

K&C Phase 4 –Status report

Updating Forest Cover and Assessing Aboveground Biomass in Various Tropical Forest Ecosystems from PALSAR-2 Polarizations

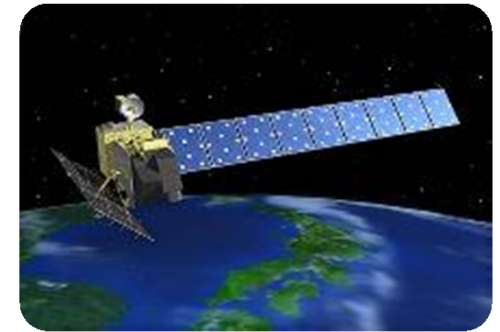
Hamdan Omar
Research Officer
Forest Research Institute Malaysia (FRIM)

Science Team meeting #22
Tokyo, Japan, February 16-18, 2016



Project Summary

Kyoto & Carbon Initiative (Phase 4)



TITLE:	Updating Forest Cover and Assessing Aboveground Biomass in Various Tropical Forest Ecosystems from PALSAR-2 Polarizations
DURATION:	2.5 years (October 2015 - March 2018)
EXEC. AGENCY:	Forest Research Institute Malaysia (FRIM)
STUDY AREA:	Peninsular Malaysia

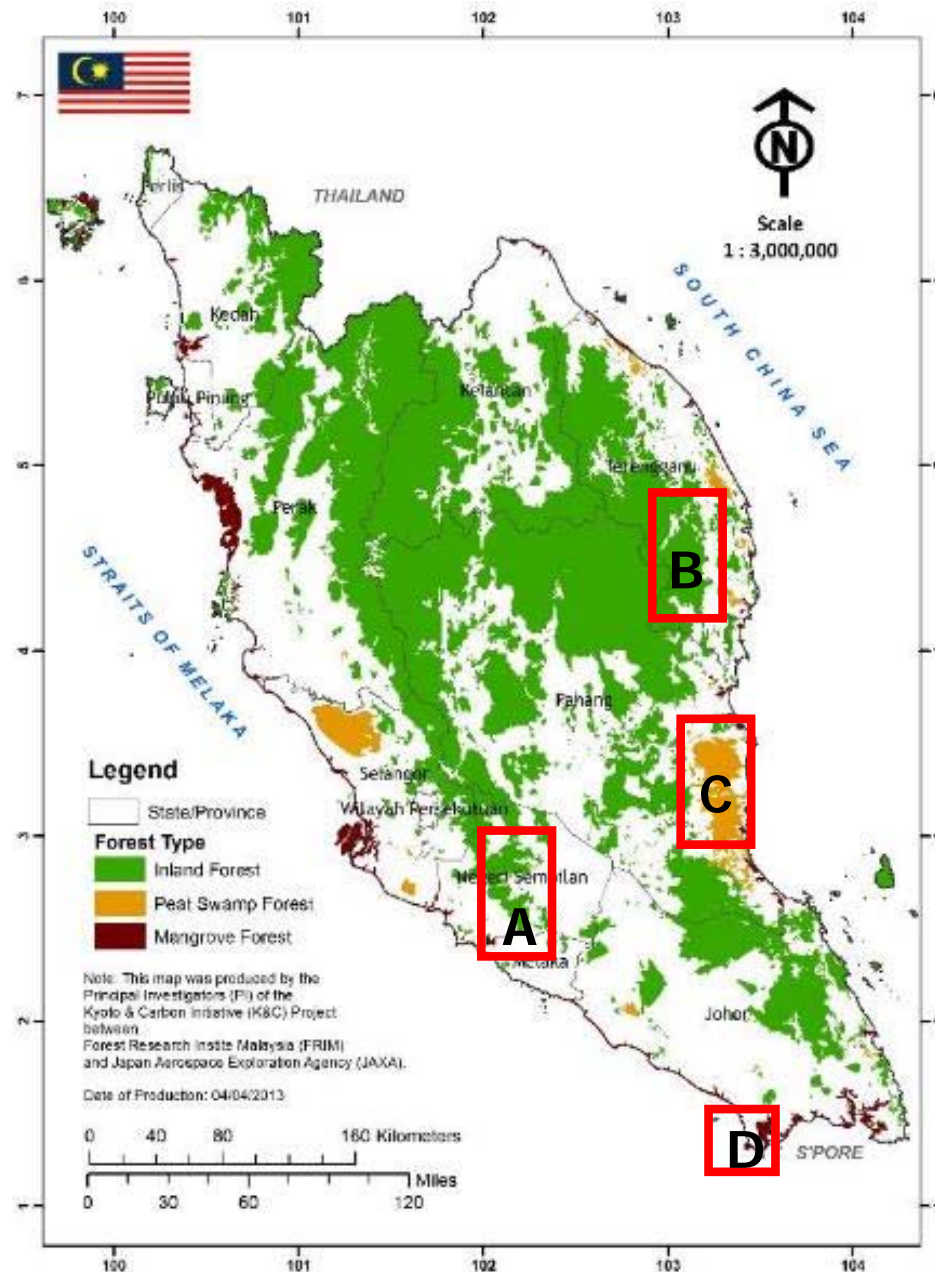
Objectives

- i. To develop a robust method for monitoring forest cover in Peninsular Malaysia by using a single PALSAR sensor. This to make sure consistent reporting, which has opportunity to be promoted and employed in REDD+ implementation.
- ii. To conduct a detailed study on the use of PALSAR (especially PALSAR-2) data for retrieving aboveground biomass in three key forest ecosystem in Malaysia, which are inland dipterocarp, peat swamp and mangrove forests.
- iii. To develop methods for accurate assessment of aboveground biomass on these forest ecosystems.

Deliverables

The project is aiming at the following deliverables and will producing:

- i. An updated forest cover map over the entire Peninsular Malaysia.
- ii. Spatially distributed maps of aboveground biomass in lowland dipterocarp forests (virgin and logged-over).
- iii. Maps of aboveground biomass on peat swamp and mangroves forests.
- iv. Methods and models for estimating aboveground biomass on the lowland dipterocarp, peat swamp and mangroves forest ecosystems in Malaysia.



Study Area

Focus Area K&C Phase 4

- A. CTFS Research plot (Virgin lowland dipt.)
- B. Dungun Timber Complex (production area lowland and hill dipt.)
- C. Pekan Peat swamp forest
- D. Kukup Island National Park (mangrove forest)

Project Milestones

No.	Key-milestone	Date of completion (Proposal)	Date of completion (Actual)
i	Maps of forest cover in Peninsular Malaysia of year 2015	June 2015	January 2016
ii	Forest inventory (i.e. ground truth) datasets	September 2015	April 2016
iii	Spatial distribution map of AGB over focus-study area A: CTFS research plot	December 2015	June 2016
iv	Spatial distribution map of AGB over focus-study area B: Logged forest in Dungun Timber Complex.	March 2016	Sept 2016
v	Spatial distribution map of AGB over focus-study area C: Peat swamp forest in South East Pahang.	June 2016	March 2017
vi	Spatial distribution map of AGB over focus-study area D: Kukup Island mangroves, Johor	September 2016	June 2017
vii	Maps of AGB in Peninsular Malaysia of year 2015	June 2017	Sept 2017
viii	Project report	March 2018	March 2018

Data sharing

Types of forest	Natural Forest				Total samples
	CTFS Research plot	Dungun Timber Complex	Peat swamp forest	Kukup Island mangrove forest	
No. of Sampling Points	50 (50 ha)	60 (108,000 ha)	60 (200,000 ha)	60 (500 ha)	230

Data will be collected on the ground and will be stored in digital shapefile (.shp) in point format. Each point will contain geographic location, forest types, basal area information, date of ground thruthing, and aboveground biomass.

All maps produced from this project will be also delivered to JAXA.

Definitions



FOREST

- A forest must have at least with **30% crown cover**, with the minimum area spanning **0.5 ha** and the minimum stands **height of 5 m** at maturity.

[by NRE]

DEFORESTATION

- Human induced permanent conversion of forest land to non- forest.
- All of the forest is cut and the land is cleared and used for another purpose.
- Temporary change in land use, like one rotation tree crop (up to 25 years) within forest reserves are not considered as deforestation

[by NRE]

**Drivers of
deforestation**

- Landuse category that have been converted permanently from forest area.

