

# Global Mangrove Watch

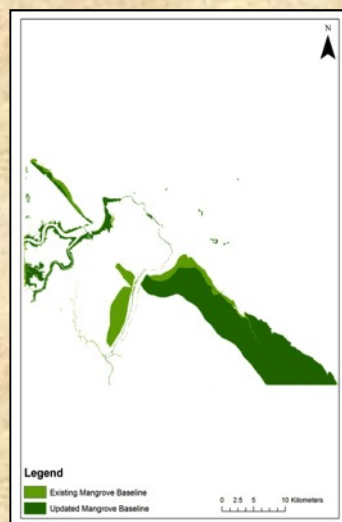
Richard Lucas, Nathan Thomas, Takuya Itoh<sup>1</sup>, Lisa Rebelo<sup>2</sup> &  
Peter Bunting

Aberystwyth University, Aberystwyth UK

RESTEC, Tsuskuba Japan.

International Water Management Institute, Vientiane, Laos.

# The USGS/NASA Global Mangrove Dataset

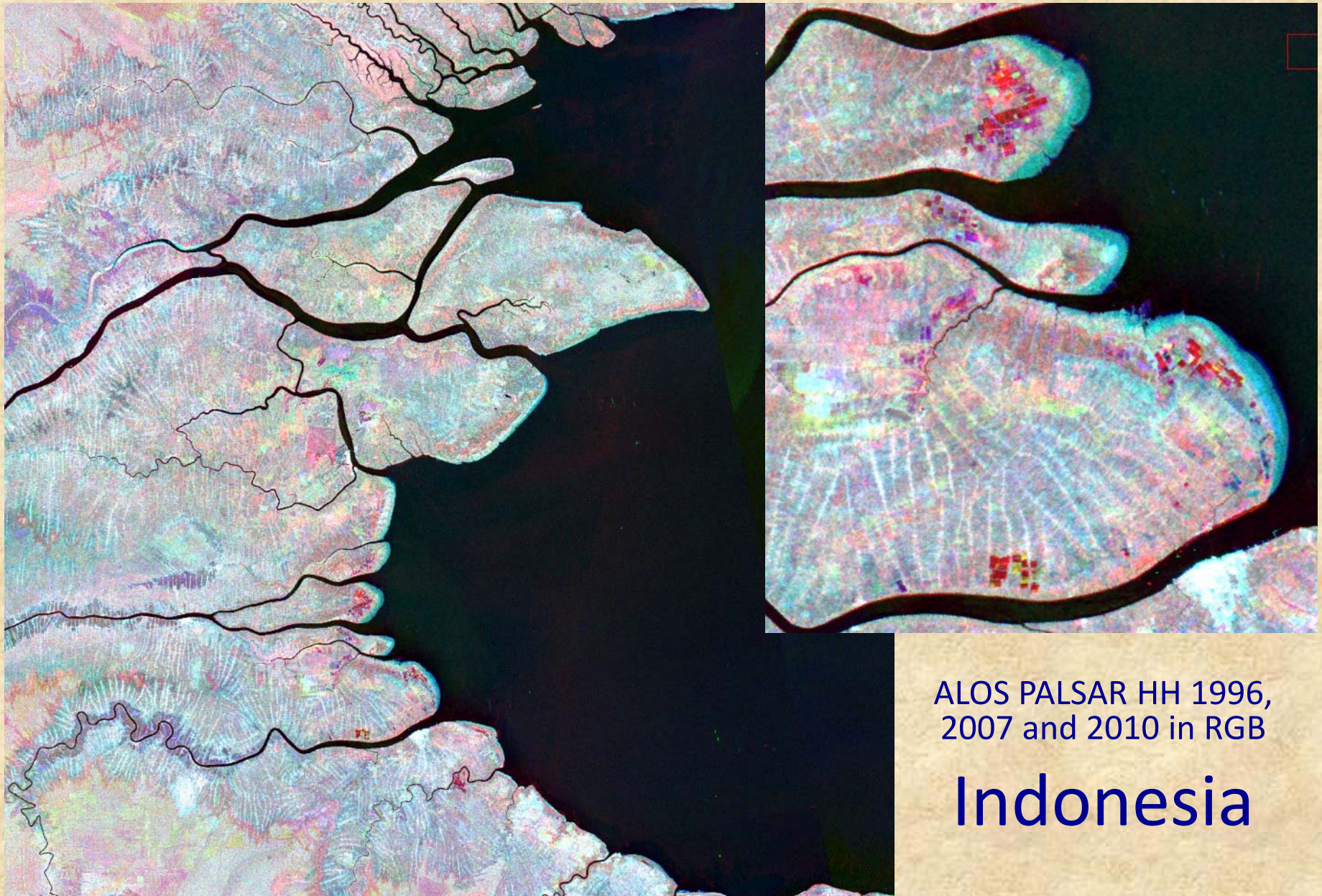


Giri, C., Ochieng, E., Tieszen, L.I., Shu, Z., Singh, A., Loveland, T. and Duke, N. (2011) Status and Distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography*, 20(1), 154-159.

