Overview of REDD+ activities in Indonesia:

Role of remote sensing satellite data in the Indonesia's National Carbon Accounting System (INCAS)

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Outline

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- Indonesia's National Carbon Accounting System (INCAS):
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  - Carbon accounting model
  - Requirements
  - Land cover change component:
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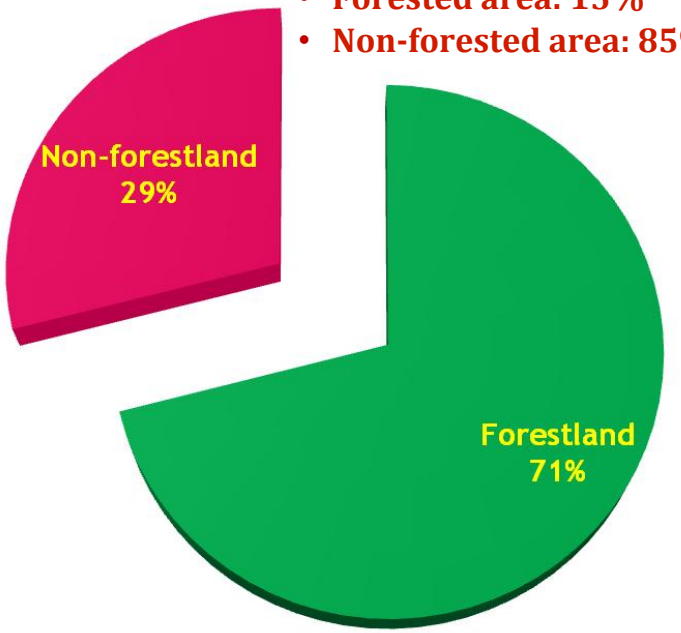
    - Method
    - Up-to-date and expected outputs
    - Utilization of SAR data
- Closing Remarks

Indonesia's commitment on REDD+

Total area of Indonesia: 187.8 million ha

Non-forestland:
- **Forested area: 15%**
- **Non-forested area: 85%**



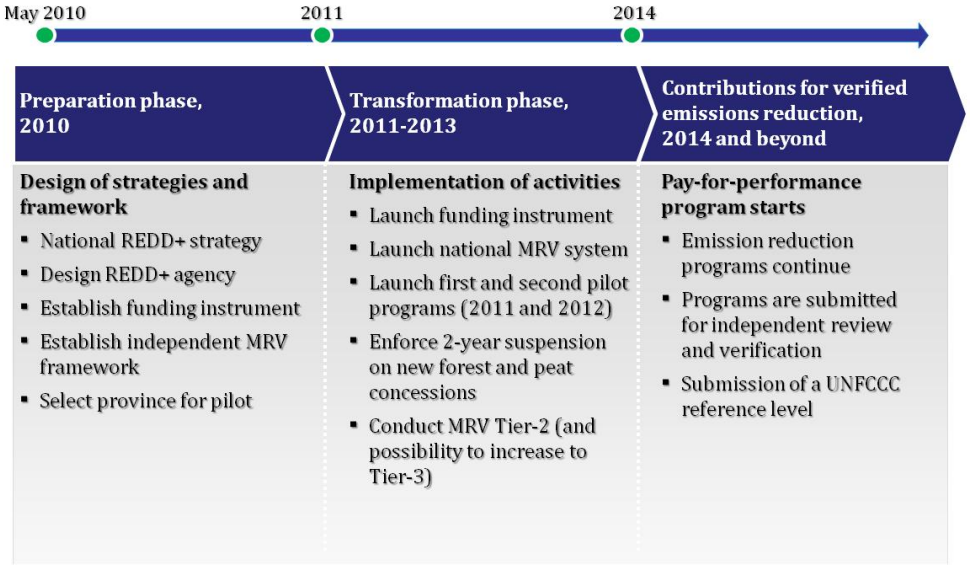
Forestland:
- **Forested area: 70%**

(28% conservation area, 43% production area)
- **Non-forested area: 30%**

Source: Landsat 2005/2006
(published by Min. of Forestry in 2008)

- **Deforestation** and **forest degradation** contribute 17%-20% of world emissions.
- 75% of deforestation and forest degradation occur in the tropics, including Indonesia.
- **Forestry** and **peatland** are significant components (60%) of Indonesia GHG emissions (2020 BAU scenario).

- In G20 summit (Pittsburgh, September 2009), Indonesia committed **26% emission reduction** or **41% reduction with the international supports in 2020.**
- Letter of Intent between Indonesia and Norway was signed in May 2009.

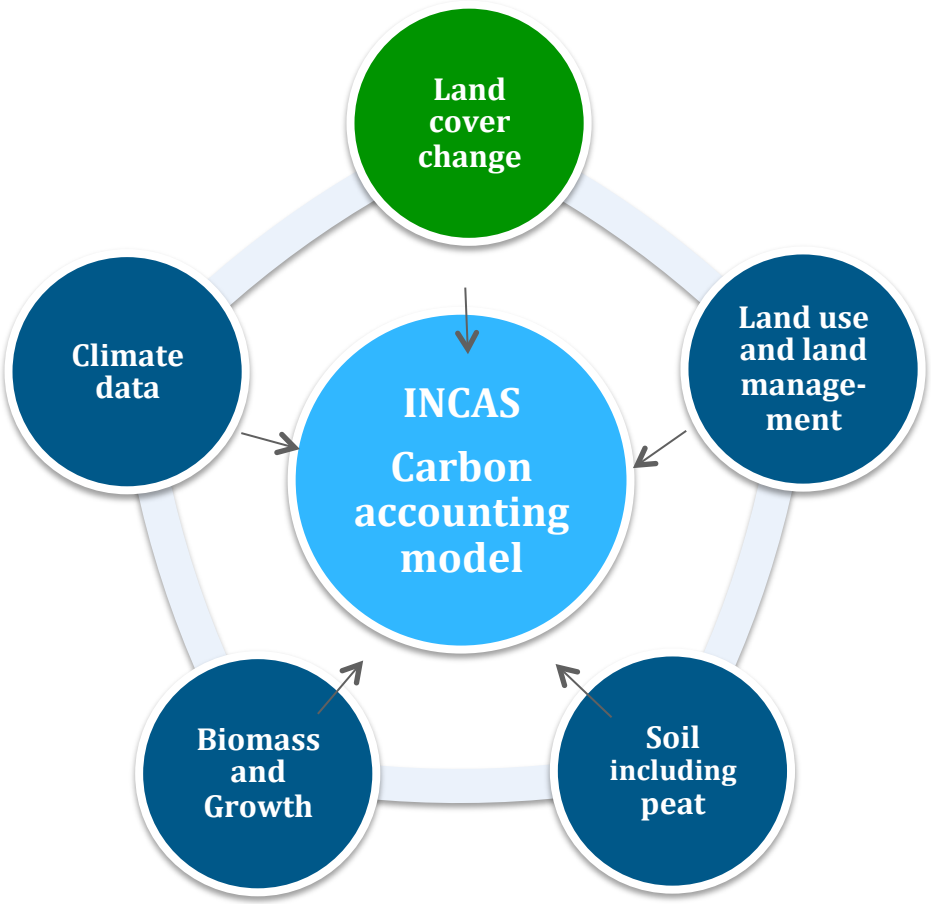


Indonesia's National Carbon Accounting System (INCAS)

Objective (2009-2013):

- INCAS will provide a comprehensive and credible account of Indonesia's land-based emissions profile and sinks capacity.
- INCAS will support Indonesia's reporting requirements under the UNFCCC and a post-2012 climate change agreement.
- It will also support entry to carbon markets and the overall MRV system.

