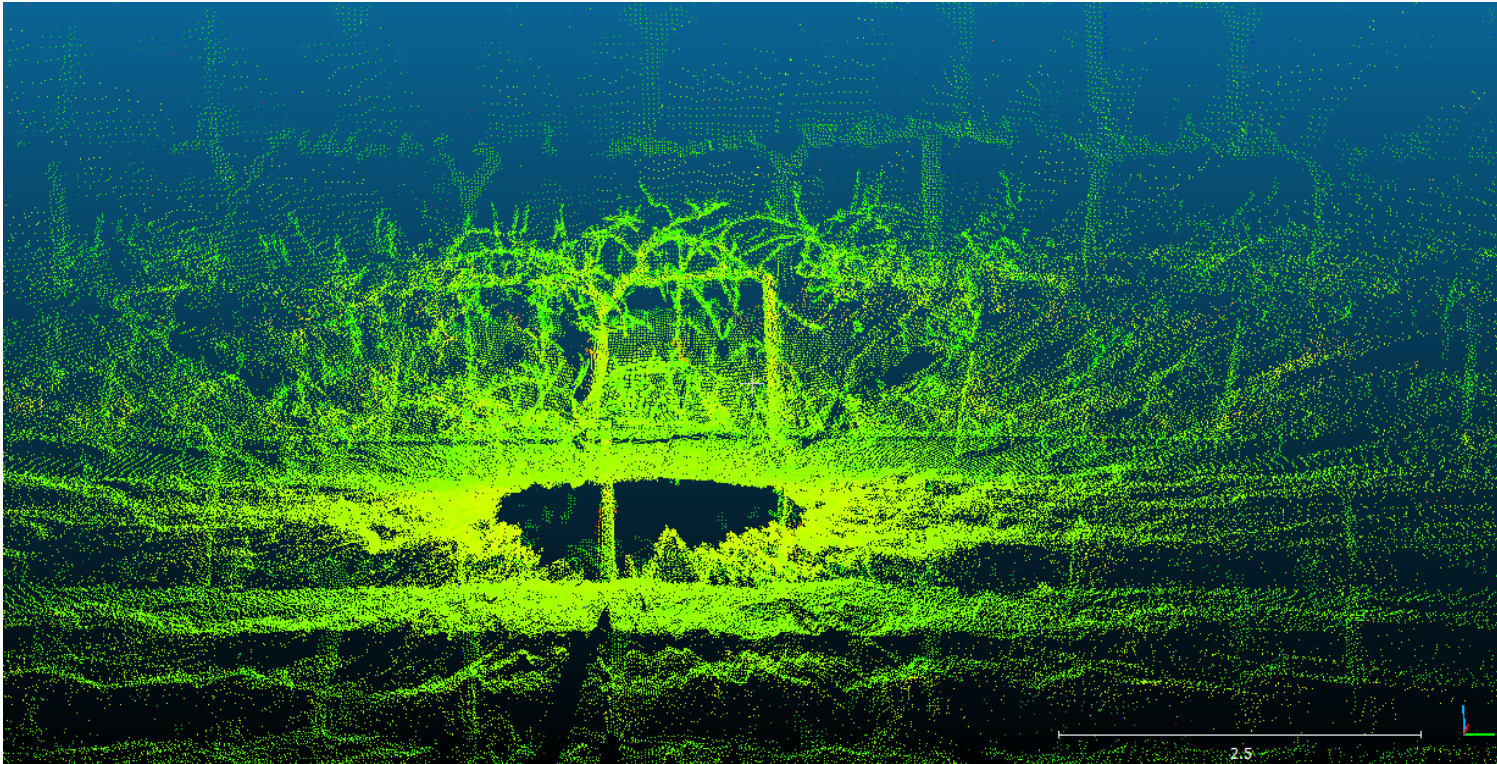
1556nm

Compact Biomass Lidar (CBL) single scan of T5REP4 (minimal prune)

