Kyoto & Carbon (K&C) Initiative

Forest Theme
Current Status of Projects

Institute of Geography and Earth Sciences,
The University of Wales Aberystwyth

Overview

- Product name:
  - Forest structural maps, northern Australia.

- Description:
  - Integration of ALOS PALSAR, JERS-1 SAR and optical remote sensing data for differentiating and refining maps of forest structural types, including woody regrowth, across Queensland and the Northern Territory

- PALSAR mode:
  - Dual polarisation.

- Observation cycles:
  - 13, 21, 29

- Production schedule (estimated):
  - Test area mapping (June, 2008)
  - Queensland area mapping (December 2008)
  - Northern Australia mapping (December 2009)

- Estimated date of delivery:
  - Six months after completion of above.

Project Aims

- To progressively demonstrate the use of ALOS PALSAR and JERS-1 SAR data, either singularly or in combination with optical data, for retrieving, mapping and detecting change in forests in northern Australia.

- Focusing specifically on:
    - Woody regrowth
    - Forest structural types
    - Distributions of biomass and changes in these

Study Area

- Local study areas:
    - Injune, central south east Queensland
    - SLATS sites, Queensland

- Prototype areas:
    - Queensland

- Product areas:
    - Northern Australia

SAR Data Acquisitions
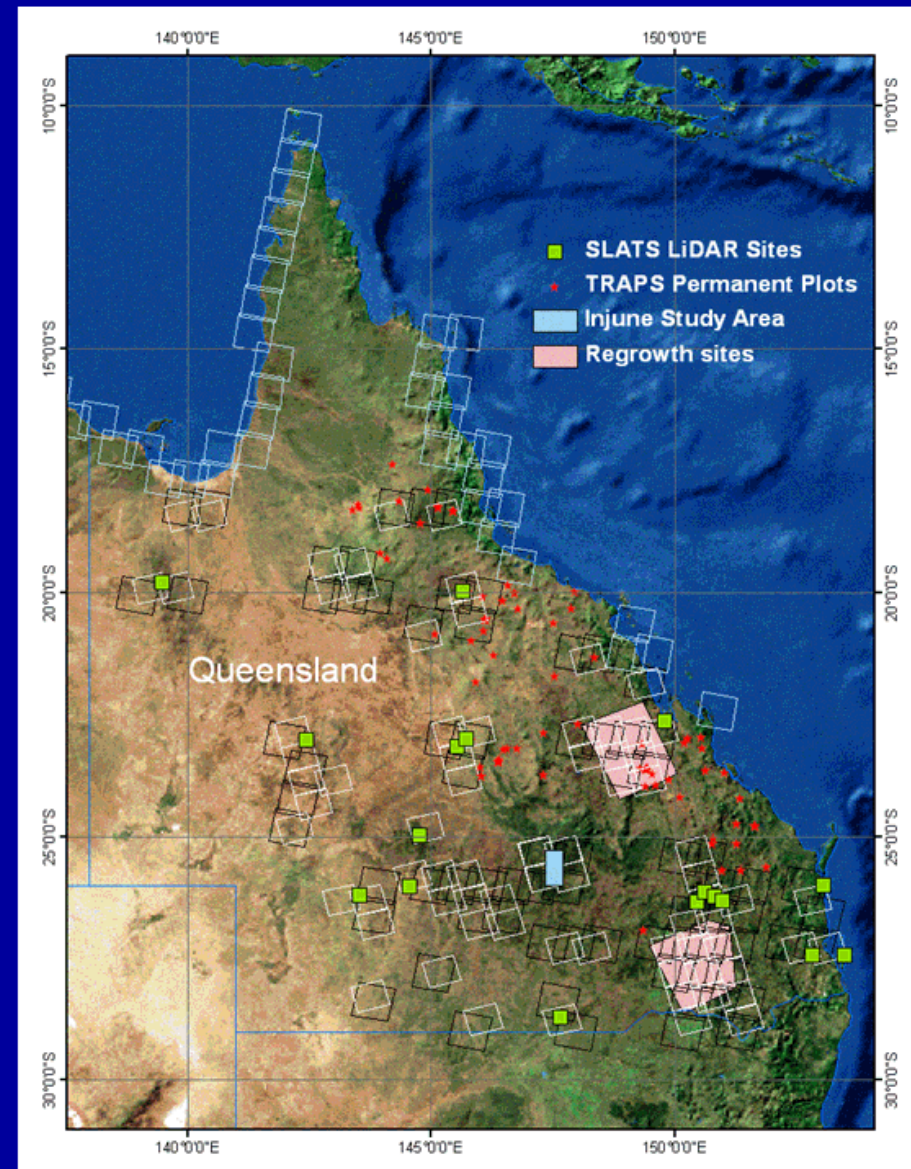
- ## ALOS PALSAR
  - 30 scenes (Queensland) – K&C
  - 50 scenes (Injune and SLATS sites, Queensland) - PI
    - Single
    - Dual
    - Polarimetric
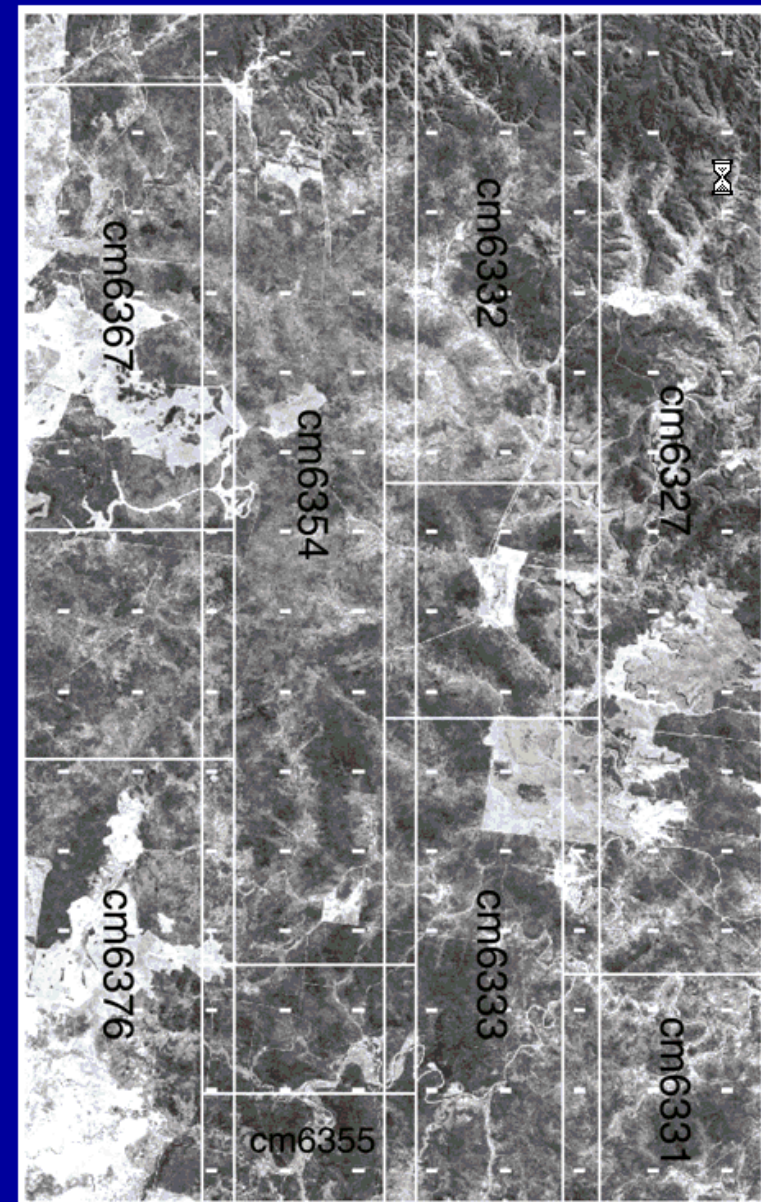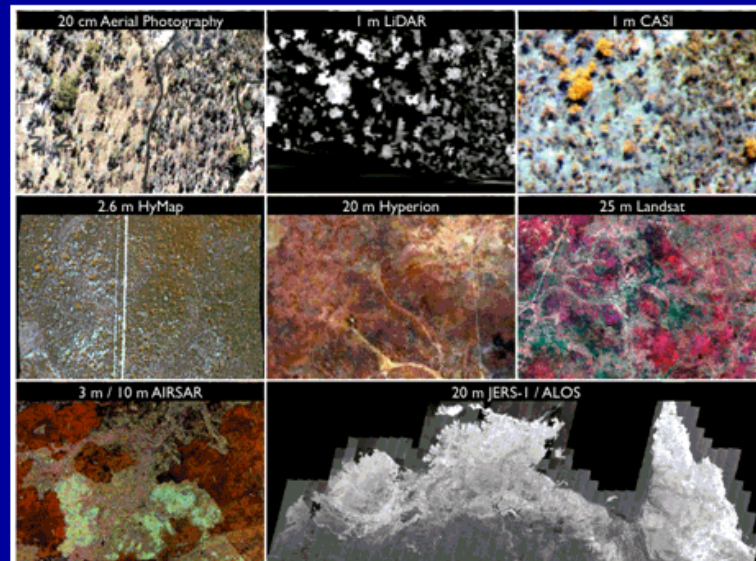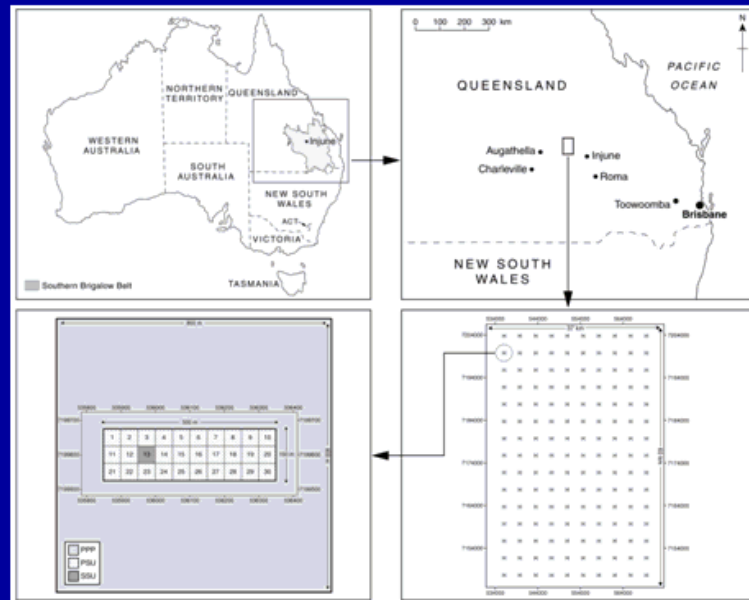   - Full range of incidence angles

