

# Forest Theme Results Australia

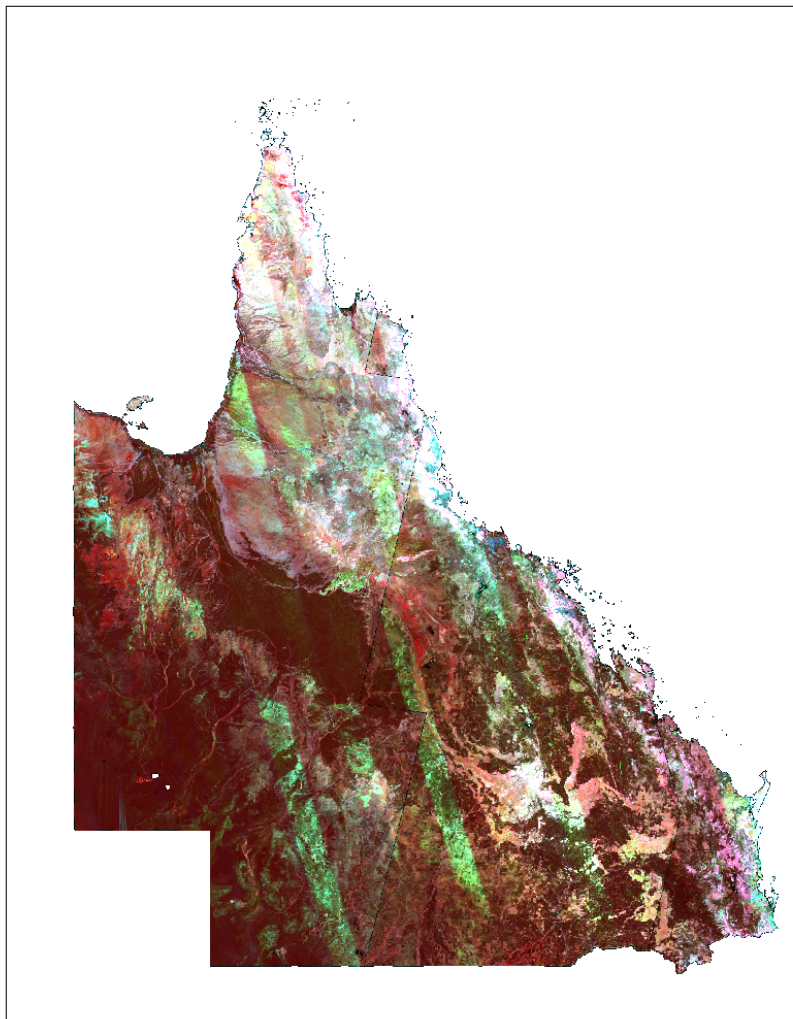
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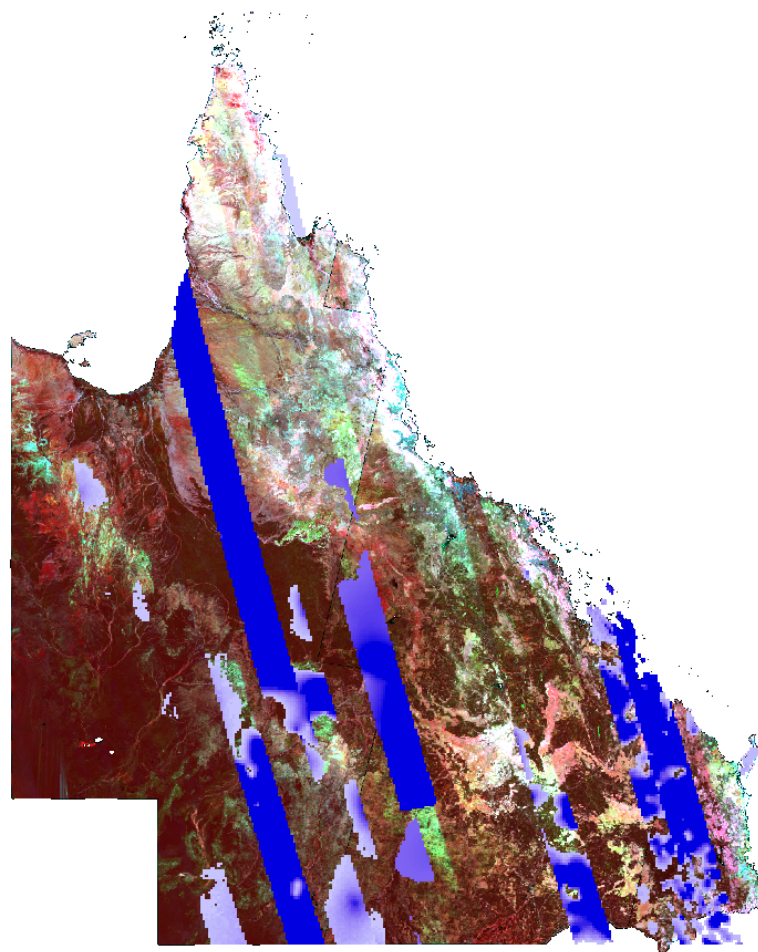
# Overview

- **Understanding variability in ALOS strips**
  - Variations in brightness between image strips from different dates and also locations.
- **Collation of additional datasets to refine algorithms for retrieving structure and biomass**
  - Wide range of forest types (open versus closed)
  - Various states of regeneration and degradation
  - Requirement for calibration and validation of retrieval algorithms
- **Regenerating forests**
  - Variability in structural form and development of regrowth
  - New requirements based on recent moratorium on regrowth clearing (April, 2009)
- **Development of retrieval algorithms**
  - Particular focus on non-linear estimation with Mahta Moghaddam
  - NASA-funded DESDynI (Paul Siqueira, Bruce Chapman).

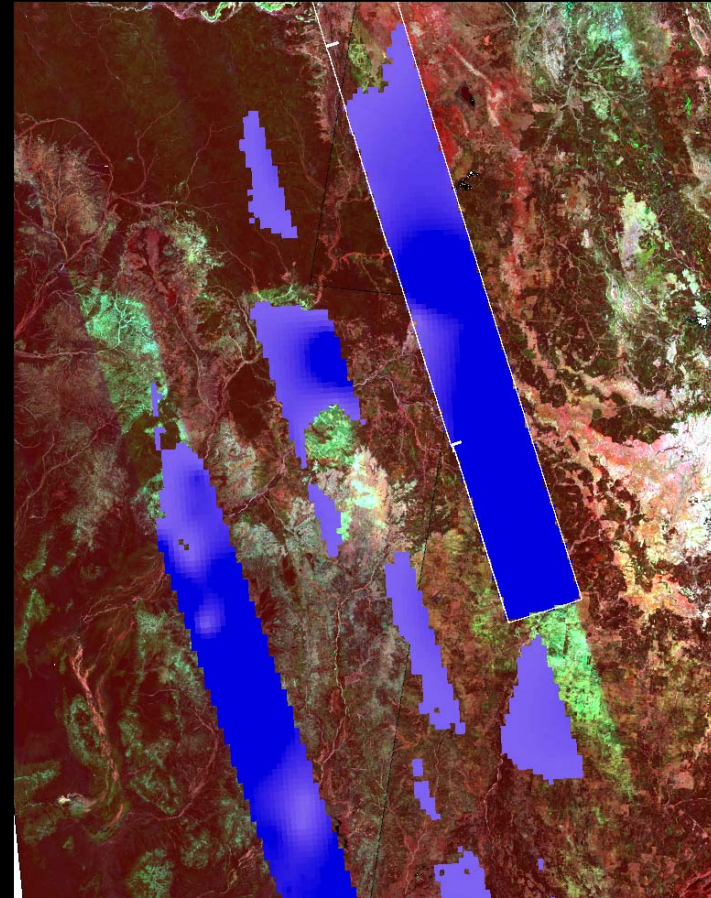
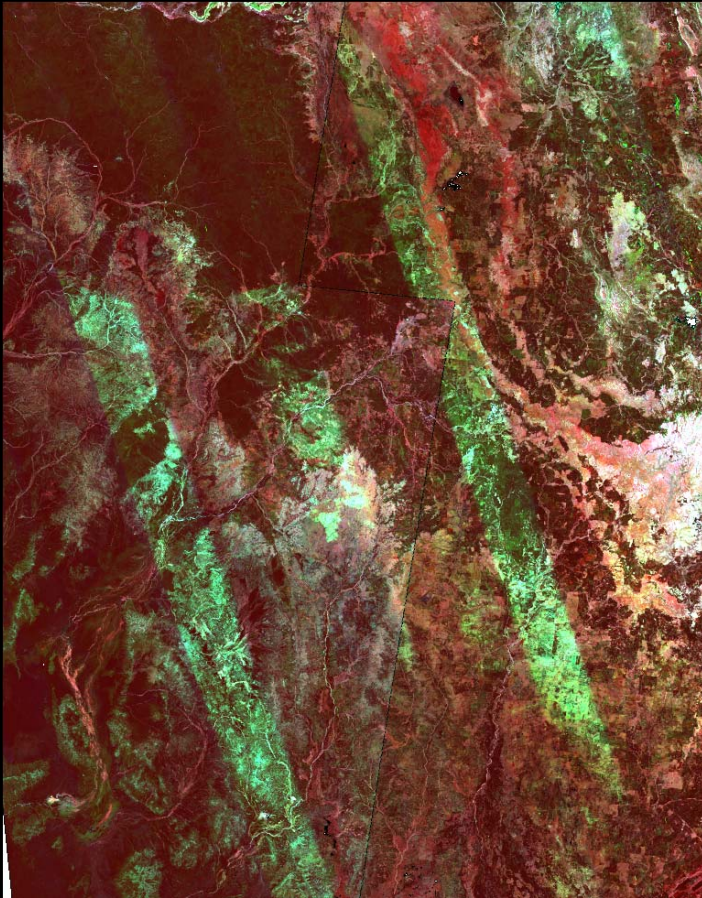
## Understanding Variability in Strips



