K&C Phase 4 – Status report

Global Mangrove Watch

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Science Team meeting #24
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Project Aim

- Aim to provide geospatial (map) information about mangrove extents and changes at national to global scales for Ramsar Contracting Parties, NGO's and the public

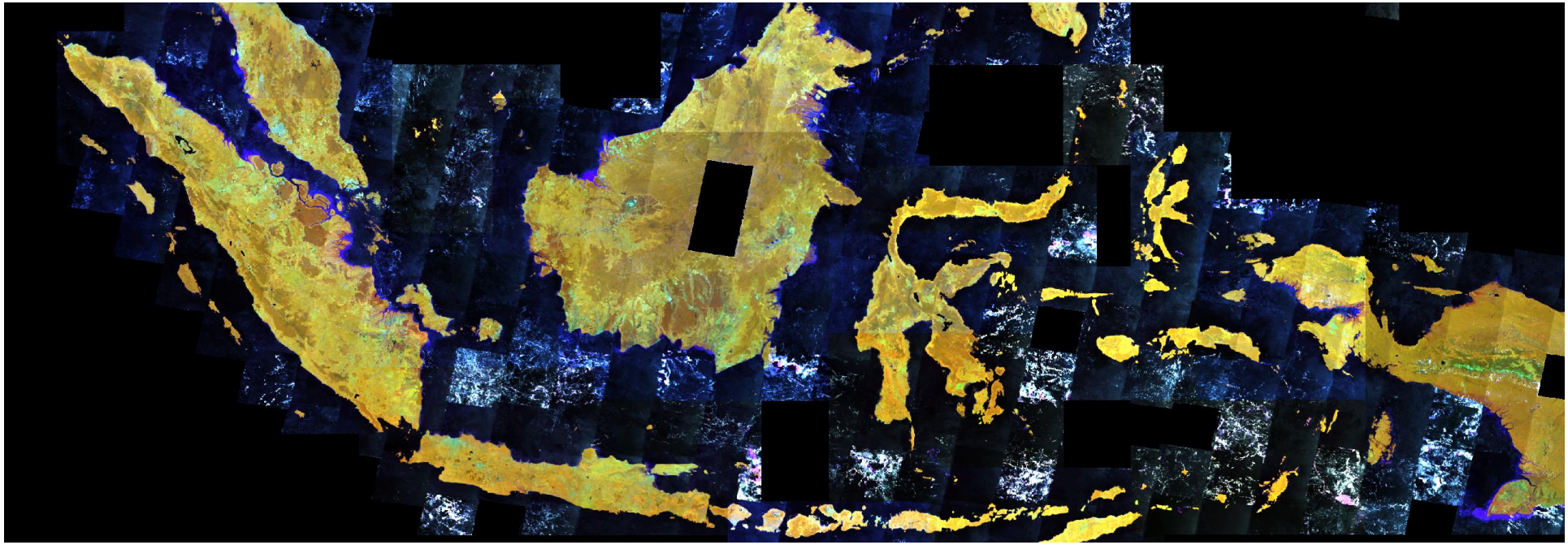
- GMW part of Ramsar Wetlands Convention workplan (STRP Task 1.1) and the GEO-Wetlands Initiative plan to develop a Global Wetlands Observation System (GWOS)

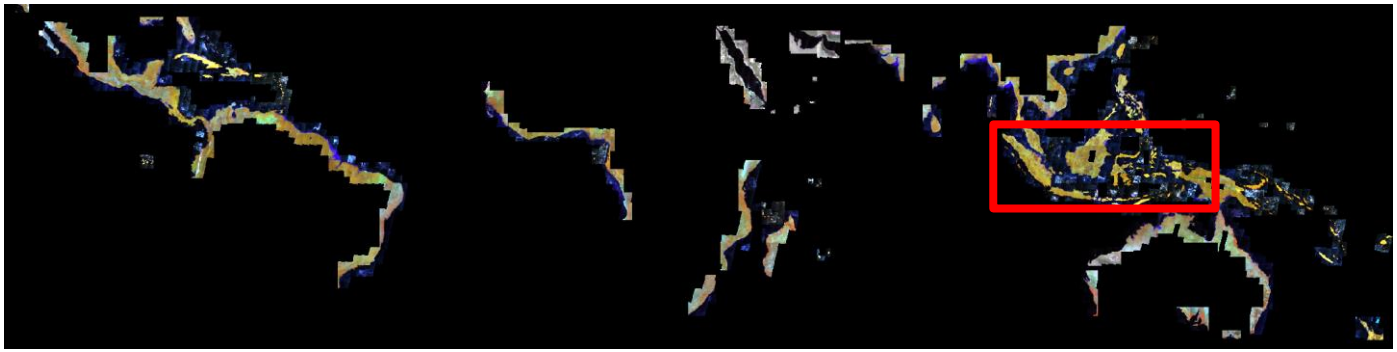
- Responds to the UN Sustainable Development Goals (SDG) - SDG6.6.1 reporting on wetlands extents (national-global)

Project Objectives

- Overall: Mapping of extent and changes in global mangrove areas using satellite data
- Generation of updated baseline extent maps of the global mangrove extent for the year 2010
- Generation of maps of annual changes in the global mangrove areas (at present 7 time epochs between 1996 and 2016).