Key components of the INCAS



Indonesia-Australia
Forest Carbon Partnership

Carbon accounting and reporting model

A Annual Forest Cover and Cover Change

Annual time-series defining areas of:

- Deforestation (permanent loss of forest cover)
- Degradation (forest clearance and regeneration or partial removal)

By biomass class

B Forest Disturbance Class Mapping

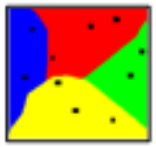
National map of forest disturbance classes at known date

- Minimal disturbance
- Moderate disturbance
- Heavy disturbance

E Carbon Accounting and Reporting Model (ICARM)

C Biomass Classification

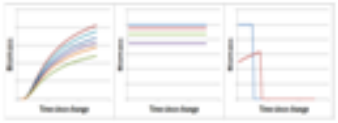
Classification of forests into groups (biomass classes) with common biomass characteristics



D Biomass Estimation

Biomass estimates for each biomass class:

- Aboveground biomass
- Root:Shoot ratios
- Litter
- Debris
- Soil
- Growth / loss rate by management



INCAS requirements

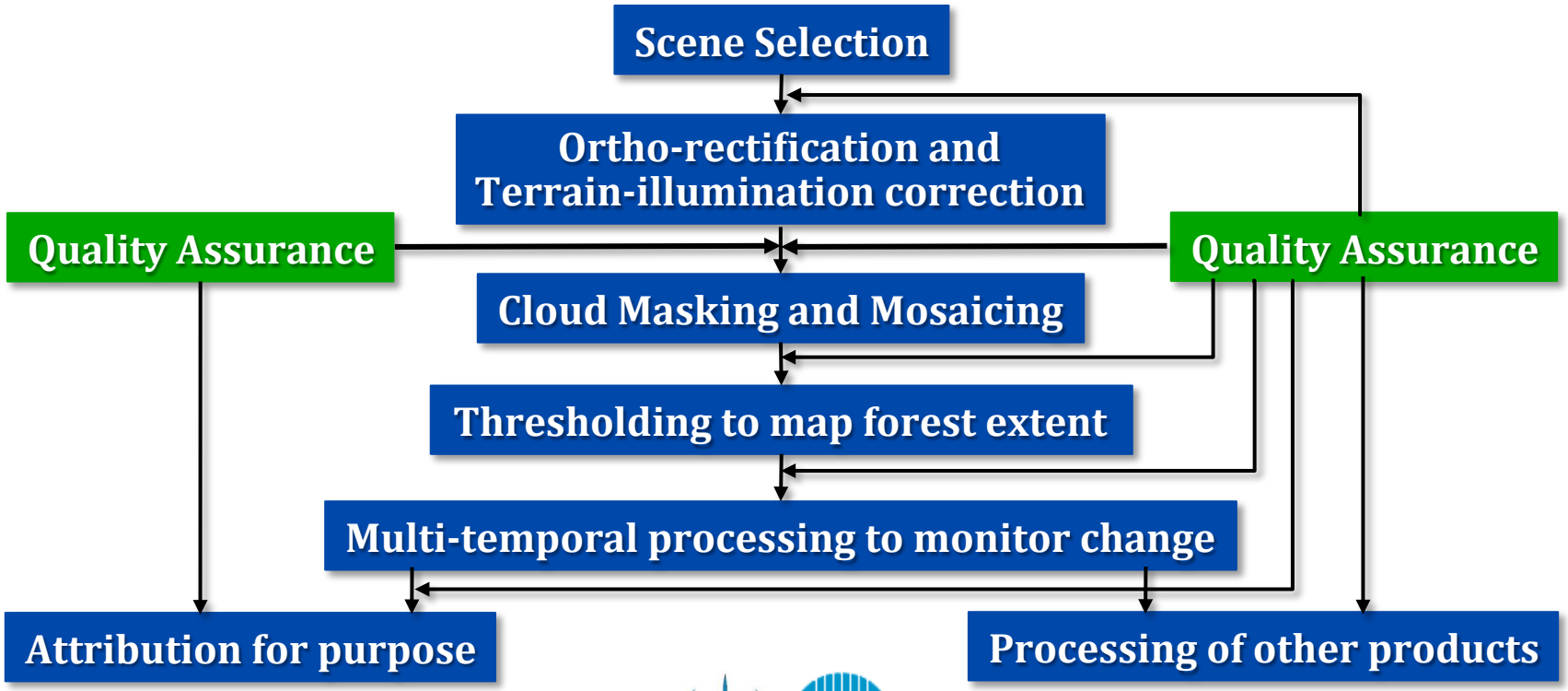
- Wall-to-wall coverage (Forest and Non-forest estate)
- Annual emissions and all carbon pools (and possibly GHGs)
- Scalable (sub-national to national)
- Systematic with ensured continuity of data availability for time-series consistency
- Verifiable and transparent
- Able to scenario test different land use and management scenarios
- Nationally consistent (e.g. in use of forest definition, method)
- Improvable (an inventory development plan for improved data and methods).

Land cover change component

Objective:

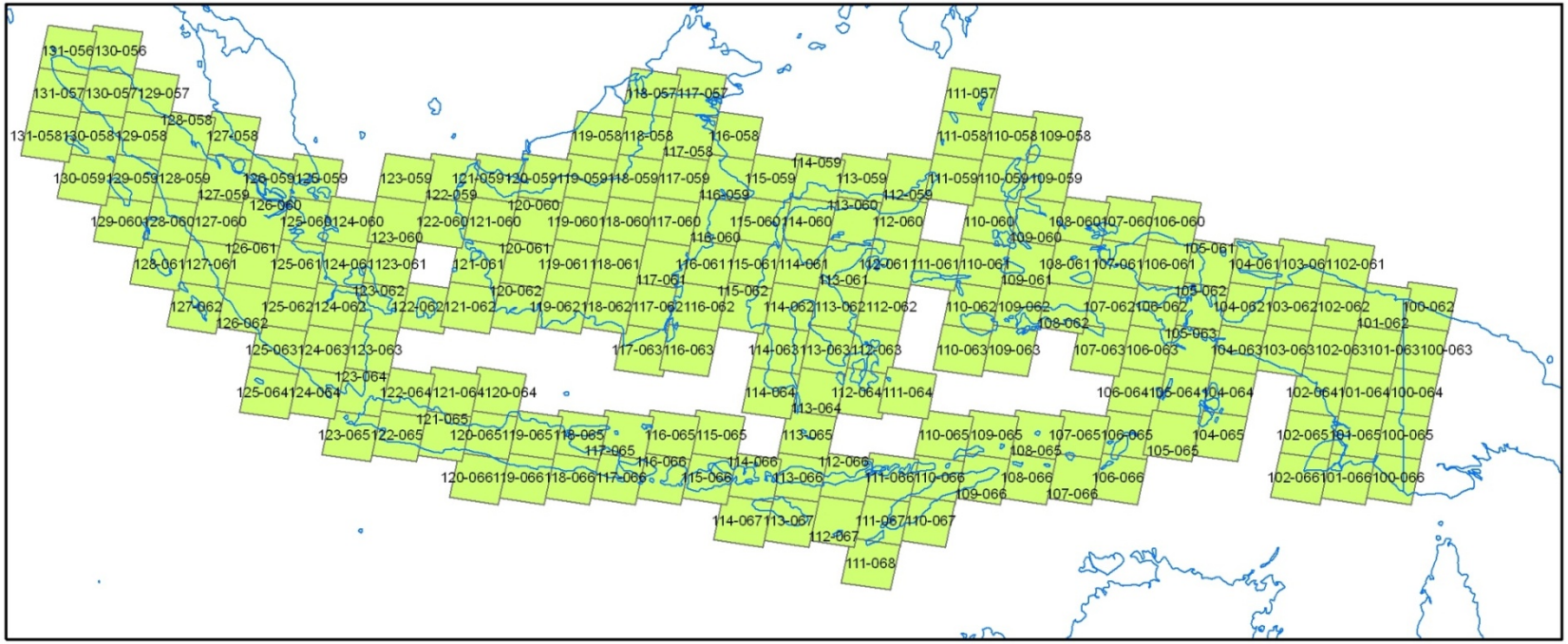
- Wall-to-wall land cover/land cover change
- Consistent, verifiable and transparent

Land cover change processing stream



Remote sensing data

Landsat path-row coverage over Indonesia



Landsat data sources:

- Geosciences Australia (GA)
- GISTDA (Thailand)
- USGS (USA)
- LAPAN (Indonesia)

Processed Landsat data (2000-2009)

Year	Kalimantan (45 scenes)	Sumatera (52 scenes)	Papua (37 scenes)	Sulawesi (28 scenes)	Others (70 scenes)
2000	70	106	42	27	85
2001	95	113	85	52	134
2002	114	123	60	40	111
2003	51	60	51	38	95
2004	90	116	75	58	136
2005	111	119	71	48	141
2006	101	126	72	64	133
2007	83	94	64	48	115
2008	83	76	50	54	110
2009	139	96	79	58	124
Total	**937**	**1029**	**649**	**487**	**1184**

Note :

- Total Landsat data for Indonesia region: **232 scenes**.
- Total Landsat data (2000-2009) available for Indonesia region : **4,286 scenes**.

