ALOS

K&C Initiative
An international science collaboration led by JAXA

Product Delivery Report for K&C Phase 2

PI: Richard Lucas

Institute of Geography and Earth Sciences, Aberystwyth University,

Aberystwyth, Ceredigion, SY23 3DB, UK

Science Team meeting #15
JAXA TKSC/RESTEC HQ, Tsukuba/Tokyo, January 24-28, 2011

K&C deliverables

Papers and Reports

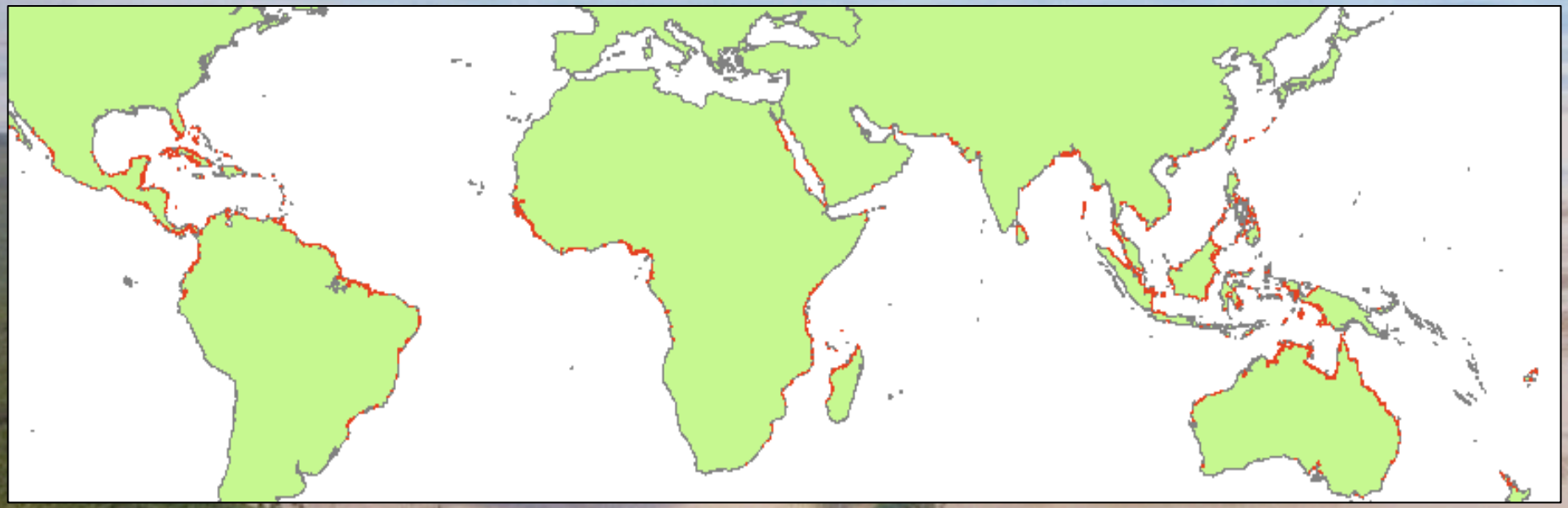
1. Published (please provide PDF file)

- K&C Phase-1 and Phase 2 reports
- K&C booklet (mangroves)
- Lucas, R.M., Mitchell, A.L., Rosenqvist, A., Proisy, C., Melius, A. and Ticehurst, C. (2006) 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*. 17, 245-264.
- Lucas, R.M. (2010). Characterisation and monitoring of mangroves using ALOS PALSAR data. Proceedings, Australian Remote Sensing and Photogrammetry Conference, Alice Springs, Australia (CD).

2. Submitted/in preparation

- Lucas et al.: Recent response of mangroves to climatic and sea level change, Gulf of Carpentaria, Australia. Remote Sensing of Environment or Wetlands Journal

ALOS PALSAR for Mangrove Characterisation, Mapping and Monitoring

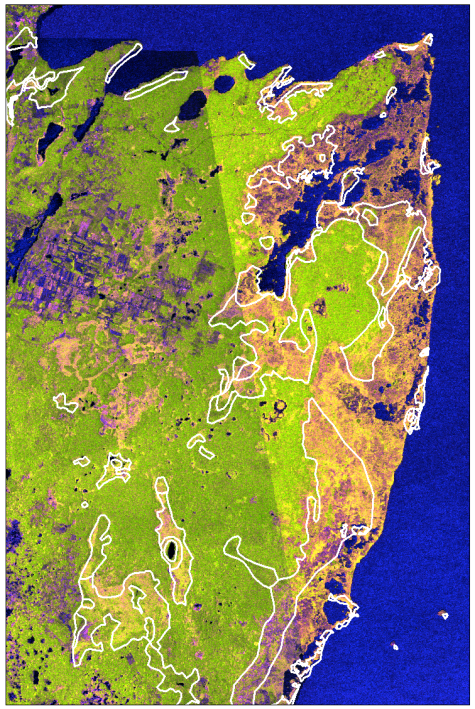


- Australia: ~1.5 million ha
- Atlantic coast, South America ~ 1 million hectare
- SE Asia: ~4.9 million hectare
- Belize

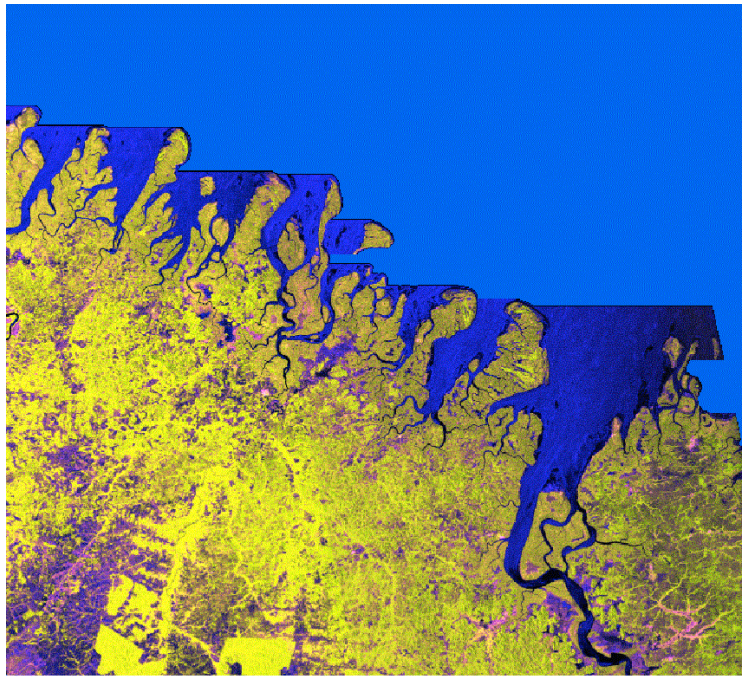
Mapping Mangrove Extent

- Difficulty distinguishing mangroves from adjacent land covers
- Nature of cover varies within and between regions