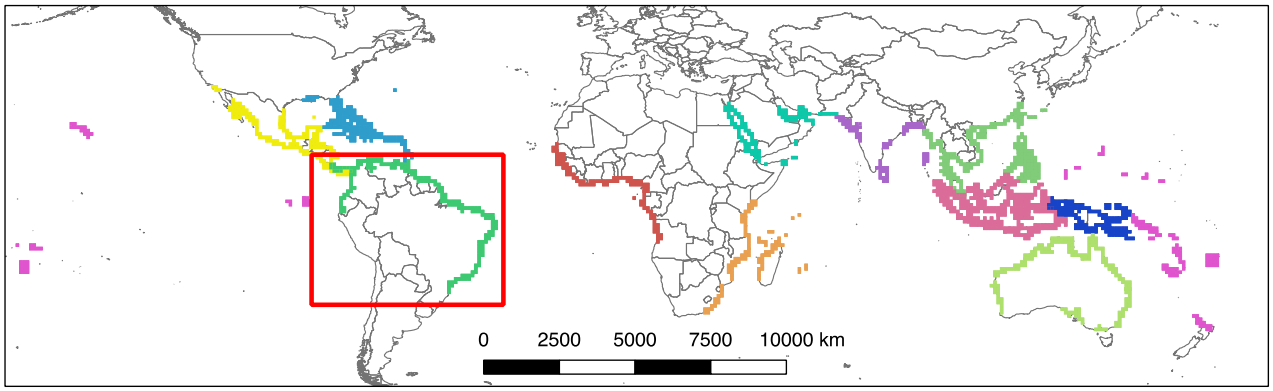
Datasets

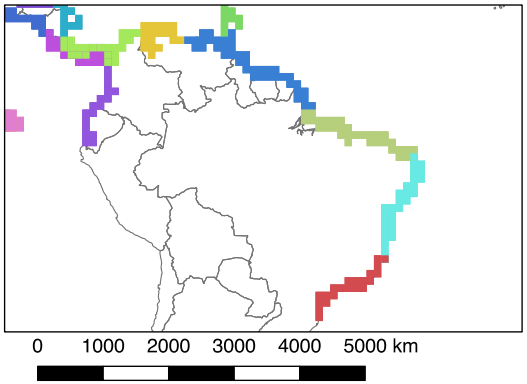




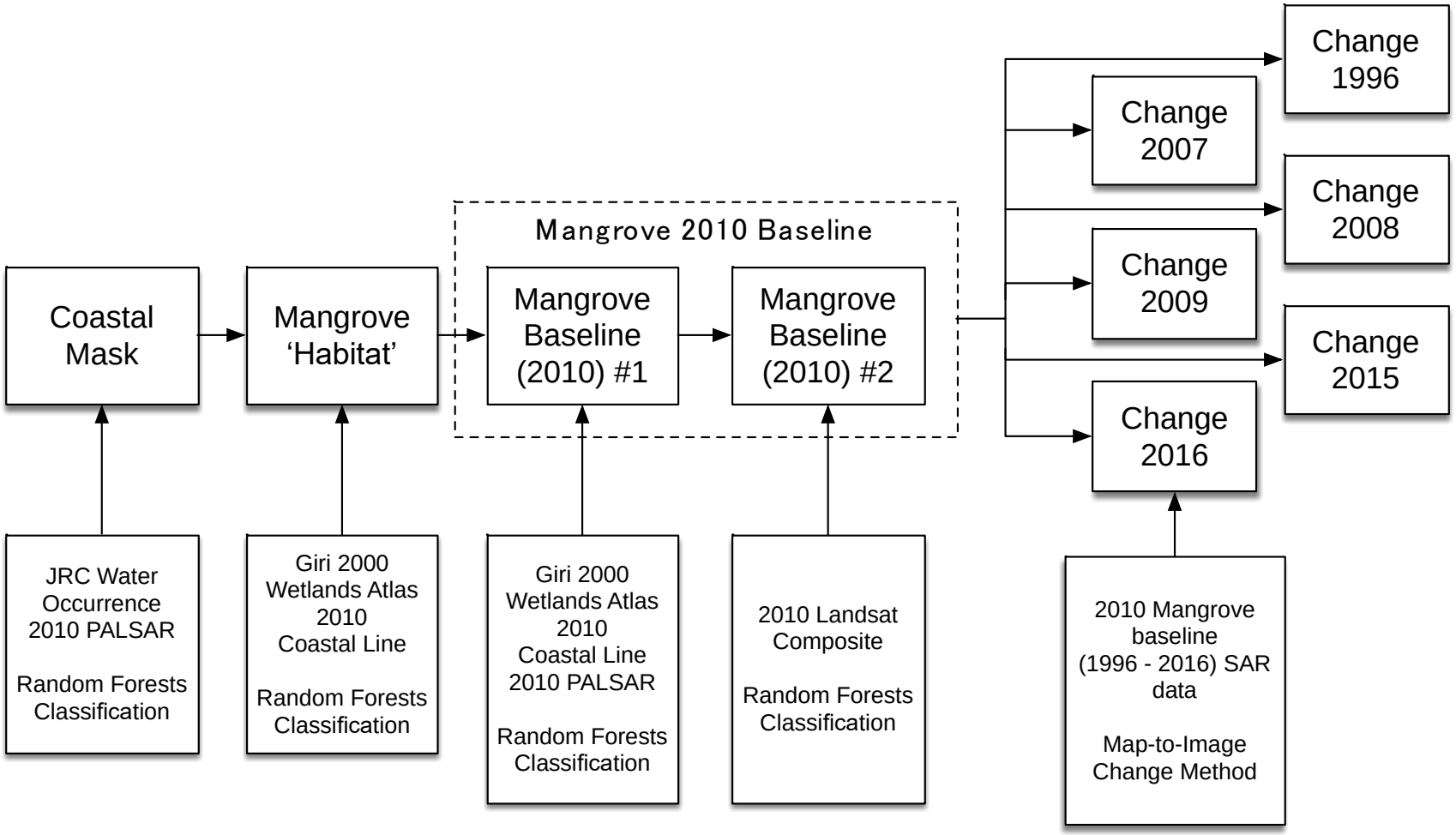
Methodology: Processing Projects

- Hierarchical Projects – processing undertaken on projects.
  - 12 Top level regions with sub-regions defined within.





