



Requirements for Sentinel-2 Applications to Support Legislated Mapping and Monitoring Activities in Australia

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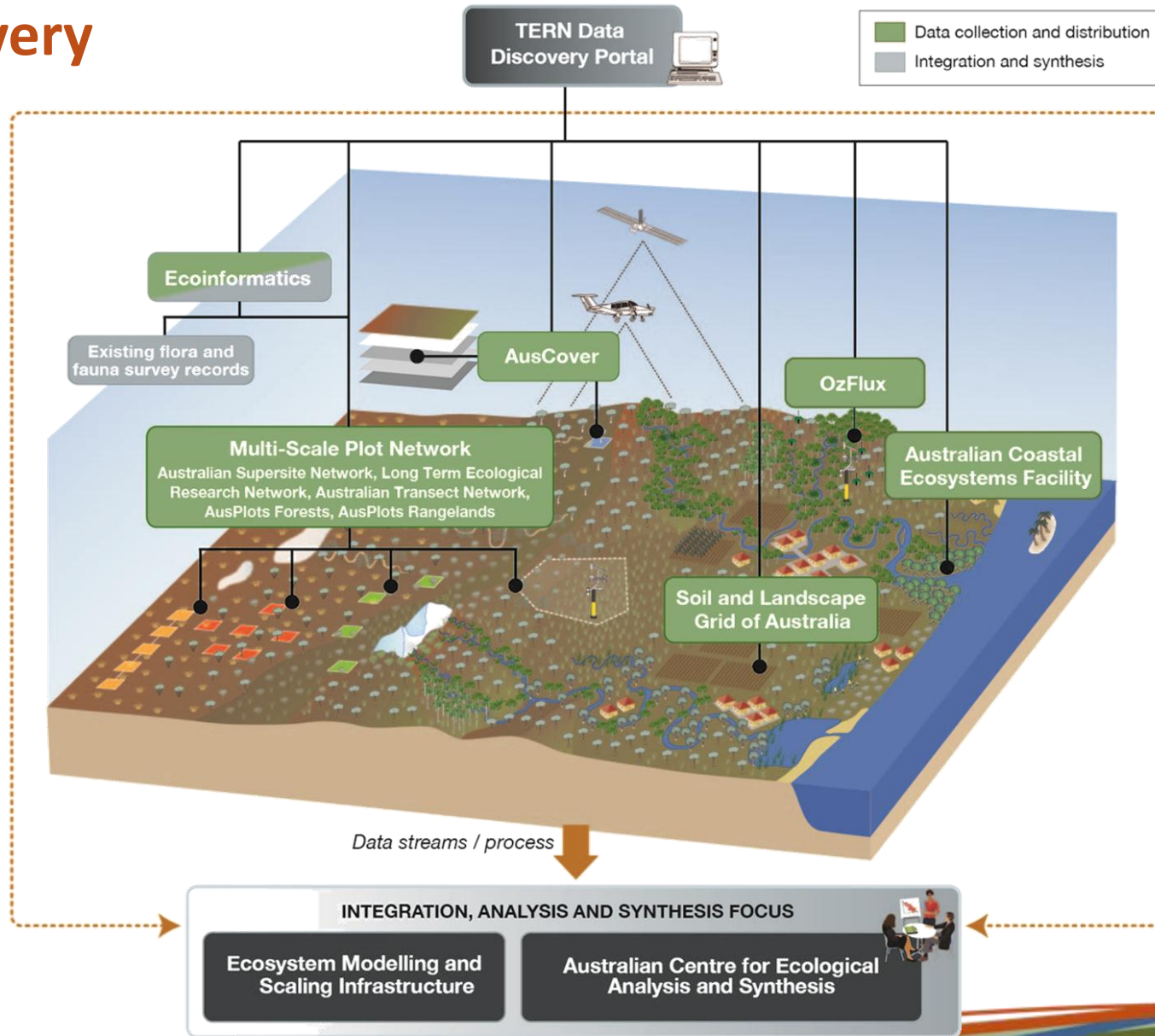
Presentation by: Alex Held

Director – AusCover TERN Facility - CSIRO

Sentinel-2 for Science Symposium May 20-22,, 2014.

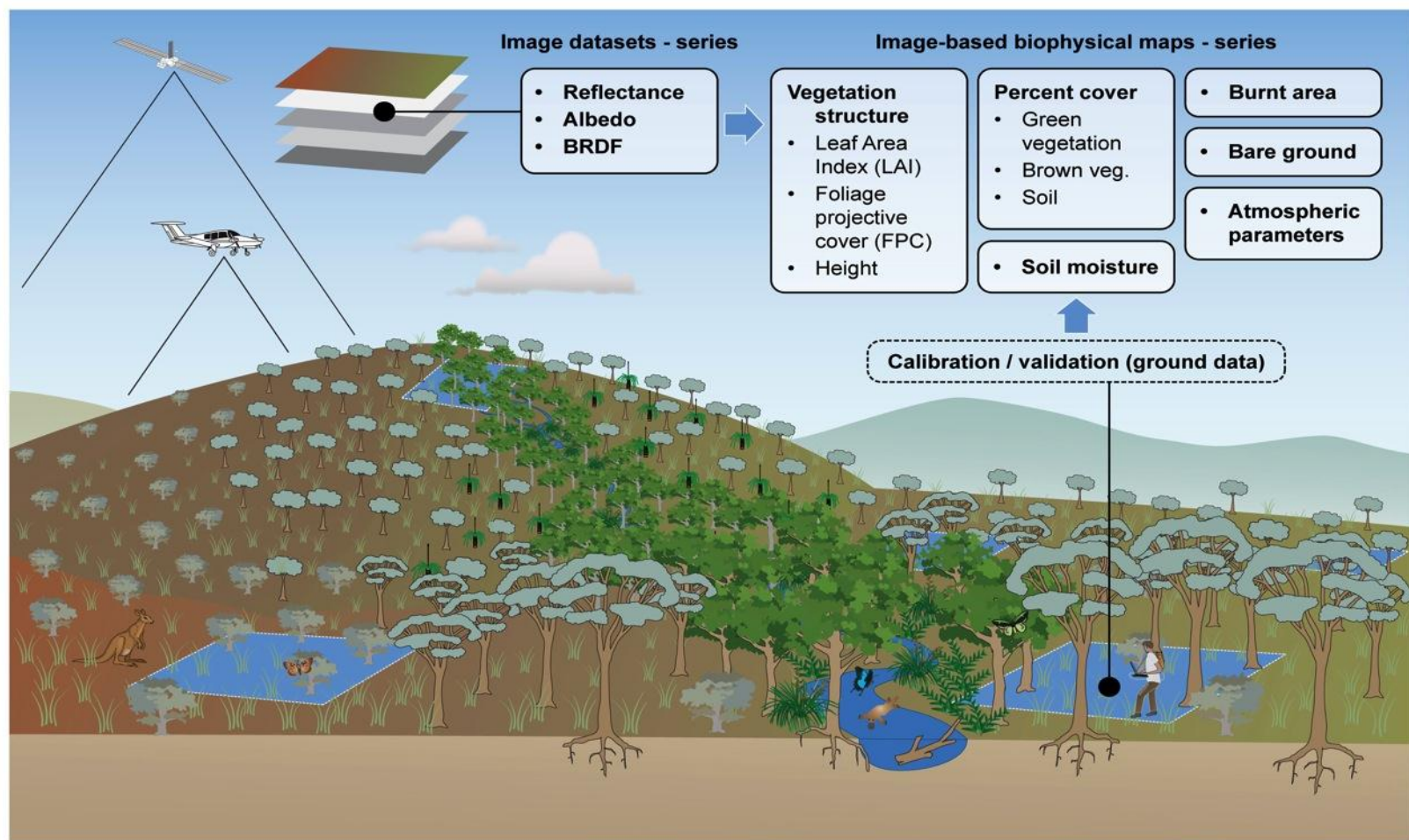
TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

What is TERN - A \$30+m National Science Infrastructure Program for Ecosystem Observations, Data collection and Delivery



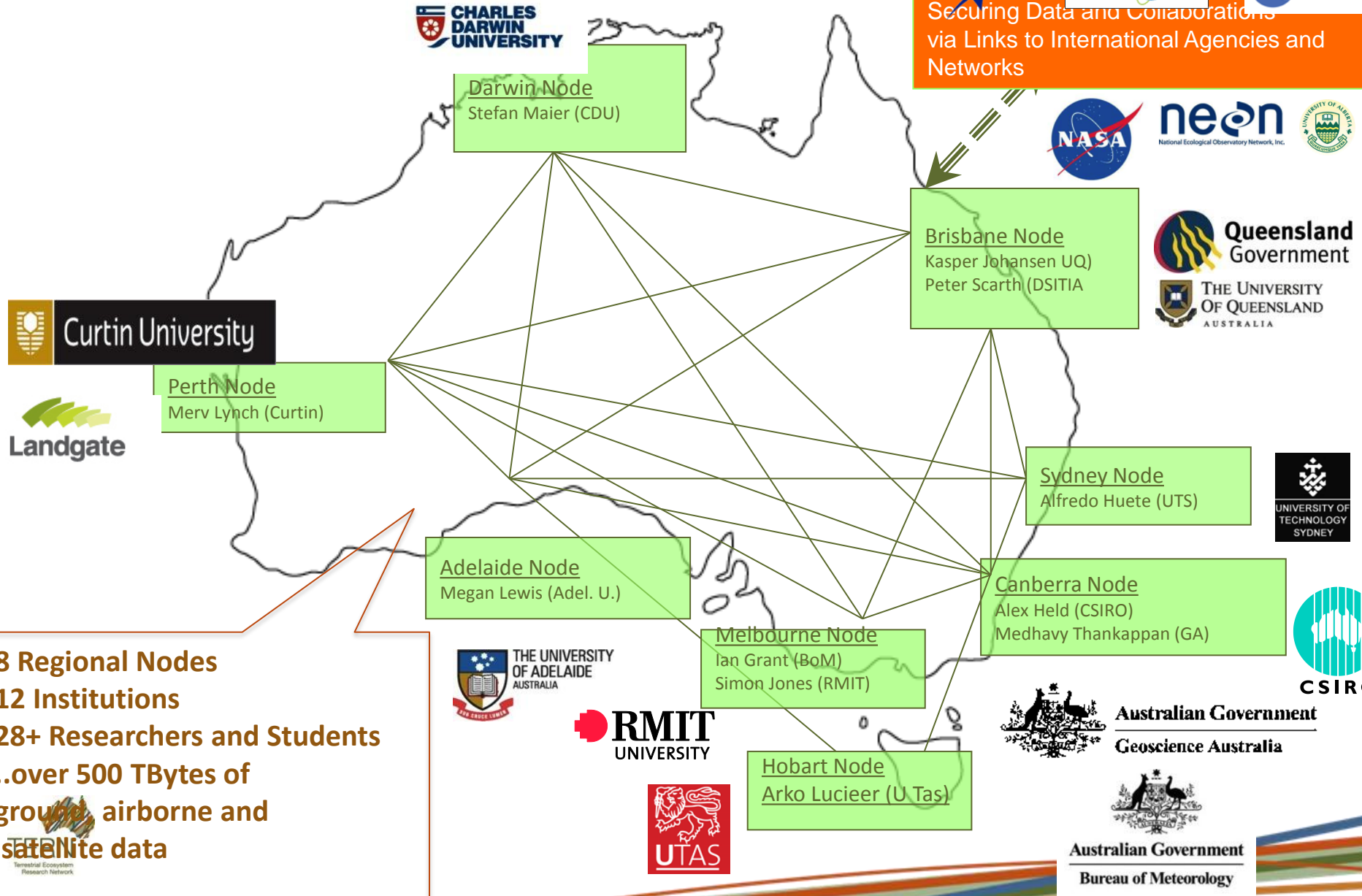
AusCover Remote Sensing Data Facility

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.