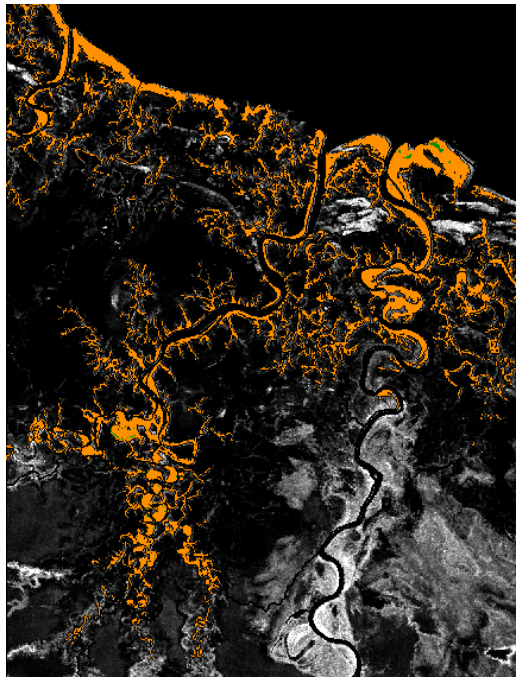
Savannas, Belize



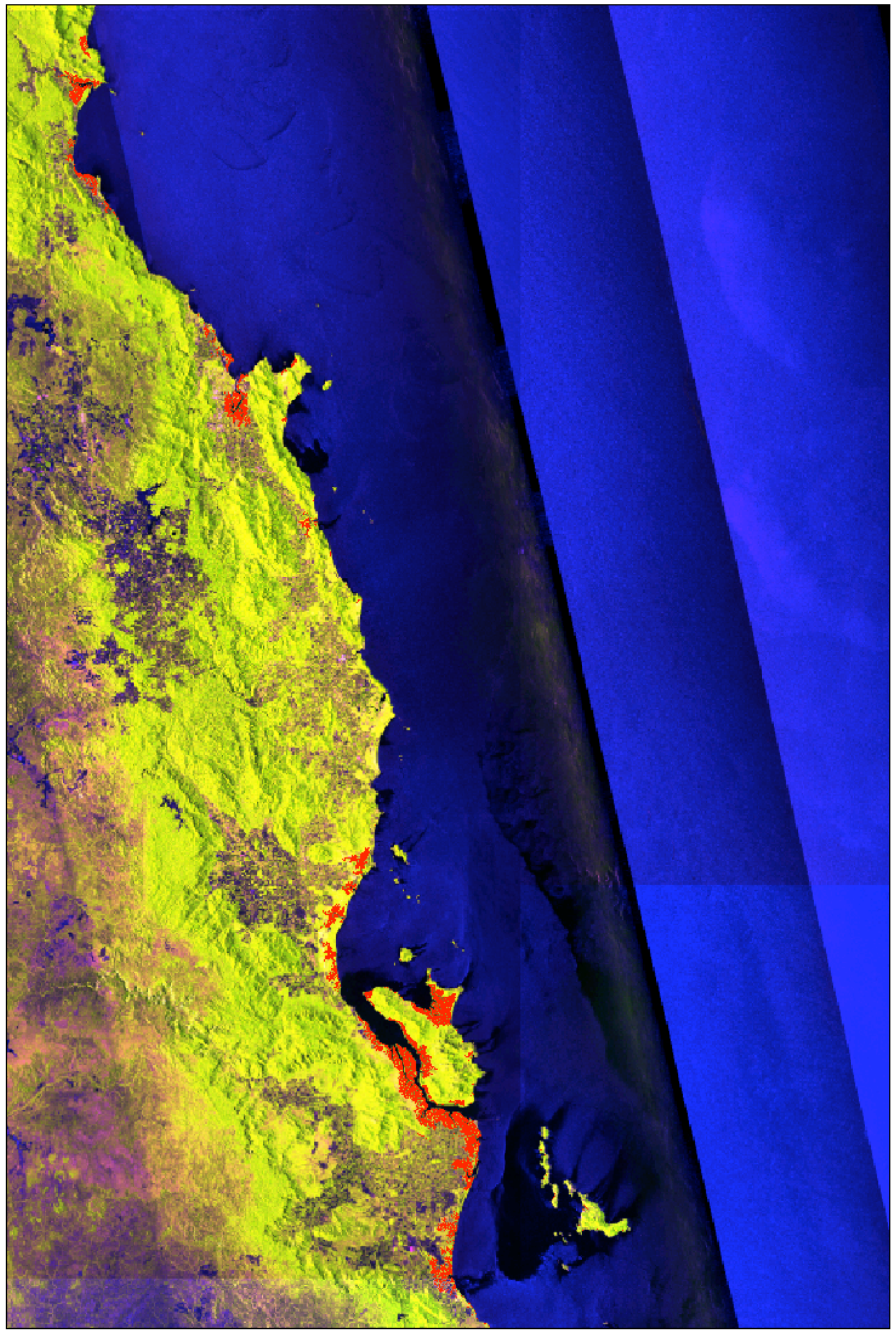
Tropical Forest Brazil



Saltflats, Australia

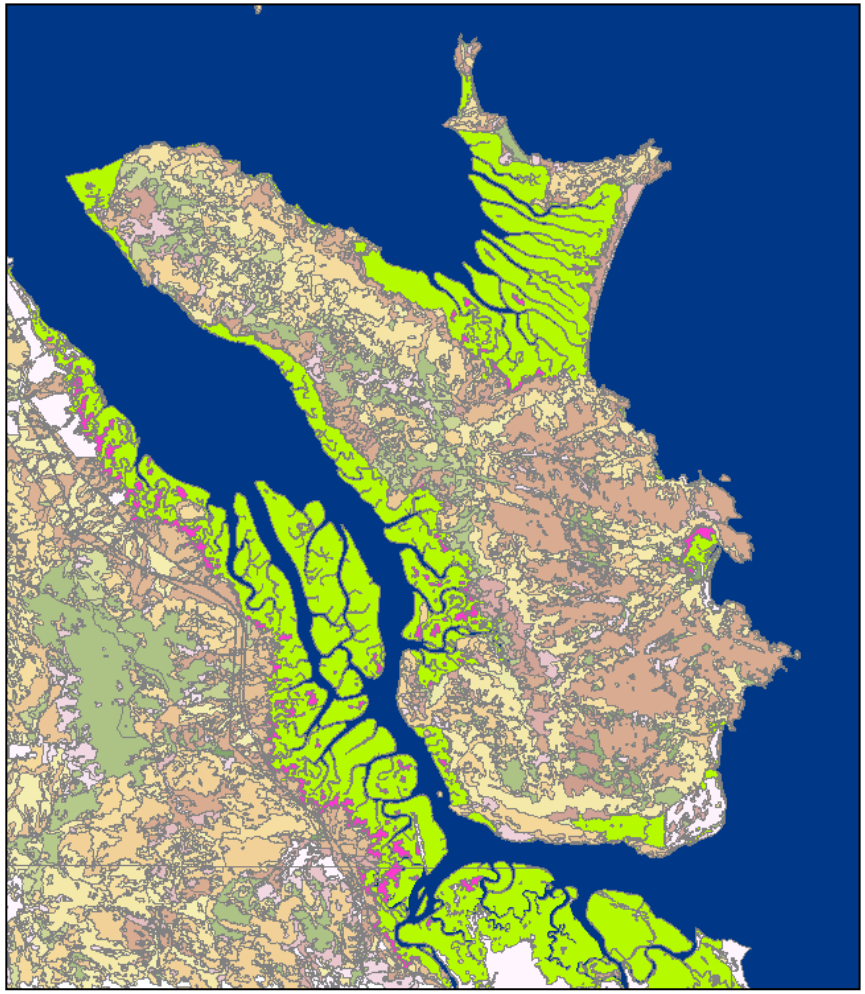


- Requirement for ancillary datasets

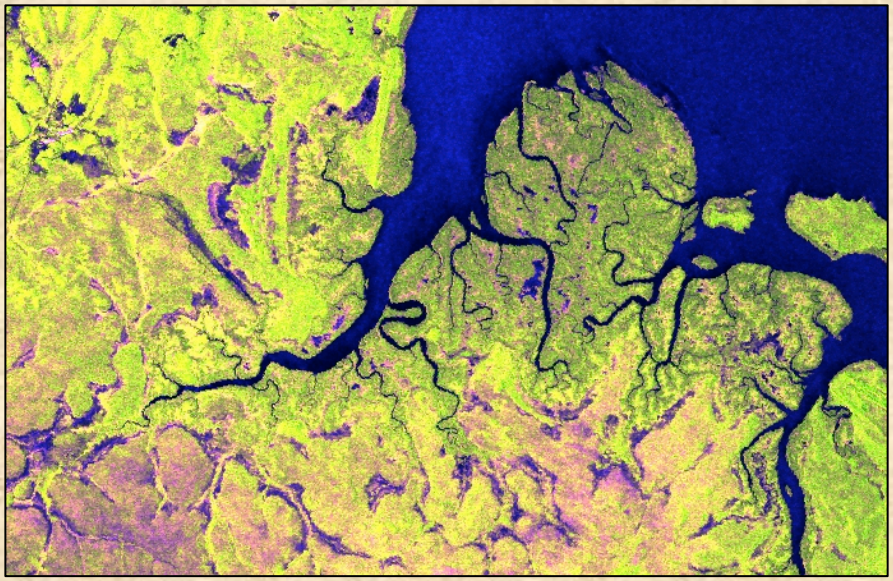


Mapping Mangrove Extent

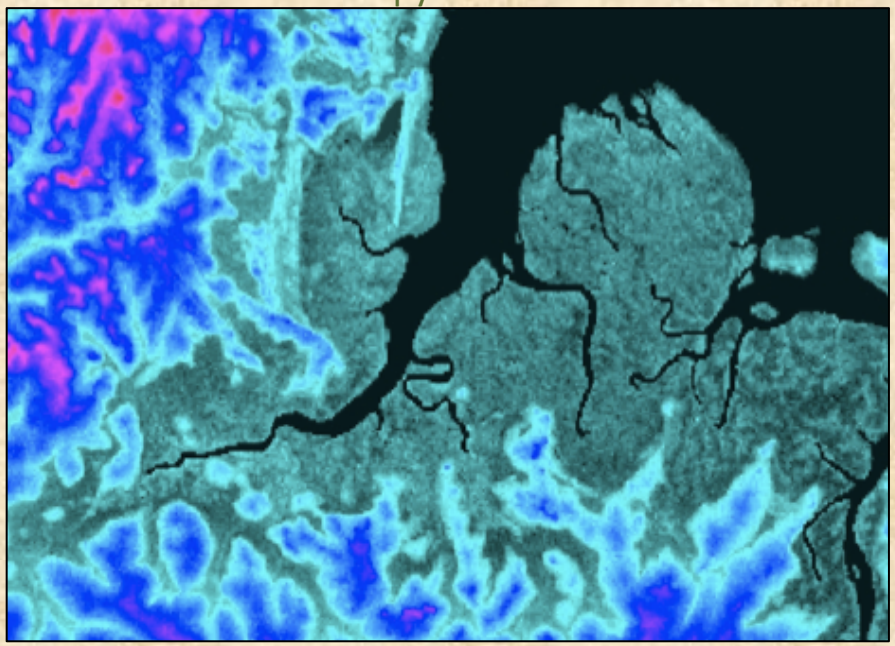
- Queensland Regional Ecosystem mapping



Mapping Mangrove Extent

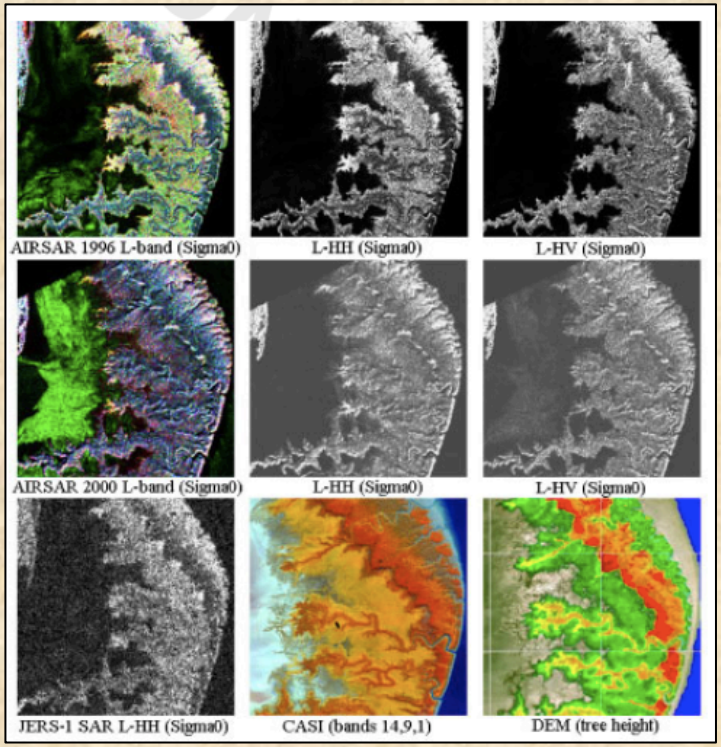


- Landsat FPC
  - Provides clear differentiation of mangrove and non-mangrove areas
- SRTM
  - Focuses classifcation on low-lying coastal areas
  - Subsequently useful for retrieval of mangrove canopy height
    - Height retrieval more succsessful in larger, contiguous areas of closed canopy forest