- Vine canes clearly evident in good detail

- This detail will improve when adjacent scans are registered together

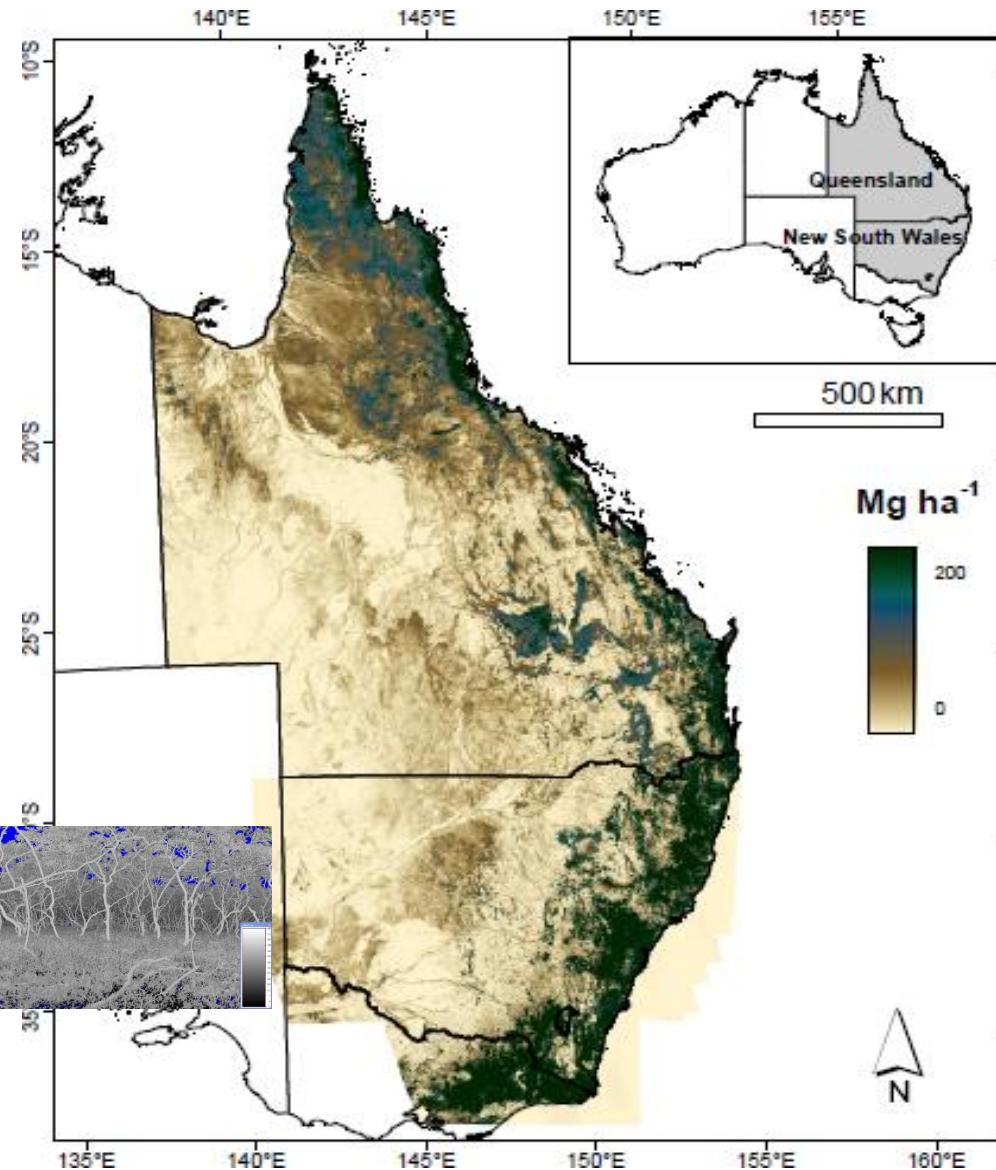
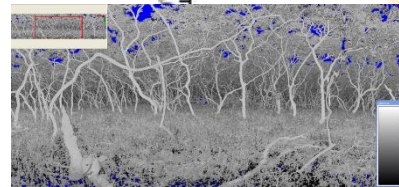
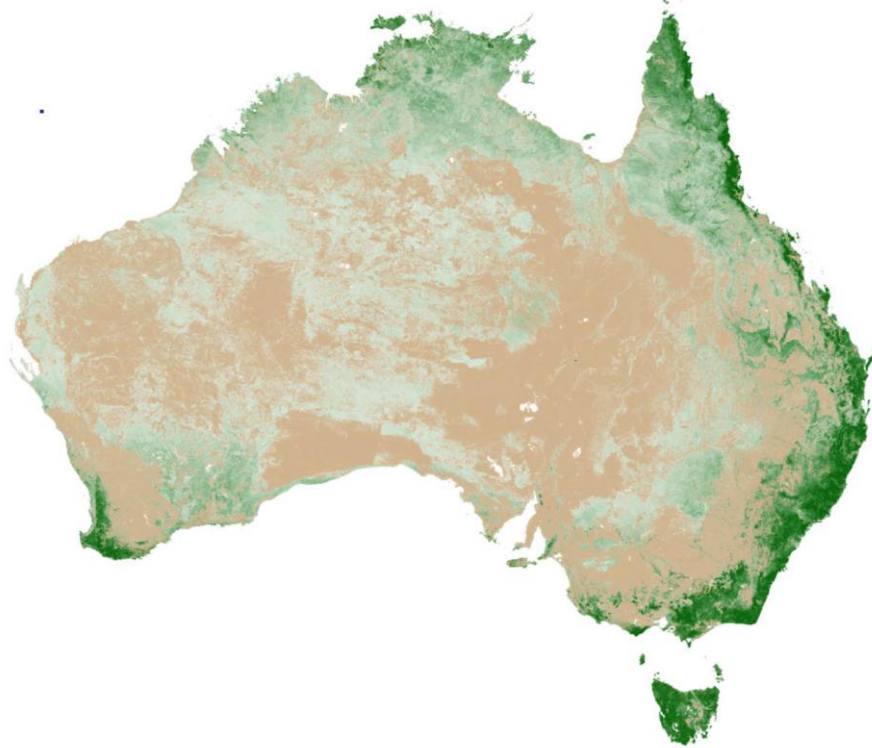
- For each panel we took 12 scans (6 each side of the measurement panel)





