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K&C Phase 4 – Status report

Richard Lucas and Emma Asbridge (Univ. New South Wales)

Ake Rosenqvist and Nobuyoshi Fujimoto (JAXA)

Nathan Thomas and Pete Bunting (Aberystwyth Univ.)

Takuya Itoh (RESTEC)

Lammert Hilarides (Wetlands International)

Chris McOwen (UNEP-WCMC)

Lisa Maria Rebelo (IWMI)

JAXA

PRIFYSGOL ABERYSTWYTH UNIVERSITY

UNSW AUSTRALIA

soloEO

SarVision

Wetlands INTERNATIONAL

Global Mangrove Watch

A pilot project for the Ramsar Global Wetlands Observation System (GWOS)

Project outline and objectives

- To develop the GMW such that it operationally integrates data from the ALOS-2 PALSAR-2 for near real time monitoring of mangroves across their range.
  - Such monitoring would be undertaken within a specifically developed web-based system (available through Wetlands International and the UNEP World Conservation Monitoring Centre (UNEP-WCMC)) that ingests data from the ALOS-2 PALSAR-2 data and compares the extent of mangroves against baselines revised using the JERS-1 SAR and ALOS PALSAR data.
- The mapping seeks to identify areas of mangrove colonisation (e.g., as a consequence of redistribution of sediments or regrowth following prior clearance) and loss (e.g., through storm damage, changes to hydrology, acid sulphate soils and/or deforestation).

Specifics

- Overall: Mapping of **extent and changes** in **global mangrove** areas using satellite radar at 25m spatial resolution
- Generation of an updated **baseline map** of the global mangrove extent for the year 2010, at a spatial resolution of 25 m.
- Generation of **maps of annual changes (2015 onwards)** in the global mangrove areas using ALOS-2 backdated using ALOS and JERS-1 SAR

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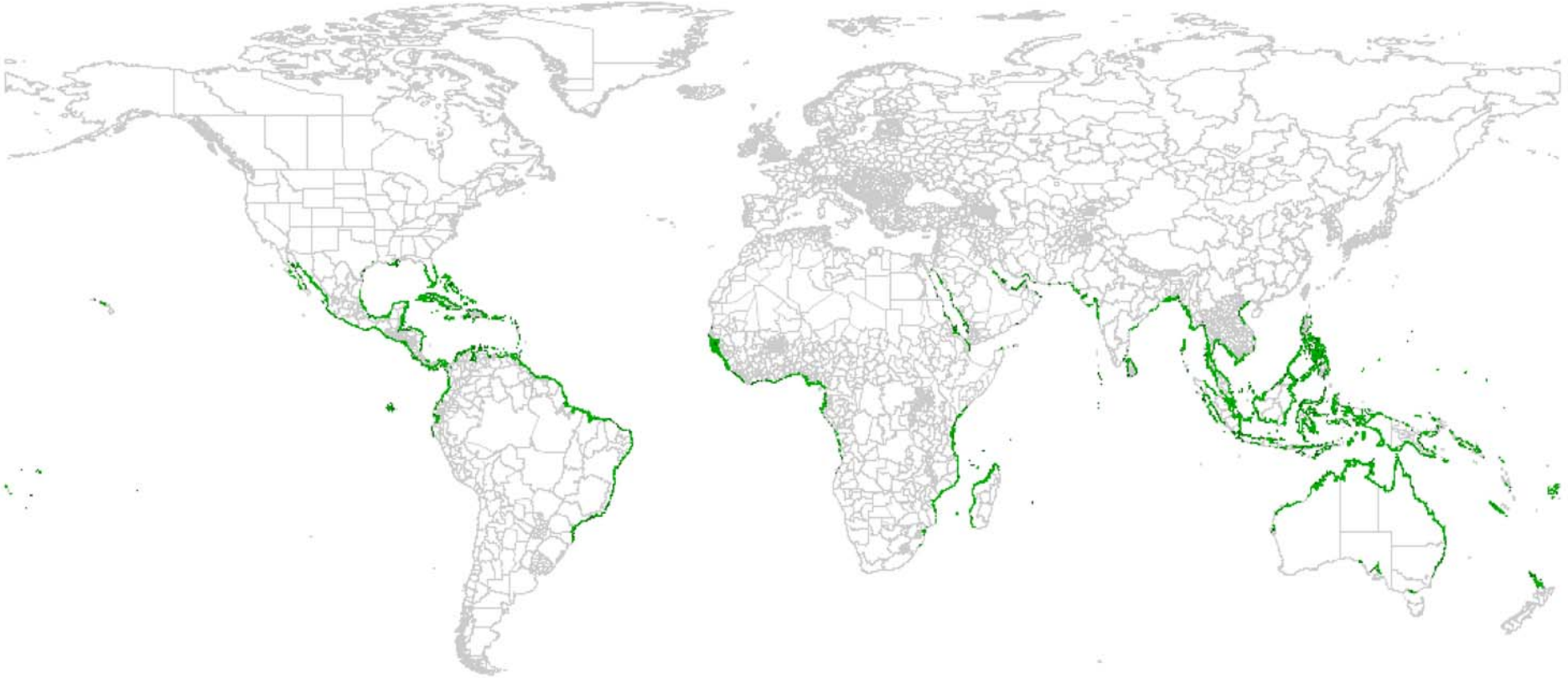
Project Area and Addressing the 3 Cs



International **C**onventions and Environmental **C**onservation)

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Relevance to Policy

- A tool for Ramsar Contracting Parties, NGO's and the public, providing geospatial (map) information at 25m resolution about mangrove extents and changes at national to global scales
- GMW selected (@STRP-17) as a Pilot Project to the Ramsar Global Wetlands Observation System (GWOS)

Existing Baselines

- **USGS** (Giri, 2000): First global baseline - derived from Landsat (optical) satellite data. Baseline now 15 years old (1998-2000).
- **World Atlas of Mangro**ves (Spalding 2010): Compiled from different data sets. Inconsistent across countries
- **World Forest Watch**: does not distinguish mangrove from other types of forest

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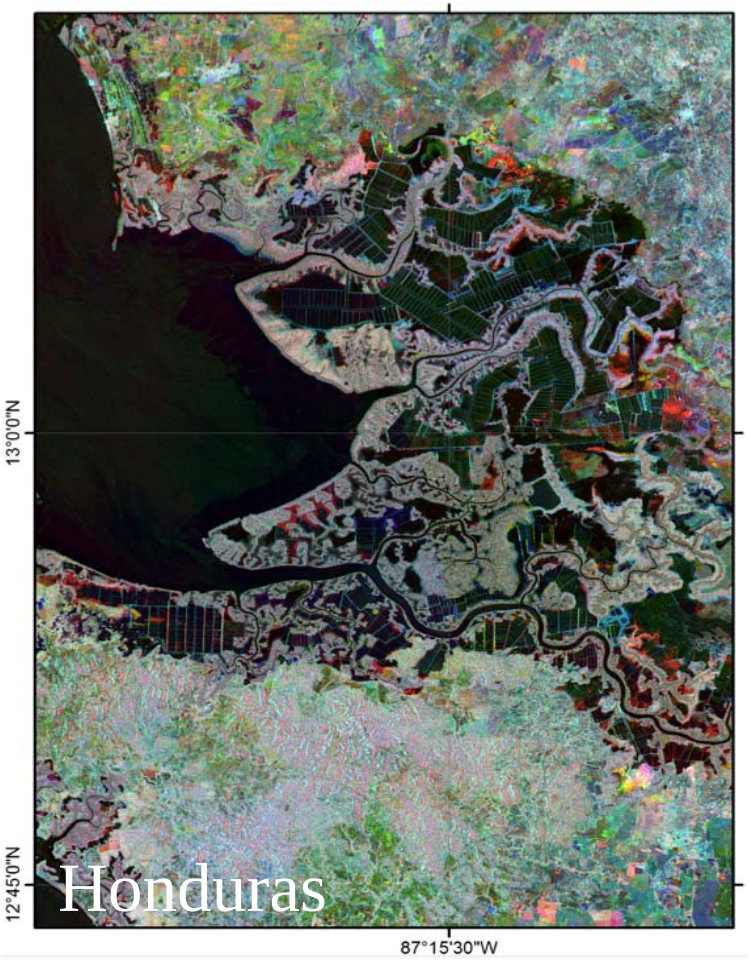
GMW Map Generation Process

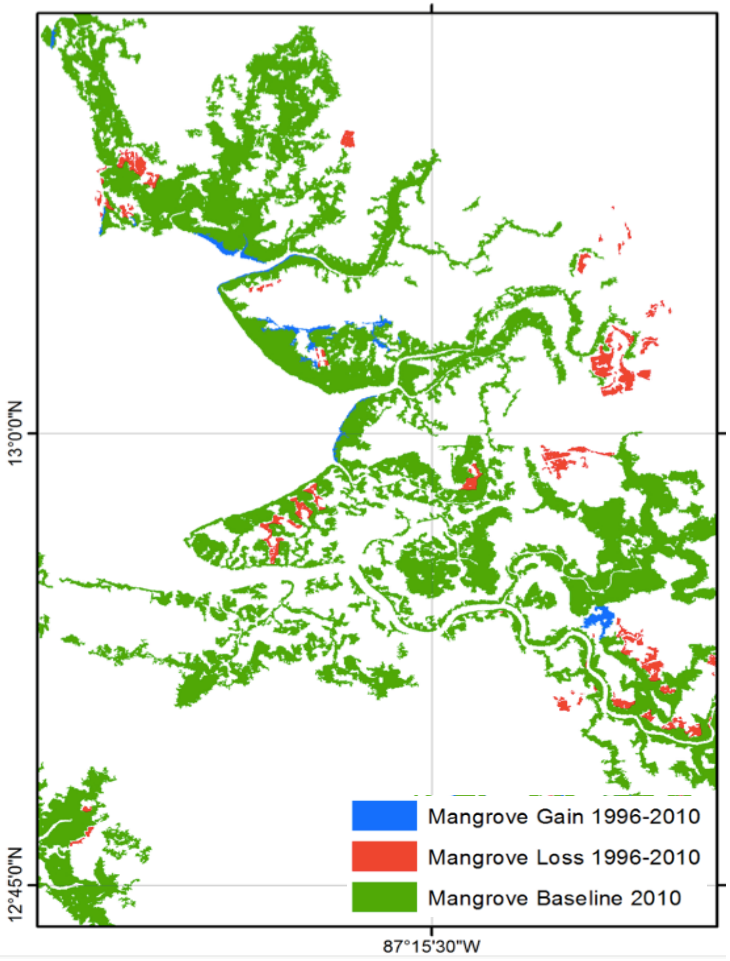
Input: Radar image(s):
Date X *or* Date X & Date Y