Methodology: Overview



Challenge – many different types of changes

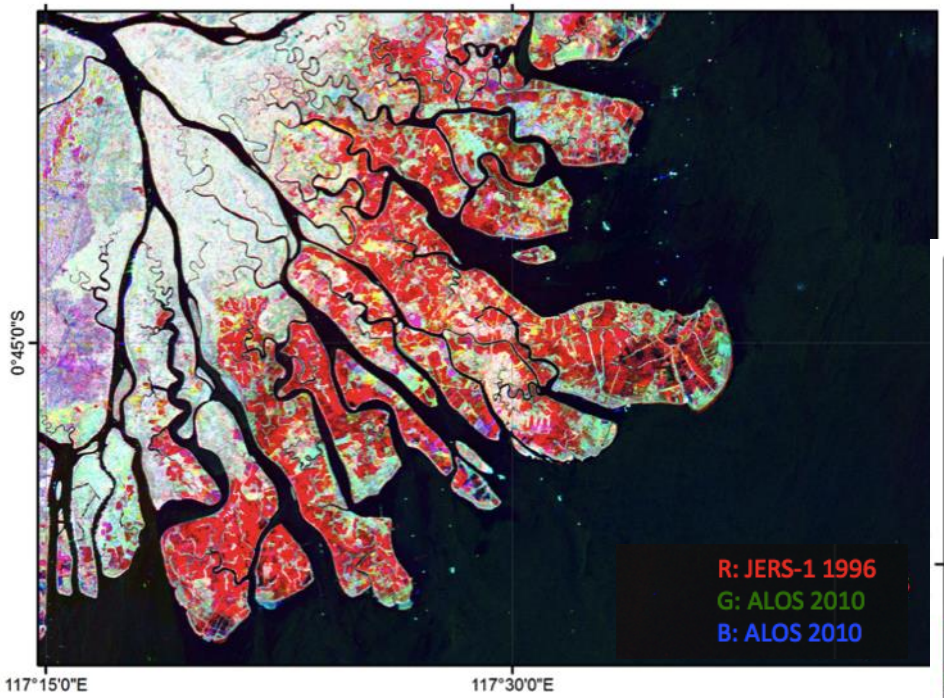
Losses

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

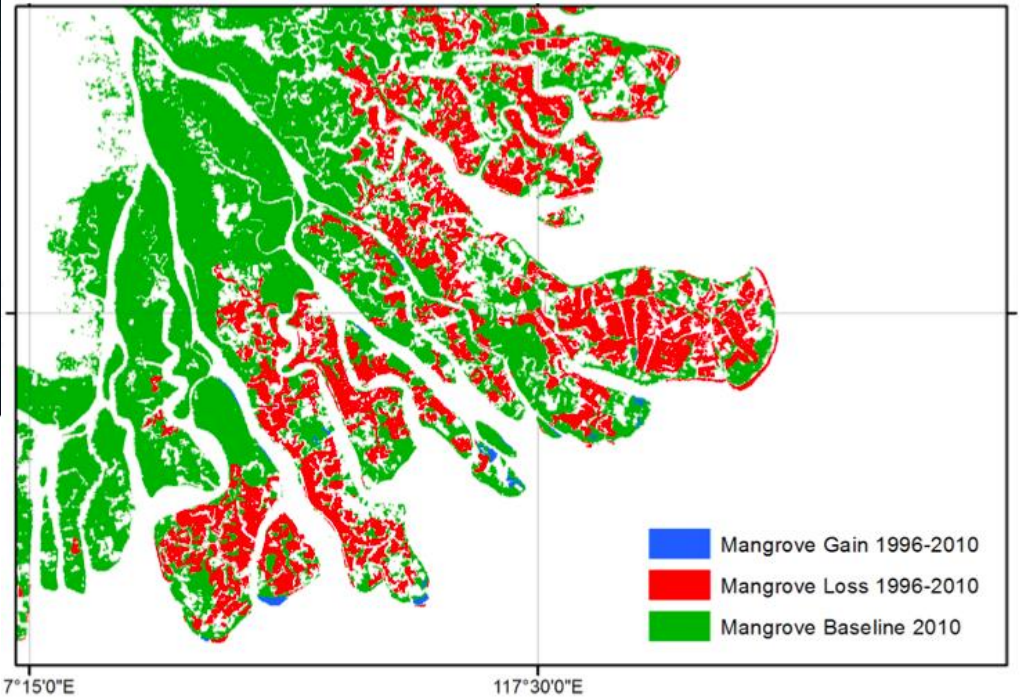
Gains

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

Anthropogenic changes: Aquaculture and infrastructure

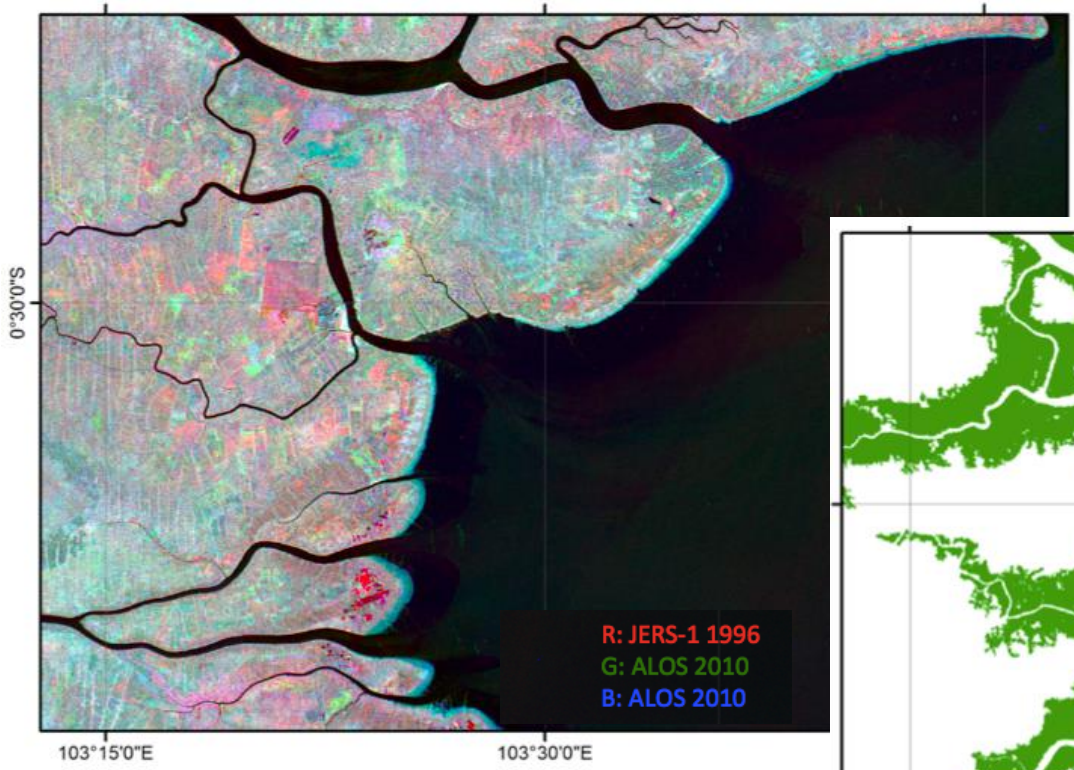


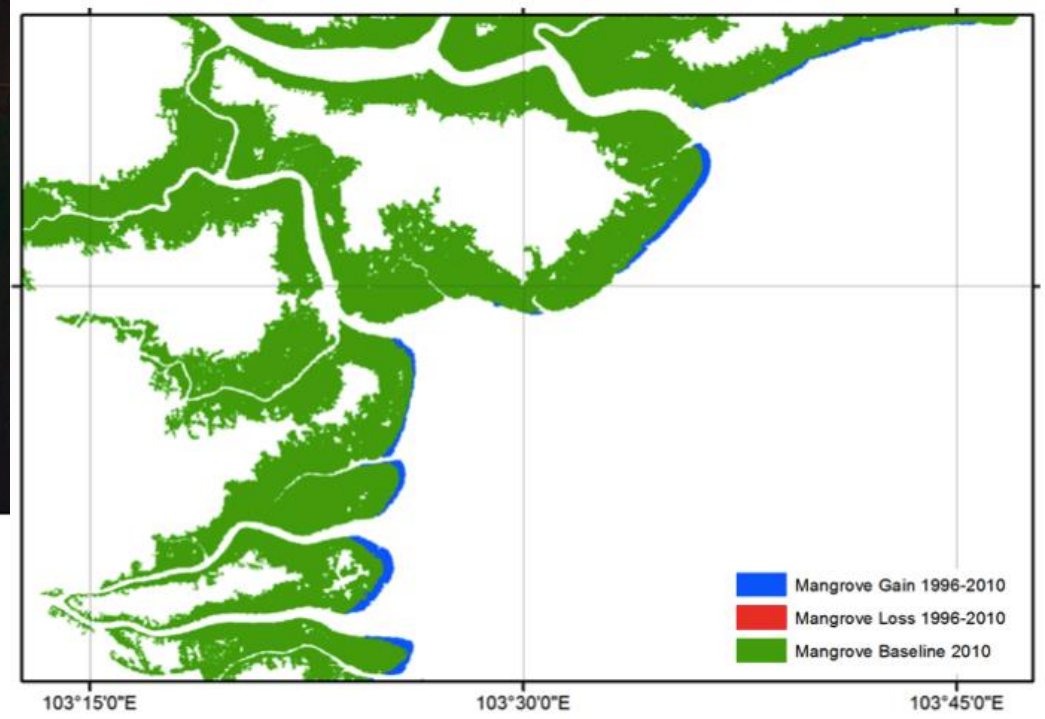
Input: Multi-temporal radar image tiles



Output: Mangrove extent and change map

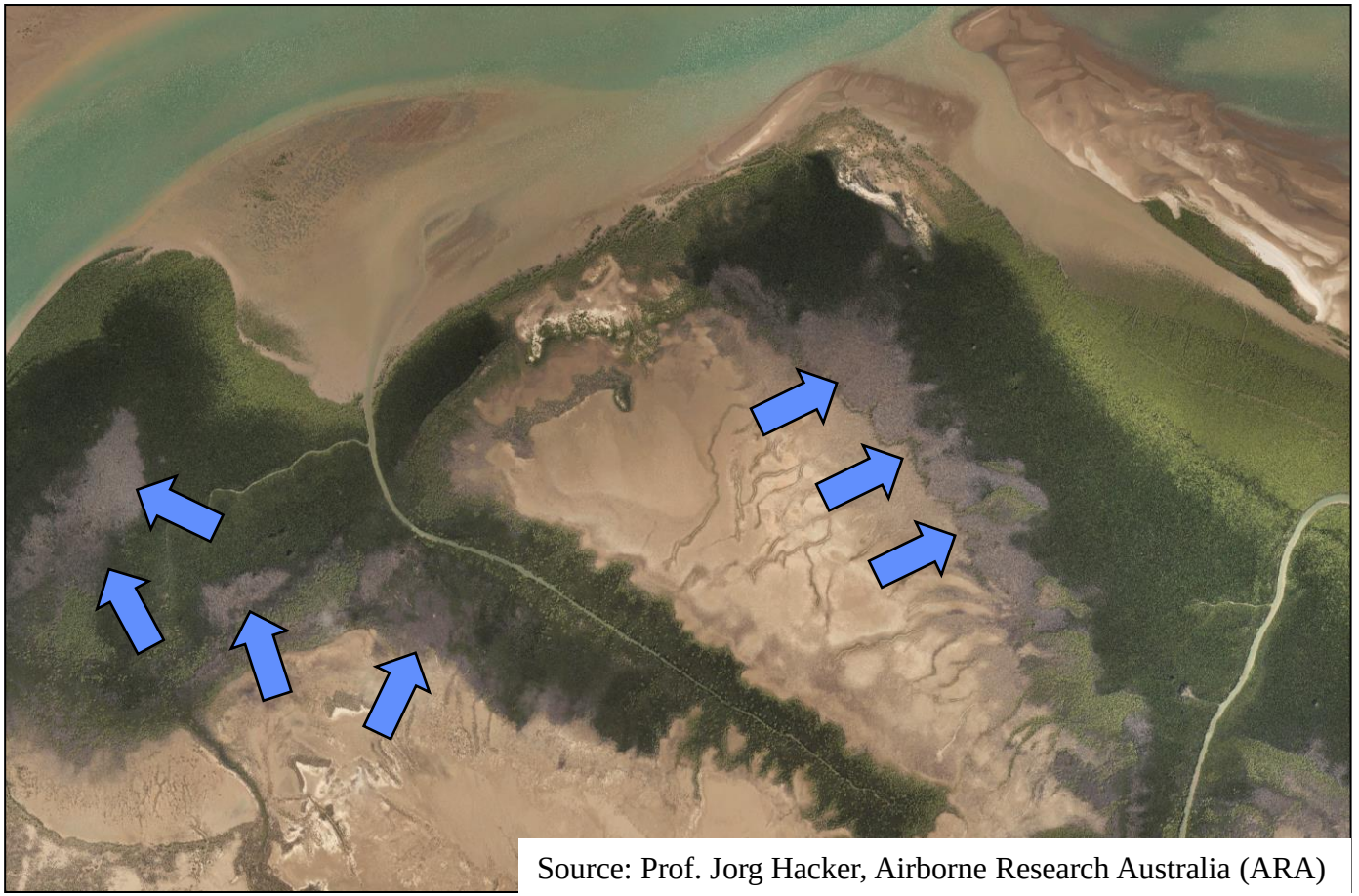
Human-induced gains in mangrove extents: Upstream deforestation causing increased sedimentation





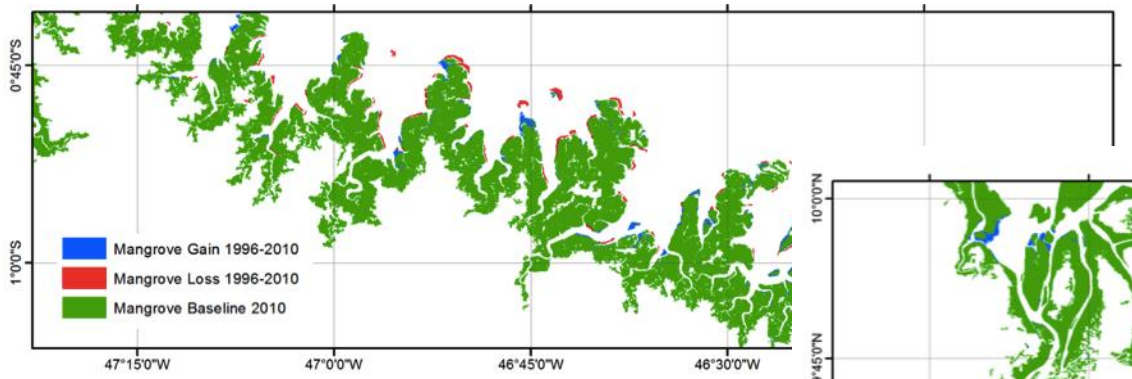
Dieback – climate change?

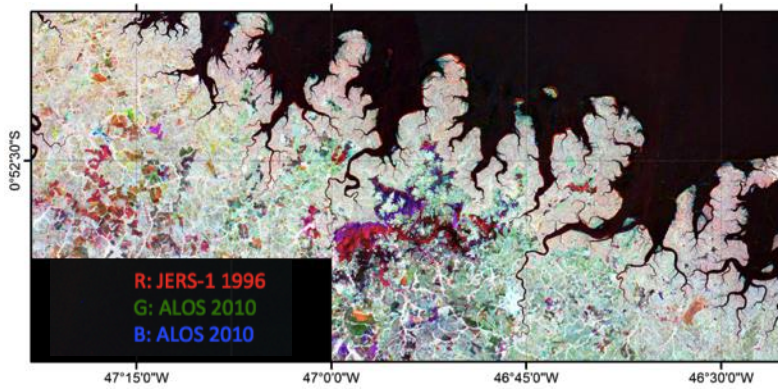
2015/16: Sudden substantive dieback of mangroves in northern Australia, from Darwin to Cape York (>1000s km coastline!)