[by FRIM-ITTO REDDES Project]

Major forest types



Hill & Upper Hill Dipt. forest



Mangrove forest



Lowland Dipt. forest

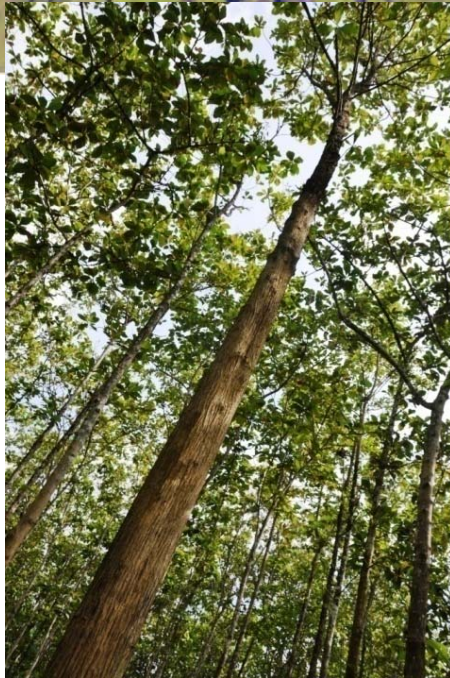


Peat Swamp forest

Montane/oak forest



Teak plantation forest



Granite/quartz Ridge forest



Rubber (TLC) plantation forest



Limestone forest



Fresh water swamp forest



Gelam forest

Progress:

The ALOS-2 PALSAR-2 (FBD 6.25m) images of year 2015 over the entire Peninsular Malaysia have been downloaded

JAXA ID: PIKC1627 Home Obs. Plan Product Search Cart Order History Help Logout

Search Condition: Basic Advance Scene ID Topic Filter

☒ ALOS-2

- ☒ PALSAR-2
 - ☒ Observation width 25km/Resoluti
 - ☒ Observation width 50km/Resoluti
 - ☒ Observation width 50km/Resoluti
 - ☒ Observation width 70km/Resoluti
 - ☒ Observation width 350km/Resolut
 - ☒ Observation width 490km/Resolut
- ☐ ALOS
 - ☐ AVNIR-2
 - ☐ Observation width 70km/Resoluti
 - ☐ PRISM
 - ☐ Observation width 35km/Resoluti
 - ☐ Observation width 70km/Resoluti
 - ☐ PALSAR
 - ☐ Observation width 70km/Resoluti
 - ☐ Observation width 350km/Resolut

Observation Date: 2015/01/01 to 2020/12/31

Cloud Coverage: 0% to 100% (AVNIR-2, PRISM)

Search Results Total Result Matched: 573 Displaying: 573 Filtered: 0

☐ Show Checked
 ☐ Show Highlighted
 ☐ Check Highlighted

Scene ID	Sensor Name	Satellite Name	Observation Start Date	Year
ALOS2032983510-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983520-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983530-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983540-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983550-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983560-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
ALOS2032983570-150102	PALSAR-2	ALOS-2	2015/01/02 04:49:29	2015
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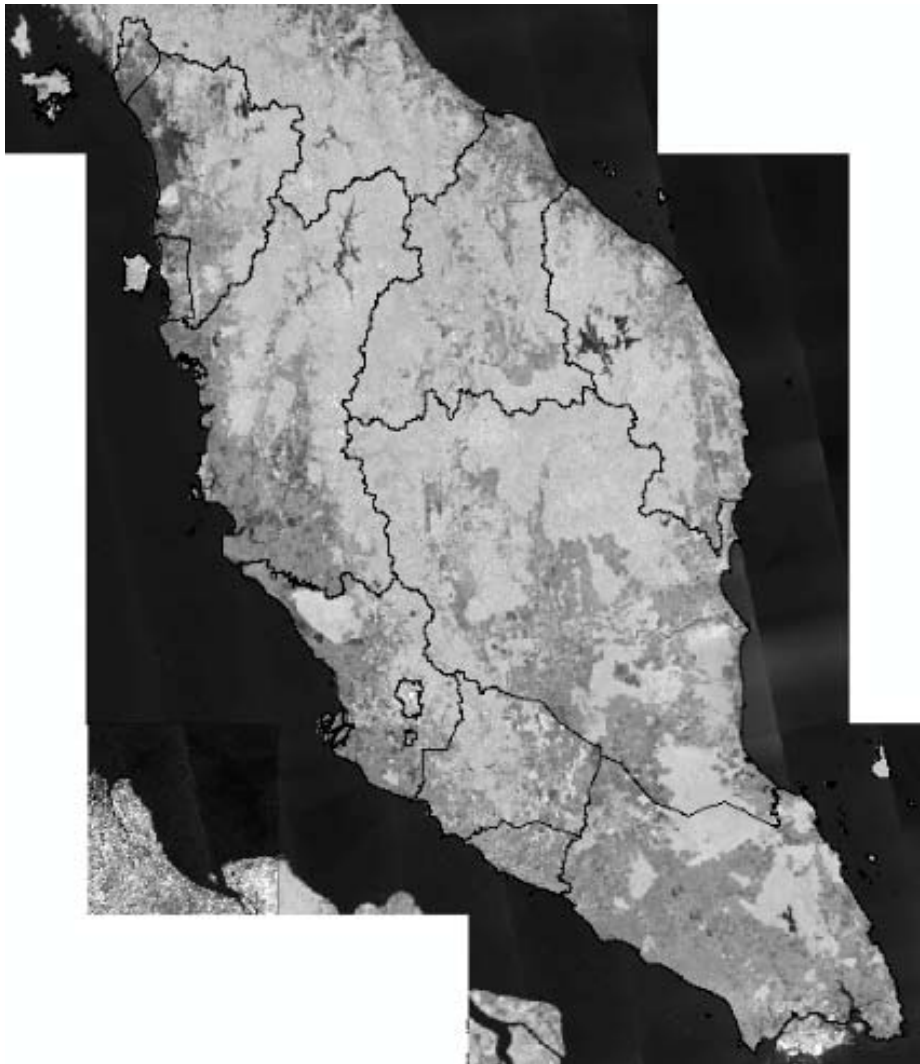
Scene Details

Image View

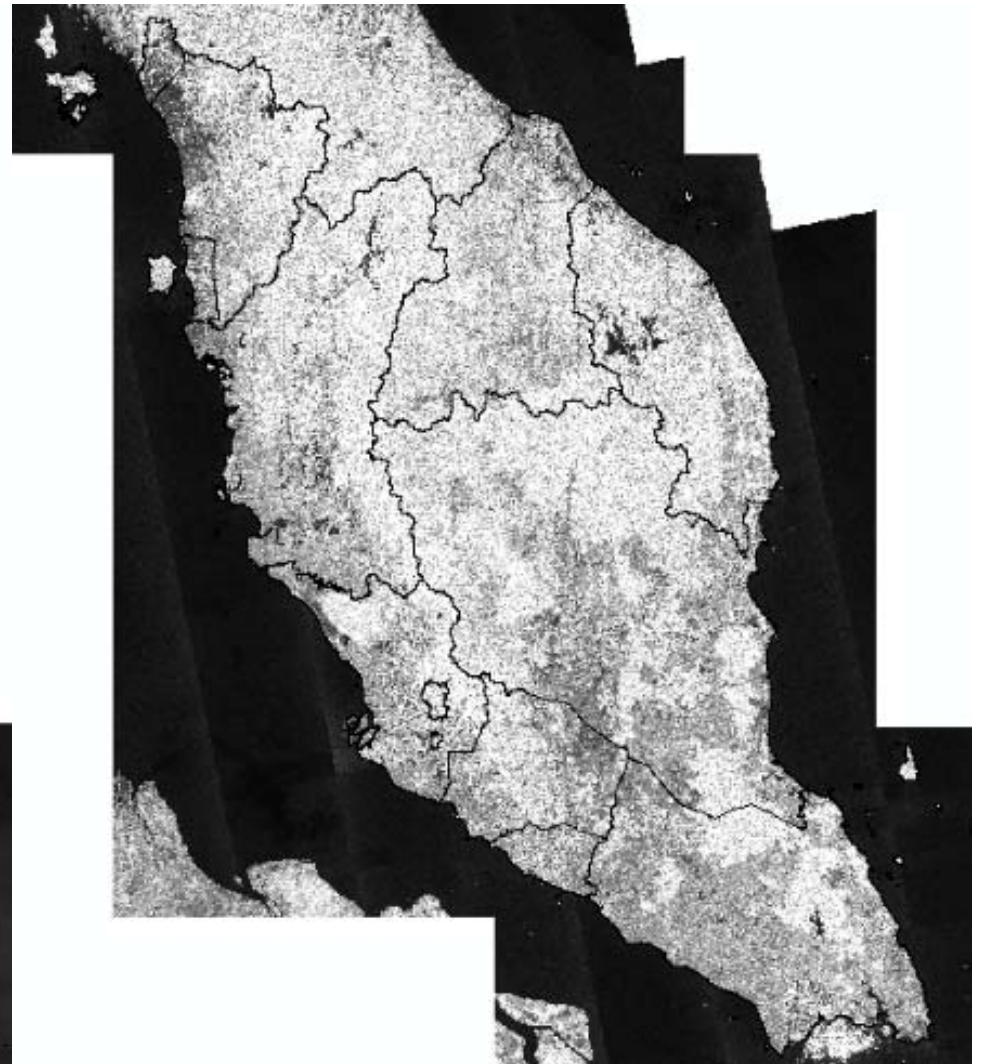
Item name	Value
Sensor Name	PALSAR-2
Operation Mode	SM1
Scene ID	ALOS2032983510-150102
OBS Path Number	35
Centre Frame Number	3510
Orbit Data Type	Fixed orbit
Observation Start Date	2015/01/02 04:49:29
Observation End Date	2015/01/02 04:52:58
Satellite Name	ALOS-2
Orbit Direction	Descending
Observation Direction	Right side observation
Nadir Pointing Angle	
Forward Pointing Angle	
Backward Pointing Angle	
Pointing Angle	0
Off Nadir Angle	38.2
Polarization	HH
Table Number	1159
Beam No	U2-9
Rev Correction	
Gain Nadir	
Gain Forward	