Thematic validation/training

Classification

Output: Mangrove map:
Extent (X) *or* Extent (X) & Changes (X-Y)



Challenge – many different types of changes

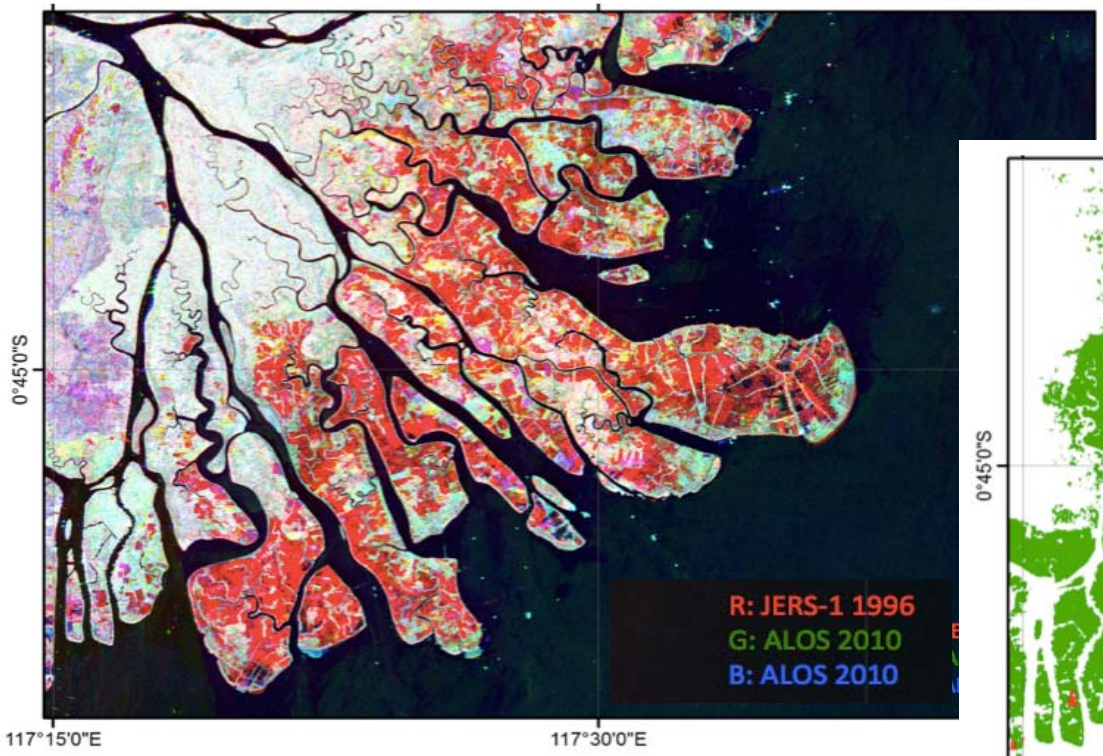
Losses

- Aquaculture
- Oil and gas exploration
- Urbanisation and infrastructure
- Logging for firewood and other uses
- Degradation

Gains

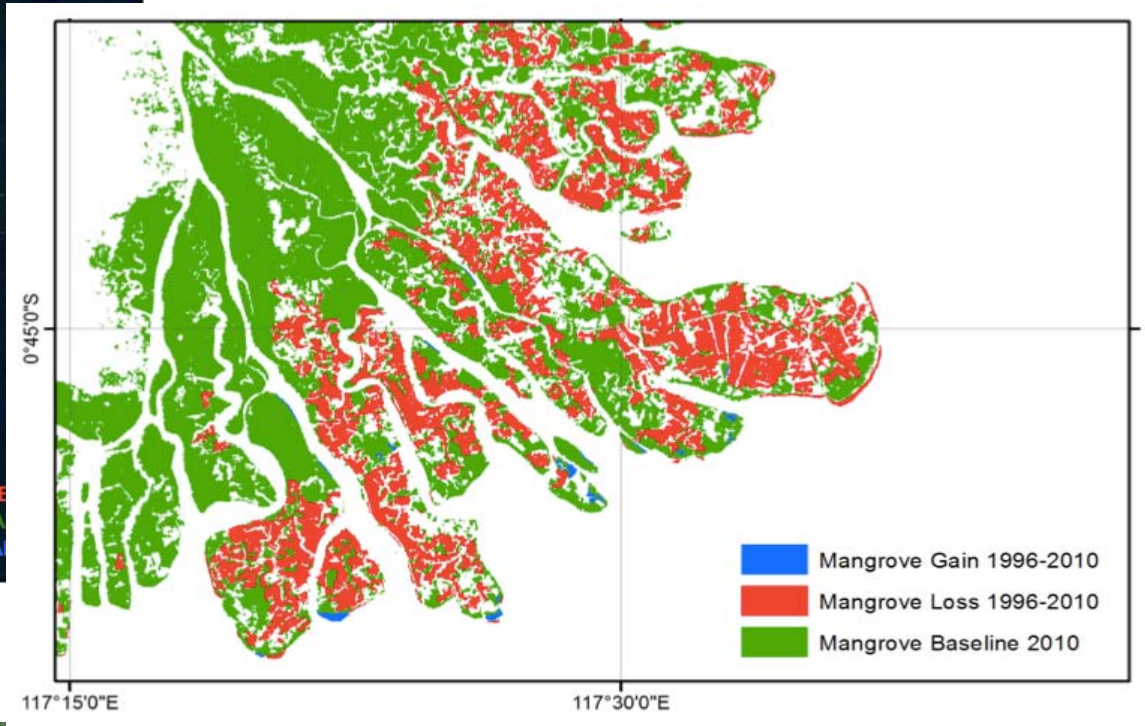
- Natural migration
- Seaward expansion (natural / anthropogenic)
- Inland expansion (e.g. due to sea level rise and flooding)
- Large-scale restoration projects

Results: Anthropogenic changes: Aquaculture and infrastructure



Input: Multi-temporal radar image tiles

Mahakam delta, East Kalimantan



Output: Mangrove extent and change ma

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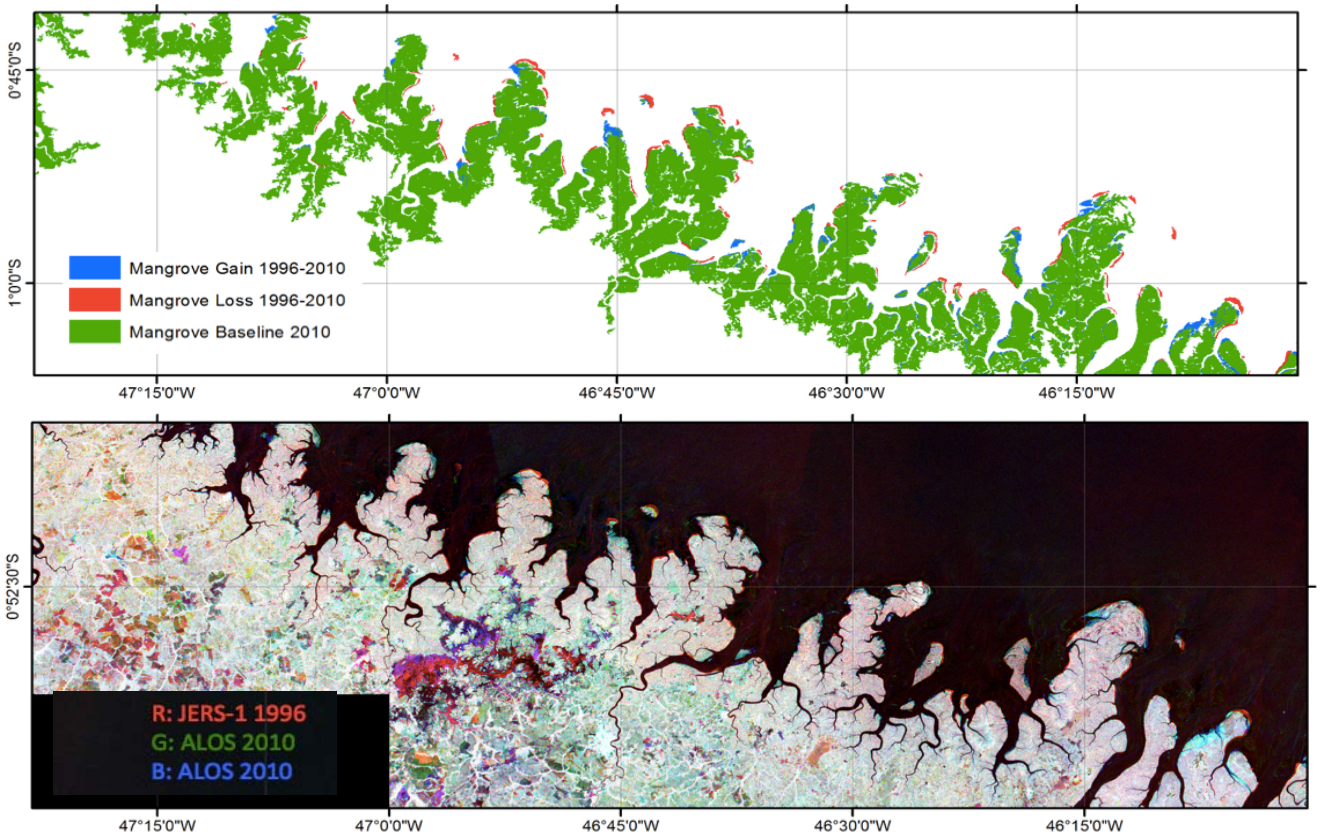
Natural processes: Gains and losses through erosion and sedimentation transport



