K&C Phase 4 – Final Report

Global Mangrove Watch

Pete Bunting (Aberystwyth Uni.)
Ake Rosenqvist (JAXA / soloEO)
Richard Lucas (Aberystwyth Uni.)
Lisa Maria Rebelo (IWMI)
Lammert Hilarides (Wetlands International)
Nathan Thomas (NASA JPL)
Chris McOwen (UNEP-WCMC)
Takuya Itoh (RESTEC)

Science Team meeting #25
Tokyo, Japan, February 5-8, 2019

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

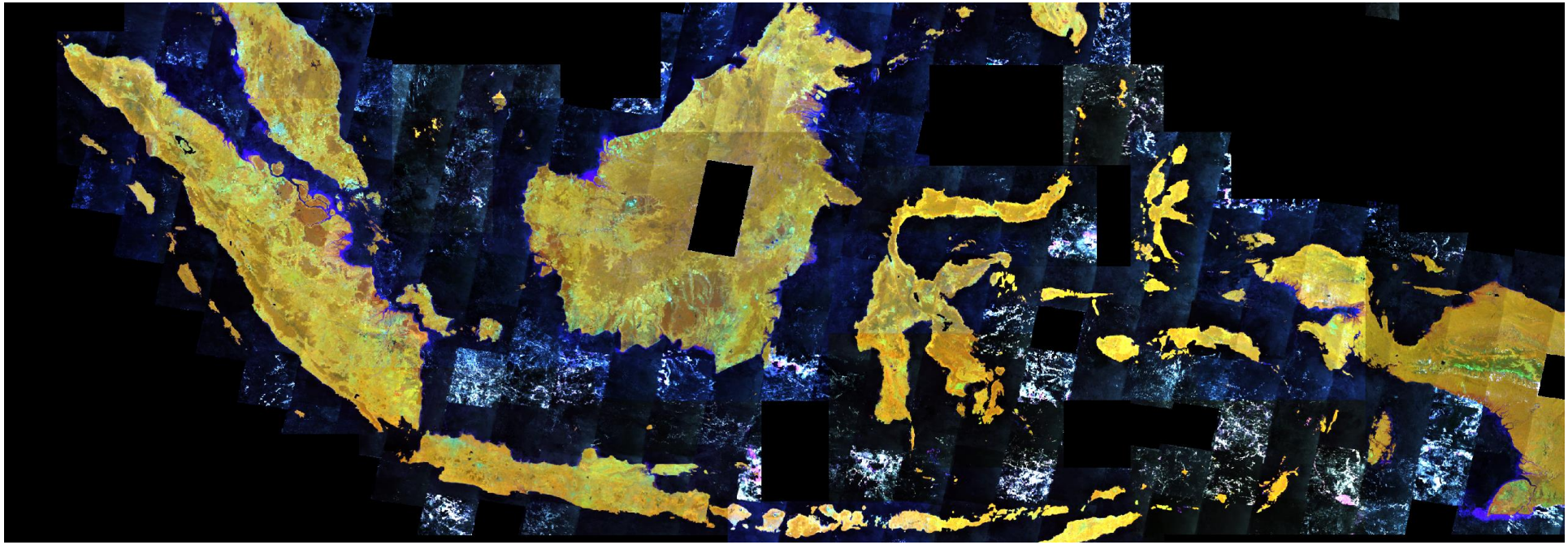
- GMW part of Ramsar Wetlands Convention workplan (STRP Task 1.1) and the GEO-Wetlands Initiative plan to develop a Global Wetlands Observation System (GWOS)

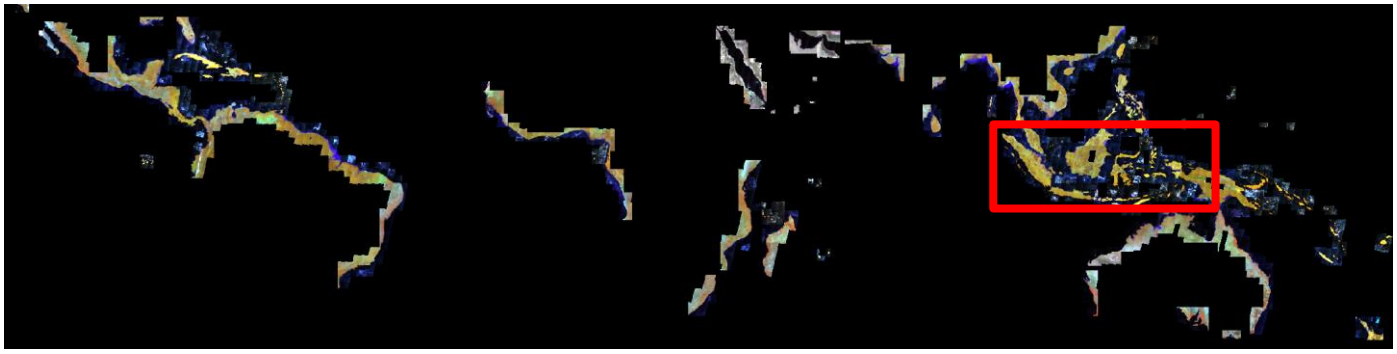
- Responds to the UN Sustainable Development Goals (SDG) - SDG6.6.1 reporting on wetlands extents (national-global)

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).