Landsat FPC/ALOS PALSAR mosaic



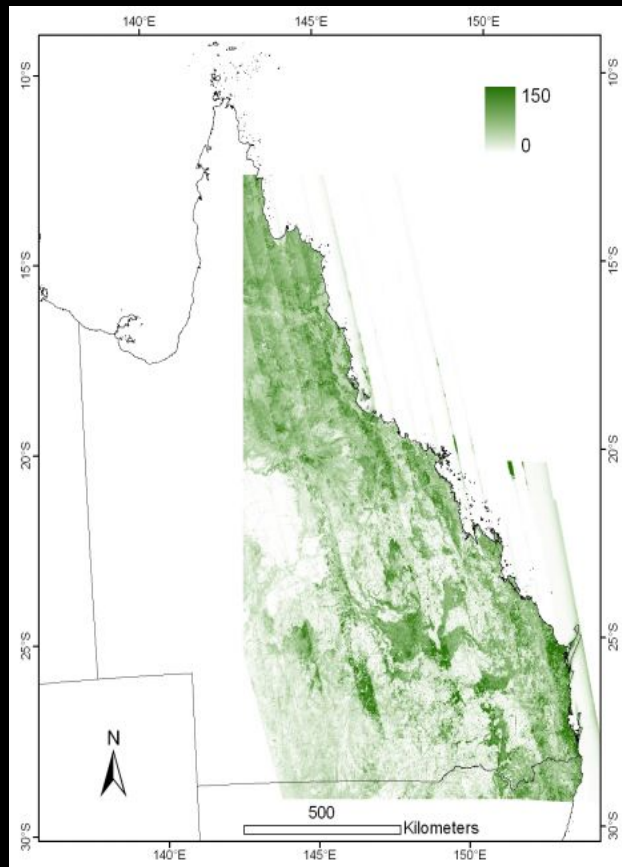
Rainfall surfaces (day of acquisition)



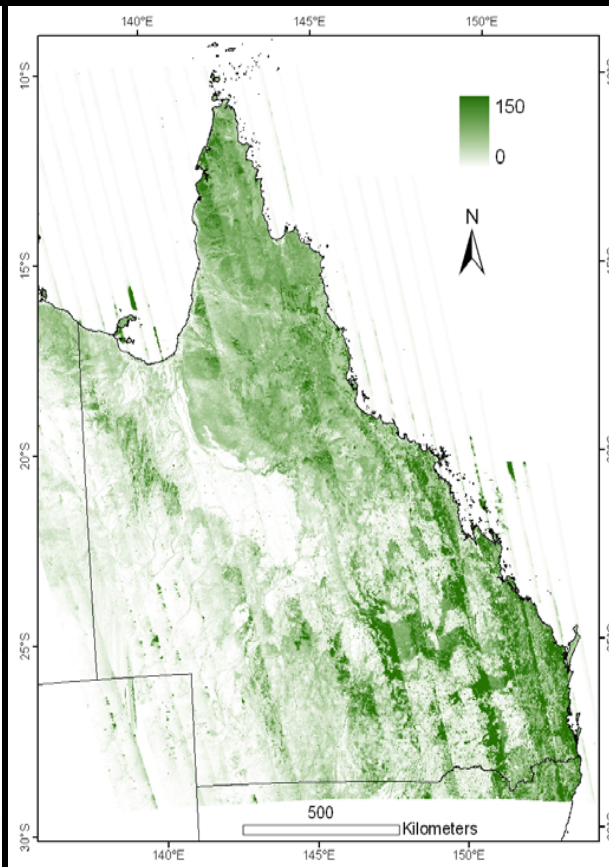
- **Suggests that:**
  - In wetter environments (e.g., boreal, tropical zones), soil and vegetation continually has a high moisture content and hence enhanced backscatter.
  - In dryer environments (e.g., wooded savannas) with high rates of evaporation, backscatter is lower.
  - May contribute to differences in relationships observed between open (typical to dryer environments) and closed (wetter environments)
  - Consideration of rainfall amount and soil moisture retention important when formulating generic equations.



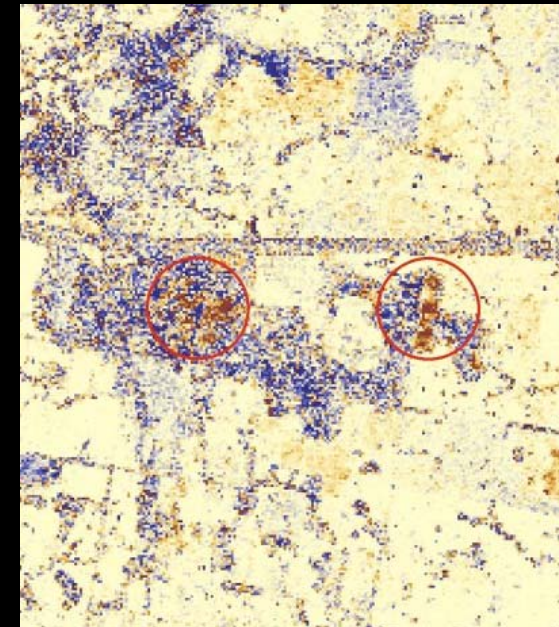
# Implications for Biomass Change Detection