Changes detection

Palsar Mosaic 2010

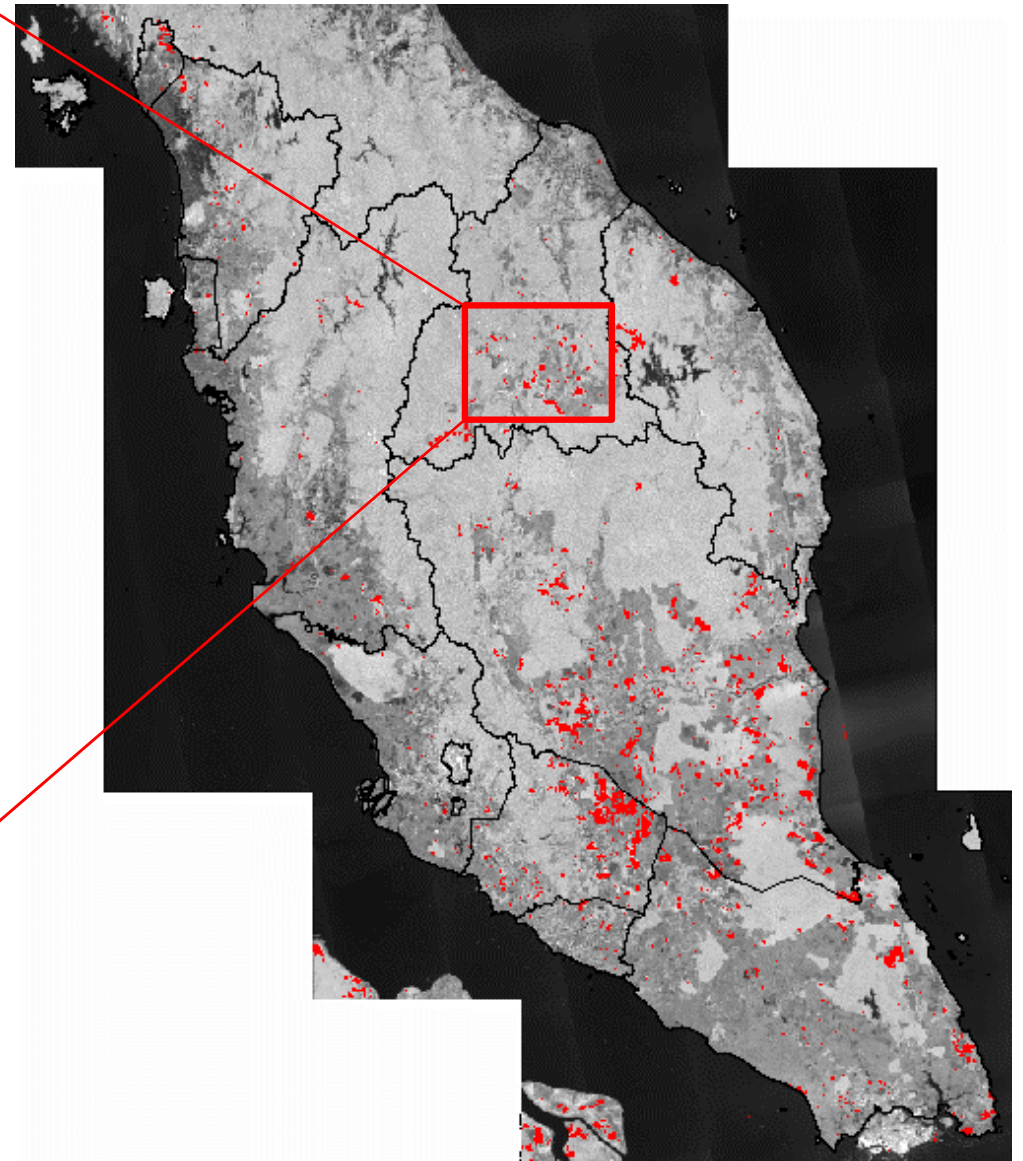
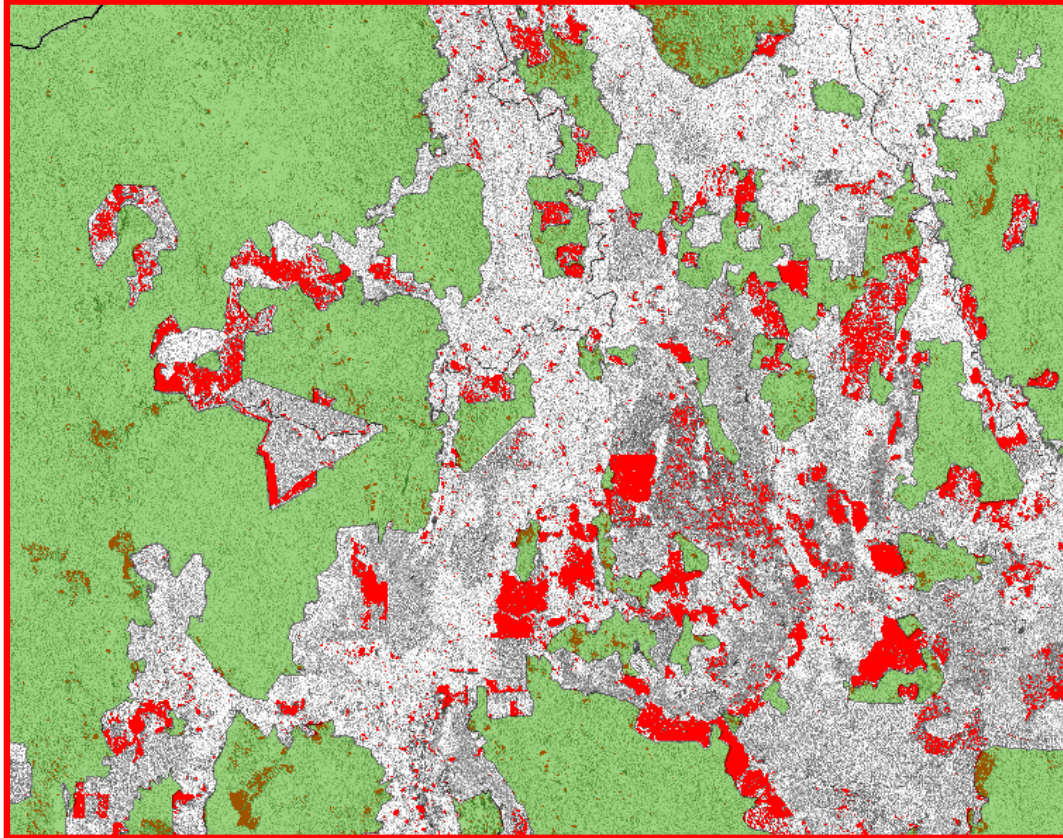