# Continental-scale Products: eg Woody Aboveground Biomass Mapping

Persistent Green Cover

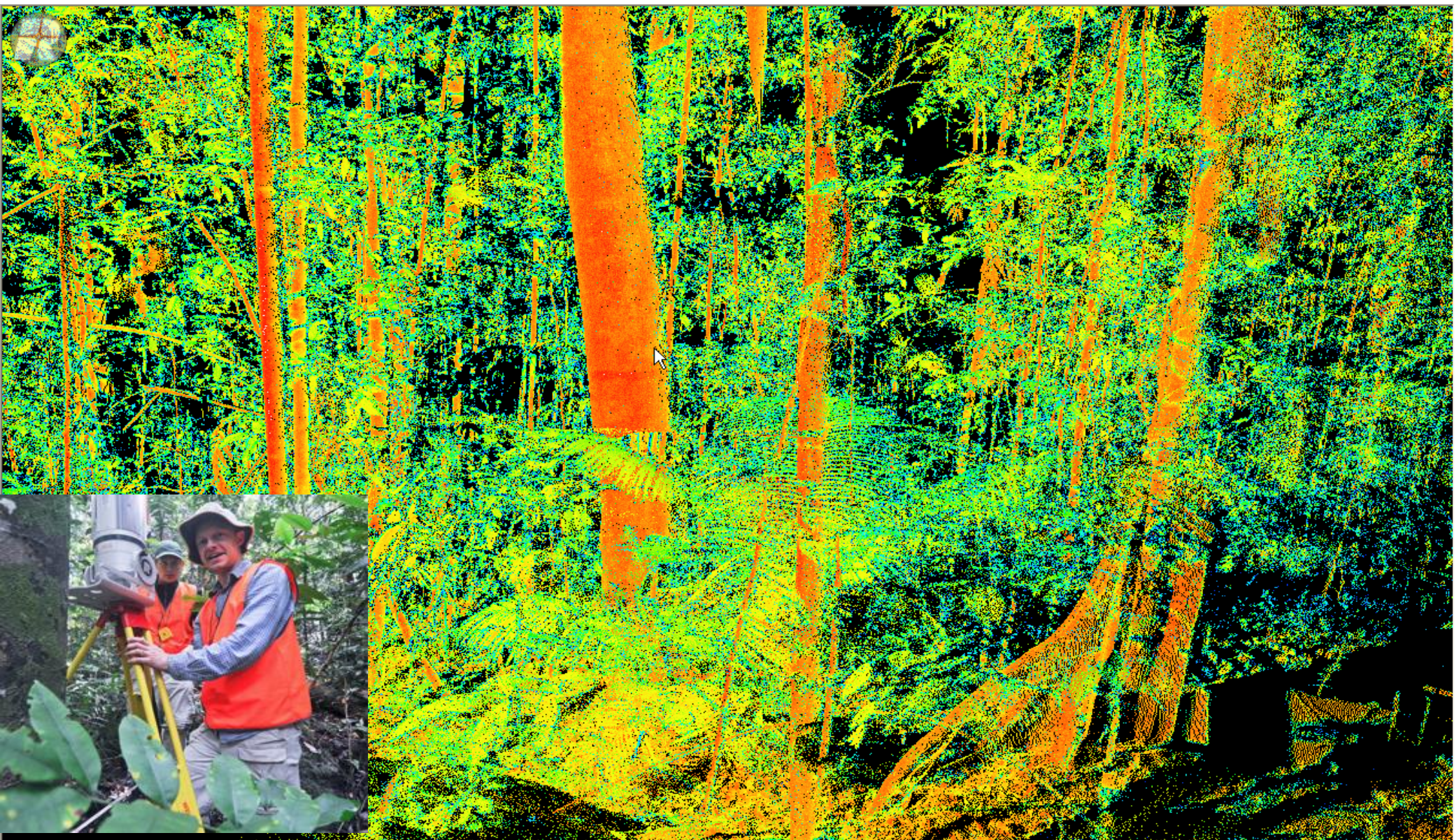


Partnership: TERN, CSIRO, UQ, QLD DISITIA, UNSW



# Biomass and Fuel Loads with Terrestrial Lidar Scanner Data

## Robson Creek - FNQ





# Tackling the EO Data Deluge

- Data archives too big to move around the country !
- More users of long time series (eg Landsat, MODIS, SpotVGT)
- So, we need to “bring users to the data”
- “Near-real” time delivery of key products to decision makers – eg fire hotspots, disaster impacts, drought maps , etc.