Bragantina Zone, Brazil

Global Mangrove Watch

Bragantina, Brazil

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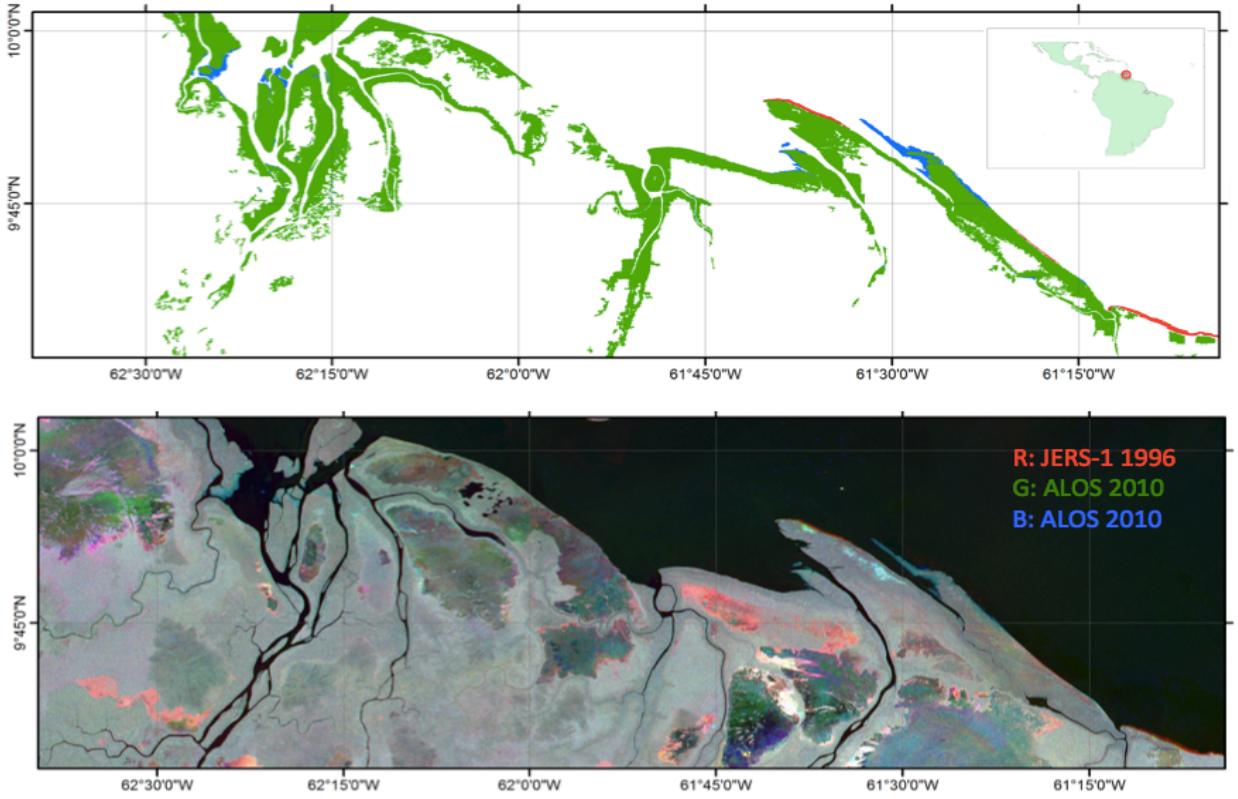
Natural processes: Gains and losses through erosion and sedimentation transport

Gulf of Paria, Venezuela



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Bragantina, Brazil

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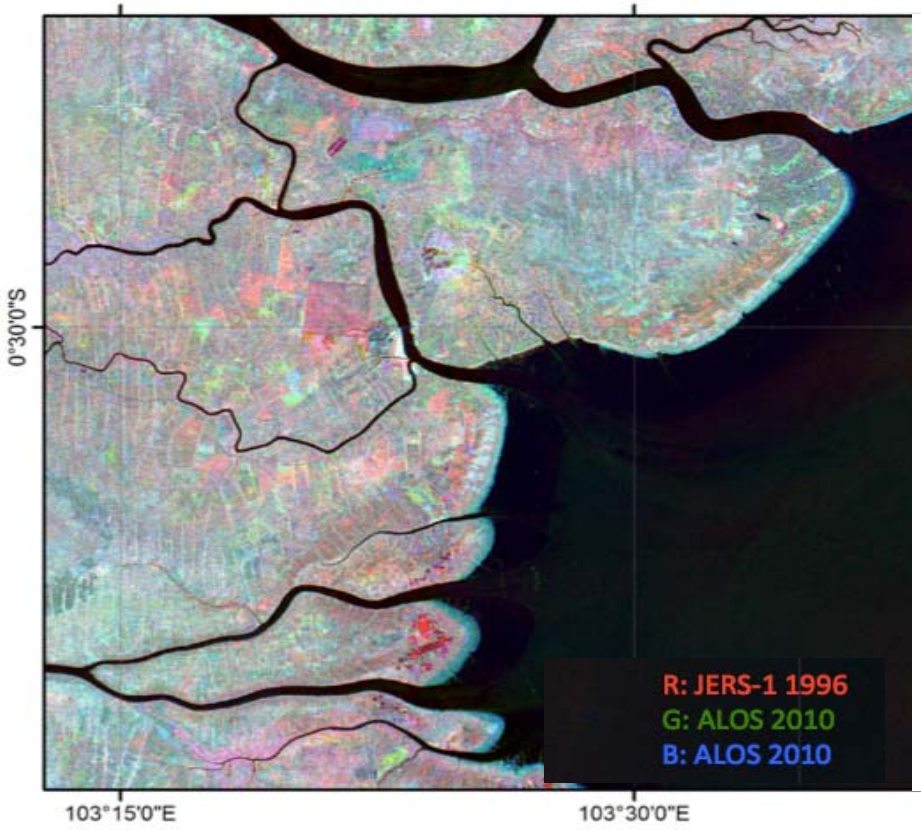
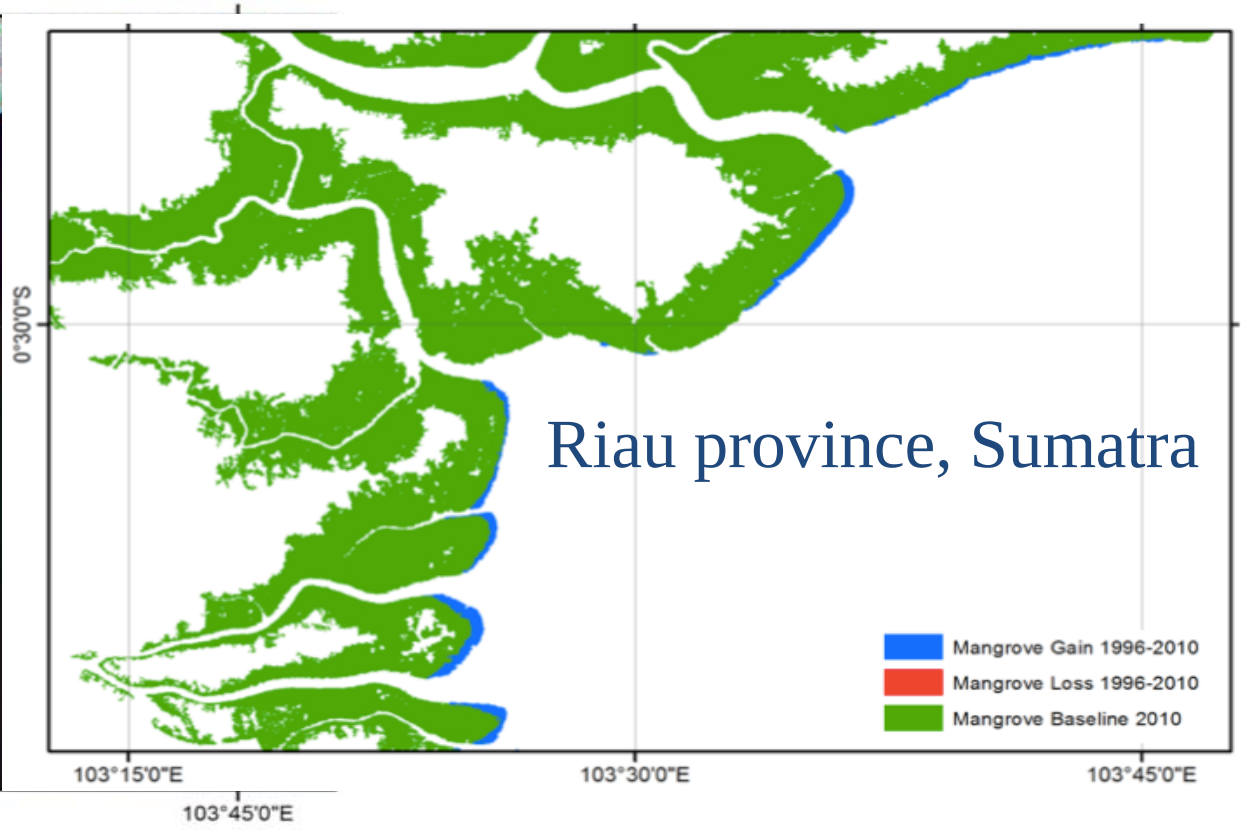
Human-induced gains in mangrove extents: Upstream deforestation causing increased sedimentation





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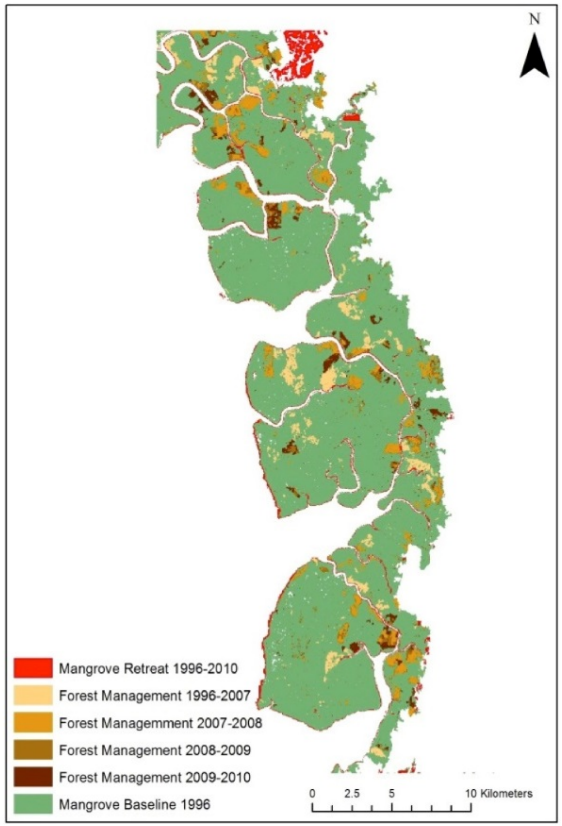
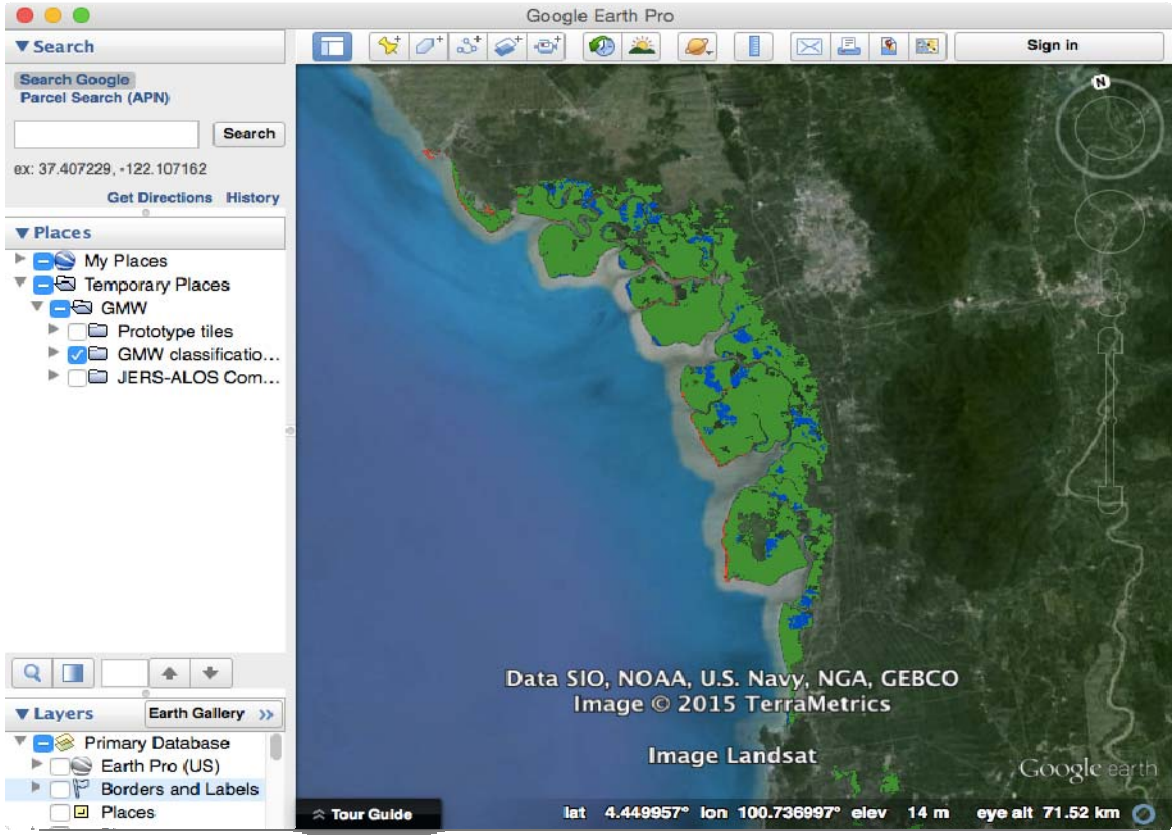
GMW product output formats