- ## JERS-1 SAR
  - 40 scenes (Queensland) – K&C

- ## Other data
  - Landsat mosacis of Foliage Projected Cover (FPC)
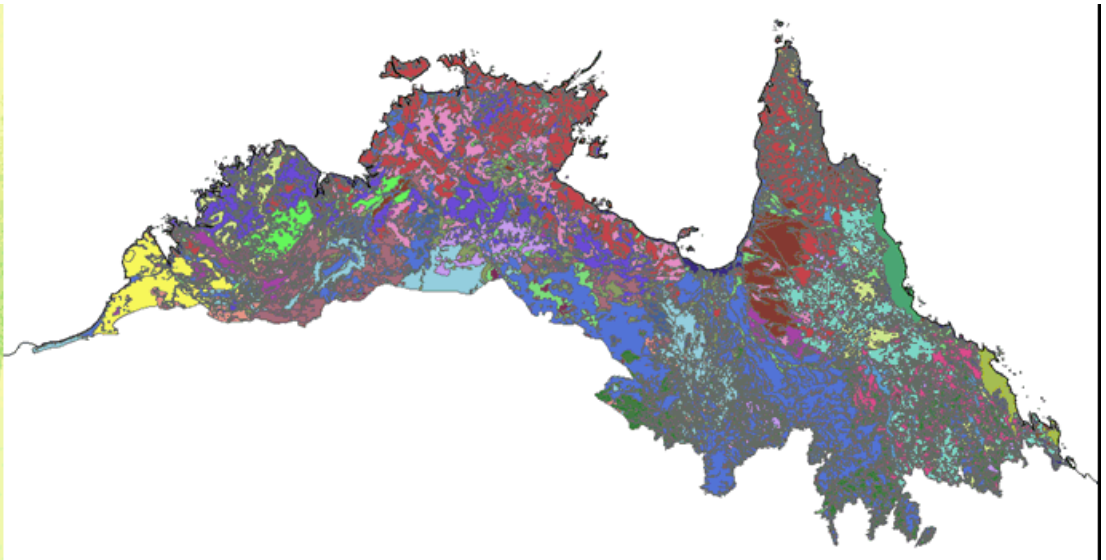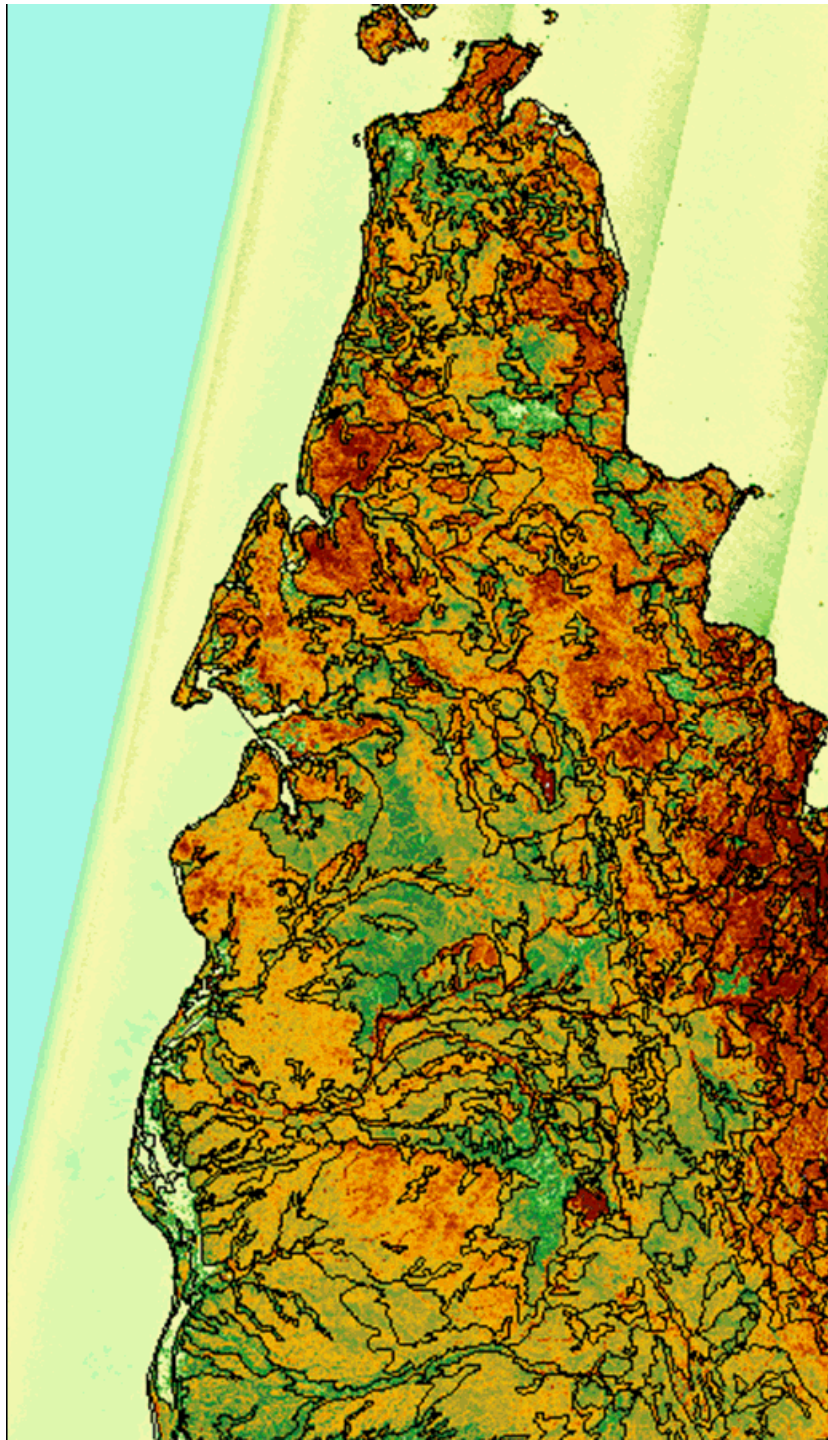
Supportive Datasets

Processing Sequences

- **Sequences**
  - Processing Level: 1.0
  - Processing software: Gamma

- **Issues**
  - Software for scene location display
  - Orthorectification
 - Links with K&C mosaics
  - Ease of ordering