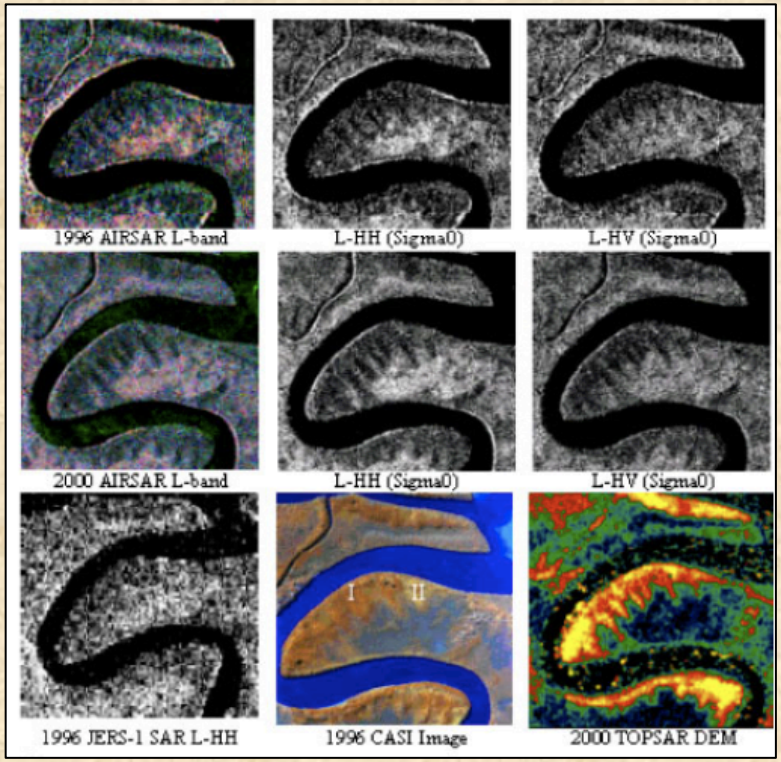


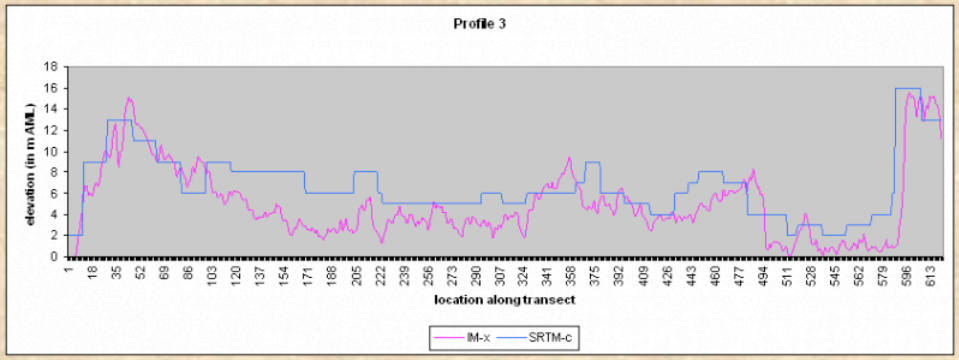
Airborne Observations of Mangrove

Kakadu National Park, NT



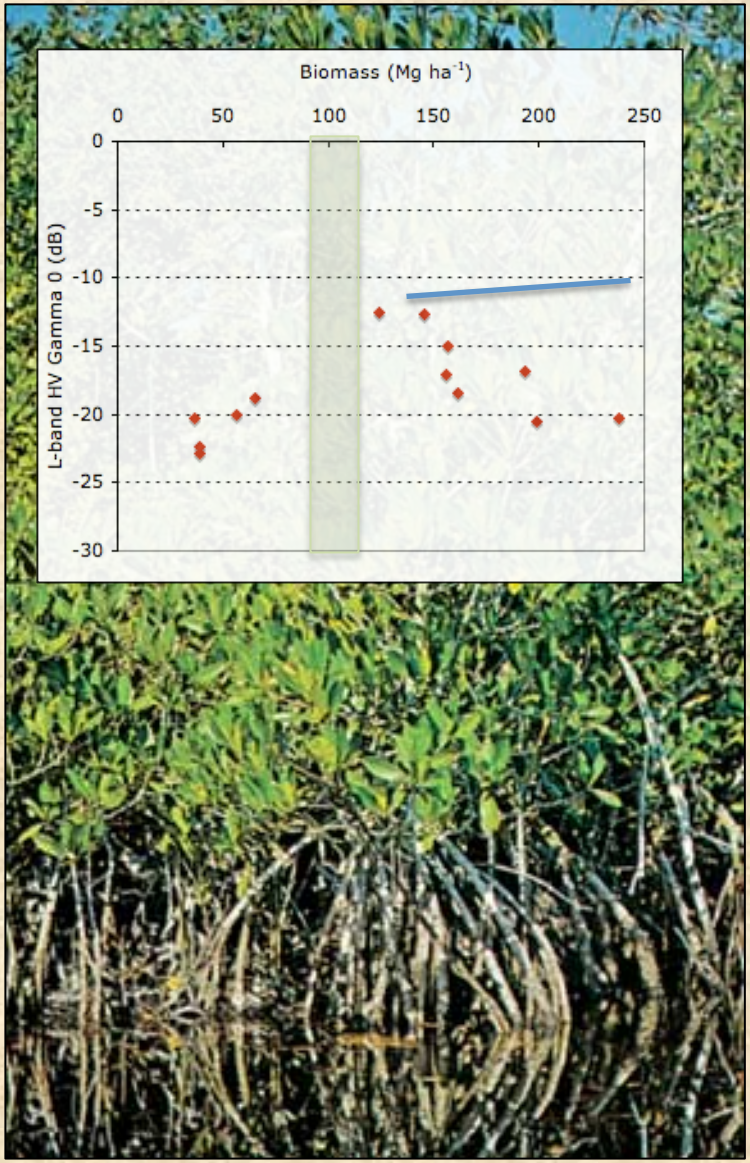
Daintree National Park, QLD





Comparison of Intermap and SRTM DEMs, Belize Mangroves

Approach to classifying mangroves

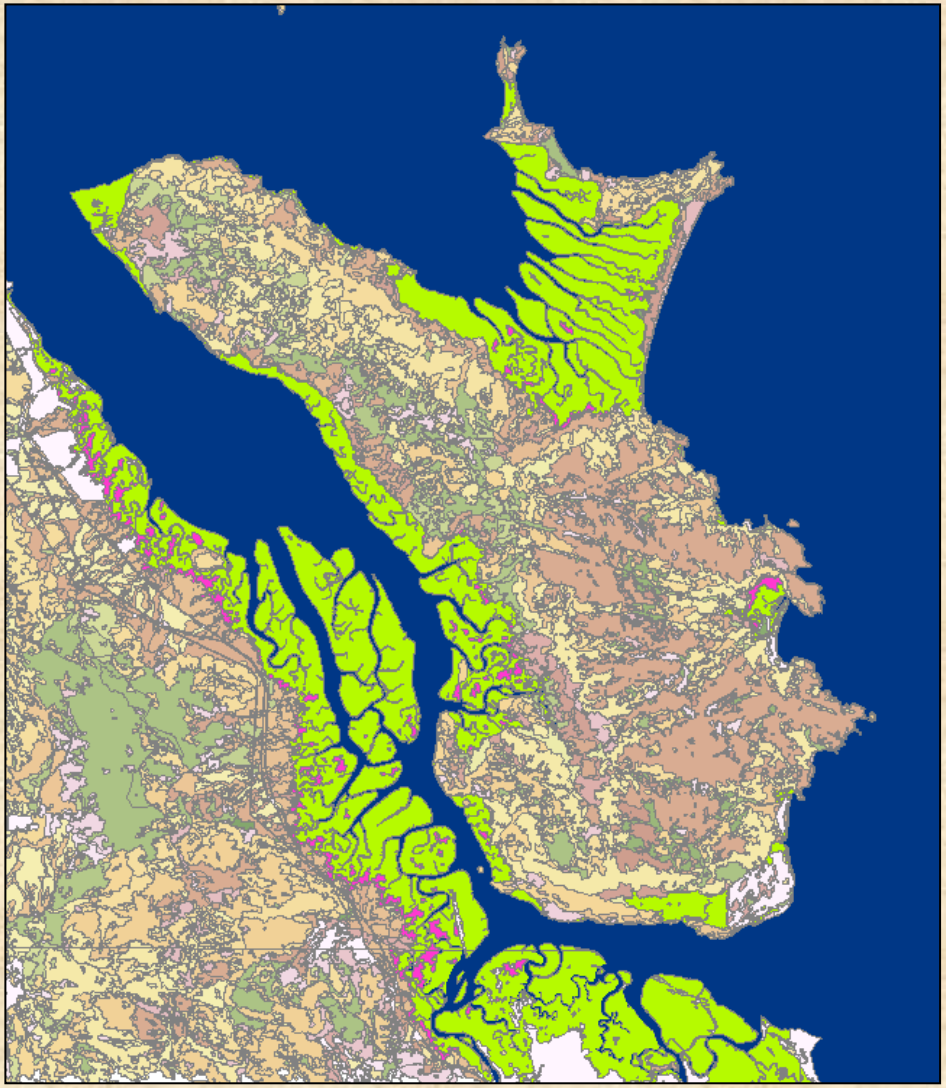


- Define extent of mangroves
  - Existing data layers
  - Landsat FPC
- Separate 'low' from 'high' mangroves
  - SRTM, LiDAR
  - Definition of height locally variable (e.g.., 10 m)
- Separate high mangroves with/without prop root systems
- Assign all remaining objects to 'low mangroves'
- Assign biomass classes (e.g., using relationships with L-band HV; upward & downward trends)

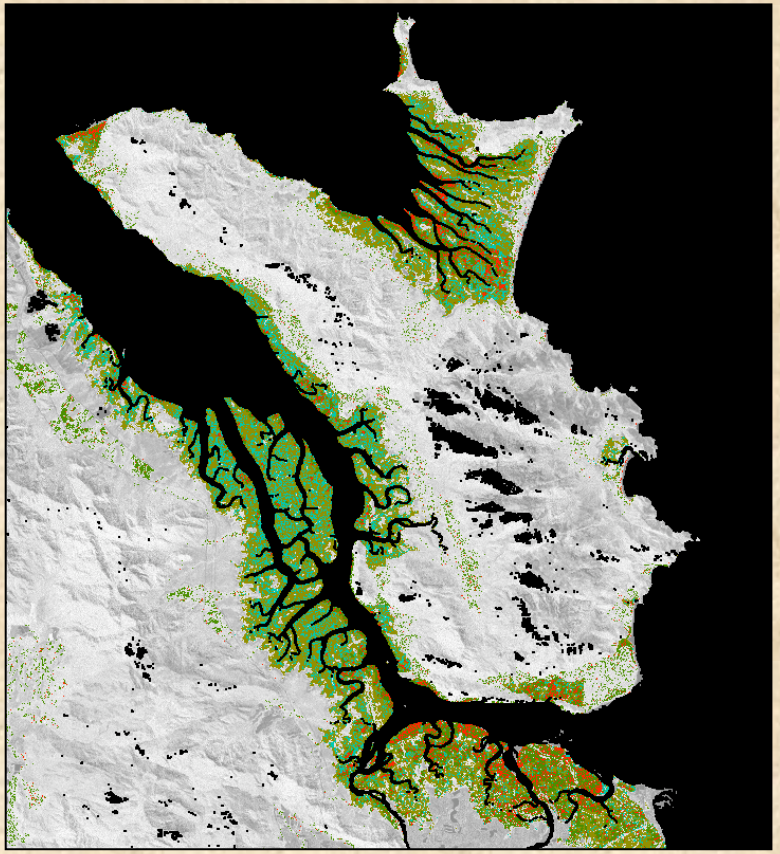
Example of Mangrove Classification

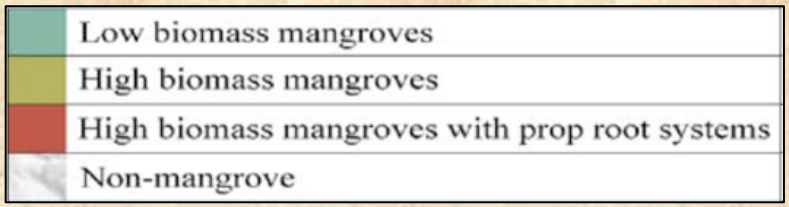
Hinchenbrook Island, Queensland, Australia