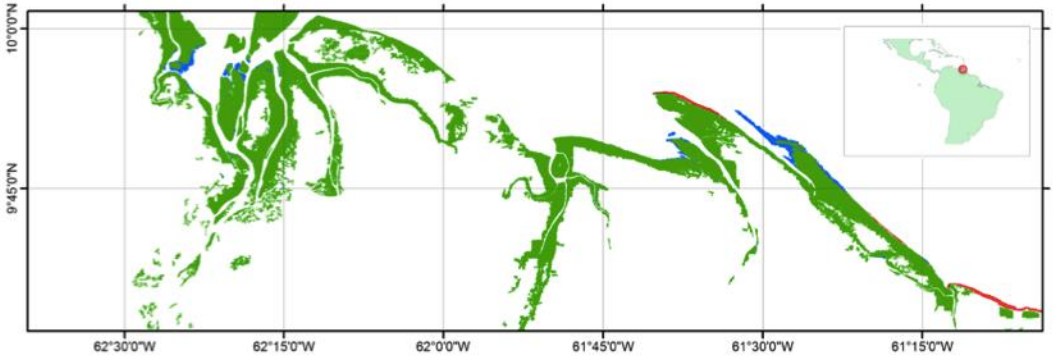


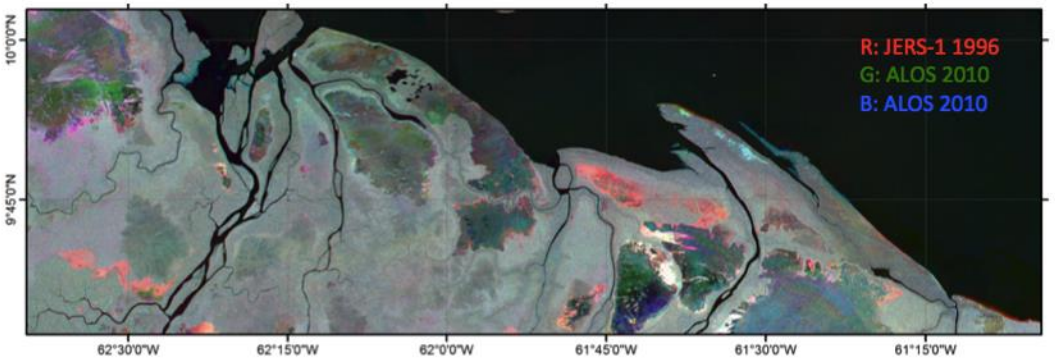
Source: Prof. Jorg Hacker, Airborne Research Australia (ARA)

Natural processes: Gains and losses through erosion and sedimentation transport







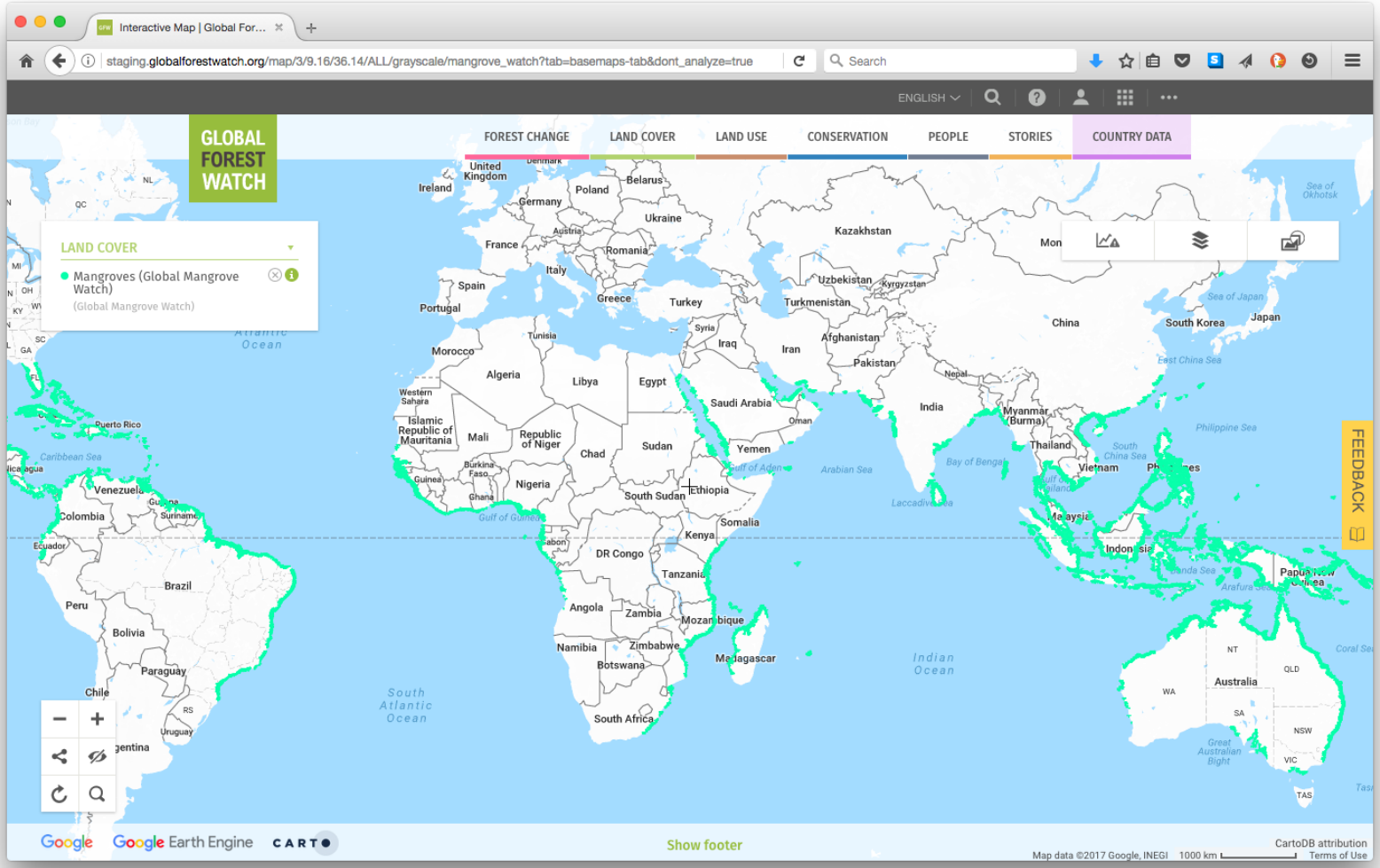


Current Status

- 2010 global mangrove Baseline (v1.2) completed
  - Optical data: distinction between mangrove and terrestrial vegetation
  - Radar data: sensitivity to mangrove structure and change

- Classification accuracy was assessed with over 53,800 randomly sampled points across 20 randomly selected regions.
  - Overall accuracy 95.25 %,
  - Omission error: 2.5%
  - Commission error: 6.0%

Global 2010 baseline (v1.2) online at www.gfw.org

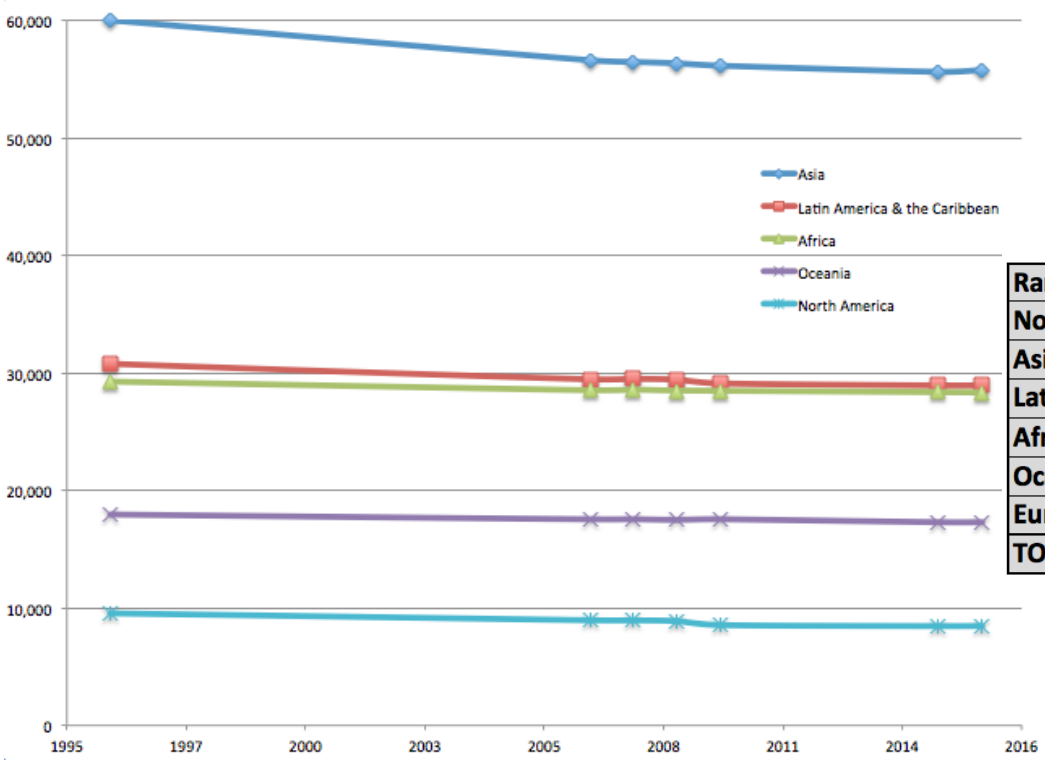


Global 2010 baseline and annual extent maps (v1.2)
Preliminary estimates

Countries - Top 10	1996	2000	2007	2008	2009	2010 Baseline	2015	2016	
Indonesia	29,595	27,694	27,967	27,804	27,769	27,676	27,487	27,463	19.6%
Brazil	11,779	10,925	11,419	11,436	11,422	11,426	11,294	11,333	8.1%
Australia	11,020	10,284	10,814	10,818	10,781	10,827	10,611	10,599	7.6%
Nigeria	7,299	6,424	7,182	7,181	7,176	7,138	7,107	7,106	5.1%
Mexico	6,978	7,796	6,575	6,536	6,505	6,261	6,223	6,240	4.5%
Myanmar/Burma	5,799	5,370	5,360	5,416	5,449	5,338	5,272	5,313	3.8%
Malaysia	5,429	5,729	5,269	5,268	5,266	5,350	5,266	5,268	3.8%
Papua New Guinea	5,030	4,923	4,923	4,915	4,907	4,953	4,895	4,902	3.5%
Bangladesh	4,692	4,918	4,591	4,596	4,572	4,590	4,557	4,539	3.2%
India	3,987	4,116	3,833	3,823	3,819	3,822	3,808	3,819	2.7%