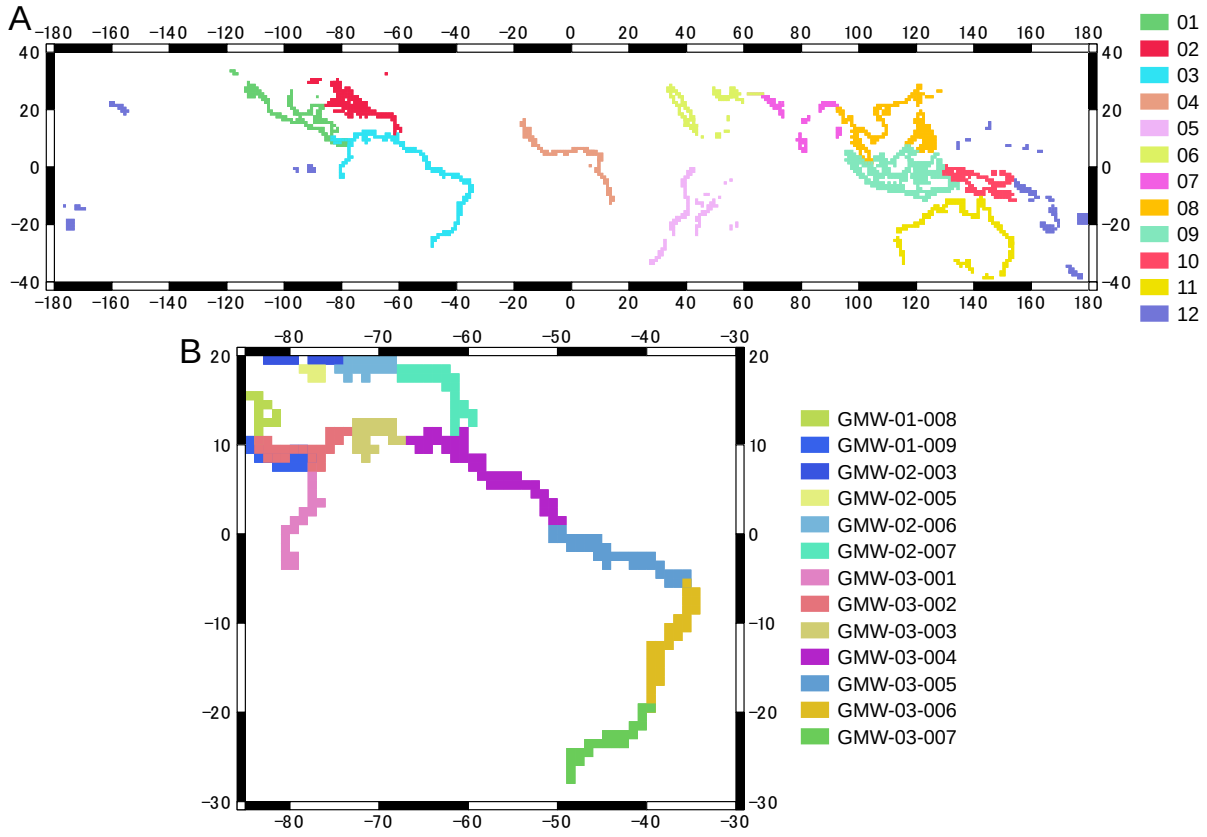
Datasets



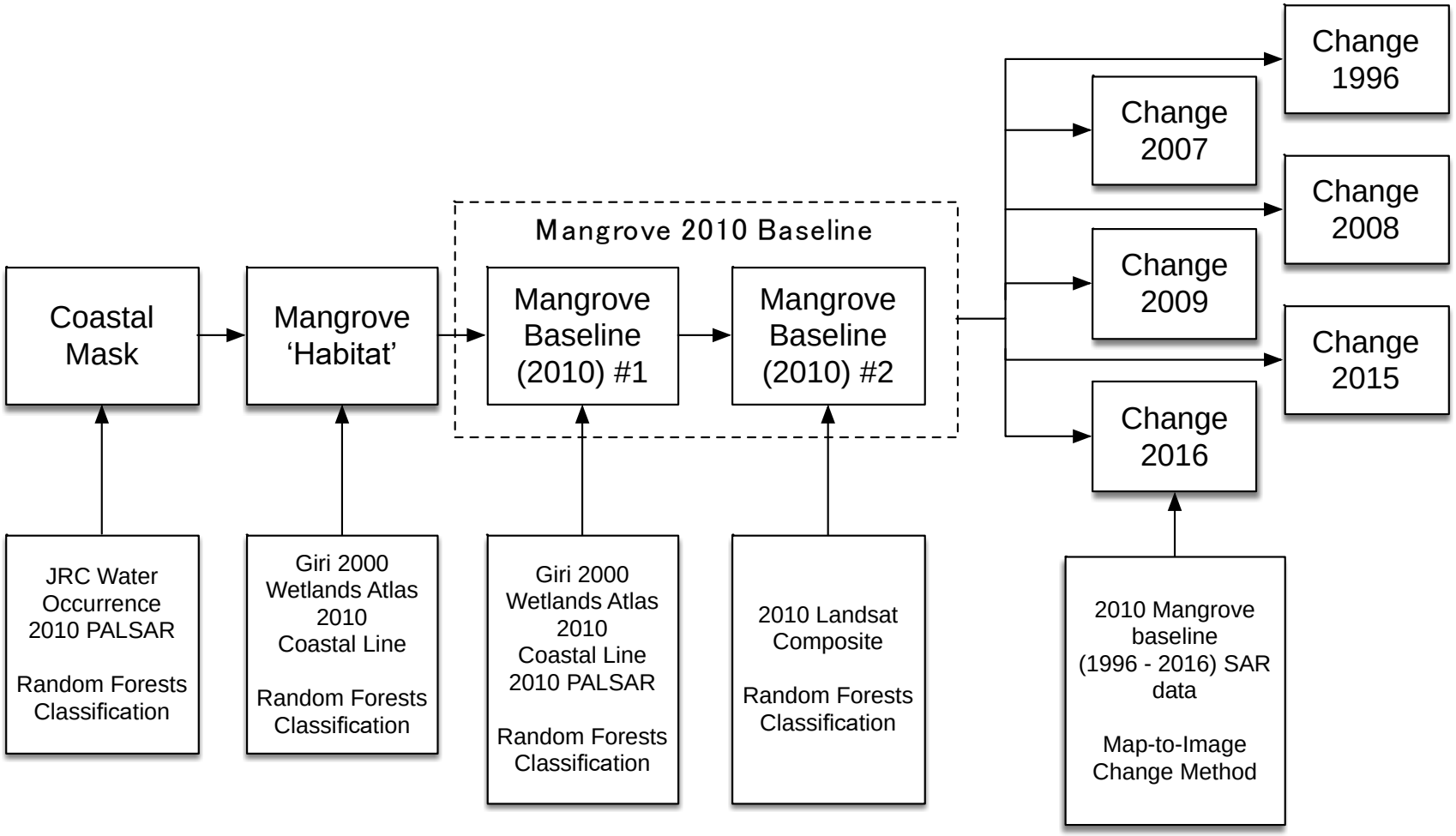


Methodology: Processing Projects