Queensland RE Mapping

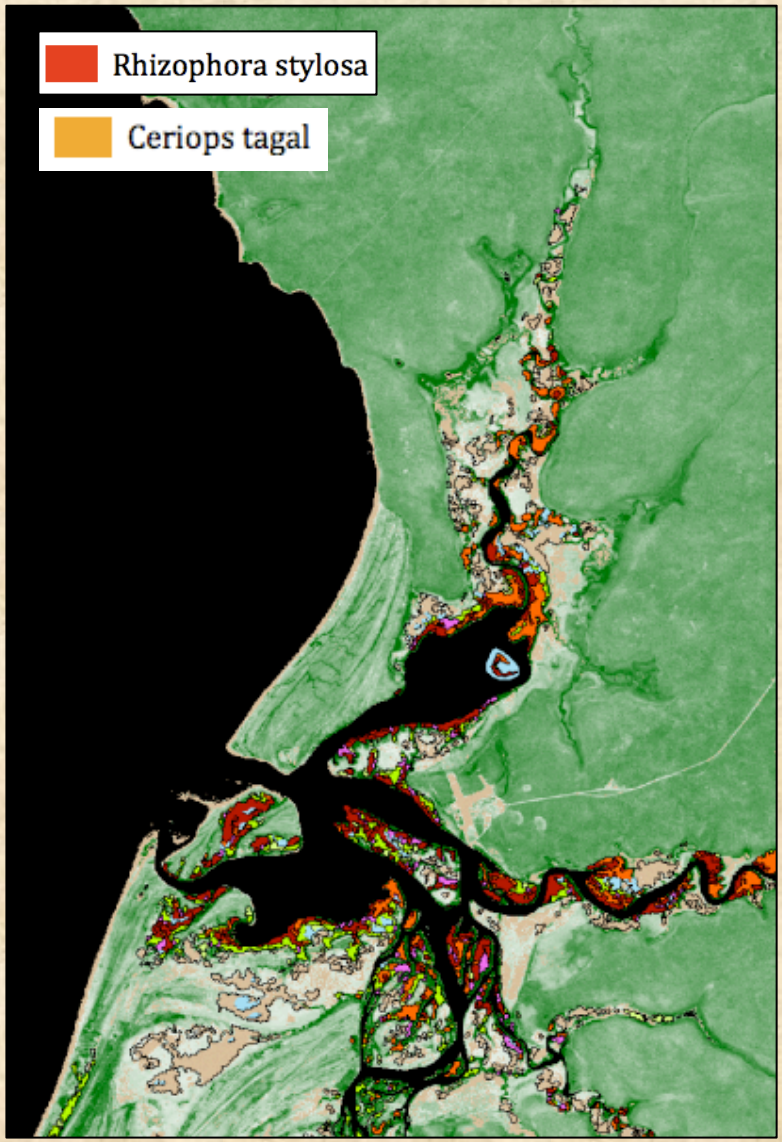


Structural classification

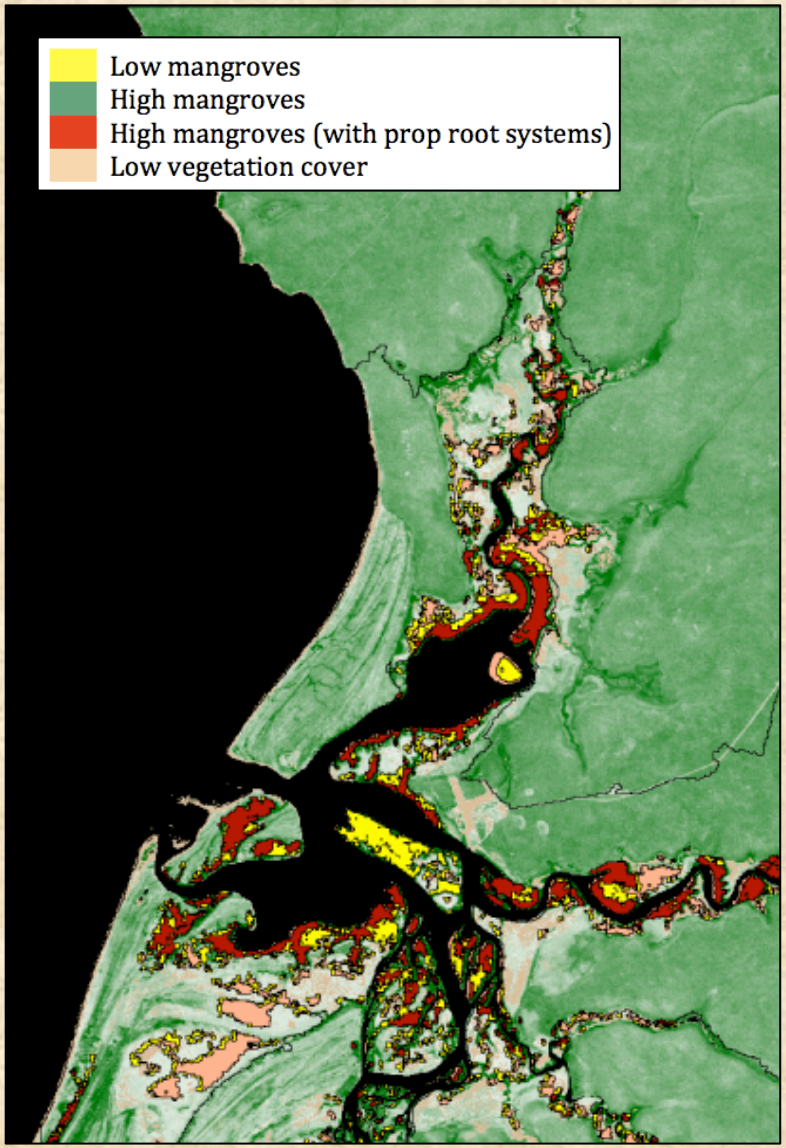




Comparisons of classifications: Cape York

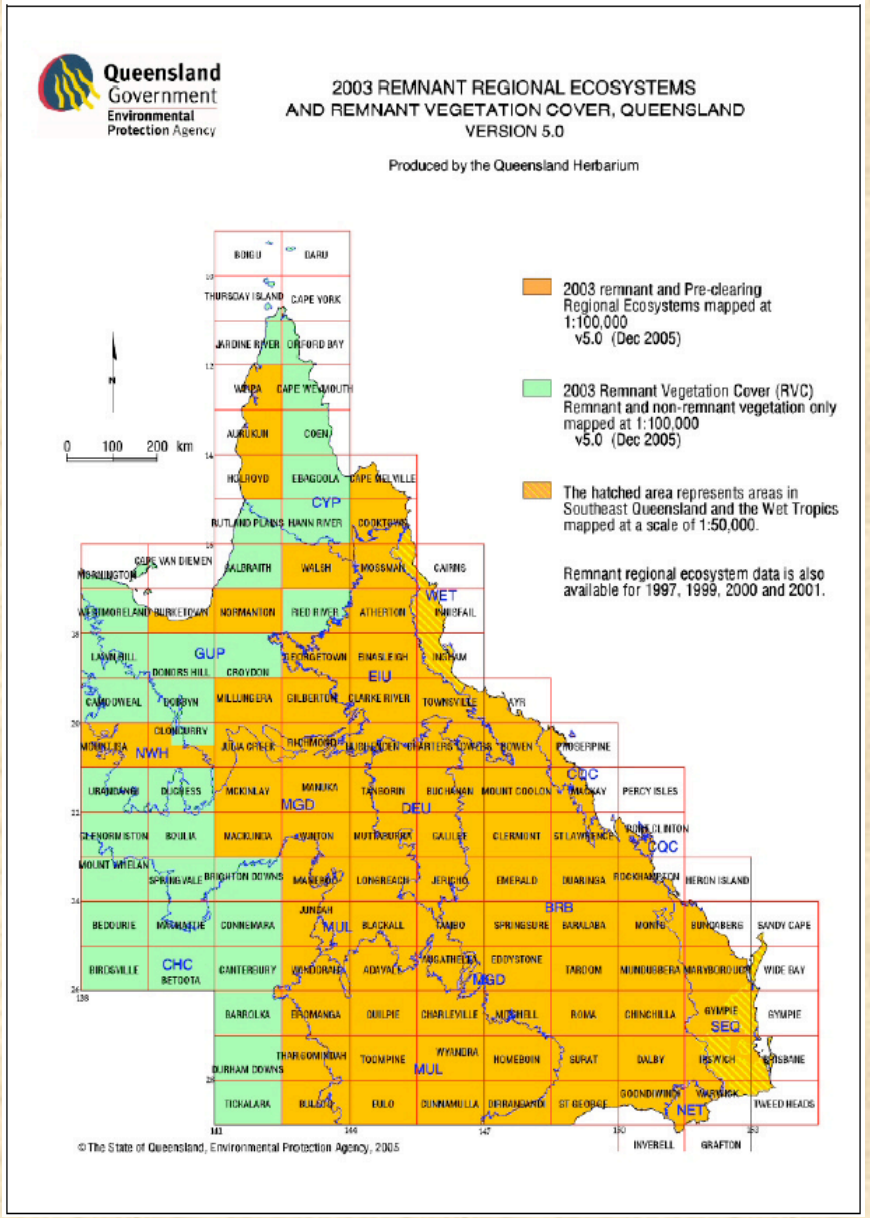


Species mapping based on optical imagery

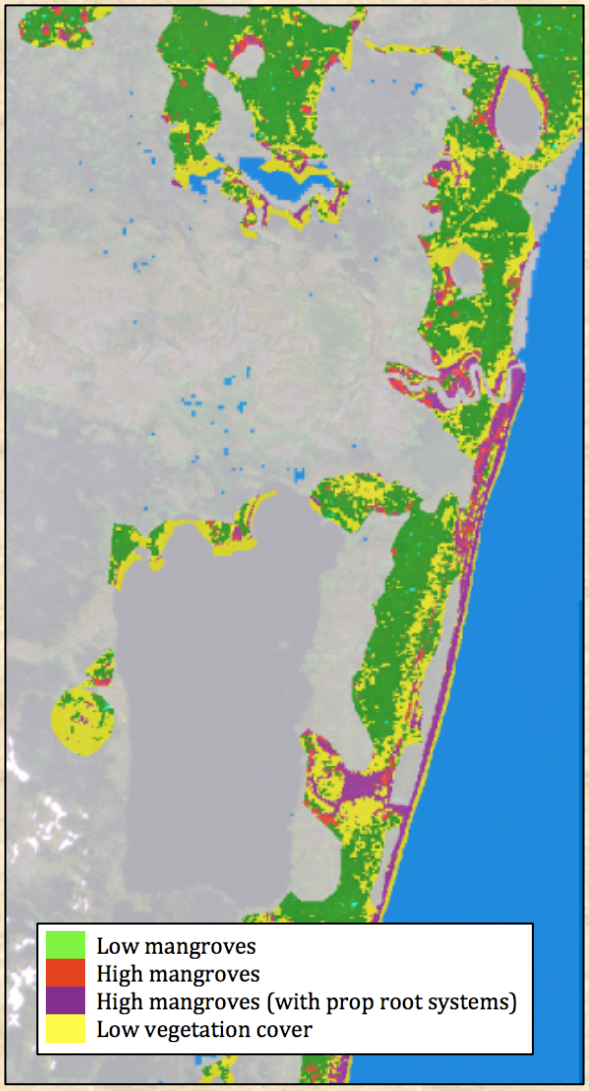


Structural classification based on ALOS, SRTM and FPC

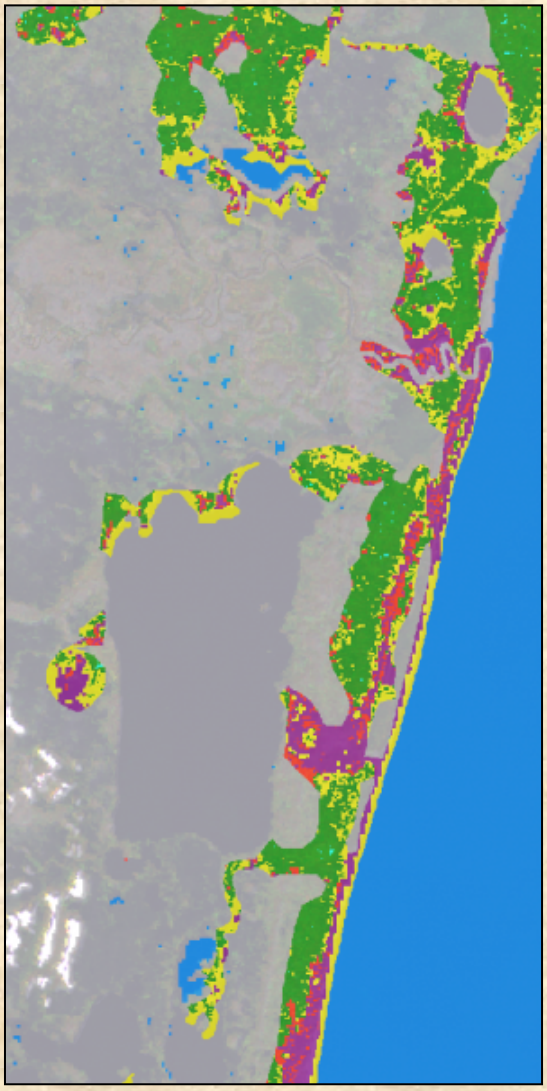
Characterizing Mangroves, Queensland, Australia



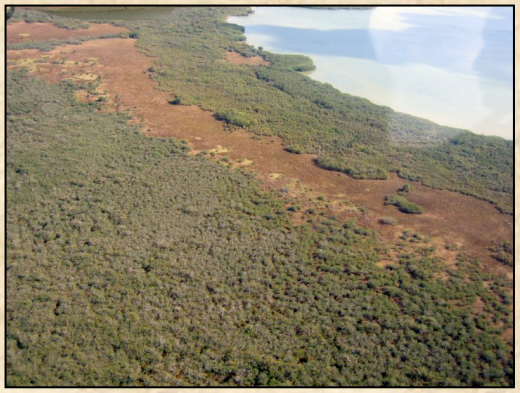
Spatial Resolution of the DEM
Central Belize