***If such products require access to full historical Pbyte archives, the EO data needs to be on “spinning disk” or cloud.***

Source: Guerschman et al (2009), Remote Sensing of Environment

# A typical day of data acquisition

Landsat7

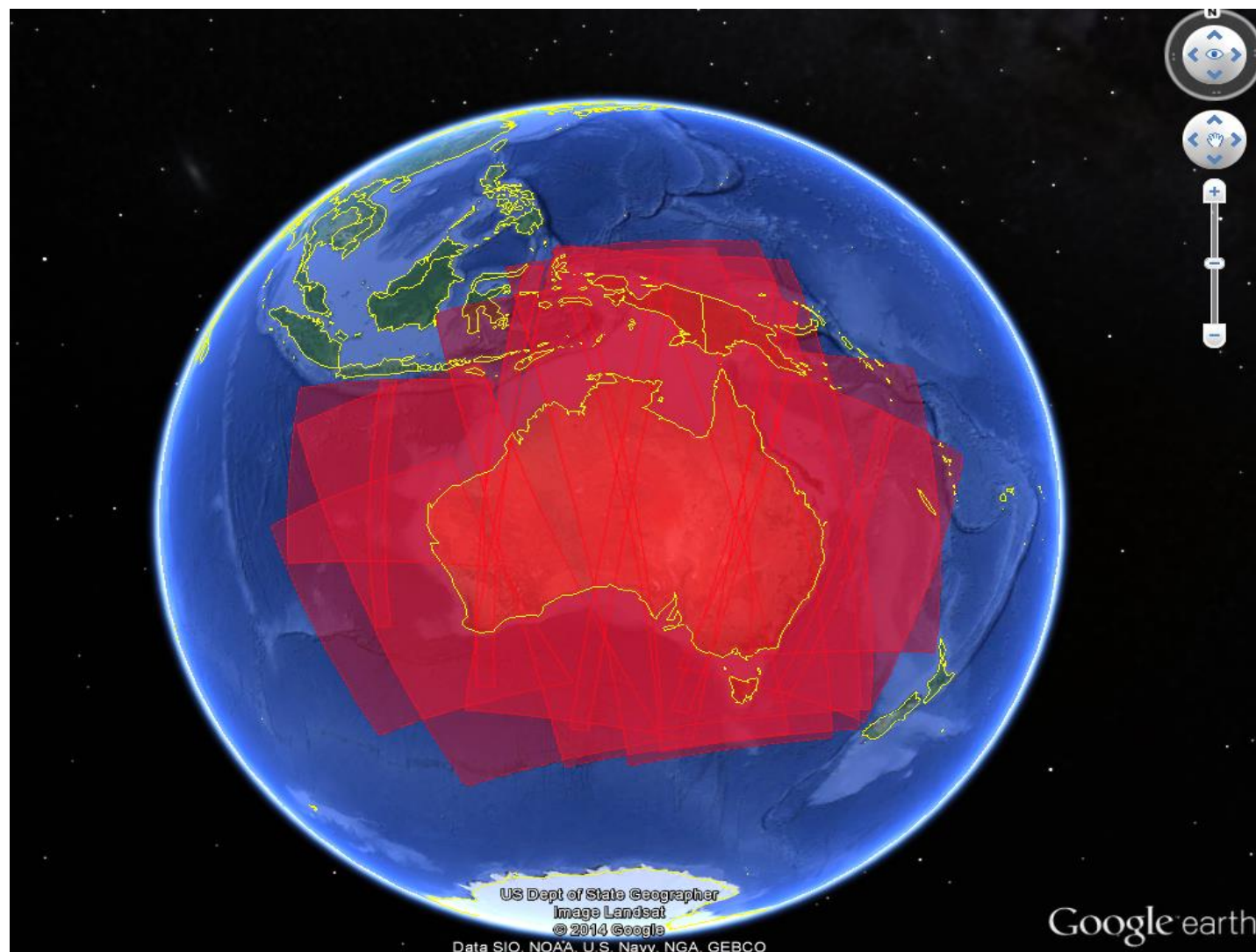
Landsat8

Terra MODIS

Aqua MODIS

Suomi NPP

Continuous  
acquisitions are  
converted to scenes  
or granule partitions  
representing time



