

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.

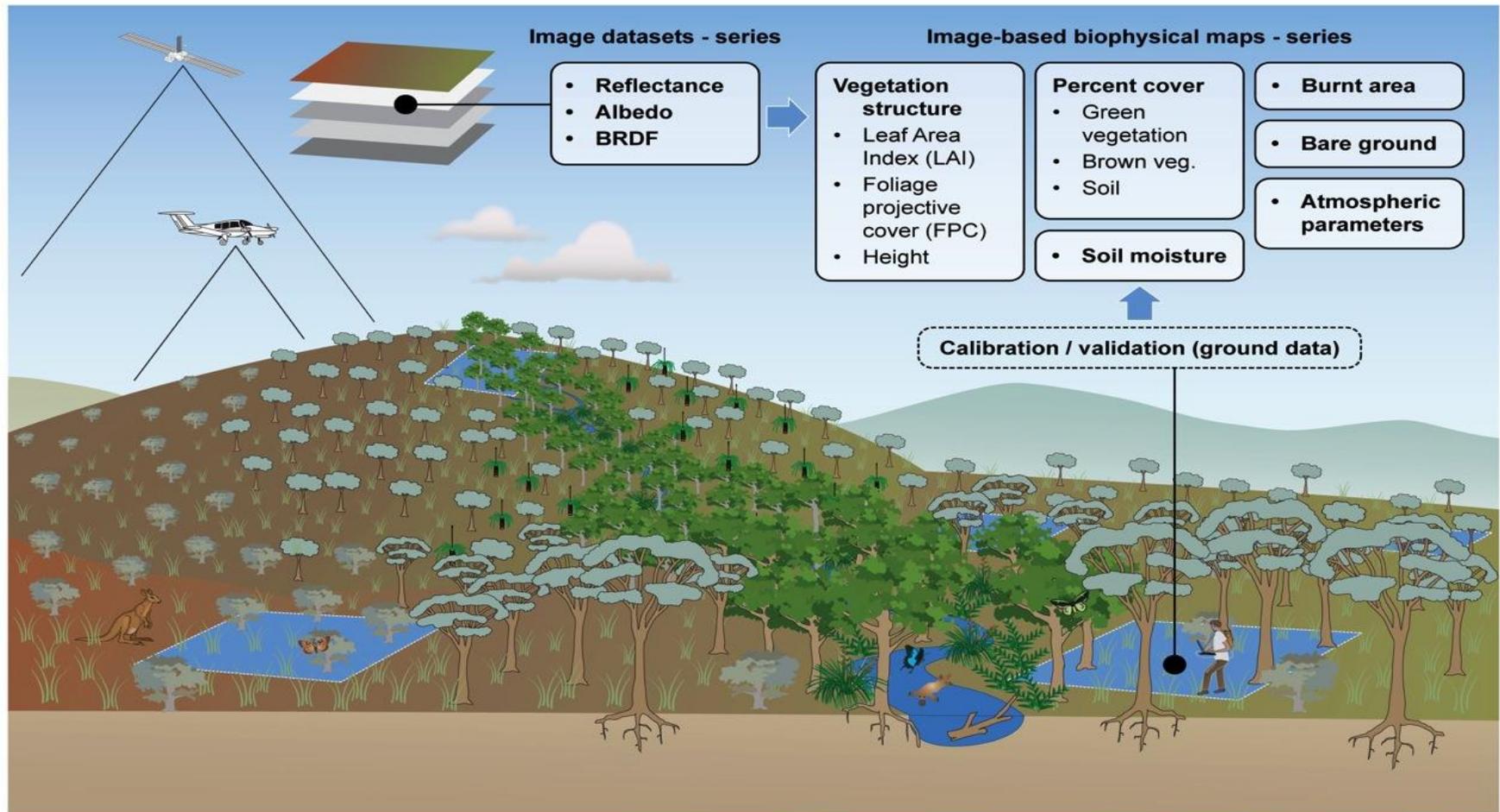
Rationale - Why do we need AusCover Network and Data Coordination in the Future?

- Australia's land-surface: 7.6 million km² ; 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

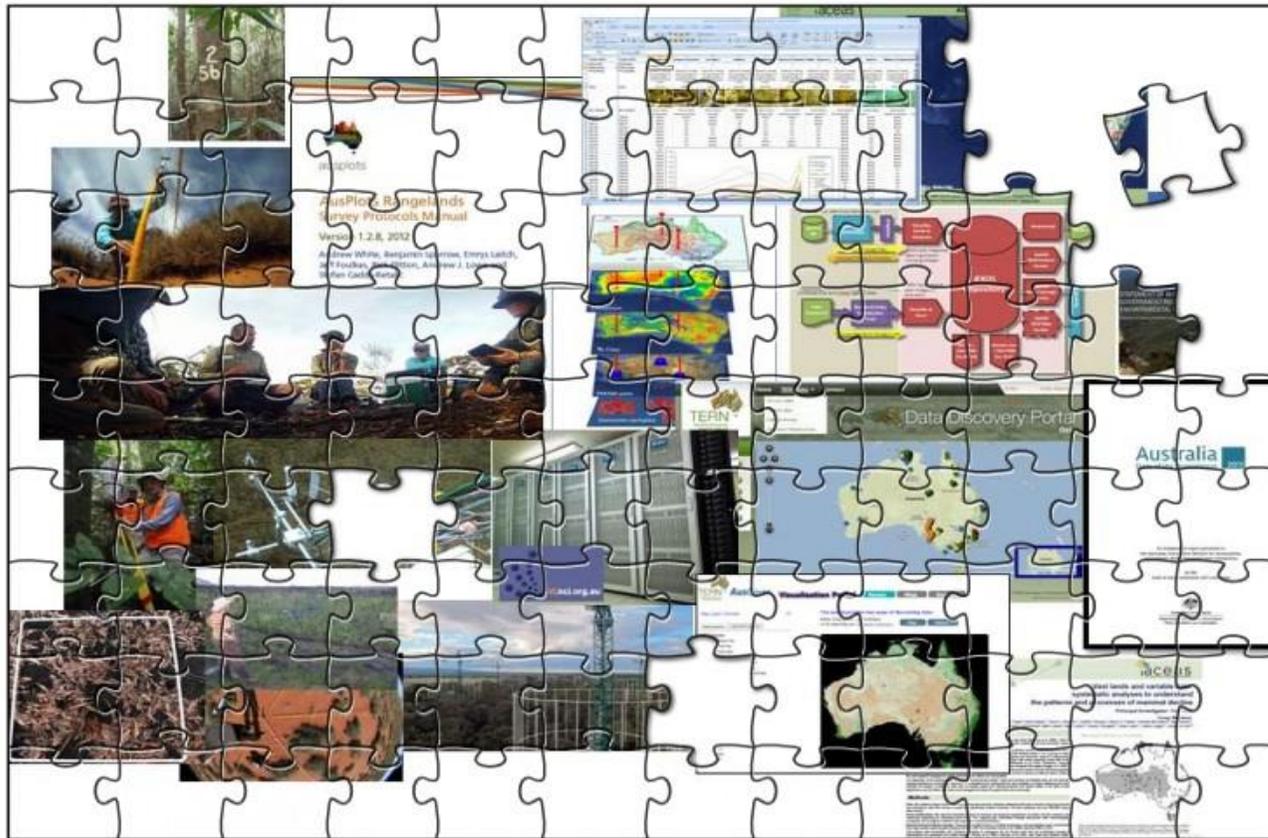
- Nationally-consistent, standard biophysical data products,
- Metadata and technical support documents
- Specialised space-borne, airborne & in-situ research-grade data

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



Darwin Node
Stefan Maier (CDU)

JAXA **CEOS** **esa**
Securing Data and Collaborations
via Links to International Agencies and
Networks



Brisbane Node
Stuart Rhinn (UQ)
Kasper Johansen UQ
Peter Scarth (UQ)



Perth Node
Merv Lynch (Curtin)



Sydney Node
Alfredo Huete (UTS)



Adelaide Node
Megan Lewis (Adel. U.)



Melbourne Node
Ian Grant (BoM)
Simon Jones (RMIT)



Canberra Node
Alex Held (CSIRO)
Medhavy Thankappan (GA)



Australian Government
Geoscience Australia

Hobart Node
Arko Lucieer (U Tas)



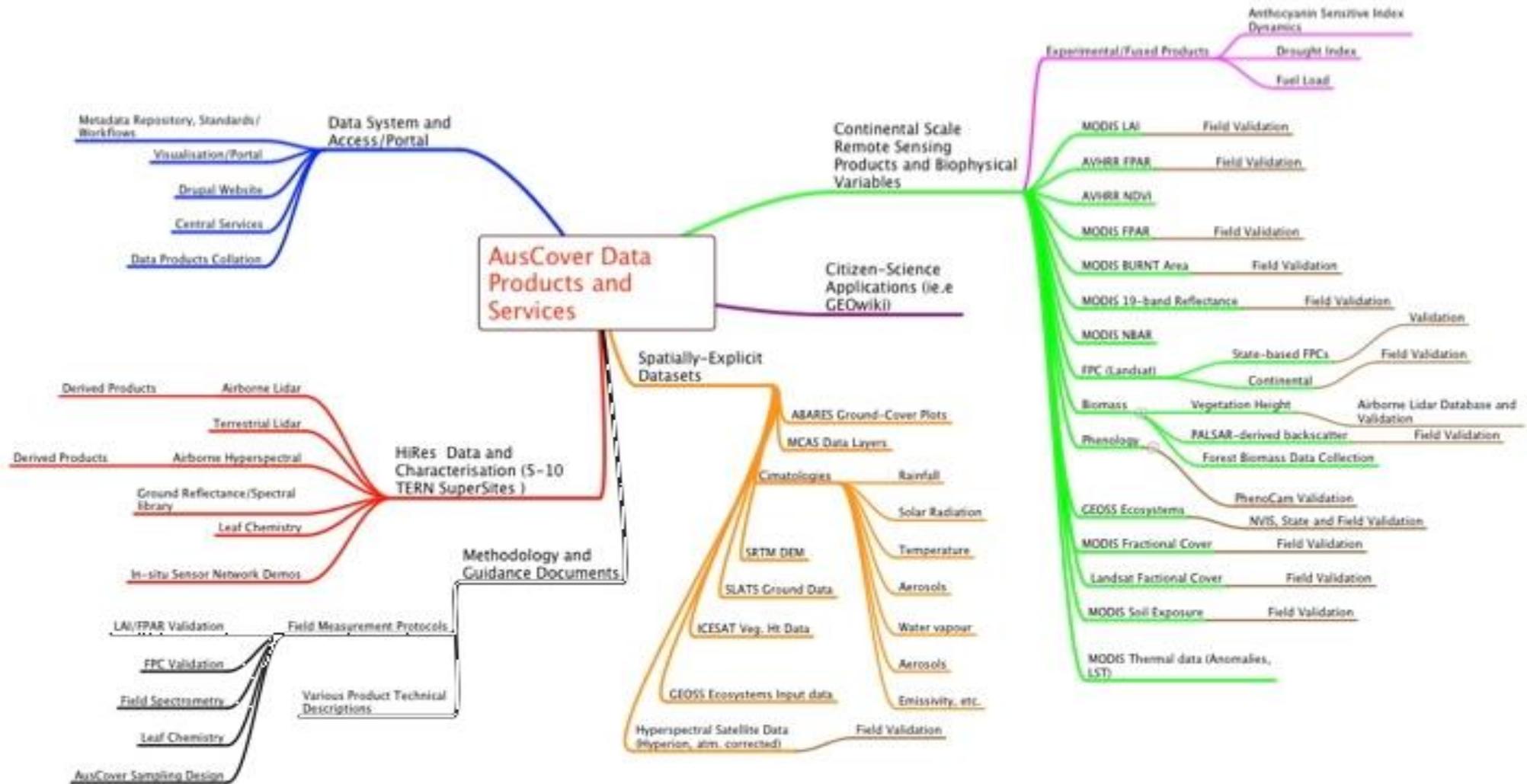
Australian Government
Bureau of Meteorology

8 Regional Nodes
12 Institutions
28+ Researchers and Students
..over 500 TBytes of
ground, airborne and
satellite data



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

Home TERN data Contact My Favourites My Searches



Data Discovery Portal

Delivering open access to Australia's terrestrial ecosystem data

Search ecosystem data

Map Based Search Use our map interface to search for data

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

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

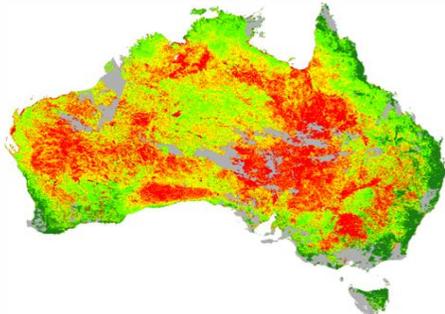
AusCover Remote Sensing Data Facility

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 0 50 70 80 90 100 %
Product ID: Curing_D3

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/urum...>
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 Propo...
Tue, 10 Dec 2013 16:50:16 +1100

System News

- News page**
Delayed production of LPDAAC mosaics
Fri, 13 Dec 2013 00:28:42 +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.