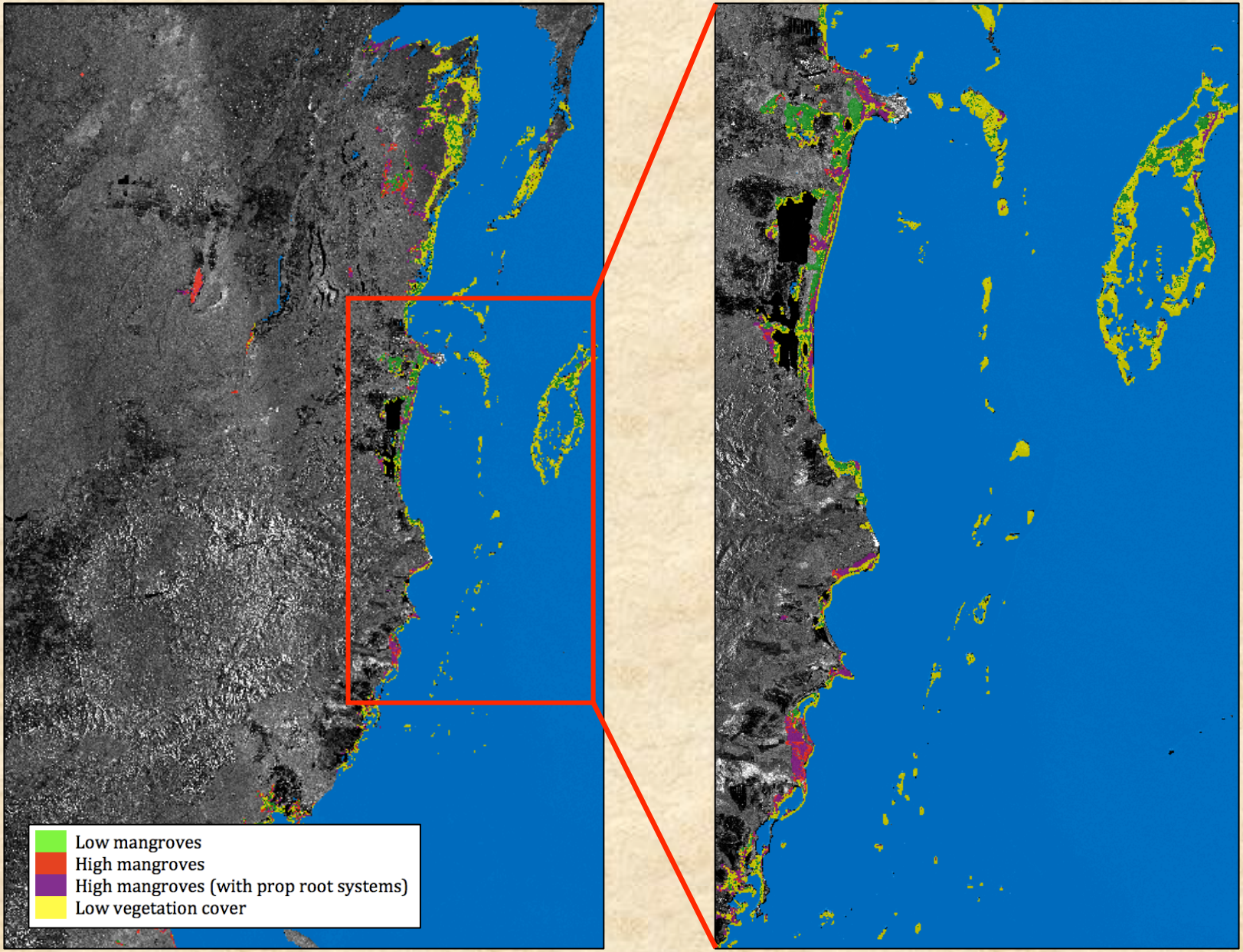
CHM - SRTM



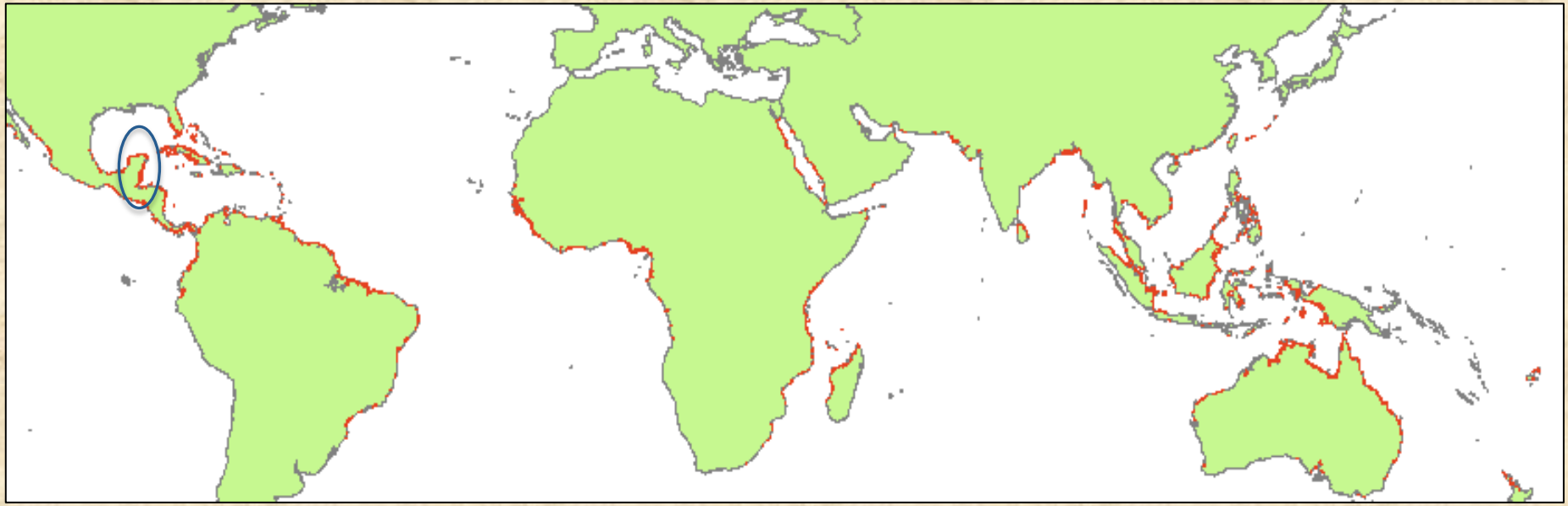
CHM - Nextmap



Regional Demonstration of Mangrove Mapping: Belize

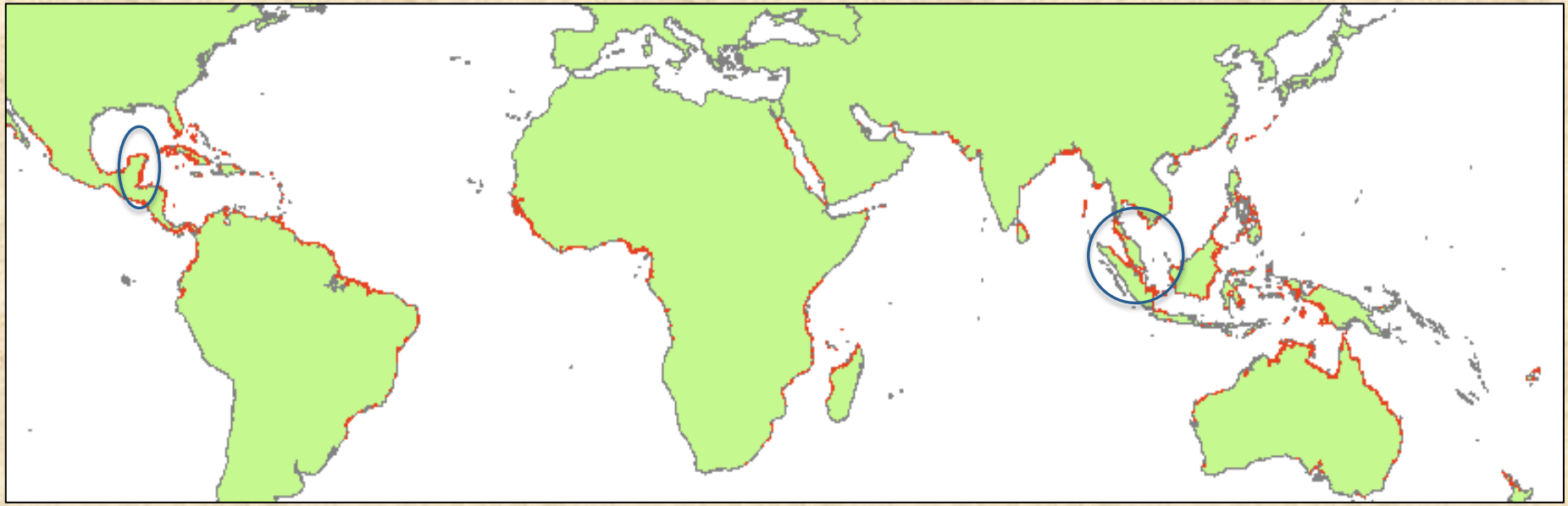


Detection of Change in Mangroves



- Belize:
  - Clearance through urbanisation and tourism
- SE Asia:
  - Clearance (e.g., fisheries, urbanisation, timber)
- Brazil and French Guiana
  - Natural processes linking with Amazonian deforestation: Sediment erosion and accretion
- Australia: Natural changes
  - Natural processes linking with climatic variation

Global Distribution and Focus of Study



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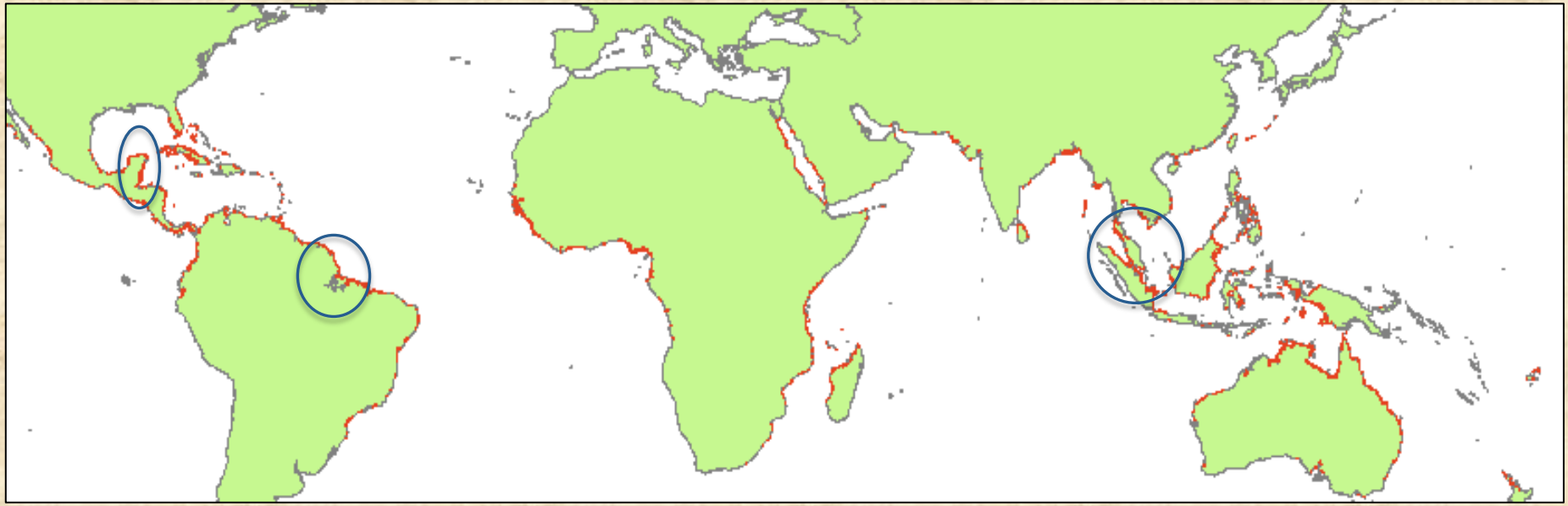

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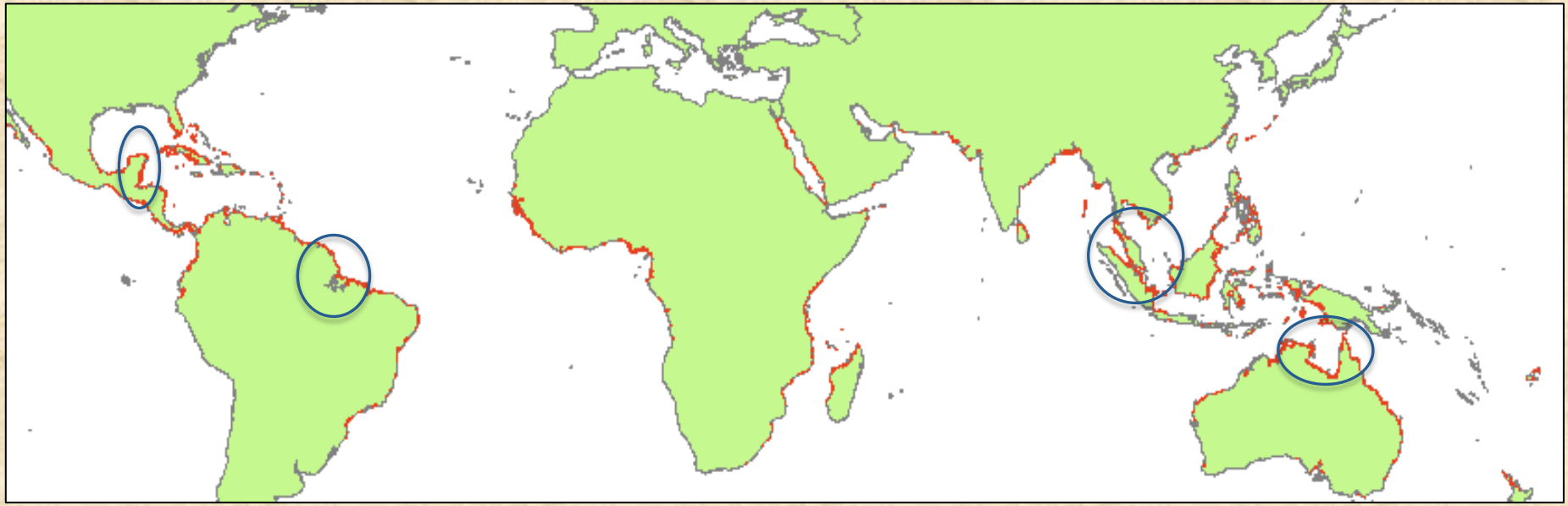