Maps (GEOTIF)



KML for visualisation in Google Earth



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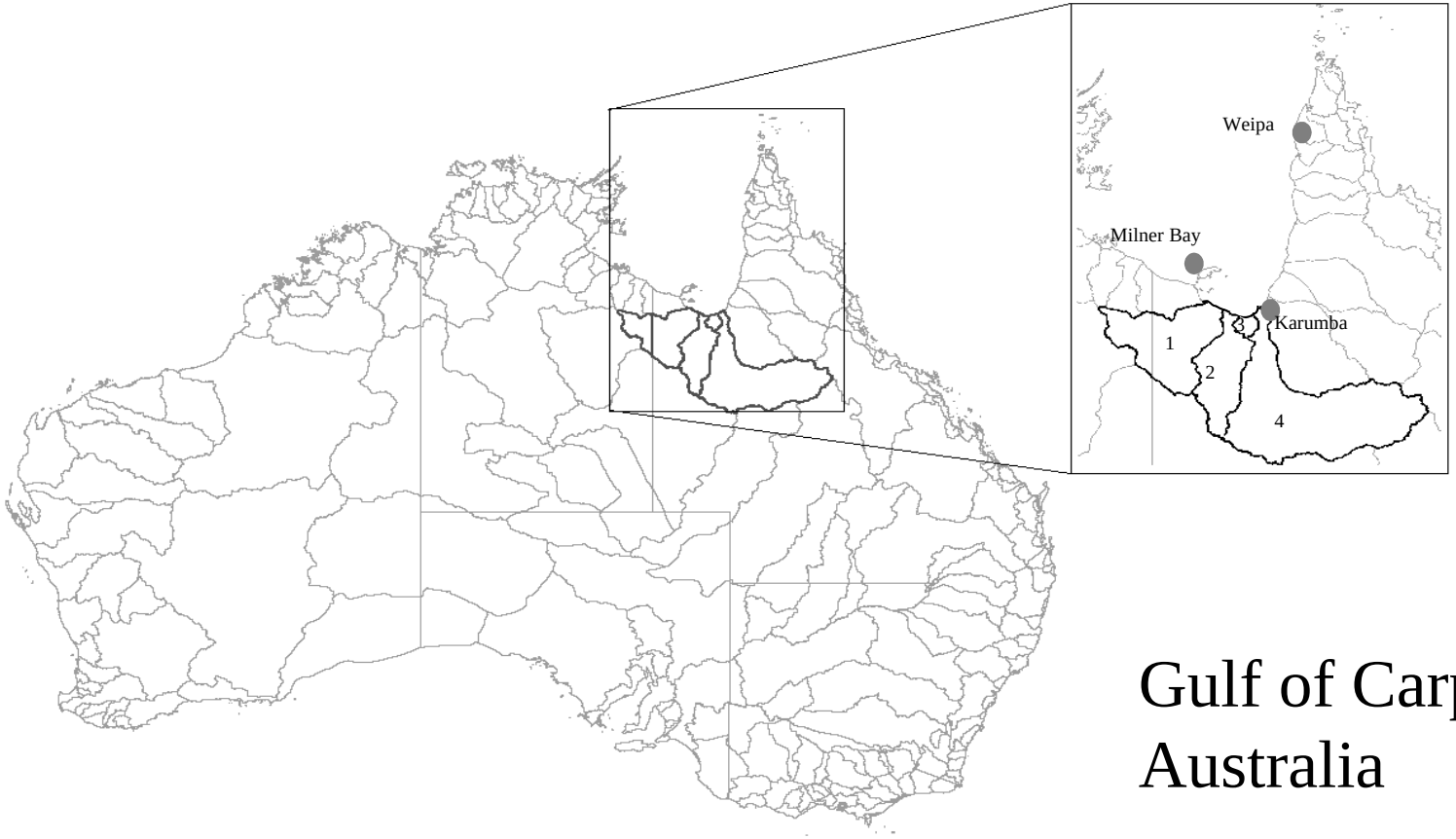
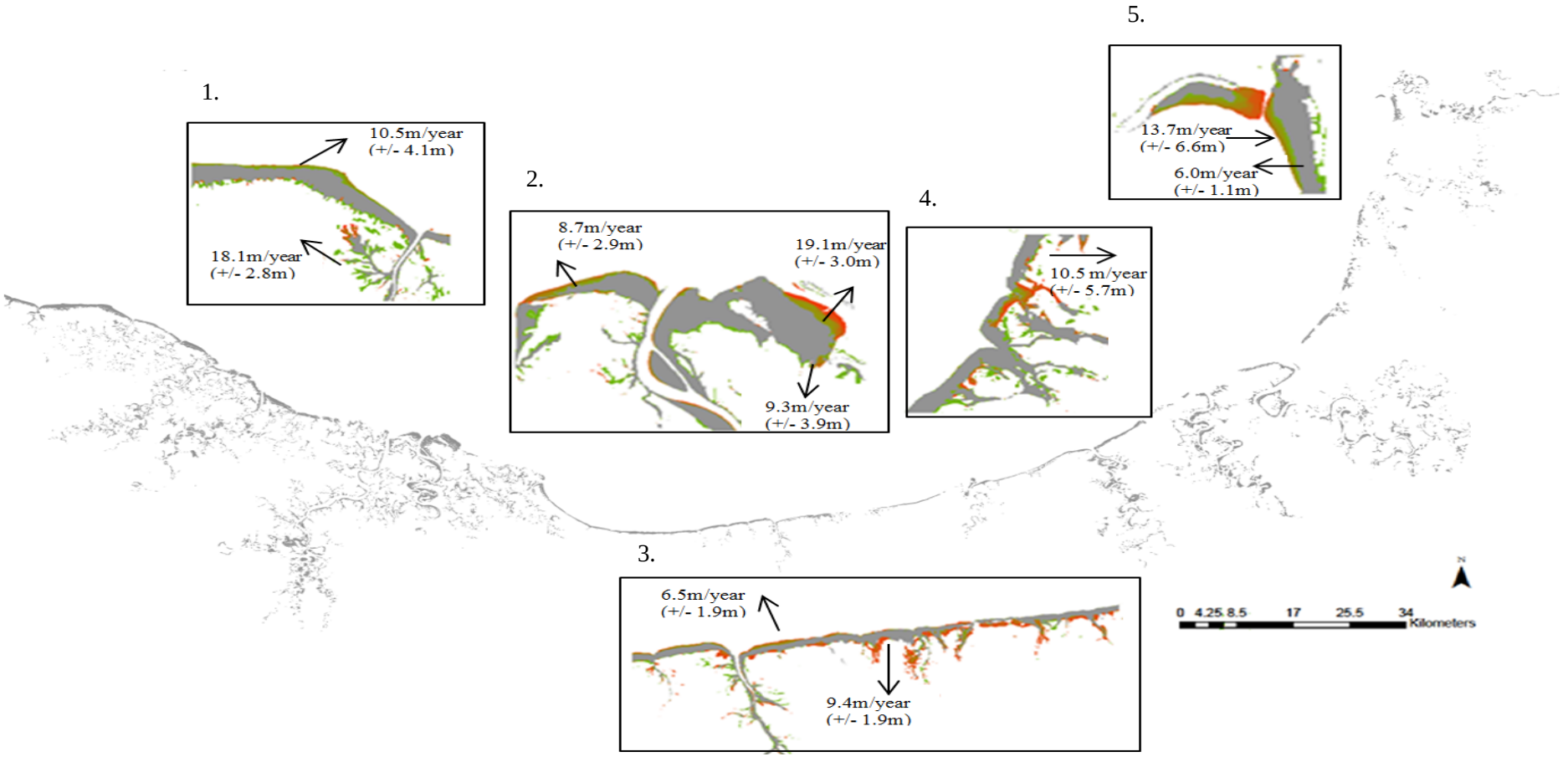
Development of Ground Truth Datasets



Gulf of Carpentaria
Australia

The Leichardt, Nicholson, Morning Inlet and Flinders River catchments entering the Gulf of Carpentaria. Sea level monitoring stations are indicated by grey circles.

Detection of Change: Dense Time-Series of Landsat Sensor Data



Hotspots indicating change in mangrove distribution over time (green to red) along a section of the Gulf of Carpentaria. The average rate of movement is quantified and the arrows indicate the direction. The grey layer indicates the mangrove extent in 1987.