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 - Tumberumba OzFlux tower site

Browse TERN facilities & datasets

AusCover Remote Sensing Data Facility

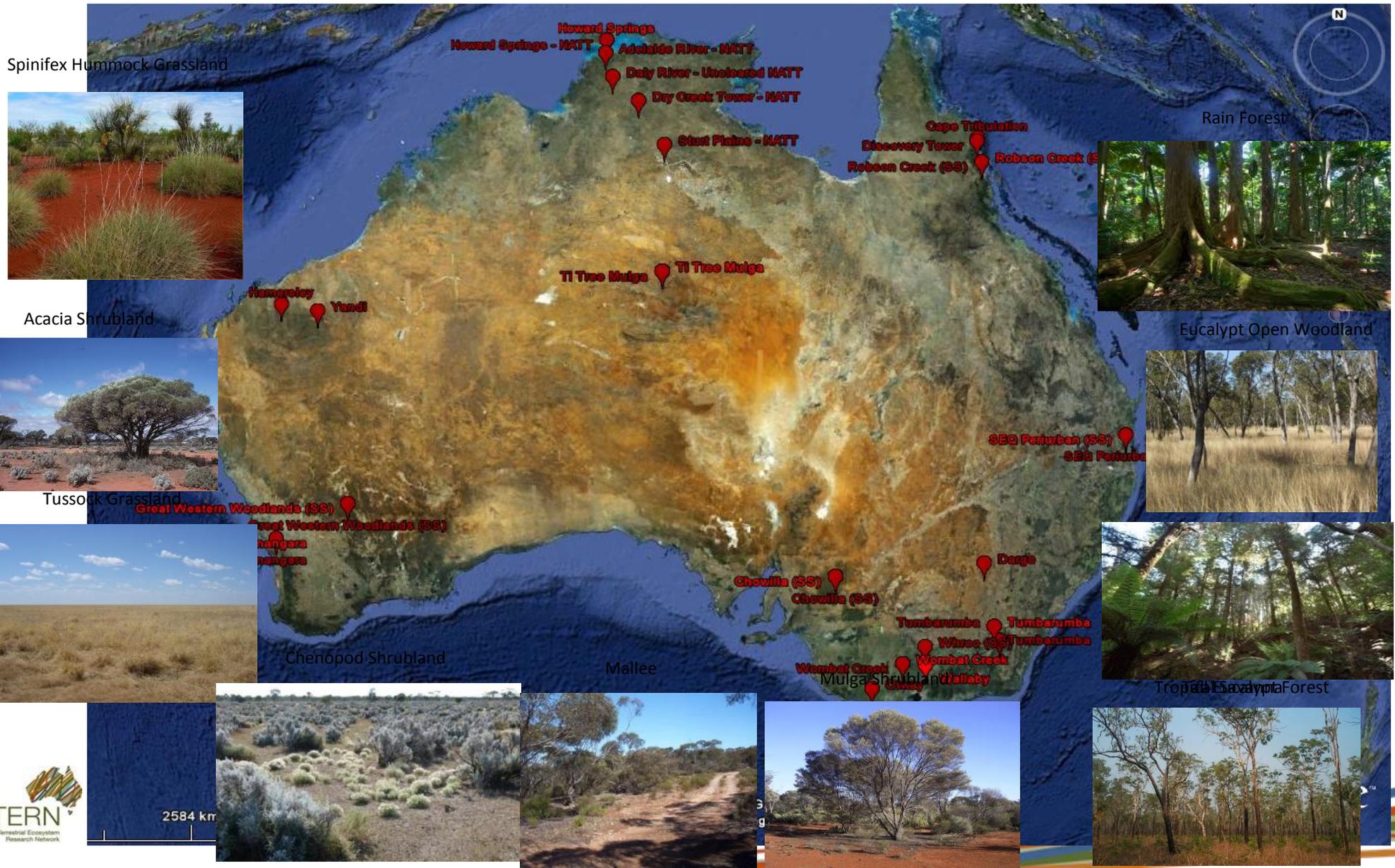
OzFlux

MSPN Multi-Scale Plot Network

ausplots



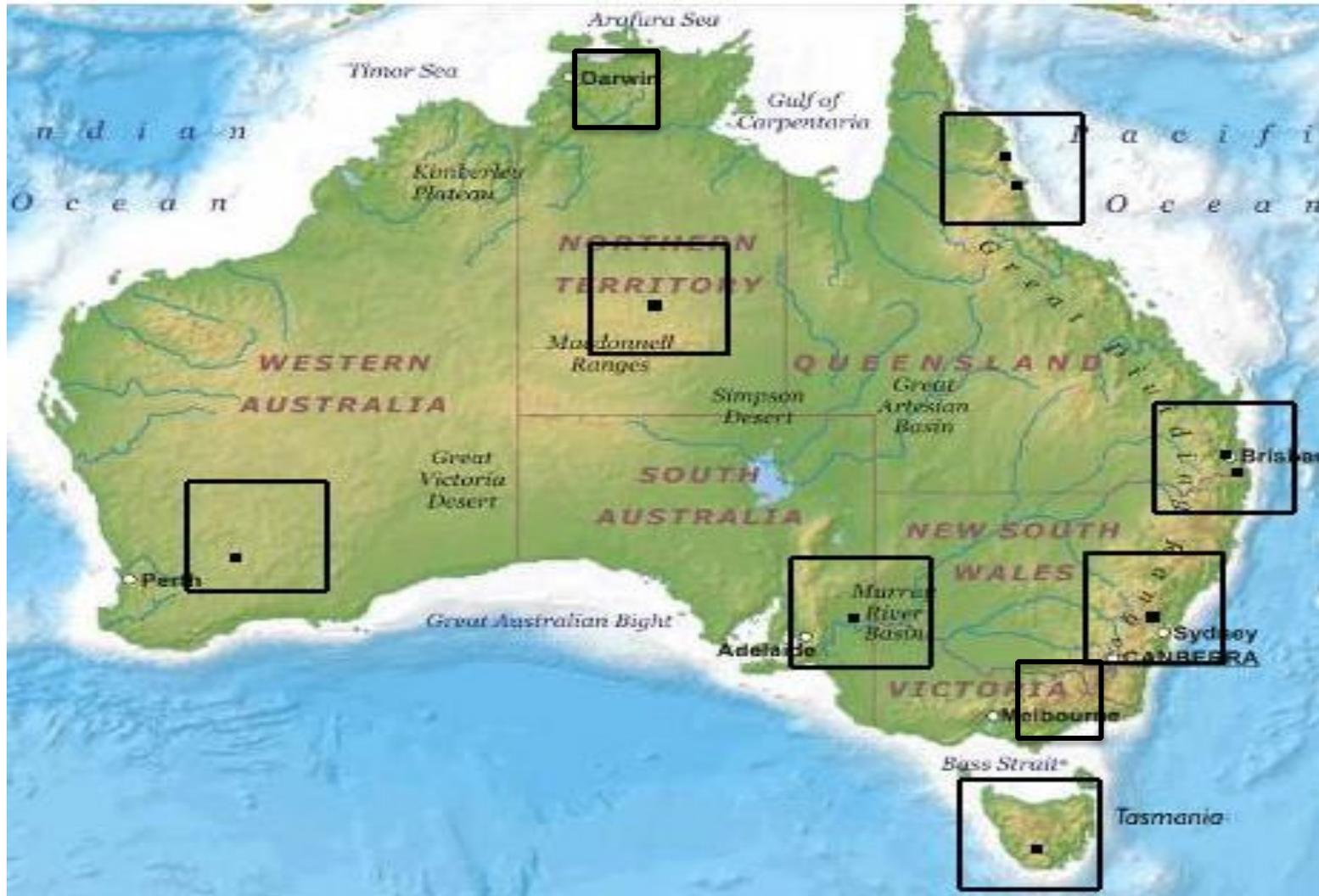
High-Spatial Resolution Remote Sensing Data Collection for Validation and Model Parameter Estimation (across TERN Supersites and other Validation Sites)



High-Spatial Resolution Remote Sensing Data Collection

(TERN Supersites and other Validation Sites)

Australia
Land Area:
7.5 m sq. Km



Field Validation Team Activities

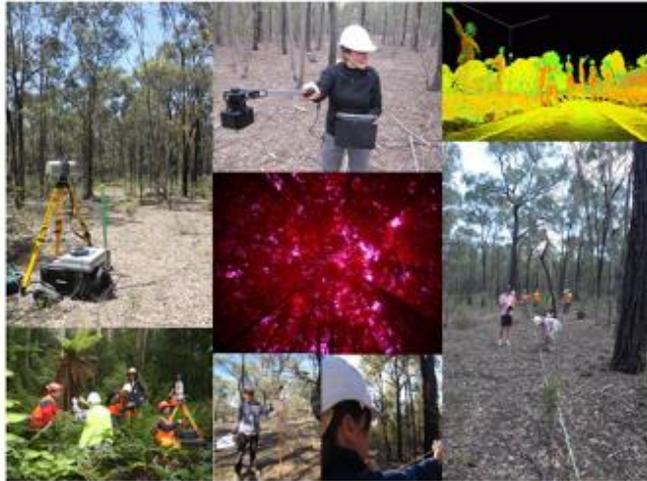
Selected photos source © Charles Tambiah and members of the AusCover team



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



Australian Government
Geoscience Australia



RMIT University

Queensland Government



University of
Zurich^{UZH}



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



Charles Darwin
UNIVERSITY
Innovation in Education

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

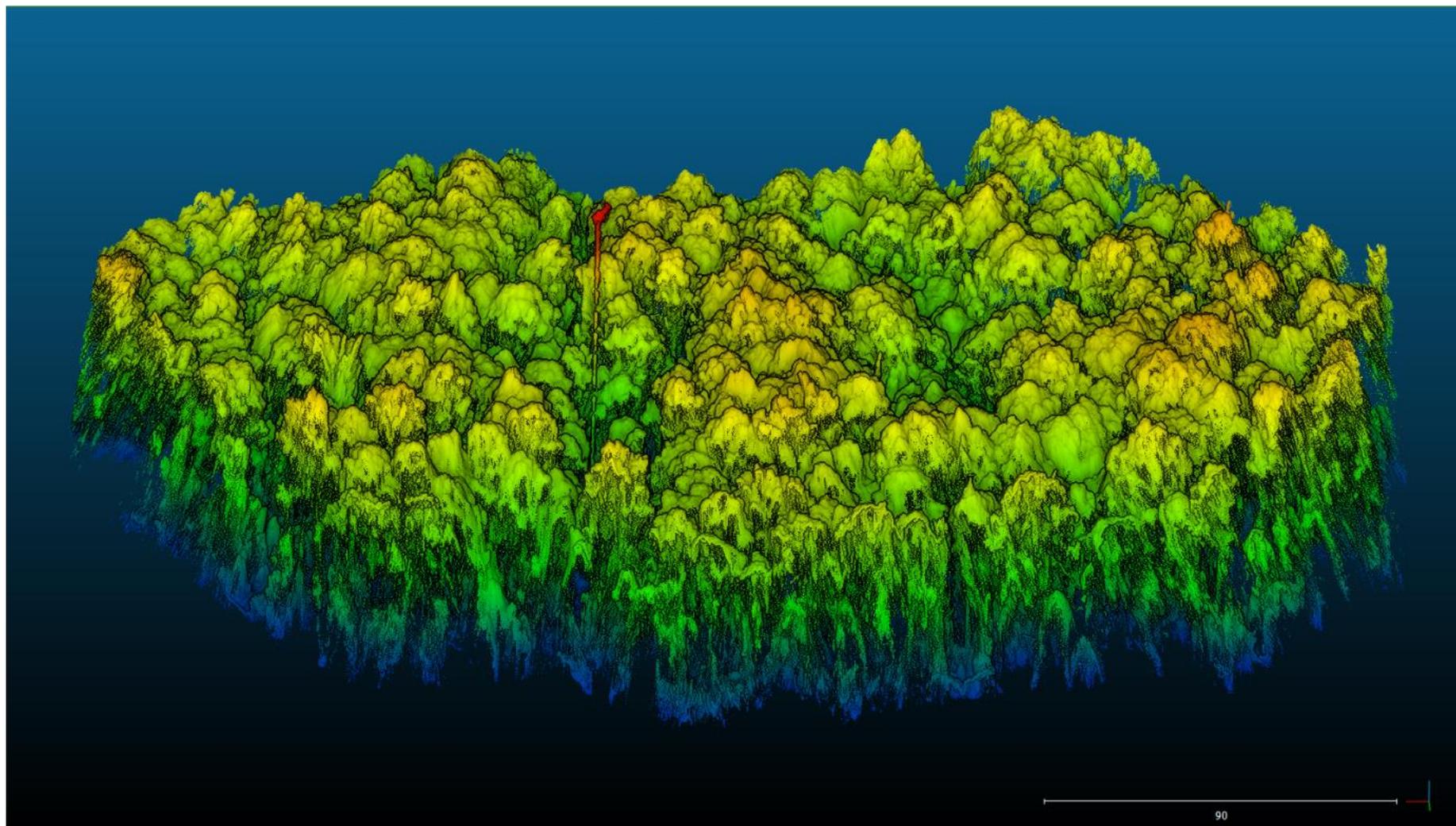


- Sample DWEL scan from Warra Flux site
- Completely different veg types in Warra – Variability within a forest
- 800m away from the other site