2007



2008

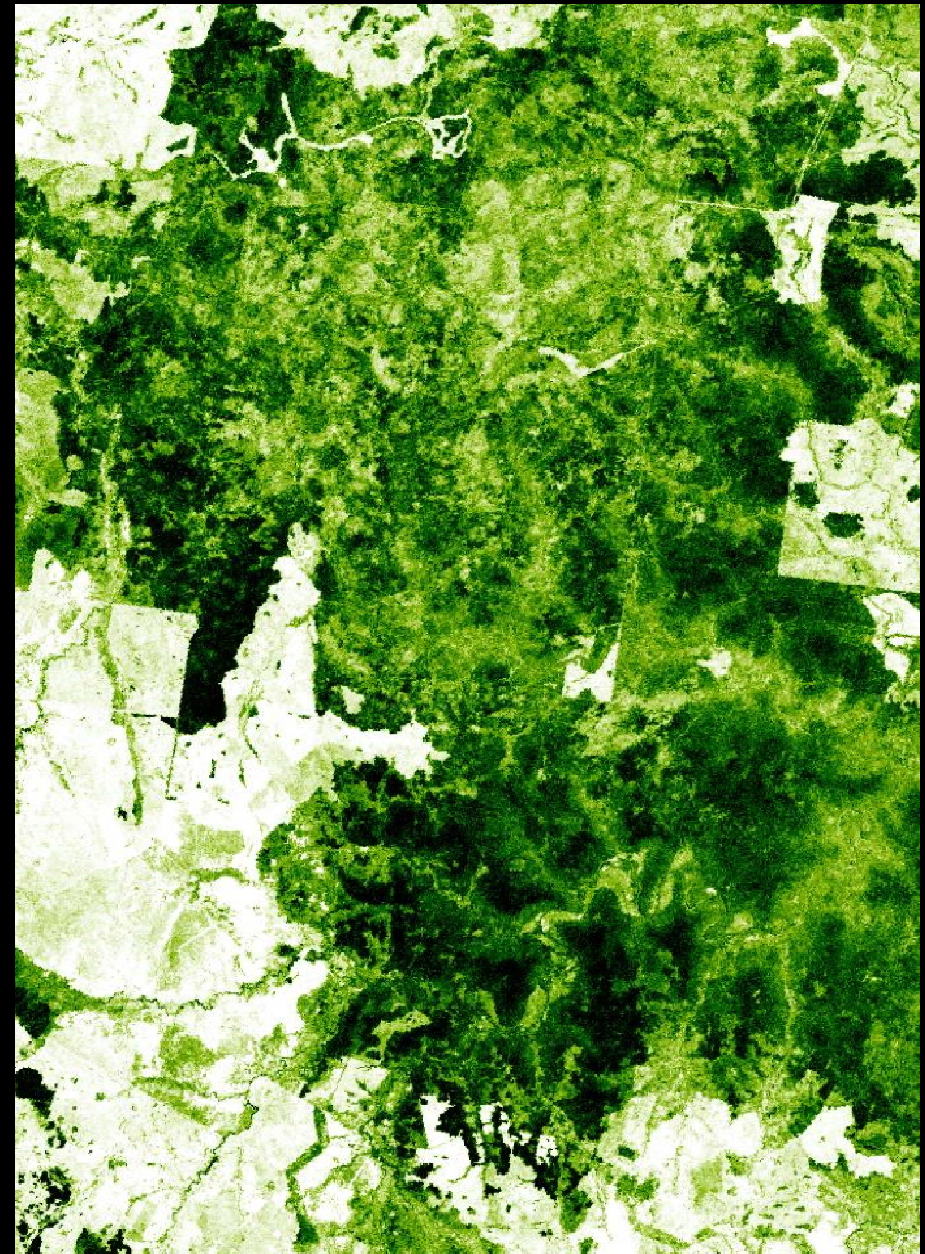
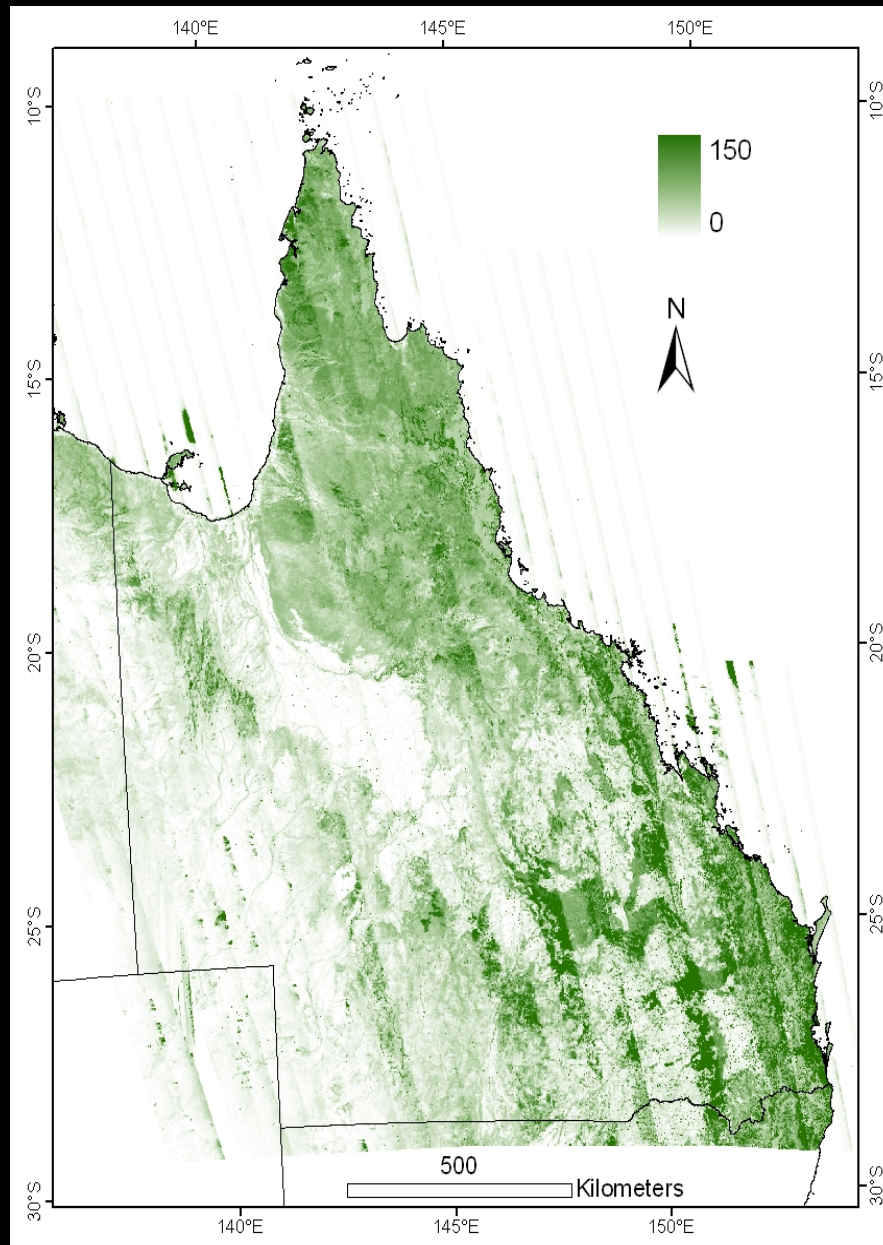


Biomass losses in red,  
gains in blue

- Requirement for consistency in backscatter within and between data to allow biomass change to be detected and quantified.



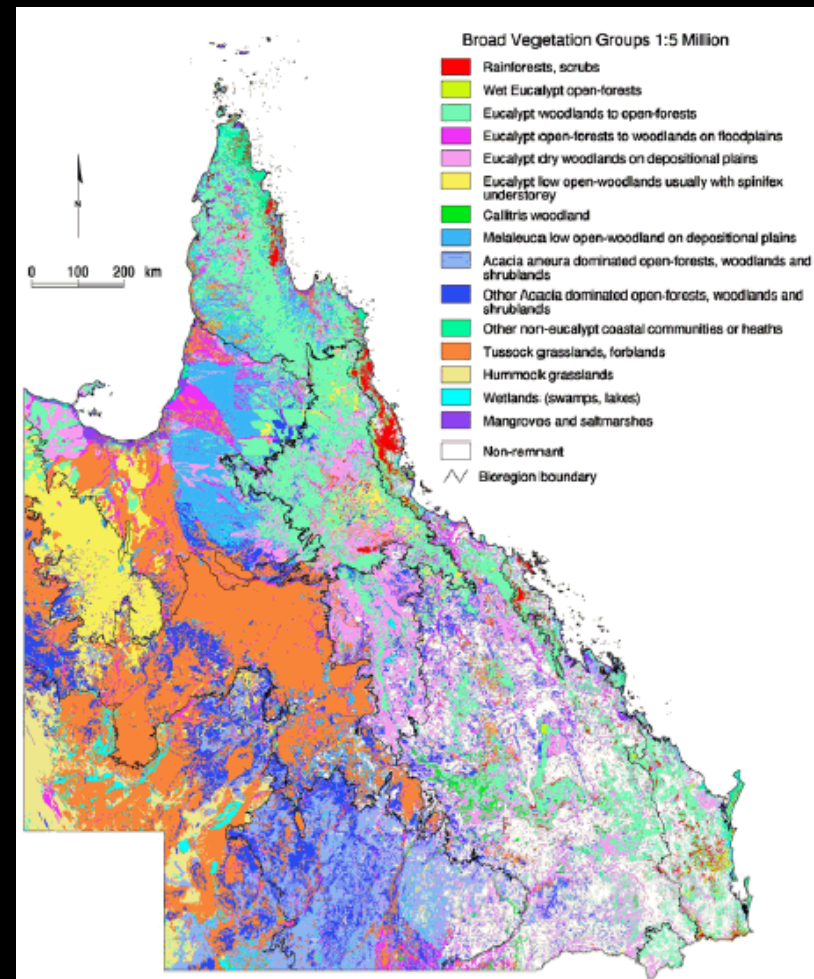
# Revision of biomass estimates based on ALOS PALSAR data