This image shows the JERS-1 SAR mosaic of Cape York – the outlines are different vegetation types delineated using aerial photography.
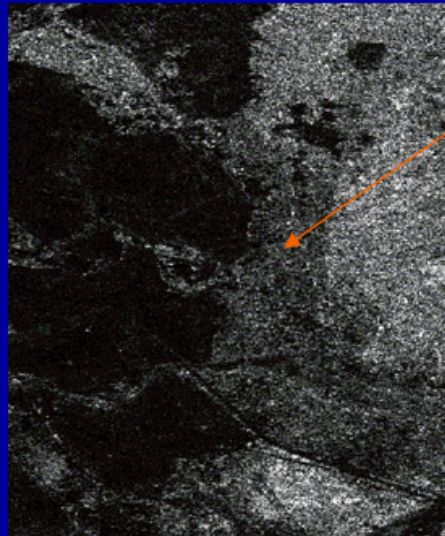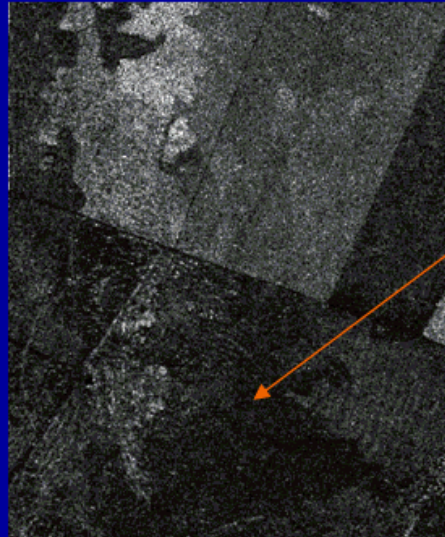
The correspondence with the SAR backscatter (coloured from low (green) to high (red) is close in many cases but not all, indicating structural variability within categories.

Preliminary results: Forest Structural Mapping

Foliage Projected Cover
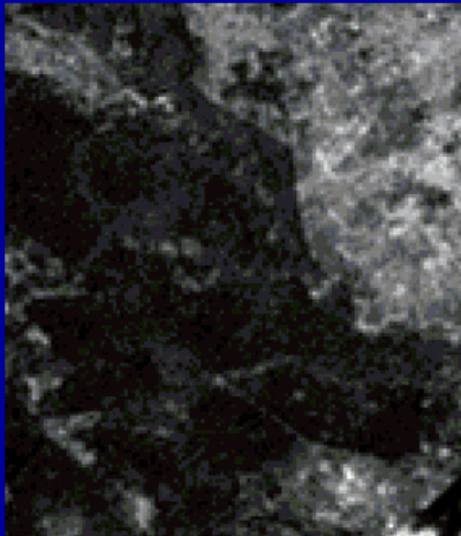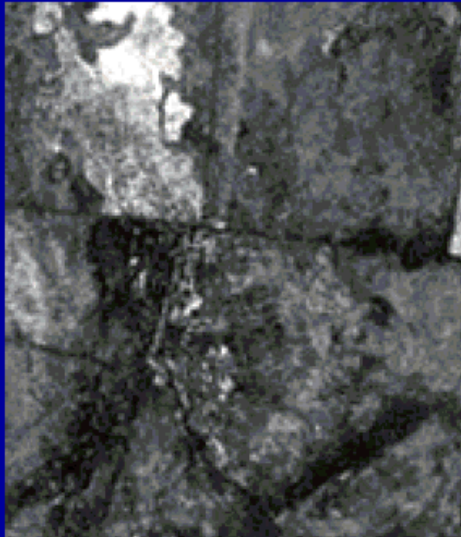
ALOS PALSAR L-band HH

For Queensland, regional mosaics of Foliage Projected Cover have been and continue to be generated from Landsat sensor data. Regrowth is detected as having a high FPC but low L-band backscatter. Dead standing trees have a low FPC and a high L-band backscatter.
These observations were made using AIRSAR data but transfer through to the ALOS data.

Regrowth

Dead standing trees

Preliminary results: discrimination of regrowth and dead standing trees.