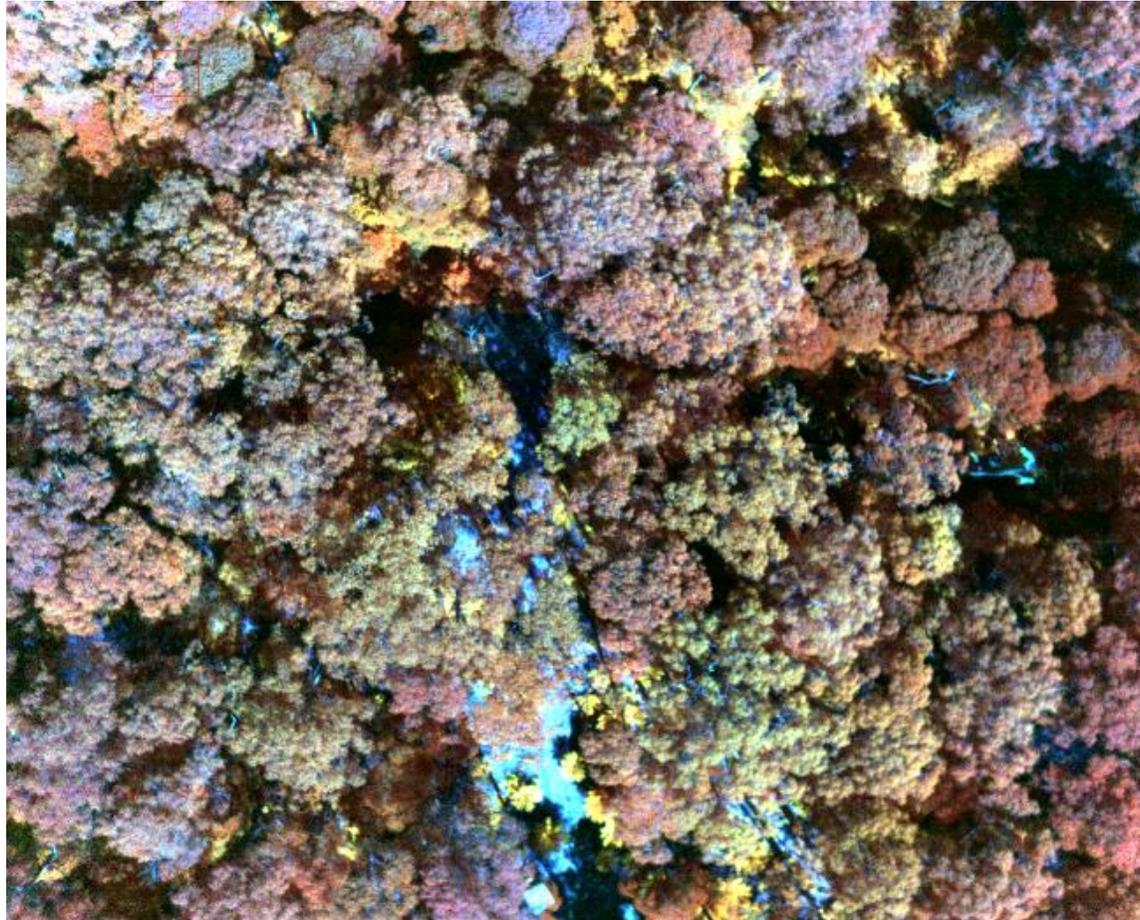
3D point cloud from UAV

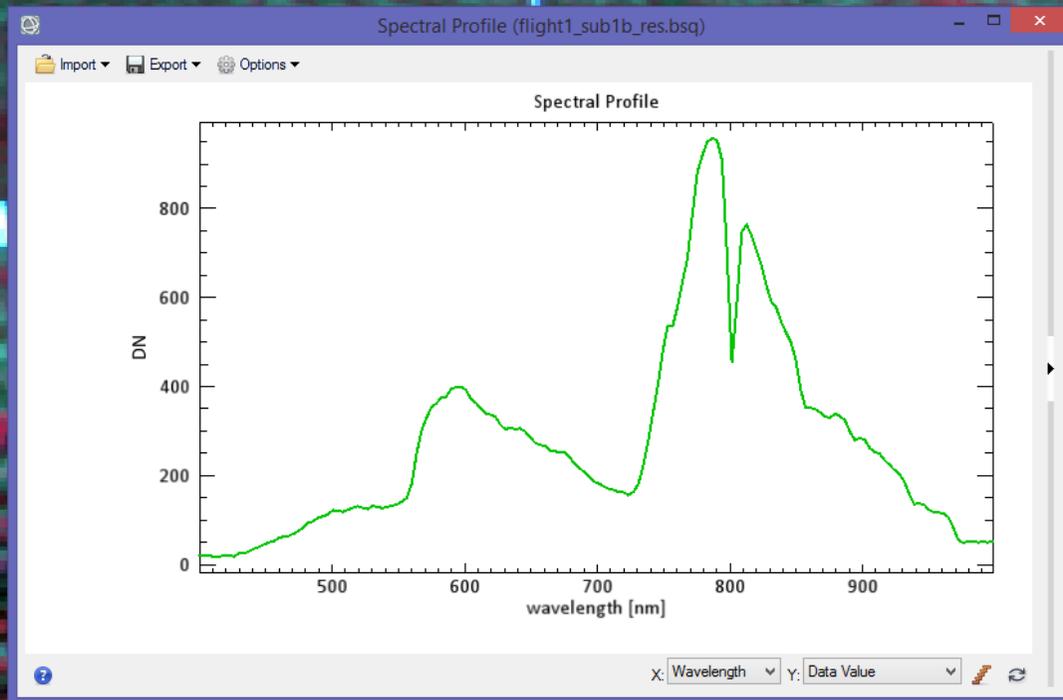
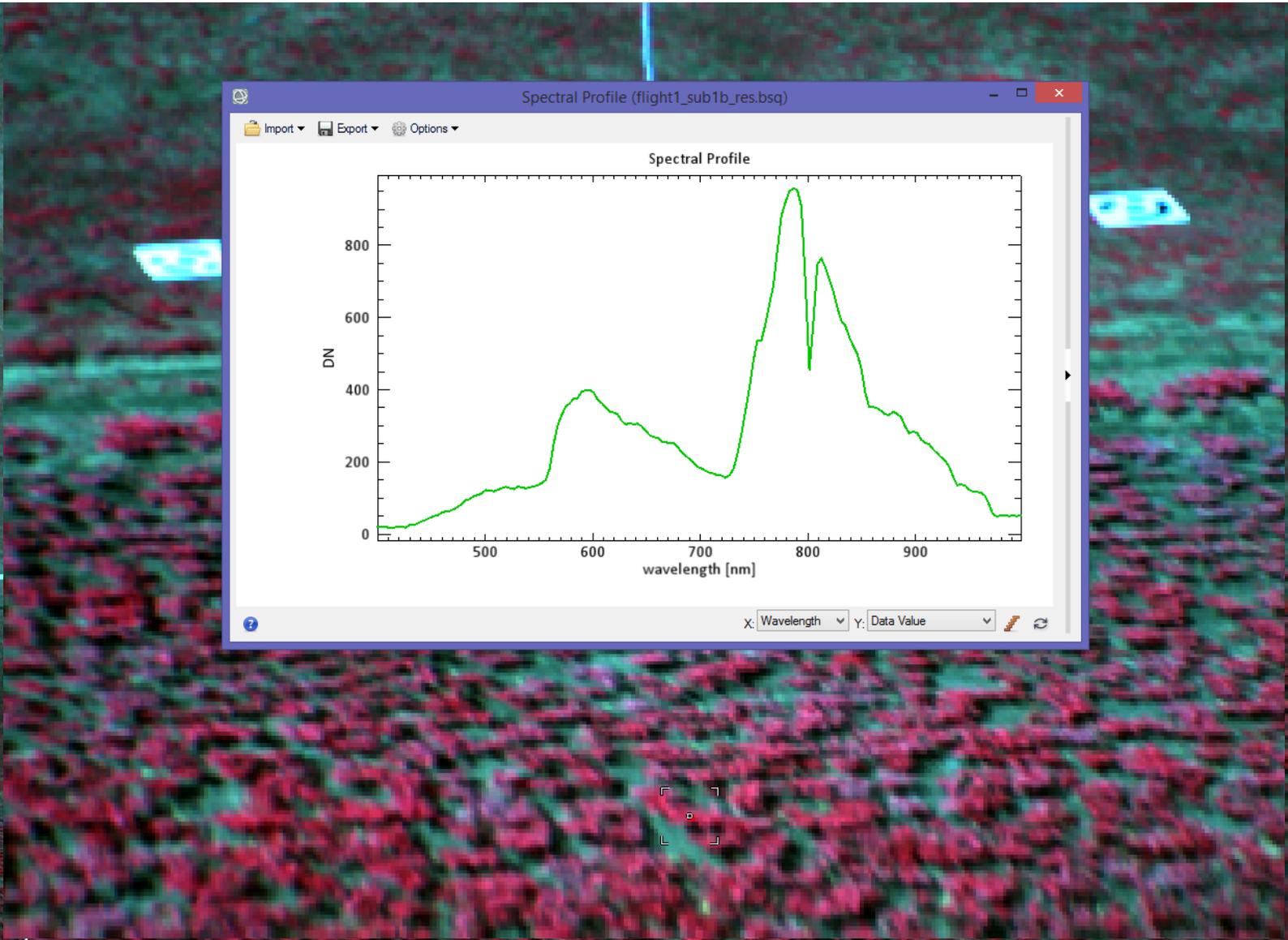
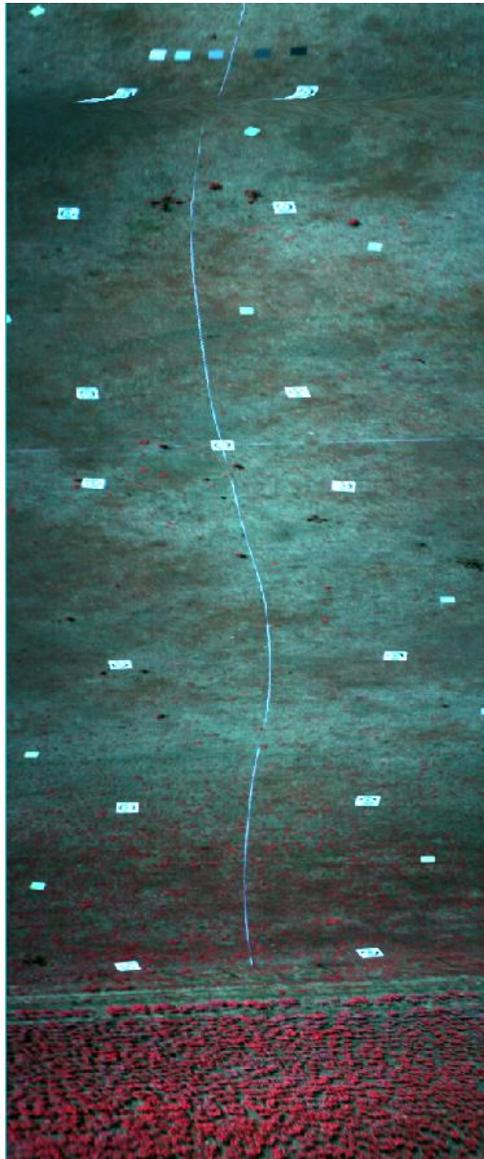


Canopy height



Multispectral UAV image of Warra Supersite

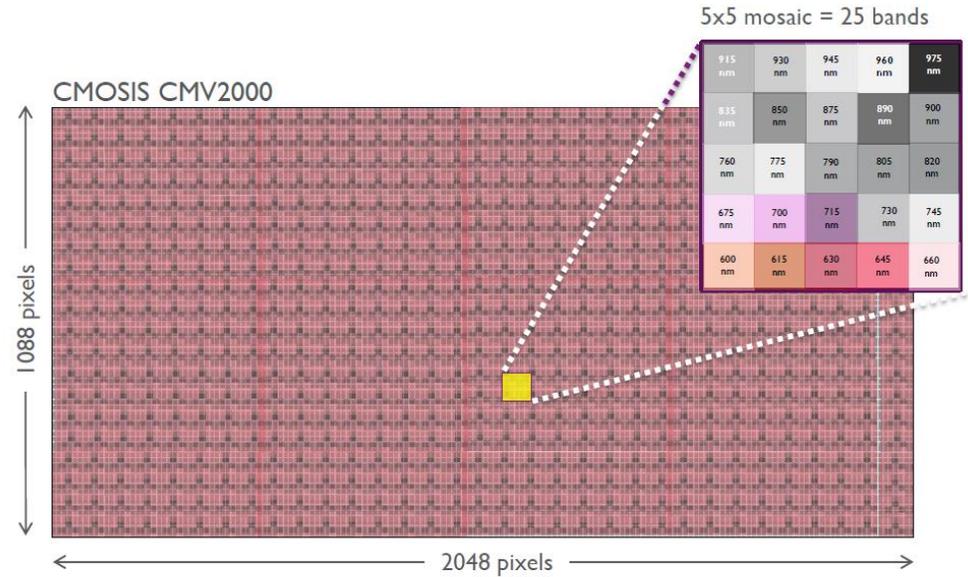




Hyperspectral snapshot sensor (IMEC)



SNAPSHOT MOSAIC HSI SENSOR (5X5 NIR)