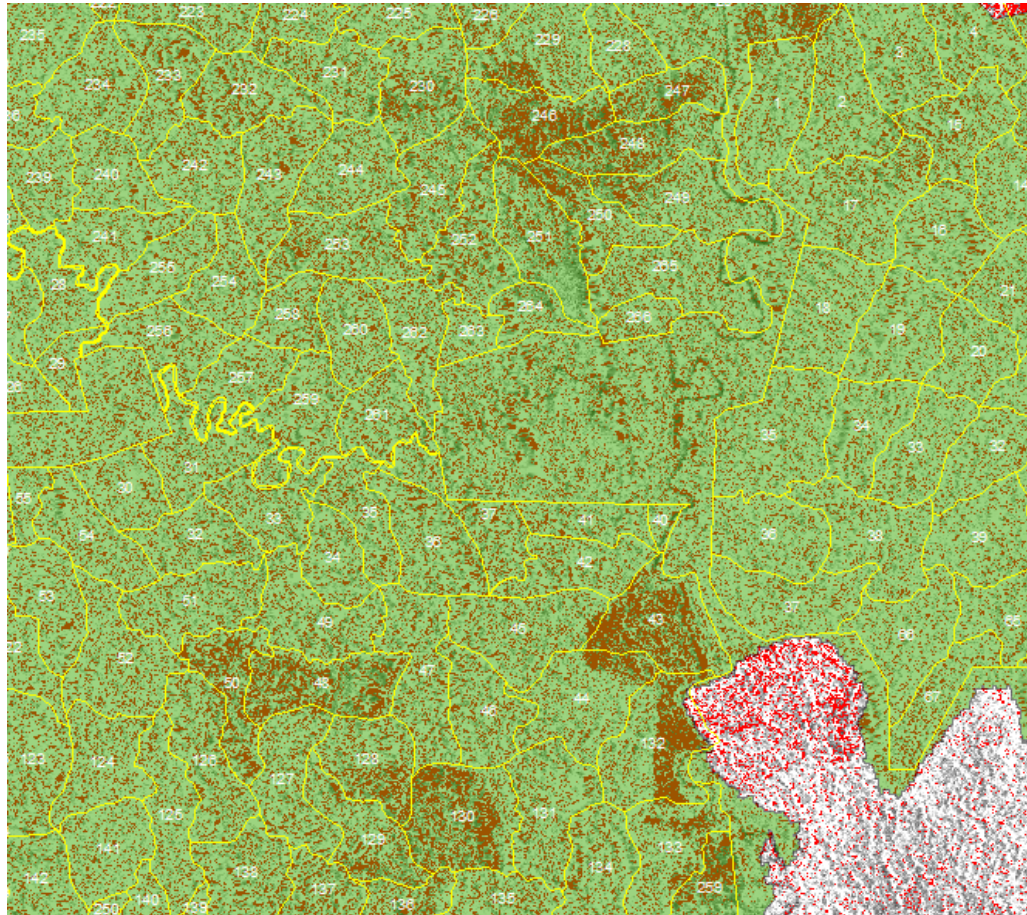
Palsar-2 Mosaic 2015



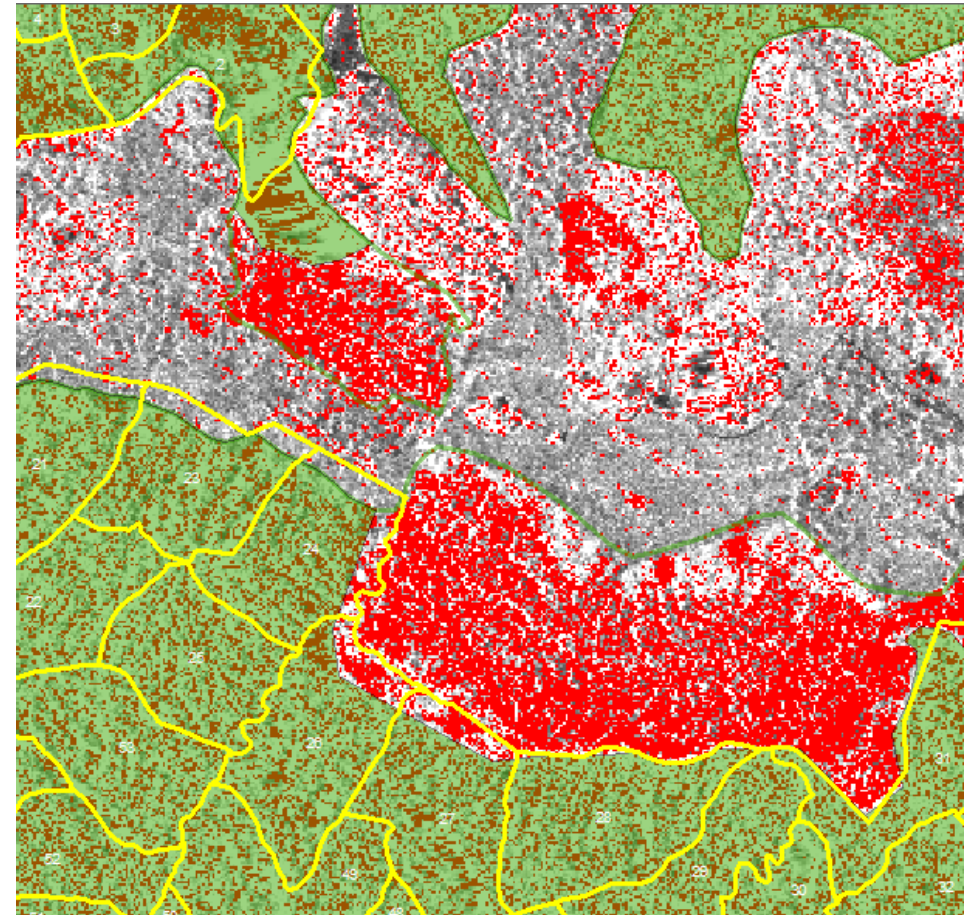
$$\text{Changes} = \text{DN}_{2010} - \text{DN}_{2015}$$