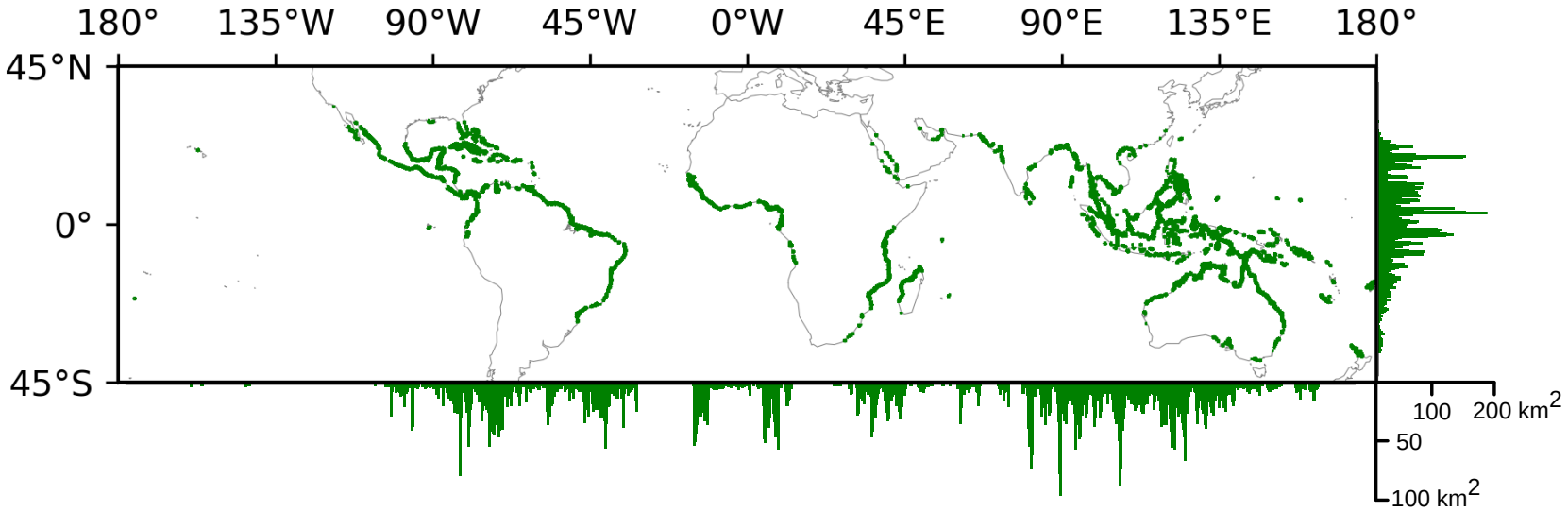
- Hierarchical Projects – processing undertaken on projects.
  - 12 Top level regions with sub-regions defined within.