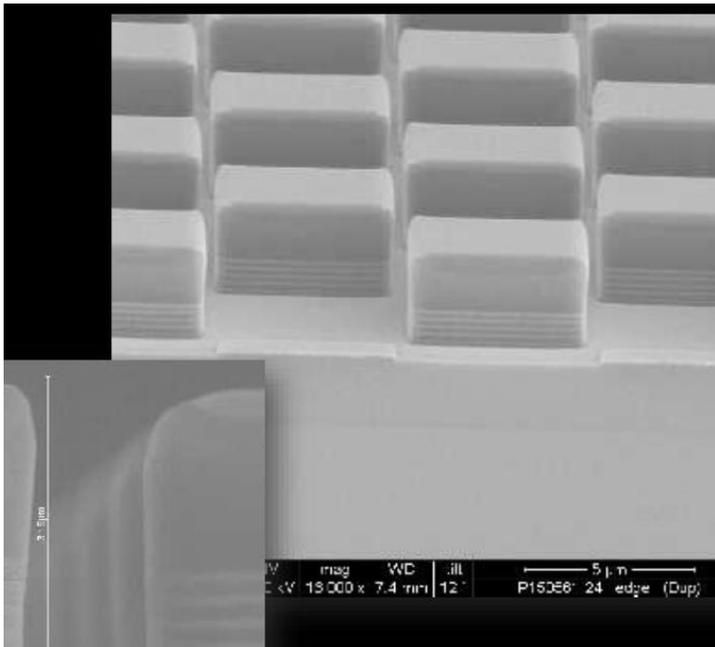


Key specifications

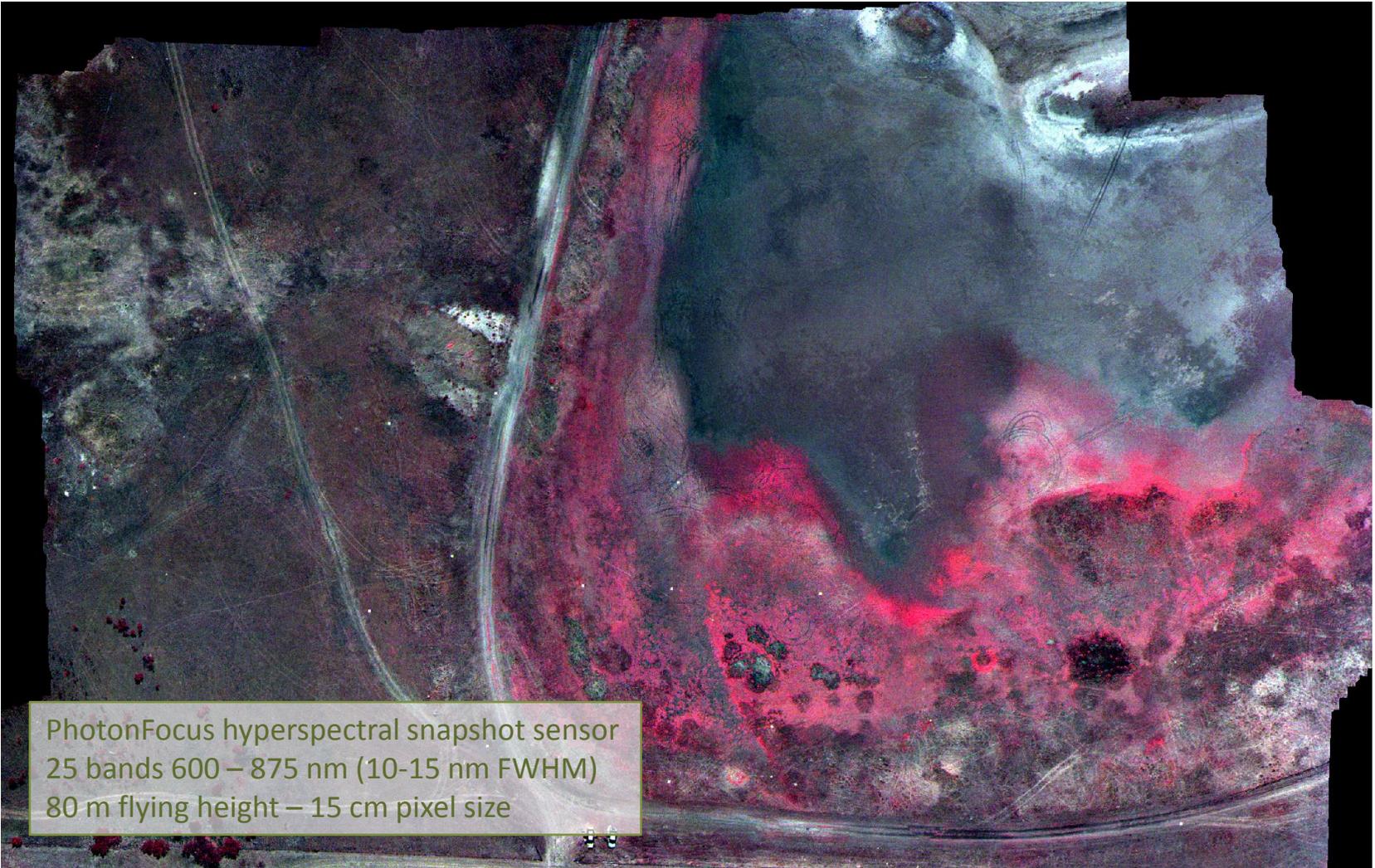
- **Spectral resolution:** 5x5 mosaic (1 filter / pixel) = 25 bands in 600-1000nm
- **FWHM:** ~ 10-15nm
- **Spatial resolution:** from 410x218 (RAW per band)
- **Speed:** up to 340 data-cubes / s (max sensor limit)



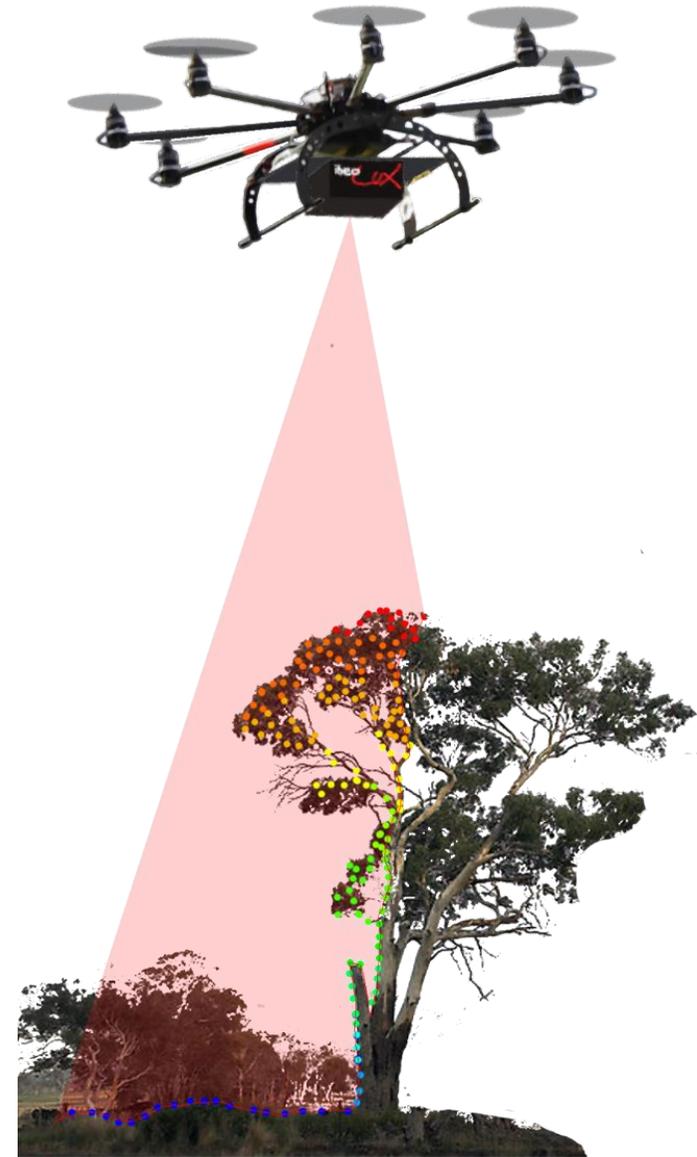
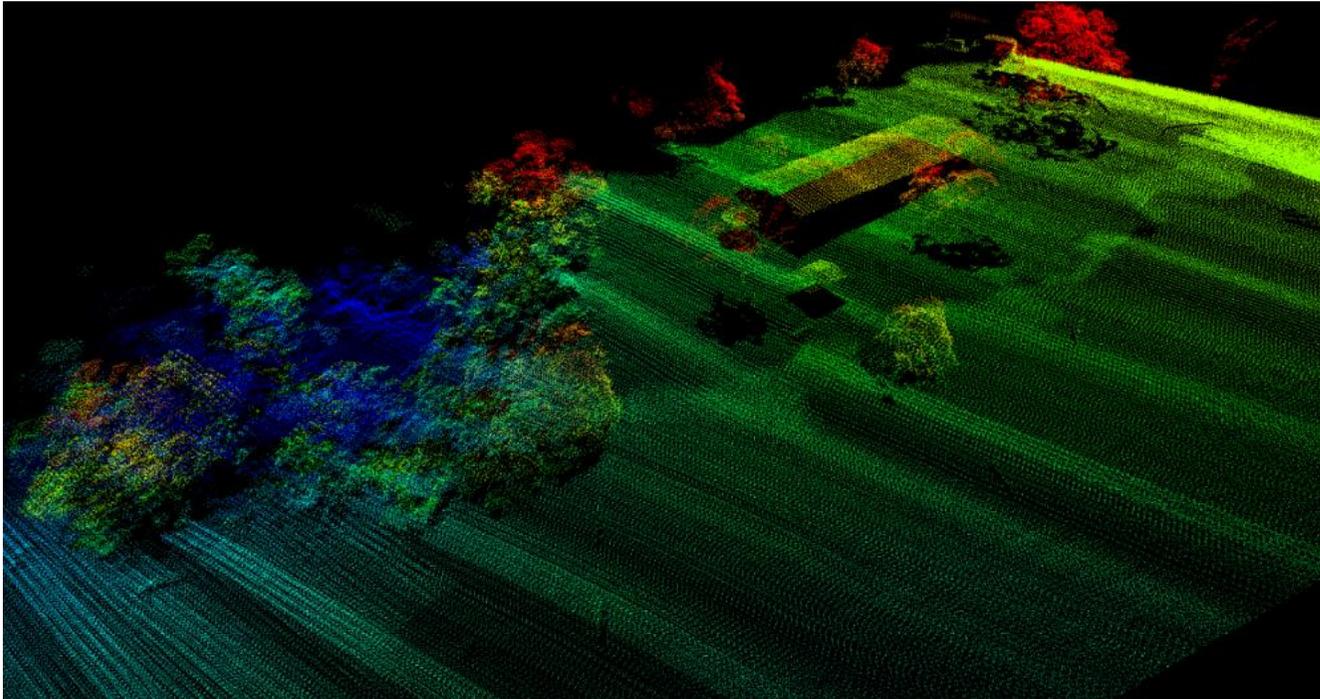
Source: IMEC and PhotonFocus

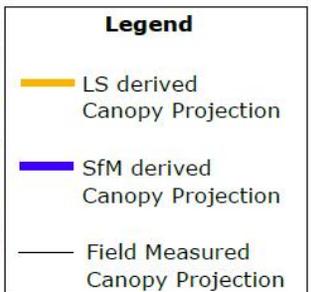
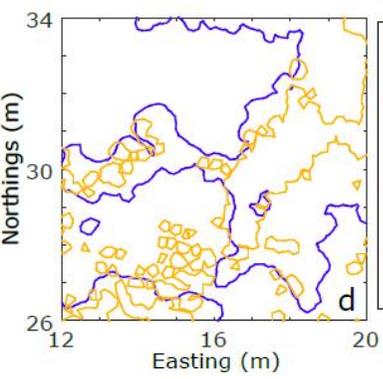
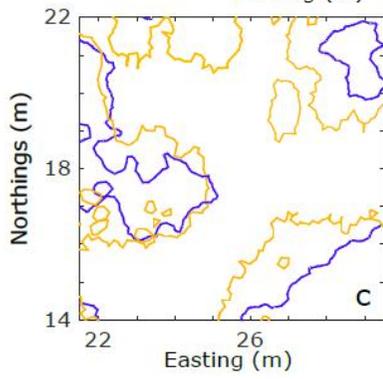
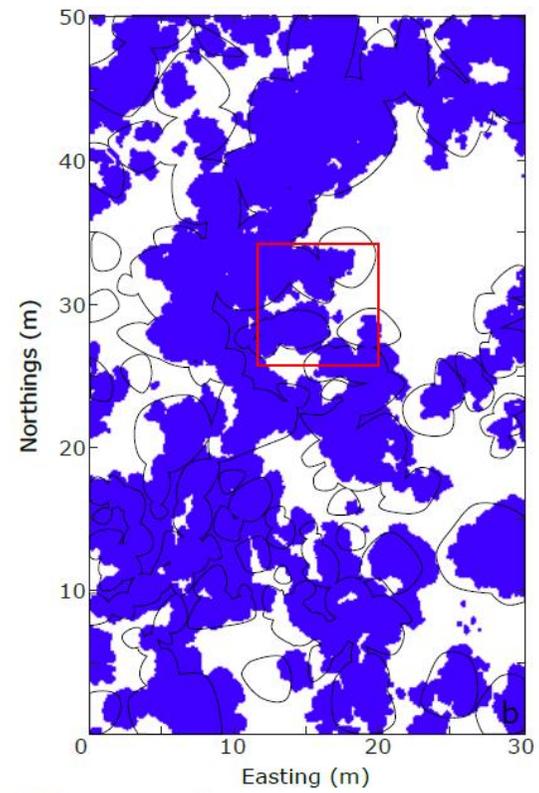
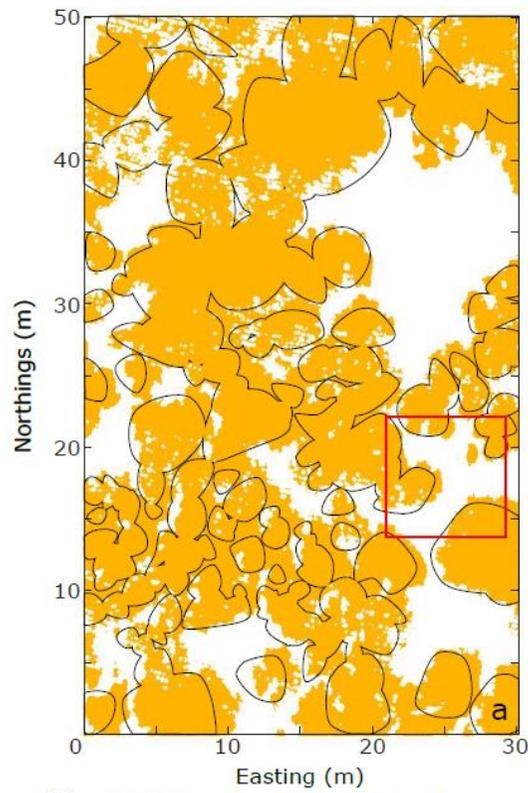
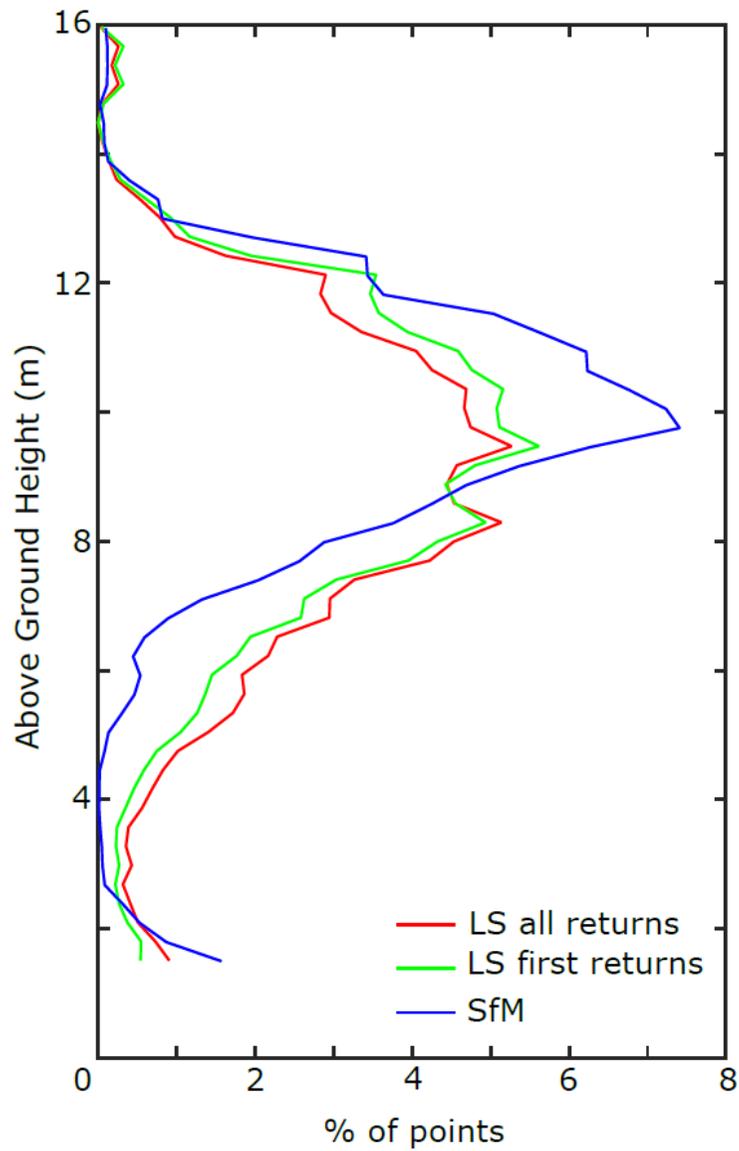