Deforestation detection



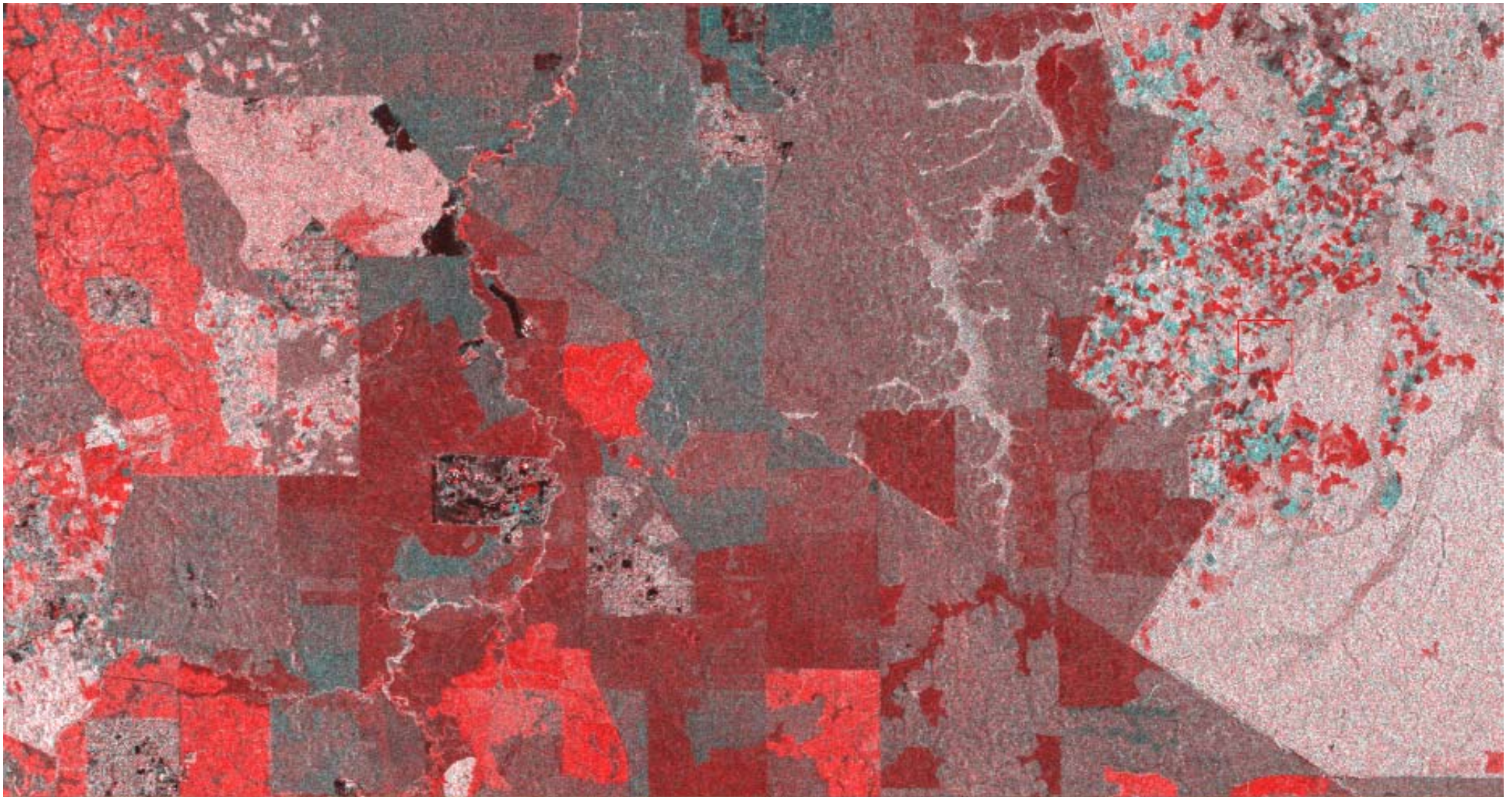


Changes inside PRF due to logging
NOT DEFORESTATION

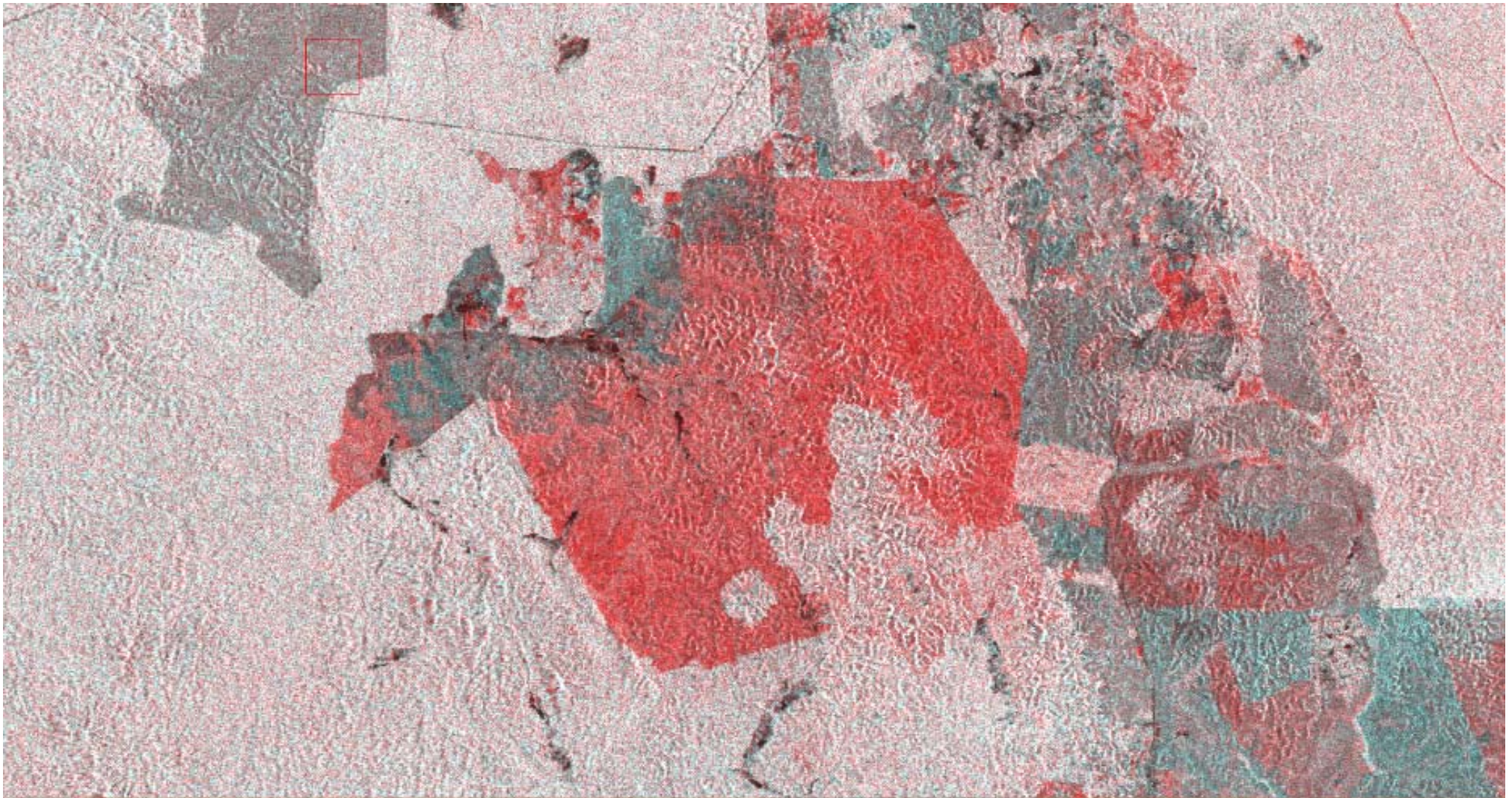


Changes outside PRF
DEFORESTATION

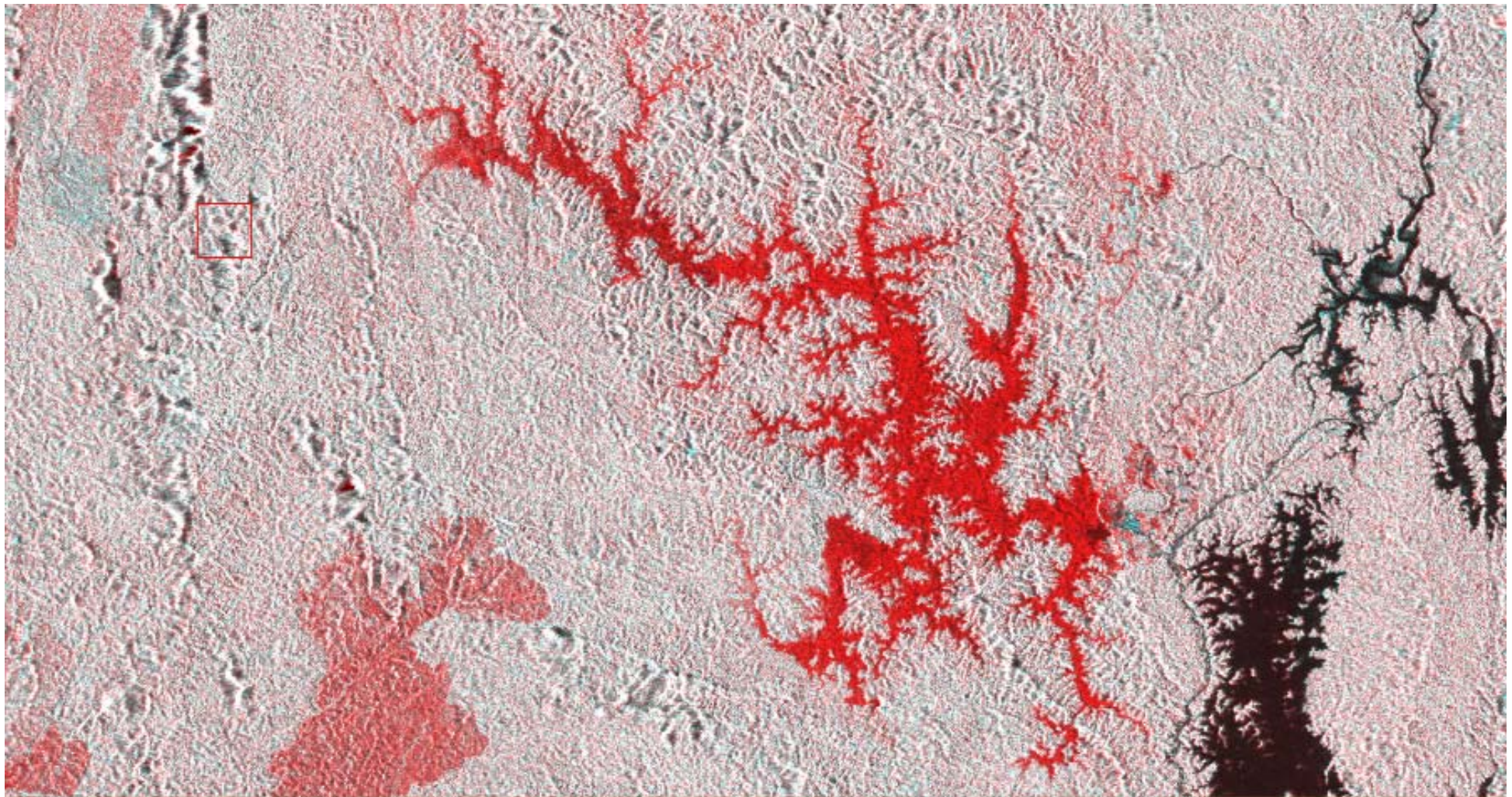
Interclass changes and from forest to other landuse