Updates based on ALOS PALSAR time-series



# Anthropogenic change; seaward expansion



ALOS PALSAR HH 1996,  
2007 and 2010 in RGB

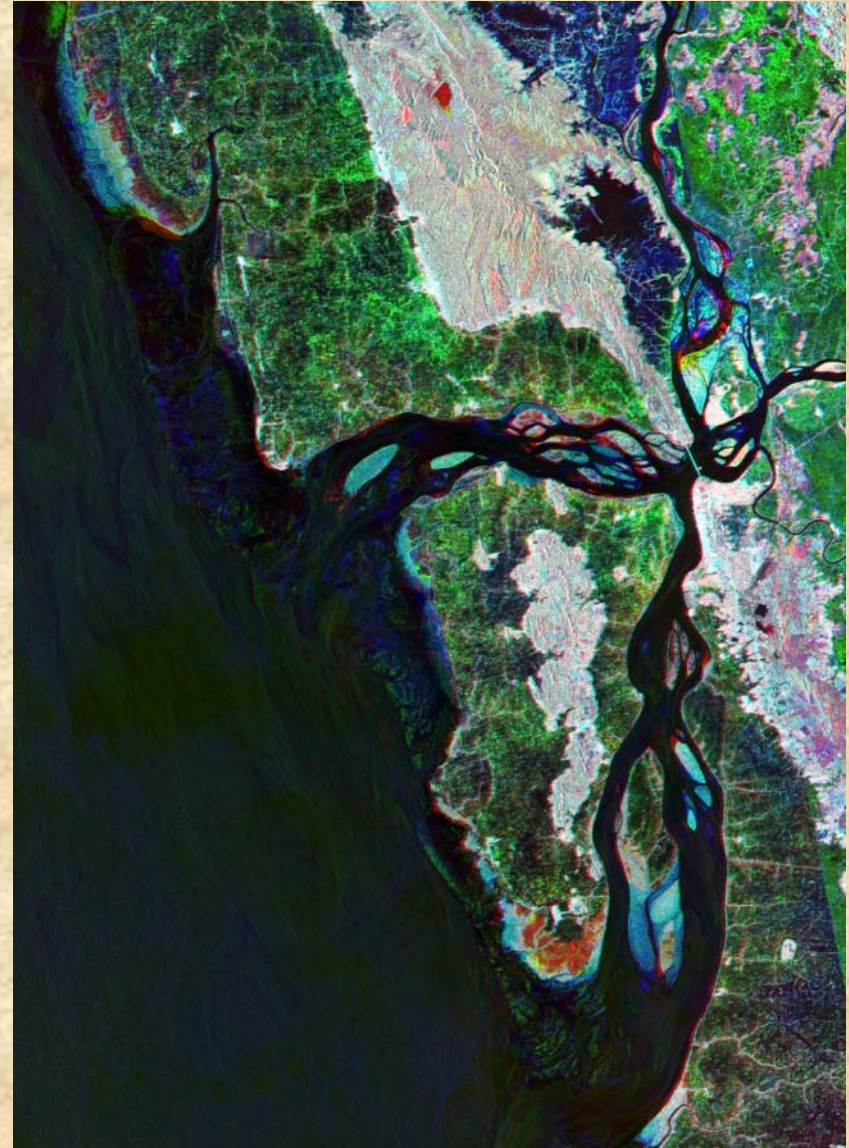
Indonesia



# Mangrove Change



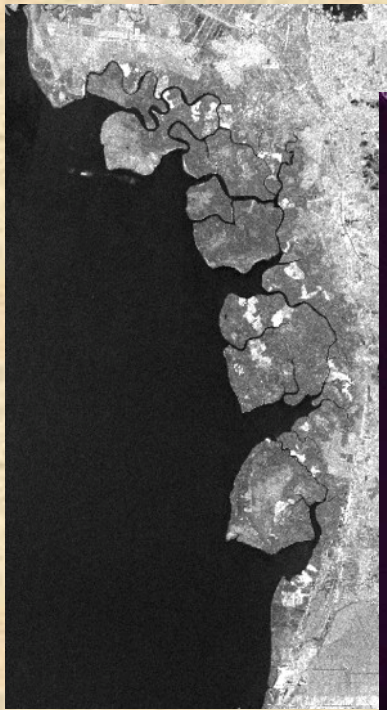
Loss



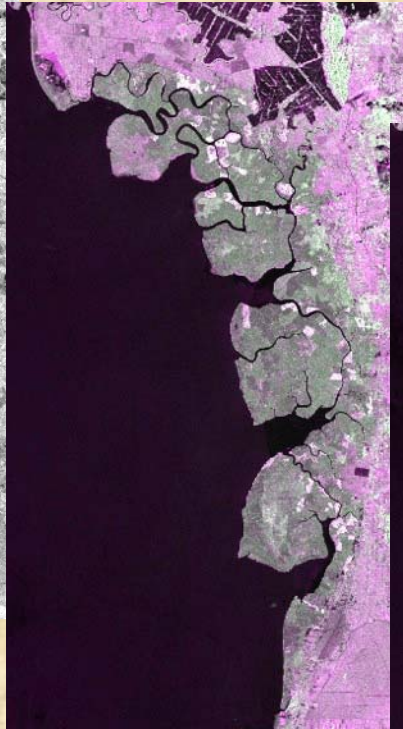
Advance



# Human-induced change, Perak, Malaysia



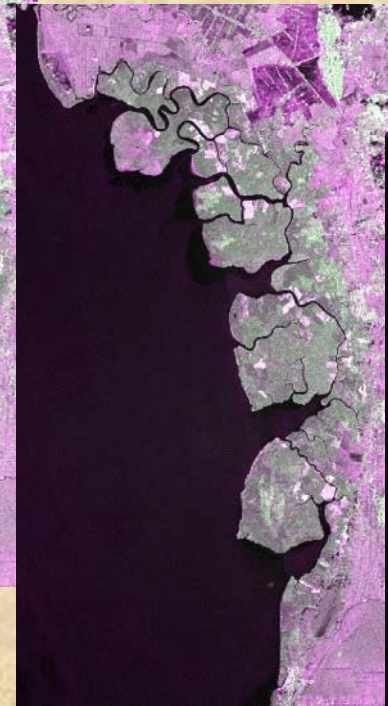
1996



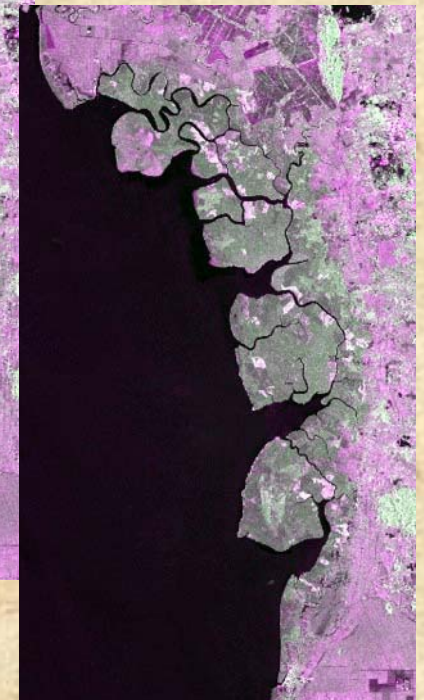
2007



2008

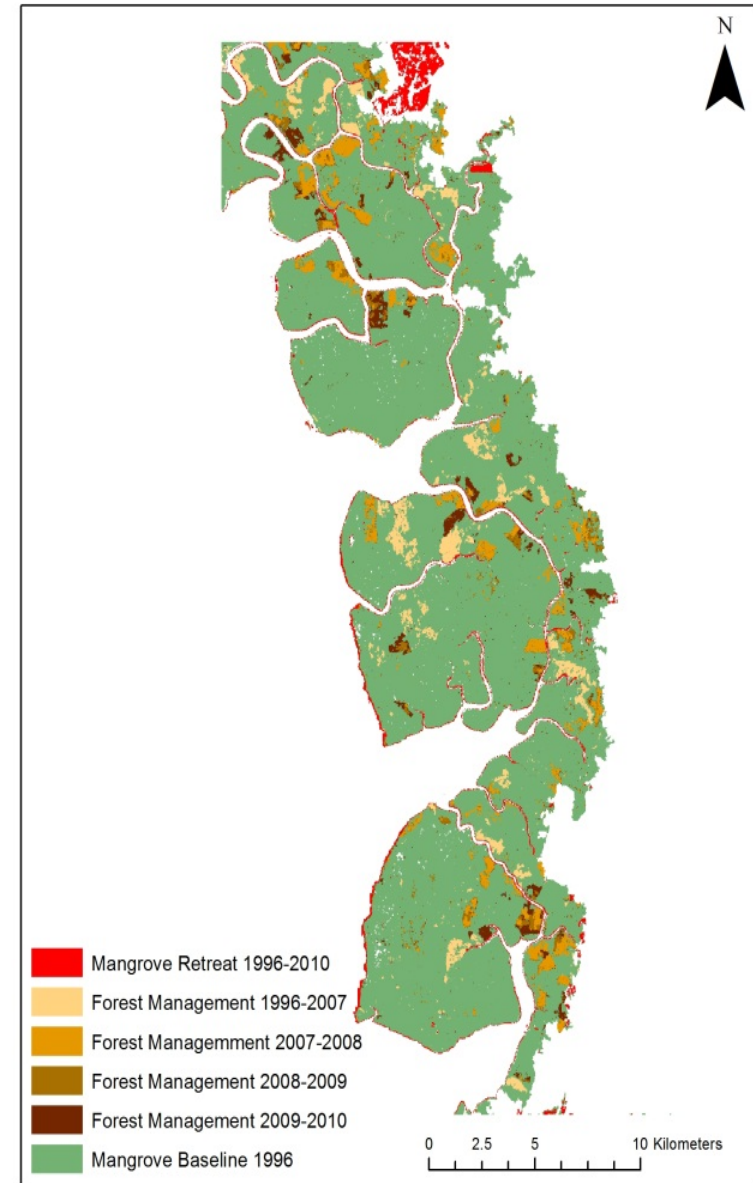
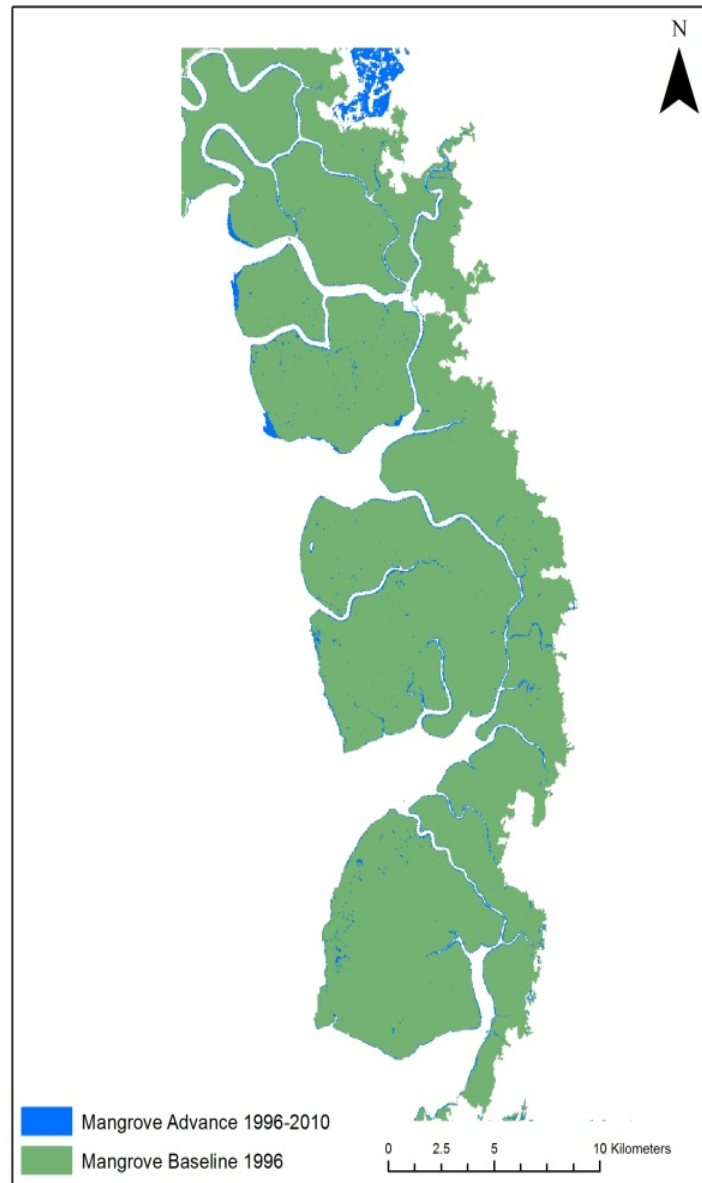
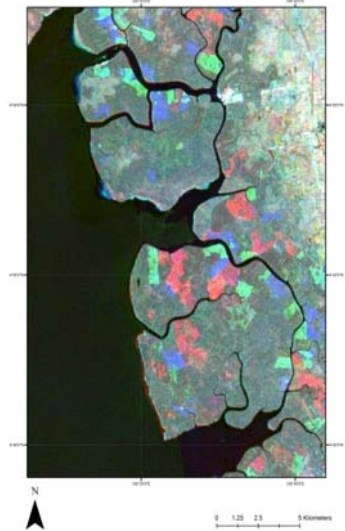