Methodology: Overview

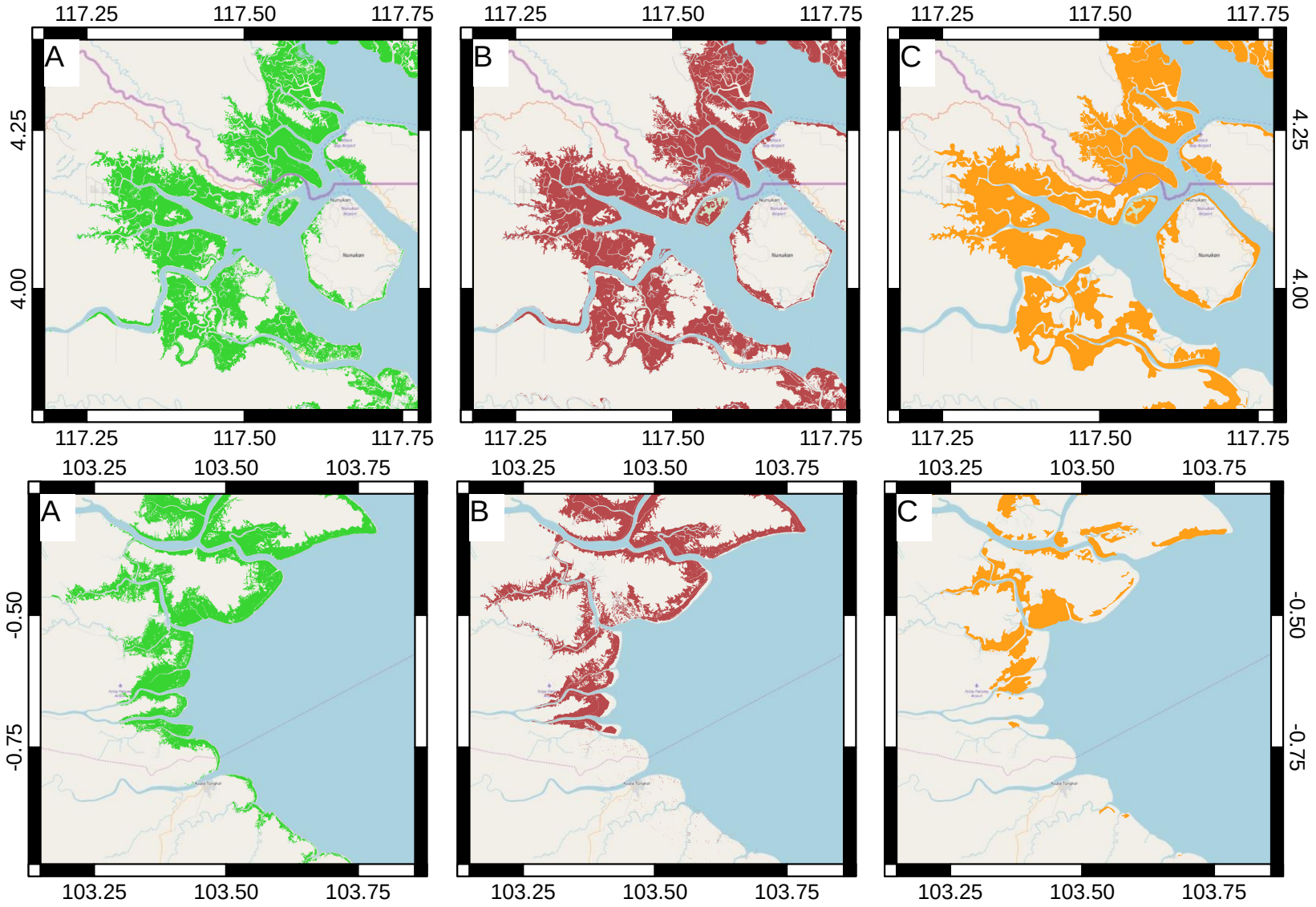


GMW Baseline Result



Region	GMW v2.0 (km^2)	Percentage of Global (%)
Africa	27,465	20.0
Asia	53,278	38.7
Europe (Overseas Territories)	1026	0.7
Latin America and the Caribbean	27,939	20.3
North America	11,563	8.4
Oceania	16,329	11.9
Total	137,600	

- Classification accuracy of mangroves 93.6–94.5% with a 99% confidence interval.
- 53,878 accuracy assessment points globally distributed.


GMW
Giri et al.,
Wetlands Atlas
117.25
117.50
117.75
4.25
4.00
A
B
C
103.25
103.50
103.75
-0.50
-0.75