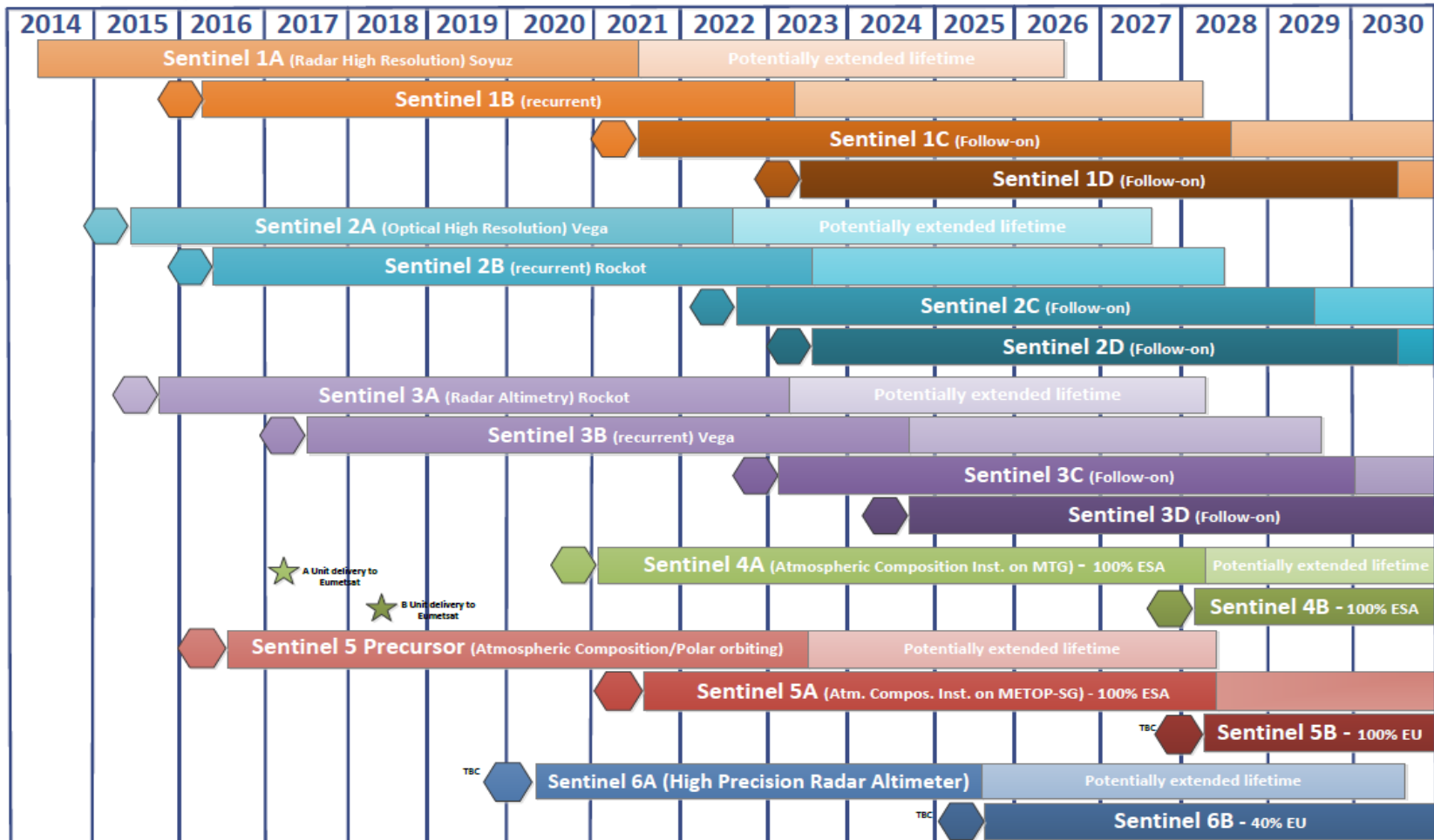


# 8 Billion Euro Copernicus Program is Launching 20 New Sentinel Satellites