The AusCover Team & Network

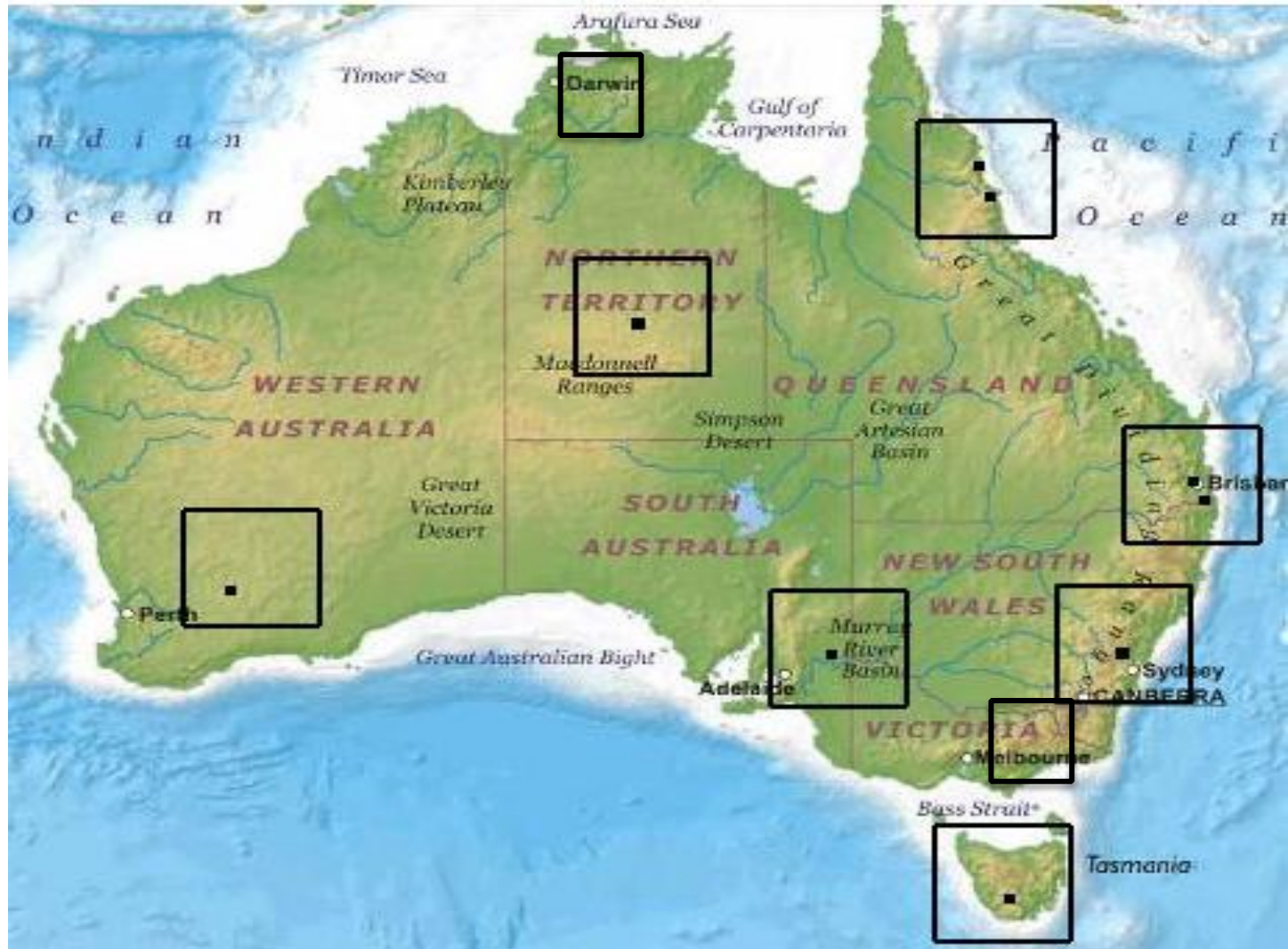
JAXA **CEOS** **esa**
Securing Data and Collaborations
via Links to International Agencies and
Networks



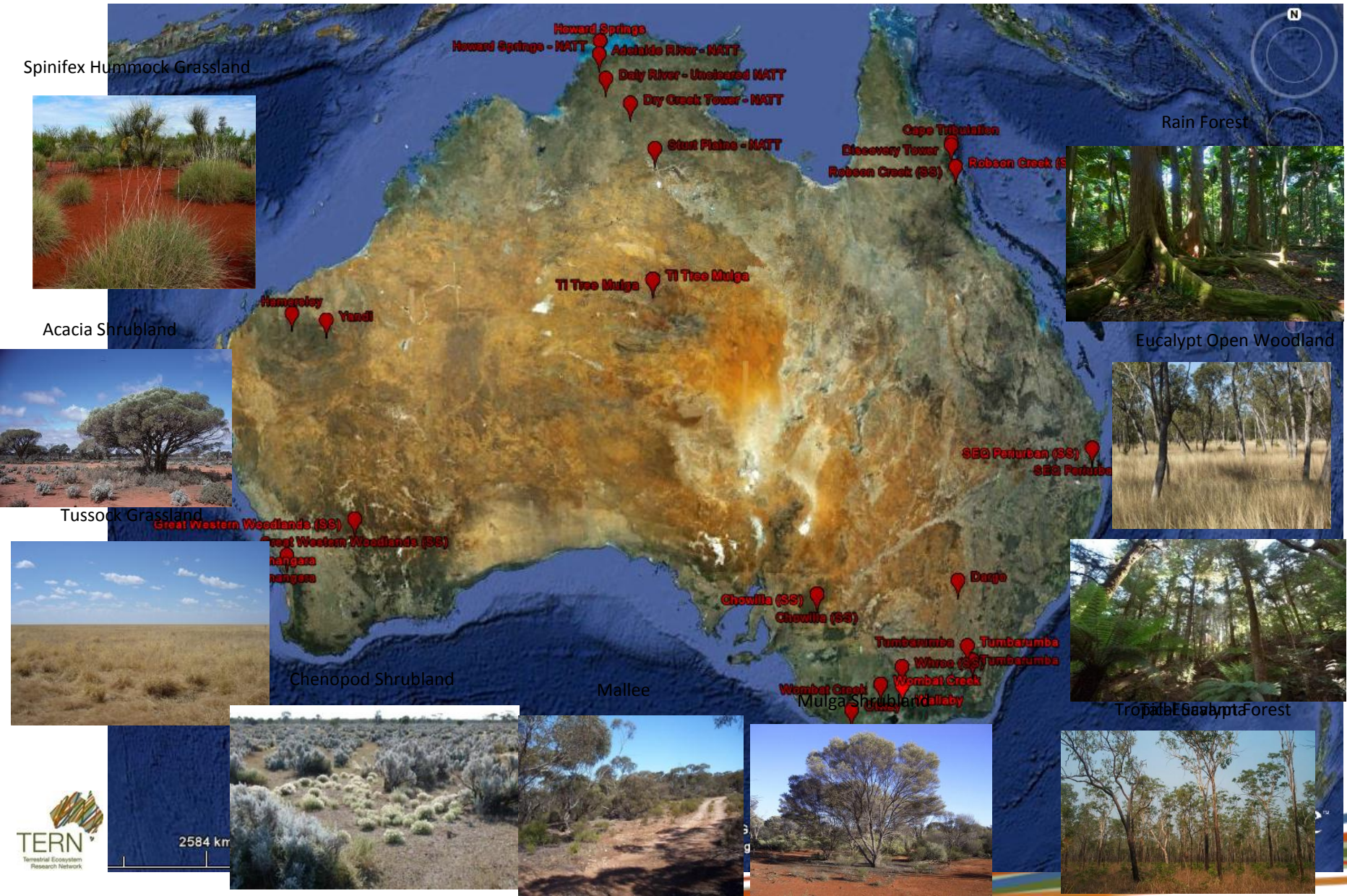
High-Spatial Resolution Remote Sensing Data Collection

(TERN Supersites and other Validation Sites)

Australia
Land Area:
7.5 m sq. Km



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

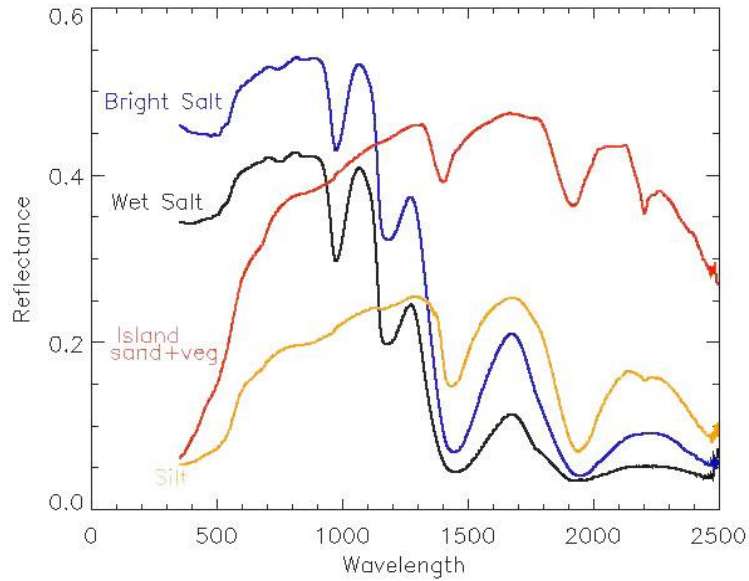


Field Validation Team Activities

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



Post-launch Satellite Testing & Validation



Visit <http://www.auscover.org.au>

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					
	Vegetation Continuous Fields - MODIS, LPDAAC MOD44B mosaic, Australia coverage					
Ecosystem Variables	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 MxD11 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					