- 40% of global mangroves in Asia & almost 20% in Indonesia

Annual rate of mangrove loss over 20 years



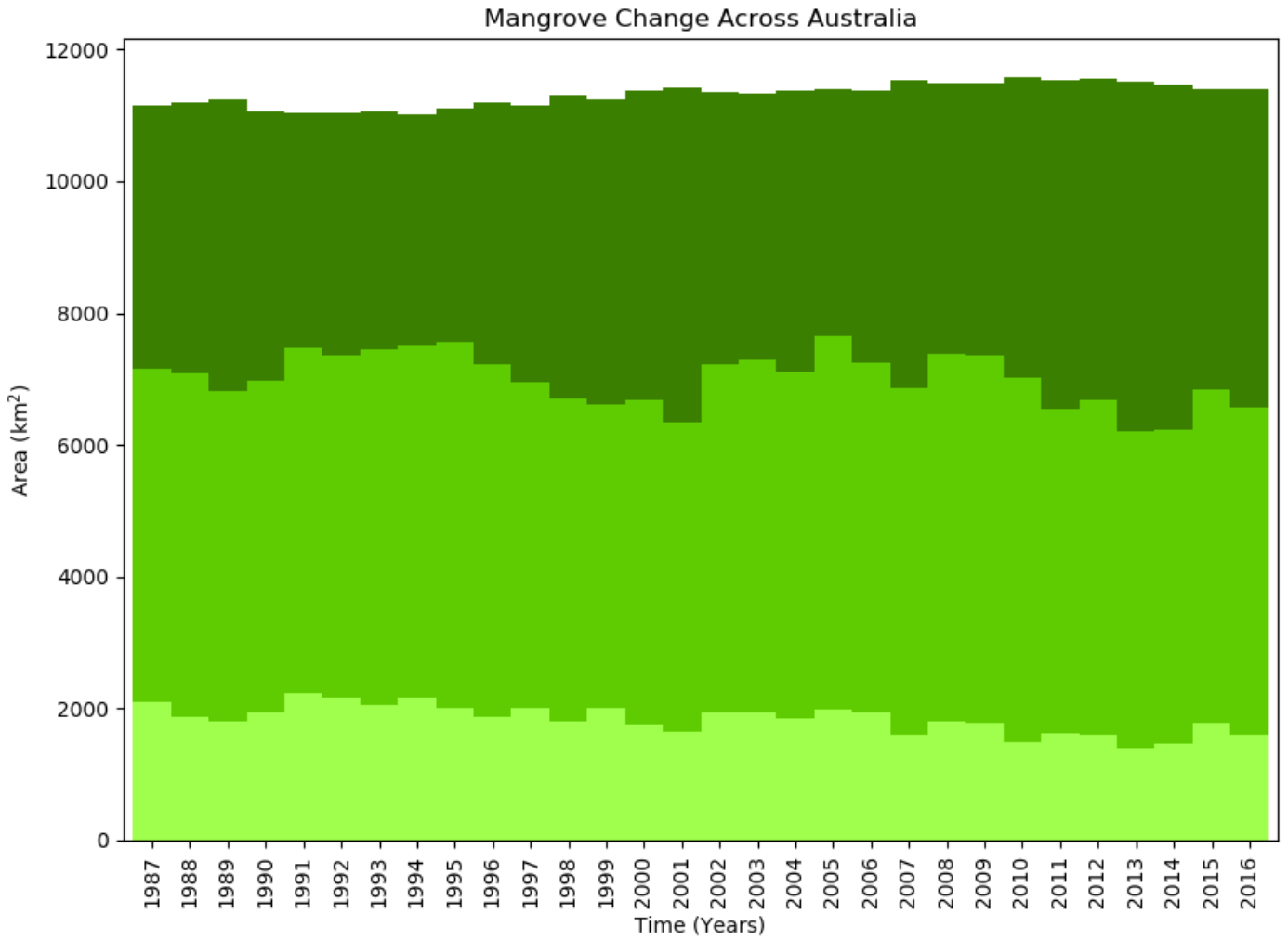
	11 yrs	9 yrs	20 yrs
Ramsar Region	**1996-2007**	**2007-2016**	**1996-2016**
North America	-0.58%	-0.61%	-0.57%
Asia	-0.55%	-0.17%	-0.38%
Latin America & Caribbean	-0.38%	-0.19%	-0.29%
Africa	-0.23%	-0.07%	-0.16%
Oceania	-0.20%	-0.16%	-0.18%
European Overseas Terr.	0.23%	0.11%	0.18%
TOTAL mangrove area [km2]	**-0.41%**	**-0.18%**	**-0.29%**

2018 milestones

- Feb 2018:
  - Finalisation of QA for 7 epoch mangrove maps
  - Release of all data on WRI Global Forest Watch and WCMC Ocean Data Viewer servers
- Q2/Q3 2018: launch of www.globalmangrovewatch.org
- Q3/Q4 2018: Generation of 2017 mangrove map from PALSAR-2 Mosaic
- Oct 2018: Proposed side event at Ramsar COP-13

Future Directions: Historical Time Series - Landsat

- Demonstrated for Australia using Geoscience Australia Data Cube.
  - Min. Extent in 1991
  - Max. Extent in 2010
- Three Cover Classes:
  - High Cover (> 80 %)
  - Mid Cover (> 50 %)
  - Low Cover (>20 %)