Status 23 January 2015



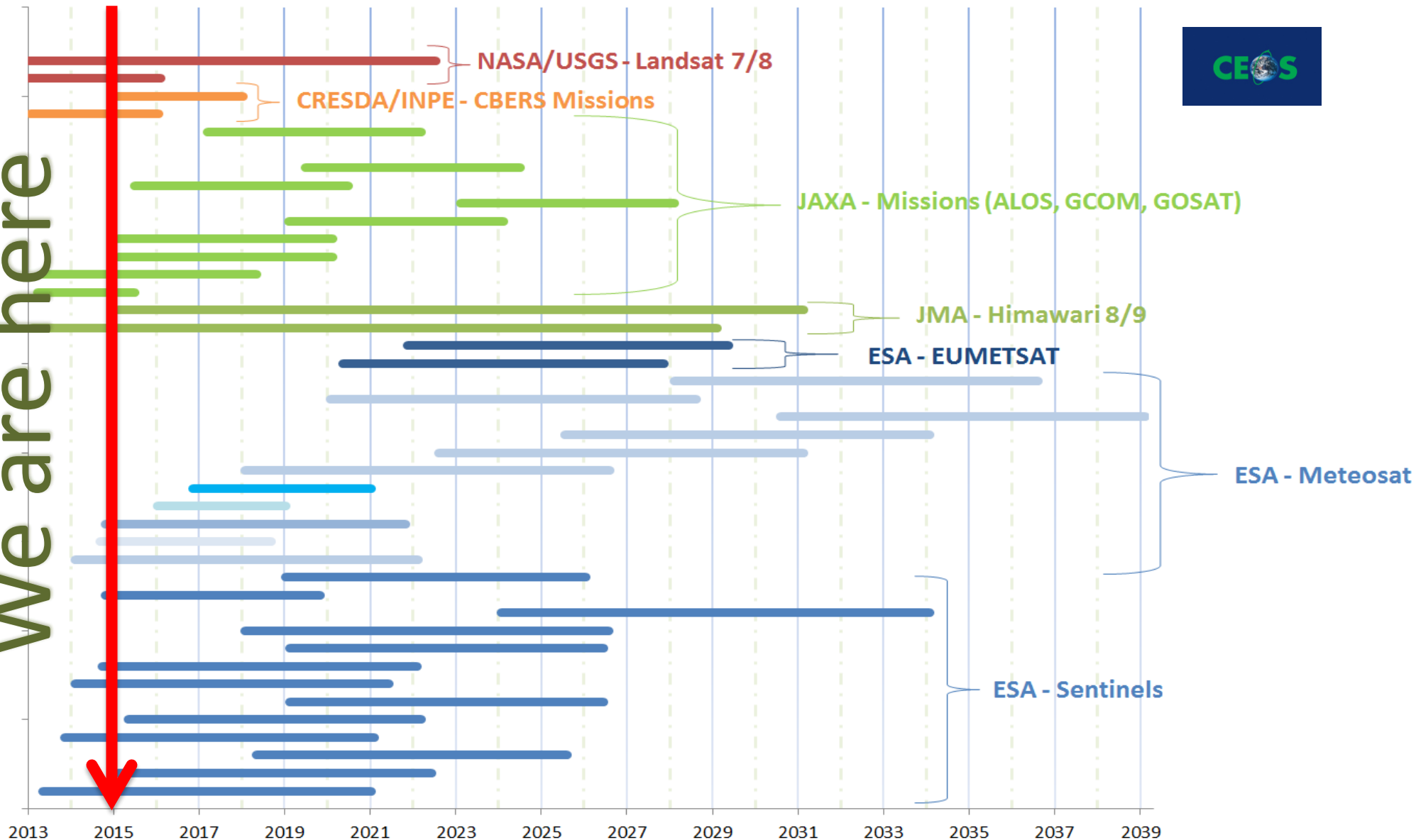
## Copernicus Constellations Deployment Schedule