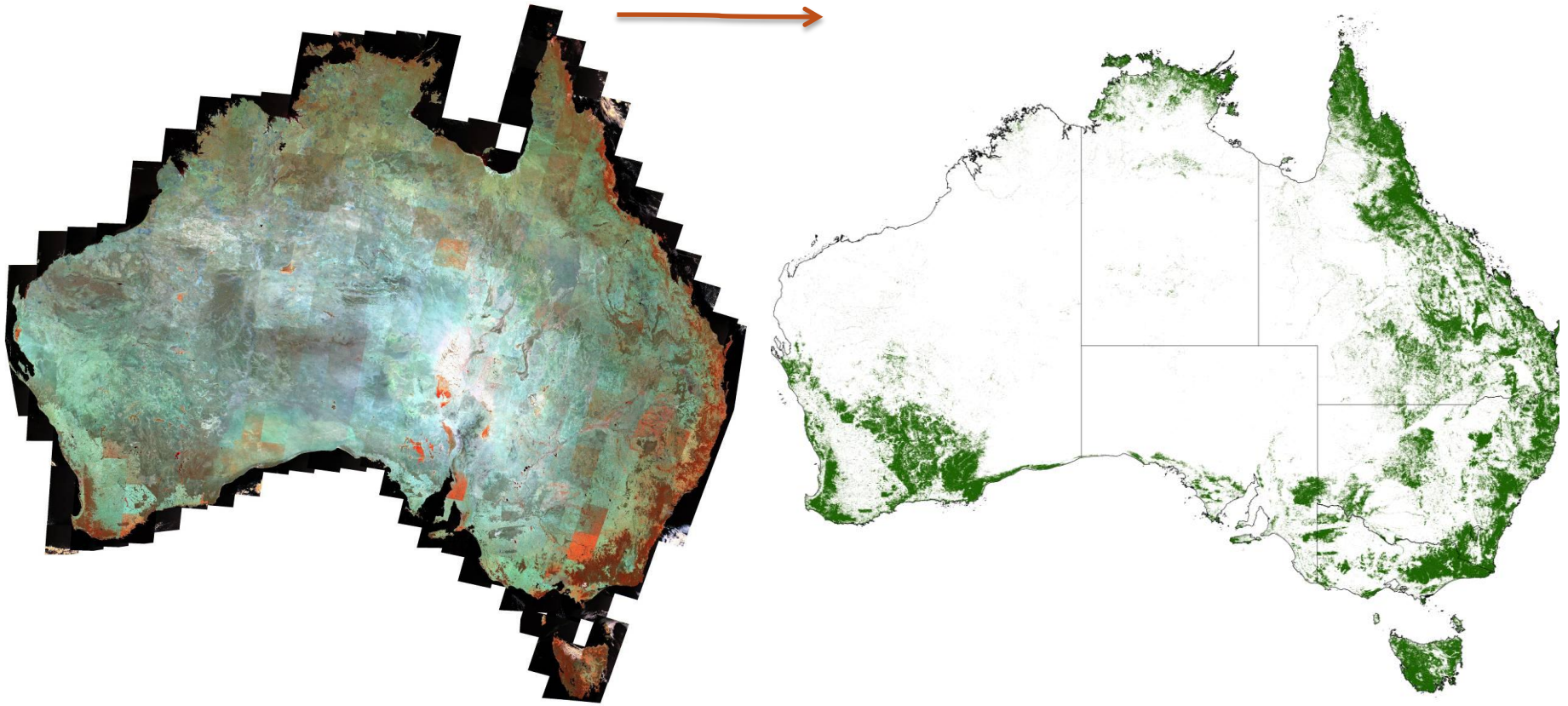
e.g. Fire- Related

- 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

FEDERAL & STATE-LEVEL ACTIVITIES IN AUSTRALIA

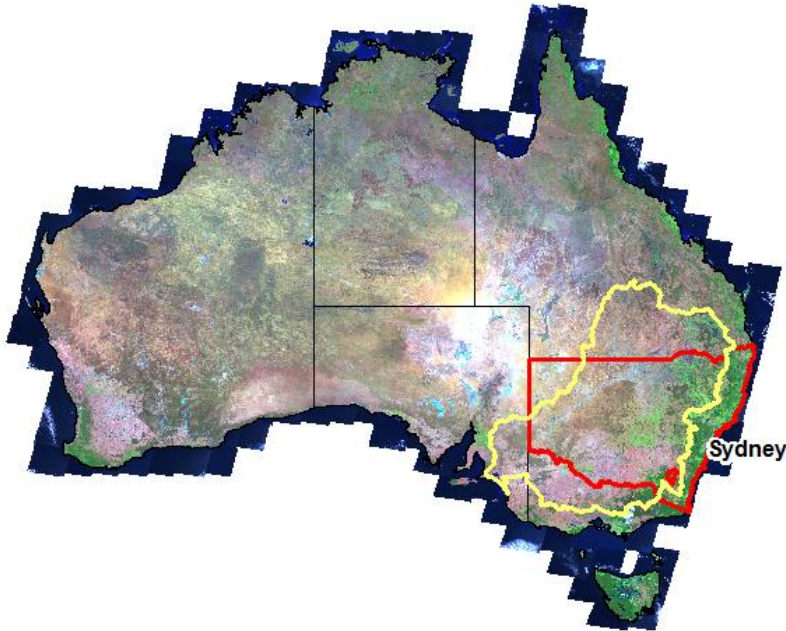
Making use of rich time-series data from operational satellites (eg Landsat, Sentinel-2) for large national and legislated programs

Time-series 19-years of Forest Cover Product for use in National Greenhouse-Gas Emissions Reporting (~ 400 Landsat scenes per year)



Source DCCEE – e.g. 1990 coverage

New South Wales. Monitoring land-management impacts



Key issues

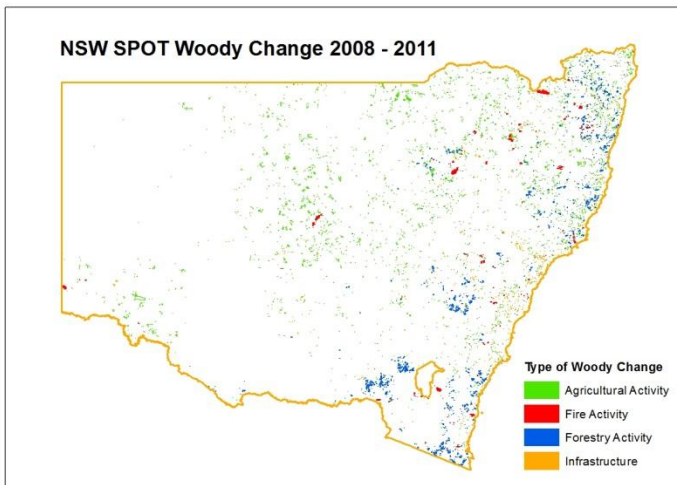
- Urban expansion. Most populated state in Australia with Sydney the largest urban centre.
- Sustainable agriculture. The Murray Darling Basin is Australia's largest river system and food-producing region.
- Mining Impacts. Expanding coal, coal seam gas, gold, and copper mining activities.

Government Legislation

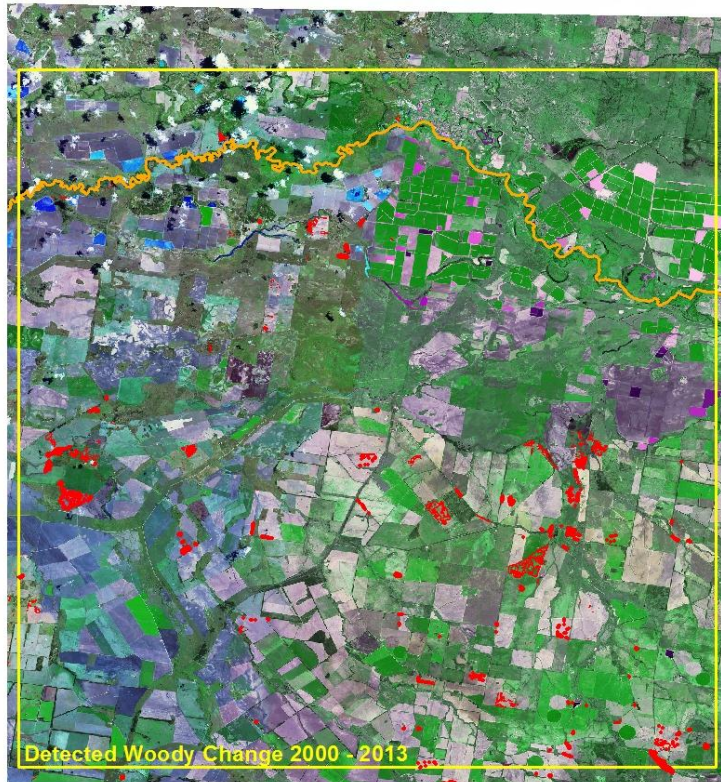
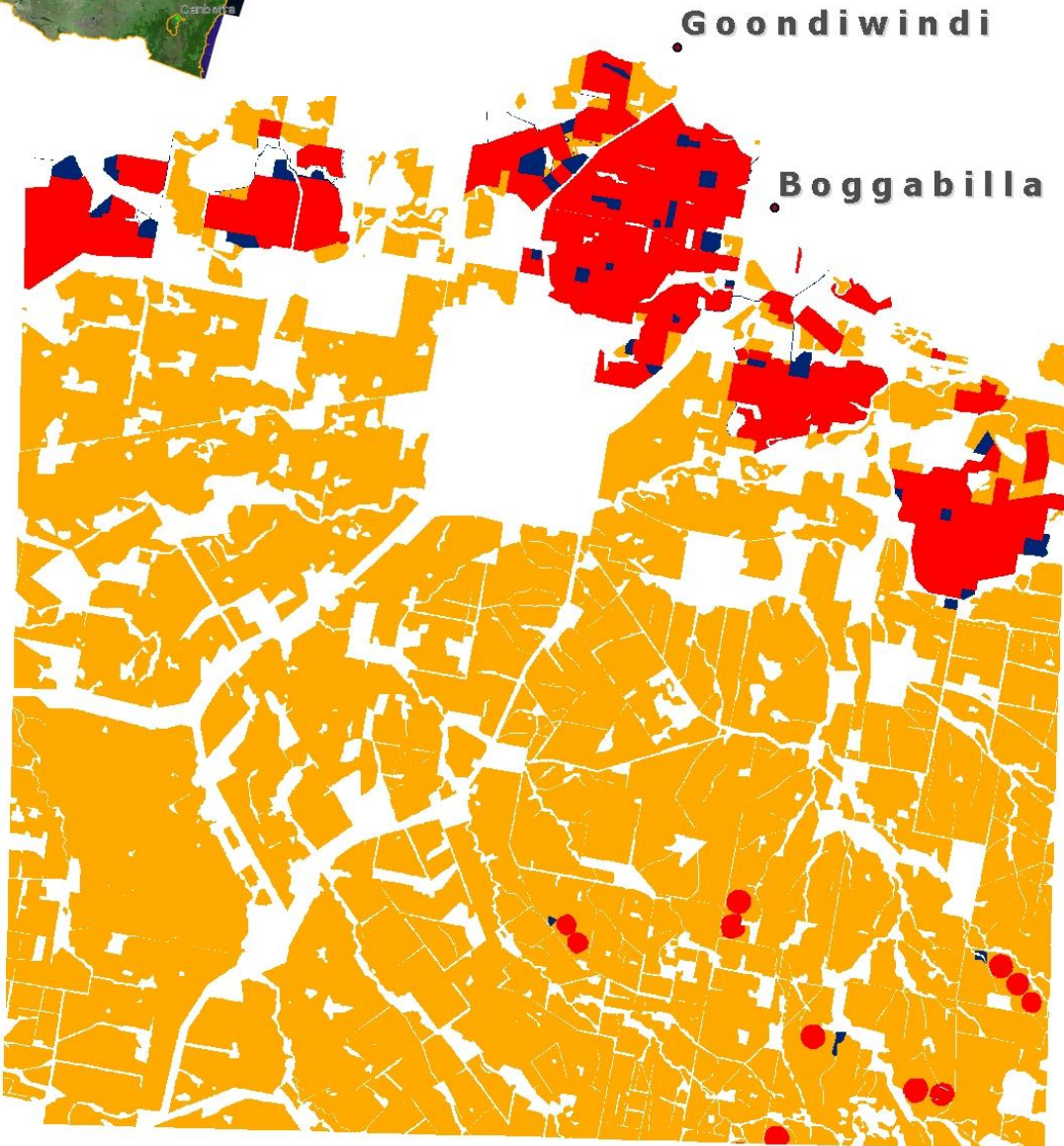
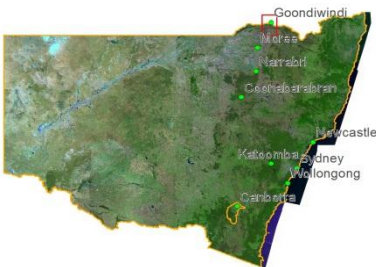
- Native Vegetation Act 2003
- Natural Resources Commission Act 2003
- Forestry Act 2012
- Plantations and Reafforestation Act 1999
- Threatened Species Conservation Act 1995

Mapping programs (current and future datasets)

- Landuse (SPOT5, Landsat, aerial, Sentinel-2)
- Woody vegetation extent and type (SPOT5, aerial, Sentinel-2)
- Woody vegetation clearing (SPOT5, Landsat, Sentinel-2)
- Proposed: Woody vegetation regrowth (SPOT5, Sentinel-2 and RADAR)