2009



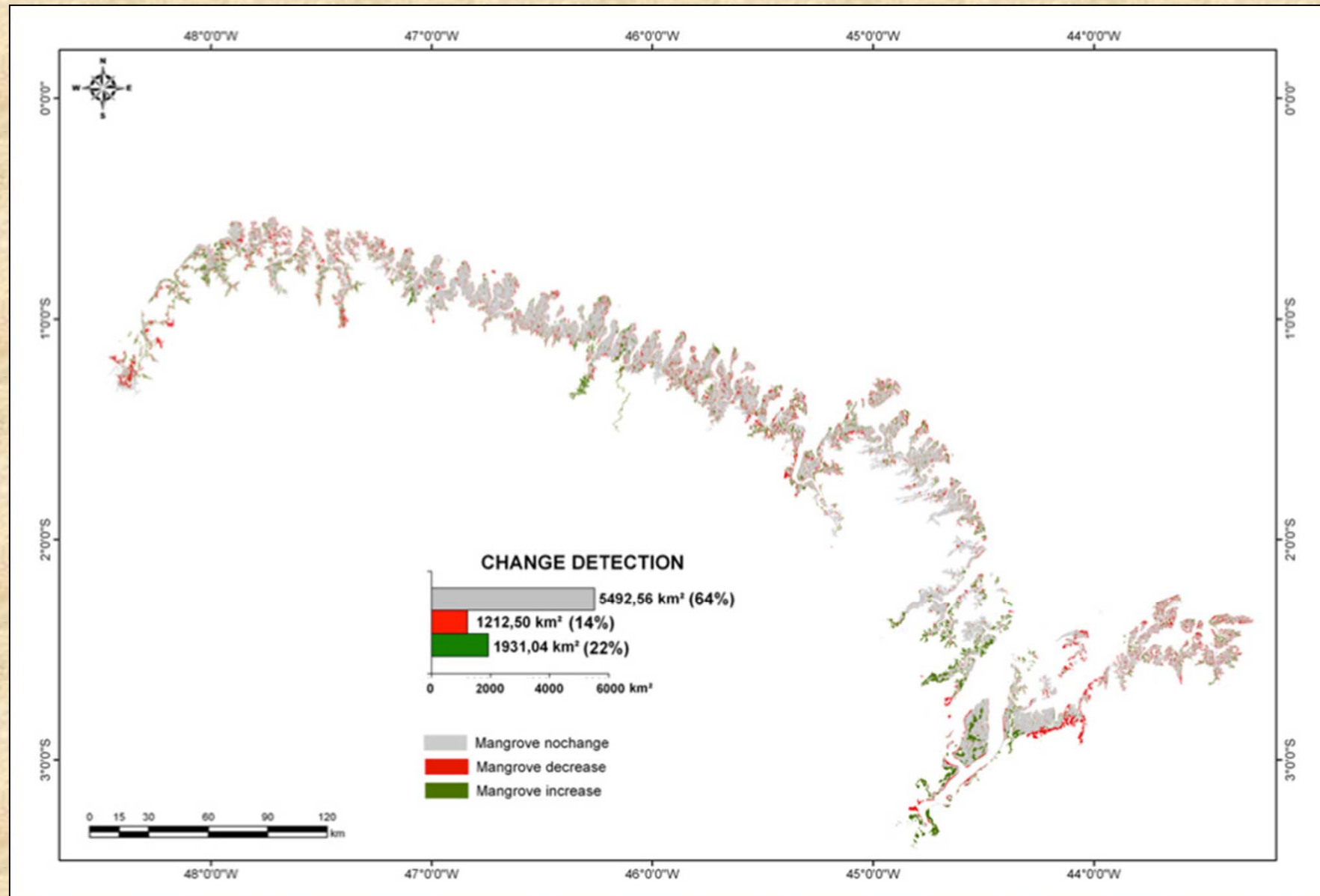
2010

# Mangrove Monitoring: Perak, Malaysia

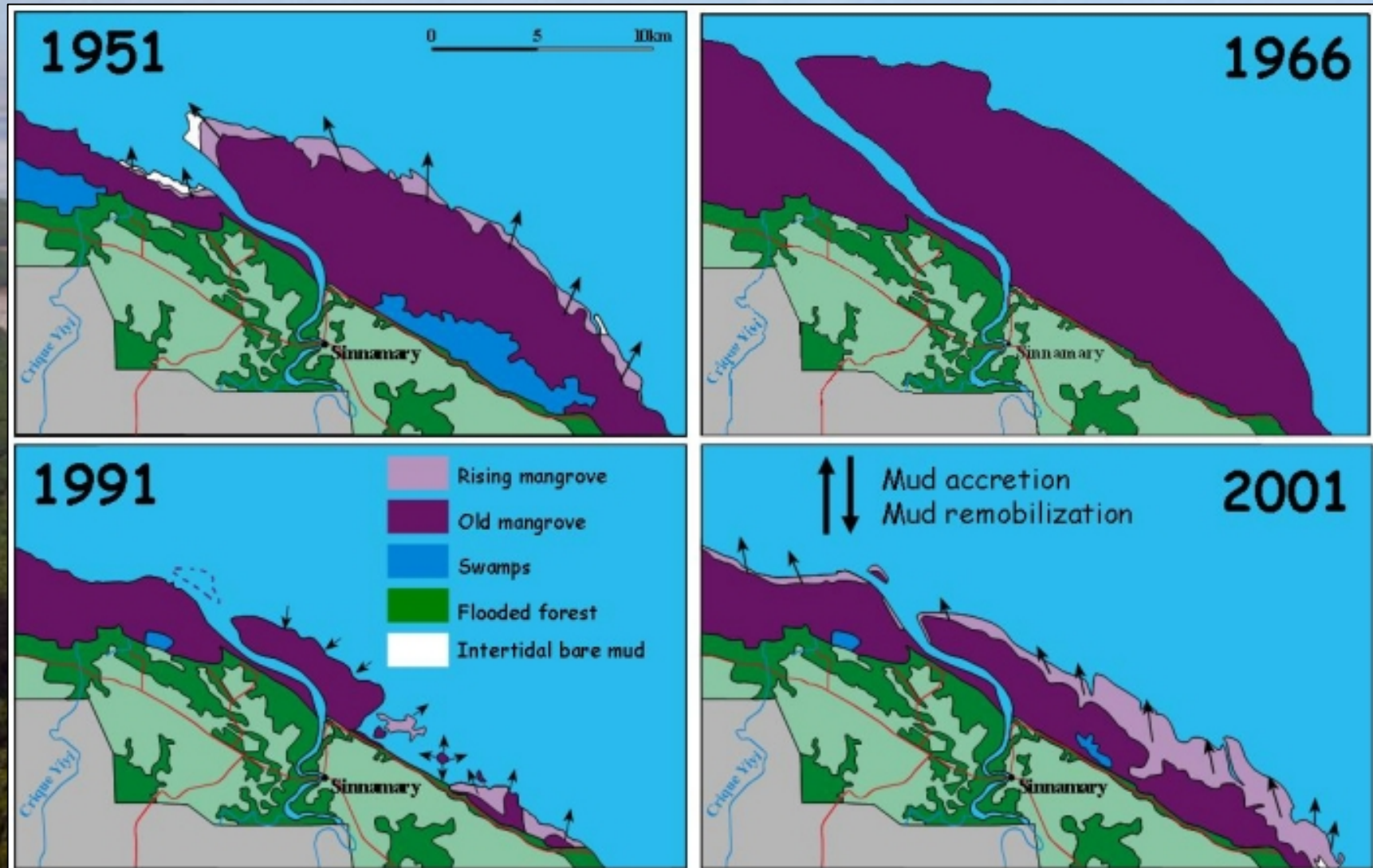




# Mangrove Change, Bragantina, Brazil

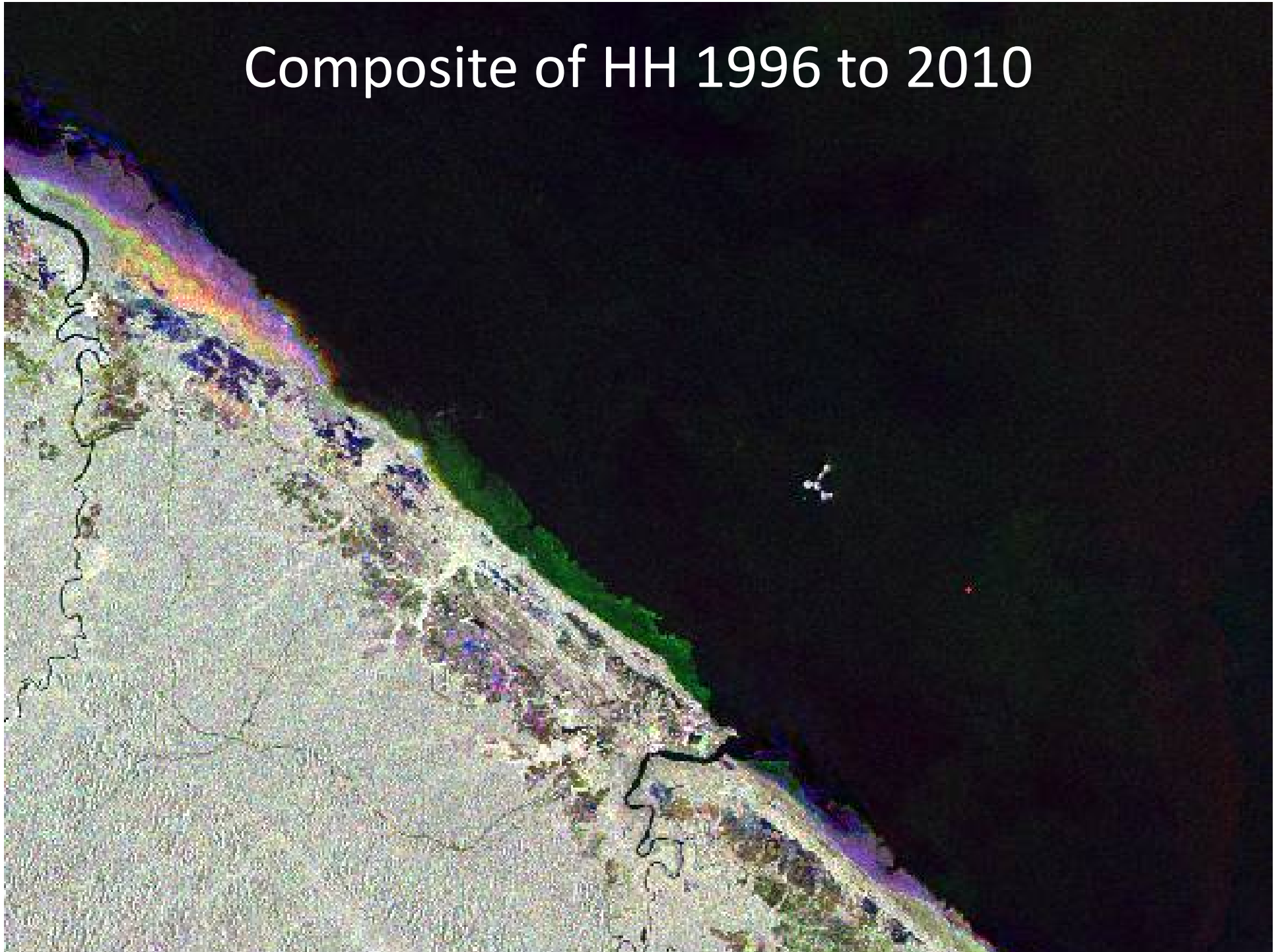


# French Guiana: Changes associated with erosion and accretion of sediments

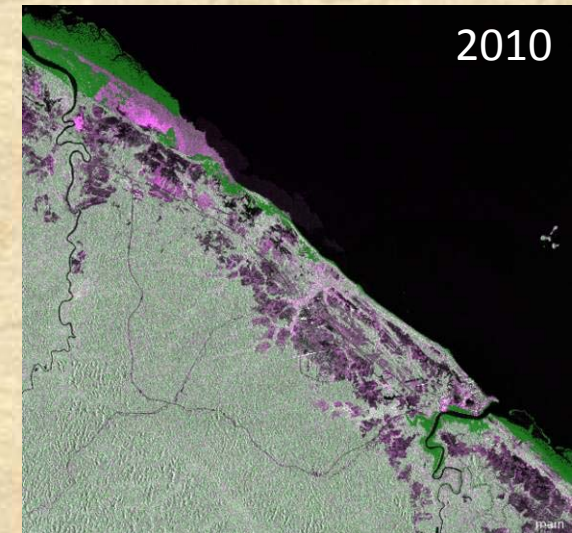
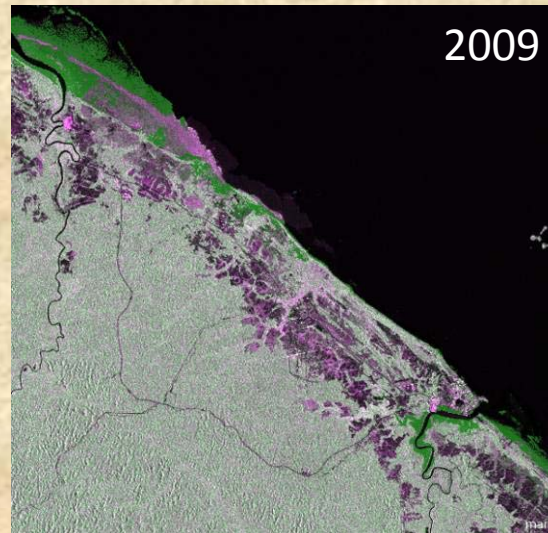