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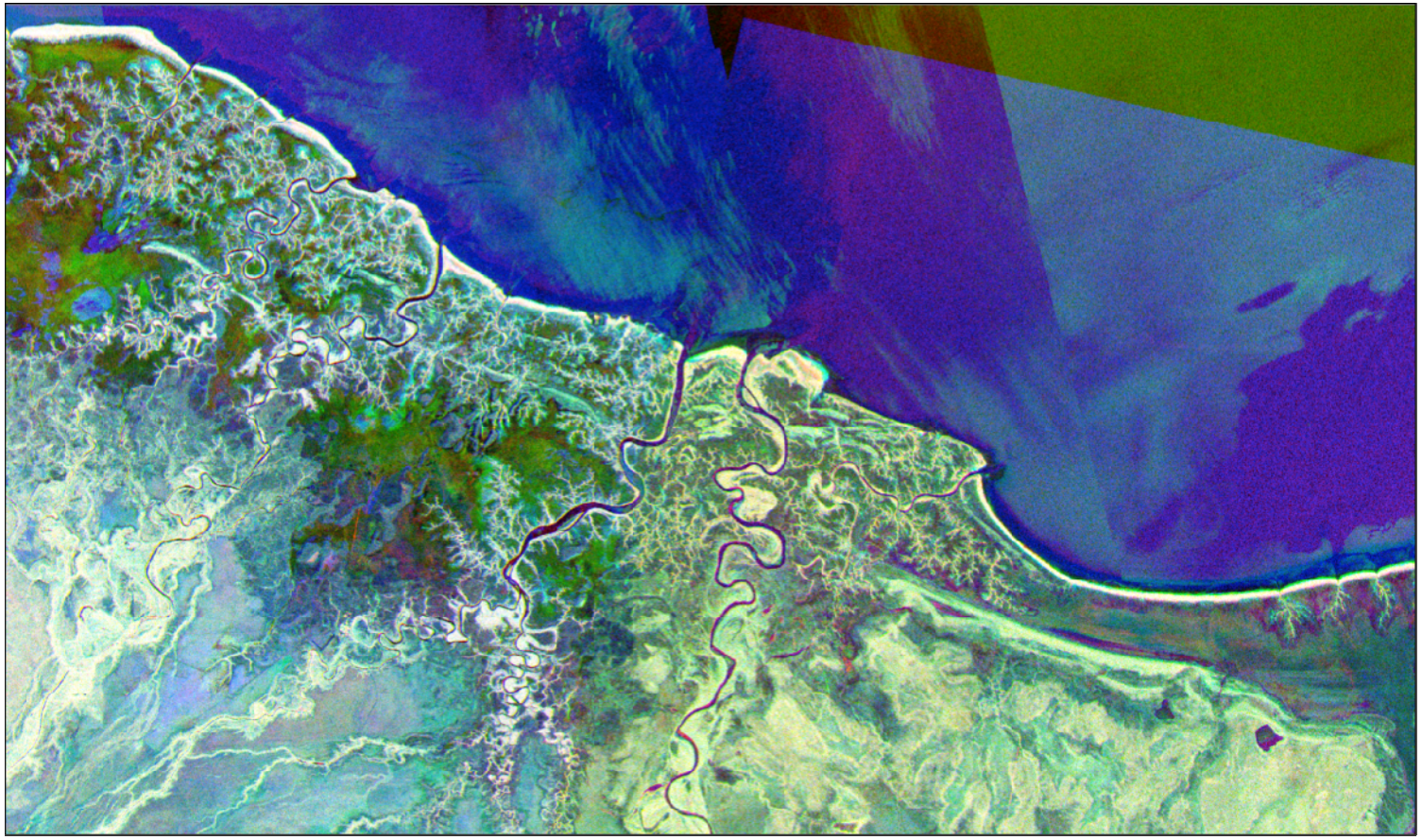
Detection of Change: Dense Time-Series of Landsat Sensor Data

R: JERS-1
1996
G: ALOS 2010
B: ALOS-2
2014



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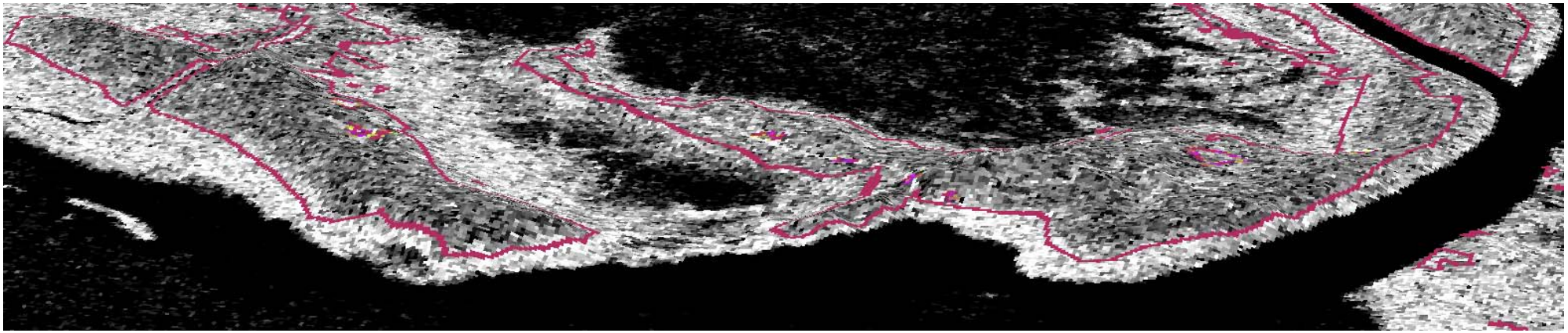

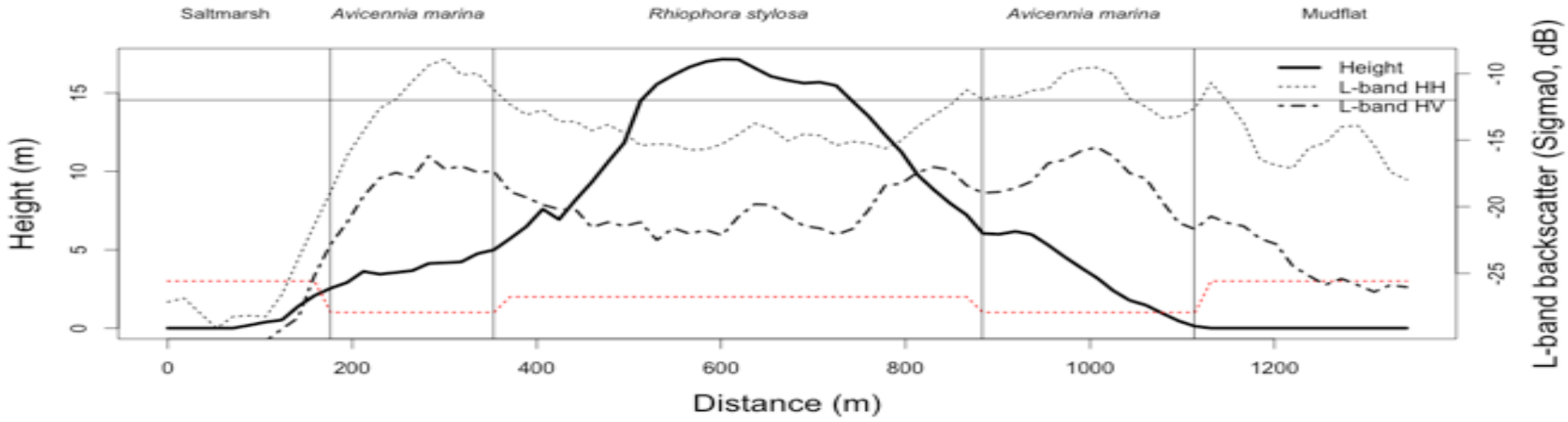

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The reduction in L-band HH backscatter in areas of tall mangrove dominated by *R. stylosa* and *C. tagal*.

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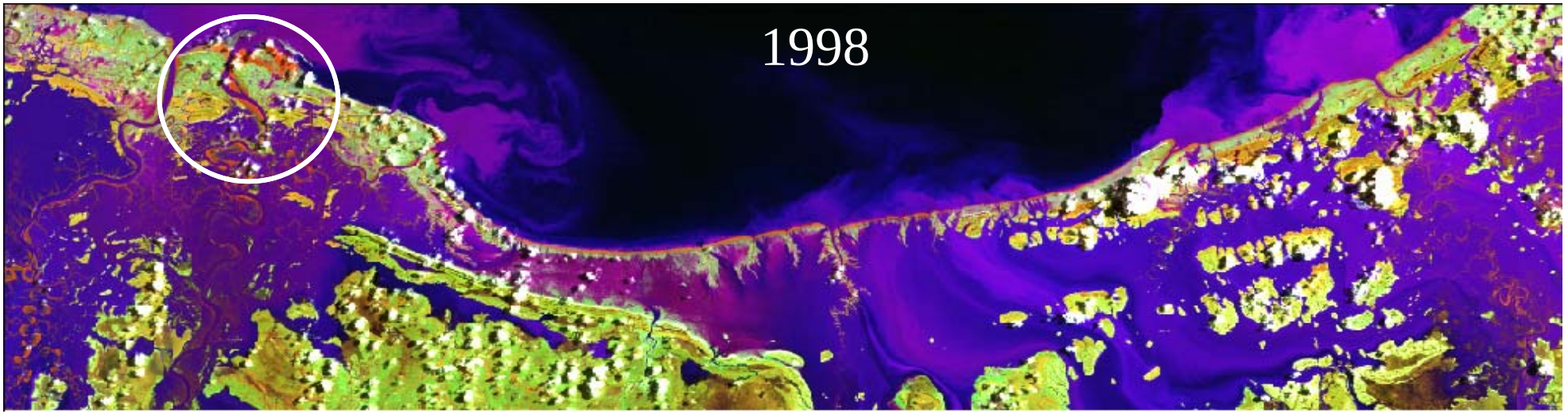

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Observations of the southern Gulf using Landsat sensor data