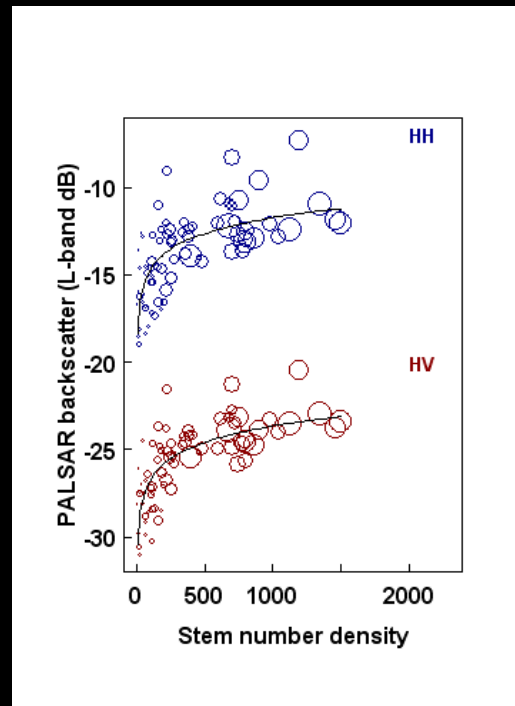
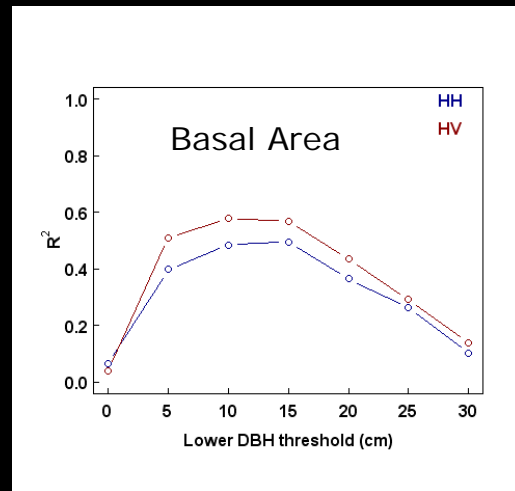


# Vegetation Distributions, Queensland

Major vegetation group	Area Pre- European (km <sup>2</sup> )	Area (circa 1997) (km <sup>2</sup> )	% of total Extent remaining
Eucalypt woodlands	473,272	367,293	77.6
Tussock grasslands	294,662	282,547	95.9
Eucalypt open woodlands	165,065	134,421	81.4
Acacia shrublands	104,368	100,660	96.4
Hummock grasslands	92,009	91,809	99.8
Acacia forests and woodlands	182,089	91,534	50.3
Chenopod shrubs, samphire shrubs and forblands	82,070	81,944	99.8
Melaleuca forests and woodlands	72,173	70,014	97
Other forests and woodlands	49,692	49,266	99.1
Acacia open woodlands	39,861	36,734	92.2
Eucalypt open forests	62,646	35,150	56.1
Tropical eucalypt woodlands/grasslands	20,684	20,653	99.9
Rainforest and vine thickets	30,055	19,558	65.1
Other shrublands	16,780	16,419	97.8
Mangroves, tidal mudflats, samphires and bare areas, claypans, sand, rock, salt lakes, lagoons, lakes	15,442	15,143	98.1
Other grasslands, herblands, sedgelands and rushlands	4,963	4,771	96.1
Callitris forests and woodlands	5,601	4,134	73.8
Casuarina forests and woodlands	11,951	1,545	12.9
Heath	633	470	74.2
Low closed forests and closed shrublands	449	445	99.1
Eucalypt tall open forests	3,976	429	10.8
Eucalypt low open forests	111	111	100
Mallee woodland and shrublands	14	14	100



# Differences in SAR-biomass relationships by forest type

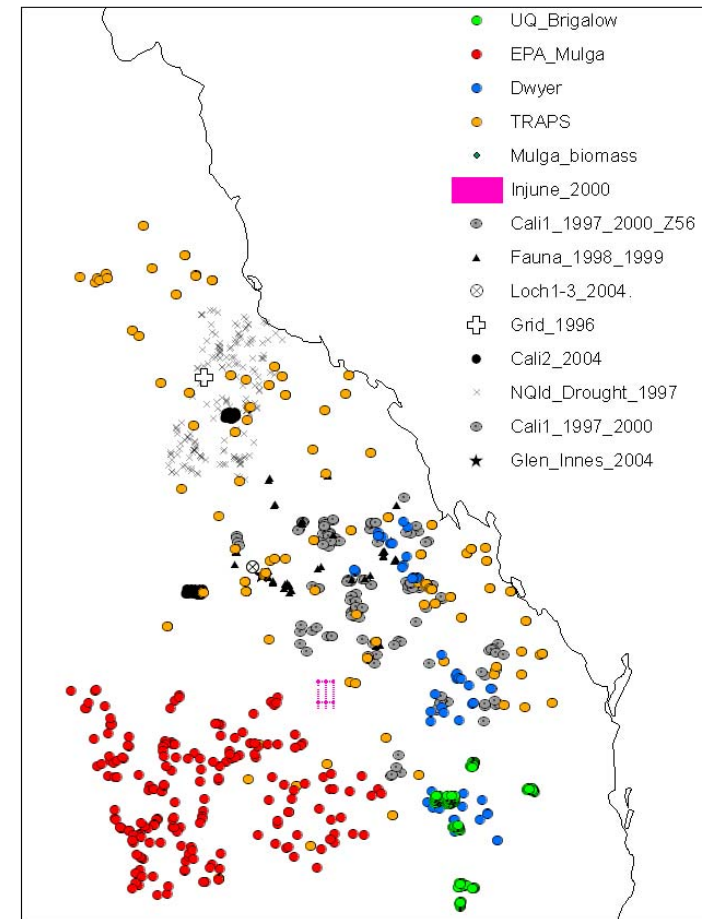


- Differences in  $\gamma^o$  identified between open forests, closed forests and mangroves
- Attributable in part to structural differences
  - In open forests, less L-band interaction with smaller stems.
  - Noticeable increase in strength of empirical relationship when only stems above a certain size class are observed.
  - Not all biomass detected with lower frequency SAR (applies largely to open forests)