Landsat data (1990-1999)

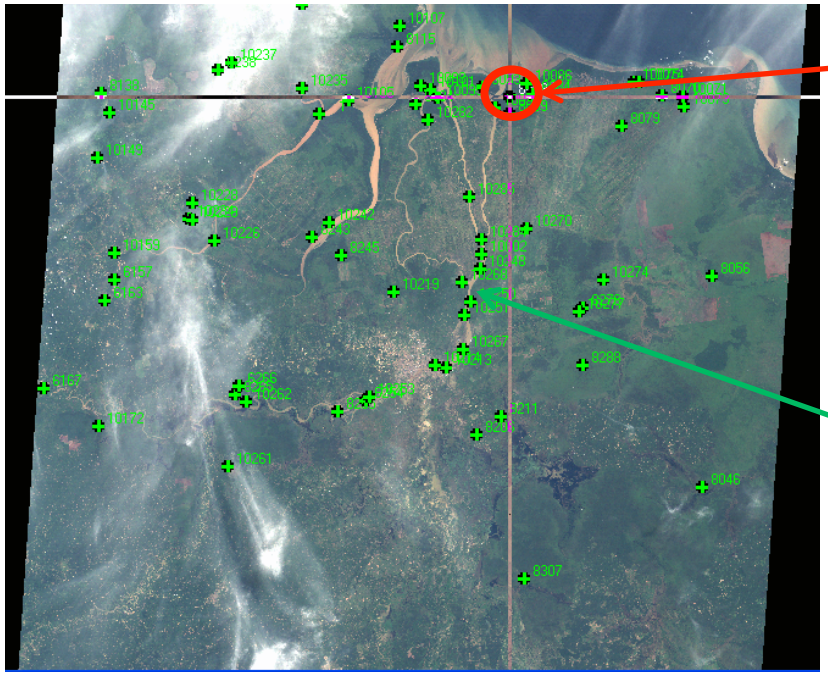
Year	Kalimantan (45 scenes)	Sumatera (52 scenes)	Papua (37 scenes)	Sulawesi (28 scenes)	Others (70 scenes)
1990	114	138	30	11	28
1991	115	135	11	31	48
1992	90	103	6	3	35
1993	96	131	12	1	29
1994	102	127	5	---	17
1995	111	175	20	12	58
1996	11	6	8	10	13
1997	27	20	9	10	33
1998	---	---	---	---	---
1999	86	83	58	41	97
Total	752	918	159	119	358

Notes:

- Landsat data for Kalimantan and Sumatera (1990 – 1995) have been obtained compeletly.

Ortho-rectification

GCP distribution



One selected GCP manually

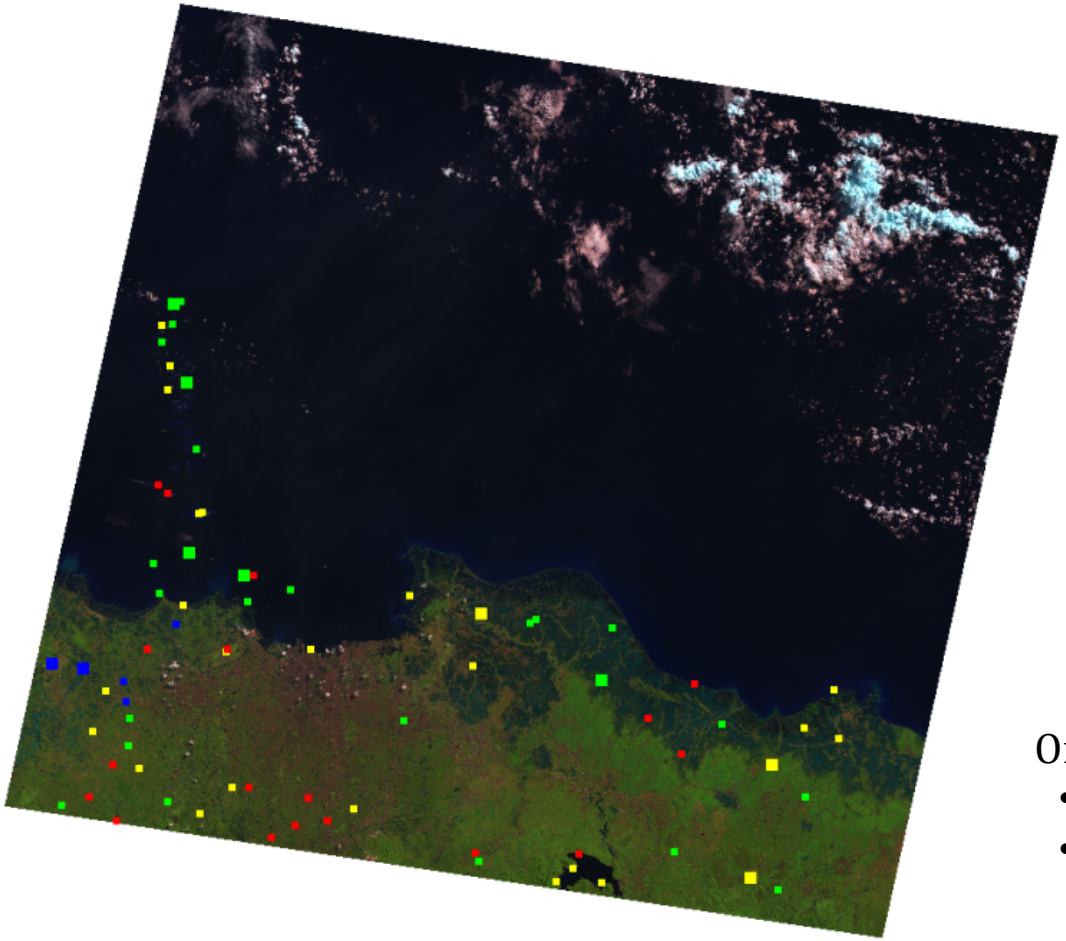
GCPs generated automatically:

- Master reference GCP database (300 GCPs/scene)
- Scene orientation (~8.1 deg)

Note :

1. Data: Landsat L1G, GCPs, GLS 2000, and SRTM 90 m.
2. Method: Three step ortho-rectification (source: CSIRO).

Ortho-rectification Quality Assurance



Error direction:

Blue : NE error direction
Green : SE error direction
Yellow : SW error directtion
Red : NW error direction

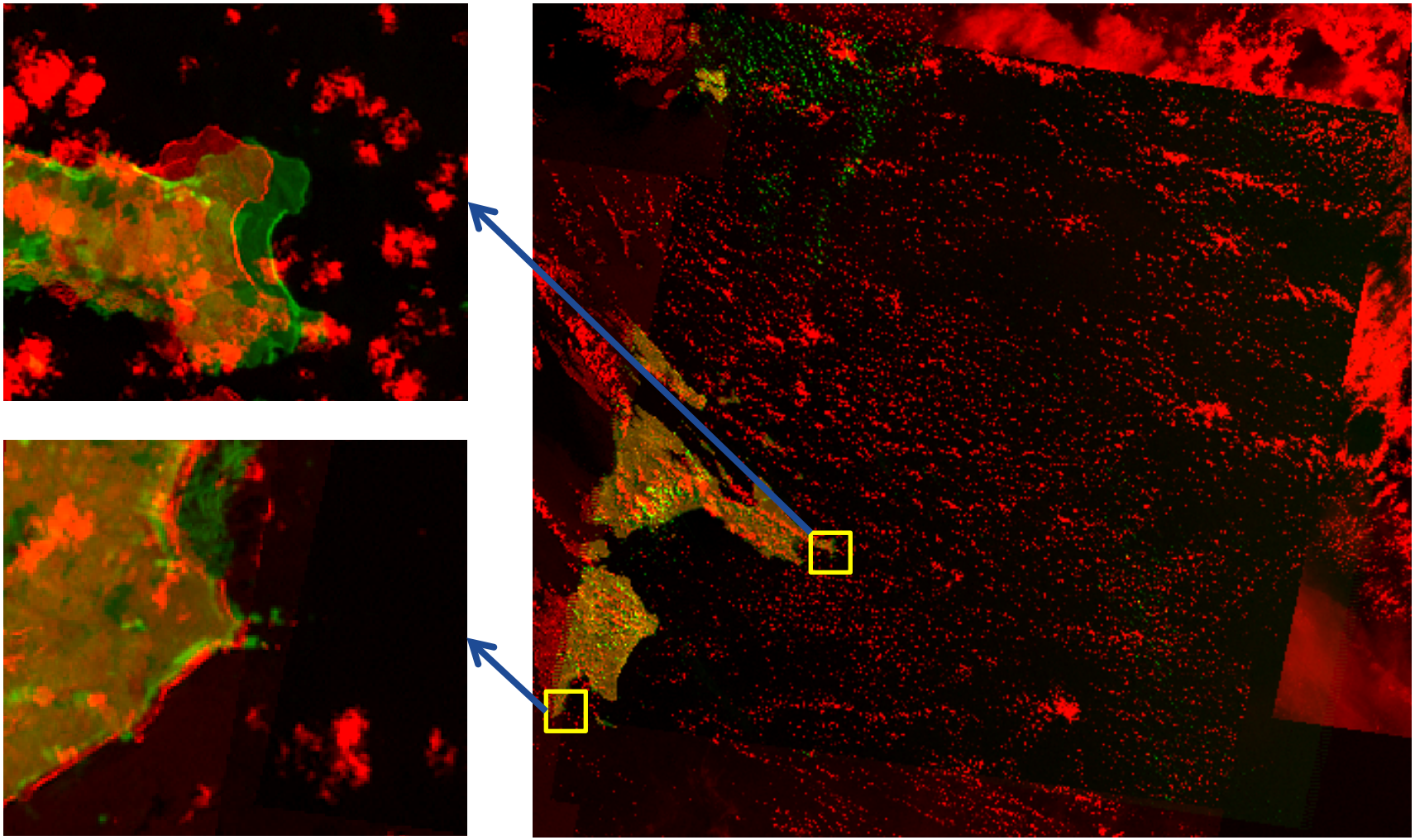
: < 1 pixel error
: 1-2 pixel error
: > 2 pixel error