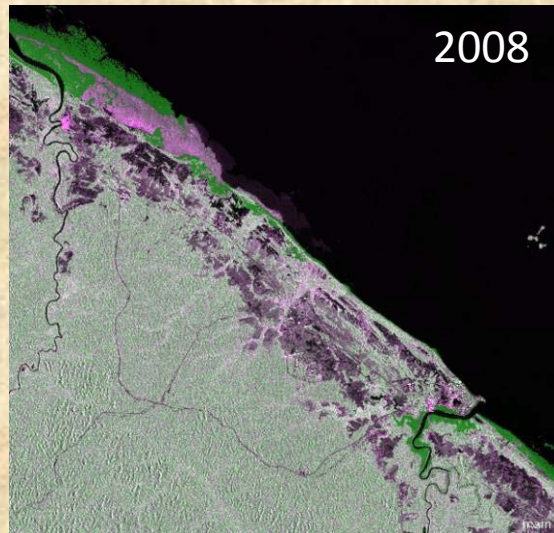
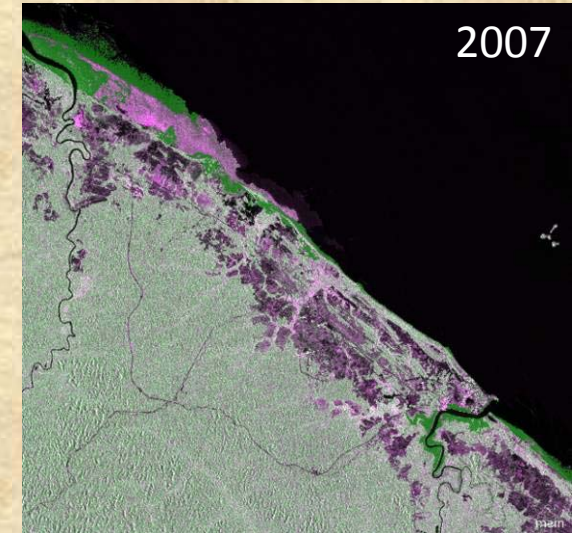
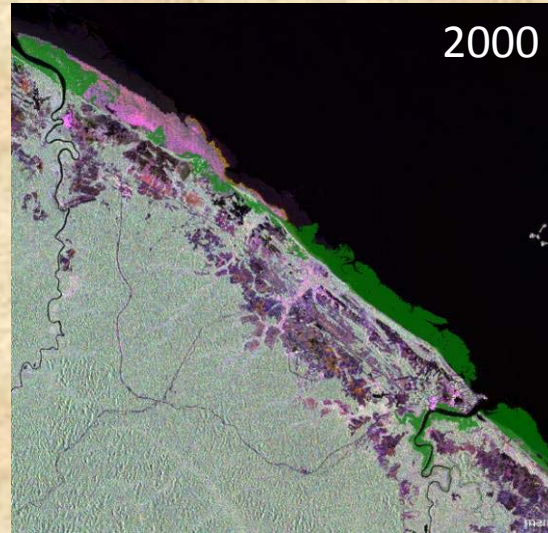
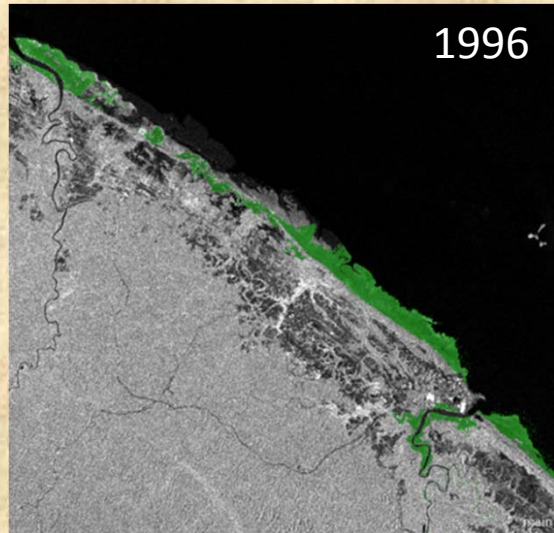




# Composite of HH 1996 to 2010

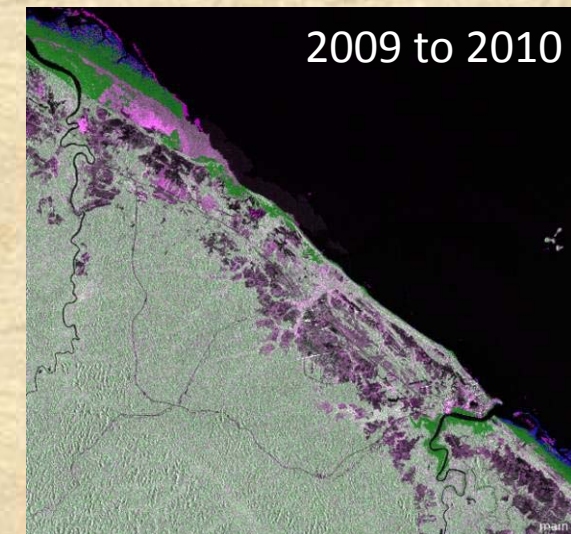
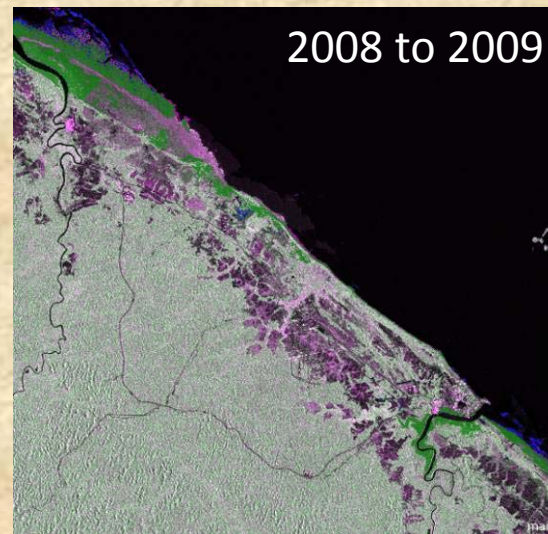
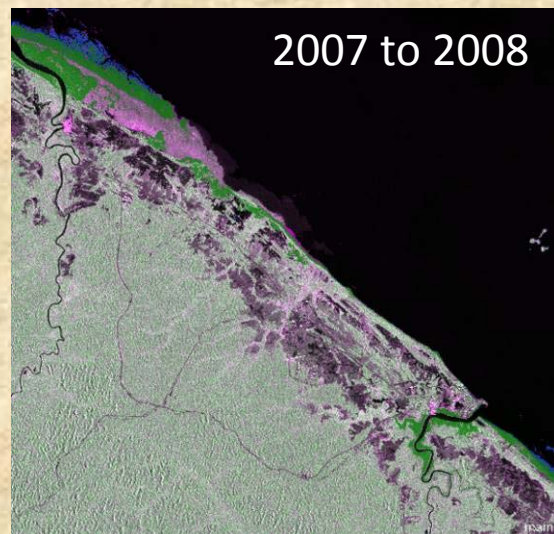
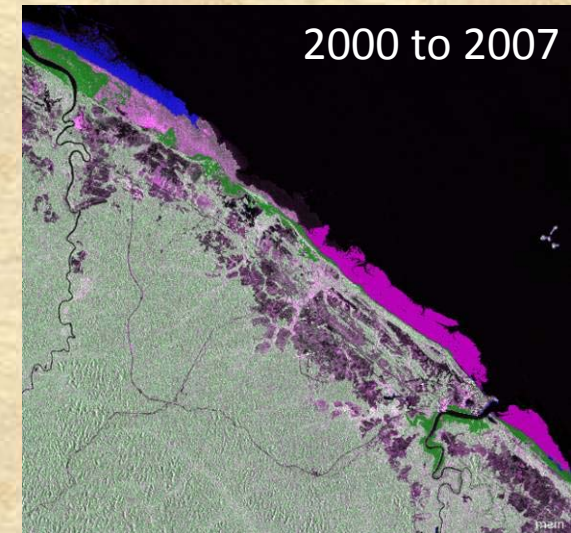
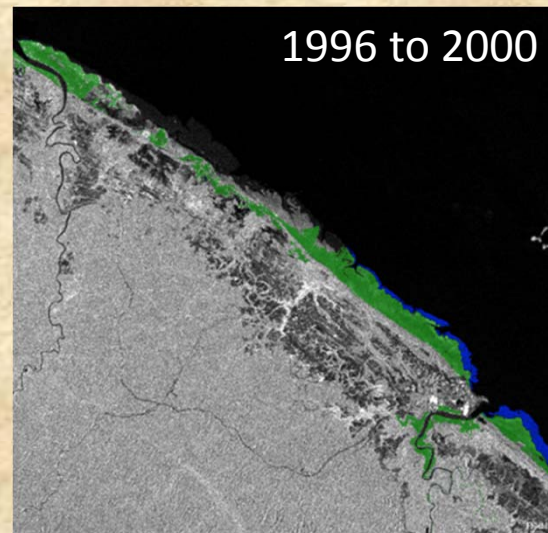