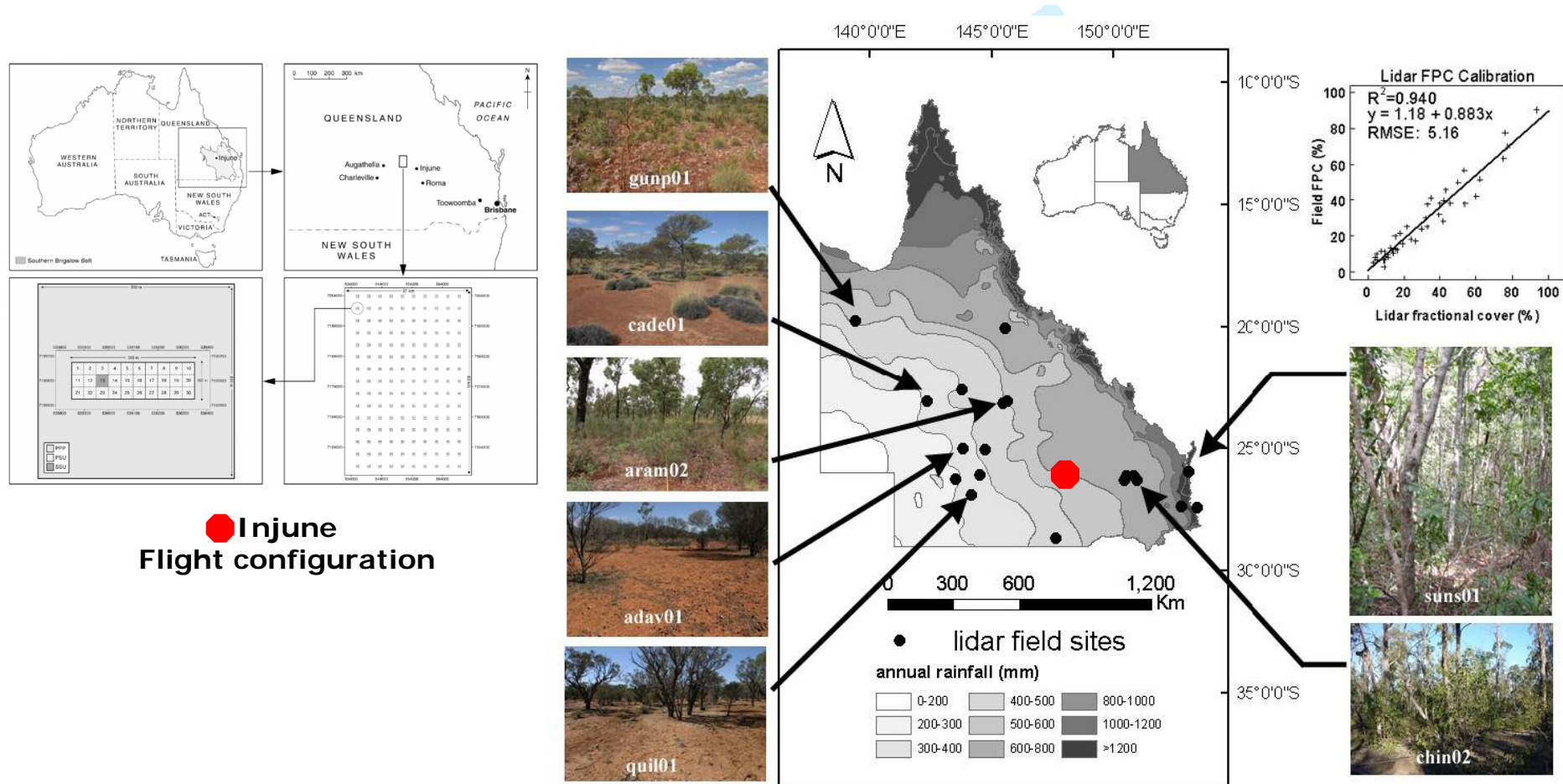


# Field-based estimates of biomass, structure and species

- Pre and post-2006
- Biomass estimated using species-specific and generic allometric equations
- Provides estimates of trunk and branch biomass
- Additional datasets include:
  - **Closed forest**
    - Wet Tropics
    - Border Ranges
    - Brisbane Forest
- Over 800 independent measures of biomass across a range of forest structural types and regeneration/degradation stages



# Integration of Airborne LiDAR



**Airborne LiDAR acquired in 2008/2009 in areas with fully polarimetric and FBD ALOS data.**

***Repeat acquisitions over Injune (2000 and 2009)***

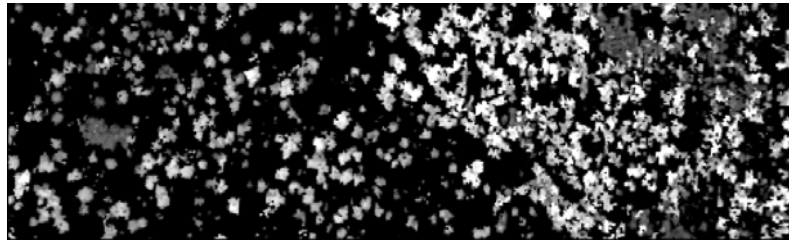
***19 other forest types images (2004 and 2008)***

***Other remote sensing (e.g., hyperspectral and terrestrial scanner data) acquired***

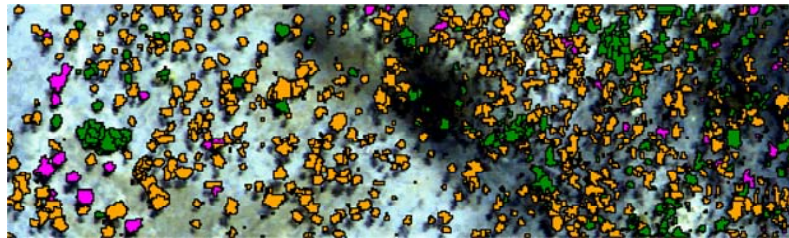


# Tree to Stand Level Products

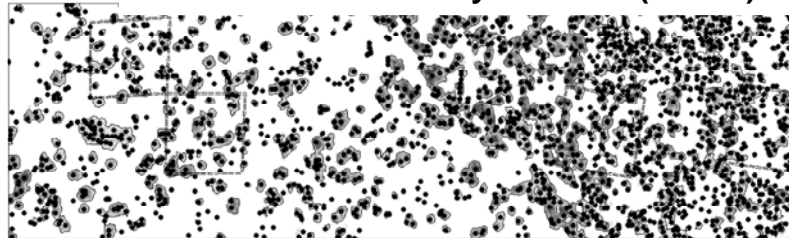
Tree height (LiDAR)



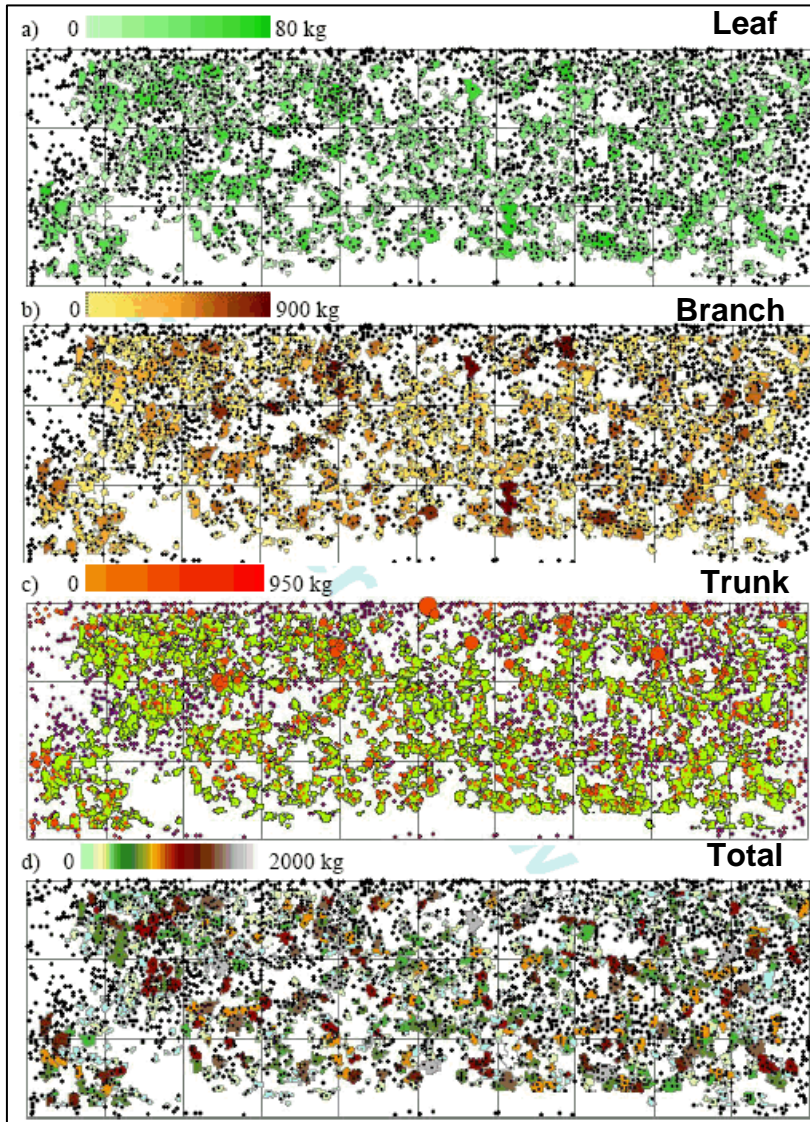
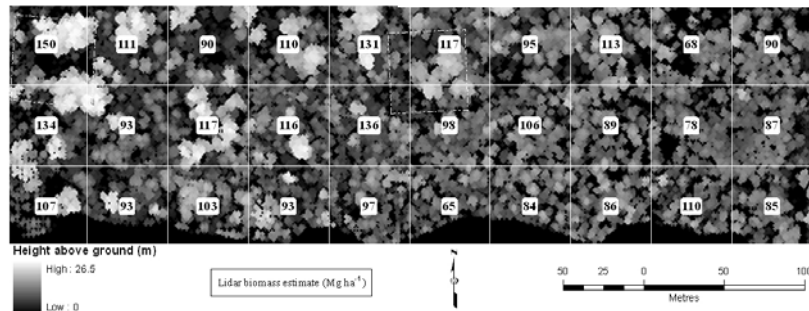
Species (Hyperspectral)