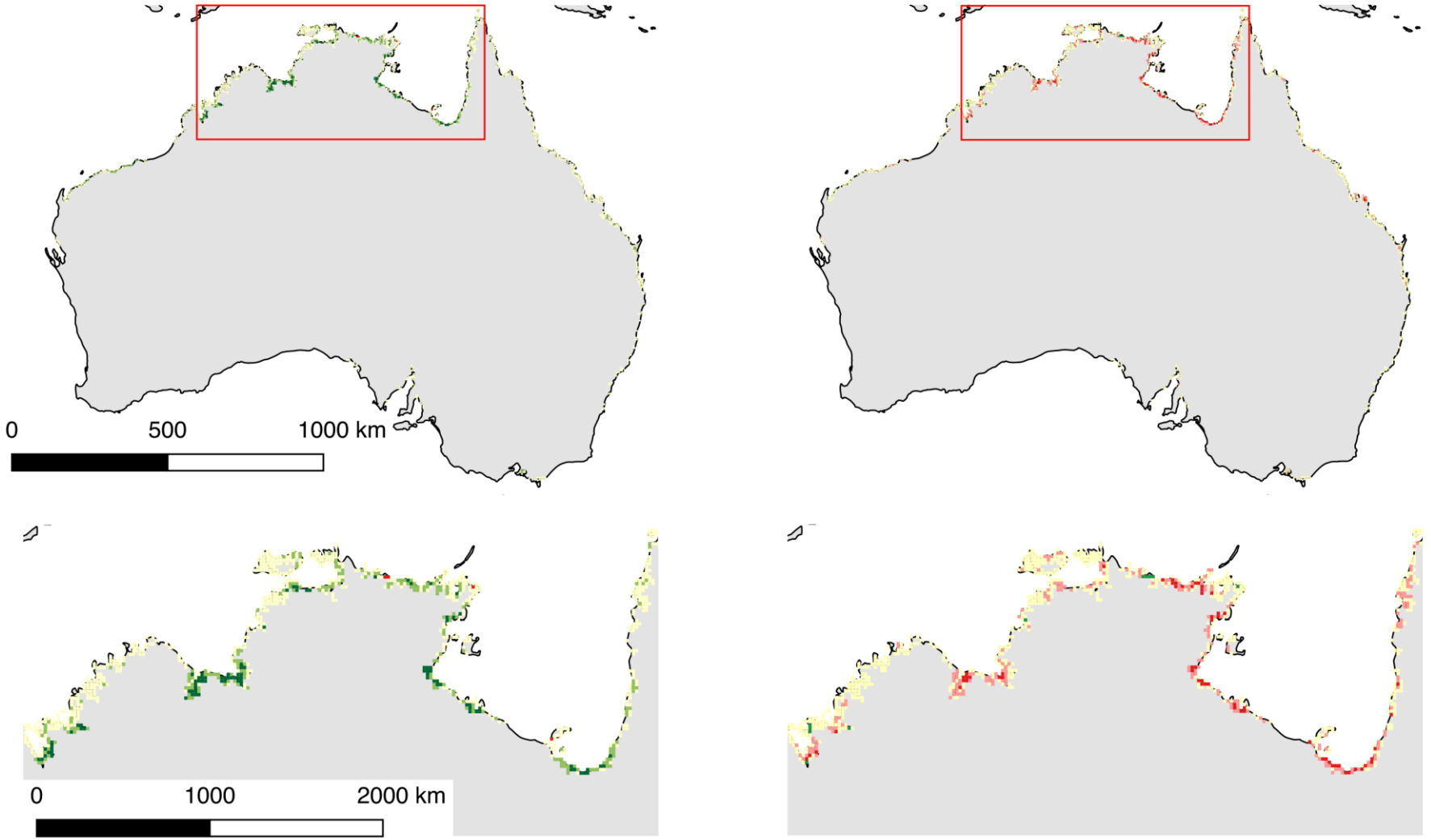


ALOS

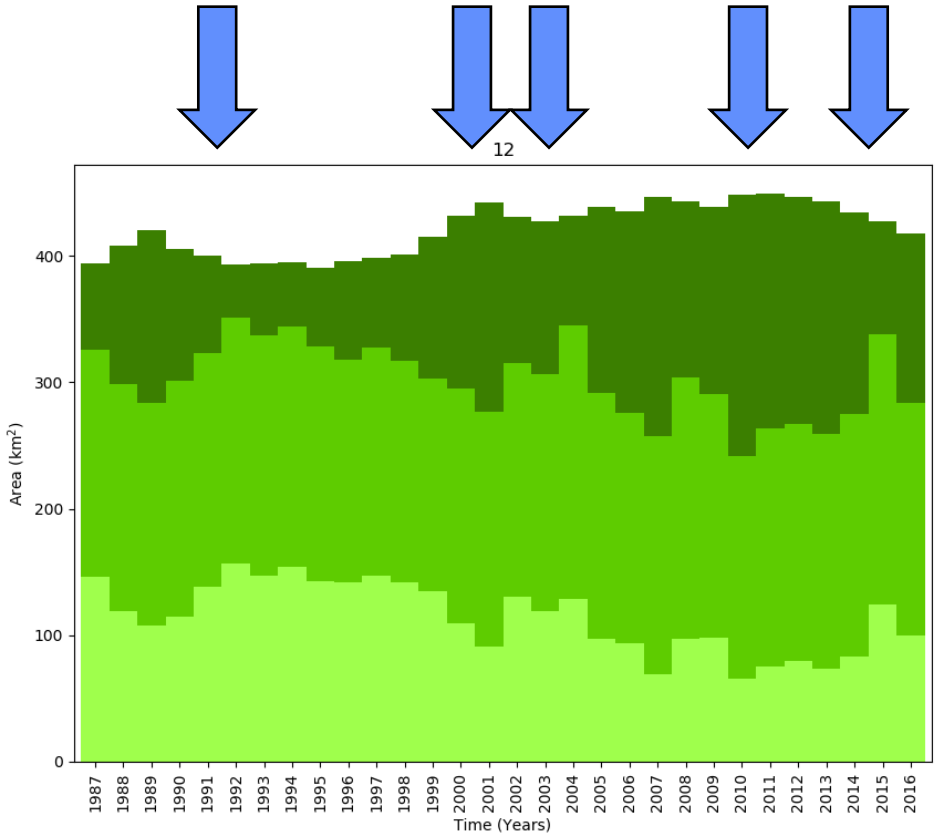
K&C Initiative
An international science collaboration led by JAXA