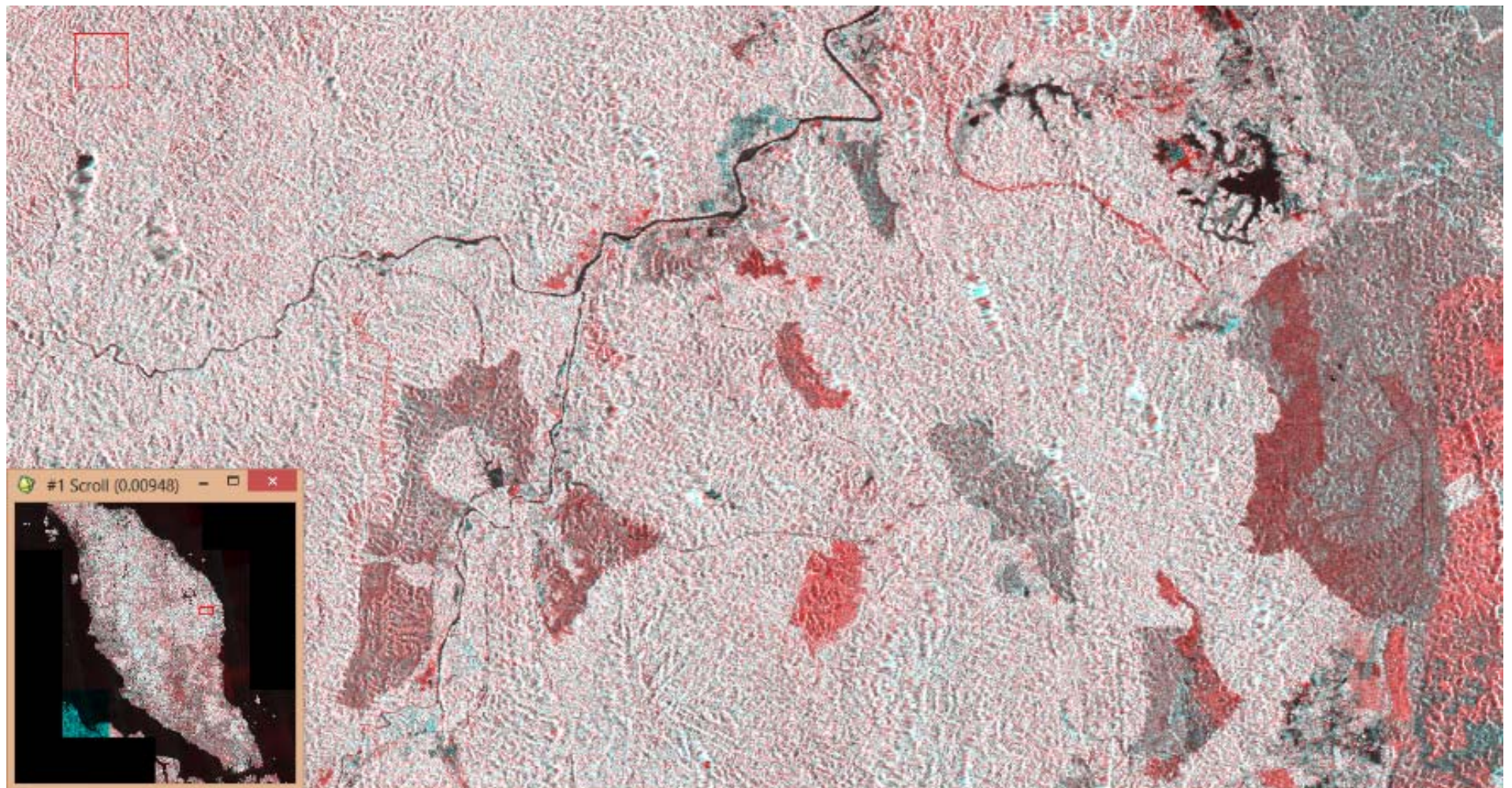
Oil palm plantation expansion



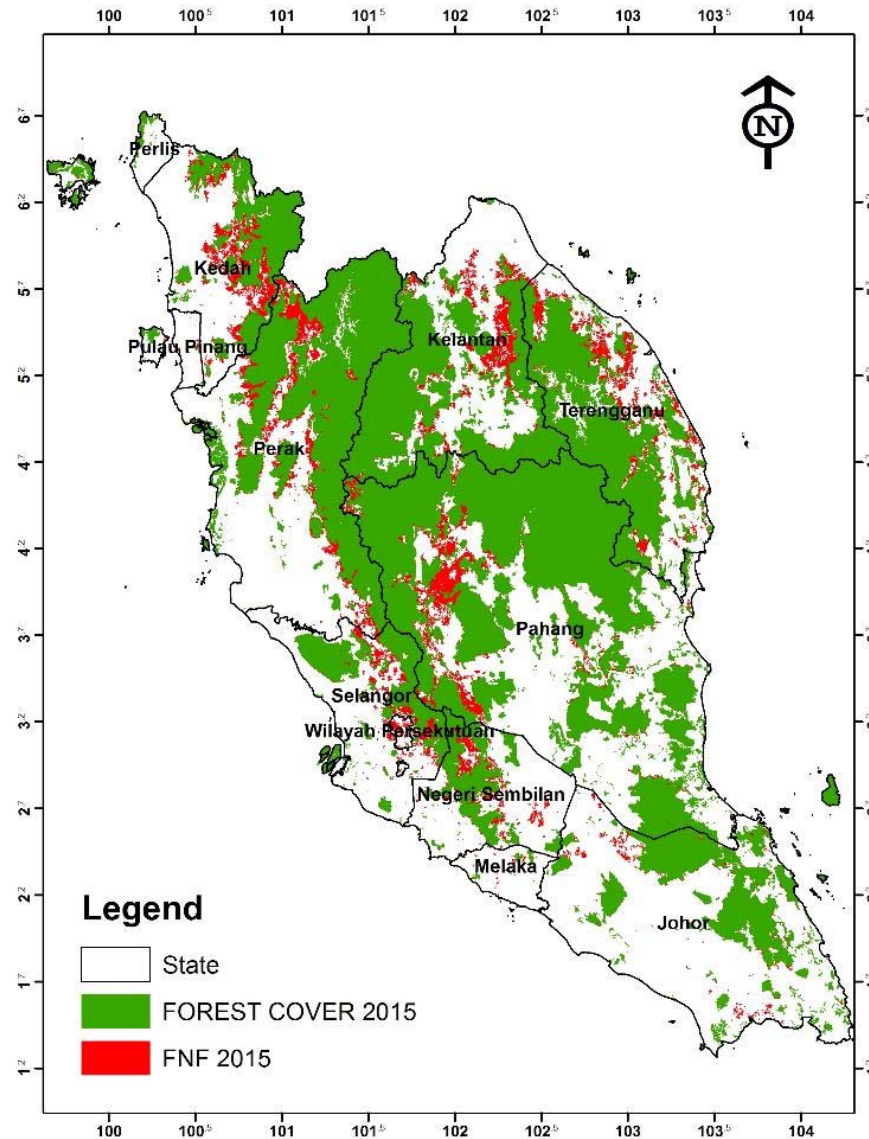
Hydro dam construction

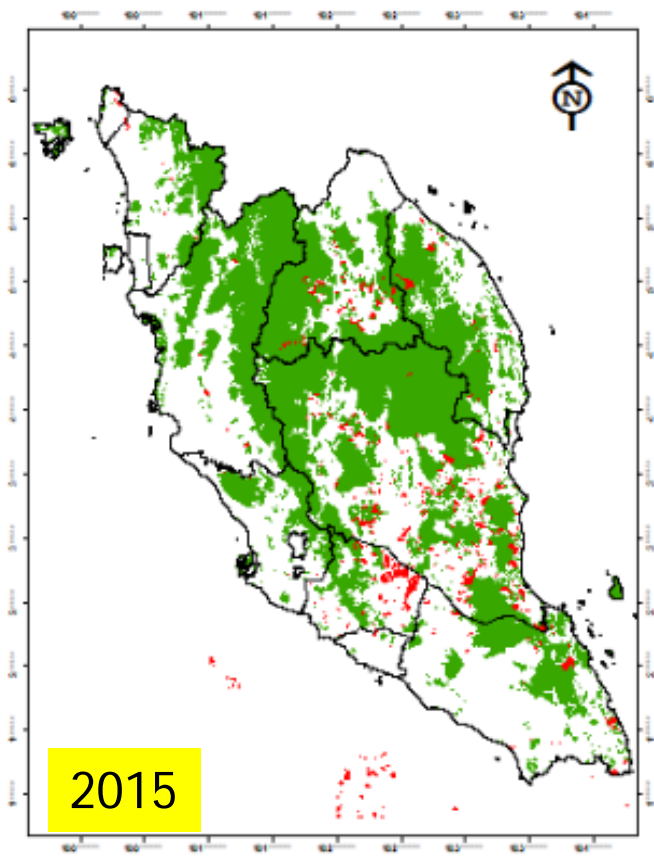
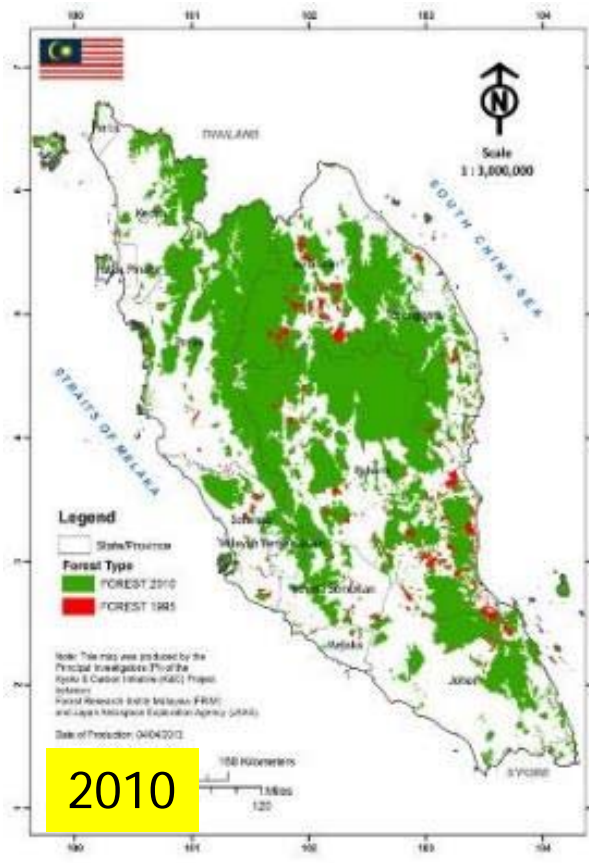
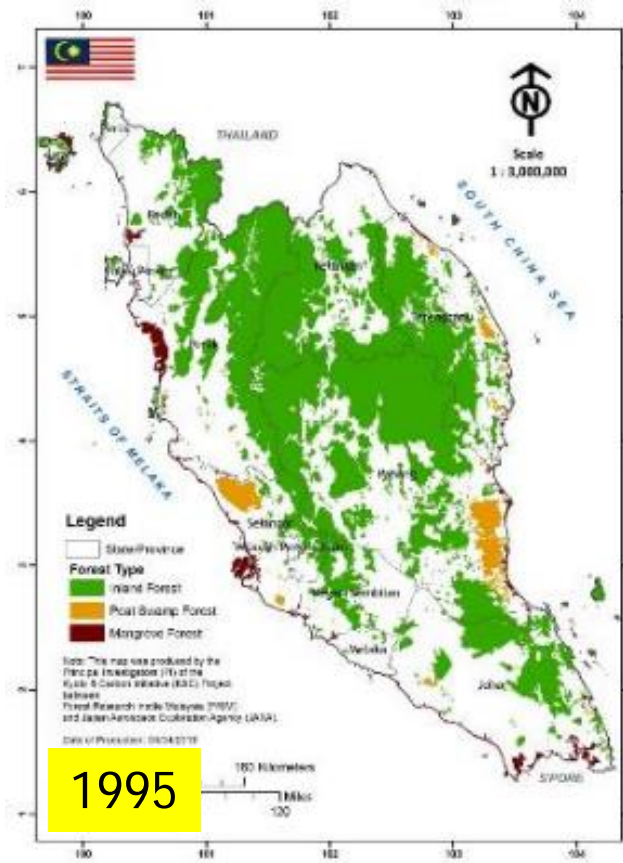


Highway construction

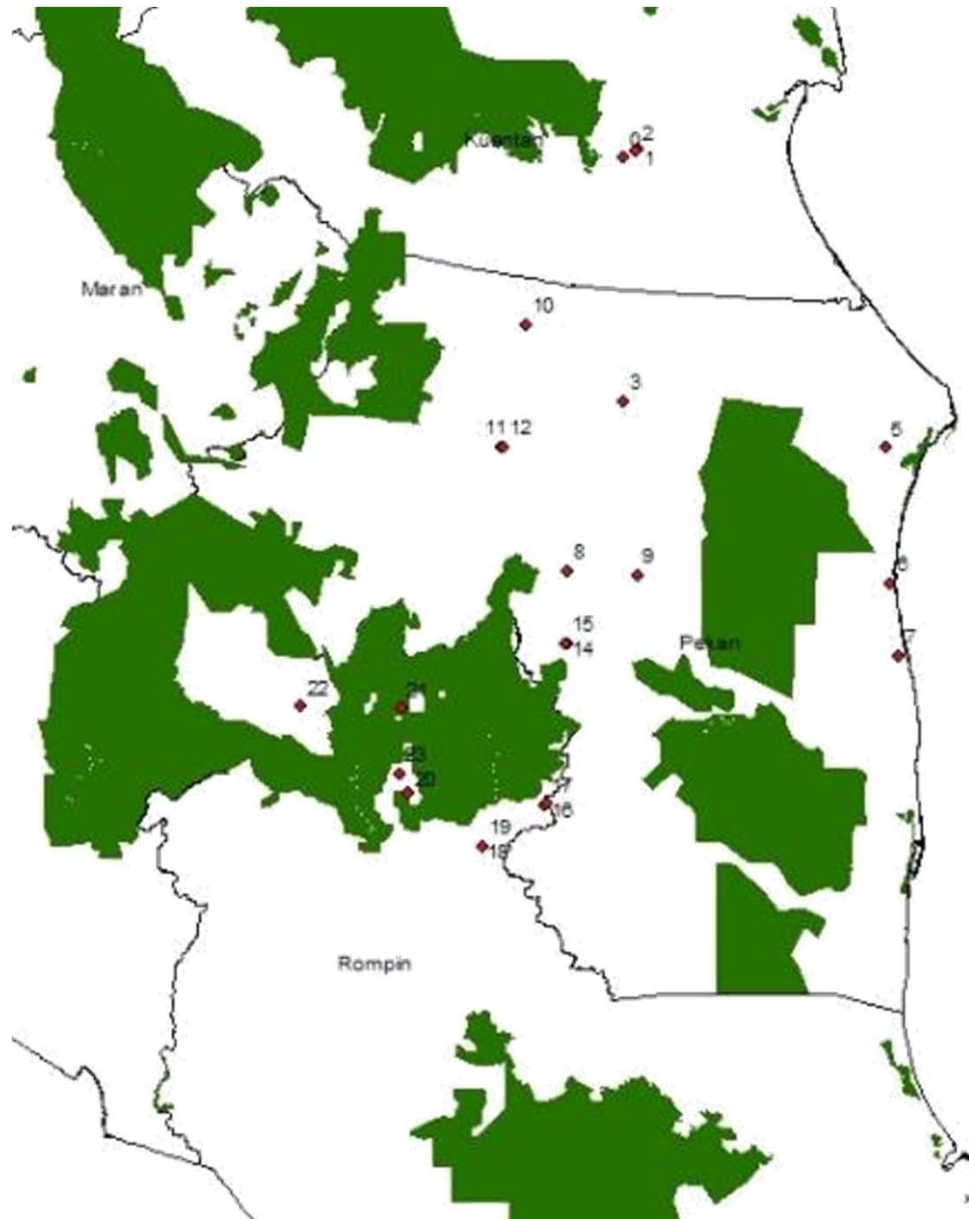


FNF Product vs Updated Forest Cover





Forest Type	Phase 3		Phase 4	Deforestation (ha) (d) = (a) – (c)	Rate of deforestation (ha/yr) (e) = (d)/20	Rate of deforestation (f) = (e/a)*100 (%/yr)
	1995 (a)	2010 (b)	2015# (c)			
Inland forest	6,054,384.47	5,690,815.57	5,525,033.57	529,350.90	26,467.55	0.44
Peat swamp forest	336,959.15	290,038.47	264,578.04	72,381.11	3,619.06	1.07
Mangrove forest	132,168.76	115,180.60	106,198.39	25,970.37	1,298.52	0.98
TOTAL	6,523,512.38	6,096,034.64	5,895,810	627,702.38	31,385.12	0.48



Ground truthing

The work was carried out to confirm the dynamic physical processes that have been occurring in the field.