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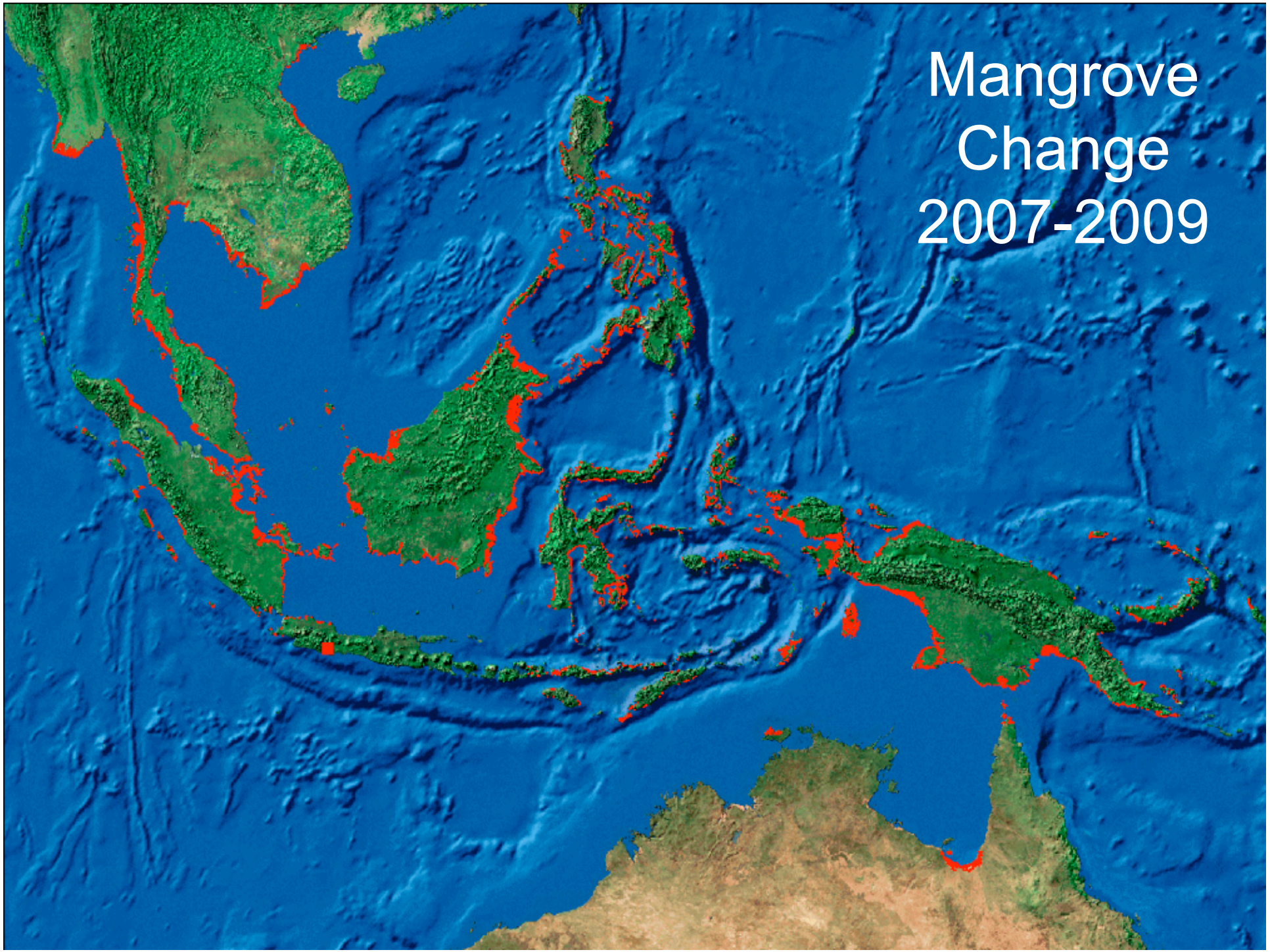
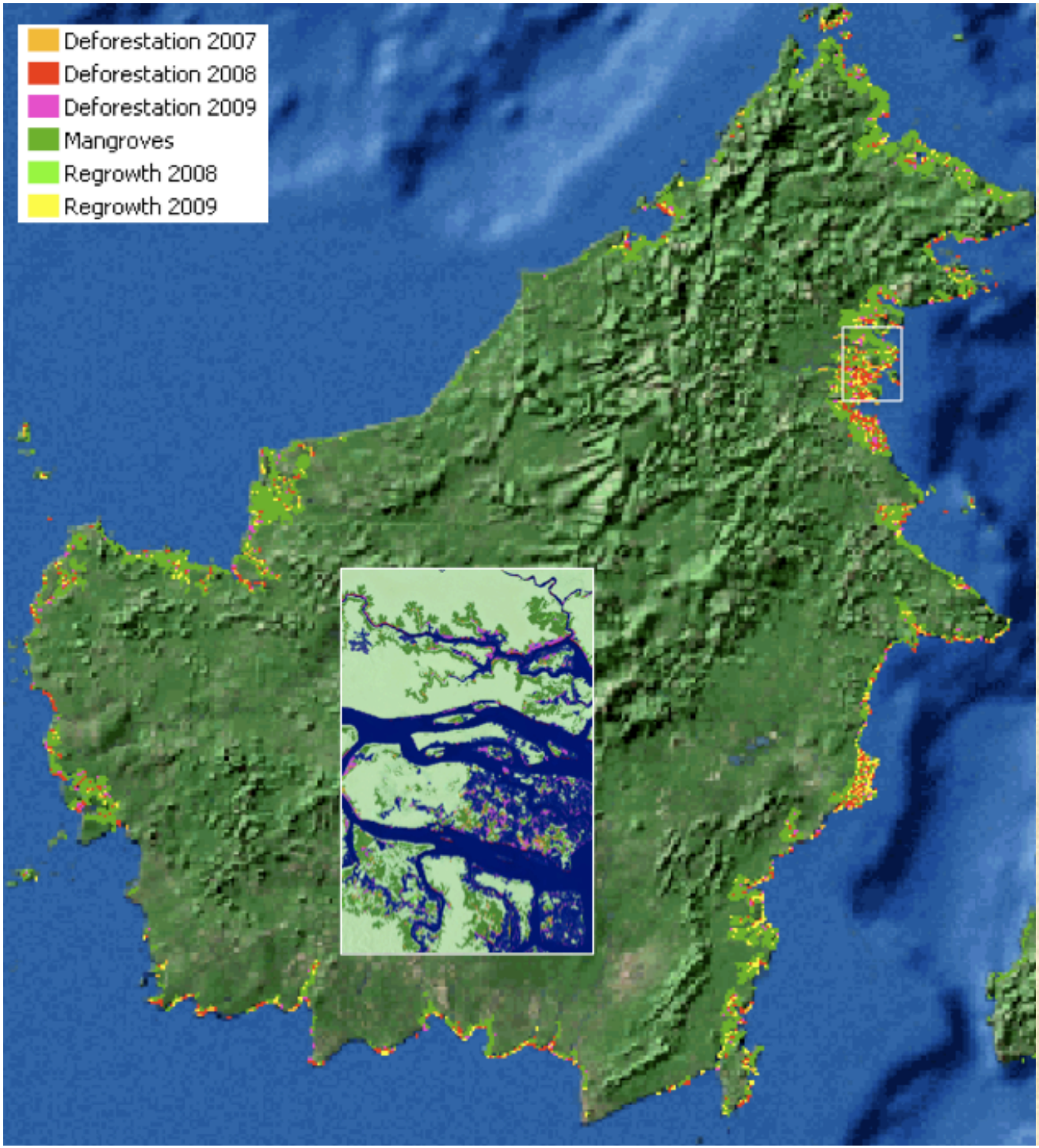
The USGS/NASA Global Mangrove Dataset

[1] C.Giri, E. Ochieng, L.L Tieszen, Z. Shu, A. Singh, T. Loveland and N. Duke. Status and distribution of mangrove forests of the world using earth observation satellite data. Global Ecology and Biogeography, 20(1), 154-159.

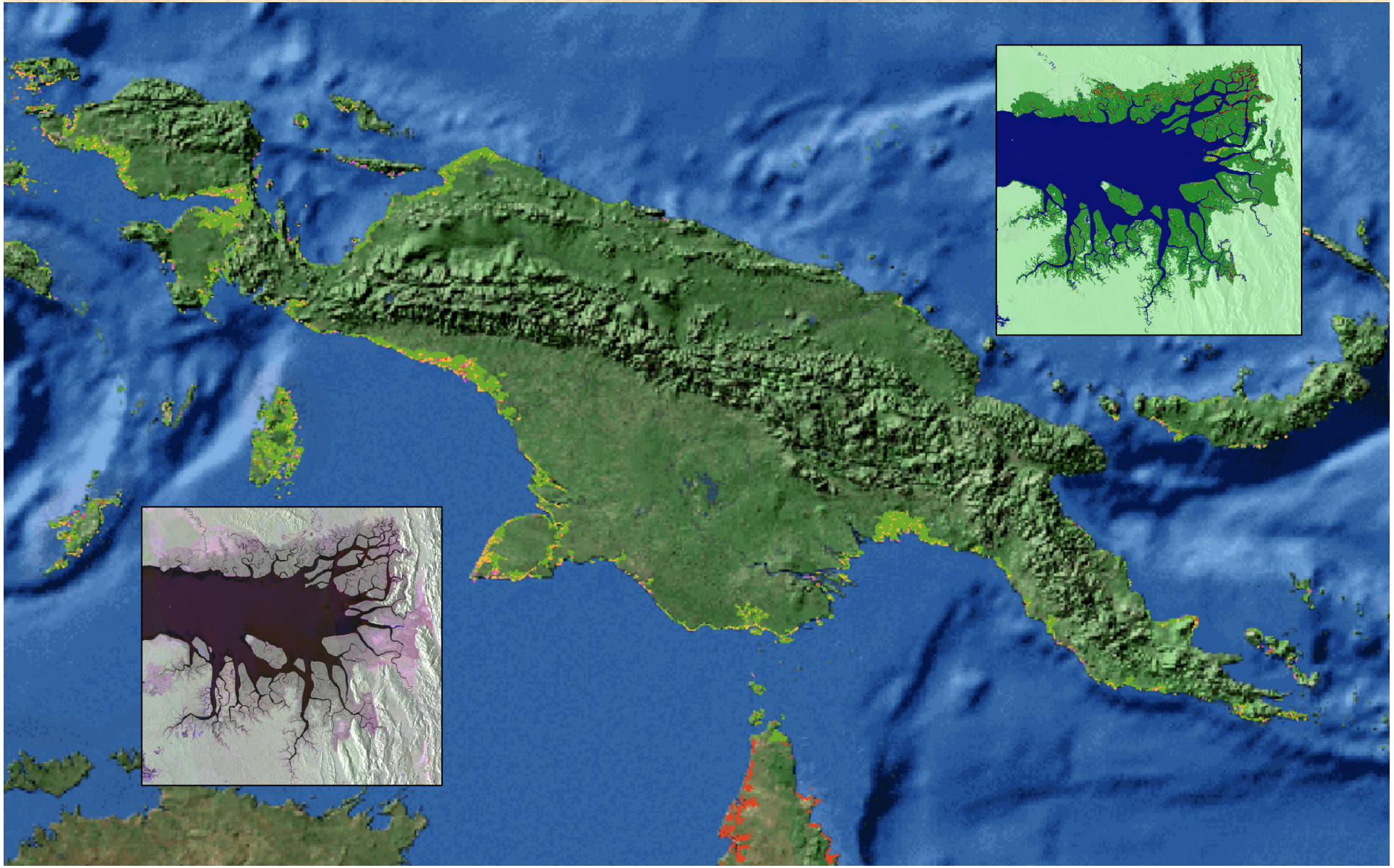

Mangrove
Change
2007-2009



Mangrove Change Assessment

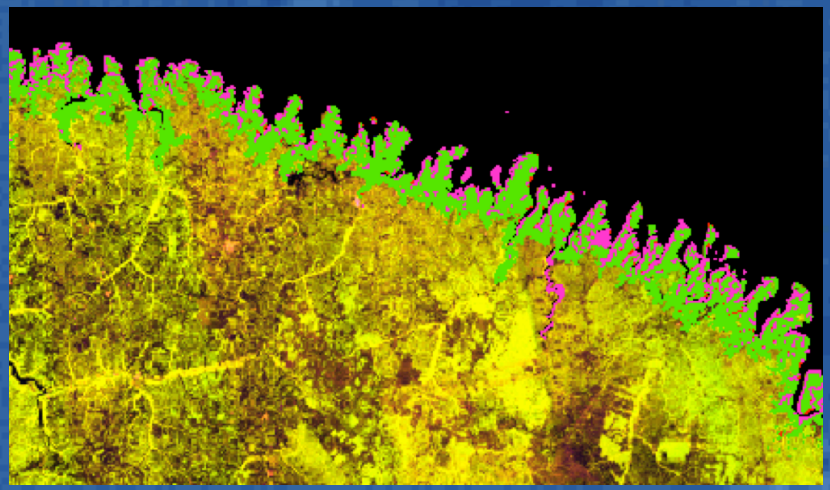
Borneo (2007-2009)