# Changes in mangrove extent, French Guyana: 1996 to 2010 (N06W053)



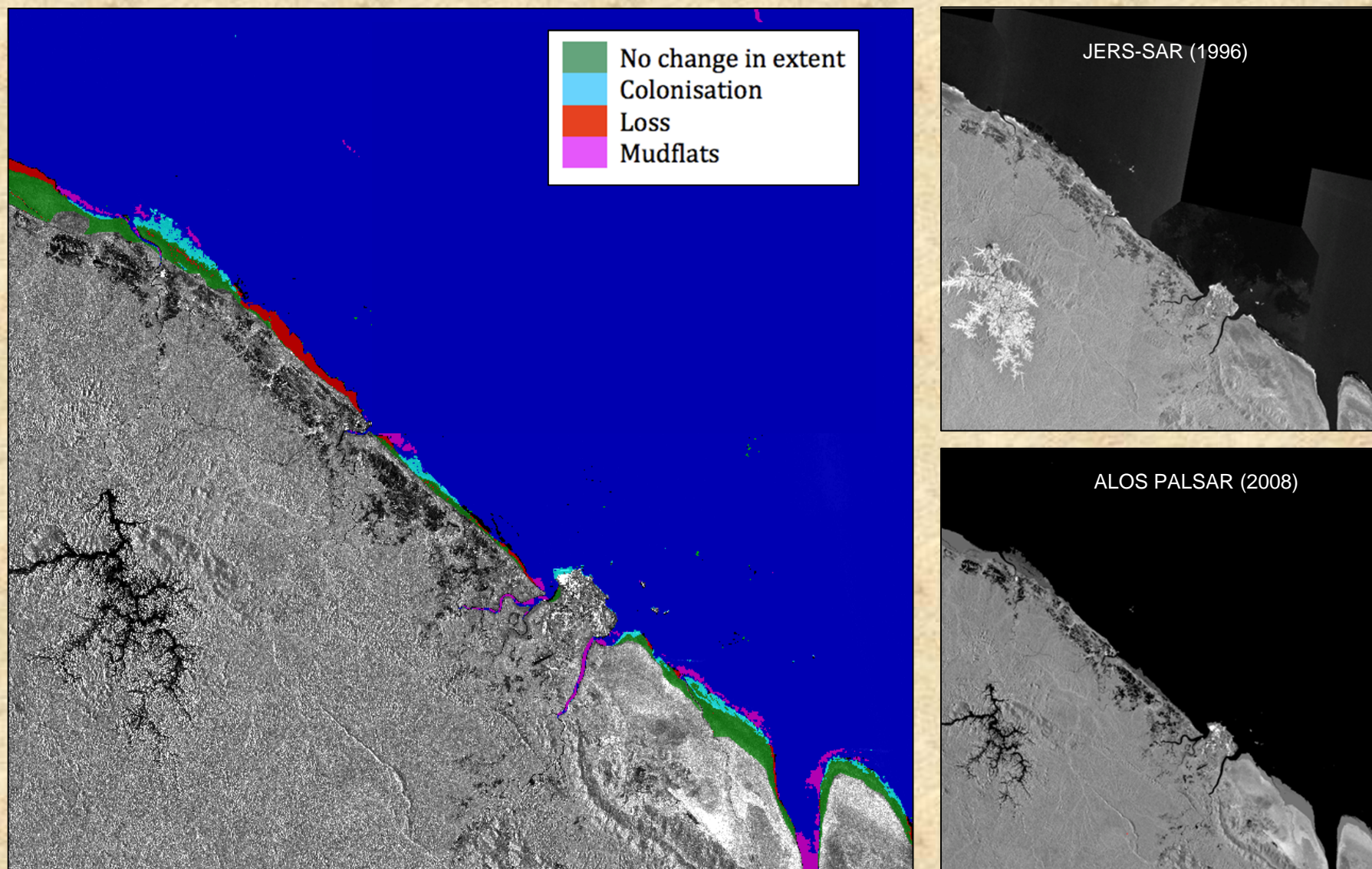


# Changes in mangrove extent, French Guyana: 1996 to 2010 (N06W053)





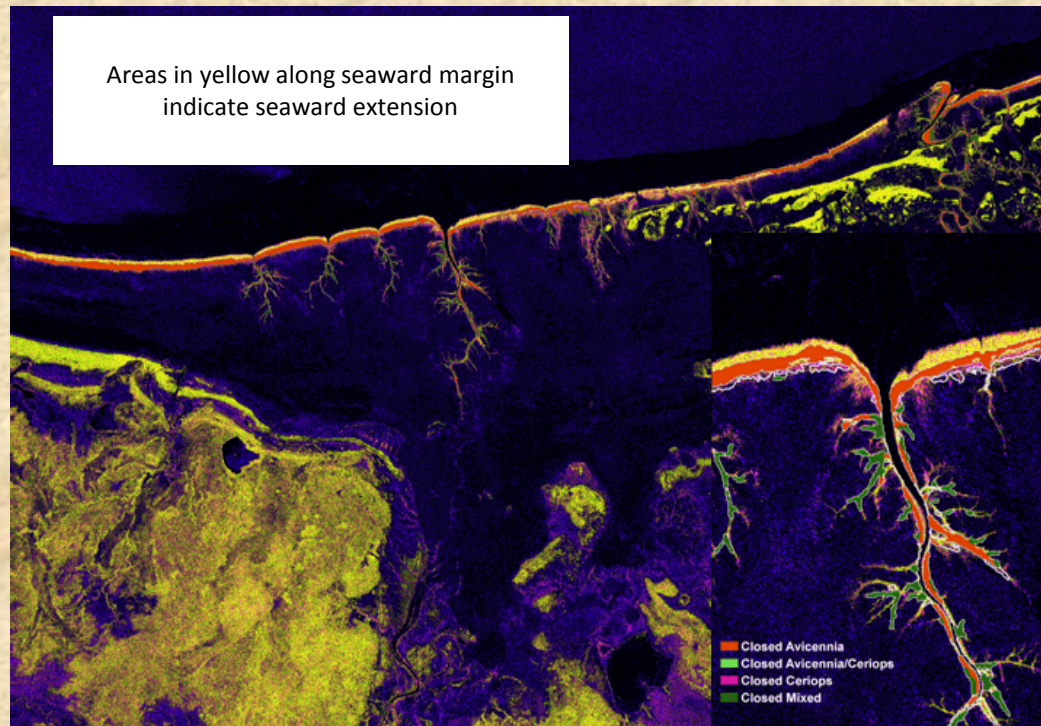
## Classification of Change: JERS-1 SAR and ALOS PALSAR comparisons



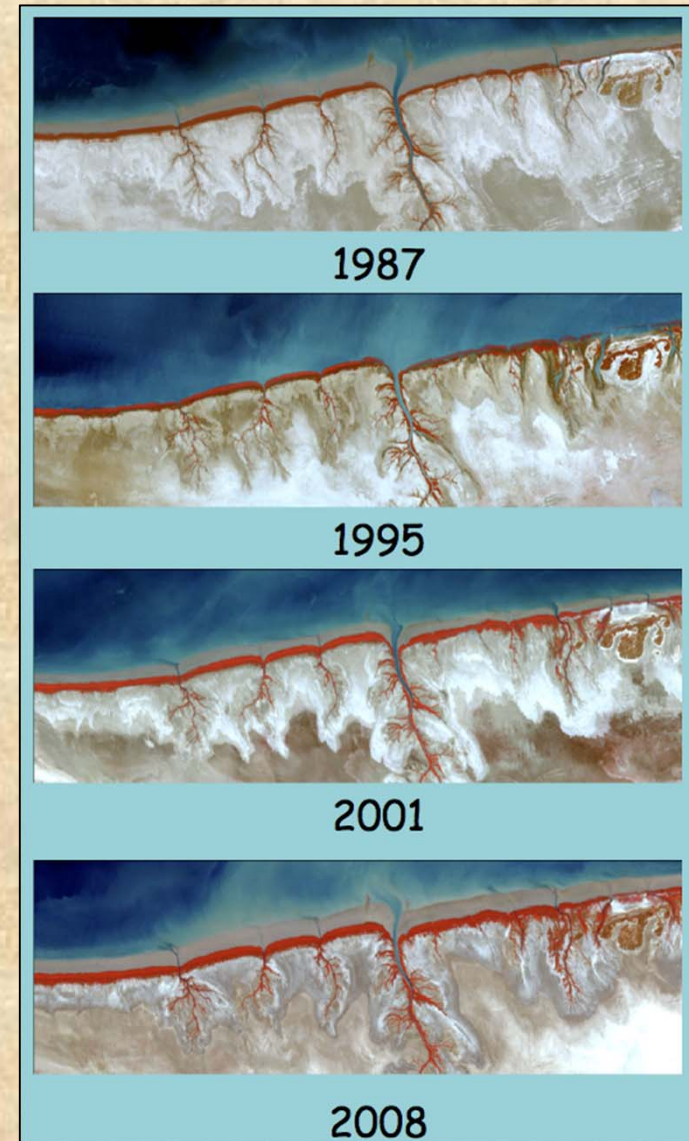
Changes in mangroves along the French Guiana coast (1996 to 2008)



# Changes in Mangrove Extent, Northern Australia



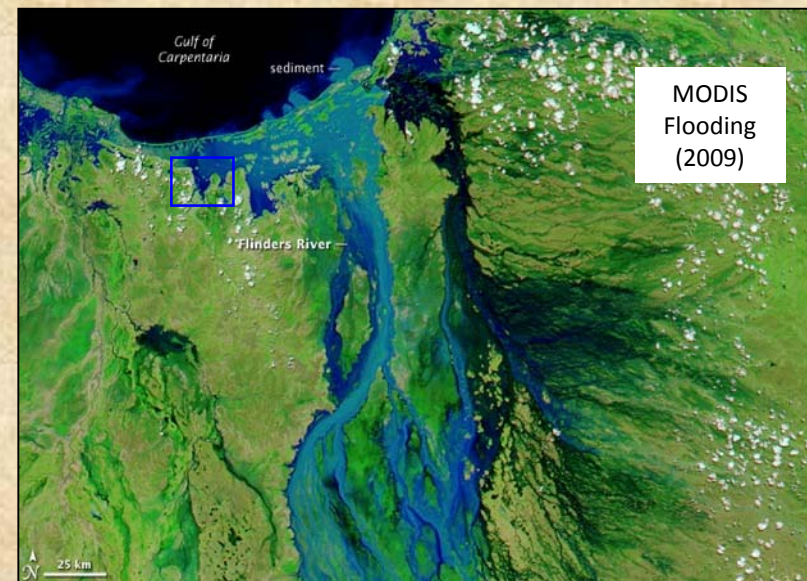
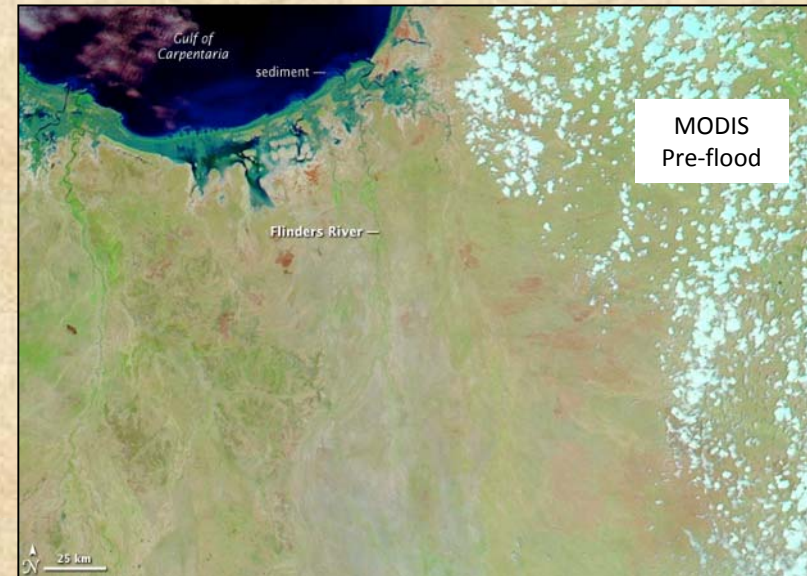
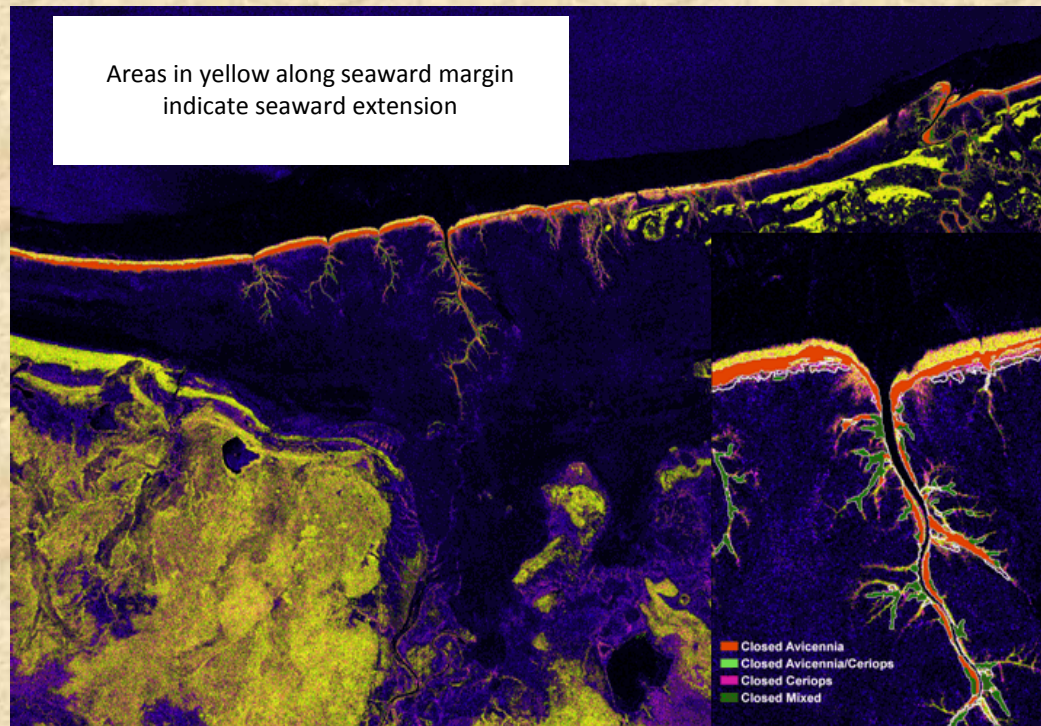
- Mapping from established baselines using ALOS PALSAR indicated relative general stability along Queensland coast
- Exception is the Gulf of Carpentaria
  - Significant seaward expansion
  - Some inland extension
- Associated with:
  - Extensive but periodic flooding and sediment discharge
  - Inland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