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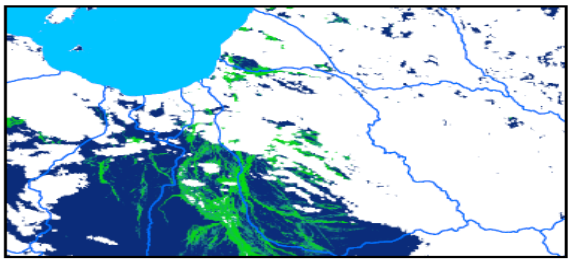
Reasons for Change: Extreme Flood Events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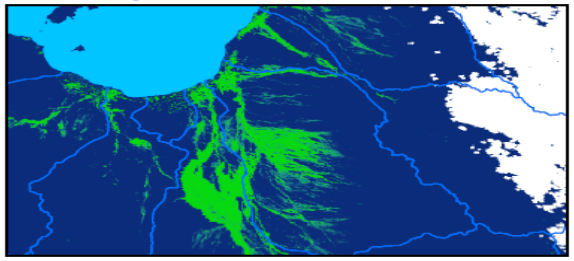
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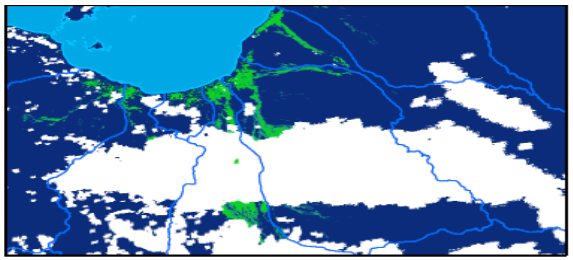
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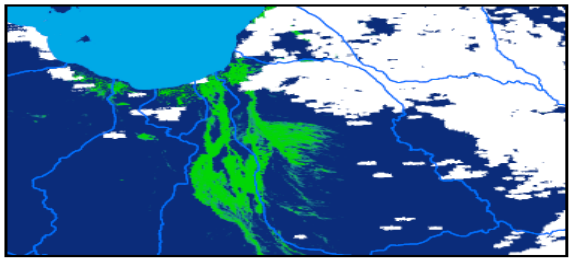
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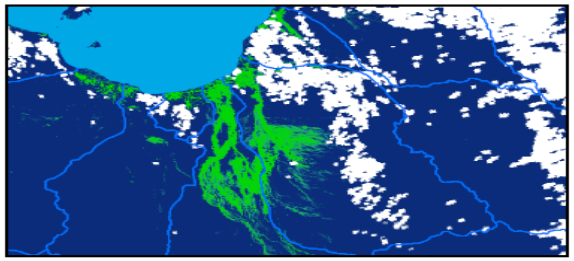
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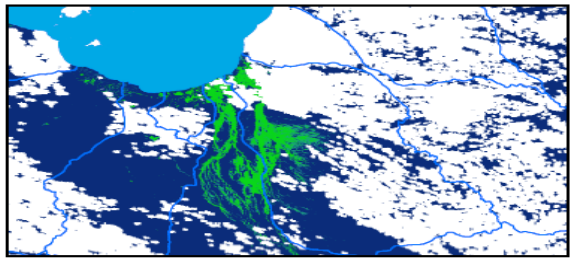
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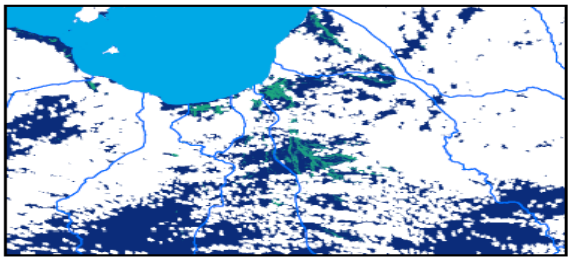
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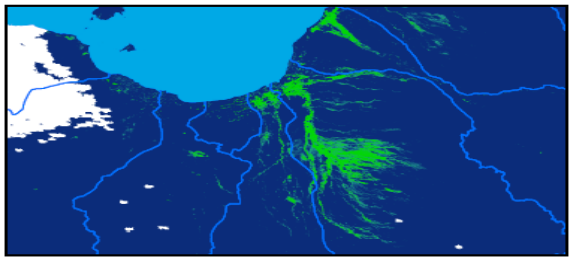
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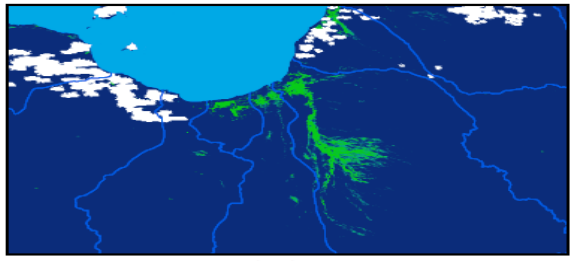
03/03/2009

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MODIS flow sequences of inundation and recession following the 2009 major flood event Along the Flinders River.

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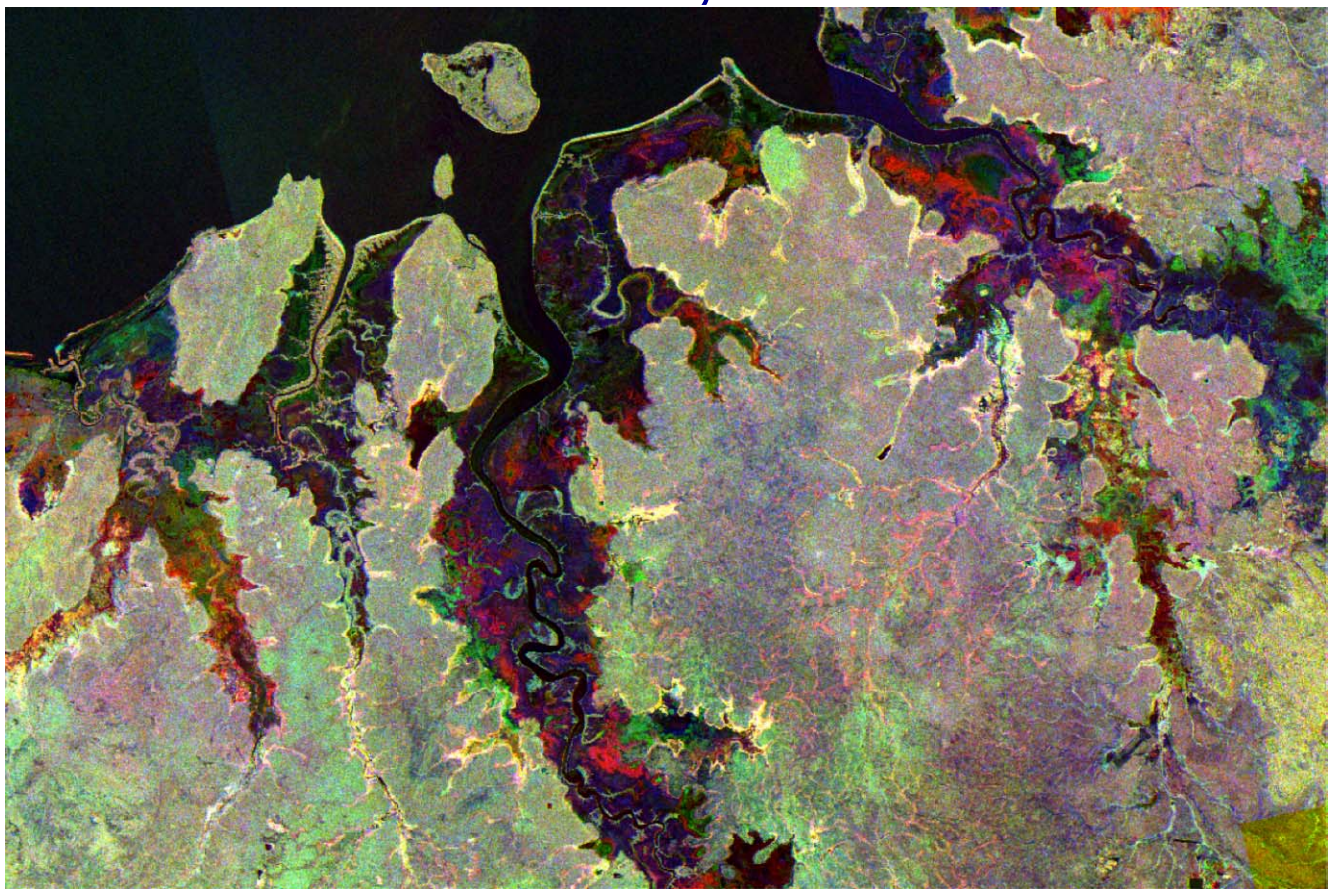
JERS-1 SAR, ALOS-1 and ALOS-2 Composite, Kakadu National Park, Northern Australia