Ortho-rectification QA pass if :

- RMS error < 1.2 pixel, and
- Visual inspection error < 1 pixel

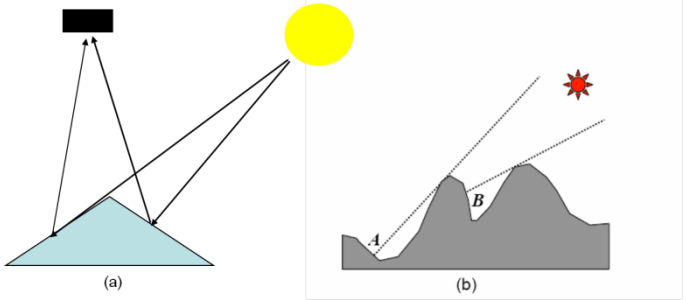
Ortho-rectification Quality Assurance

Landsat-5 (124/060, date: 30 Aug 2004, ID: LT5124060200424 3BKT00)



Red layer : Band 5 - GLS 2000 (reference)
Green layer : Band 5 – Landsat-5 (124/060, date: 30 August 2004)

Terrain correction

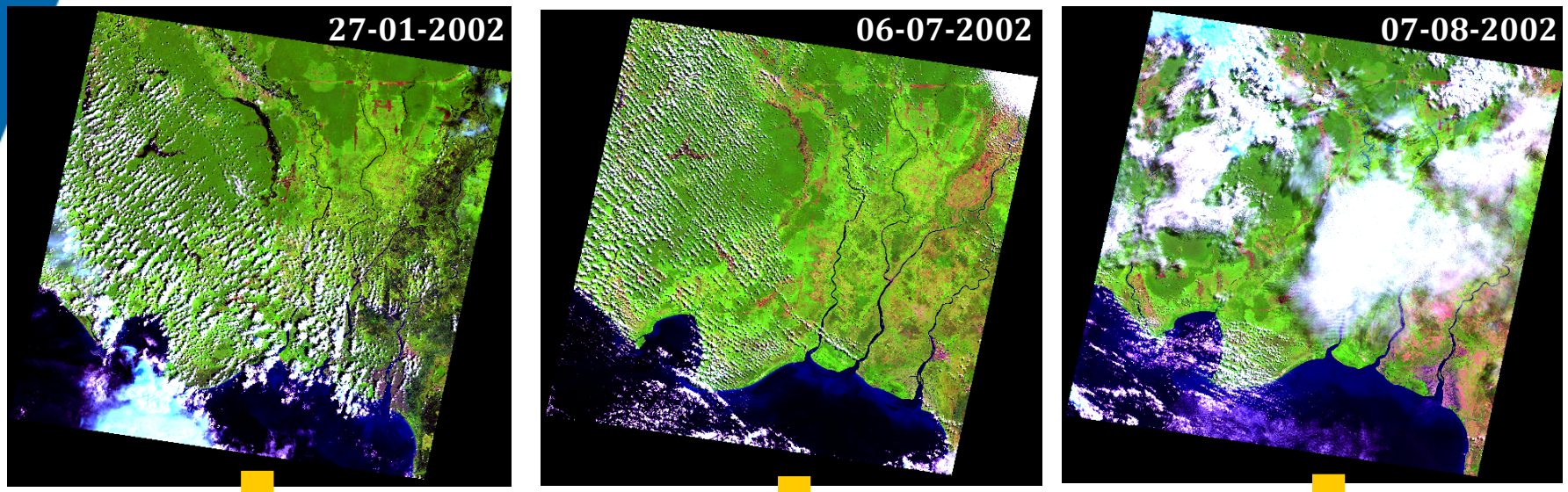


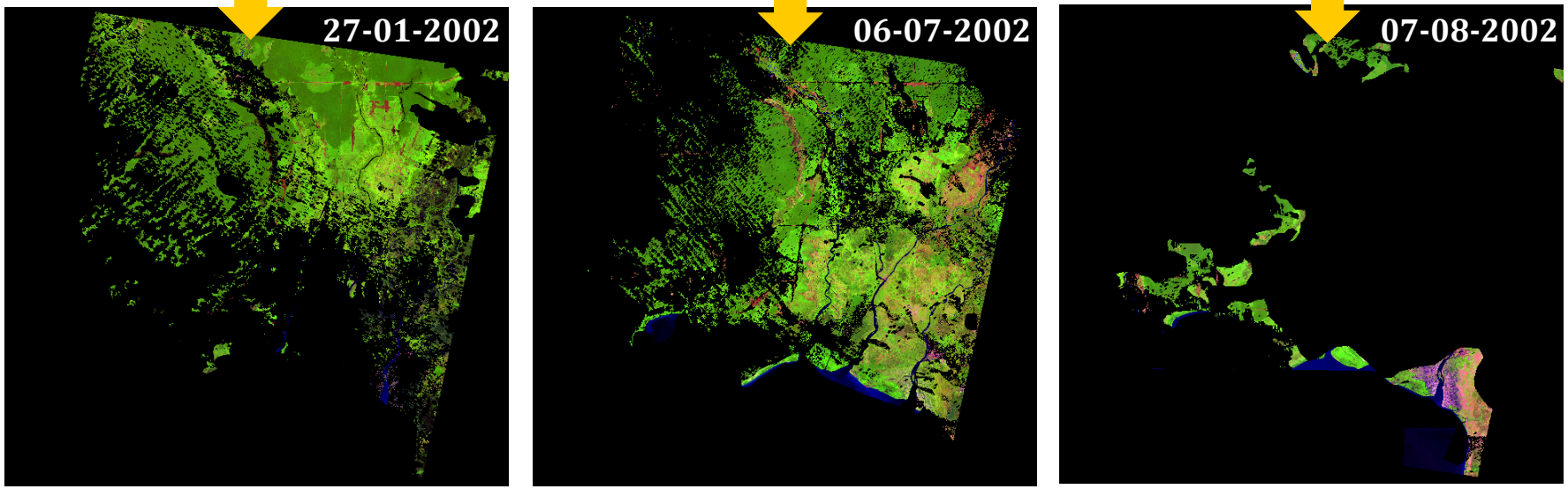
Sides of hills facing the sun have more input radiation to reflect and appear 'brighter' than sides of hills facing away from the sun.

The LOS profile:
'A' receives no direct input radiation and so is in shadow and is set to no 'data'.
'B' receives direct input radiation and a correction is applied.