Time-series Classification of Mangroves, 2007 and 2008, New Guinea

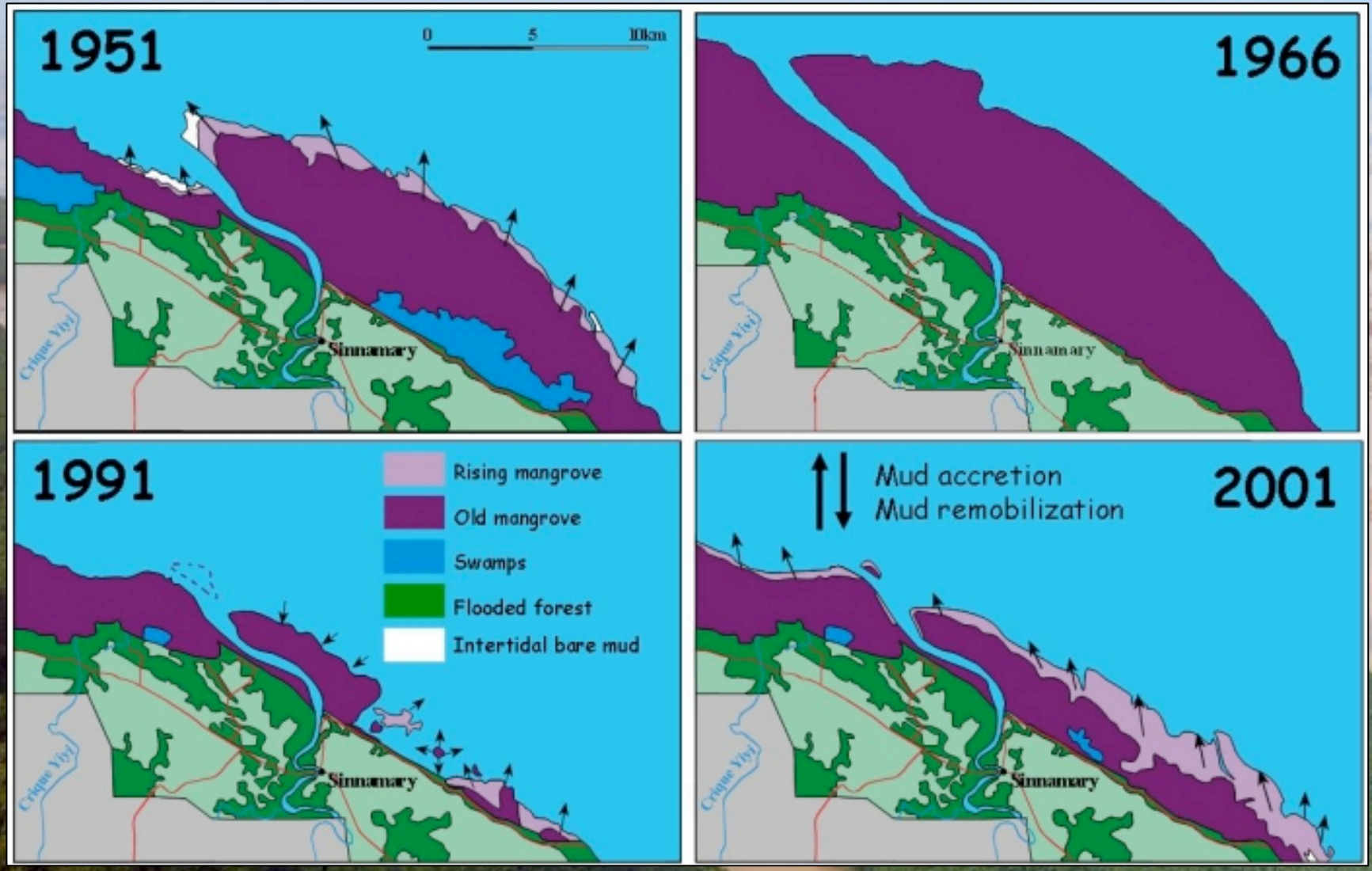


Mangrove Change

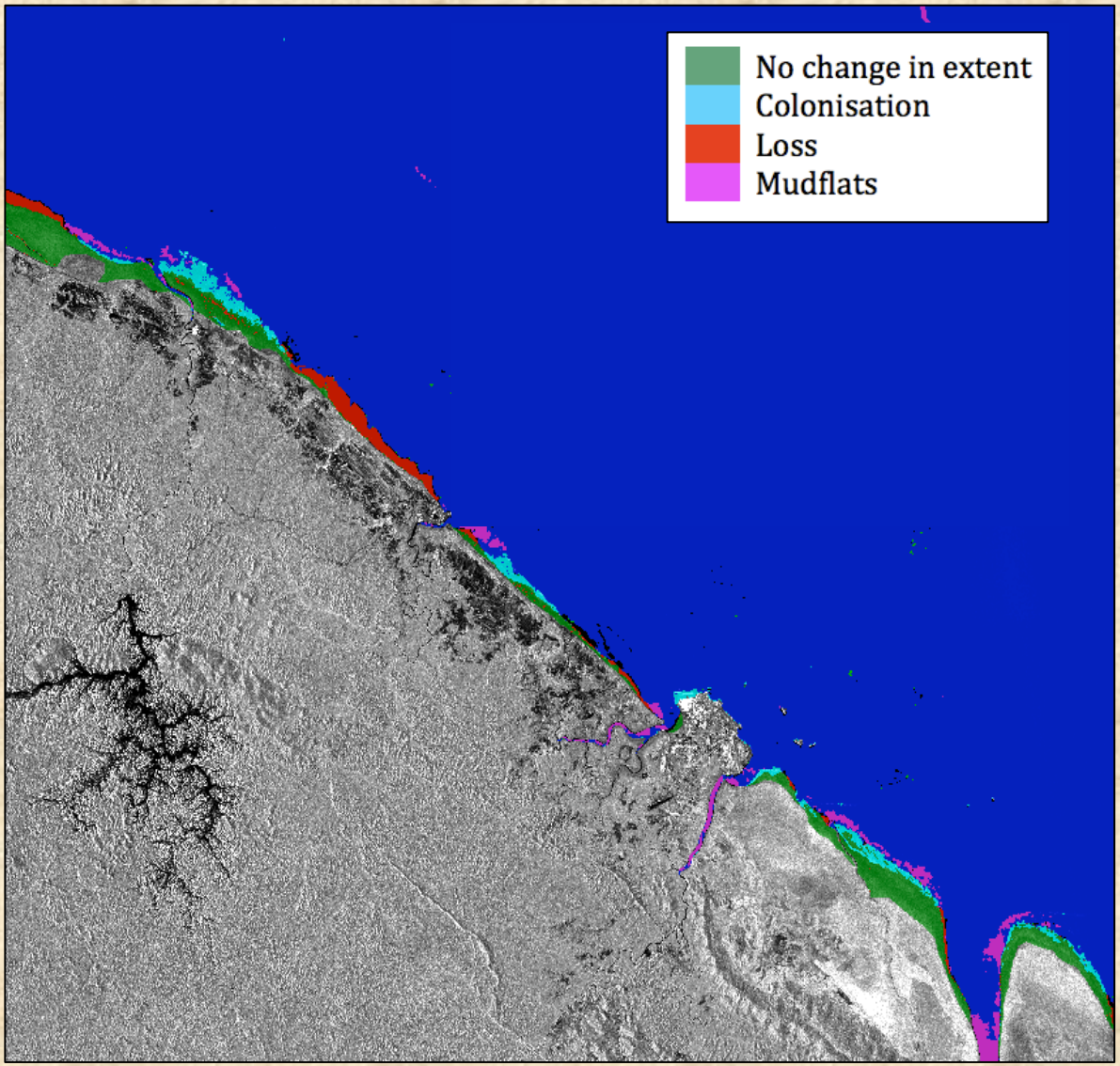
Atlantic Coast
South America
(2007)

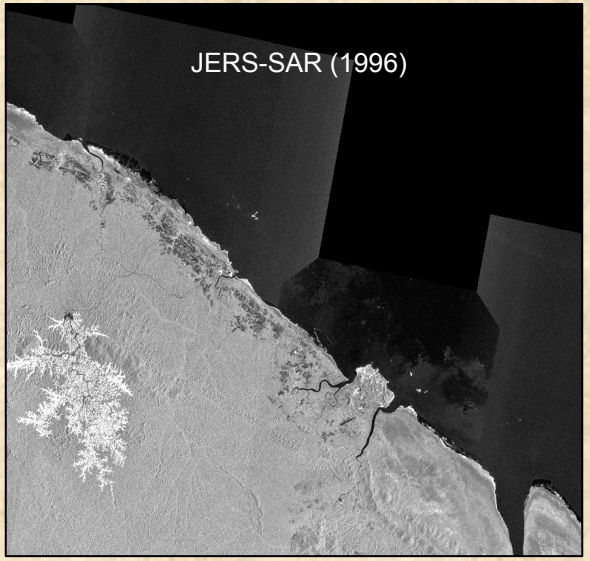


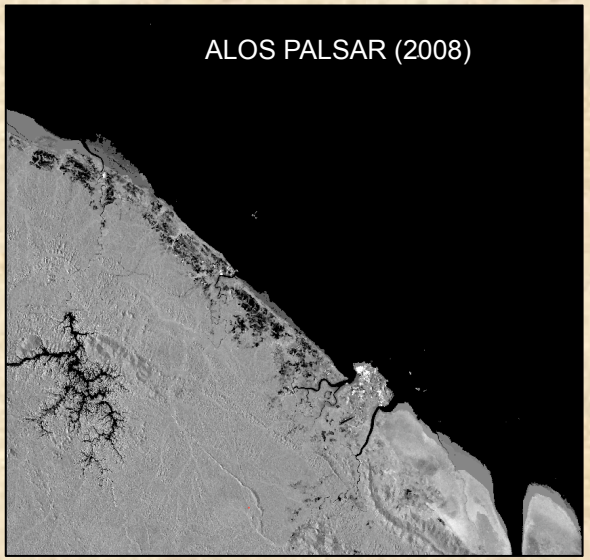
French Guiana: Changes associated with erosion and accretion of sediments



Classification of Change: JERS-1 SAR and ALOS PALSAR comparisons

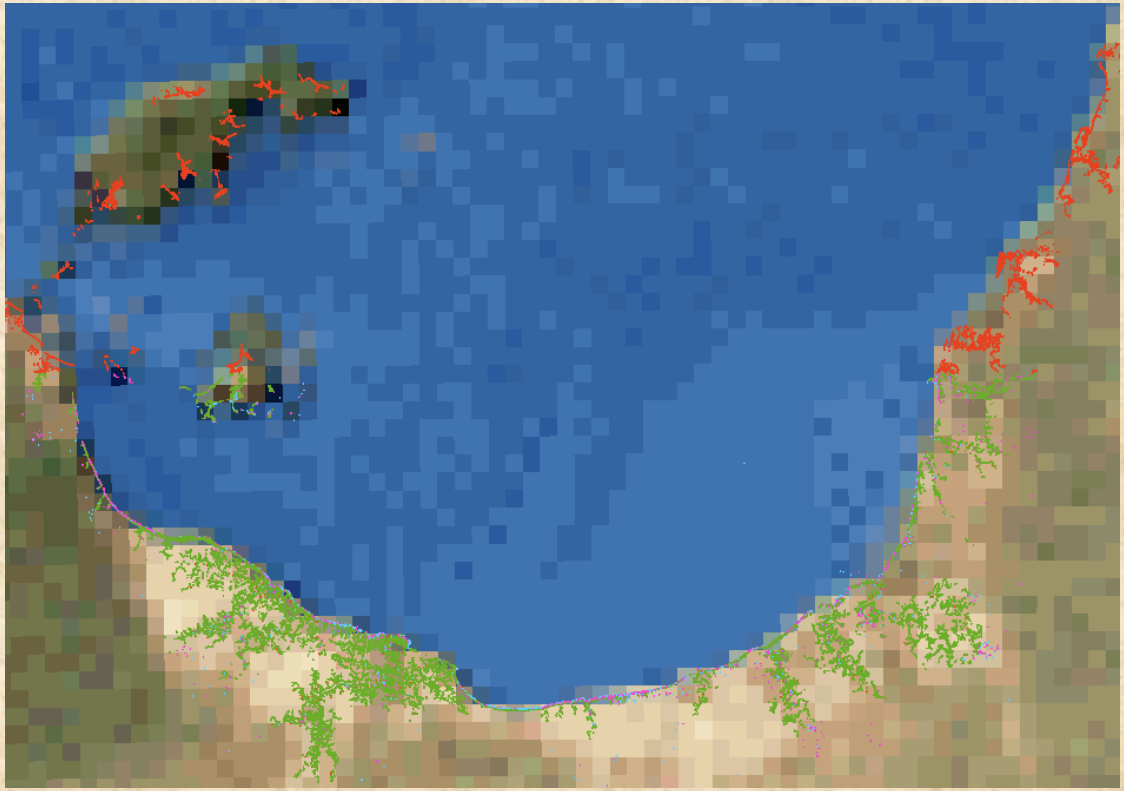


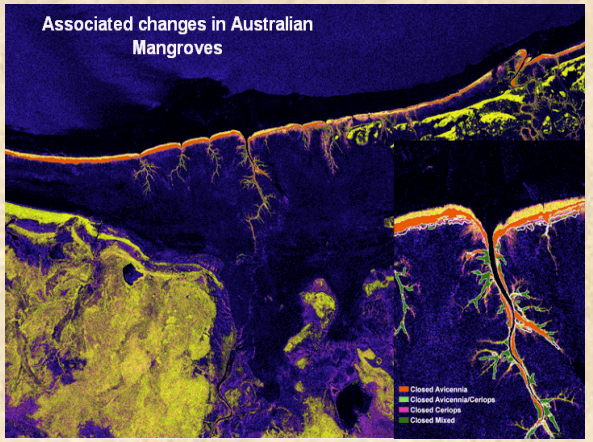




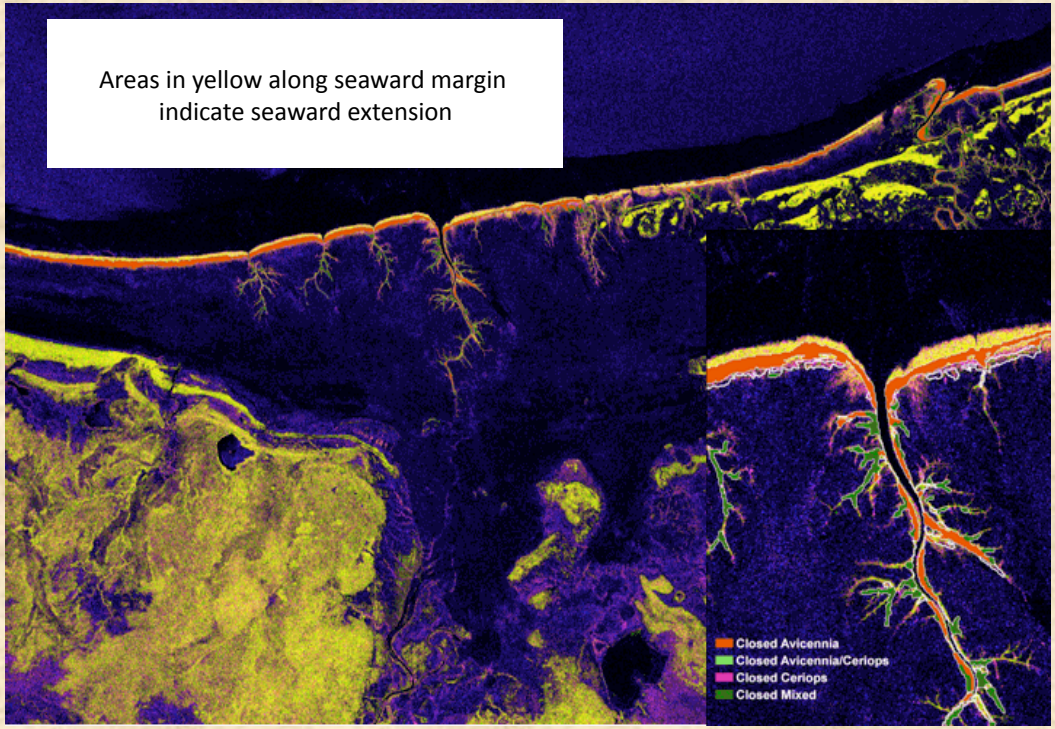
Changes in mangroves along the French Guiana coast (1996 to 2008)