Challenge – many different types of changes

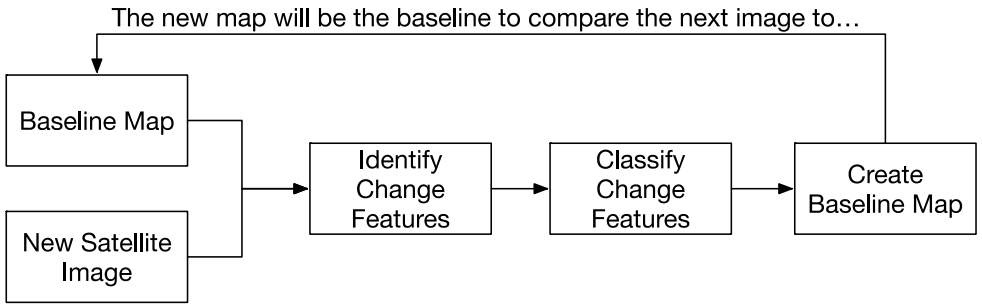
Losses

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

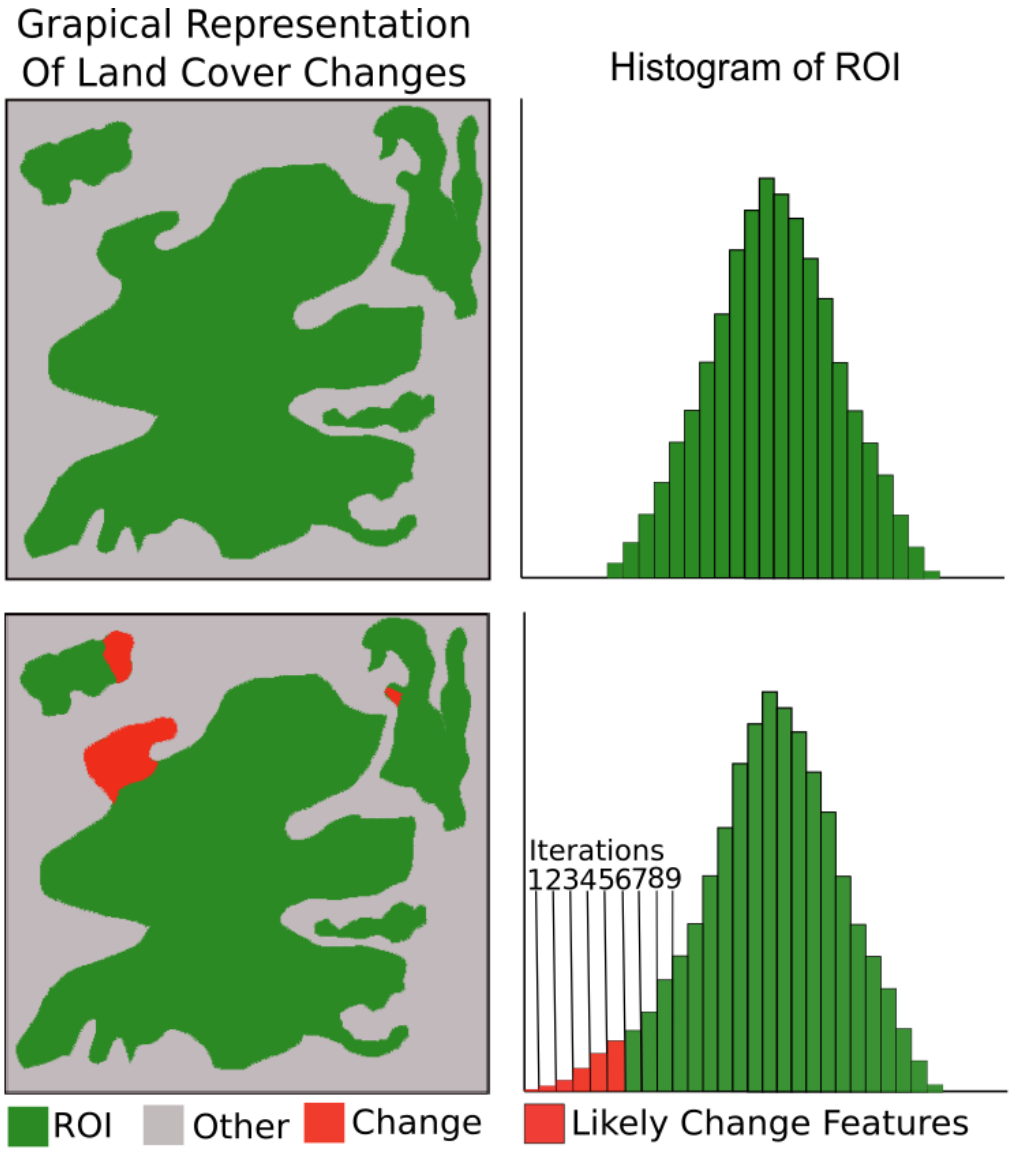
Gains

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