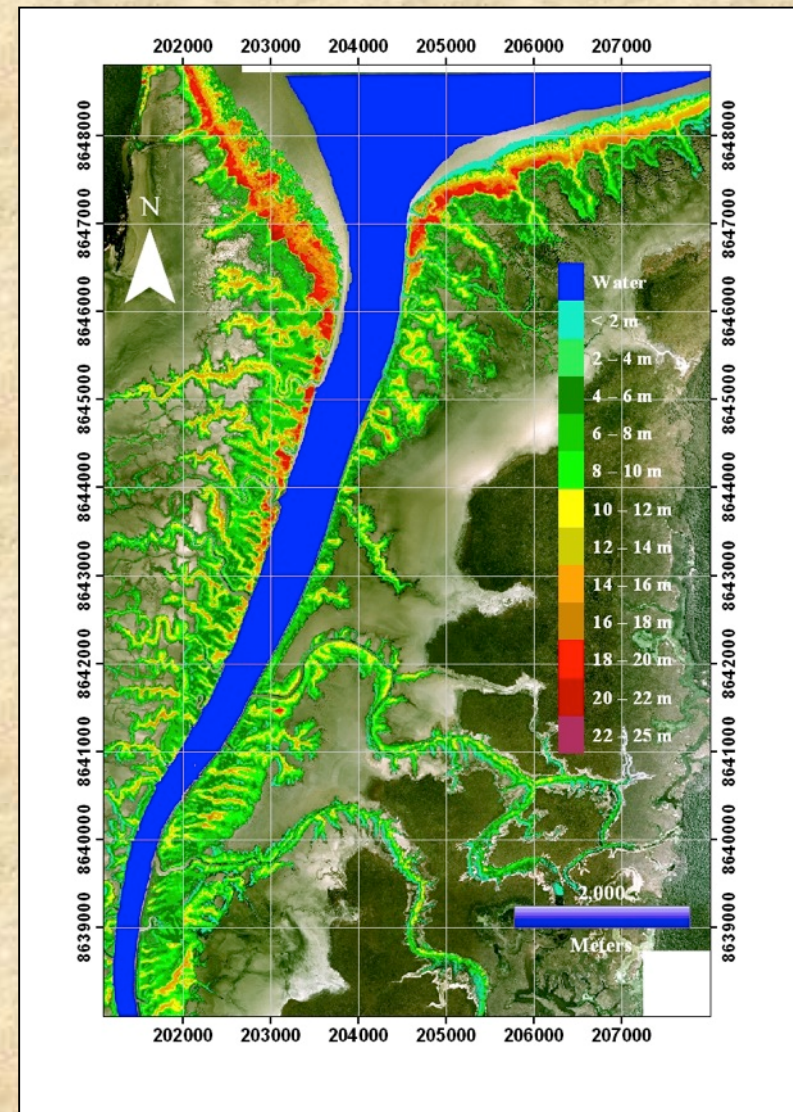


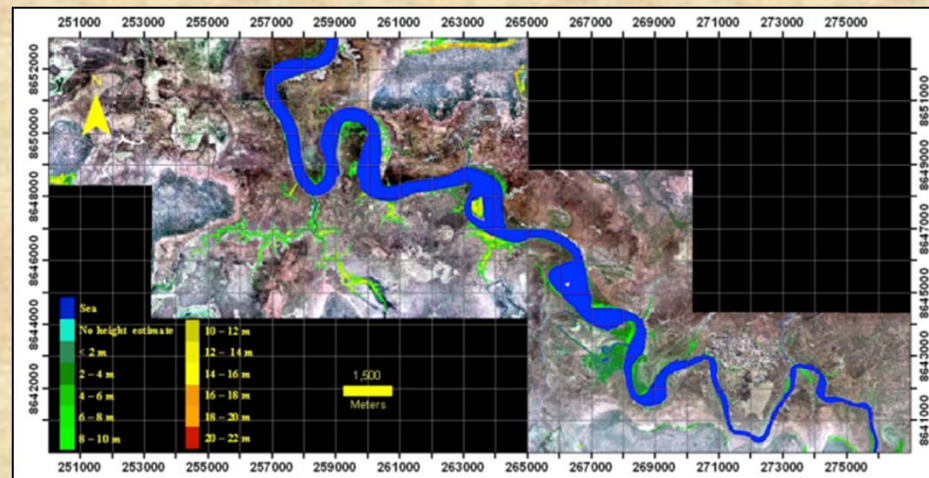
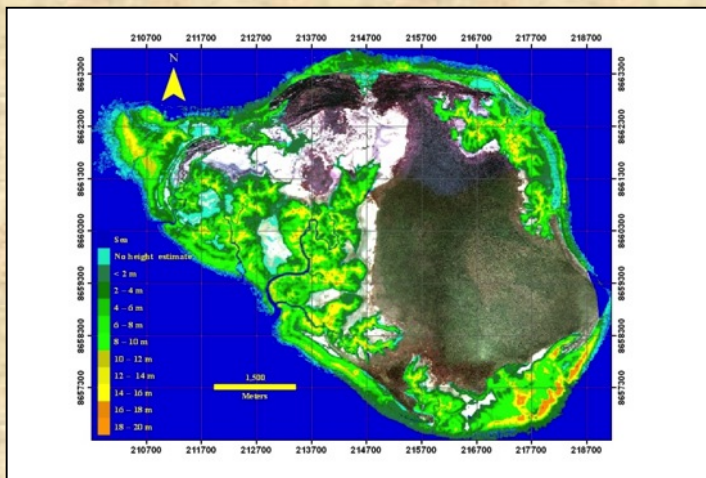
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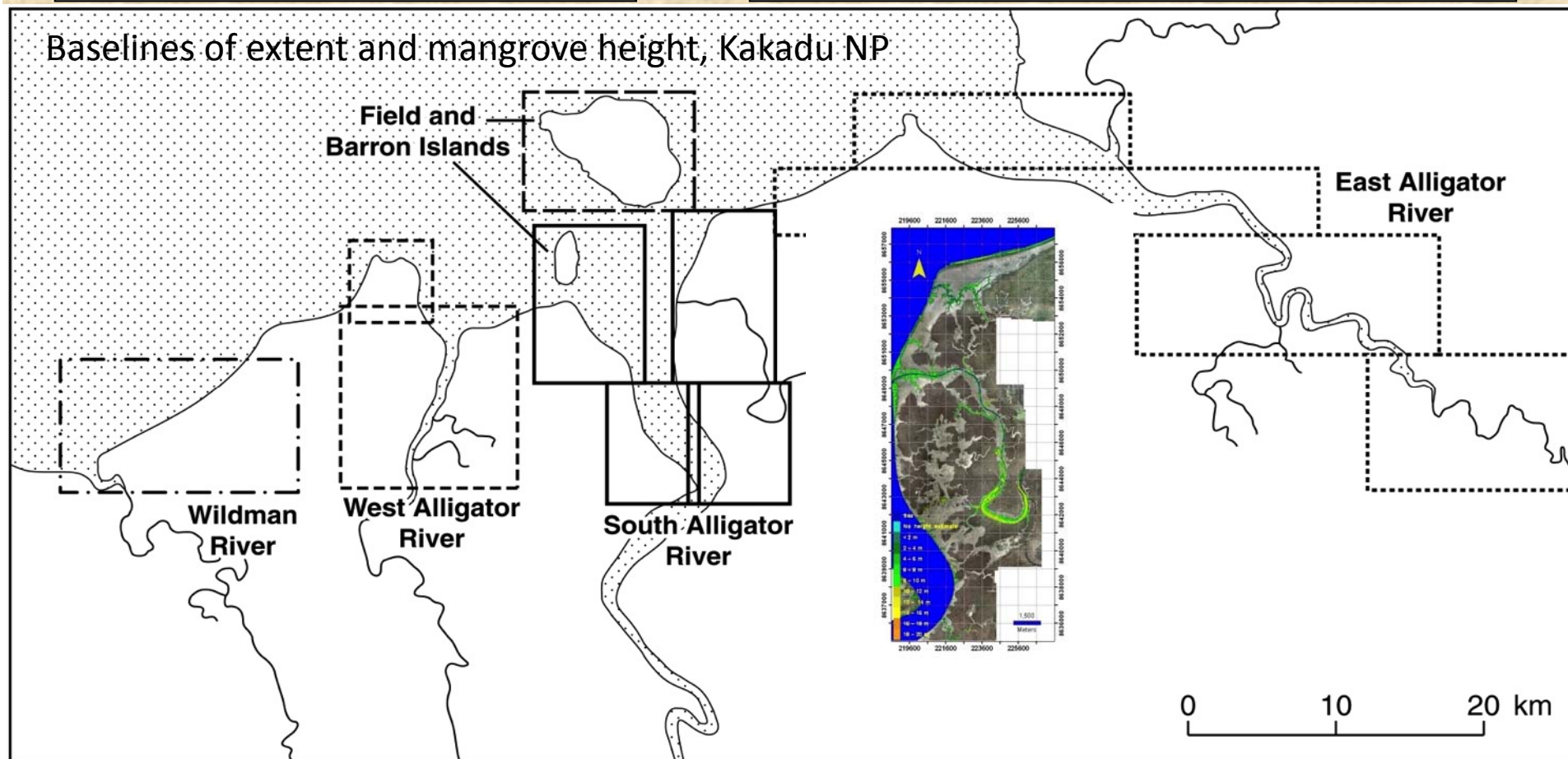
# Requirement for Baseline Datasets