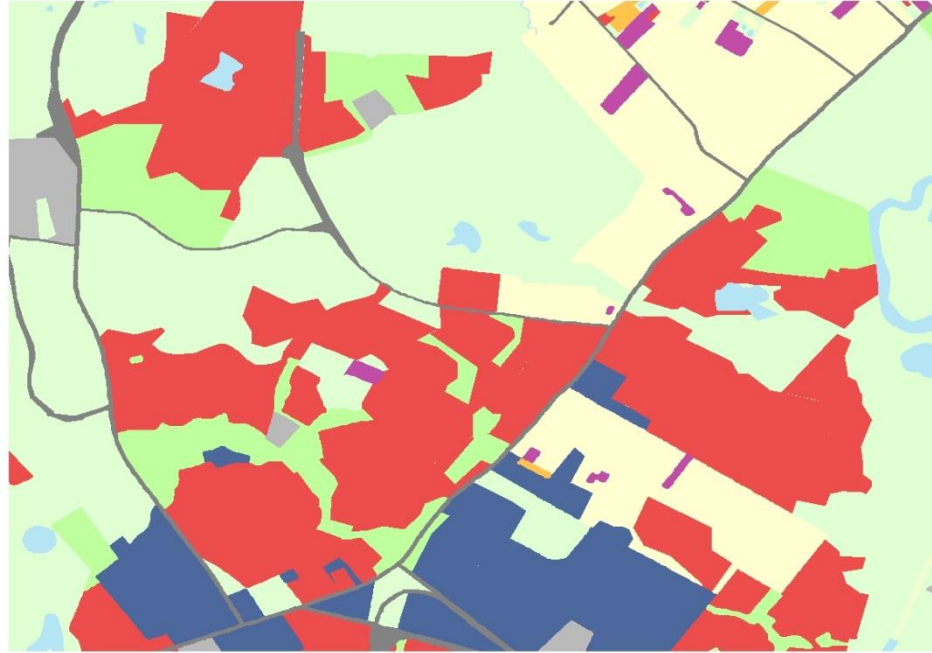
Monitoring Landuse Change – Agricultural Expansion



LANDUSE 2013

-  Dryland Cultivation
-  Irrigated Cultivation
-  Irrigation Infrastructure

Monitoring Urban & Commercial Expansion in the South West Growth Centre of Sydney



Legend

- | | |
|--|---|
|  Grazing |  Transport |
|  Drainage Features & Dams |  Intense Animal Industry |
|  Urban Developments |  Horticulture |
|  Industrial/Commercial |  Parklands & Recreation |
|  Rural Residential |  Schools/Government Facilities |

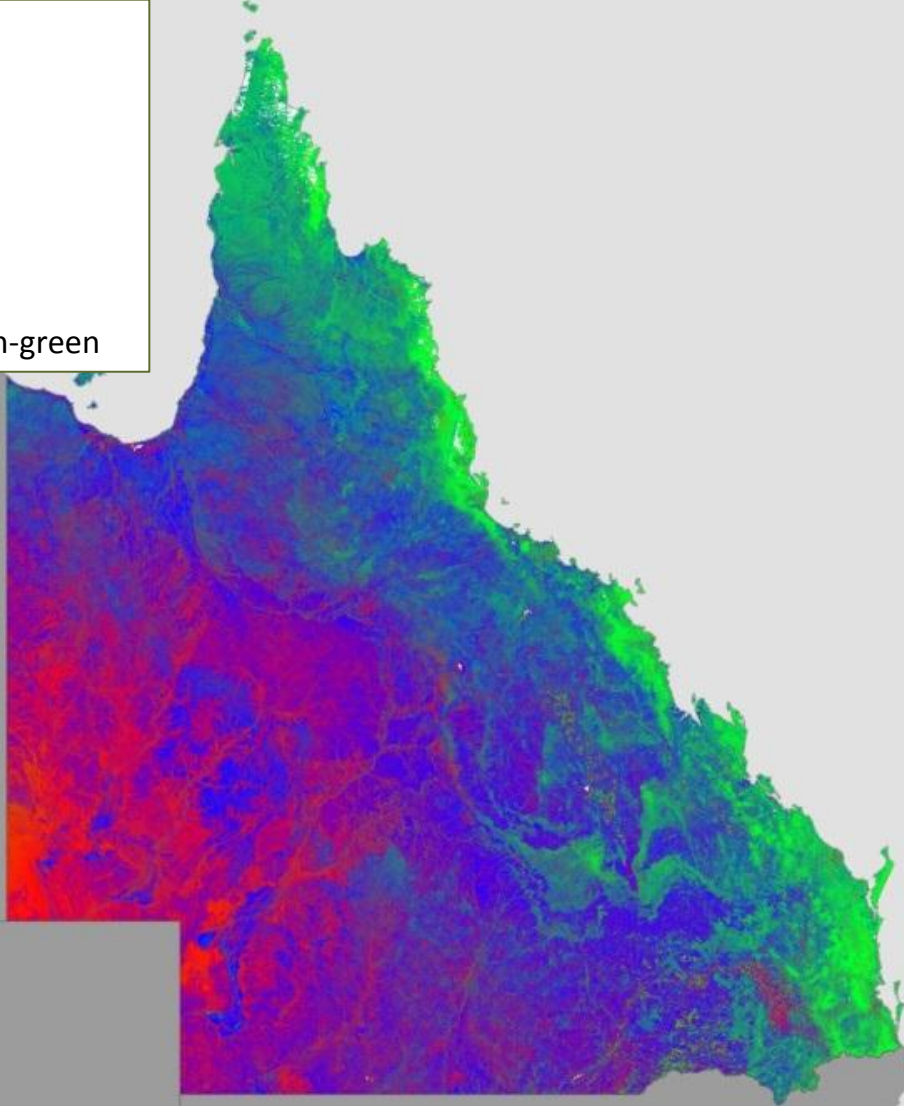
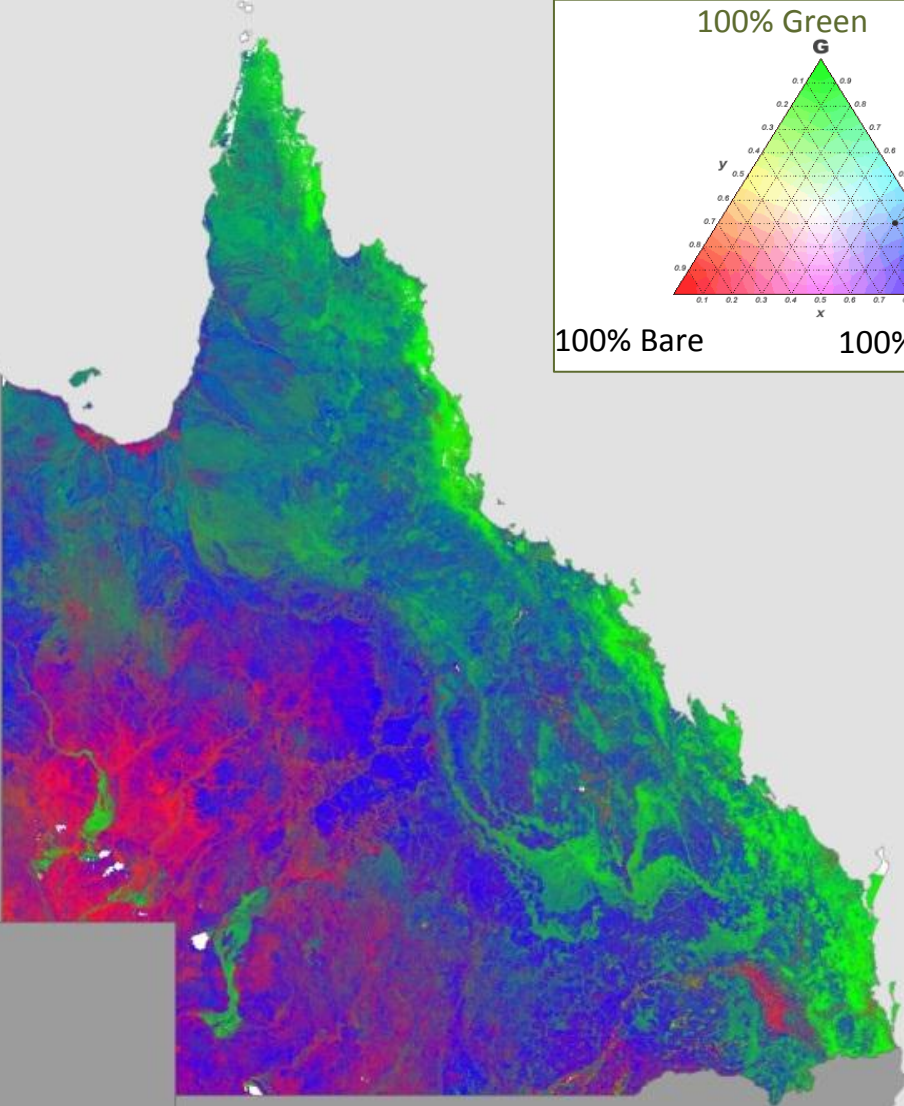
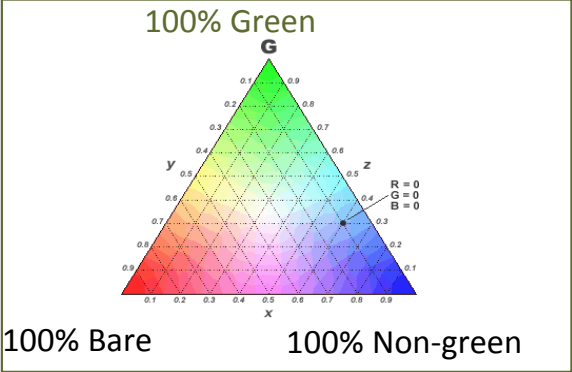
Queensland Landscape Monitoring Programs

- Queensland Land Use Mapping Program (QLUMP)
- Crop Frequency Mapping
- State-wide Landcover and Trees Study (SLATS)
- Ground Cover Monitoring Program
- Fire Scar Mapping Program
- Water-body mapping
- Coal Seam Gas Infrastructure Mapping

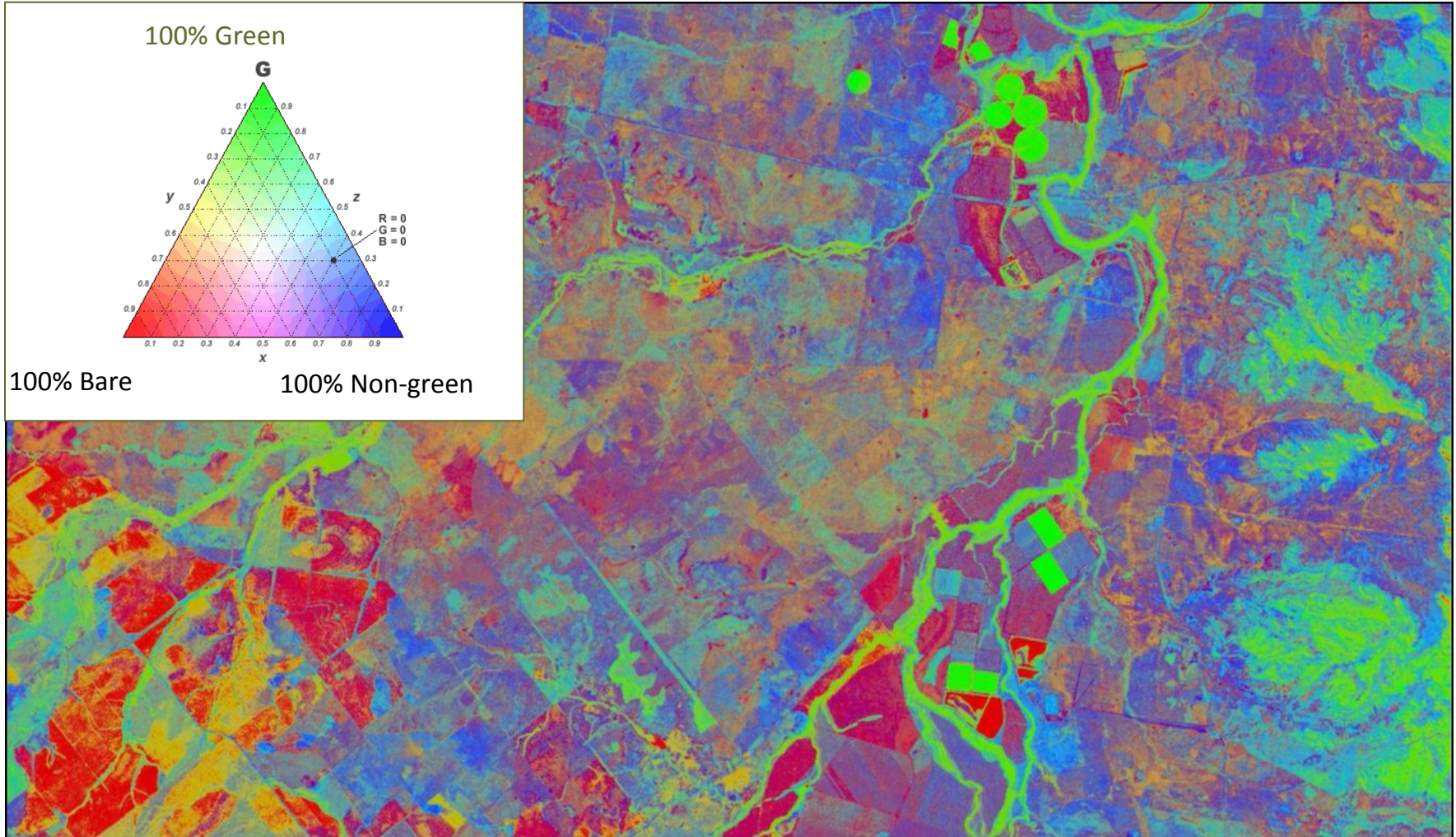
Fractional Vegetation Cover for Queensland