Cloud masking

Terrain corrected scenes

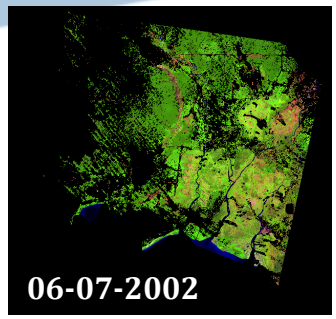


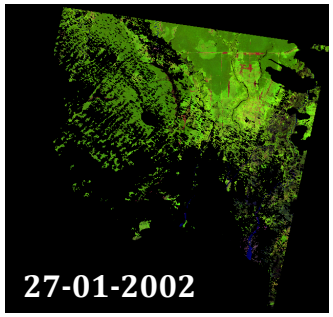


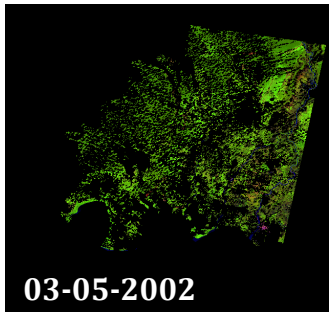
Cloud masked scenes

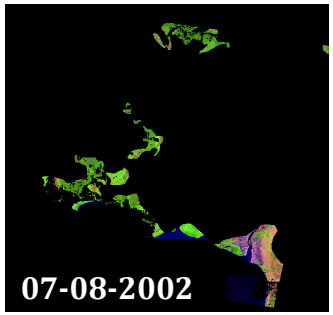
Mosaicing

Cloud masked scenes

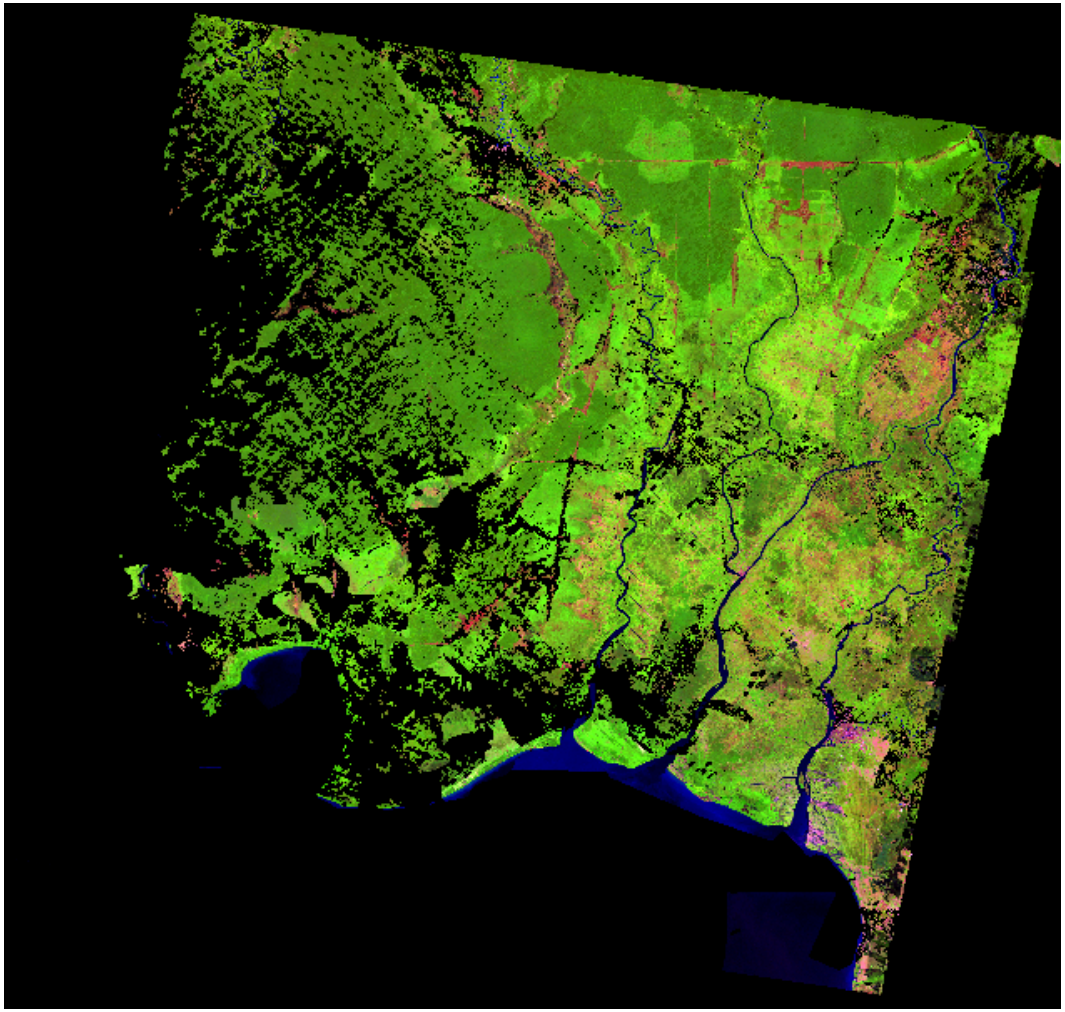






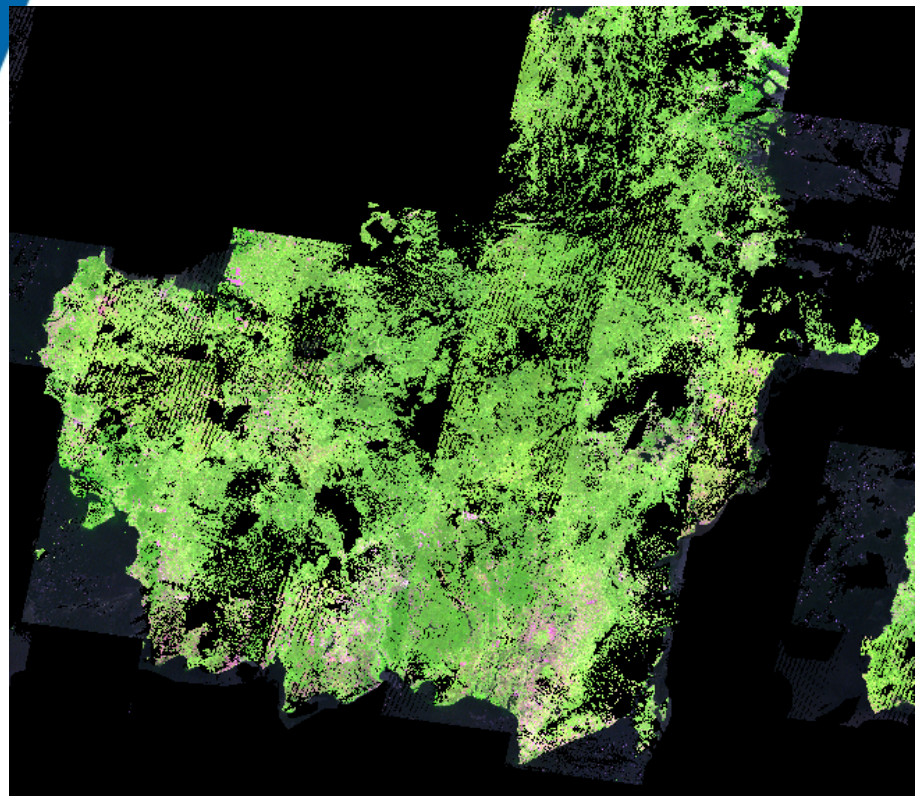


Cloud masked mosaic scene (2002)

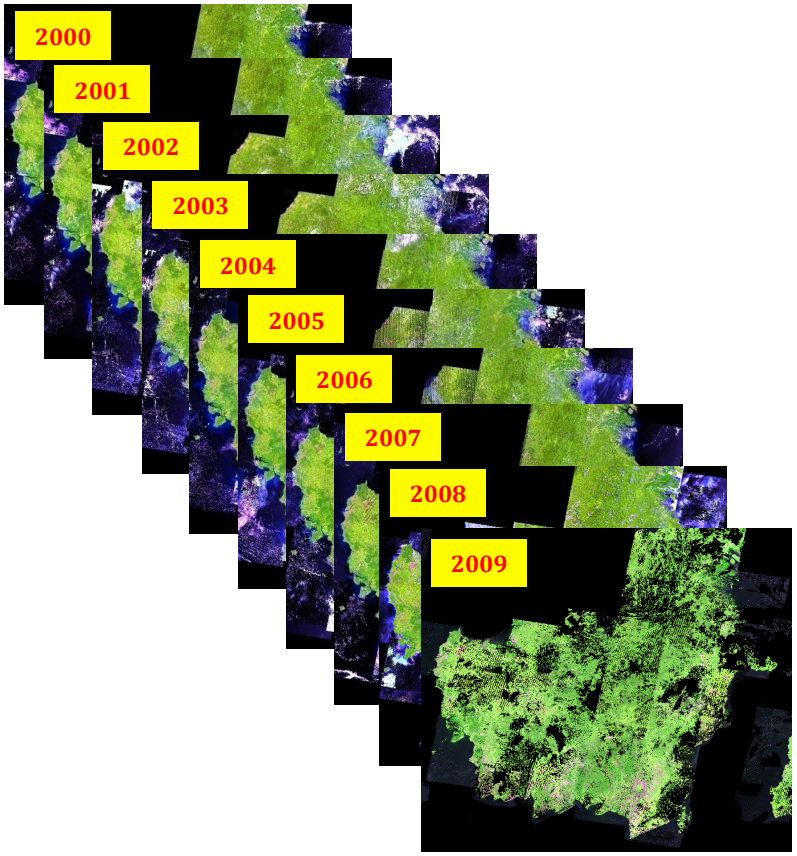


Annual cloud masked mosaic images

Cloud masked mosaic images (Kalimantan, 2008)