Location and density of stems (LiDAR)

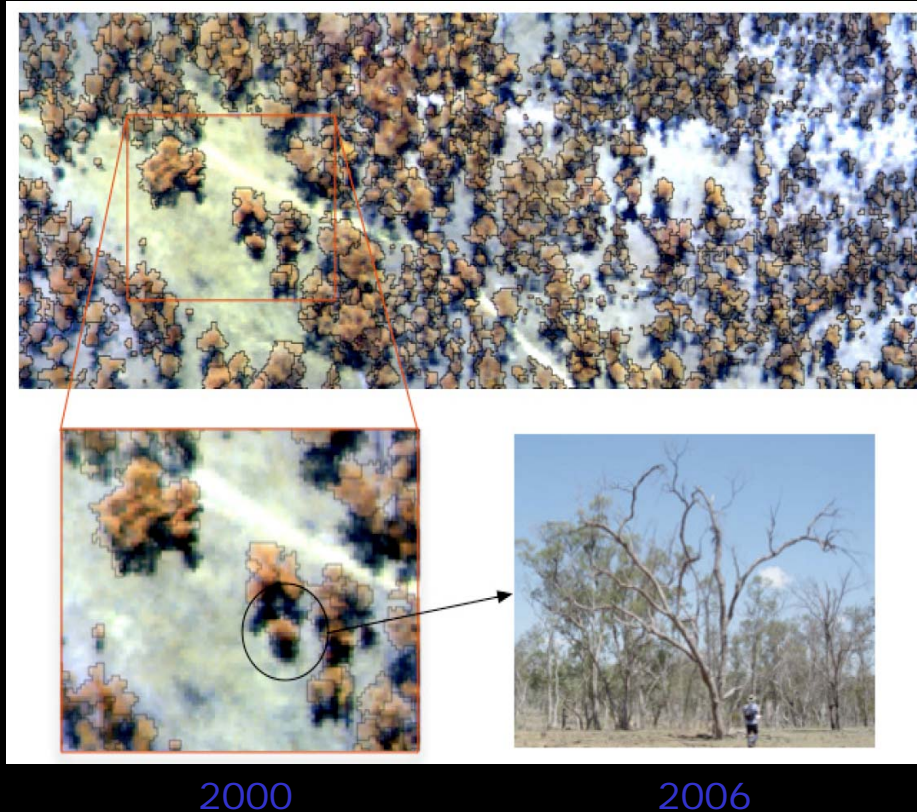


Stand-level biomass





# Detection of Environmental Change



Drought impacts,  
Injune, Queensland

- Time-series comparison of LiDAR/optical data/products
  - 2000 (Injune)
  - 2004/5
  - 2008/9
- Time-series comparisons
  - JERS-1 SAR
  - ALOS PALSAR (2007 onwards)
  - Landsat-derived FPC
- Detection of:
  - Woody thickening
  - Forest degradation

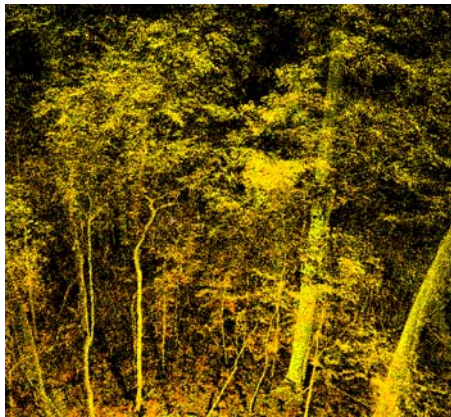
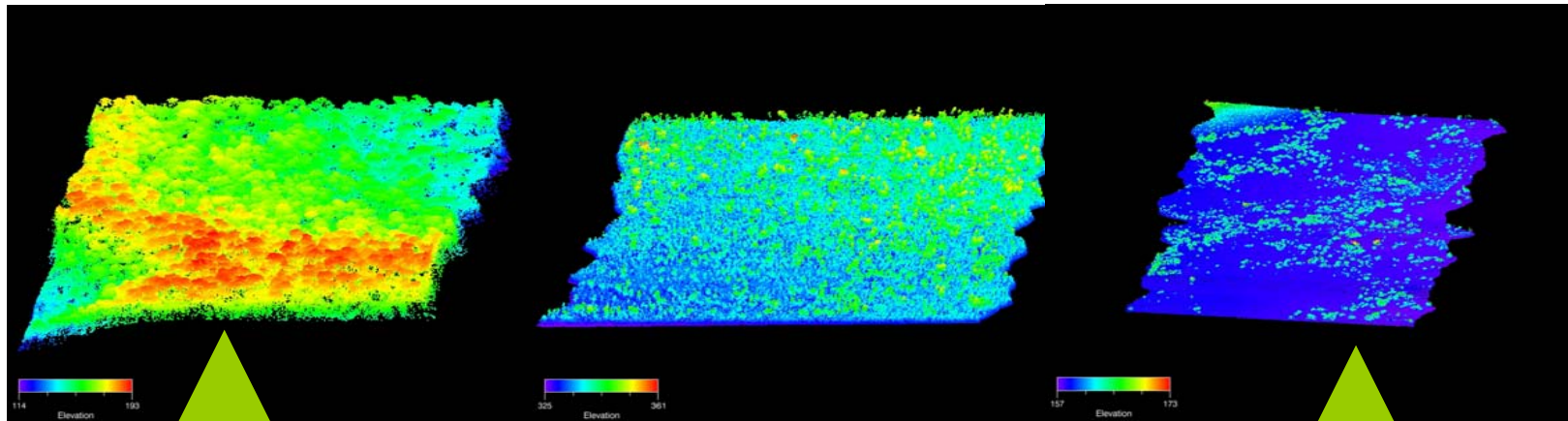
# New Datasets for Interpreting ALOS PALSAR data