Native grasslands Tasmanian Midlands



UAS LiDAR





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

“Devourer” X8 heavy-lift multi-rotor

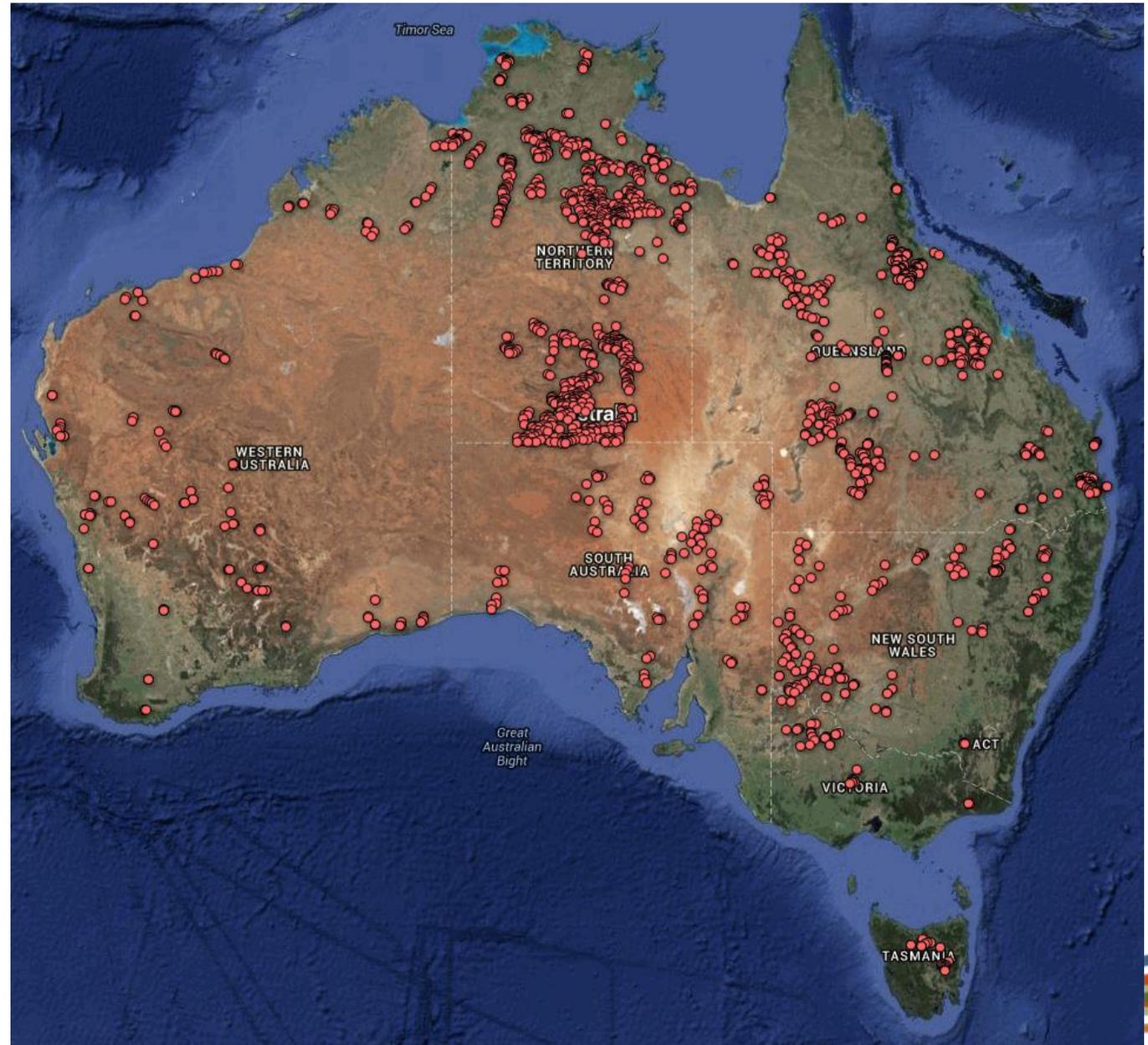
Intel NUC data logger



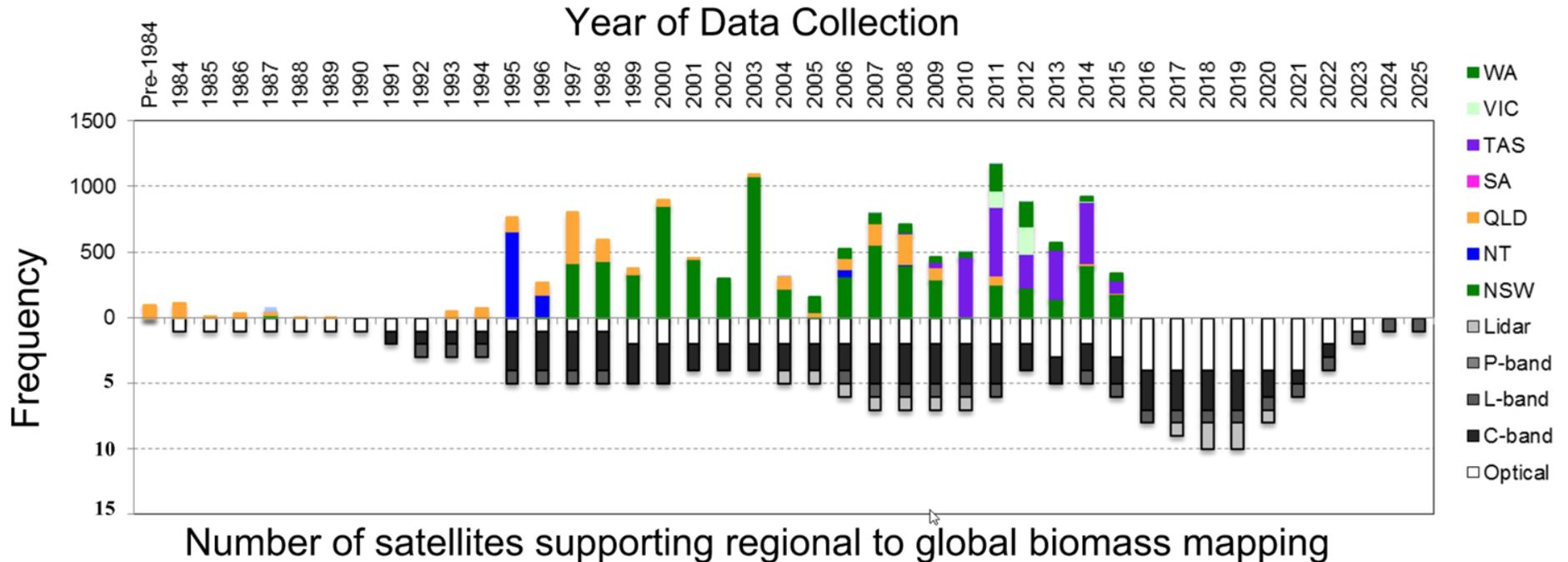
- ▶ \$7999
- ▶ Dual Returns
- ▶ 830 grams
- ▶ 16 Channels
- ▶ 100m Range
- ▶ 300,000 Points per Second
- ▶ 360° Horizontal FOV
- ▶ ± 15° Vertical FOV

Fractional cover field sites

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



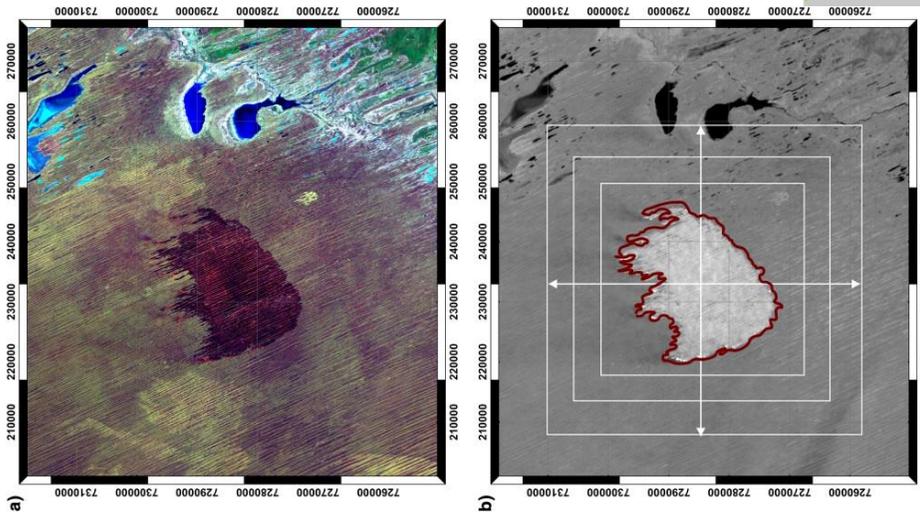
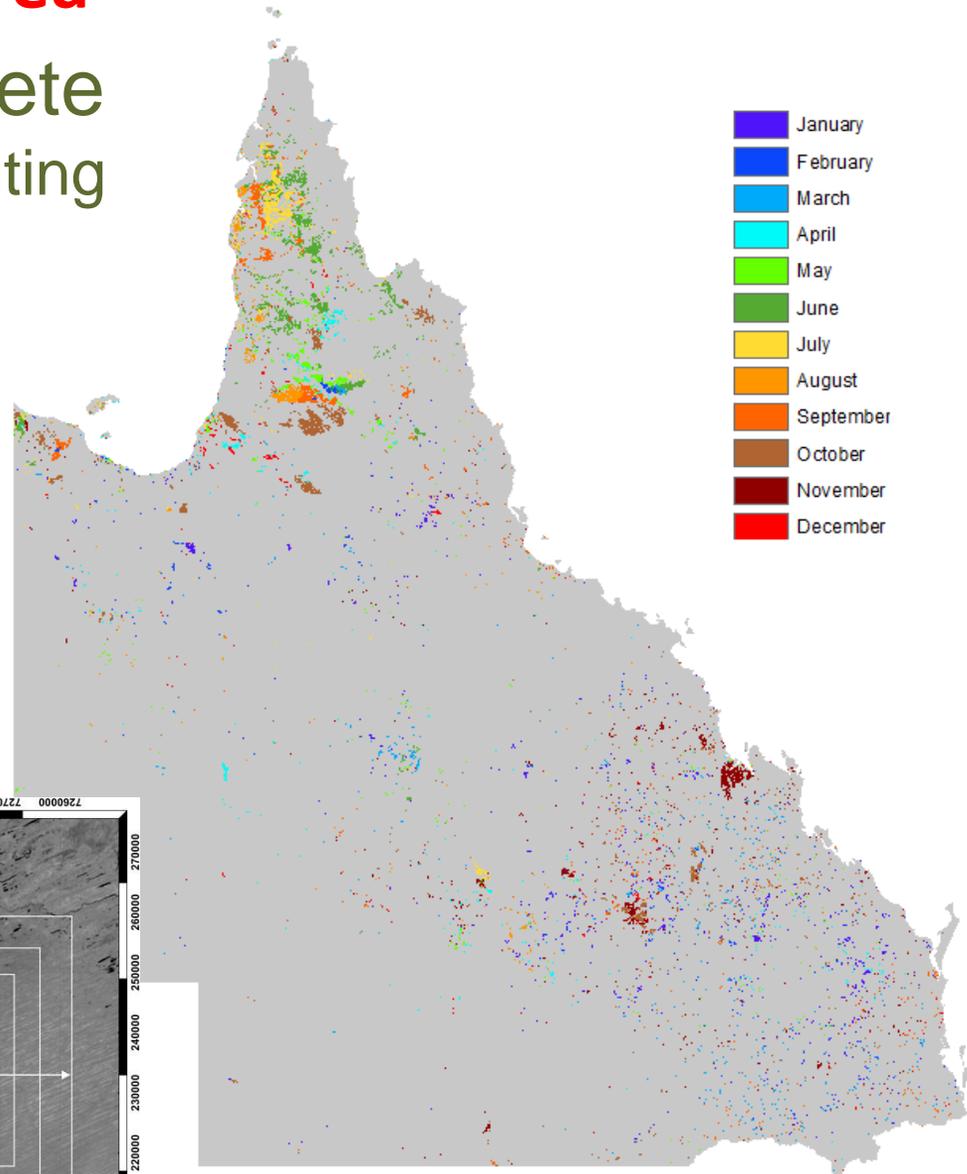
Future data needs for earth observation CALVAL