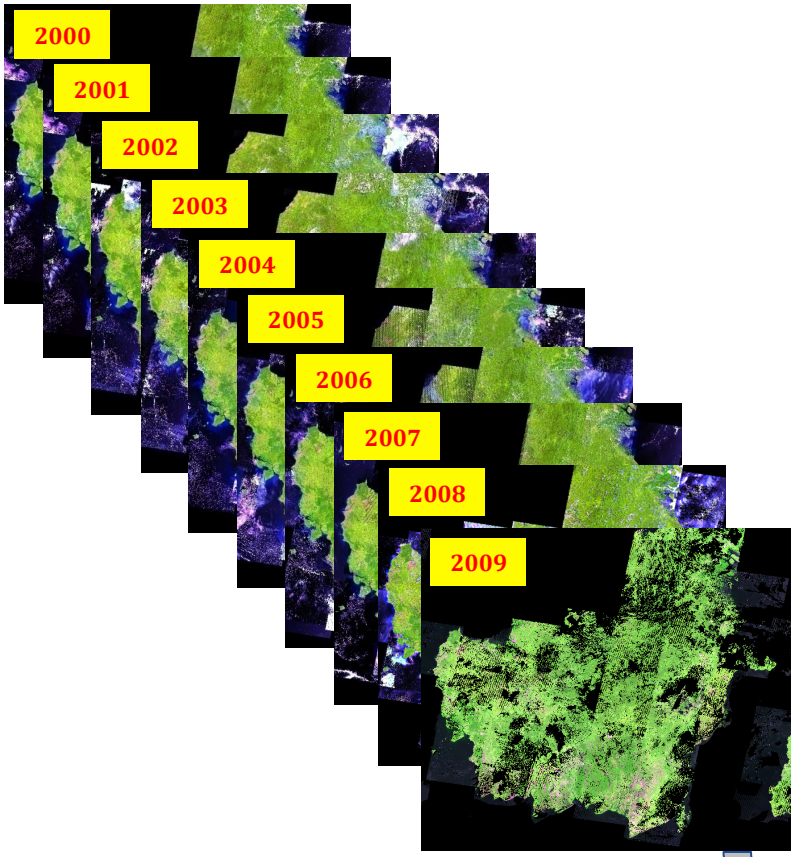


Annual cloud masked mosaic images (Kalimantan, 2000-2009)

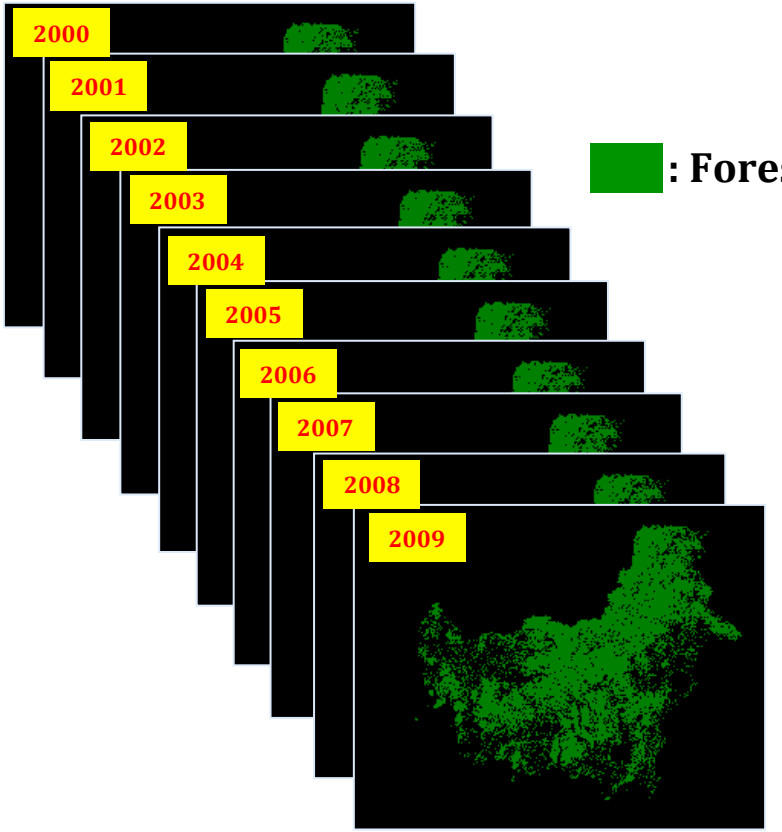


Annual forest map

Annual cloud masked mosaicing (Kalimantan, 2000-2009)



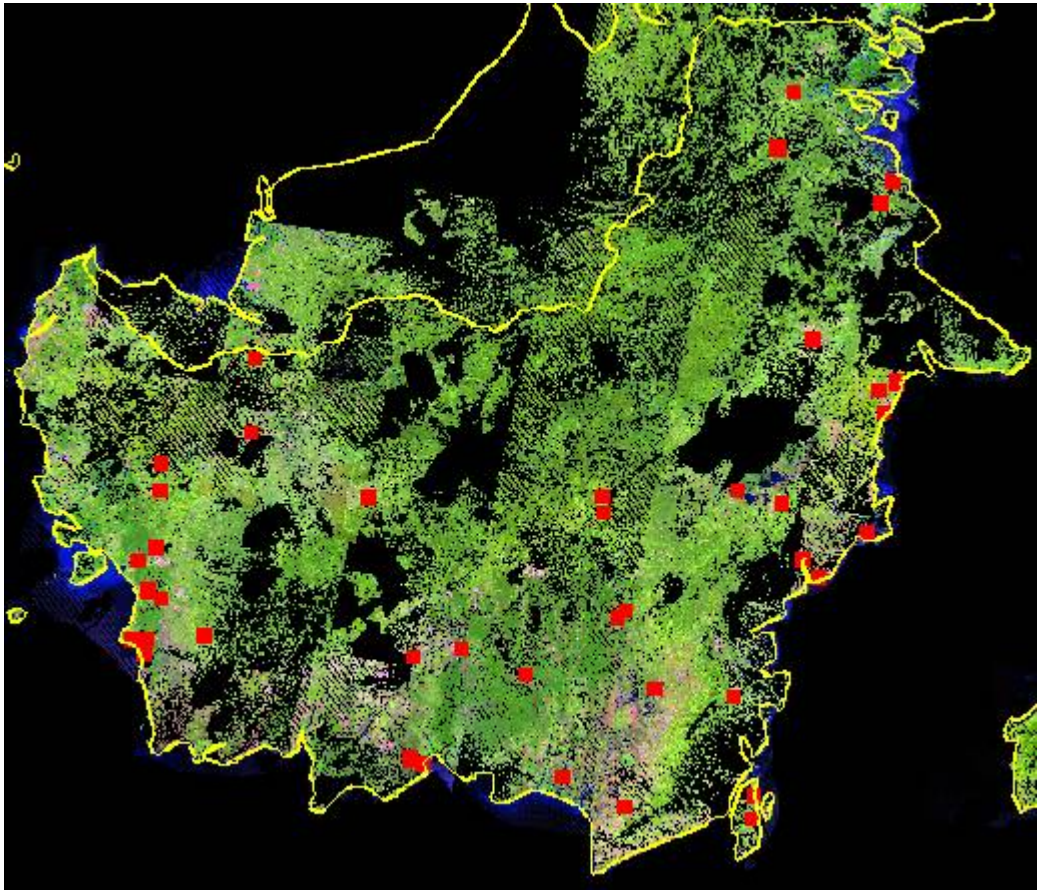
Annual forest map (Kalimantan, 2000-2009)