Changes: Gulf of Carpentaria, Queensland, Australia

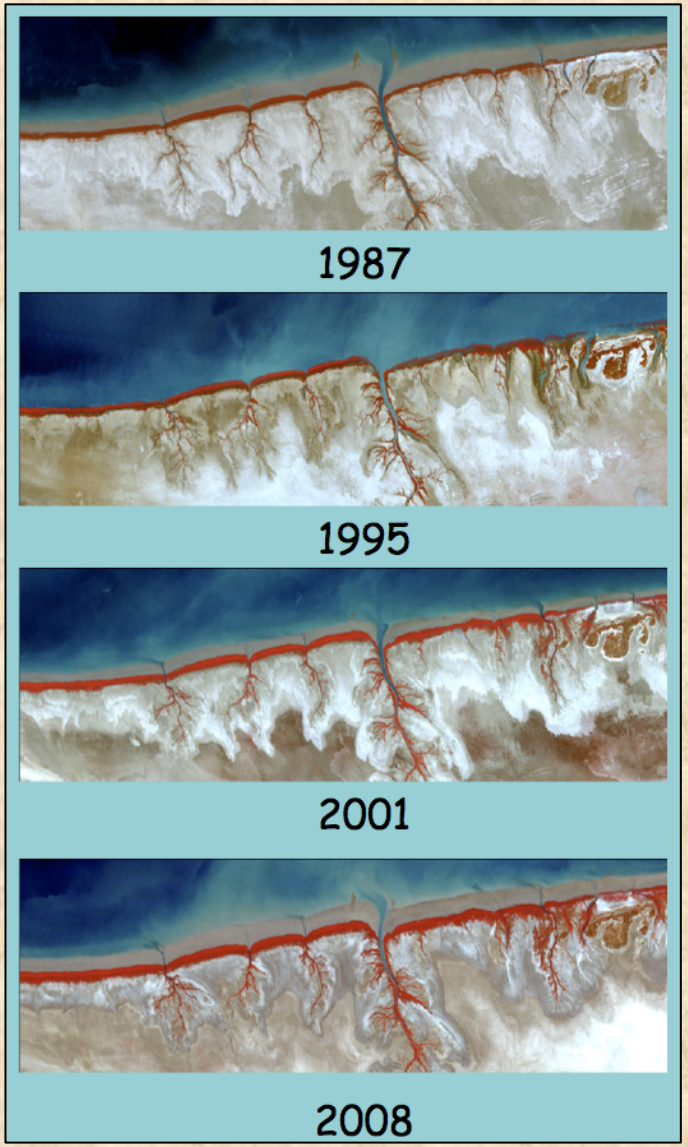




Changes in Mangrove Extent, Northern Australia

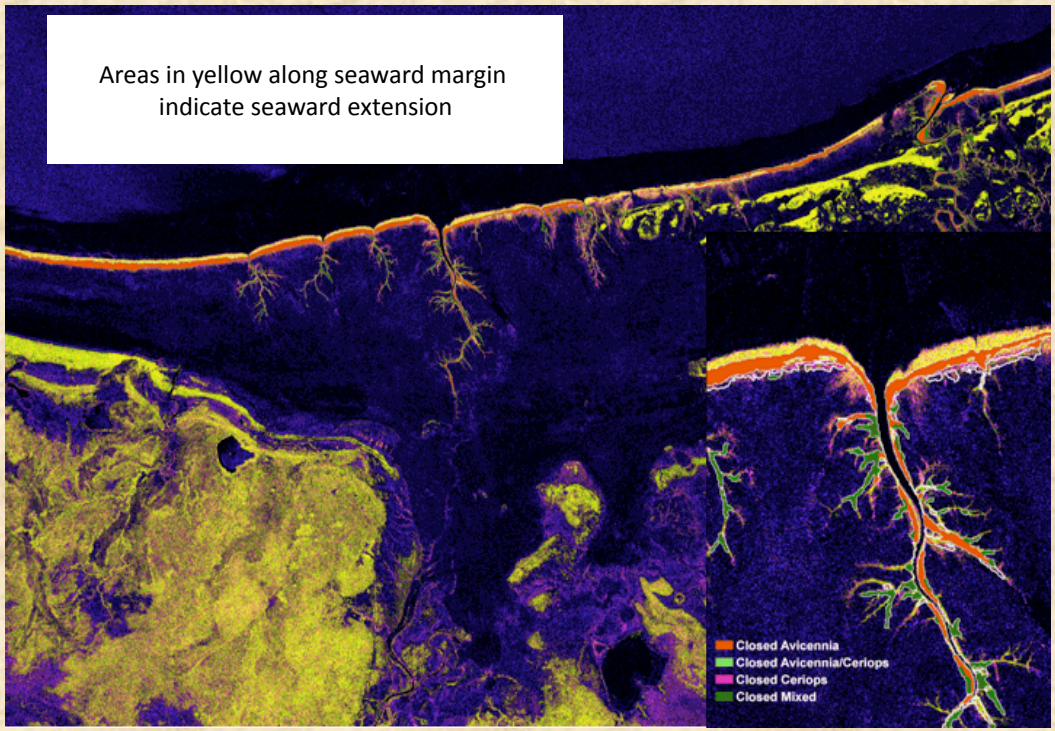


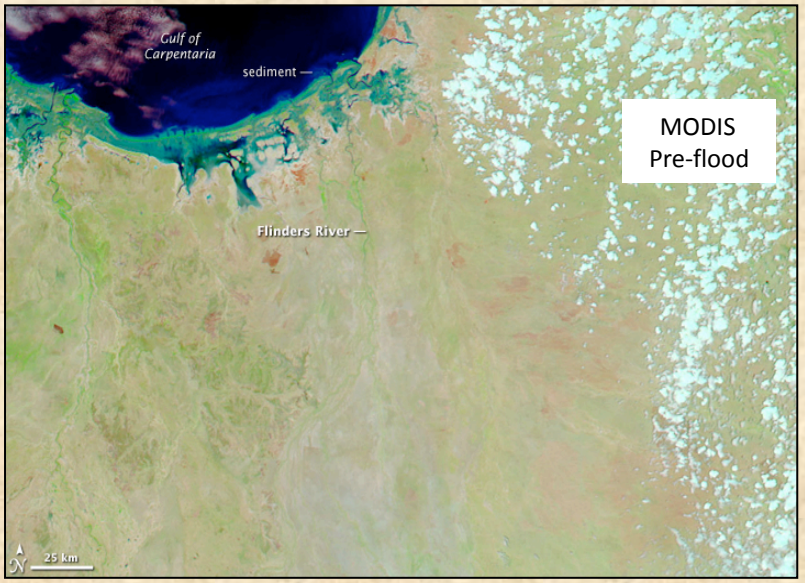
- Mapping from established baselines using ALOS PALSAR indicated relative general stability along Queensland coast
- Exception is the Gulf of Carpentaria
  - Significant seaward expansion
  - Some inland intrusion
- Associated with:
  - Extensive but periodic flooding and sediment discharge
  - Inland intrusion of sea water

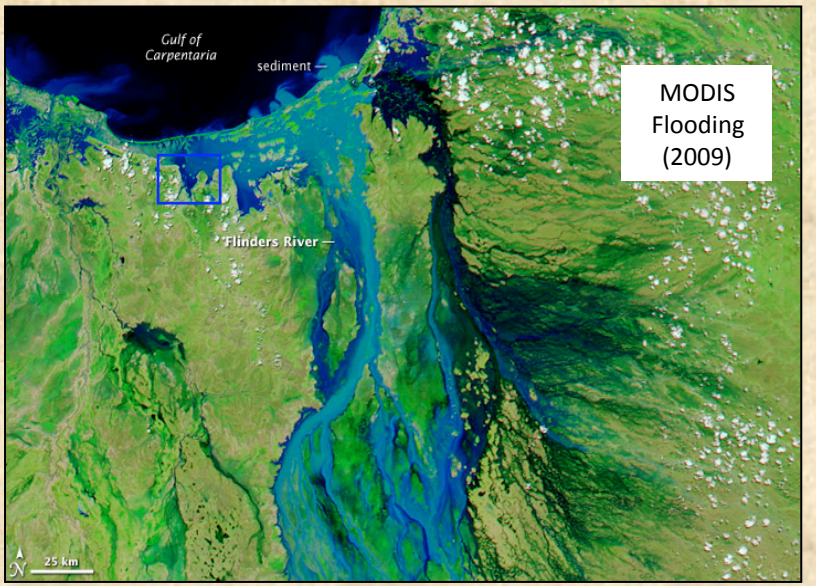


Changes in the extent of mangroves, as observed using time-series of Landsat sensor data

Changes in Mangrove Extent, Northern Australia







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Conclusions

- Mangrove Extent from ALOS PALSAR
  - Depends upon nature of the adjoining land cover
  - In some areas, classification from ALOS can be achieved (e.g., where mangroves with prop root systems adjoin rainforest)
  - Generally requires:
    - Reference to existing regional coverages
    - Optical remote sensing data or derived products (e.g., FPC).
      - Even if for only seeding classifications

- Structural Classification
  - Integration of ALOS PALSAR data with height maps useful for structural classification with potential for:
    - Global application
    - Biomass retrieval
  - Higher resolution and more timely DEMs required
    - Tandem-X
    - Airborne LiDAR
  - Current approach requires validation and refinement of algorithms

- Change detection
  - In cloud-covered regions in particular, time series comparison of ALOS PALSAR and also JERS-1 SAR allows detection of change in extent but also structure/biomass.
  - Useful input to a coastal monitoring system
  - Better understanding of causes and consequences of change
    - Natural
    - Anthropogenic
    - Climate change (sea level fluctuation)

- Requirement for ground truth
  - Airborne remote sensing data (including historical) are needed to provide ground truth and baseline information against which to quantify change but also assess the ability of detecting change from spaceborne sensor data.
  - Collation of existing and new mangrove survey data within a centralized database would be advantageous

Acknowledgements

- Japanese Space Exploration Agency (JAXA) and the Kyoto and Carbon Initiative
- Definiens AG, Munich
- School of Biological, Earth and Environmental Sciences (BEES), the University of New South Wales, Australia (UNSW).
- The Queensland Department of Environment and Resource Management (QDERM)
  - Queensland Herbarium
- University of Edinburgh
- IRD (France)

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1. Published (please provide PDF file)

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2. Submitted/in preparation

- Lucas et al.: Recent response of mangroves to climatic and sea level change, Gulf of Carpentaria, Australia. Remote Sensing of Environment or Wetlands Journal

K&C deliverables

Data sets and Thematic products
(mosaics, classification maps etc.)

1. Completed and Delivered to JAXA

- *Mangrove structural classification*
  - *Belize*
  - *Queensland*
- *Mangrove change maps*
  - *North Queensland*
  - *Atlantic coast South America*
  - *Belize*
  - *Southeast Asia*

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Acknowledgements

The Queensland Department of Environment and Resource Management (QDERM), including the Queensland Herbarium, the University of Edinburgh, the University of Belize, Southern Environmental Association (SEA) Belize, and the Toledo Institute for Development and Environment (TIDE), Belize.

Chandra Giri of the US Geological Survey (USGS) is also thanked for provision of the global mangrove data layer. The research has been undertaken within the framework of the JAXA Kyoto & Carbon Initiative. ALOS PALSAR data have been provided by JAXA EORC." All illustrations are copyright of the ALOS K&C *© JAXA/METI, QDERM and Queensland Herbarium EPA.*