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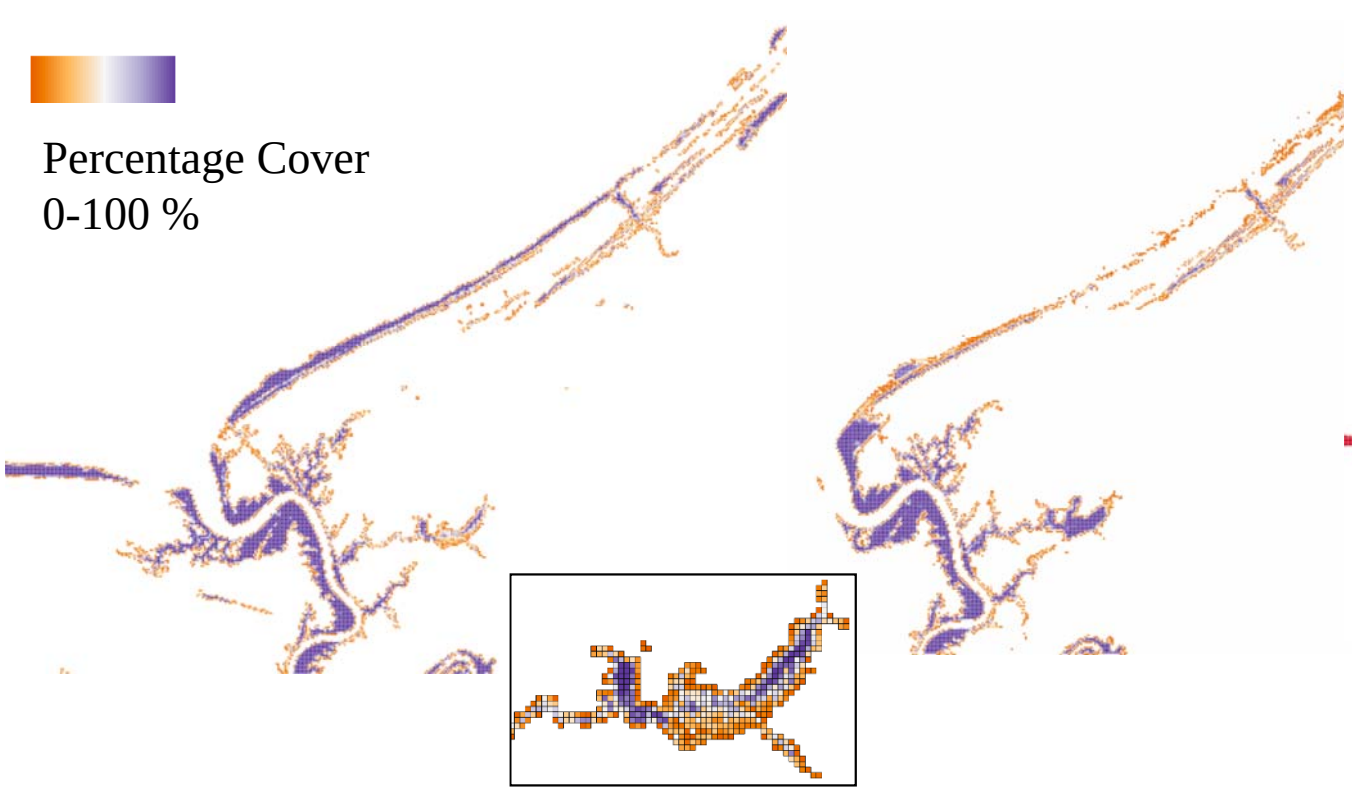
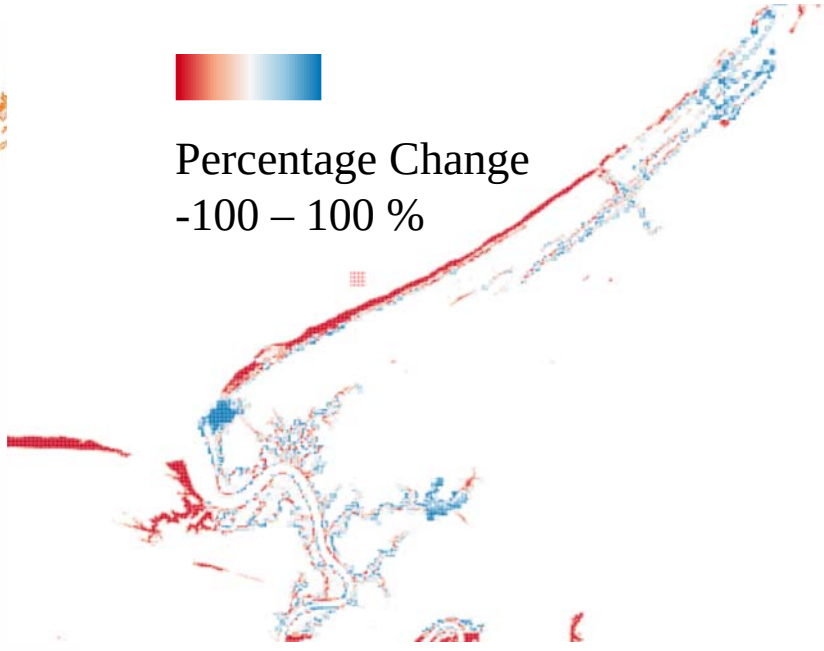
Changes in Mangrove Extent, Wildman River, Kakadu National Park, Northern Australia

Percentage Cover
0-100 %



25 m cells

Percentage Change
-100 – 100 %



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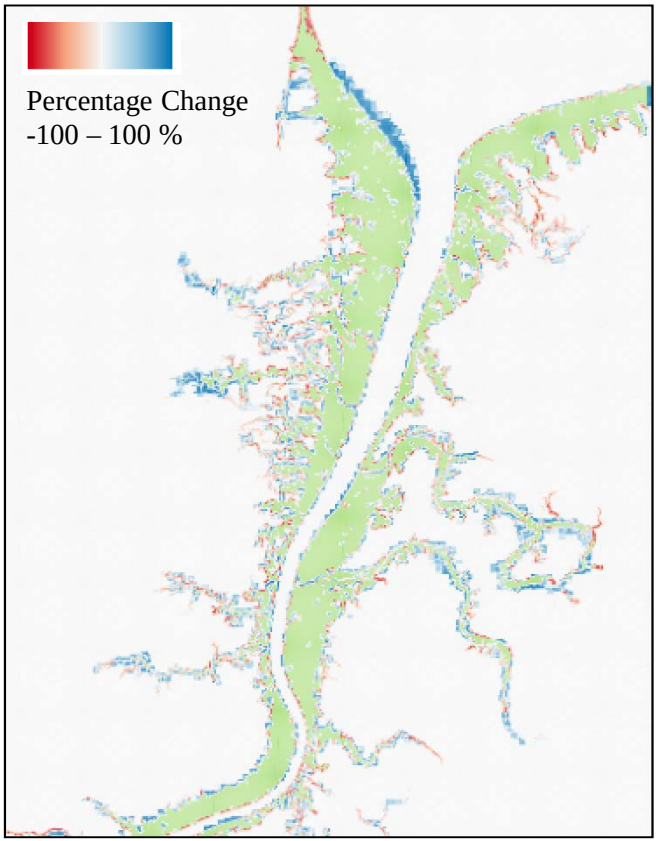
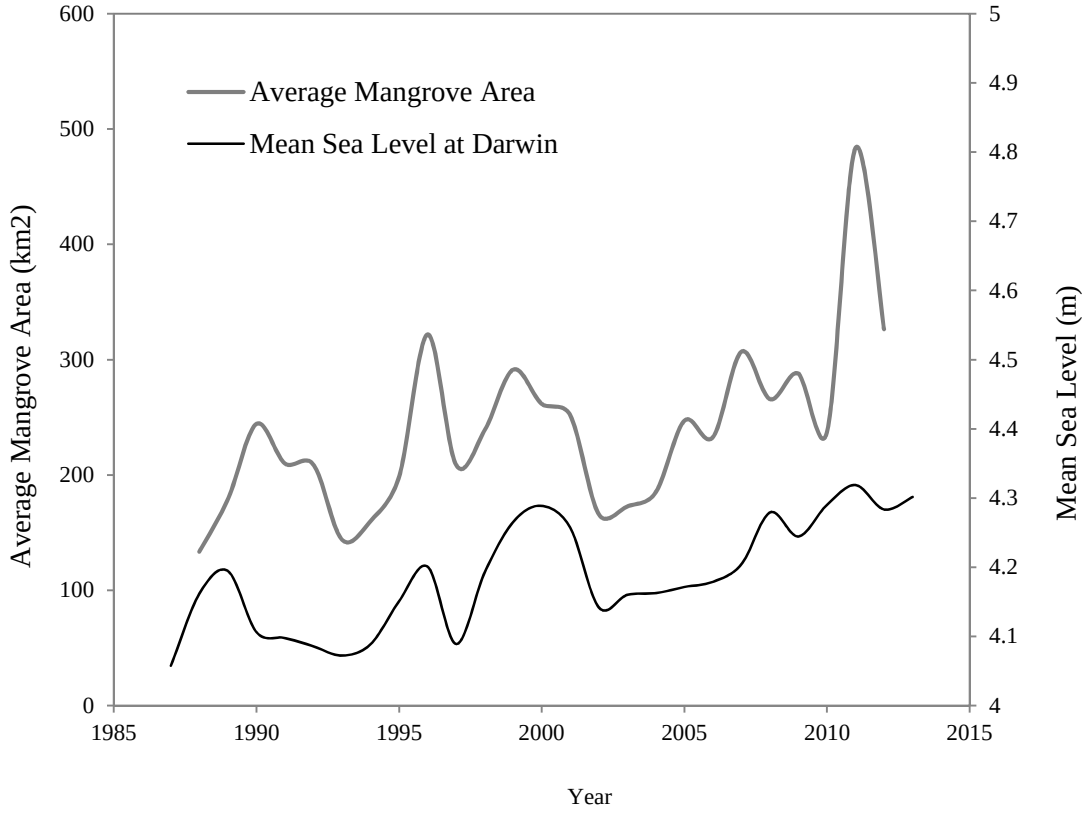
Changes in Mangrove Extent, West Alligator River, Kakadu National Park, Northern Australia





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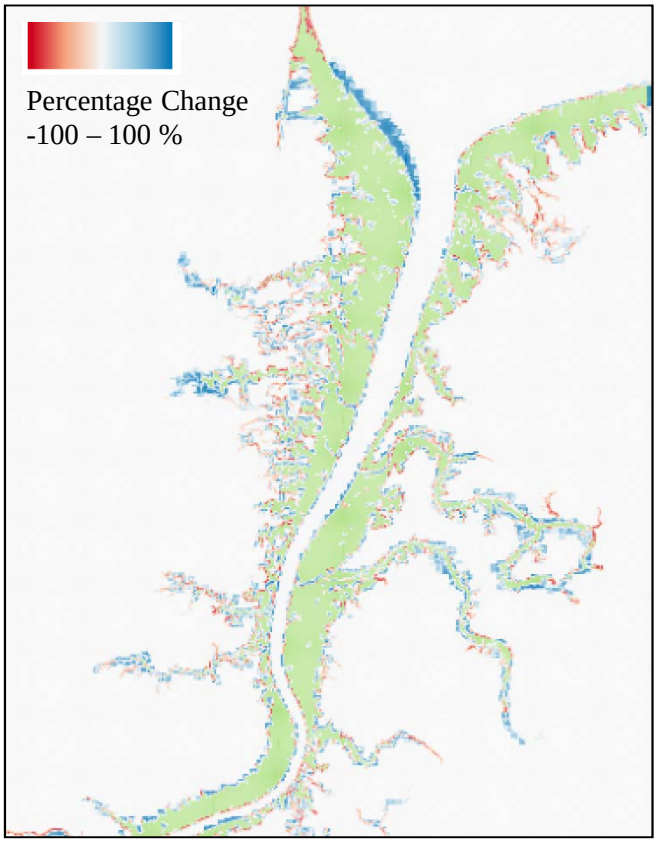
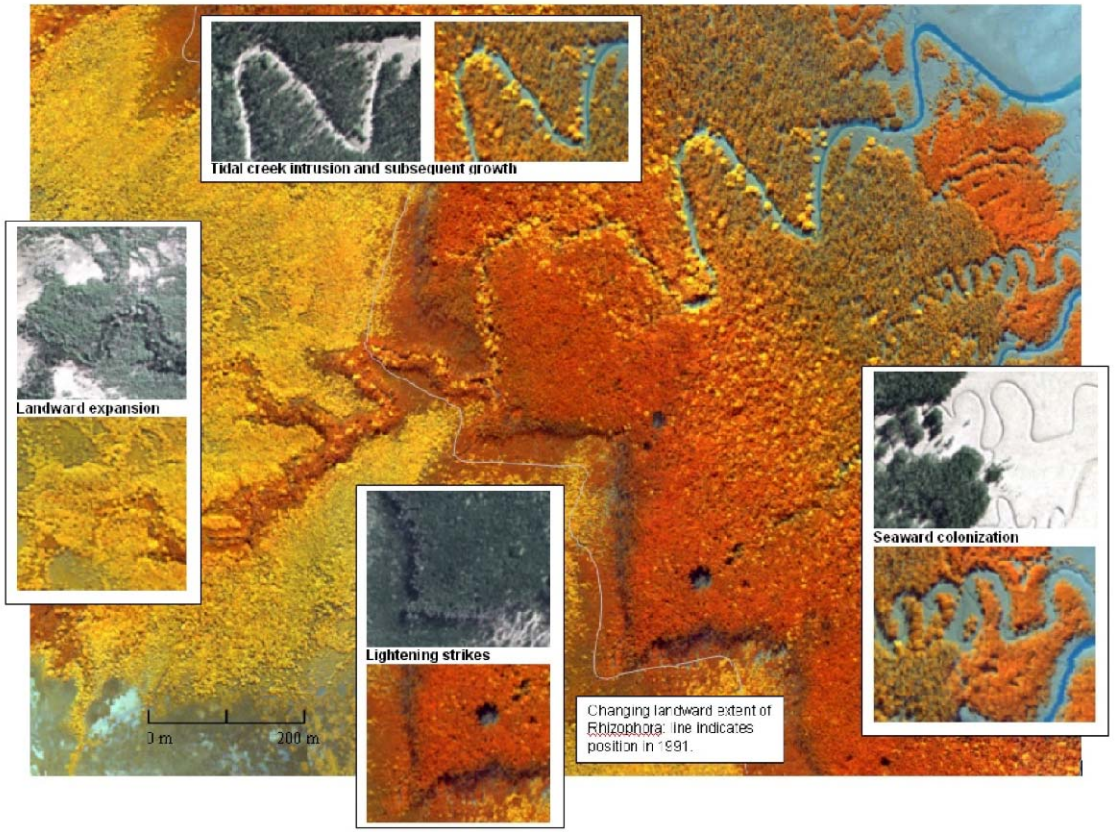
Changes in Mangrove Extent, West Alligator River, Kakadu National Park, Northern Australia