Bayesian probability

Interpretation of the high-resolution imagery

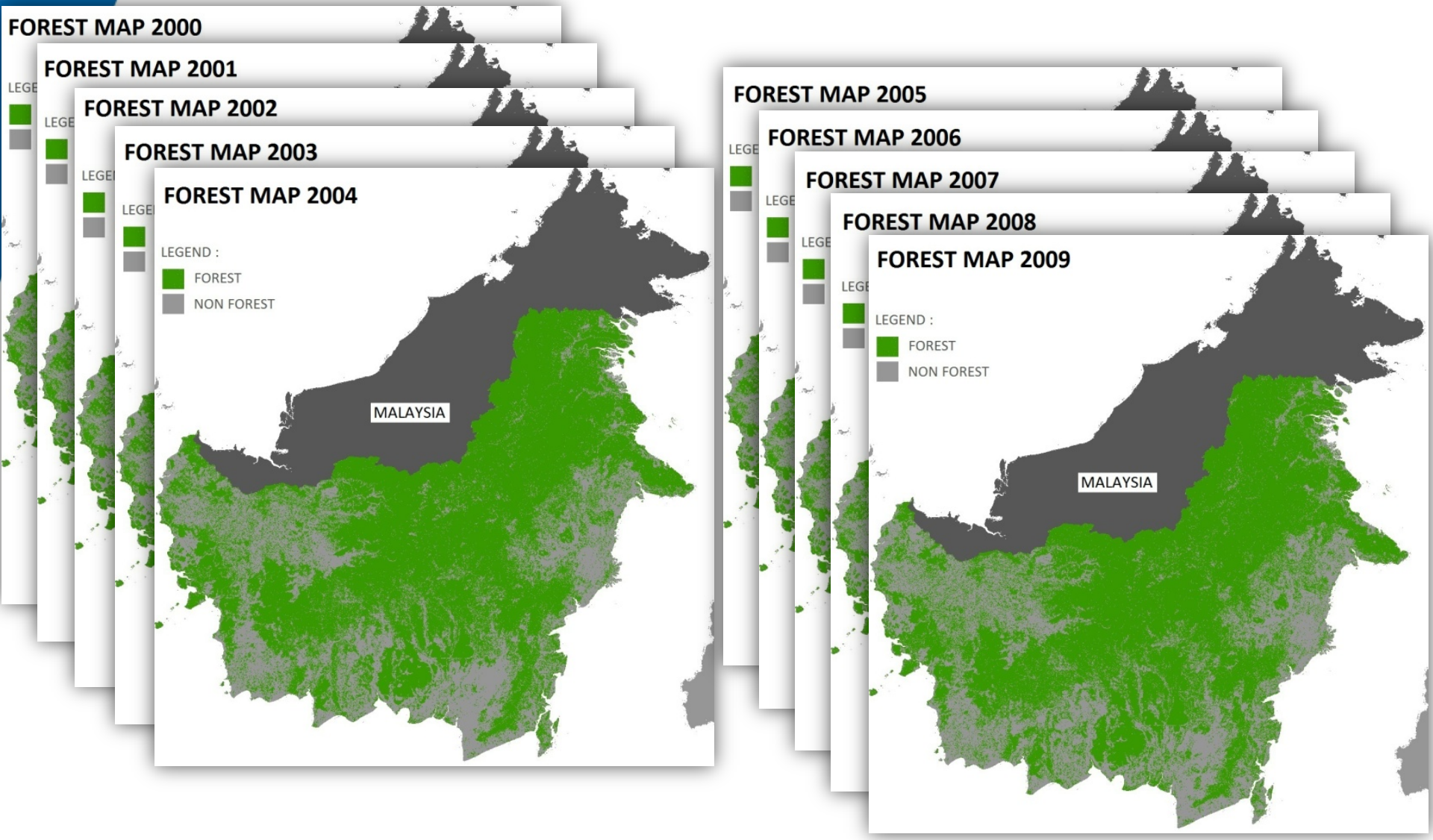
High-resolution data (1-2m) and local expertise utilized to create a forest base for 2008.



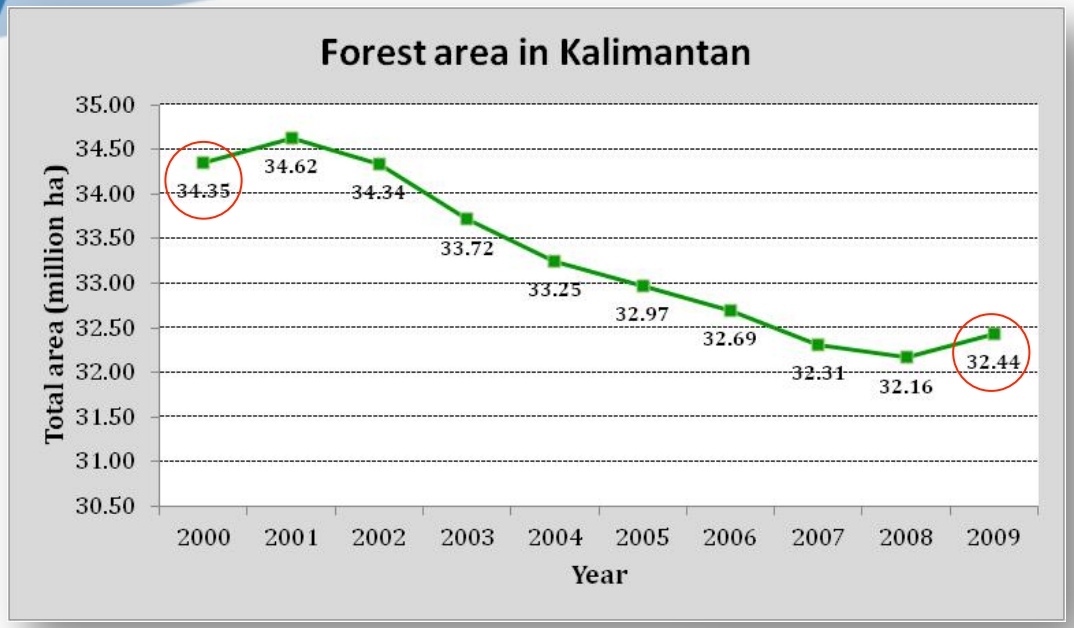
- 53 high-resolution images utilized from Quickbird, Ikonos, World View-2, and Geo Eye-1 from 2001 to 2010 (mostly 2007 to 2009).

The position of the cloud gaps varies between years. The forest classification will estimate land cover from the 'before' and 'after' years to fill cloud gaps.

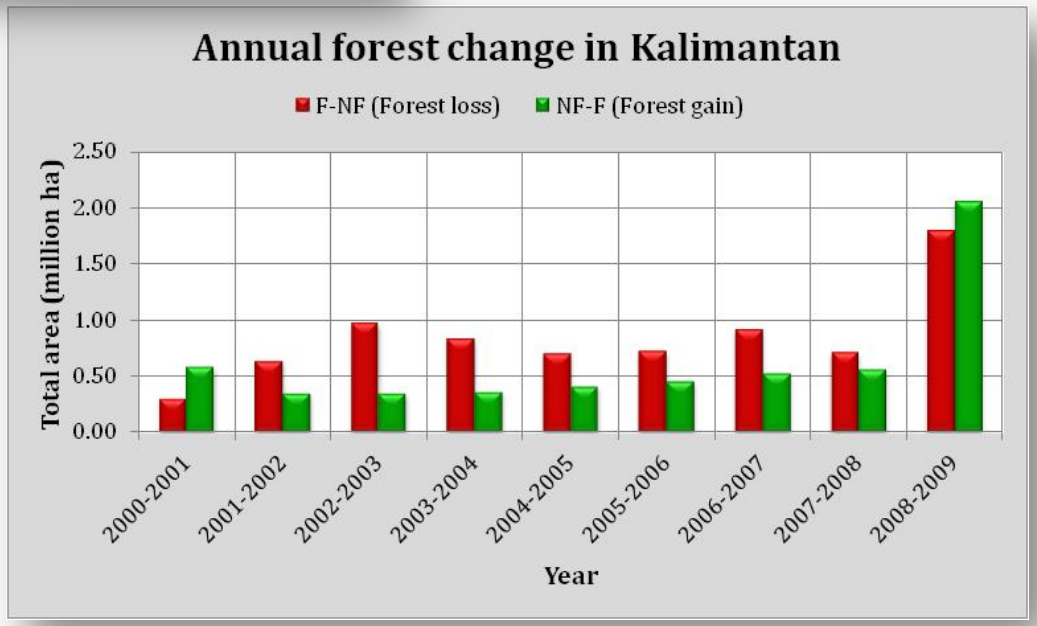
Forest/Non-Forest Map (Kalimantan, 2000-2009)



Annual forest and forest change areas (Kalimantan)



: The result has not been included with the previous or later years



Outputs from Land Cover Change

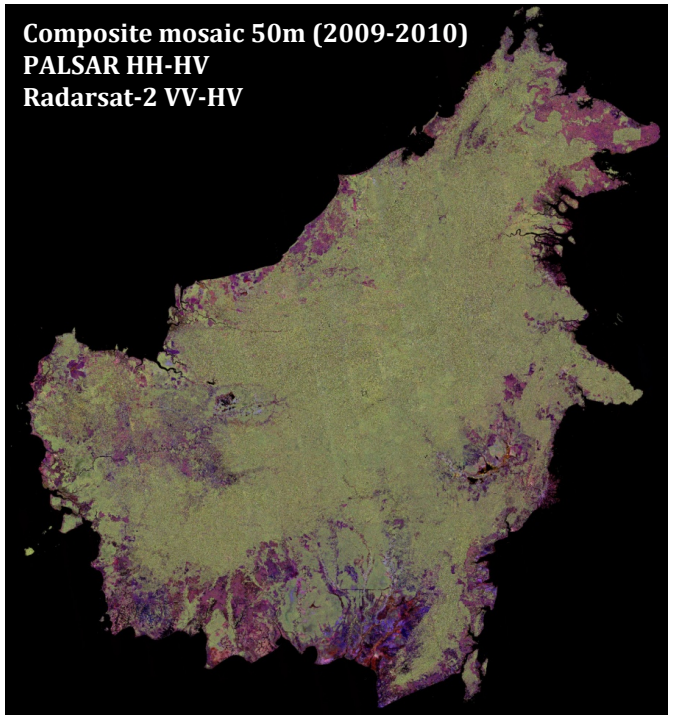
Up-to-date and expected output from the Land Cover Change component:

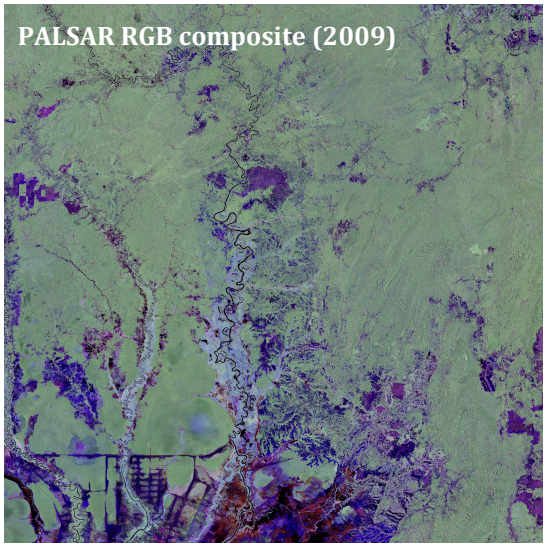
- Nov 2011: Kalimantan FNF map (2000-2009)
- May 2012: Sumatera FNF map (2000-2009)
- Jun 2012: Papua FNF map (2000-2009)
- Sep 2012: Sulawesi FNF map (2000-2009)

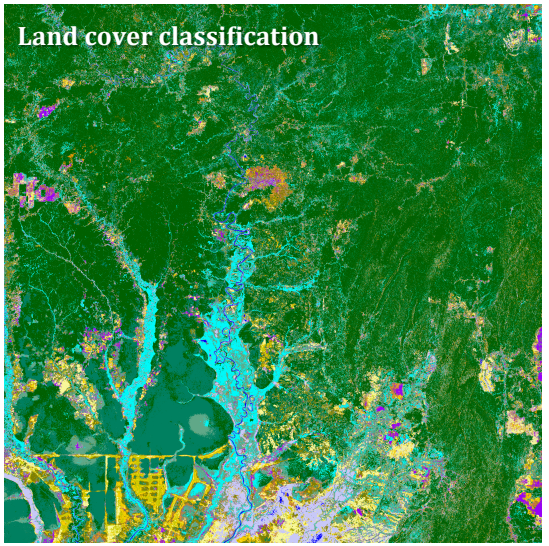
In parallel, Indonesia data for 1990-1999 start to be collected. With increasing data processing system, these data would be processed faster.

Utilization of SAR data

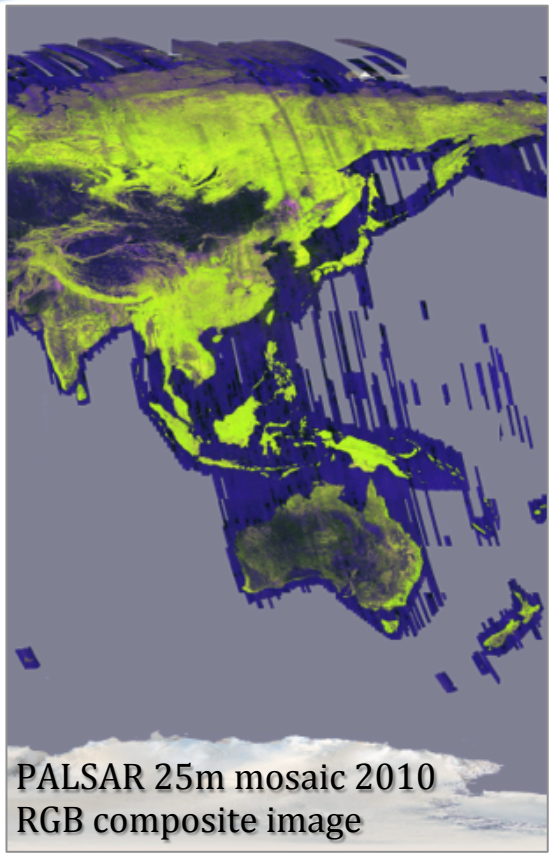
- In collaboration with Wageningen University (2010-2011).
- To result in:
  - Specifications for an operational radar-based forest and land cover monitoring system in Indonesia according to international guidelines.
  - The transfer of dedicated radar satellite image processing system to Indonesia.
  - The training of Indonesian technical staff in the use of system.
  - The production of (radar-based) forest and land cover maps covering entire Borneo and/or Sumatera of the period of 2007-2010 using this system.

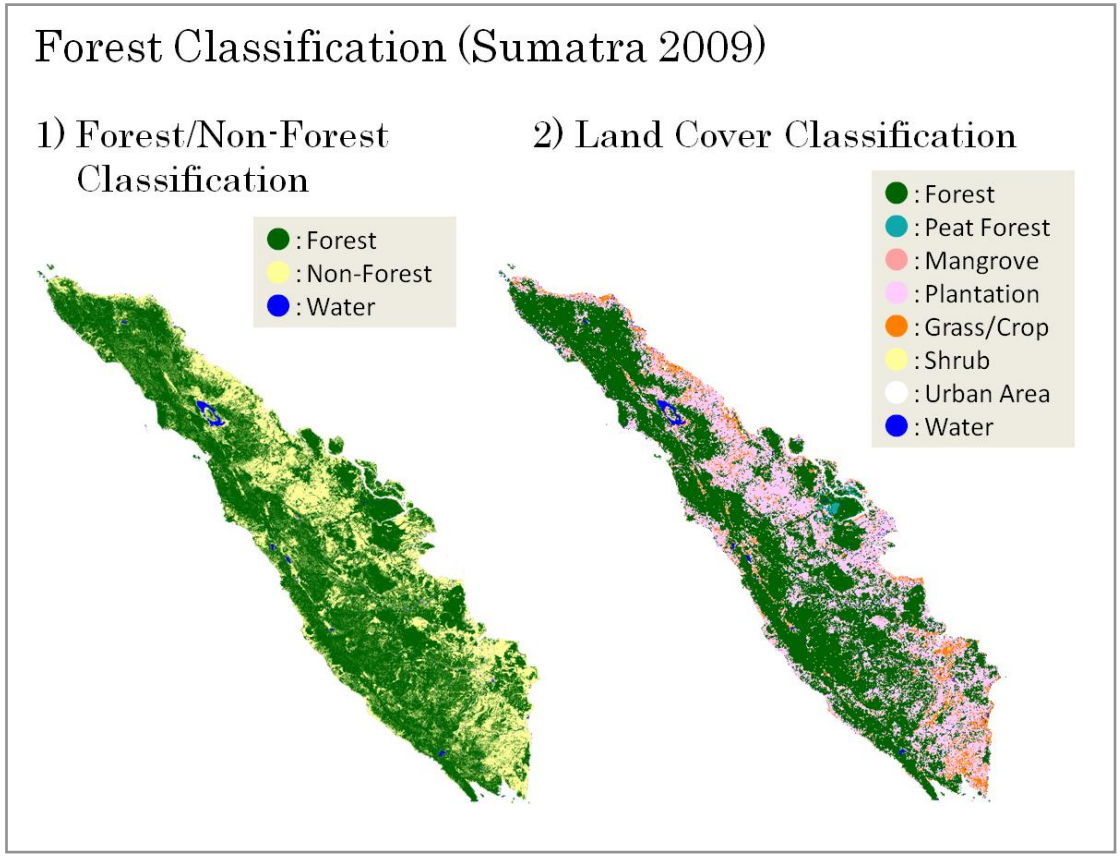






Utilization of SAR data





- In collaboration with JAXA (2011-2013) in Kyoto&Carbon-3 (KC-3).
- Objectives:

  To conduct the use of ALOS PALSAR archives and the verification dataset in Sumatra island through: the development of forest carbon tracking modellings, capacity building, data sharing, ground-truth experiments, information production, and workshop/seminar.

Closing remarks

- INCAS (2009-2013) will result in a comprehensive and credible account of Indonesia's land-based emissions profile and sinks capacity at the national scale.
- INCAS will utilize the systematic satellite remote sensing (optical and SAR) data to produce the time-series consistency of annual land cover/ land cover change maps with high accuracy level.
- The annual land cover change, forest disturbance classes, biomass classes, and biomass estimates for each biomass class integrated into the Indonesian Carbon Accounting and Reporting Model (ICARM) will quantify the carbon estimates.

THANK YOU