Biomass Retrieval

Height above ground (m)
High : 26.5
Low : 0

Lidar biomass estimate (Mg ha⁻¹)

Biomass (Mg ha^{-1})

Low incidence angle
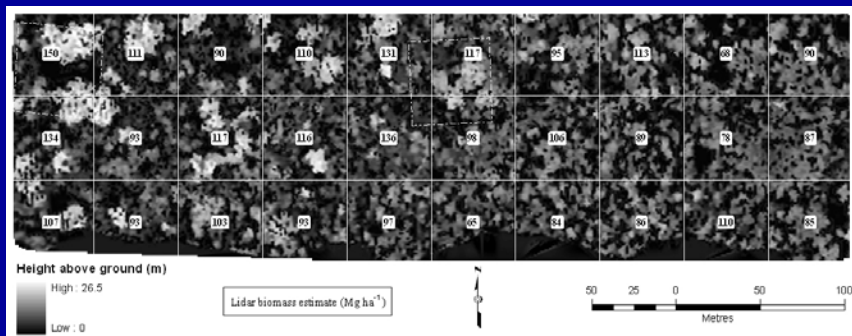
High incidence angle
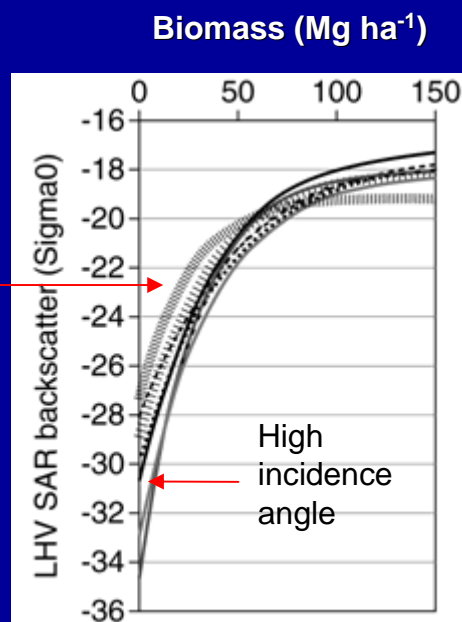
Observations using AIRSAR suggest that L-band HV acquired at higher incidence angles are best suited for biomass retrieval