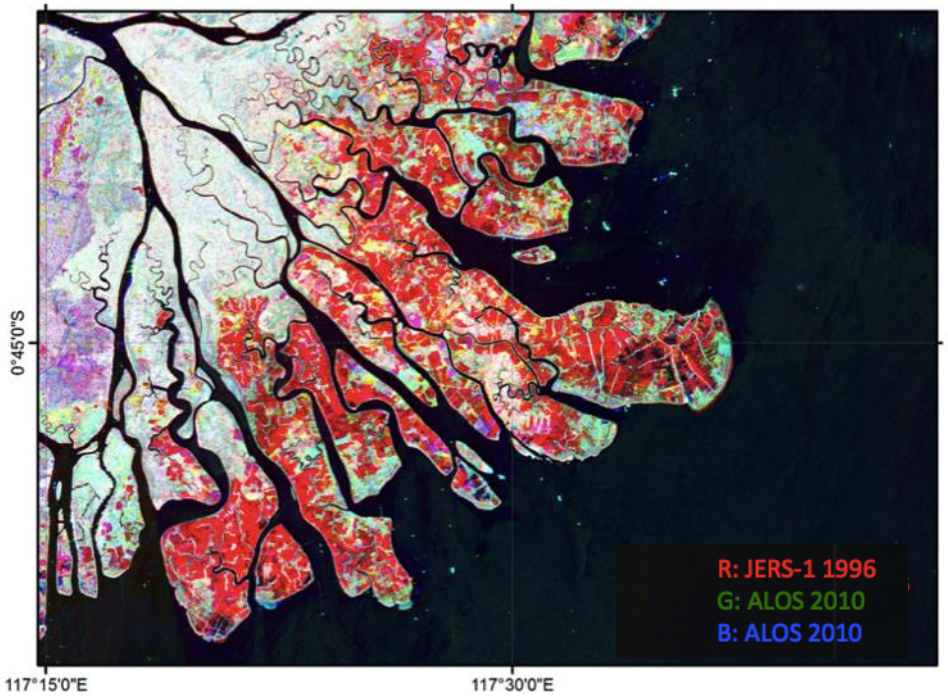
Map-to-Image



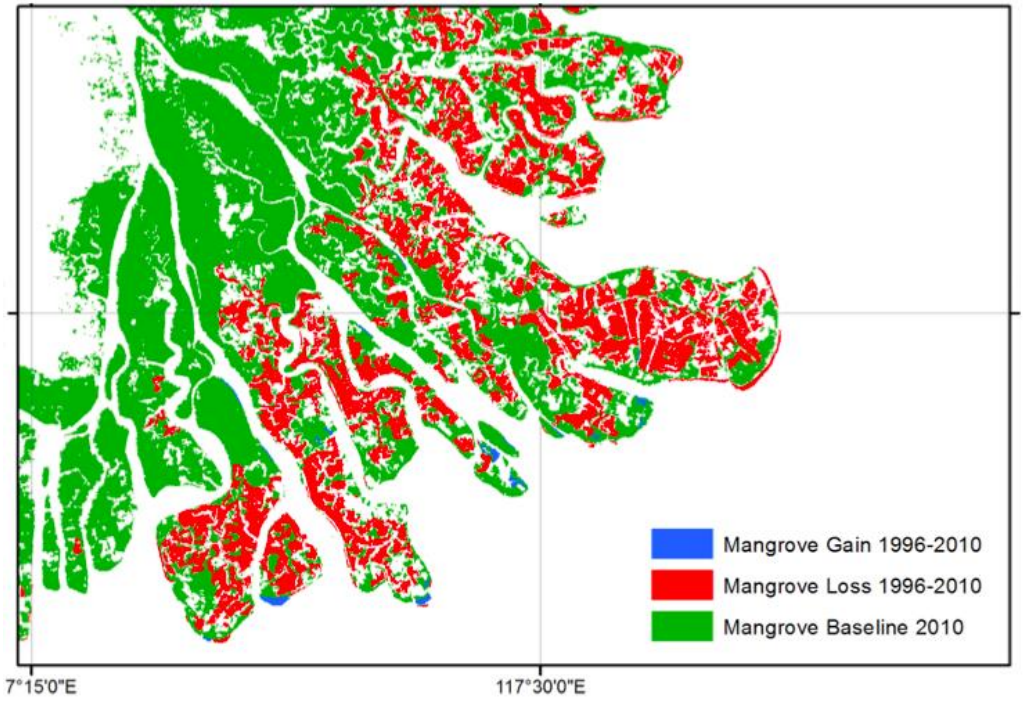
- Aim is for an automated monitoring system
- Make use of the existing map
- Only change things which have changed.
- Assumption of class normality