Winter 2011

Winter 2013



Landsat - Fractional cover example

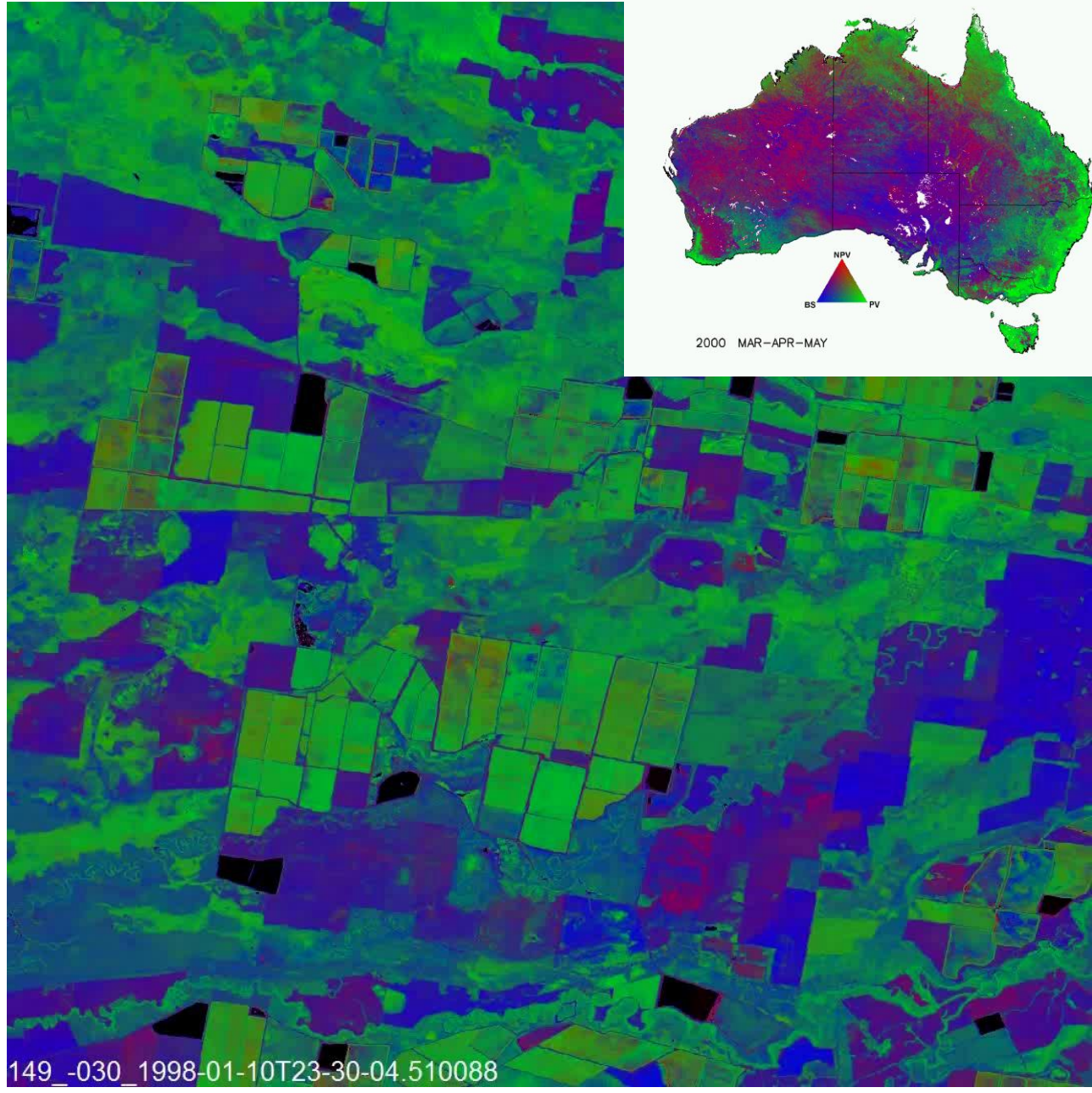


Implementation of FC-Algorithm on the "Australian Geoscience Data Cube" on NCI Supercomputer

Co-funded by Geoscience Australia, CSIRO, and Fed. Dept of Industry

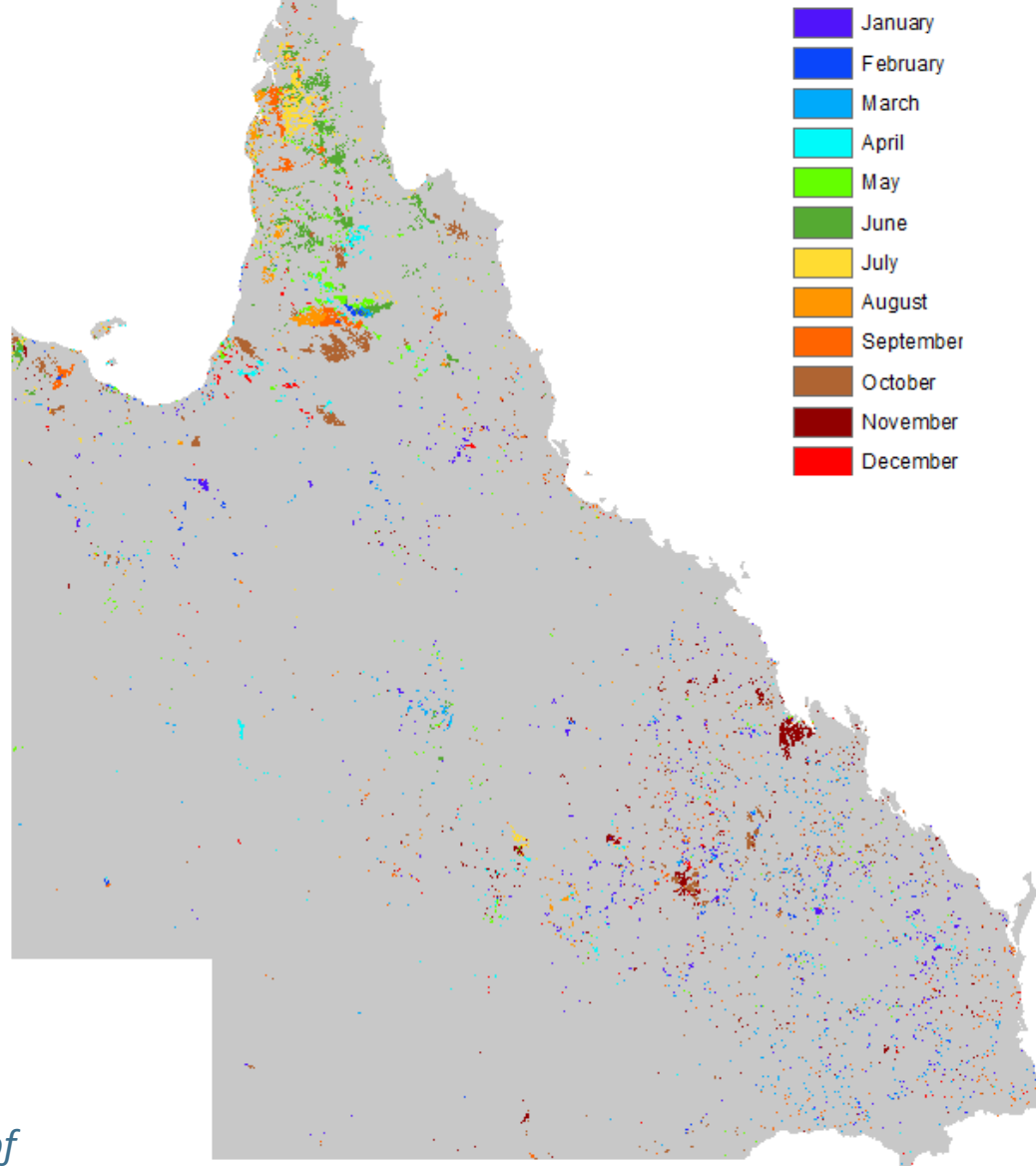


Keytah Station Fractional Cover (CSIRO & QLD DISITIA Algorithm)