- Detection of change (particularly inland) is often slow and subtle
  - Loss of species
  - Degradation of structure
  - Growth
- Historical archives of aerial photography can be used to map historical extent and retrieve canopy height
  - Species composition more difficult to ascertain
- Change detection requires comparison with previous maps of extent and characteristics
  - Derived from aerial photographs
- Coastal LiDAR capture represents an important baseline
  - Same date acquisitions with airborne optical (hyperspectral) data beneficial
- Potential to integrate with a satellite-based monitoring system for targeted acquisitions
  - Landsat (changes in extent, communities)
  - ALOS PALSAR (changes in structure/biomass)



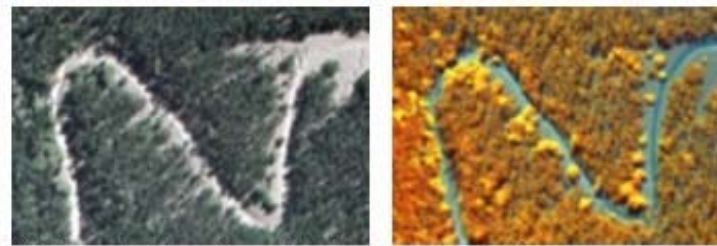


## Baselines of extent and mangrove height, Kakadu NP

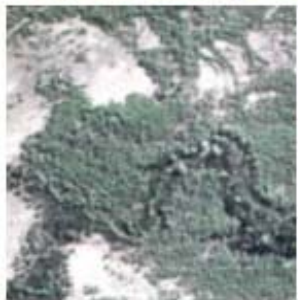




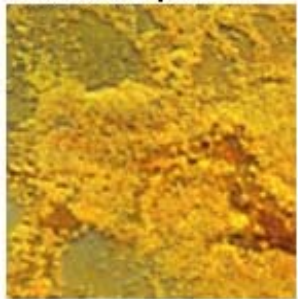
## Establishing baselines



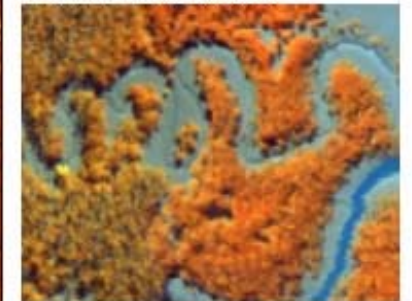
Tidal creek intrusion and subsequent growth



Landward expansion



Seaward colonization



Lightening strikes



Changing landward extent of Rhizophora: line indicates position in 1991.

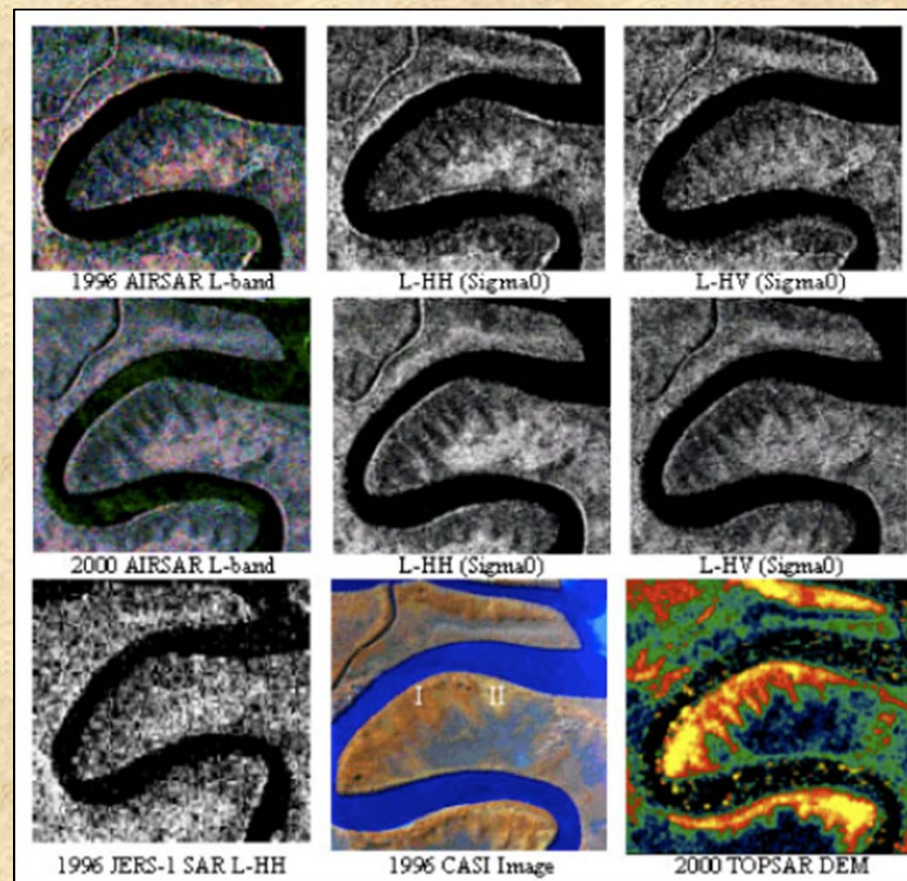
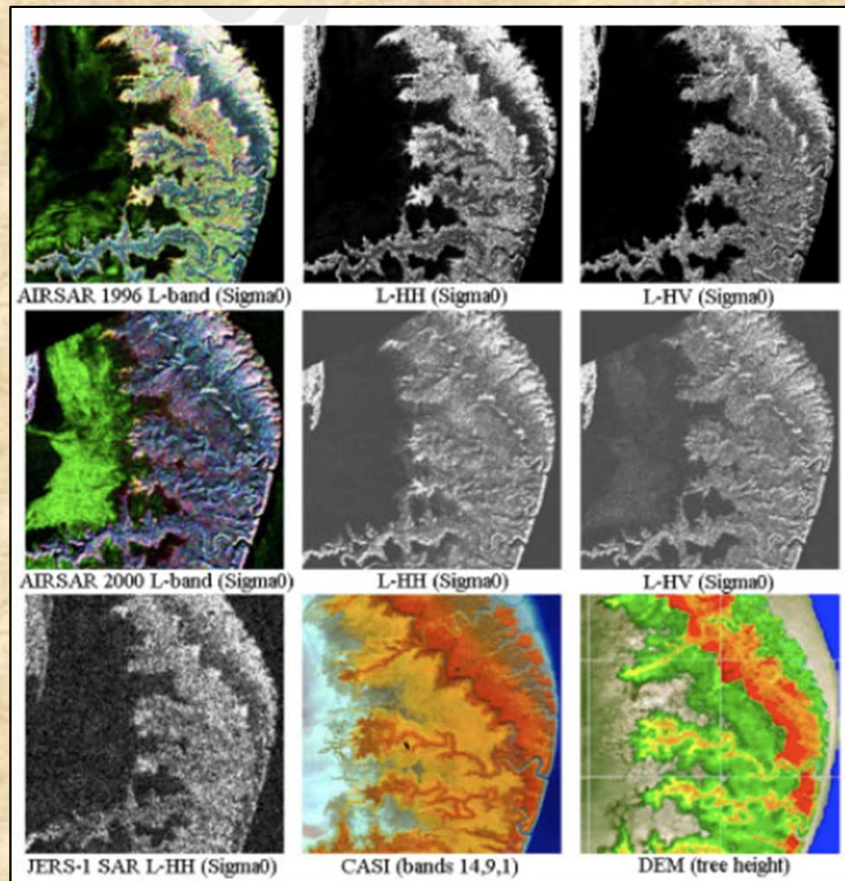
0 m 200 m