Anthropogenic changes: Aquaculture and infrastructure

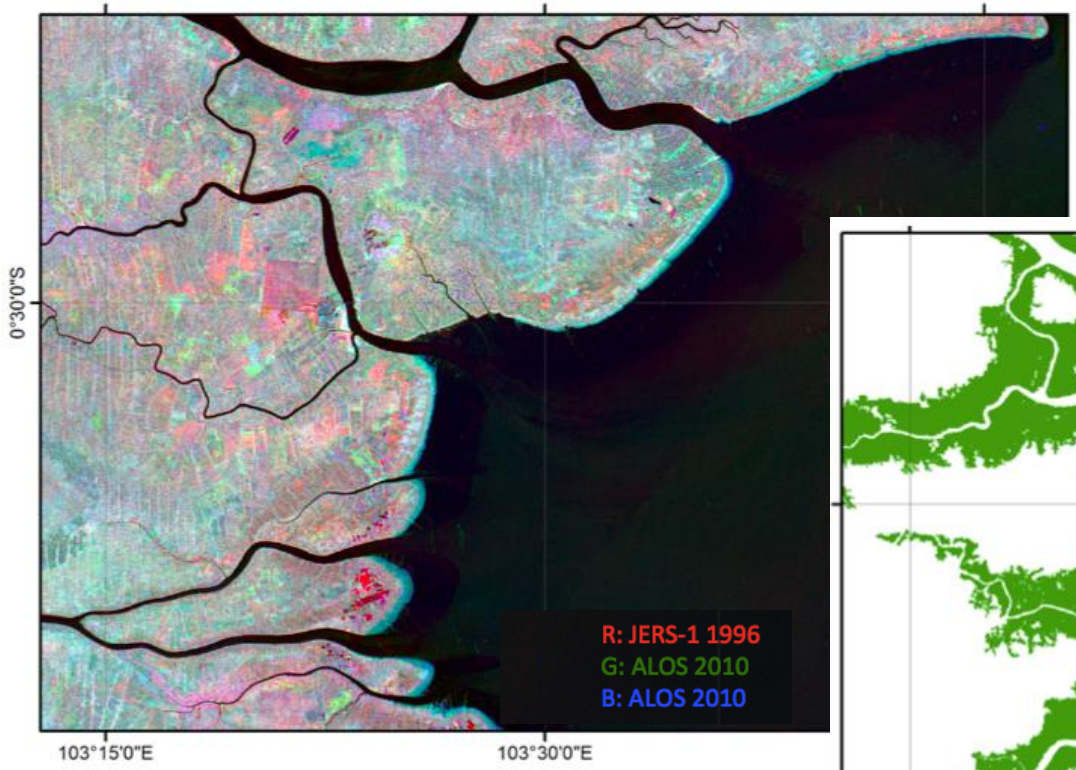


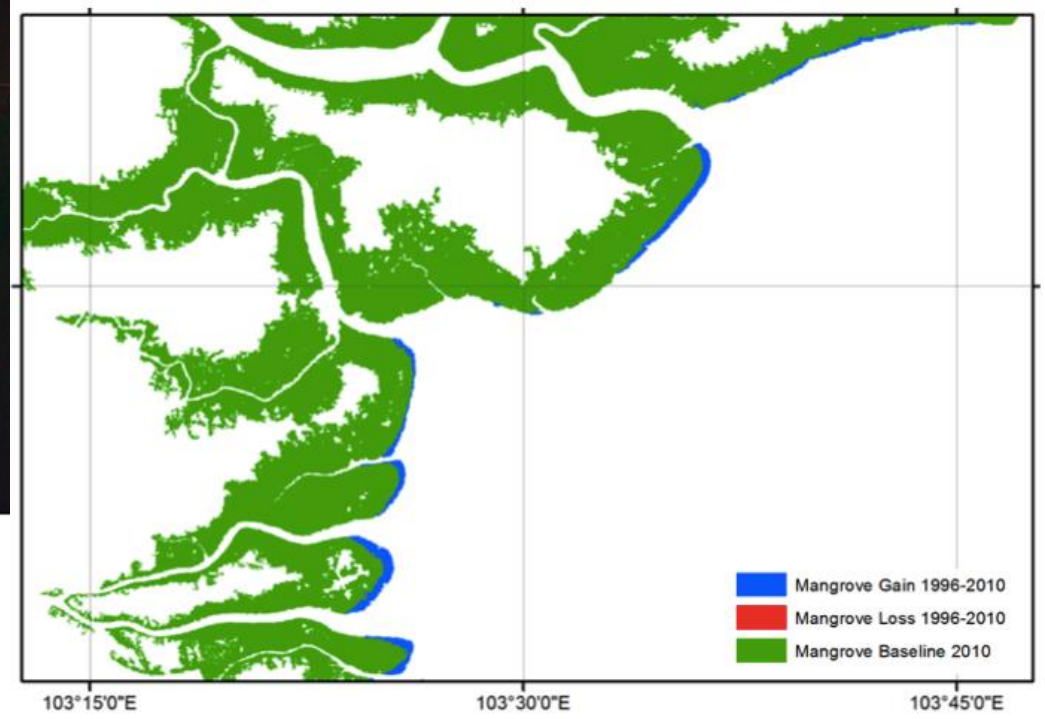
Input: Multi-temporal radar image tiles



Output: Mangrove extent and change map

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





Total Mangrove Extent Per Year

RAMSAR	1996	2007	2008	2009	2010	2015	2016
Africa	27,836	27,470	27,514	27,501	27,465	27,315	27,280
Asia	55,875	53,588	53,606	53,530	53,278	52,717	52,909
European Territories	976	1,010	1,018	1,023	1,026	1,029	1,024
Neotropics	28,909	28,206	28,228	28,201	27,939	27,731	27,716
North America	12,764	12,320	12,427	12,309	11,564	11,879	11,692
Oceania	16,435	16,287	16,301	16,303	16,329	16,054	16,064
	142,796	138,880	139,094	138,867	137,601	136,726	136,685
	100 %	97.3 %	97.4 %	97.2 %	96.4 %	95.7 %	95.7 %

Loss

RAMSAR	2007l	2008l	2009l	2010l	2015l	2016l
Africa	596	572	594	691	813	843
Asia	2,967	2,917	3,005	3,414	3,944	3,777
European Territories	34	31	31	36	43	46
Neotropics	1,138	1,122	1,158	1,453	1,686	1,730
North America	951	904	984	1,676	1,425	1,539
Oceania	282	268	266	263	518	503
	5,967	5,815	6,038	7,532	8,430	8,438
	4.2 %	4.2 %	4.3 %	5.4 %	6.1 %	6.2 %

Gain

RAMSAR	2007g	2008g	2009g	2010g	2015g	2016g
Africa	233	254	263	324	299	293
Asia	727	695	705	863	835	858
European Territories	68	73	77	85	96	94
Neotropics	434	441	450	482	508	536
North America	511	572	534	482	549	474
Oceania	137	136	137	160	142	137
	2110	2171	2167	2397	2430	2394
	1.5 %	1.6 %	1.6 %	1.7 %	1.8 %	1.8 %

Accuracy of Change

	Loss	Gain	No Change		Users
Loss	11287	675	5023	16985	***66.5 %***
Gain	248	6637	2194	9079	***73.1 %***
No Change	1403	1776	16054	19233	***83.5 %***
	12938	9088	23271	33978	
Prods	***87.2 %***	***73.0 %***	***69.0 %***		**75.0 %**

- Overall accuracy of change 75 %.
- 45,297 accuracy points
  - 12938 Loss
  - 9088 Gain
  - 23271 Random Sample No Change