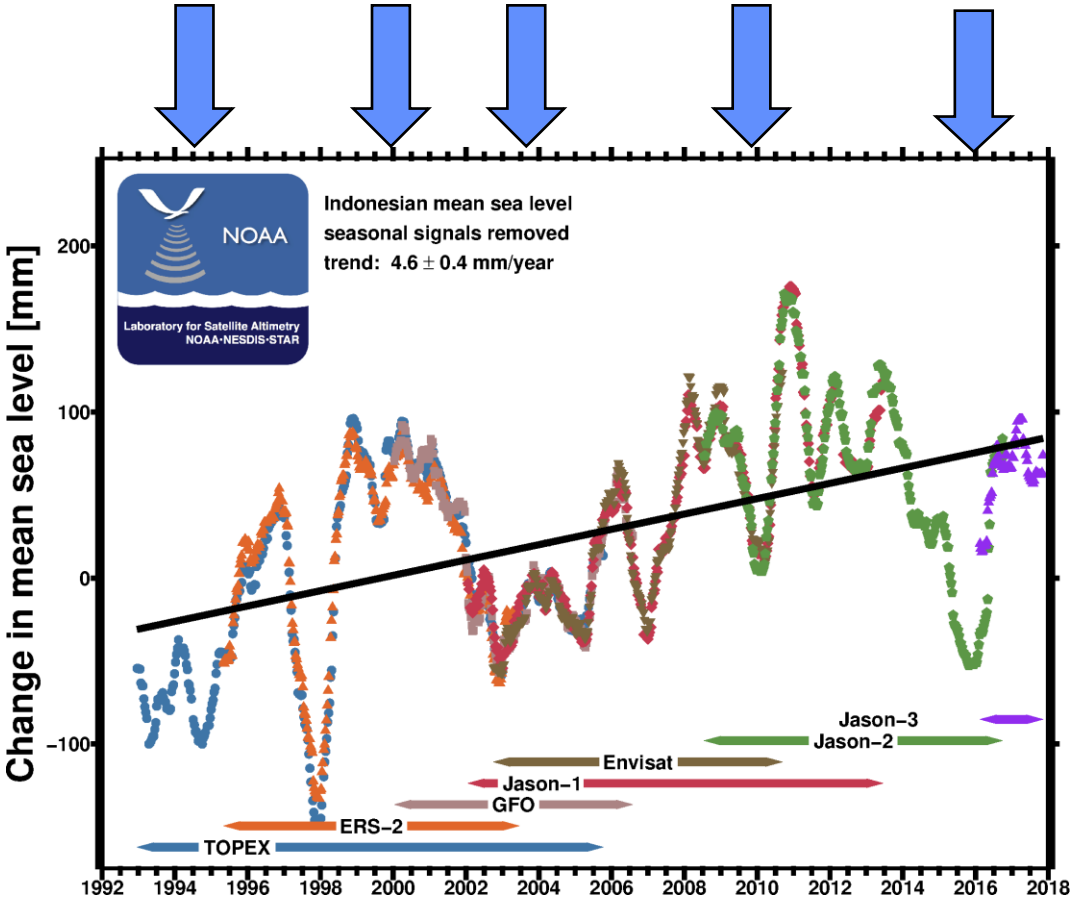
Australian Mangrove Change

Australian Mangrove Change from 1991 to 2010 and 2010 to 2016

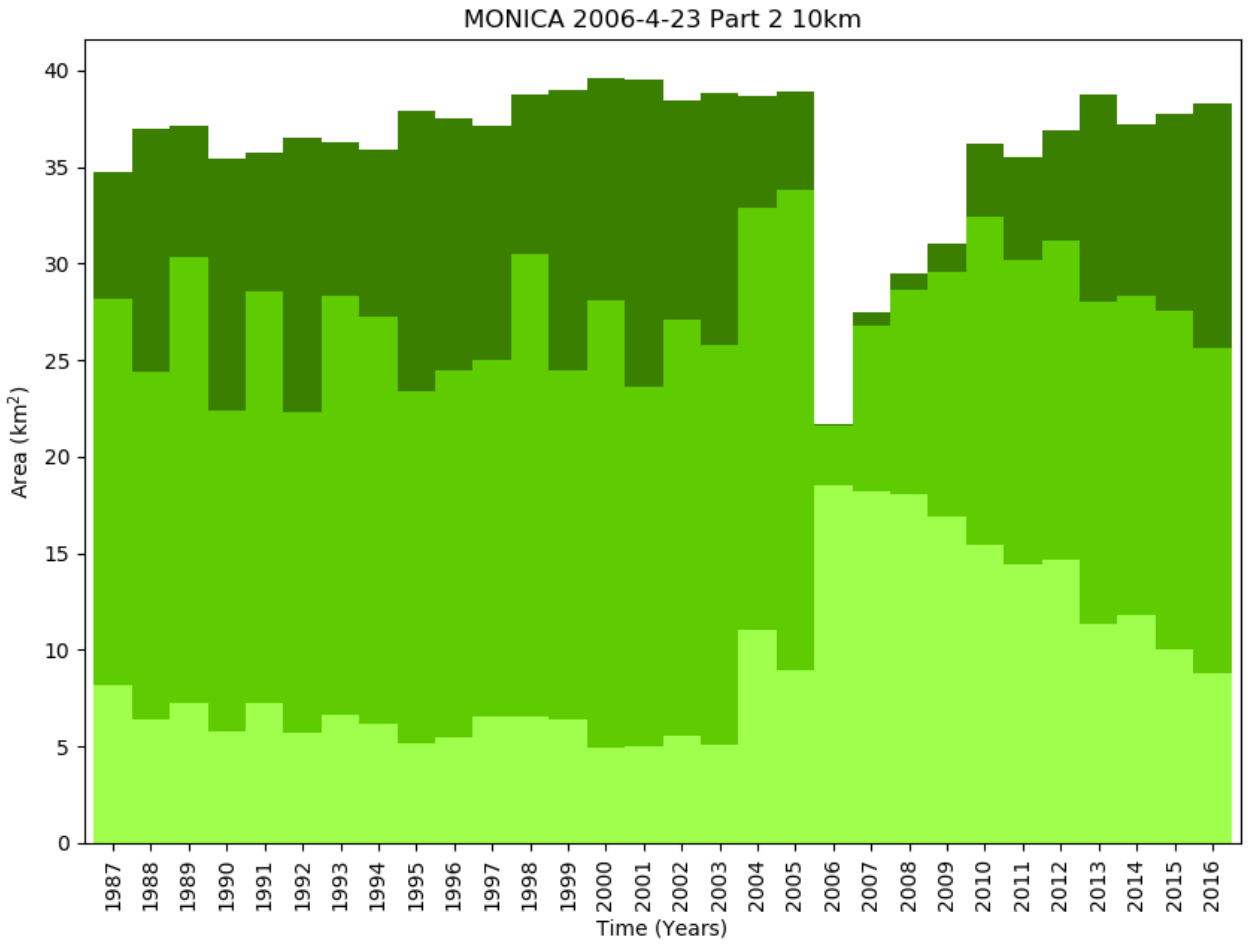


Australian Mangrove Change: Sea Level?



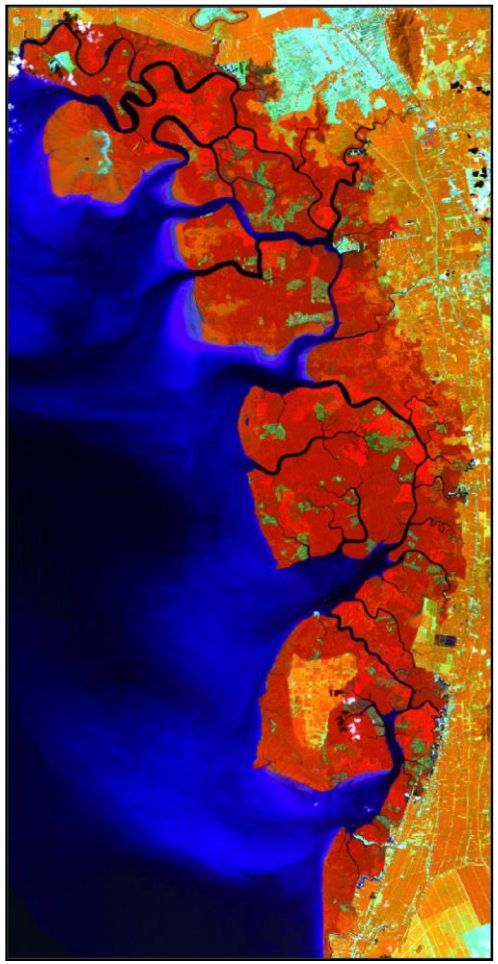


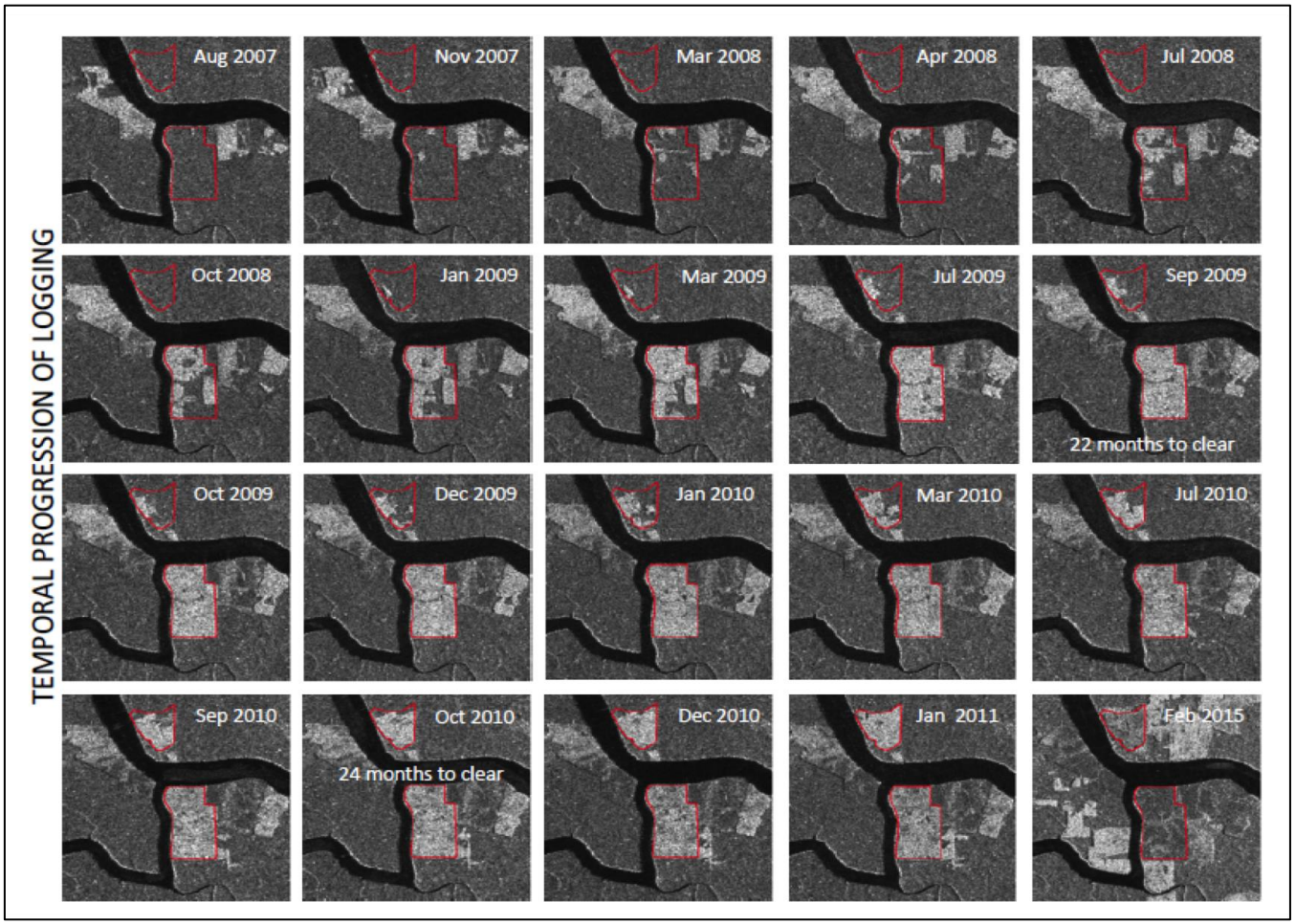
Australian Mangrove Change: Cyclones Impact / Recovery



Matang Mangrove Forest Reserve, Malaysia

Temporal trajectories of L-band SAR indicate logging activities (for Charcoal)