cm6367

cm6332

cm6354

cm6327

cm6376

cm6333

cm6355

cm6331
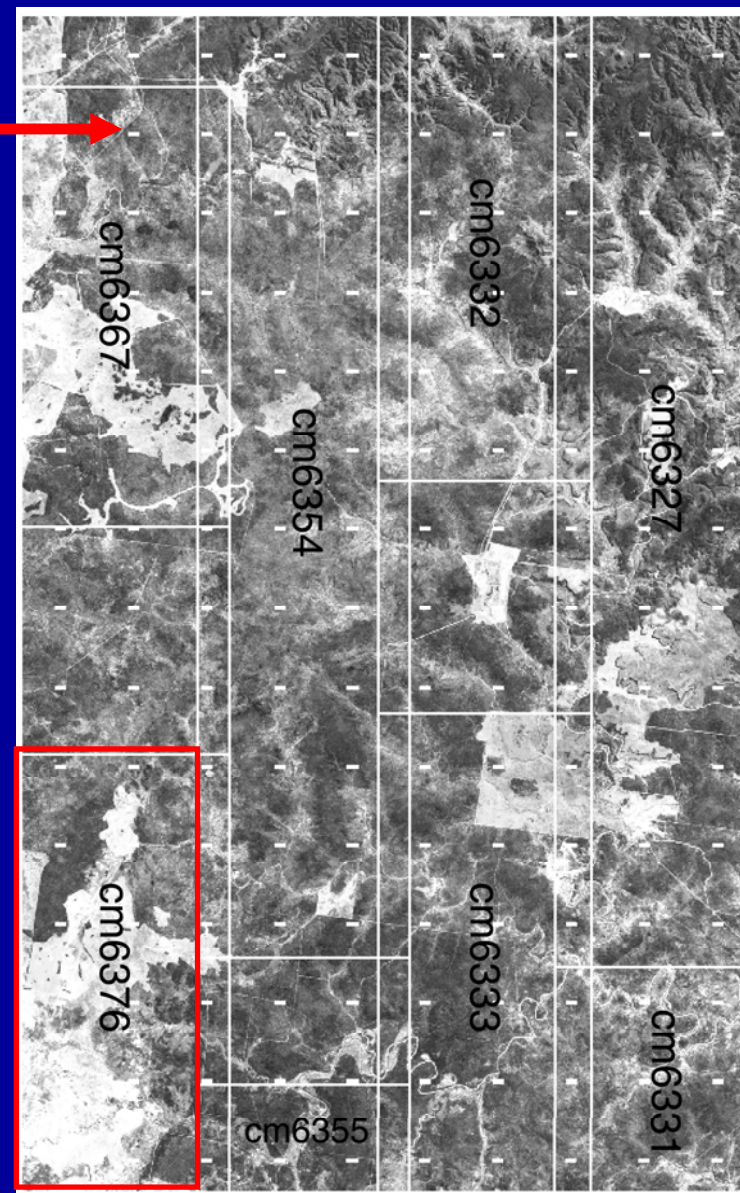
Biomass Retrieval

- PALSAR data acquired at multiple polarisations and incidence angles over Injune.

- Evaluate impact on biomass retrieval

- Develop new techniques to overcome saturation (e.g., inversion, inclusion of height and FPC)
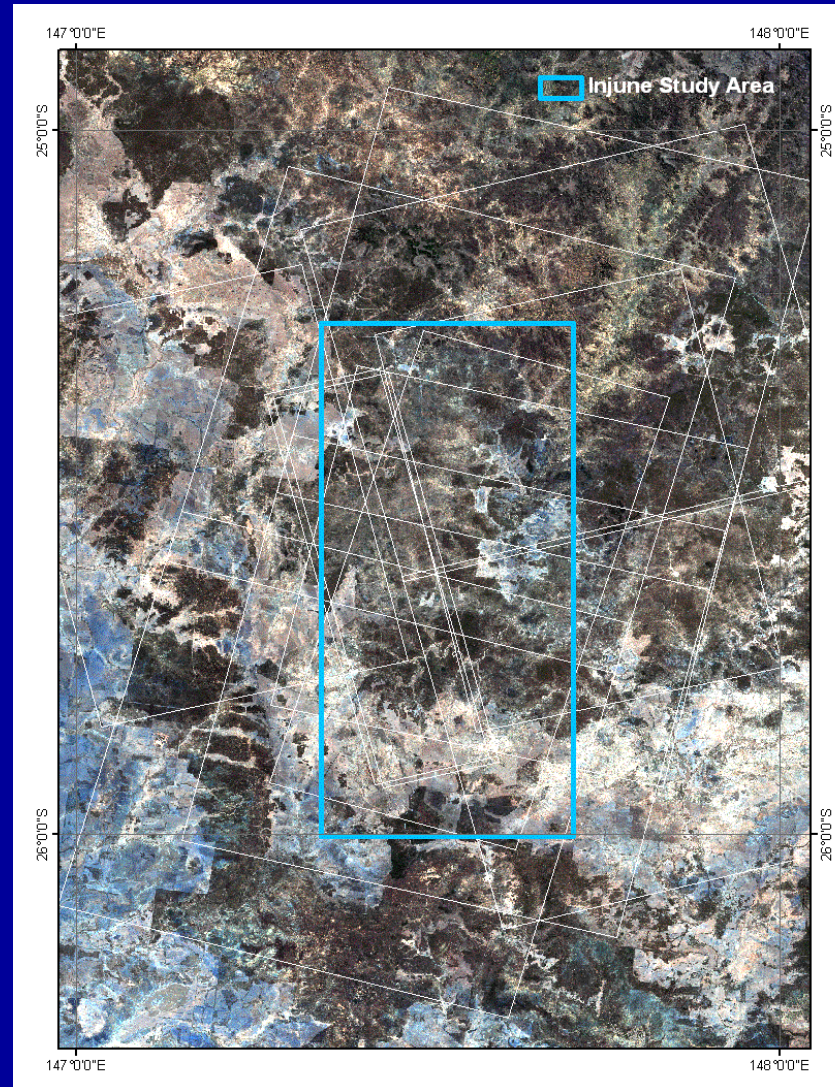
ALOS PALSAR acquisitions over Injune

Biomass map generated from AIRSAR

Future work

- Orthorectification of ALOS PALSAR data using SRTM mosaic.