# Airborne Observations of Mangrove

Kakadu National Park, NT

Daintree National Park, QLD

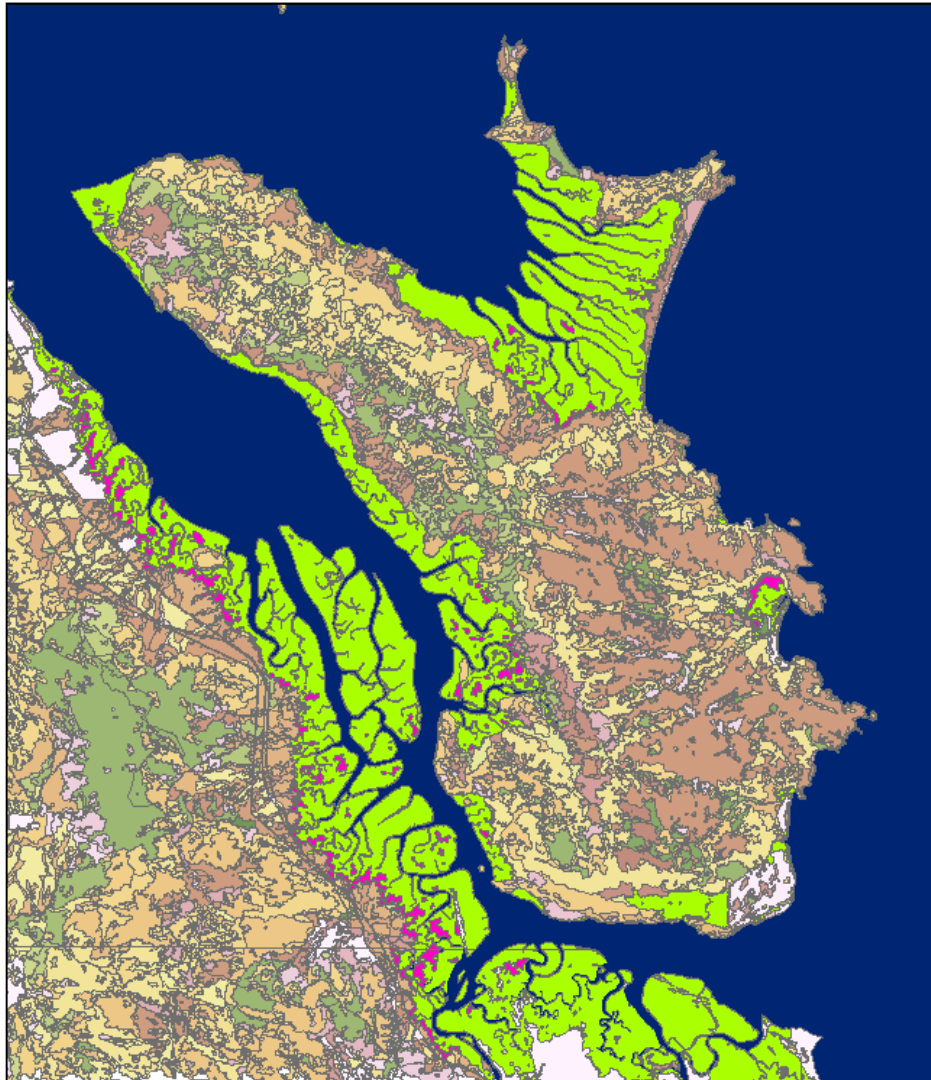




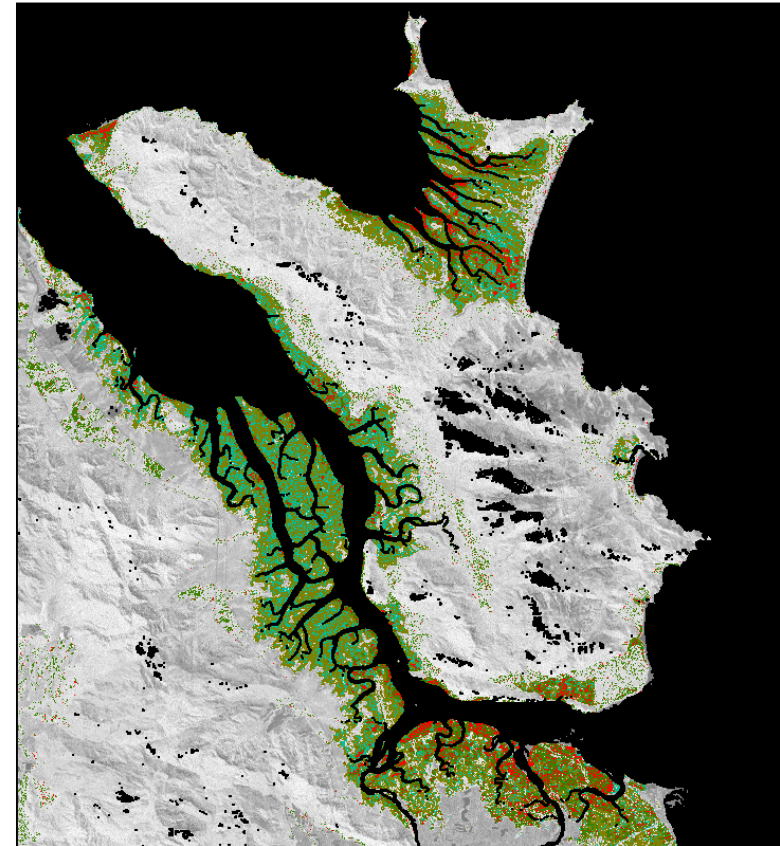
# Example of Mangrove Classification

Hinchenbrook Island, Queensland, Australia

Queensland RE Mapping



Structural classification



Low biomass mangroves
High biomass mangroves
High biomass mangroves with prop root systems
Non-mangrove

# Next steps

- Collate ground data (field and airborne, including products) from around the world.
  - Structure, biomass, species
  - Change
- Evaluate accuracy based on current tile classifications
- Identify new tiles with change
  - Zambezi (Carl Trettin)
- Composite of JERS-1 SAR, ALOS HV (2007) and ALOS (2010) in RGB.
  - Locate areas of significant change.
- Aim: Nature paper
  - Identify areas of significant change
  - Explain the change.



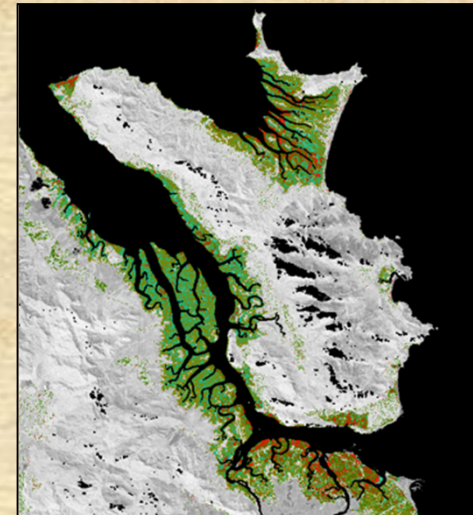


# Next steps

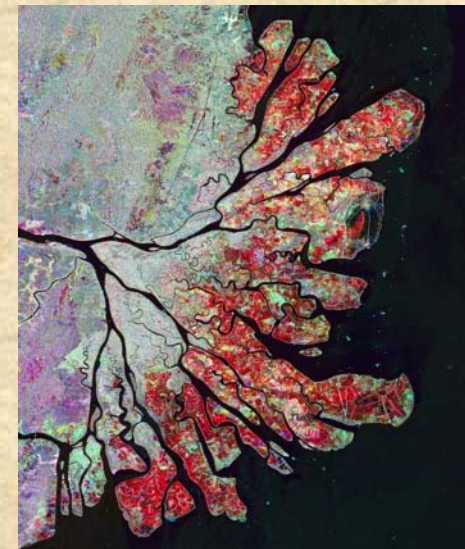
- Generate a shapefile of:
  - 1 degree tiles as a grid around coastlines with mangroves (guided by Giri map)
  - Overlay Giri's map
  - Manually delineate where simple
  - eCognition process where complex
    - (ultimately eCognition everywhere to align with forest/non-forest map)
  - Assess accuracy based on ground truth
- Use knowledge to generate a baseline before ALOS-2 launch.
  - Avoids overlap with ALOS-2 processing
  - Consider Taku's time!



- **Structural classification**
  - Within the mapped area
  - Use SRTM to get height (ICESAT adjusted)
    - M.Simard/L. Fatoyinbo
  - Evaluate Tandem X
    - F. Krugler
  - With ALOS,
    - Structure
      - Low mangroves (i.e., height).
      - High mangroves (no root systems)
      - High mangroves (root systems)
    - Biomass
- **Change**
  - Area losses and gains
  - Biomass (carbon) gained and lost
  - Feeds directly into IPCC.

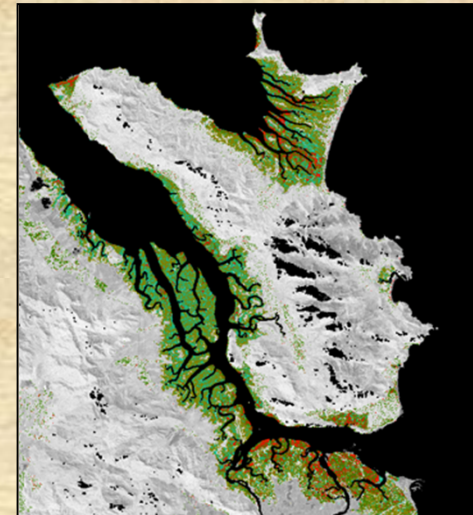


Low biomass mangroves
High biomass mangroves
High biomass mangroves with prop root systems
Non-mangrove

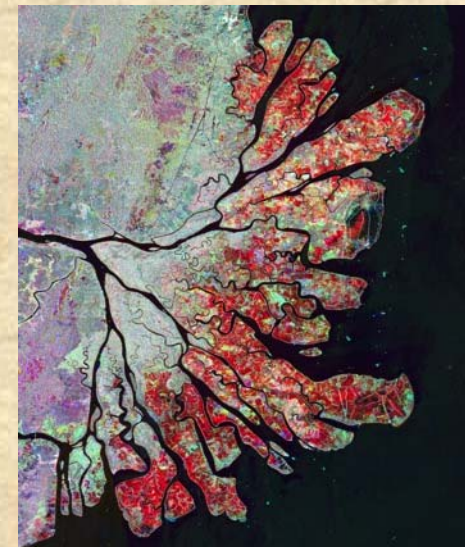




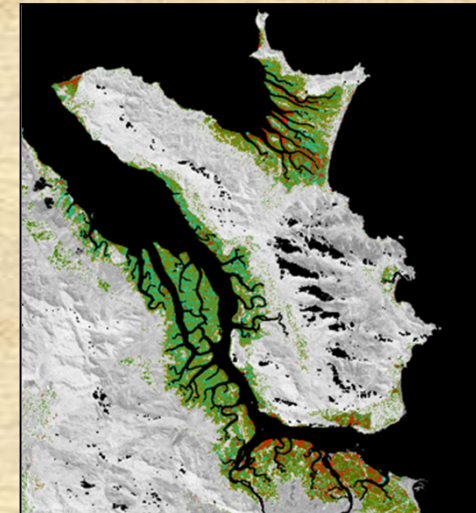
- Processing in eCognition (or manual delineation)
- Developed open source software
  - Python
  - RSGISLib
- Capability
  - Defines the potential area of mangrove
  - Reference to Giri's map
  - Takes, for each tile, the statistics of the mangrove
    - Segmentation
    - Slope, altitude, canopy height, distance from coast (statistics)
    - Applies back to tile(s)
    - Used to map potential areas
    - Mask potential area to confine analysis
  - In development:
    - Produce the full classification as in eCognition.
    - Becomes an open source mangrove monitoring system



Low biomass mangroves
High biomass mangroves
High biomass mangroves with prop root systems
Non-mangrove



- **Preparation ALOS-2**
  - Generate the baseline map of mangroves for 2010.
  - Establish the protocol/methods for:
    - Detecting change
      - Comparison of 2010 baseline with ALOS 2 map.
    - Revise baseline
    - Calculate carbon emissions.
    - Calculate accuracy
      - Based on data acquired at same time as ALOS-2.
    - Development of web-based system for delivery of change/carbon maps.
- **Other steps**
  - Publish the following papers
    - Requirements for an L-band GMW (Marine and Freshwater Research)
    - K&C Position paper on mangroves (Environmental Science and Policy)
    - Method for change detection (WEM)
    - Nature paper
  - Develop the K&C page with results as they happen
- **Coordinated approach with funding**
  - Put in a proposal for a GMW communications and meetings (linked to Ramsar)
  - Use the GMW as a demonstration for Ramsar Global Wetlands Observing System
  - Coordinate links with other initiatives (e.g., MEASURES).



Low biomass mangroves
High biomass mangroves
High biomass mangroves with prop root systems
Non-mangrove