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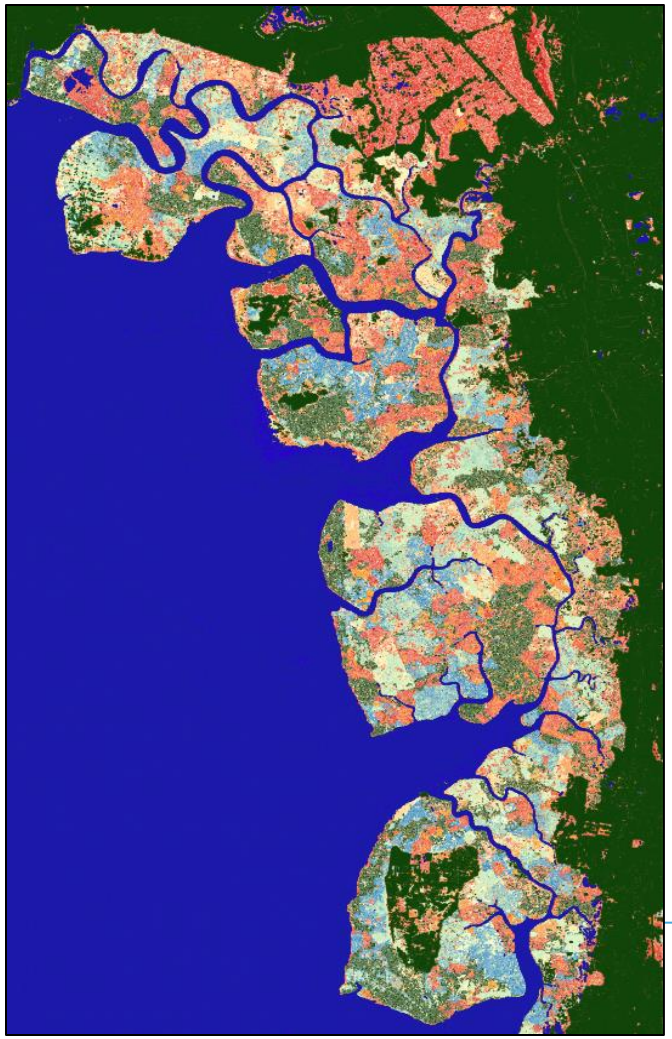
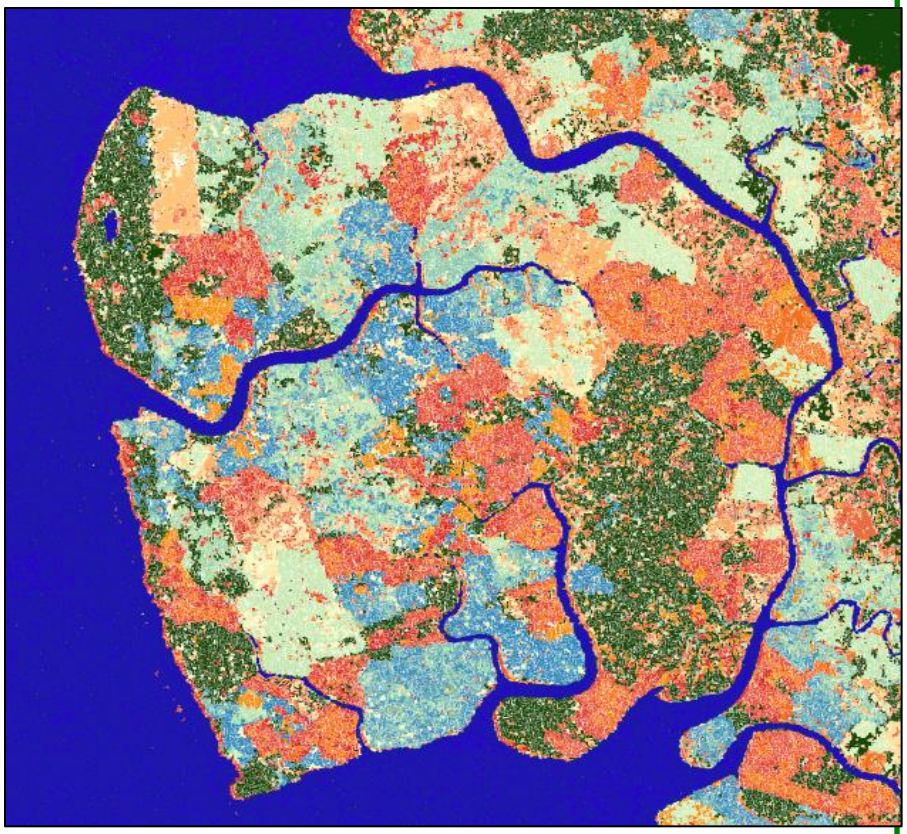
AGE CLASS MAP OF MATANG MANGROVE FOREST RESERVE – DATE OF CLEARANCE



Tropical forest	24 Jun 2010	01 Feb 2008	26 Jul 1996
	07 Mar 2010	17 Dec 2007	12 Jun 1996
Primary Mangrove	16 Feb 2010	30 Nov 2007	14 Apr 1996
22 Sep 2016	20 Jan 2010	01 Nov 2007	16 Mar 1996
15 Feb 2016	22 Dec 2009	30 Aug 2007	09 Aug 1995
01 Oct 2015	05 Dec 2009	01 Aug 2007	30 Mar 1995
15 Jun 2015	20 Oct 2009	25 May 2007	07 Feb 1995
04 May 2015	21 Sep 2009	08 Feb 2007	01 Jan 1995
20 Apr 2015	04 Sep 2009	01 Sep 2006	18 Nov 1994
15 Mar 2015	06 Aug 2009	01 Jun 2006	05 Oct 1994
19 Feb 2015	20 Jul 2009	16 Dec 2004	22 Aug 1994
02 Oct 2014	30 May 2009	30 Dec 2003	12 Apr 1994
03 Jun 2014	14 Apr 2009	29 Aug 2002	24 Mar 1994
23 Nov 2013	17 Jan 2009	03 Mar 2001	27 Feb 1994
20 May 2012	19 Dec 2008	30 Jul 2000	14 Jan 1994
23 Jan 2011	27 Nov 2008	27 Dec 1999	09 Jun 1993
18 Jan 2011	03 Nov 2008	25 Jul 1998	12 Mar 1993
08 Dec 2010	17 Oct 2008	13 Dec 1997	30 Jan 1992
09 Nov 2010	12 Oct 2008	26 Aug 1997	28 Feb 1991
23 Oct 2010	17 Jul 2008	13 May 1997	14 Apr 1990
24 Sep 2010	16 Apr 2008	16 Apr 1997	22 Feb 1989
07 Sep 2010	18 Mar 2008	18 Jan 1997	29 Jul 1988
09 Aug 2010	14 Mar 2008	22 Oct 1996	29 Apr 1996
23 Jul 2010	01 Mar 2008	08 Sep 1996	

Time-series of Landsat and 100 JERS-1 SAR, ALOS PALSAR and ALOS-2 PALSAR-2 scenes used to generate a comprehensive sub-annual age class map for the MMFR



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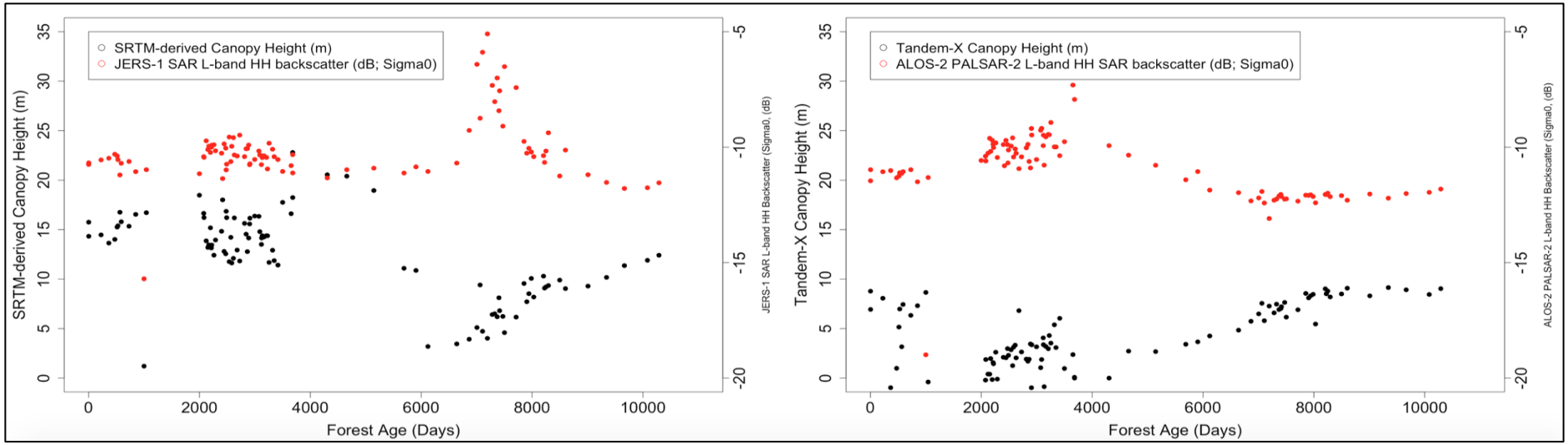
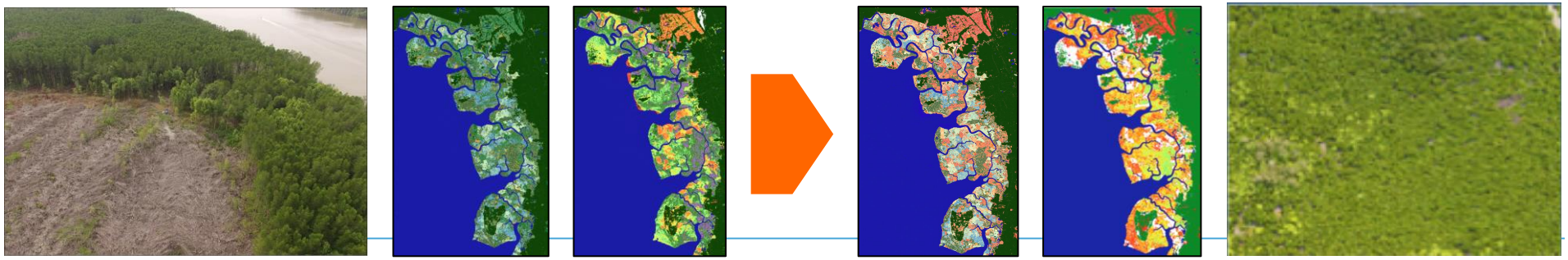
RELATIONSHIPS BETWEEN VARIABLES" CHANGES IN L-BAND HH BACKSCATTER AS A FUNCTION OF HEIGHT

Coarse woody debris remaining on the ground following clearing leads to a rapid increase in L-band HH backscatter. As the forest regenerates subsequently, the backscatter steadily reduces as the canopy attenuates the signal but then increases again with the amount of woody material accumulating through growth. After achieving a certain level of structural development (through a combination of stem, branch and root growth), the backscatter then declines





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Future Work…

- Baseline of mangrove could be improved further.
  - Small features (e.g., riverine mangroves in North Australia)
  - Separation of mangroves from other forest types (e.g., Papua New Guinee)
  - What is mangroves in and around aquaculture?
- Spatial resolution of Sentinel-2 might help in some cases.
- Global historical annual landsat baselines
  - Given availability with cloud cover etc.
- Near real-time monitoring system
  - SAR (e.g., Sentinel-1, NISAR etc.)