Courtesy Geoscience Australia

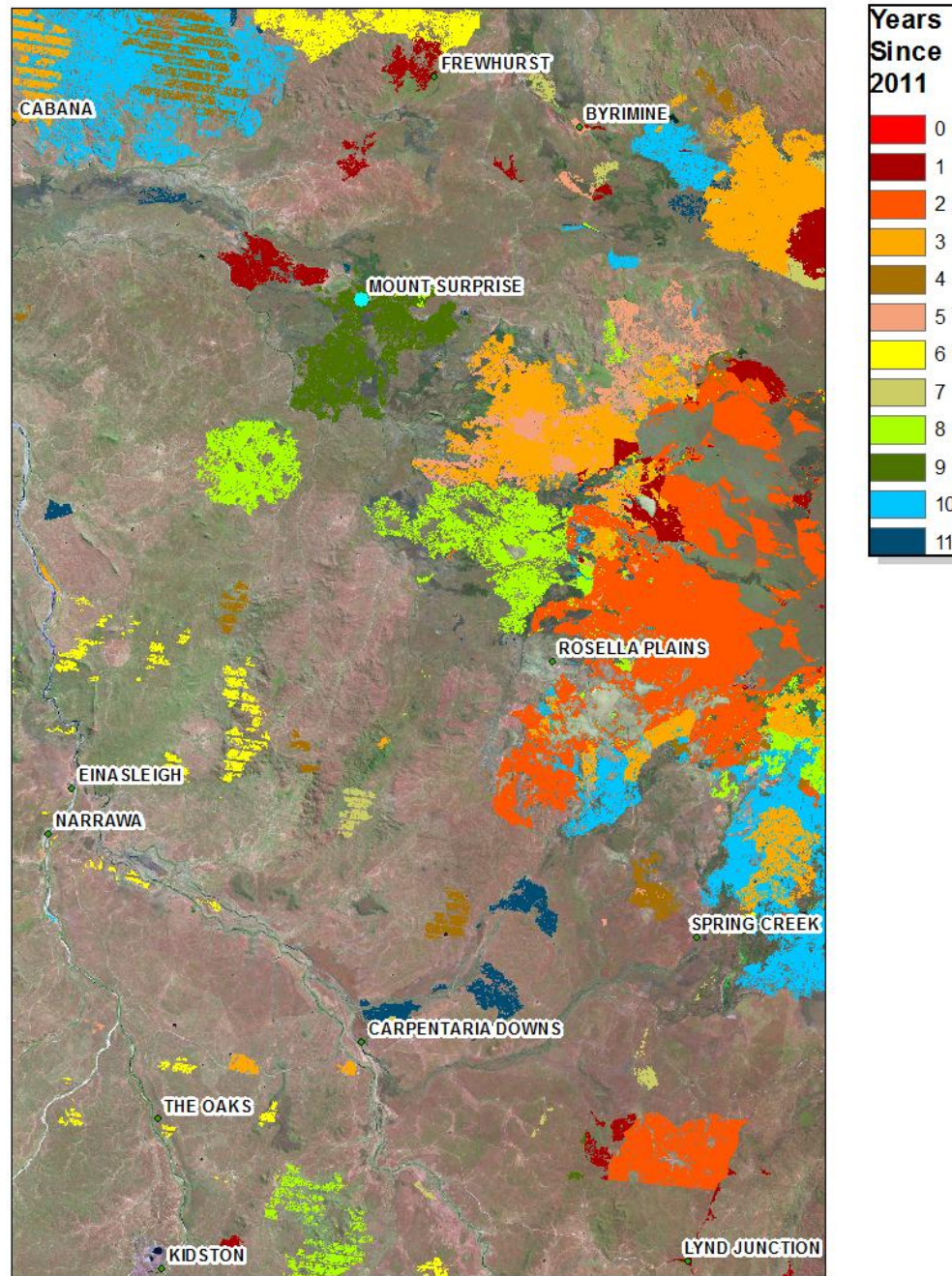
Fire Scar Mapping 1986 to 2013



*Goodwin and Collett, Remote Sensing of
Environment, 2014*

1988

Time Since Burn From Landsat Time Series (2000-2011)



Western Australia - Land Monitor Project

Project Partner Agencies

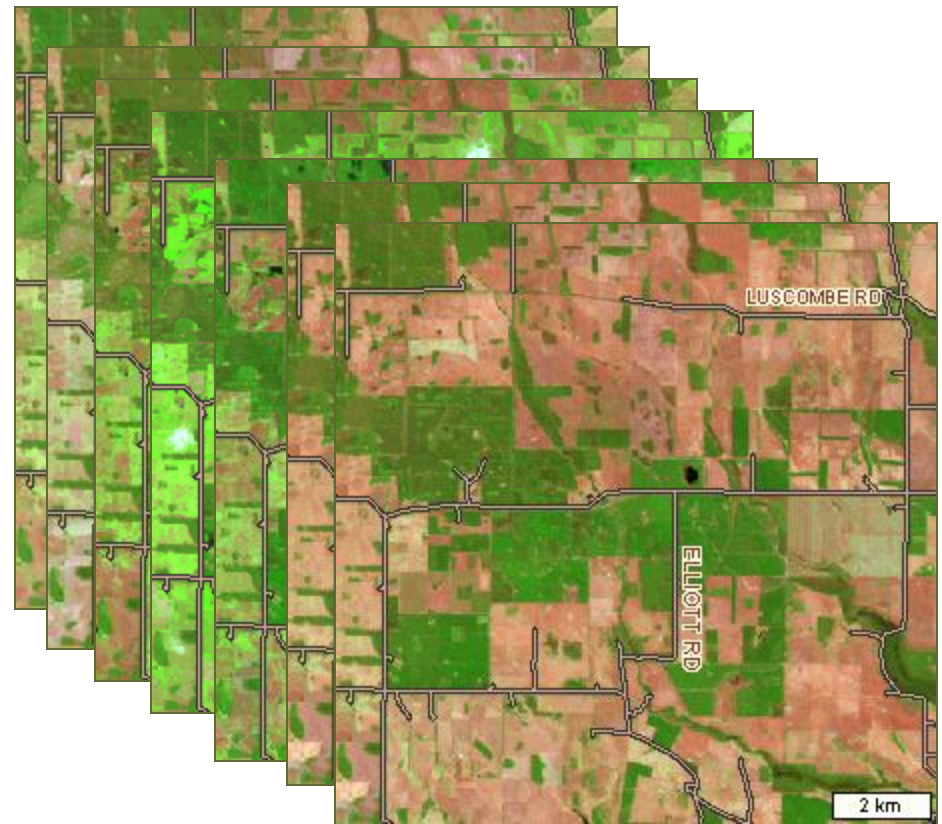
- Landgate (WALIA)
- Department of Agriculture and Food WA (DAFWA)
- CSIRO, Mathematical and Information Sciences
- Department of Environment and Conservation (DEC)
- Department of Water
- Water Corporation
- Department of Planning and Infrastructure

Western Australia - Land Monitor Project

Calibrated Landsat TM and ETM Satellite Imagery

- Suitable for time series analysis over the whole Ag. Area - ~ 15 Landsat scenes
- Summer Images for Vegetation Mapping and Monitoring
- Spring Images for Salinity Mapping and Monitoring