## Airborne Laser Scanner data

Tropical rainforest

Wooded savanna

Low open woodland



## Terrestrial Laser Scanner

Field measures of structure/biomass

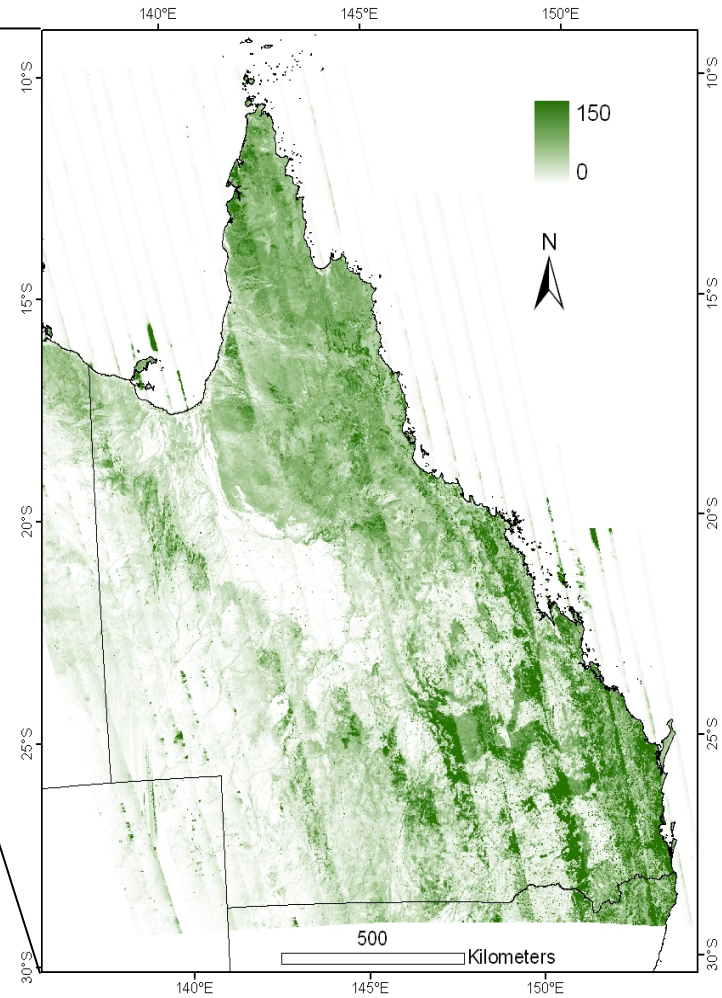




# Scaling structural attributes and biomass




**Retrieved estimates of biomass  
& structure  
(Airborne data)**




**Scaled using Spaceborne  
SAR (ALOS, BIOMASS?)**



# Queensland Moratorium on Regrowth Clearing

**Queensland  
Government**

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**Vegetation management**


- Clearing and development
- Legislation and policy
- Vegetation communities
- Regional Vegetation Management Codes
- Property vegetation management plans
- Fact sheets
- Property Maps of Assessable Vegetation (PMAVs)
- Financial assistance
- Environmental offsets

**Vegetation management**

**Regulatory Impact Statement—Vegetation Management Amendment Regulation 2009**

The Department of Environment and Resource Management has released a Regulatory Impact Statement (RIS) for public consultation about the review of fees and charges for vegetation management-related services.

[Read more about the RIS →](#)

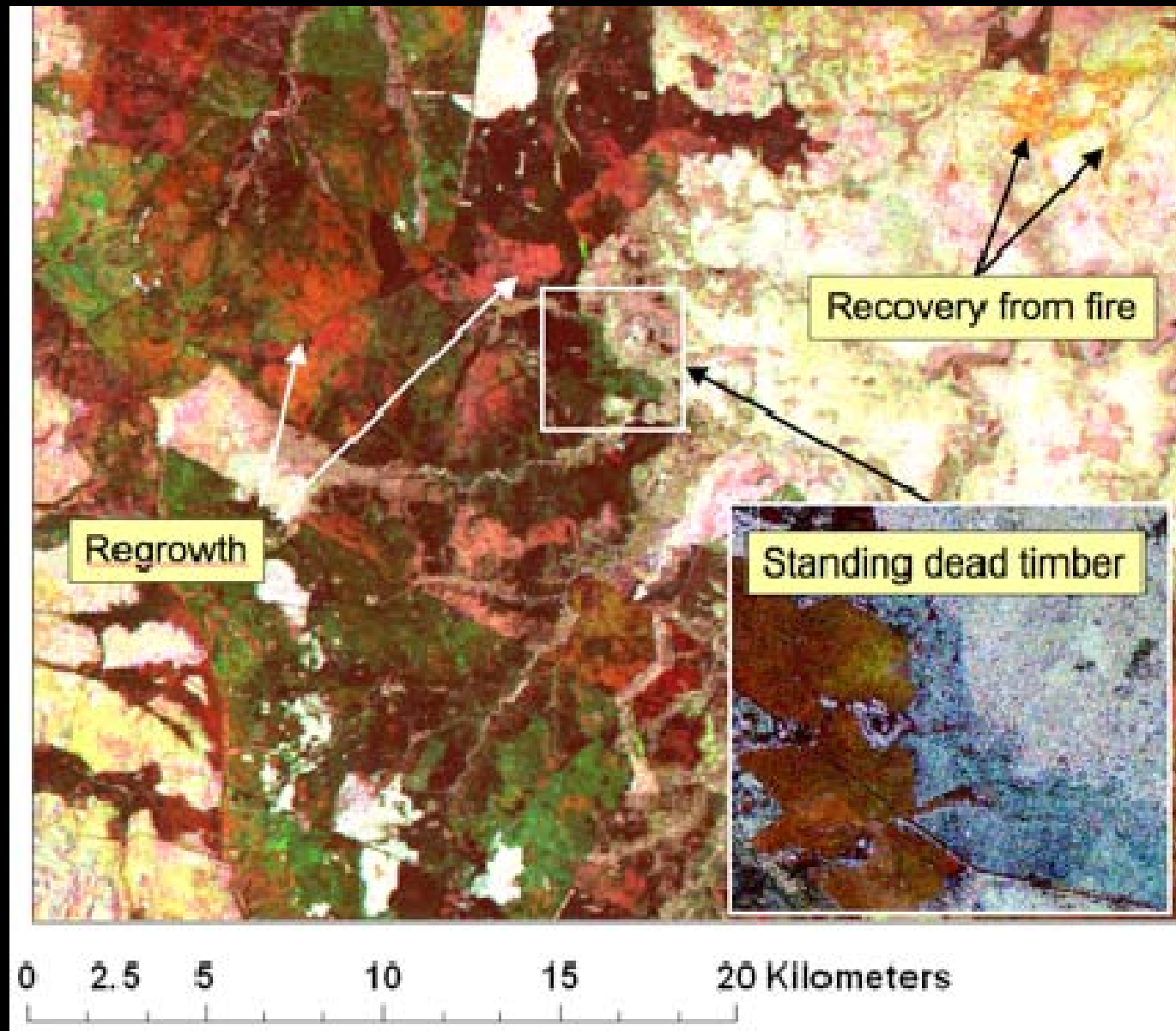
**Moratorium on clearing of high-value regrowth**

On 7 April 2009, the Queensland Government announced a three-month moratorium on clearing high-value regrowth vegetation. A series of guides has been developed to assist landholders and local governments with the new moratorium process.

[Read more about the moratorium →](#)

- All native regrowth within 50 metres of a watercourse in the priority reef catchments and endangered regrowth vegetation in rural areas across the state on freehold and agricultural and grazing leasehold land is protected for a period of at least three months.
- Large areas of regrowth are still unprotected