- Evaluation and development of algorithms for:
  - Retrieving biomass/structure and mapping forest stuctural types within the local study areas (e.g., Injune).
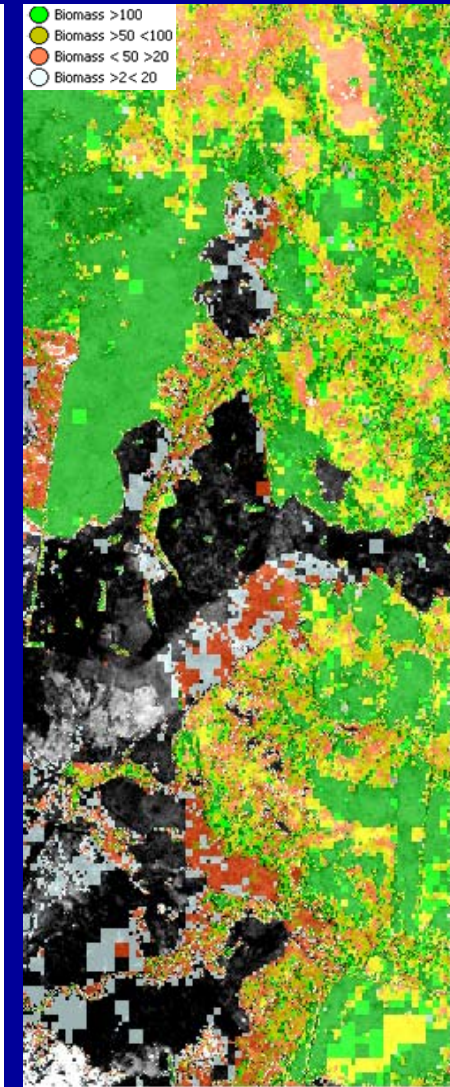 - Detecting change using time-series of JERS-1 SAR/ALOS PALSAR with Landsat-derived Foliage Projected Cover (FPC)

- Application of algorithms using the 50 m ALOS PALSAR/Landsat-derived FPC mosaics in the local study areas.

- Regional application to Queensland using the full mosaics.

- Evaluation over northern Australia and production of regional maps.

Key publications relating to ALOS

- Lucas, R.M. and Armston, J.A. (2007) ALOS PALSAR for characterising wooded savannas in northern Australia. Proceedings, International Geoscience and Remote Sensing Symposium (IGARSS), Barcelona, CD, Spain, July, 2007.

- Lucas, R.M., Accad, A., Randall, L. and Bunting, P. (2007). Assessing human impacts on Australian forests through integration of airborne/spaceborne remote sensing data.   In: *Patterns and Processes in Forest Landscapes: Multiple uses and sustainable management.* Ed. R. Lafortezza, J. Chen, G. Sanesi and T.R. Crow (in press).

- Lucas, R.M., Mitchell, A.L., Rosenqvist, A., Proisy, C., Melius, A. and Ticehurst, C. (2007) The potential of L-band SAR for quantifying mangrove characteristics and change. Case studies from the tropics and subtropics.   *Aquatic conservation: marine and freshwater ecosystems* - Special Issue: Radar Applications for Wetlands Management (in press).

- Lucas, R.M., Lee, A. and Williams, M. (2007). The role of LiDAR data in understanding the relationship between forest structure and SAR imagery. *IEEE Transactions in Geoscience and Remote Sensing,* 44 (10), 2736- 2754.

- Lucas, R.M., Cronin, N., Moghaddam, M., Lee, A., Armston, J., Bunting, P. and 6Witte, C. (2006). Integration of Radar and Landsat-derived Foliage Projected Cover for Woody Regrowth Mapping, Queensland, Australia, *Remote Sensing of Environment*, 100, 407-425.

- Lucas, R.M., Cronin, N., Lee, A., Witte, C. and Moghaddam, M. (2006). Empirical relationships between AIRSAR backscatter and forest biomass, Queensland, Australia, *Remote Sensing of Environment*, 100, 388 - 406.

- Liang, P., Moghaddam, M., Pierce, L.E. and Lucas, R.M. (2005). Radar backscattering model for multi-layered mixed-species forests. *IEEE Transactions on Geoscience and Remote Sensing*, 43, 2612-2626.

- Lucas, R.M., Moghaddam, M. and Cronin, N (2004).   Microwave scattering from mixed species woodlands, central Queensland, Australia.   *IEEE Transactions on Geoscience and Remote Sensing*, 42, 2142-2159, October, 2004.

- Moghaddam, M. and Lucas, R.M. (2003). Quantifying the biomass of Australian subtropical woodlands using SAR inversion models. *Proceedings, International Geoscience and Remote Sensing Symposium (IGARSS)*, Toulouse, CD, France, July, 2003