1988 1990 1992 1994 1996 1998 2000 2002 2003 2004 2005 2006 2007 2008



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Vegetation Products

Vegetation Cover since 1988

Perennial woody vegetation with annual updates,

Vegetation Change since 1988

Describing areas of increase, decline and stability

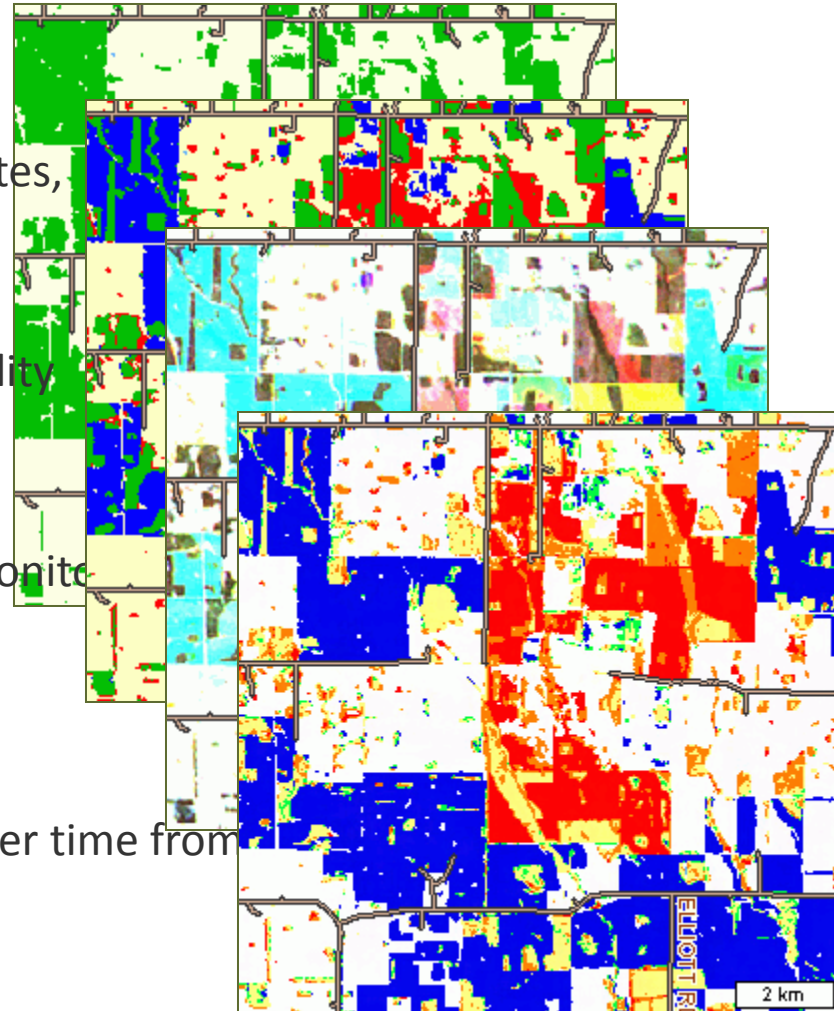
Vegetation History

Change over time using imagery from three monitors

Vegetation Trend

Trend class and index

Summarising the status of vegetation cover over time from

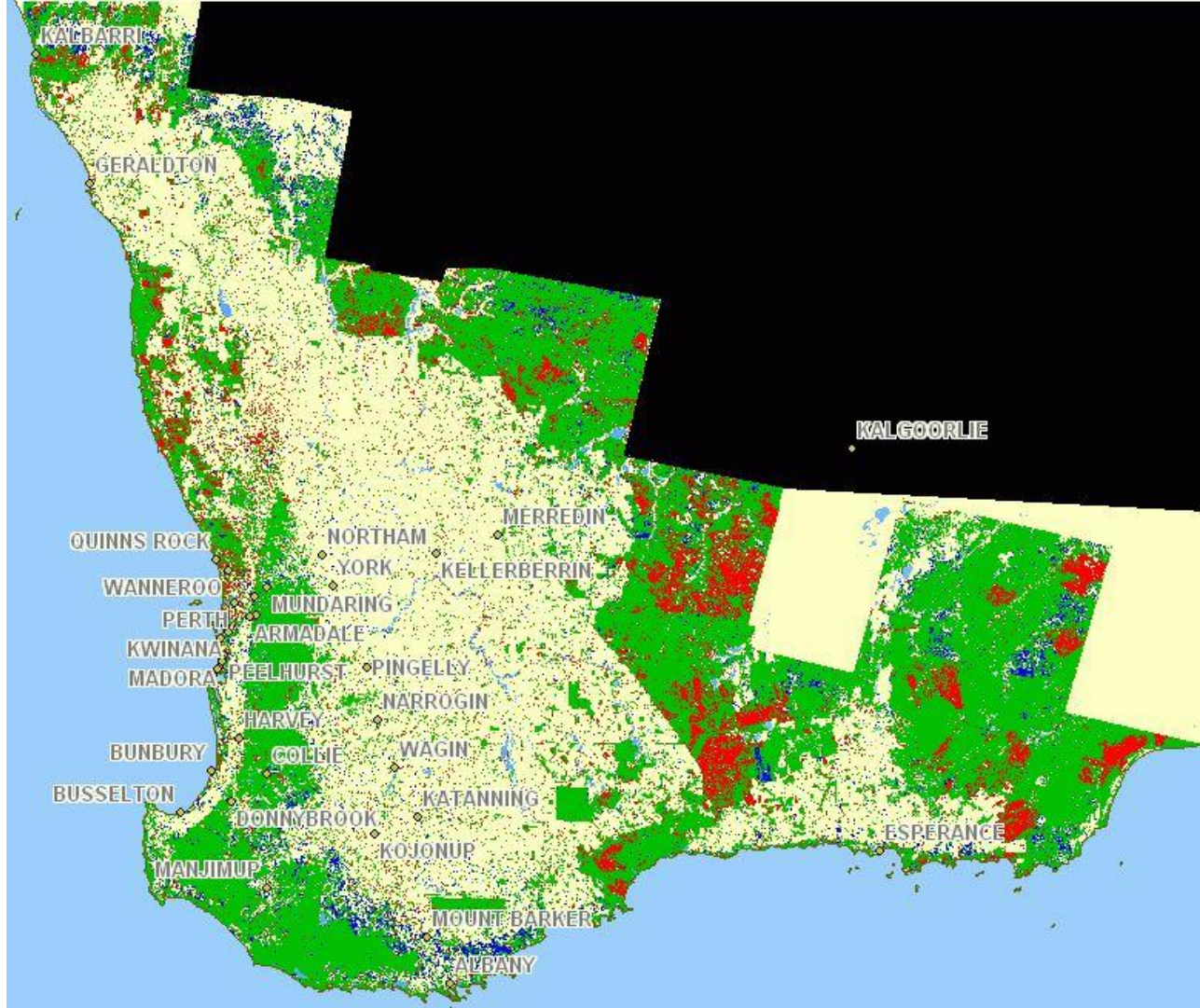


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Coverage

Satellite Imagery and
Vegetation products

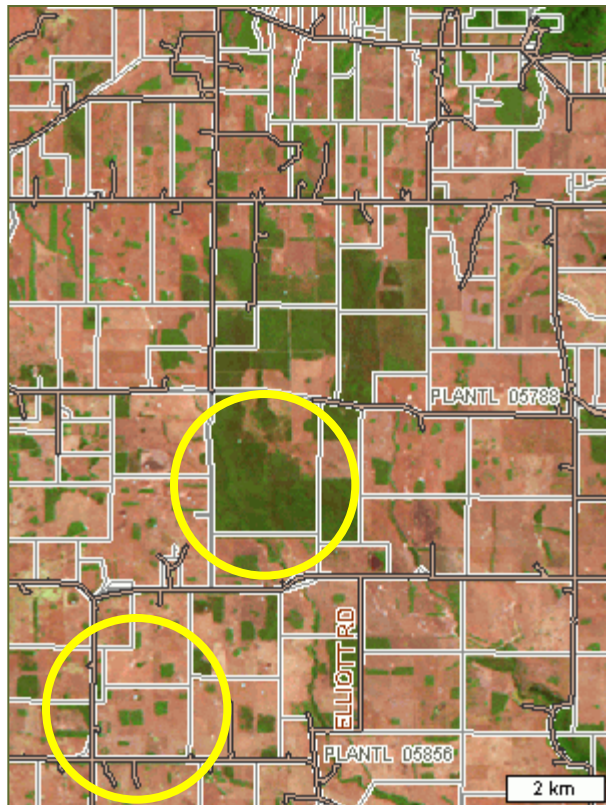
Extent = 390,000km²
Kalbarri to Esperance



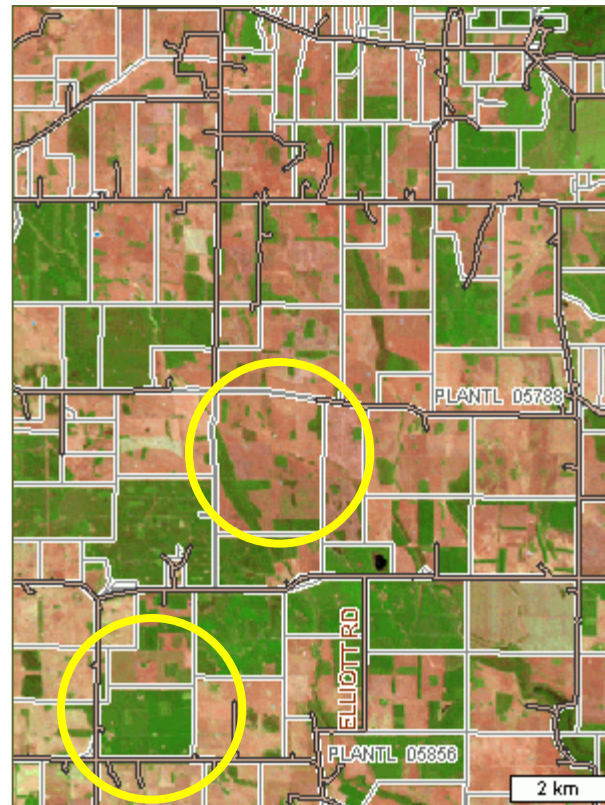
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Vegetation Change in Agricultural Areas

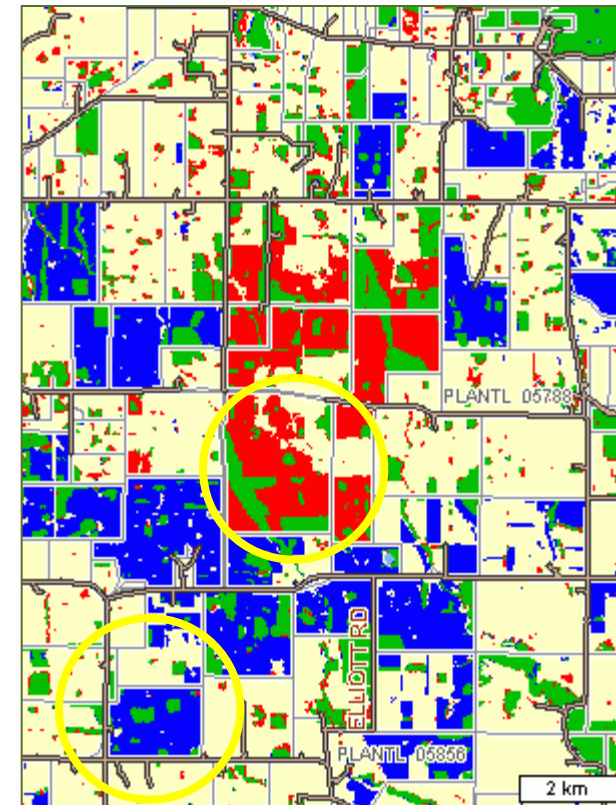
1988



2007



Change 1988-2007



- vegetation change - decrease 1988-2007
- vegetation change - increase 1988-2007
- vegetation in both 1988-2007

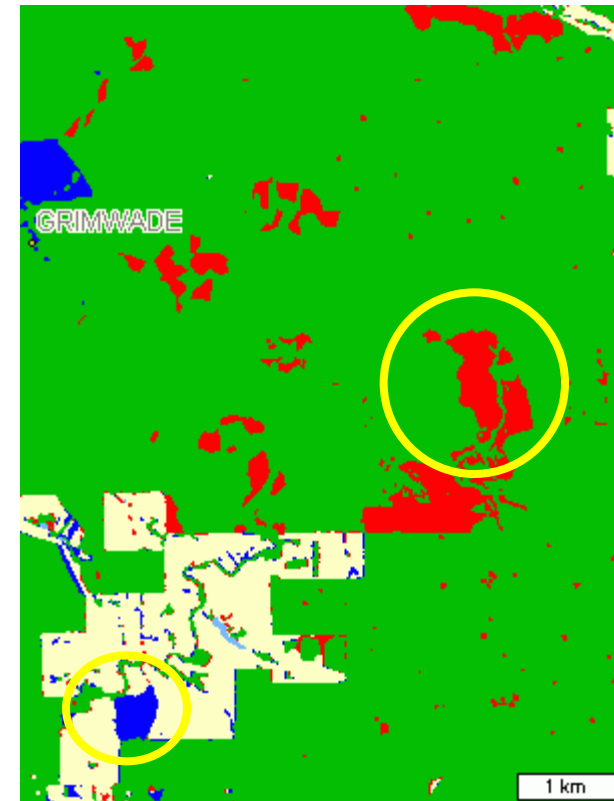
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Vegetation Change in Forested Areas

1988

2007

Change 1988-2007



- vegetation change - decrease 1988-2007
- vegetation change - increase 1988-2007
- vegetation in both 1988-2007

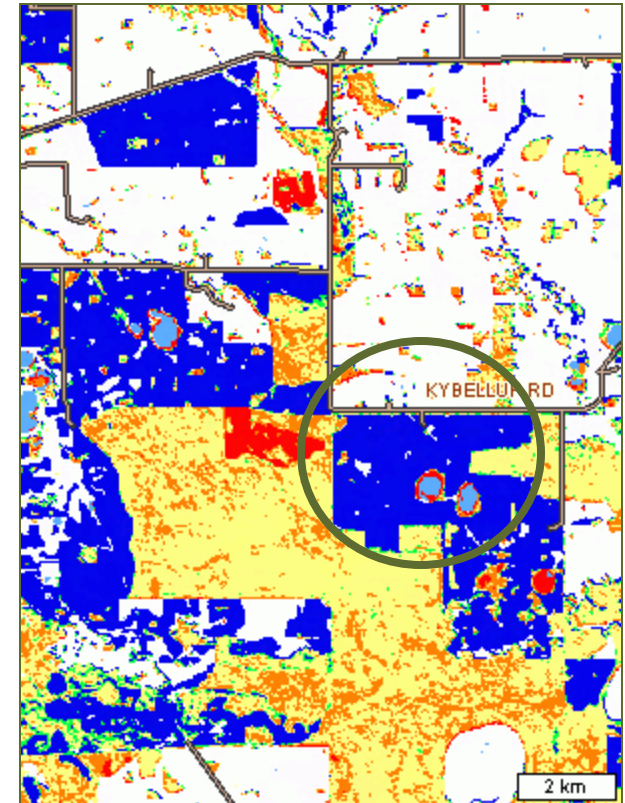
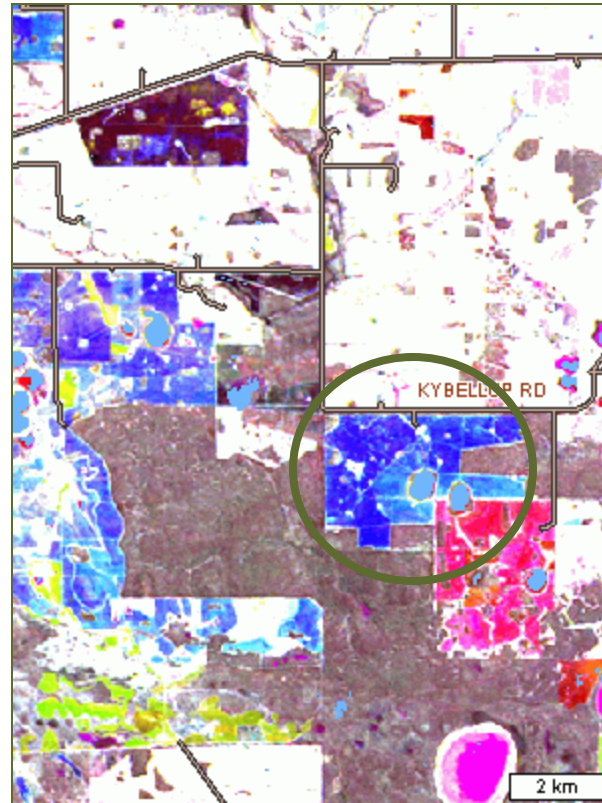
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Vegetation History and Trend

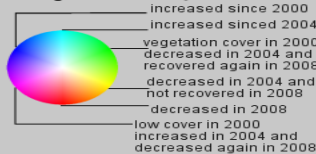
2008 image

History 2000, 2004, 2008

Trend 1990-2008



Colour Interpretation Guide for Vegetation History Product



Black and grey show where vegetation has been stable from 2000 to 2008

- red veg trend-large decrease 1990-2008
- orange veg trend-small decrease 1990-2008
- yellow veg trend-stable 1990-2008
- light green veg trend-small increase 1990-2008
- dark green veg trend-large increase 1990-2008