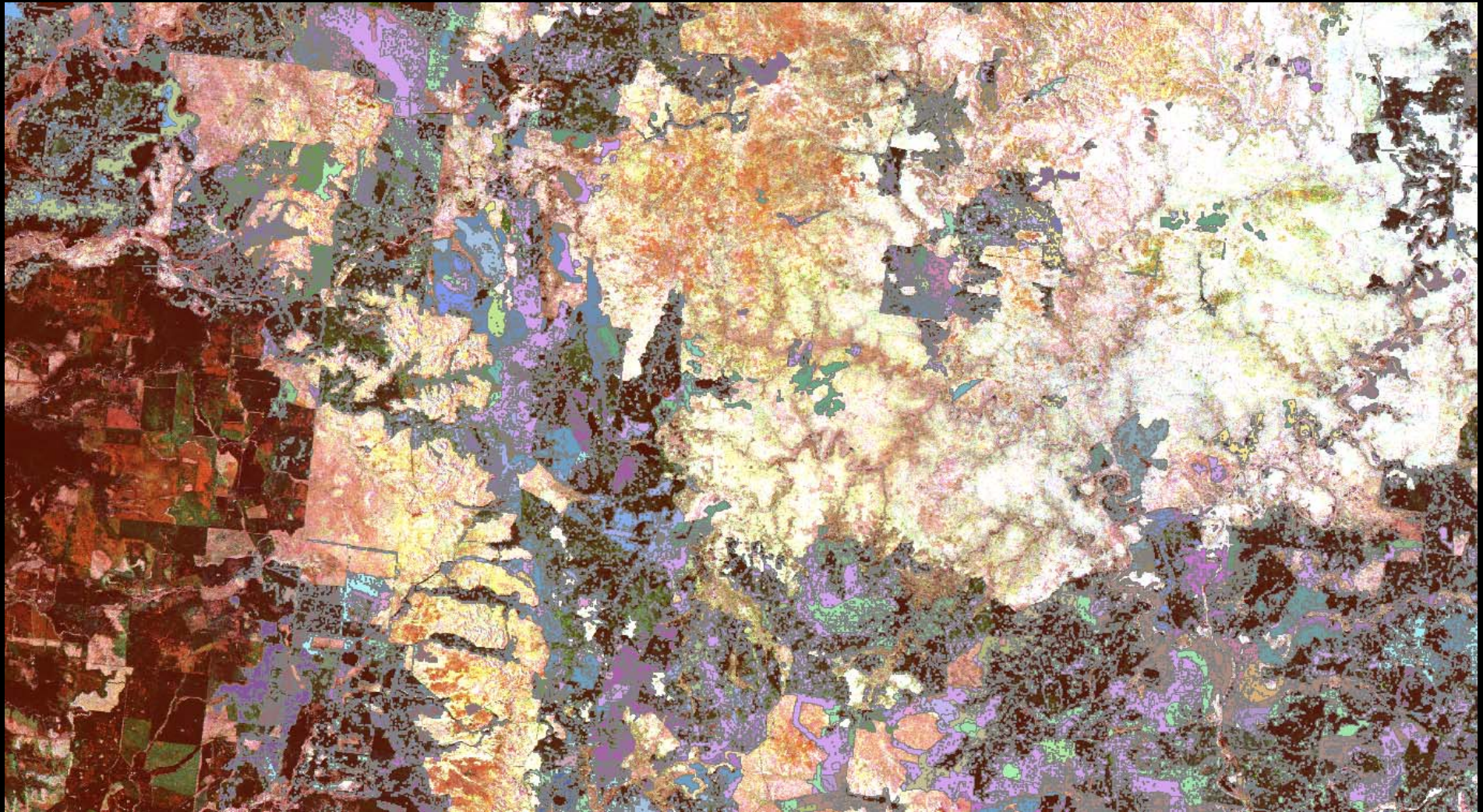
## Forest Characterisation: Integration of ALOS PALSAR and Landsat FPC






# Regional Ecosystem Mapping

## Differentiating regrowth types





# Forest cover mapping, Queensland, Australia

**Queensland**  
Government

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**Statewide Landcover and Trees Study**  
Benefits  
Methodology  
Technology  
Products  
Reports and publications  
Contacts

**Statewide Landcover and Trees Study (SLATS)**

Queensland is a large state, 1.7 million square kilometers in area, with 81 million hectares of woodland and forests. The Statewide Landcover and Trees Study (SLATS) project provides policy makers, industry and community interest groups, and landholders with:

- accurate information on woody vegetation cover
- information on changes in the cover
- mapping and statistical information.

In recent years, land clearing (or deforestation) has become an increasingly controversial topic in the natural resource debate that contrasts the economic aspects of land development with the ecological need to conserve biodiversity and reduce greenhouse gas emissions.

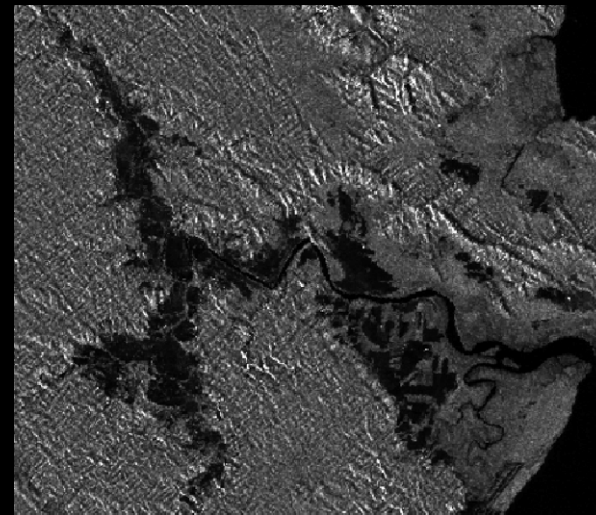
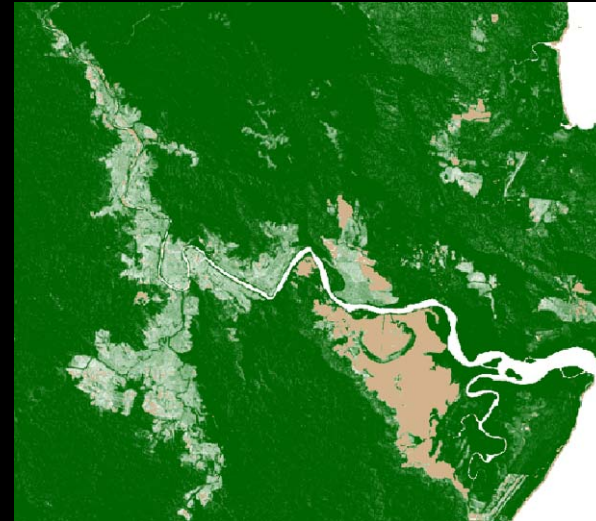
The SLATS project is a major vegetation monitoring initiative to investigate the overall cover of woody vegetation, and to report on the previously unquantified extent of land clearing in Queensland using scientifically developed and tested methods. These methods combine field verification and computer processing using state-of-the-art remote sensing and Geographic Information System (GIS) technologies.

Some of the project's aims are to:

- contribute to the monitoring of greenhouse gas emissions
- assist in vegetation management planning and compliance
- provide updates for the Queensland Herbarium's regional ecosystem mapping program.

- **NSW are currently implementing a similar scheme**

## Refinement of woody/non-woody vegetation maps, Queensland



- Landsat-derived FPC used to discrimination woody vegetation (10-12 % threshold)
- Confusion with pastures avoided using ALOS PALSAR

# Overview

- **Understanding variability in ALOS strips**
  - Rainfall and retention of moisture in soil and vegetation
  - Requirement to select scenes acquired during periods of no or low rainfall.
- **Collation of additional datasets to refine algorithms for retrieving biomass and structure**
  - Over 800 field-based estimates of biomass and structure for refinement of algorithms
- **Regenerating forests**
  - ALOS provides unique opportunity to characterise the structure, biomass and growth stages of forests.
  - Potential to refine mapping of certain regrowth forms.
- **Additional uses**
  - Refinement of forest/non-forest maps in areas with herbaceous vegetation and where cloud cover presents observations from optical remote sensing data.
  - Non-linear estimation algorithm for retrieving biomass and structure
  - Support for NASA project



# Acknowledgements

- Japanese Space Exploration Agency (JAXA) and the Kyoto and Carbon Initiative
- Electrical Engineering and Computer Science, the University of Michigan
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- Queensland Department of Primary Industries (DPI) Tropical Beef Centre (TBC)
- Queensland University of Technology (QUT)
- School of Geosciences, University of Wollongong
- **School of Biological, Earth and Environmental Sciences (BEES), the University of New South Wales, Australia (UNSW).**
- **The Bureau of Rural Sciences (BRS)**
- **The Queensland Department of Natural Resources and Water (QDNRW)**
- **The School of Resources, Environment and Society (SRES), Australian National University (ANU), including the *WildCountry* Science Project**
- **The Cooperative Research Centre for Greenhouse Accounting (CRCGA)**
- **The Institute of Geography and Earth Sciences (IGES), University of Wales, Aberystwyth (UWA)**
- **Queensland Herbarium**
- **Queensland University**