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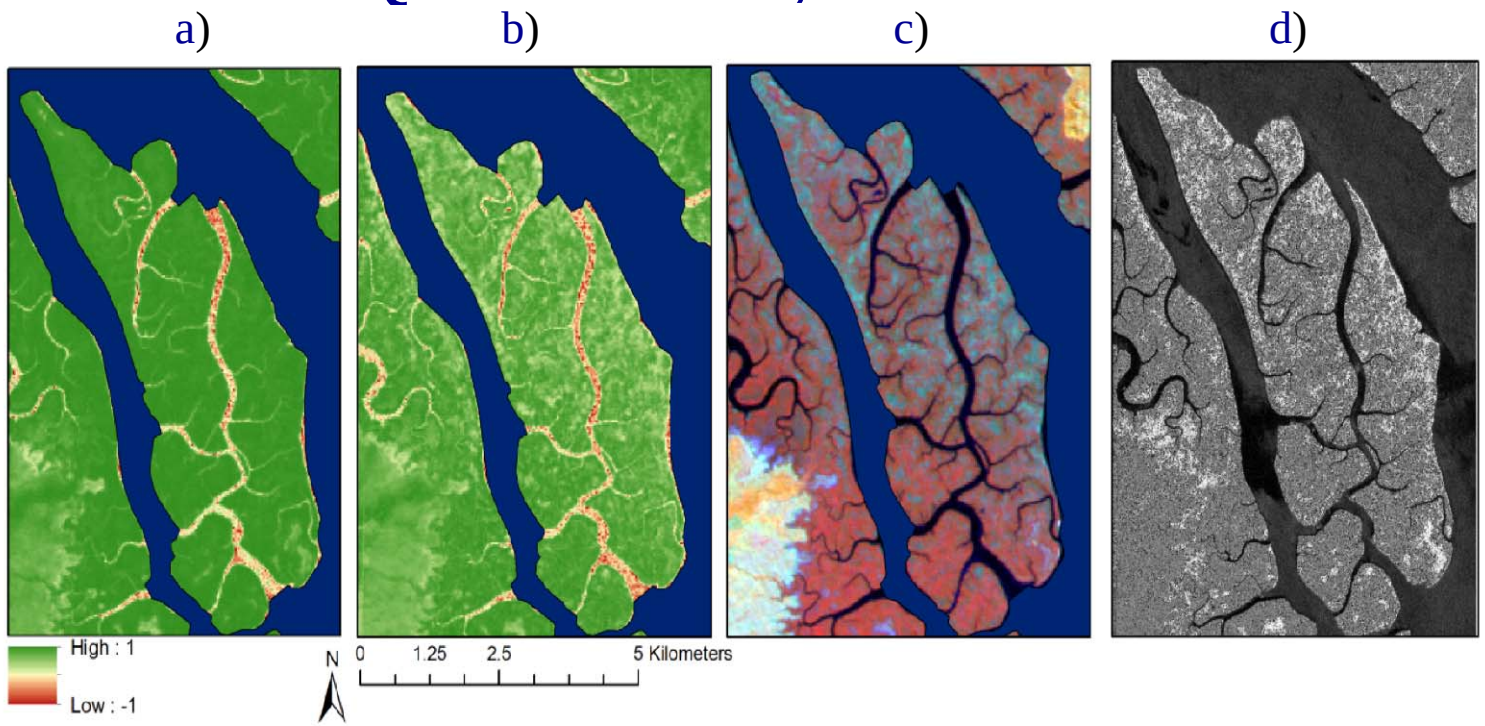
Cyclone Damage, Hinchinbrook Island, Queensland, Australia



Time-series comparison of Landsat-derived Normalised Difference Vegetation Index (NDVI) from 2010 (a; pre-cyclone) and 2011 (b; post cyclone) revealed a loss of foliage cover, with the destruction also evident in the colour composite of Landsat sensor data for 2011 (c; NIR, SWIR and Red in RGB). The area affected was also evident in aerial photography. Using ALOS-2 Ultra Fine Beam data (d), the loss of mangroves following Cyclone Yasi in 2010 was detected (high HH backscatter (white) associated with fallen trees) and was associated with higher biomass areas (typically dominated by Rhizophora species)

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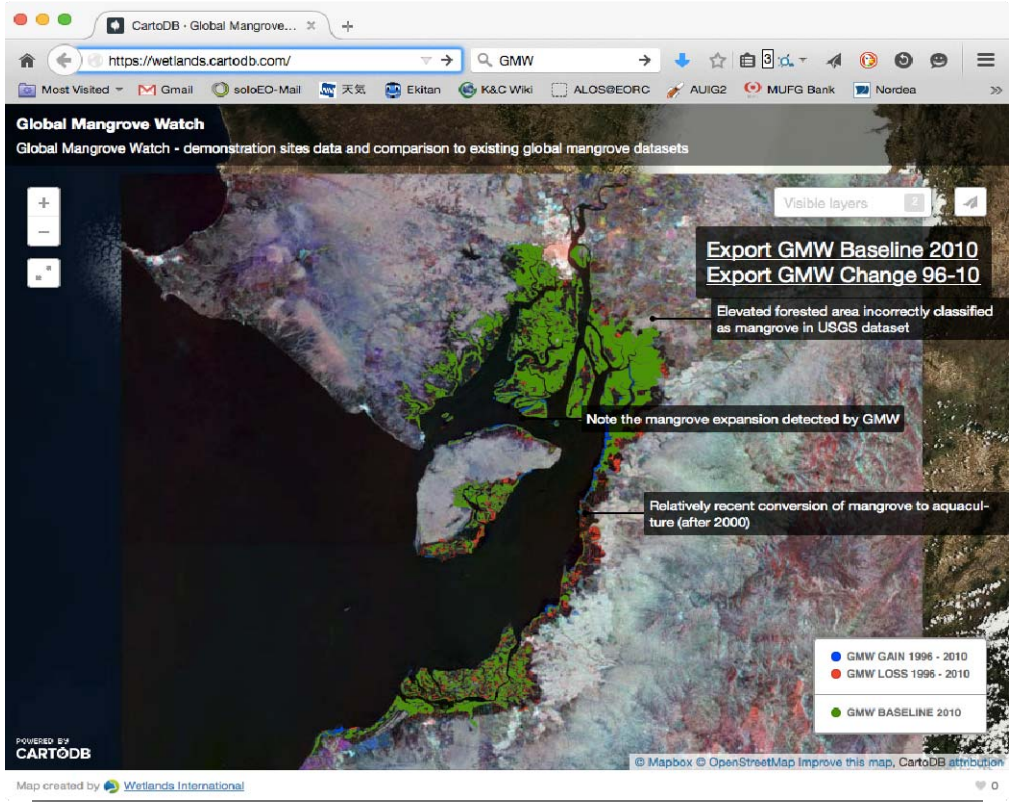
GMW product output formats

GIS interface under development by WI for analysis, import and export of data and results



Transparency and open data

All satellite data, classification algorithms and software and mangrove maps utilised in GMW are open and free of charge.

- Mangrove maps
- 25m satellite radar image tiles
- Classification software (open source: RSGISLib.org)
- Classification algorithm specifications
- GIS interface

Users are able to use the maps “as generated by GMW”, or access the original satellite data, classification software and rule settings to replicate, validate, or improve the mangrove classifications.

Implementation schedule and Milestones

- Development of methods for change classification over 16 Prototype Areas with *in situ* data – 2014/2015
- Finalisation of change classification algorithms – Oct. 2015
- Development of ground truth datasets – May 2016
- Download of global mosaic tiles covering mangroves (~1500 per year for 1996/2007, 2010, 2015) – Oct 2015-Mar 2016
- Implementation of extent and change detection algorithms at regional and global scales – 2016/Q1-Q2
  - Generation of 2010 global baseline map –2016/Q2
  - Generation of 2010-2015 change maps – 2016/Q3
  - Generation of 1996-2010 (alt 2007-2010) change maps – 2016/Q4
- Development of GMW www interface – 2016/Q3-Q4
- Integration into Ramsar GWOS – 2016 (TBC)

Deliverables etc.

- Based on data and map products
  - Up-to-date maps of mangrove extent generated through time-series comparison of JERS-1 SAR, ALOS PALSAR and ALOS-2 PALSAR-2 data delivered through a web-based system.
  - Available ground truth data for validating the GMW products.

"GMW Coalition" Partners:

- Japan Aerospace Exploration Agency – JAXA (Japan)
- University of New South Wales (Australia)
- Aberystwyth University (Wales/U.K.)
- Wetlands International (NL)
- UNEP-WCMC (U.K.)
- SarVision (NL)

JAXA GMW homepage:
http://www.eorc.jaxa.jp/ALOS/en/kyoto/mangrovewatch.htm