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



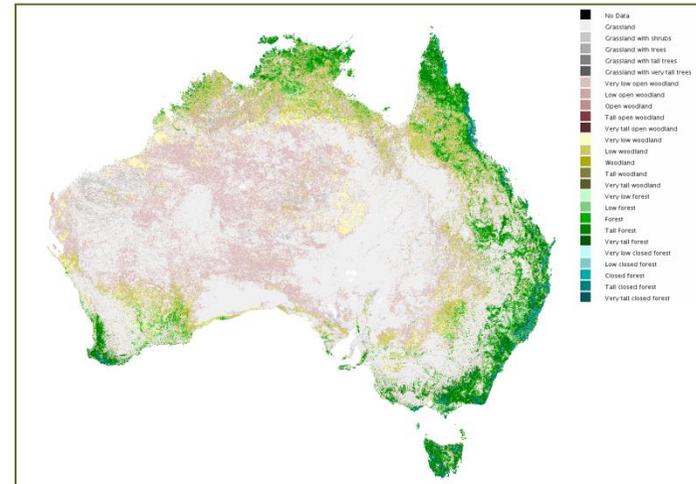
1988



Biomass and Structural Map, Australia

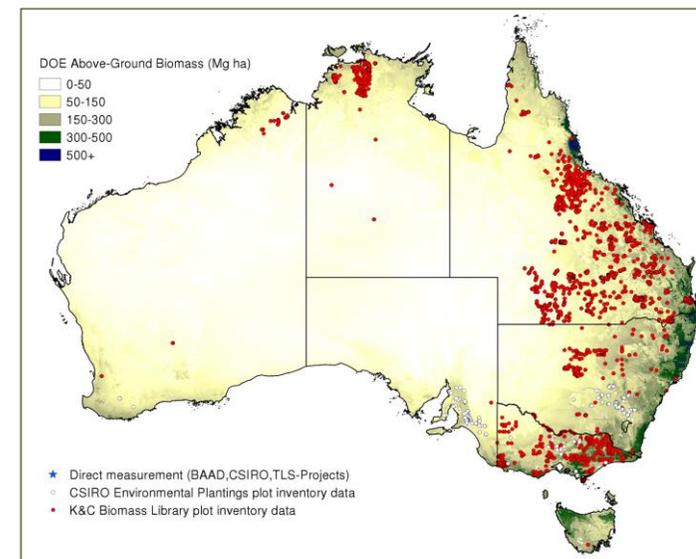
- Structural classification

- 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

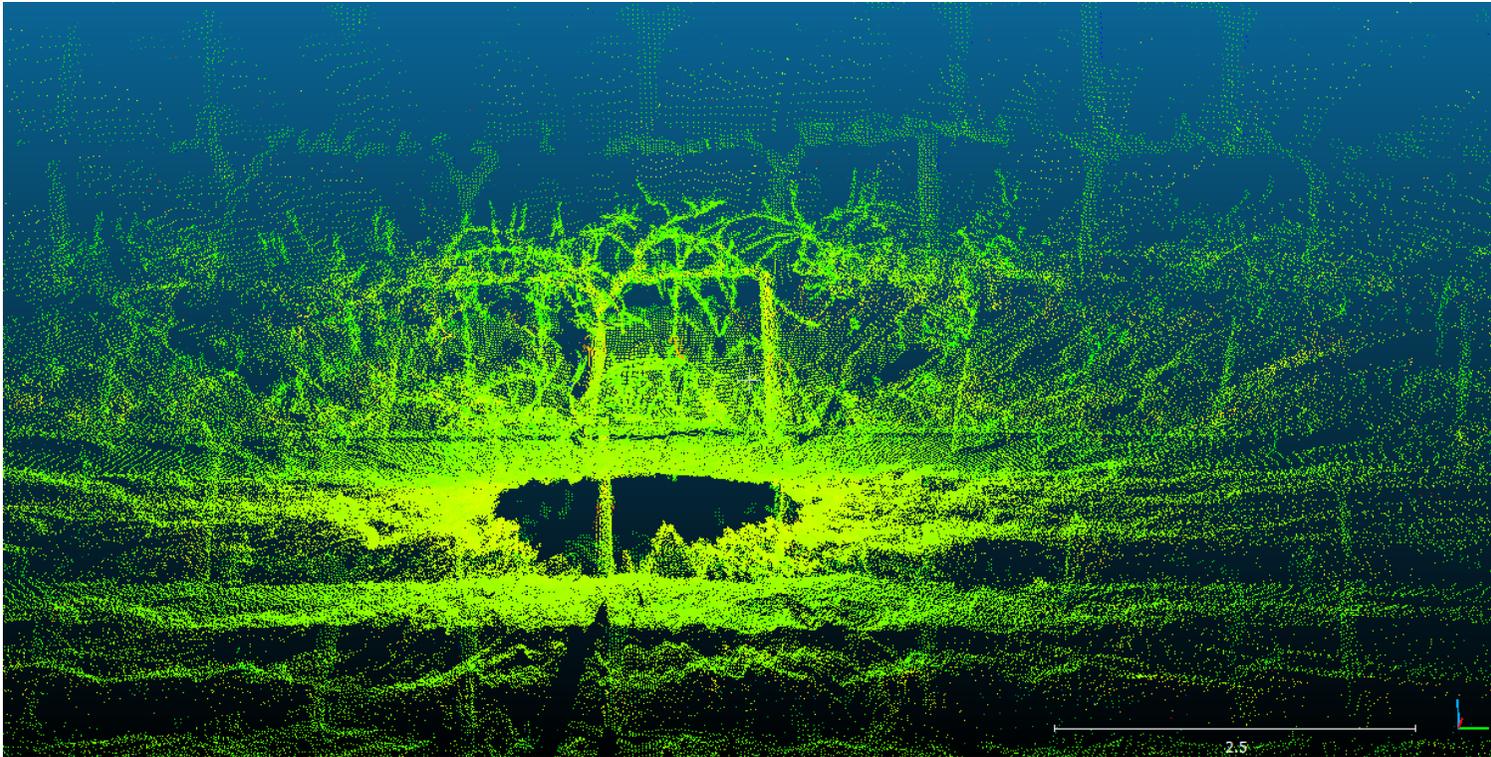


Compact Biomass Lidar (CBL) single scan of T5REP4 (minimal prune)

-Vine canes clearly evident in good detail

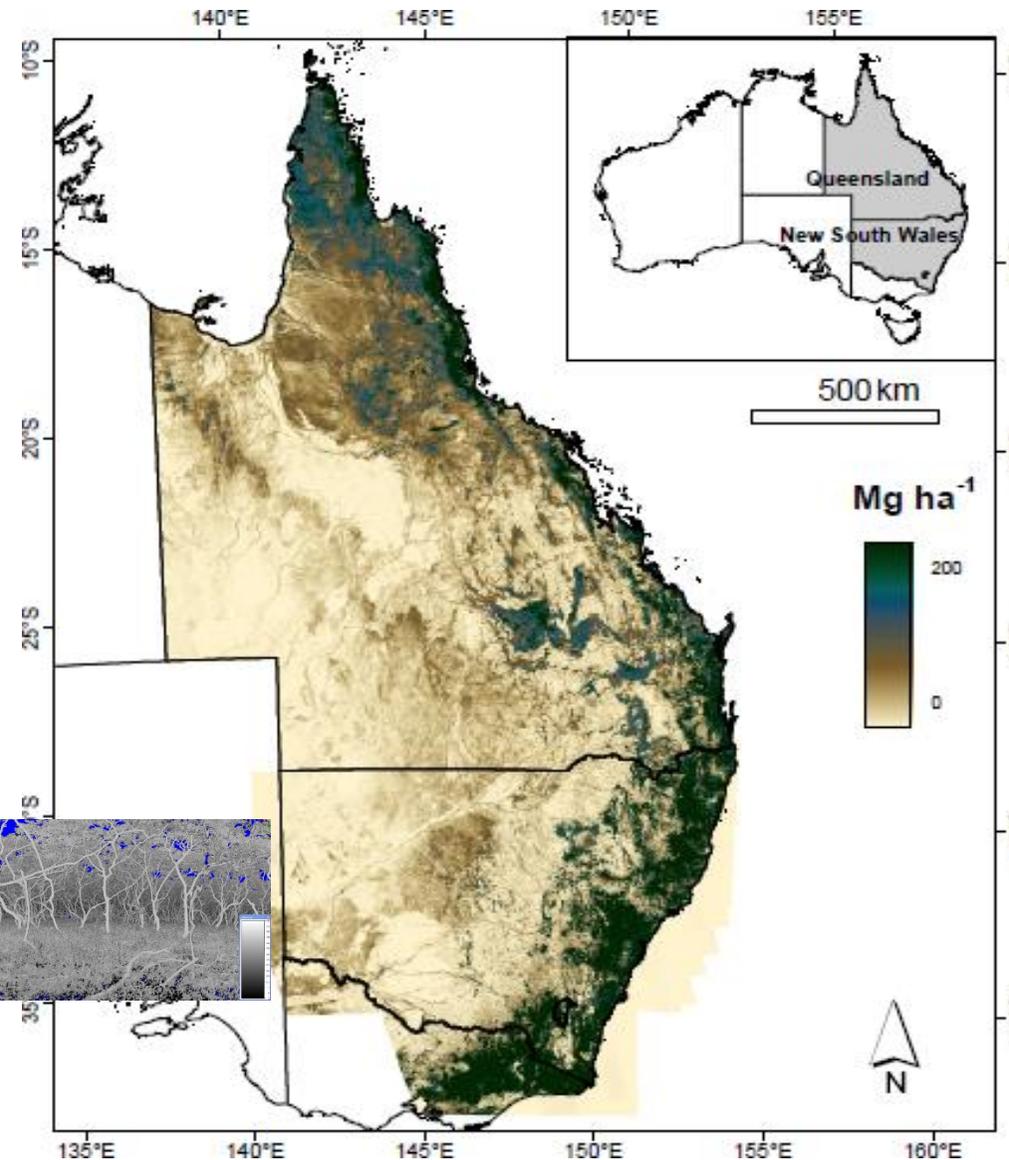
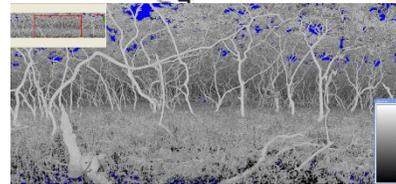
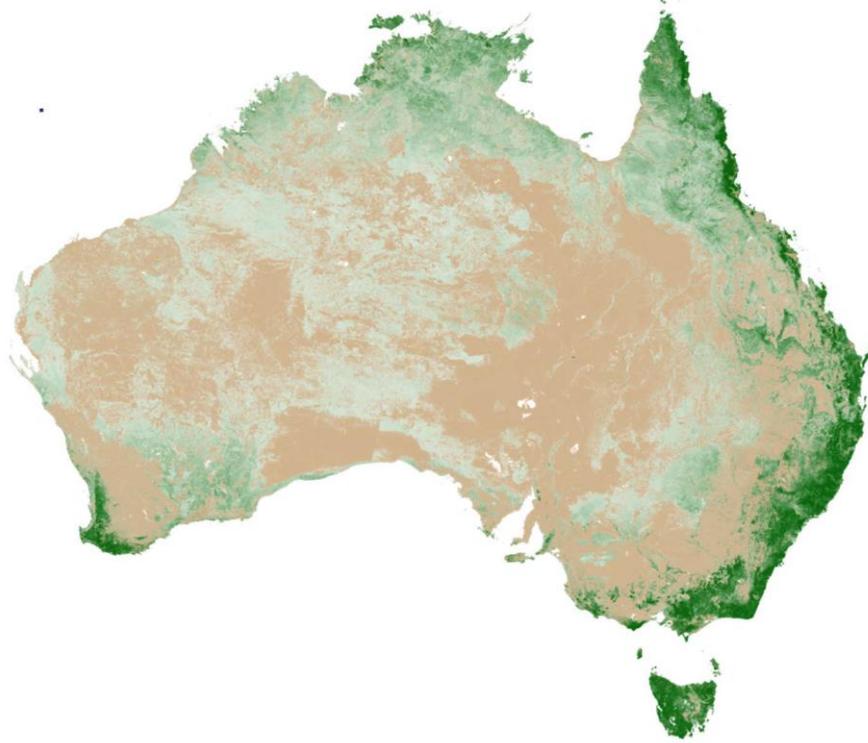
-This detail will improve when adjacent scans are registered together