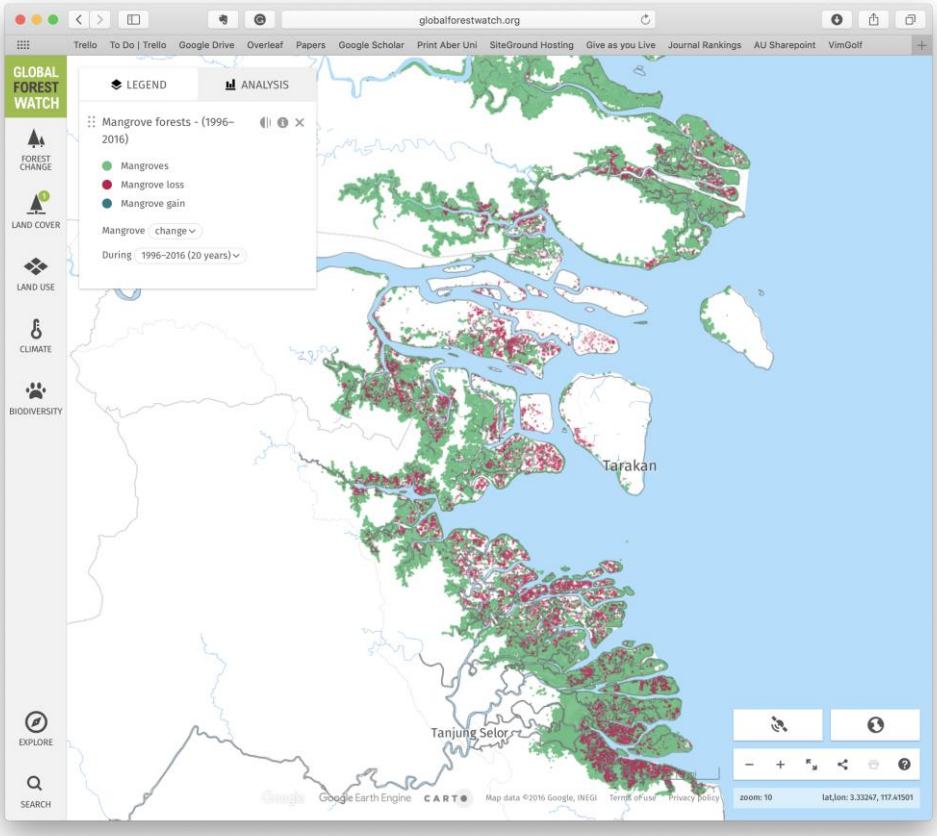
Deliverables and other output

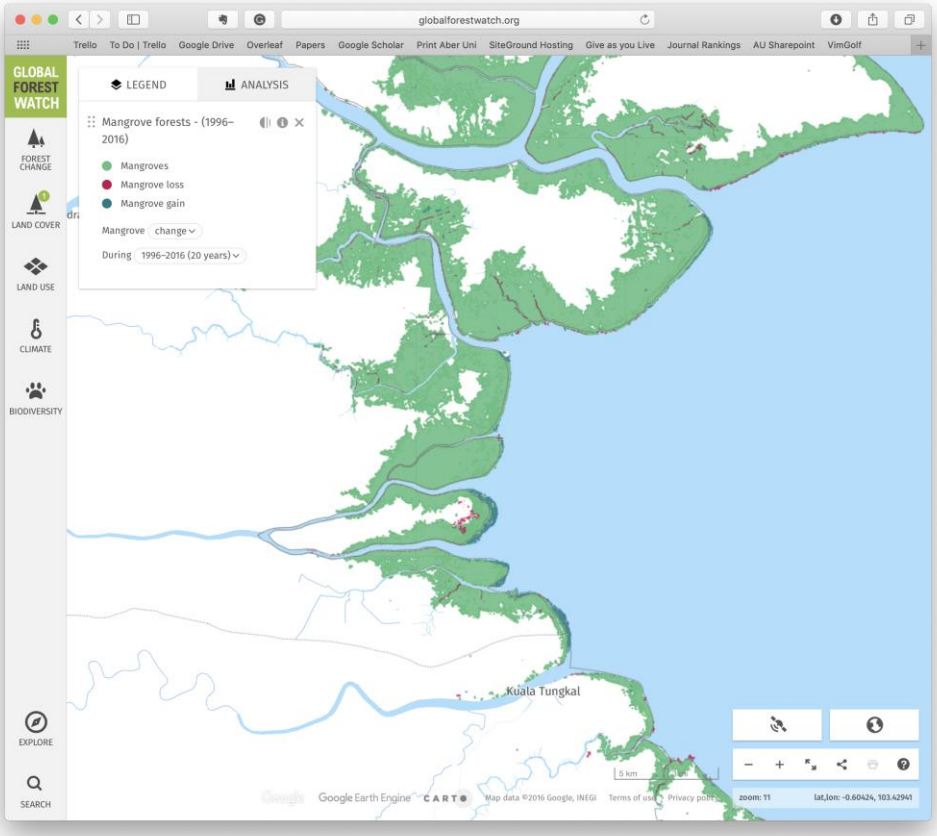
- Data for download:
  - UN Ocean Data Viewer: http://data.unep-wcmc.org/datasets/45
  - Visualisation, including change: https://www.globalforestwatch.org

- Bunting, P., Rosenqvist, A., Lucas, R., Rebelo, L.-M., Hilarides, L., Thomas, N., et al. (2018). The Global Mangrove Watch—A New 2010 Global Baseline of Mangrove Extent. Remote Sensing, 10(10), 1669.

- Thomas, N., Bunting, P., Lucas, R., Hardy, A., Rosenqvist, A., & Fatoyinbo, T. (2018). Mapping Mangrove Extent and Change: A Globally Applicable Approach. Remote Sensing, 10(9), 1466.

Global Forest Watch





Post-KC proposal:

Global Mangrove Watch: Moving to finer spatial resolutions

- Objectives:
  - Detection of extent changes at finer spatial scales
  - Structural Mapping: height, vertical-structure and biomass
- Globally distributed study sites.
- ALOS-3, ALOS-4 and MOLI
  - ALOS-2, Rapideye/Sentinel-2 and GEDI can be used to develop methods.
- Relevance to the 4 K&C thematic drivers:
  - RAMSAR Reporting, SDG6.6.1 (reporting on wetlands extents), Carbon cycle science
- Expected outcomes and deliverables
  - Globally applicable methods applied to study regions
  - If data available then global application