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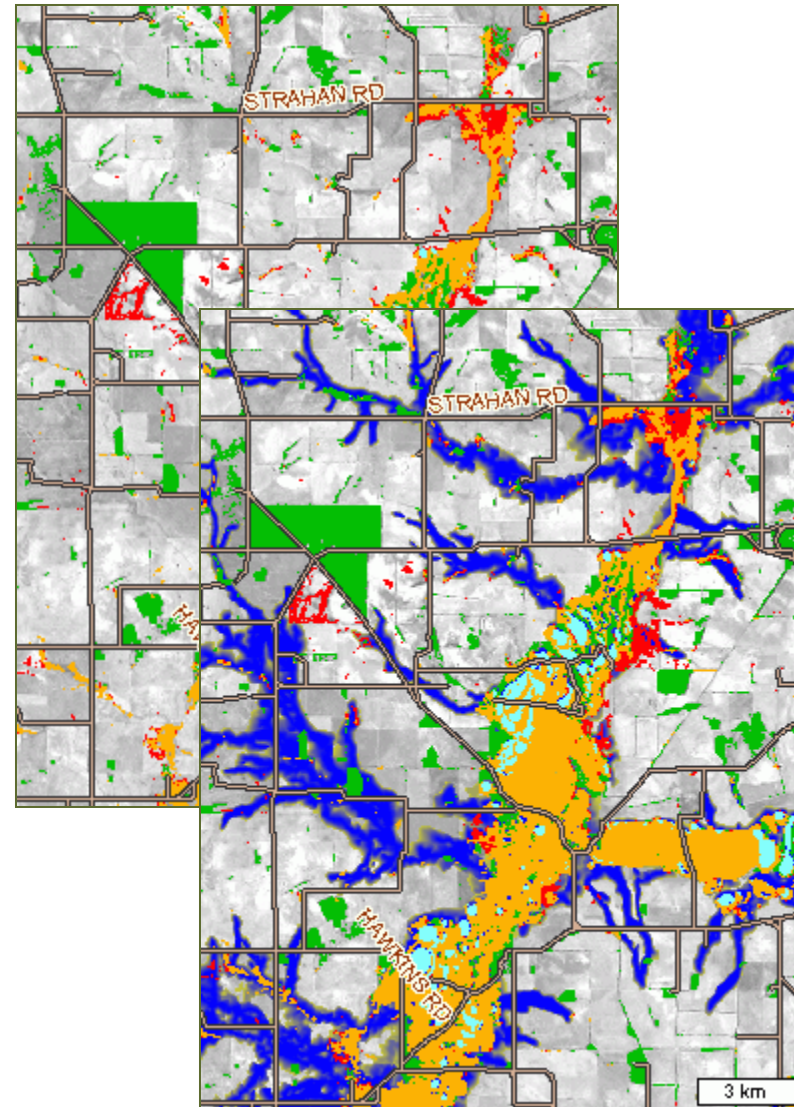
Salinity Products

Salinity Monitoring from 1988 to 2000

Consistently low productive land

Salinity Risk / Valley Hazard

Predicting areas at risk of developing high water tables



Western Australia - Land Monitor Project

Salinity Coverage

Salinity and Areas-at-risk

Extent = **250,000km²**

Excludes coastal plain

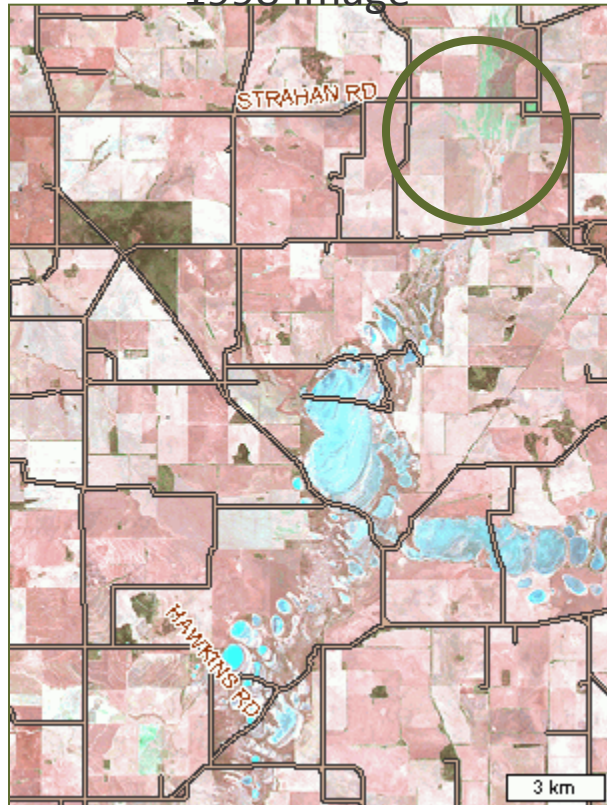


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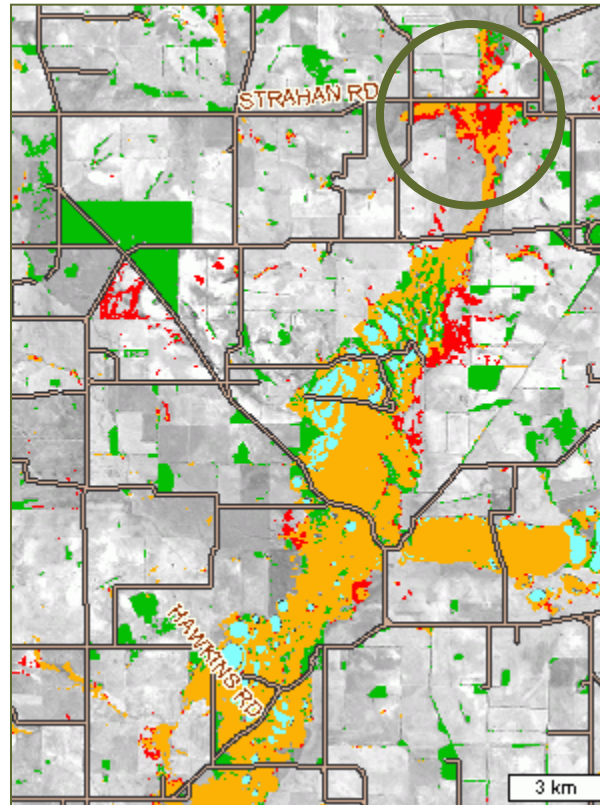
Salinity Monitoring and Risk

Image Sequence

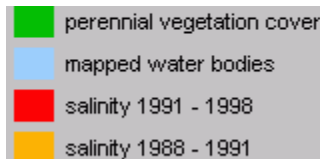
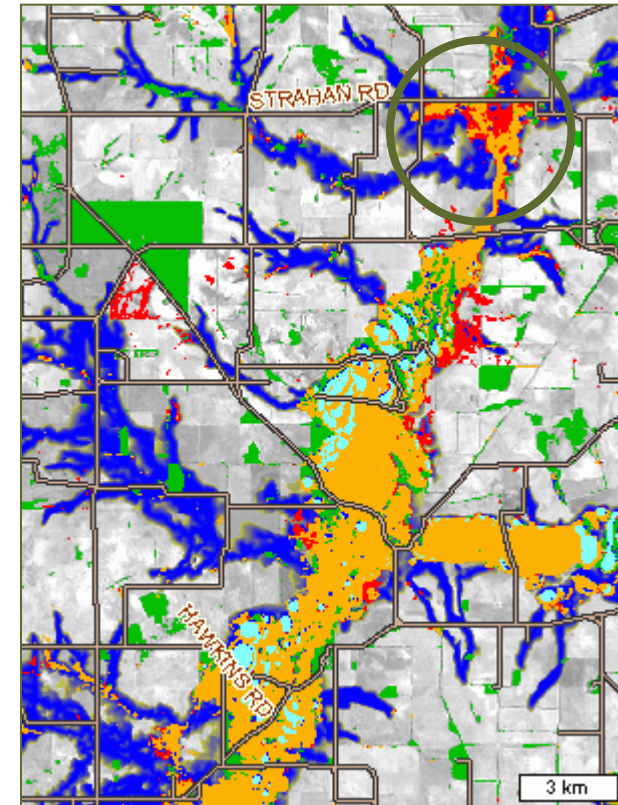
1998 Image



Salinity Monitoring



Salinity Risk

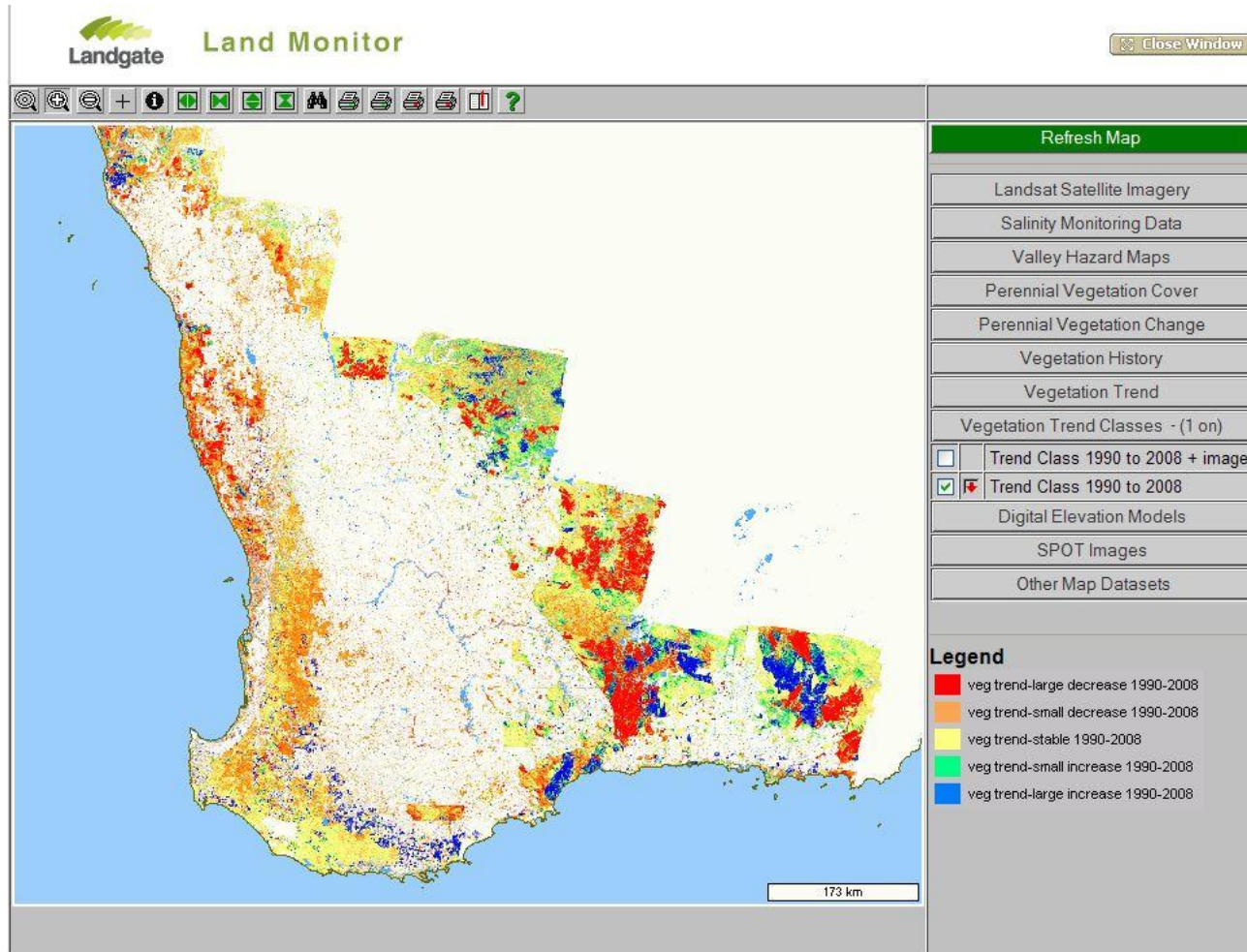


Web map service

landmonitor.landgate.wa.gov.au

Public Access – zoom restrictions apply

Project Subscriber Access – free subset and limited download of vegetation products for non-commercial purposes



Land Monitor project - present and future activities

2009 Landsat imagery to be ordered through
Department of Climate Change (DCC) May/June

Processed by CSIRO June-August

Imagery and vegetation products delivered to
partners and made available on web map service by
September

Plan to migrate from Land Monitor rectification

base to DCC base [Accuracy of LM base over SW WA is not as good as DCC base (whole continent). DCC base benefit since the technology can be moved across the rangeland, methodology is documented therefore can outsource, more consistent]

Acknowledgements



Many thanks ESA for the opportunity to showcase Australia-wide uses for multi-spectral time series data, and future Sentinel-2 data

Questions?