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



Continental-scale Products: eg Woody Aboveground Biomass Mapping

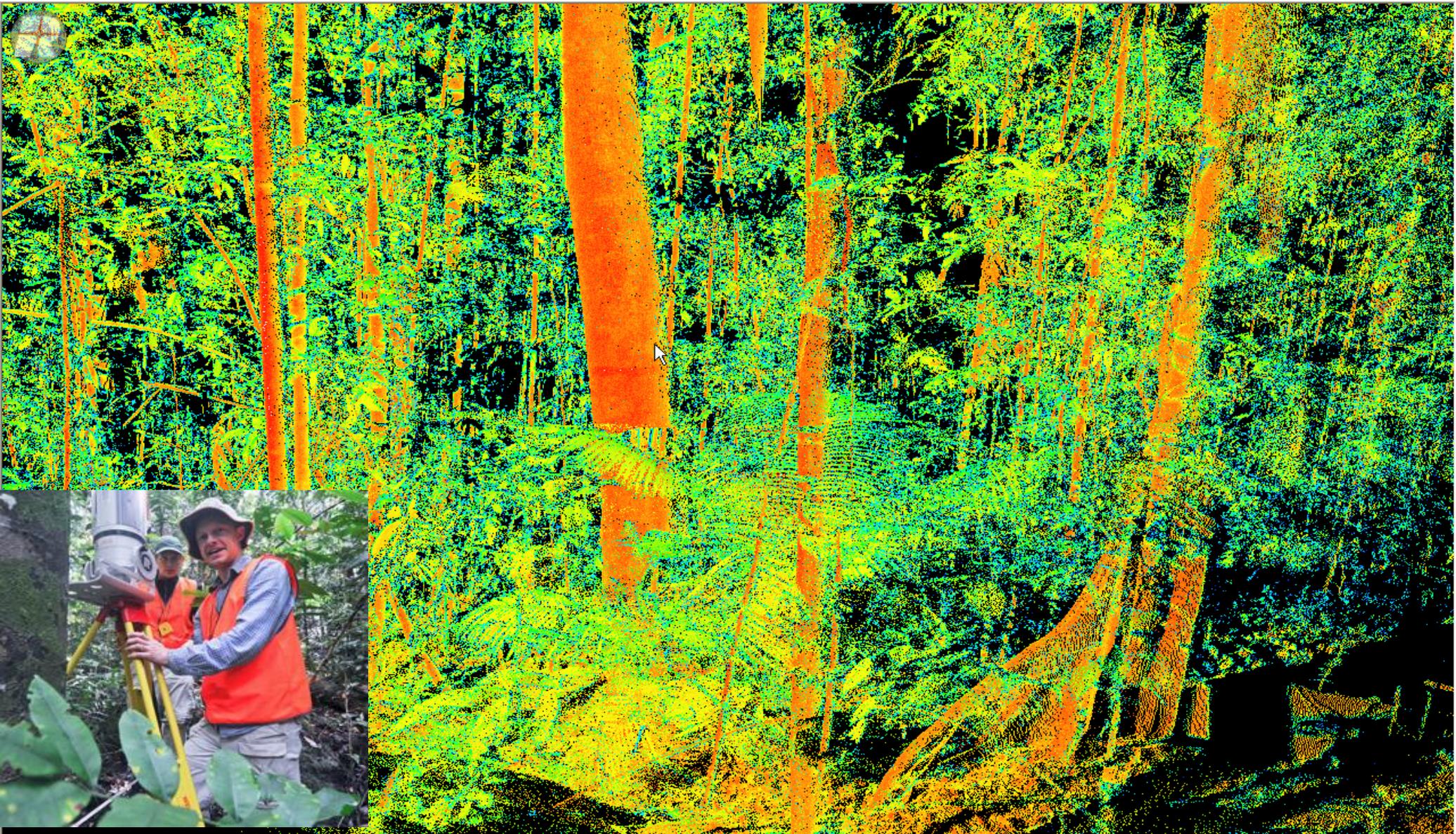
Persistent Green Cover



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

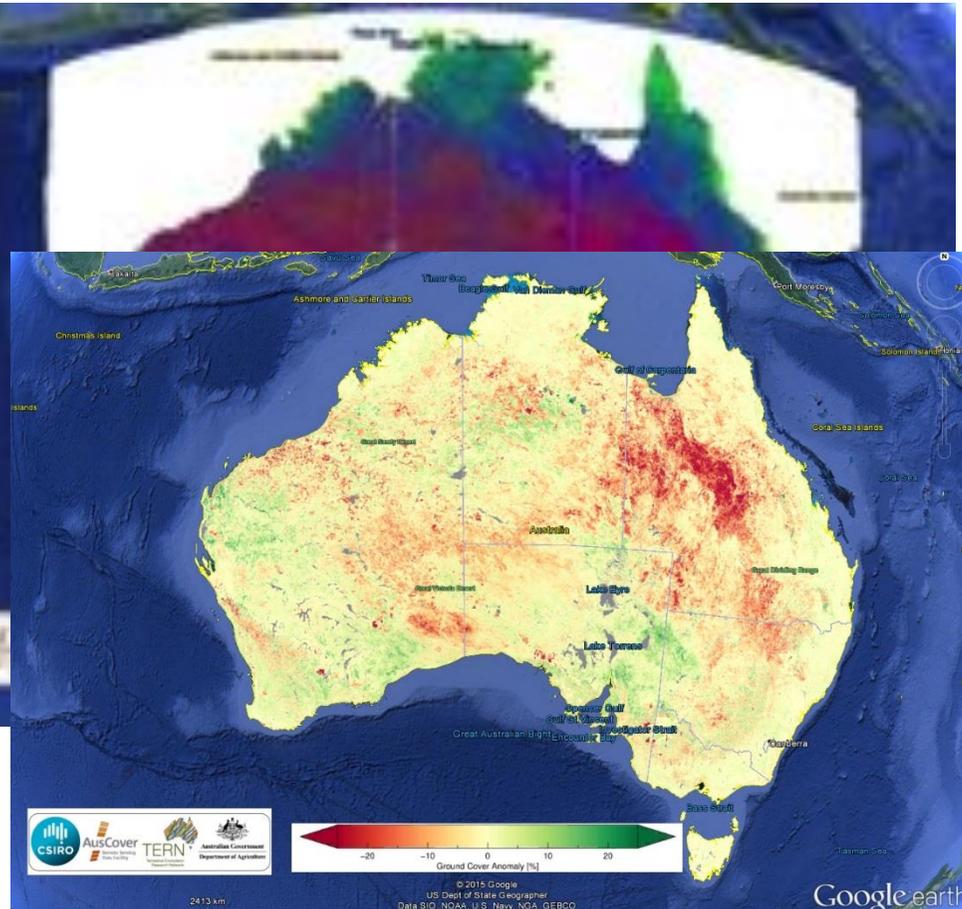
Biomass and Fuel Loads with Terrestrial Lidar Scanner Data

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.



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

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

A typical day of data acquisition

Landsat7

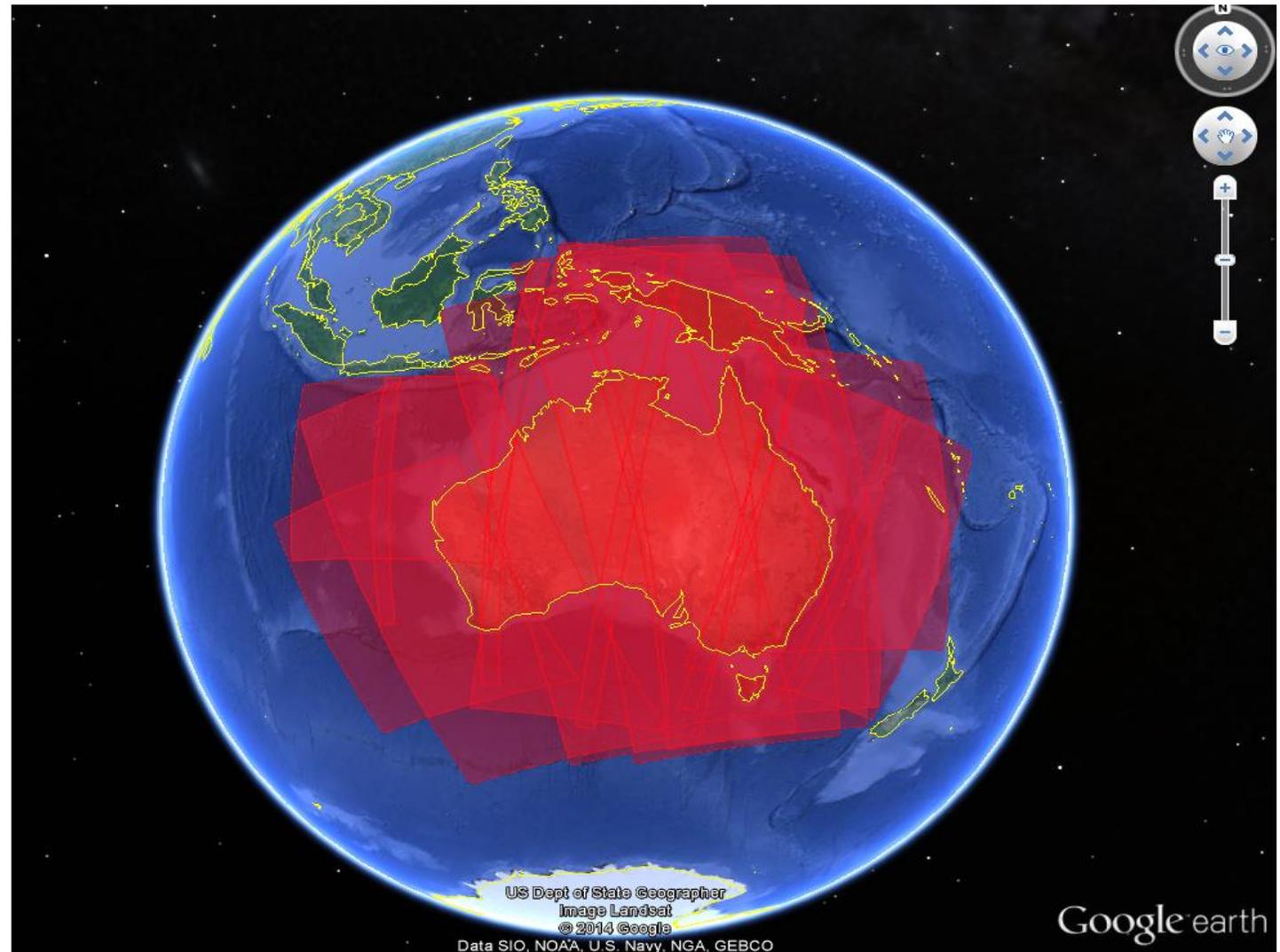
Landsat8

Terra MODIS

Aqua MODIS

Suomi NPP

Continuous acquisitions are converted to scenes or granule partitions representing time