# Challenge of Variety – the Next Decade

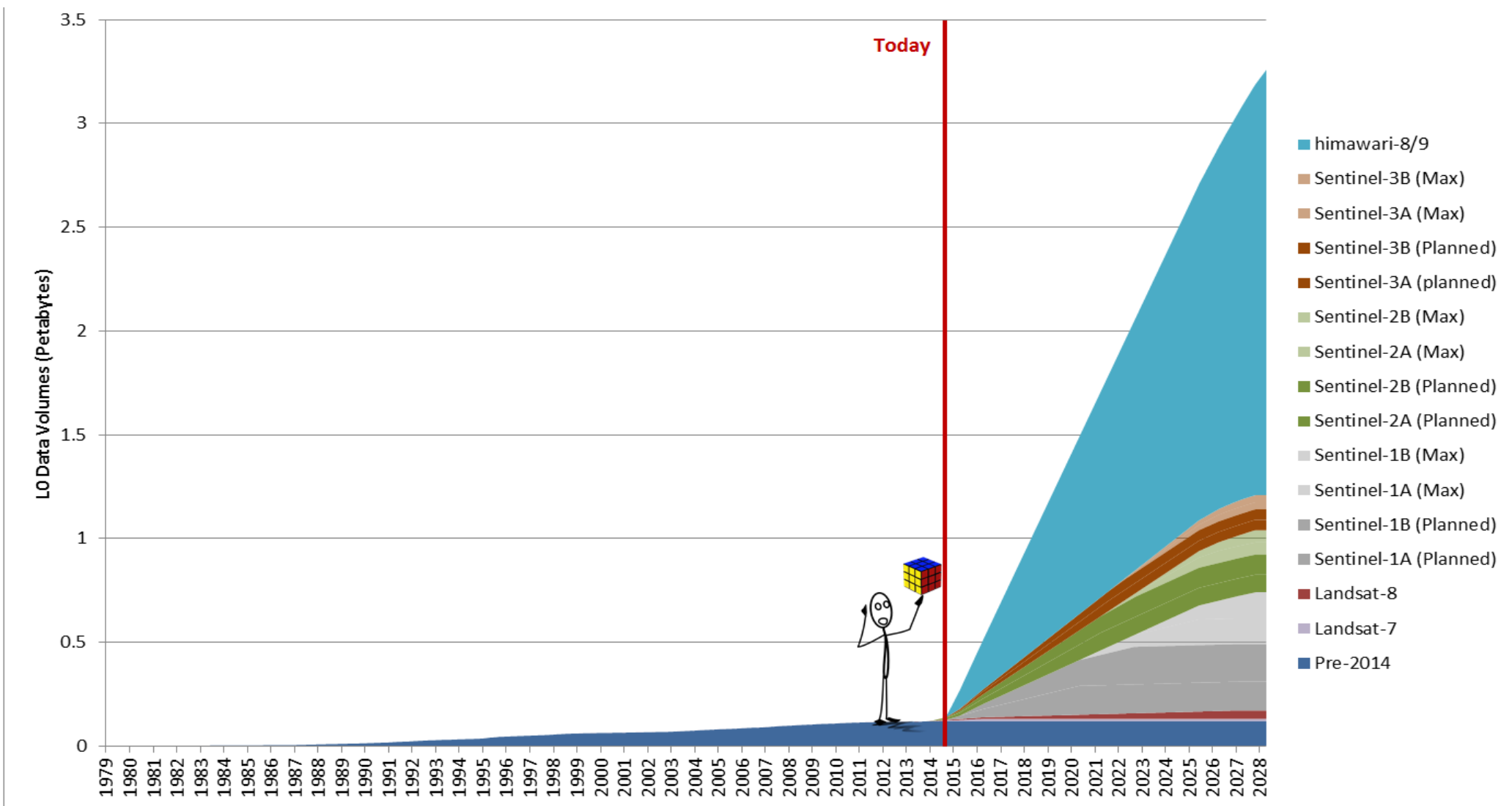


We are here





# Next Decade's Estimated L0 data volumes over Australia



# Using High-Performance Computational Capacity

## - The National Computational Infrastructure (NCI)

- Raijin @ National Computational Infrastructure
- 57,472 cores (Intel Xeon Sandy Bridge technology, 2.6 GHz) in 3592 compute nodes;
- 160 TBytes (approx.) of main memory;
- 10 PBytes (approx.) of usable fast filesystem (for short-term scratch space).

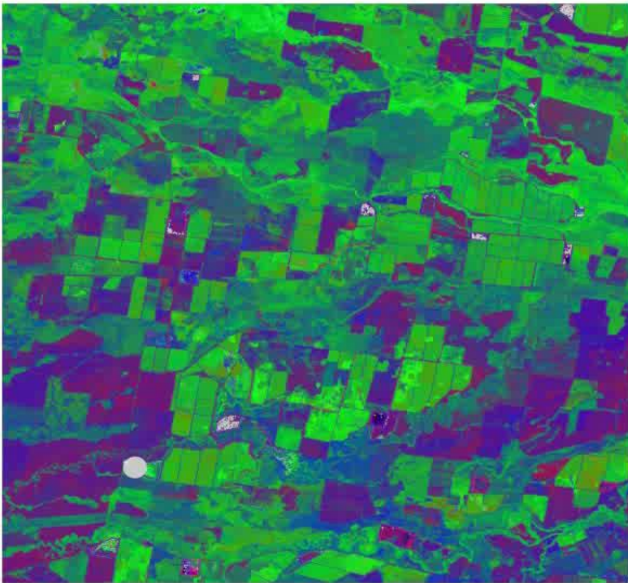
37	Research Institute for Information Technology, Kyushu University Japan	QUARTETTO - HA8000-tc HT210/PRIMERGY CX400 Cluster, Xeon E5-2680 8C 2.700GHz, Infiniband FDR, NVIDIA K20/K20x, Xeon Phi 5110P Hitachi/Fujitsu
38	National Computational Infrastructure, Australian National University Australia	Fujitsu PRIMERGY CX250 S1, Xeon E5-2670 8C 2.600GHz, Infiniband FDR Fujitsu
39	Purdue University United States	Conte - Cluster Platform SL250s Gen8, Xeon E5-2670 8C 2.600GHz, Infiniband FDR, Intel Xeon Phi 5110P Hewlett-Packard