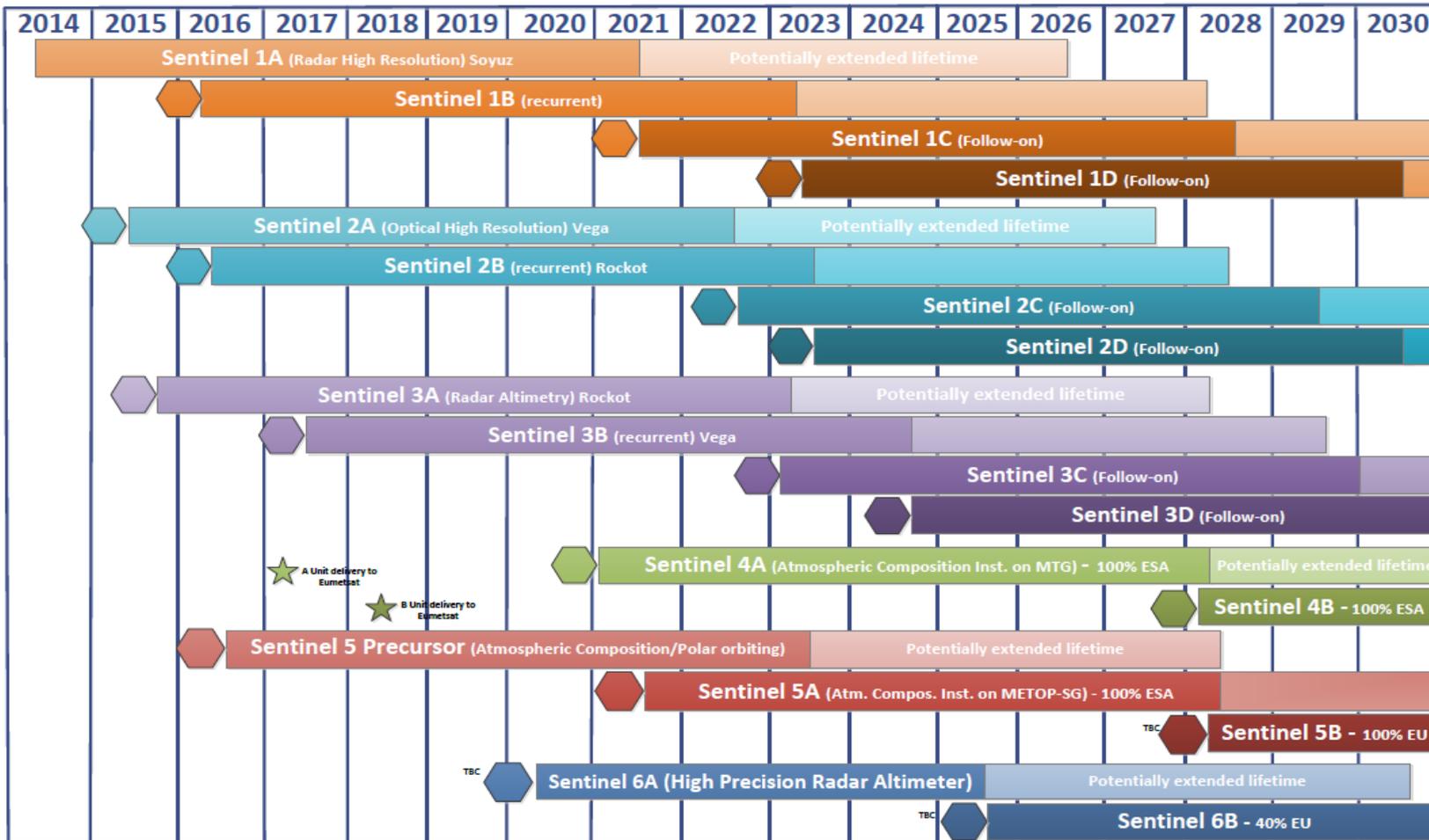


8 Billion Euro Copernicus Program is Launching 20 New Sentinel Satellites

Status 23 January 2015



Copernicus Constellations Deployment Schedule

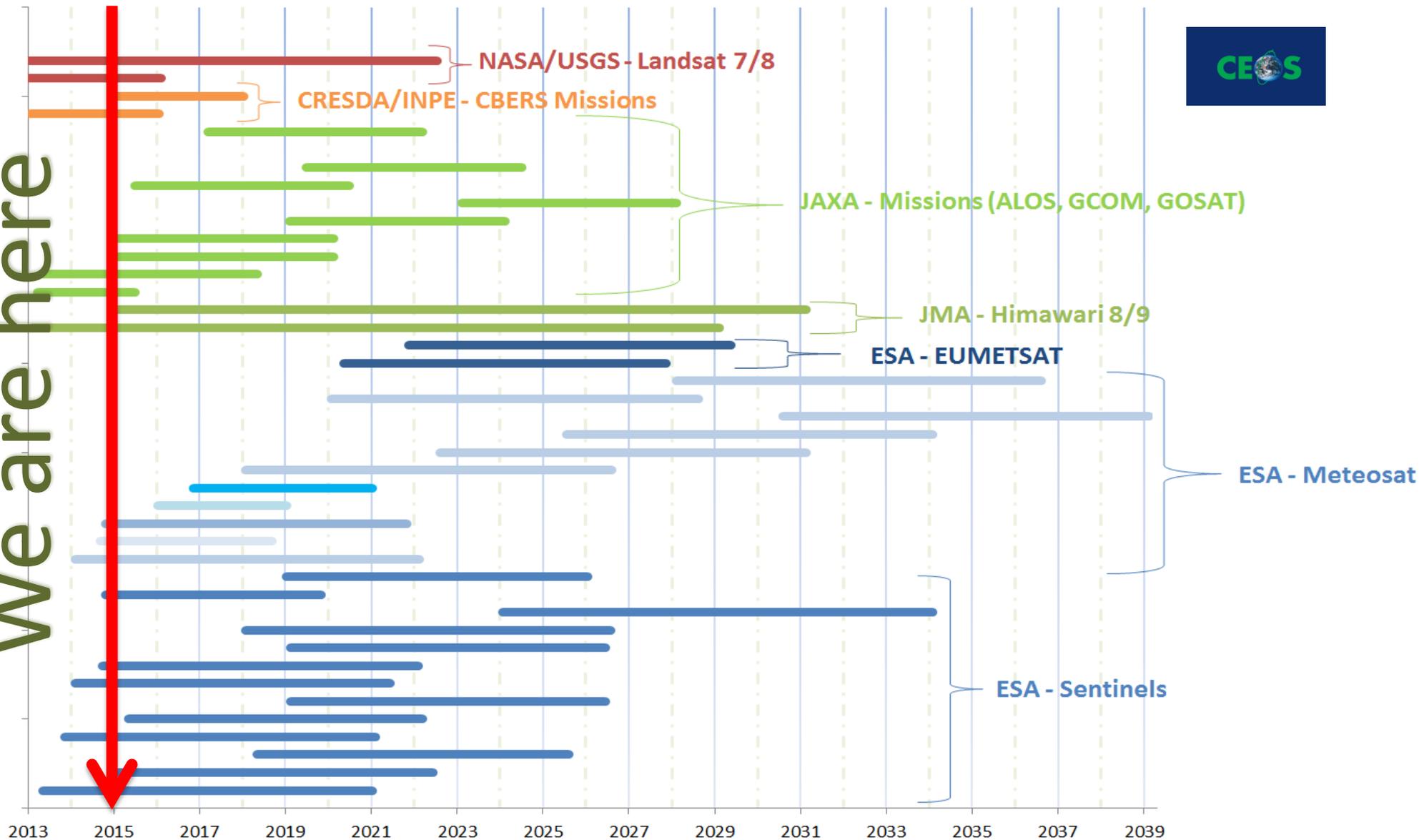


Legend: Flight Acceptance Review

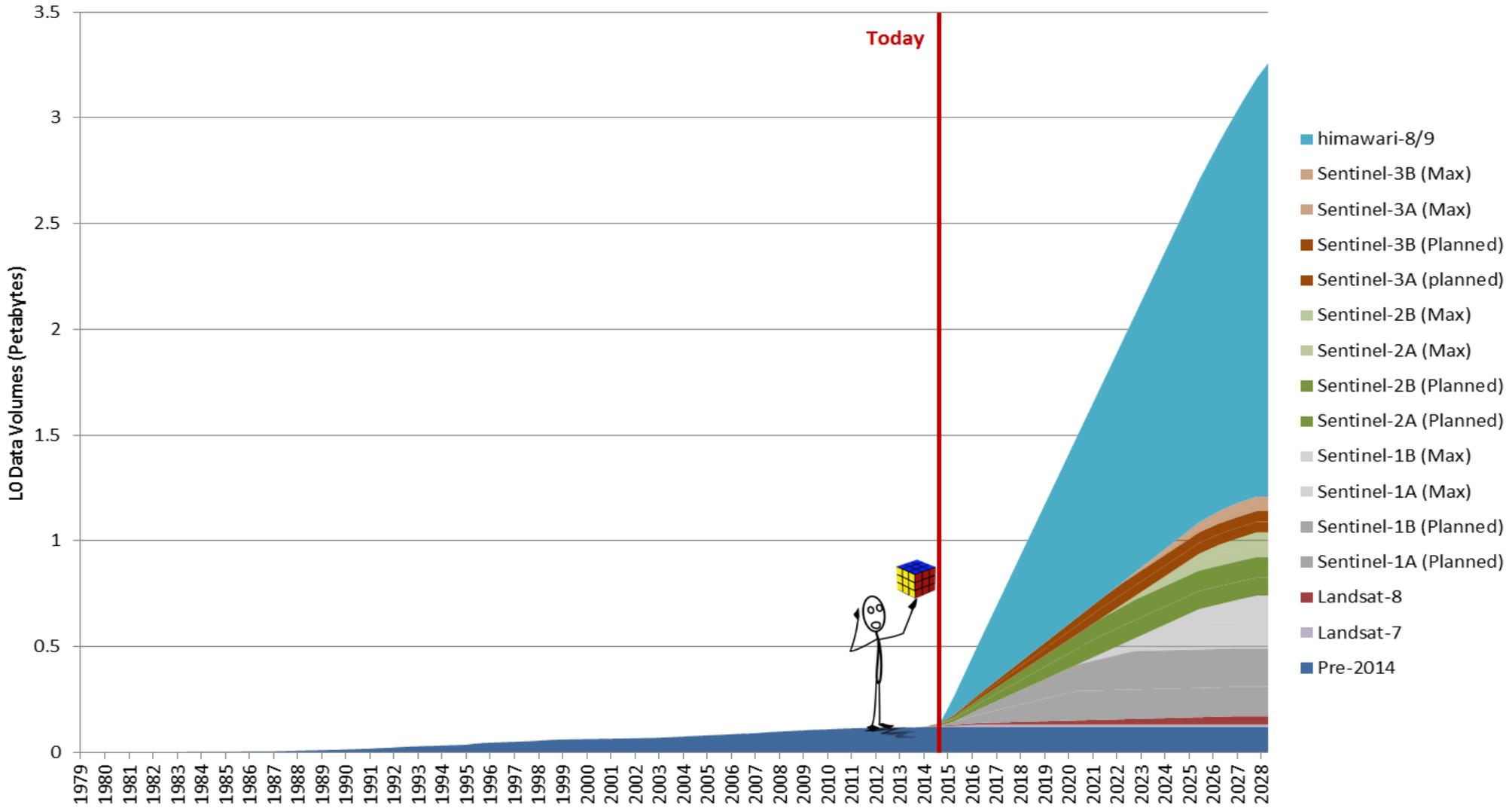
Challenge of Variety – the Next Decade



We are here



Next Decade's Estimated L0 data volumes over Australia



Using High-Performance Computational Capacity - The National Computational Infrastructure (NCI)

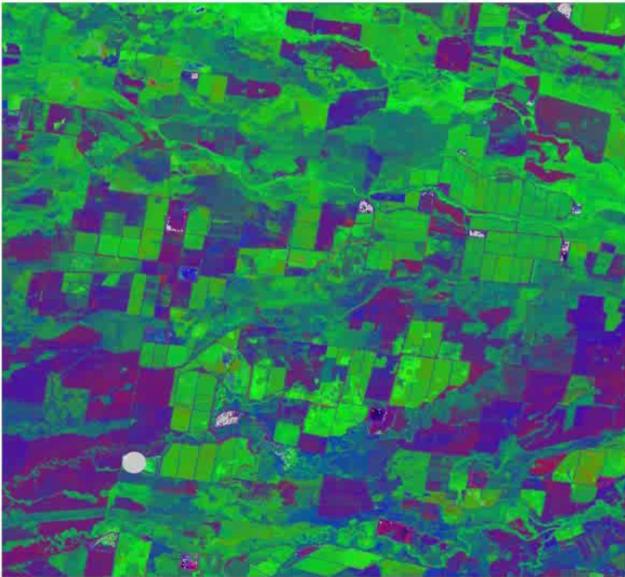
- Raijin @ National Computational Infrastructure
- 57,472 cores (Intel Xeon Sandy Bridge technology, 2.6 GHz) in 3592 compute nodes;
- 160 TBytes (approx.) of main memory;
- 10 PBytes (approx.) of usable fast filesystem (for short-term scratch space).

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



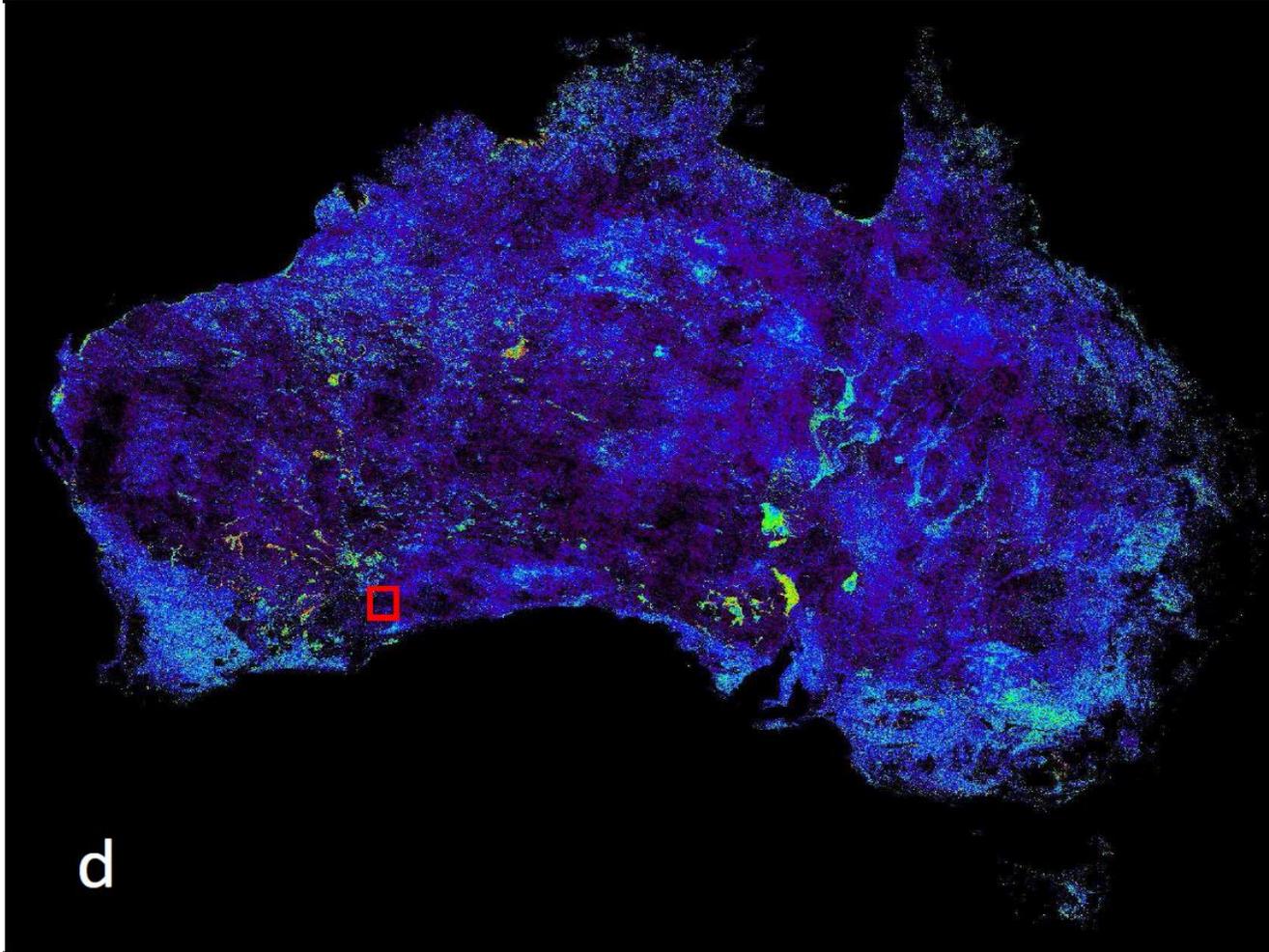
*<http://top500.org/>

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).