\*<http://top500.org/>

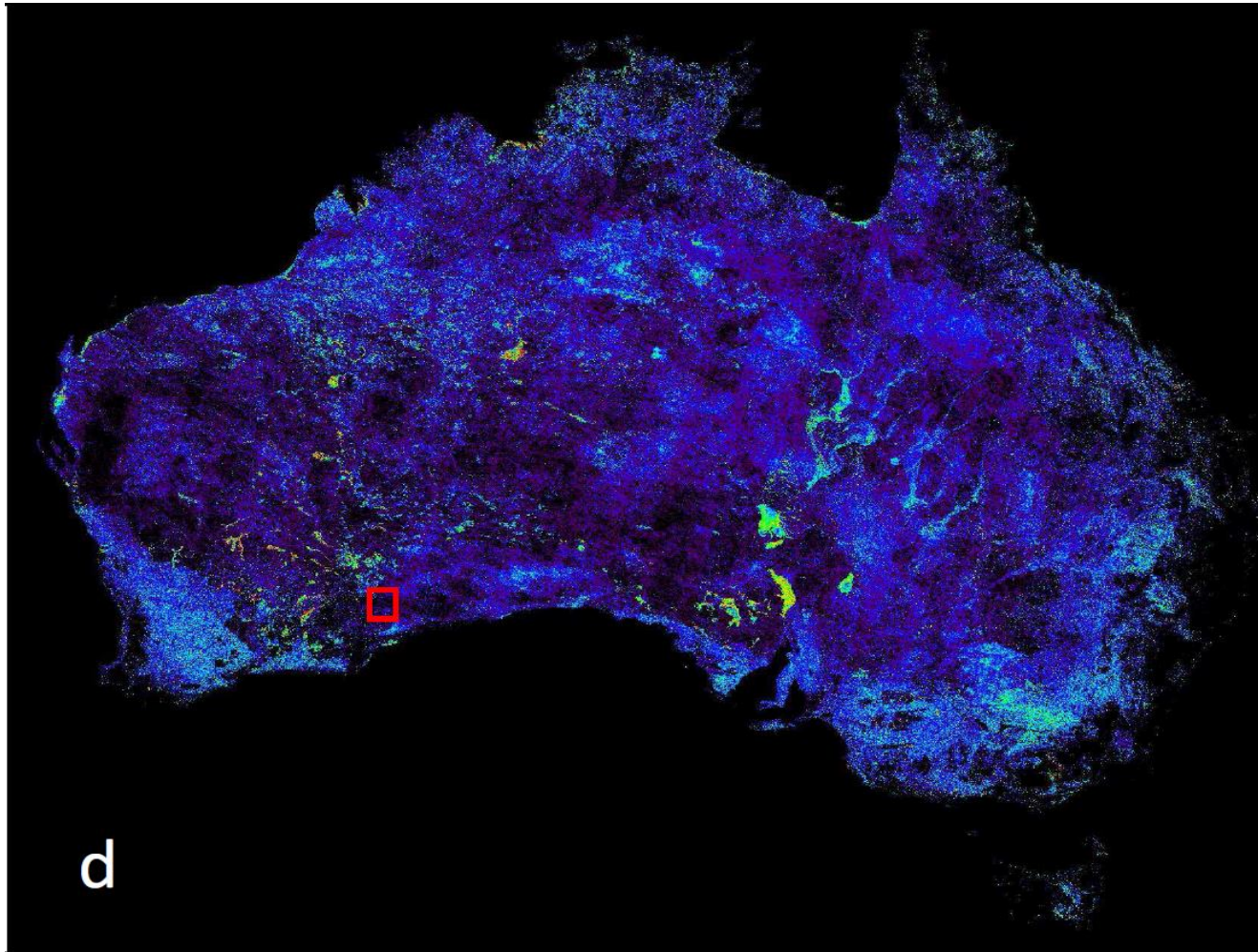


# Full time-series analysis on “DataCube- Landsat ‘Fractional cover’ product - Visualising time-series



# Application

## Satellite Vicarious Calibration Site Location - CSIRO



- Continental assessment
- LS5 (2003-2010)
- Identification of climatic zones, spatial and temporal variation, seasonal suitability for calibration activities
- The result is now being analysed to identify suitable sites for ground targets in combination with other data (e.g. ASTER).