Ground thruthing



Oil palm expansion



Rubber plantation expansion



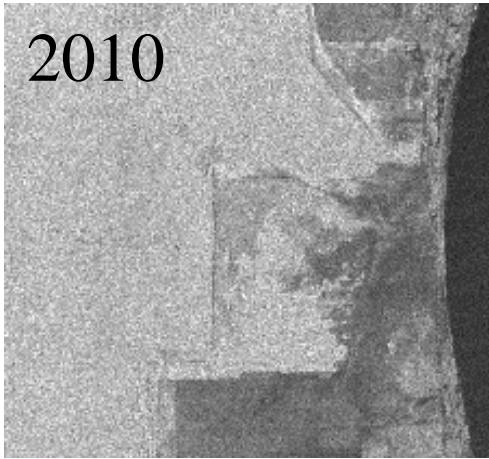
Aquaculture expansion



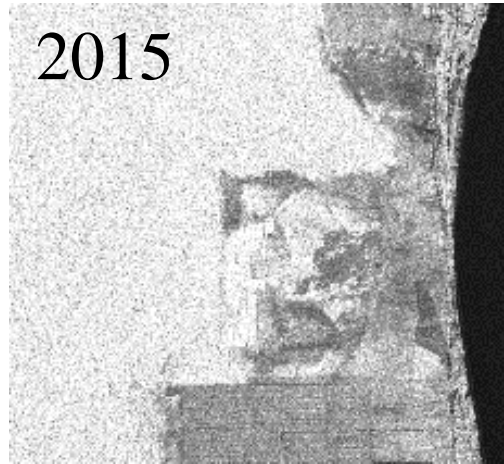
Forest clearing for oil palm
plantation expansion

Location: Pekan and Rompin,
Pahang

2010



2015



2010-2015



Forest fire: April 2014

Forest fire event turned the forest into clear land and grassland



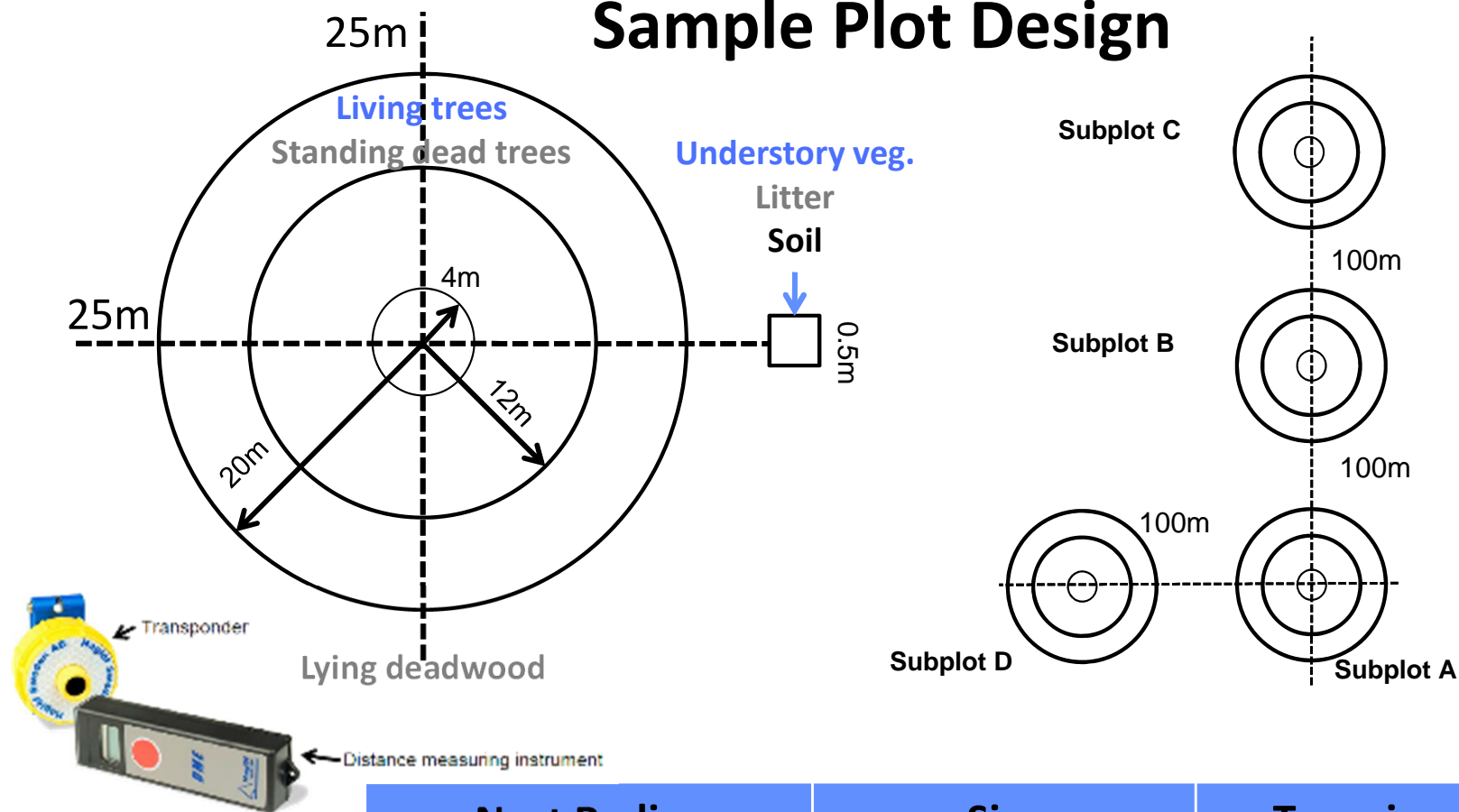
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Ground sampling



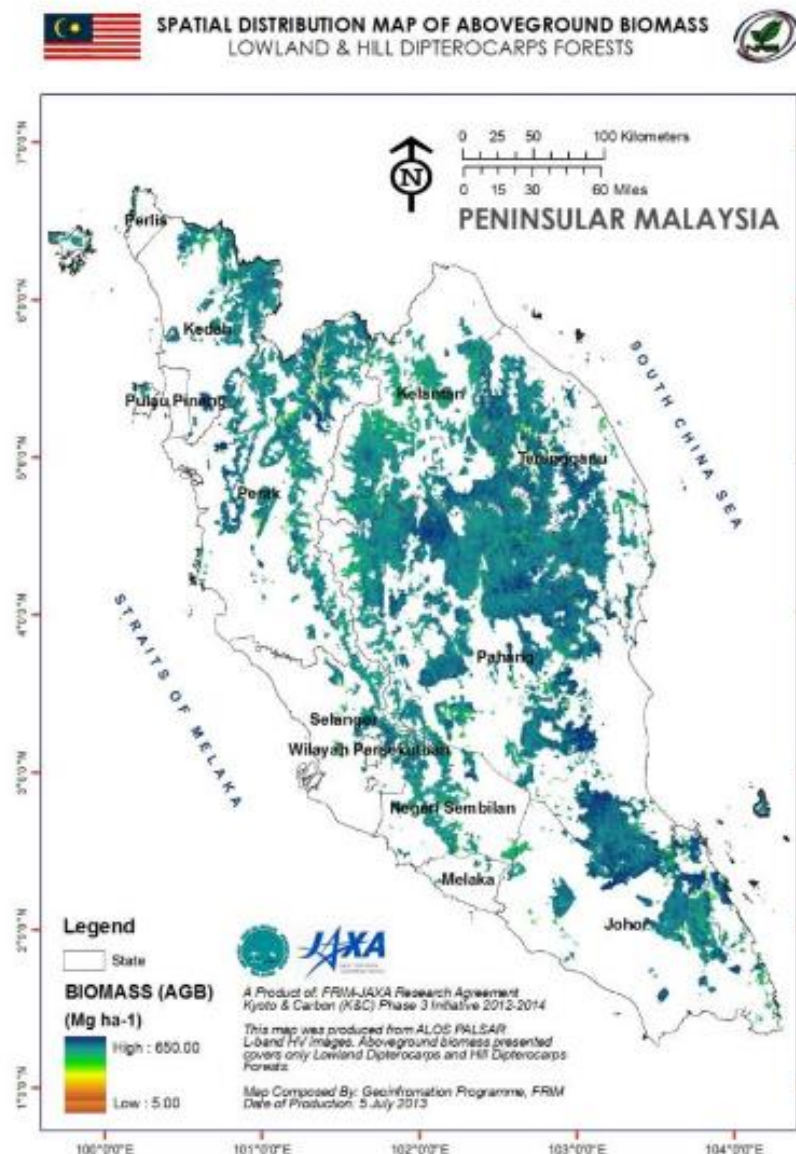
Sample Plot Design



Nest Radius (m)	Size	Tree size, DBH (cm)
4	Small	≥ 10
12	Medium	≥ 20
20	Large	≥ 40

Stand level AGB estimation

Forest type	Allometric function	Source
Inland forest	$AGB = [\exp(-1.803 - 0.976 \ln(\rho) + 2.673 \ln(D) - 0.0299 [\ln(D)]^2)]$	Chave et al. (2014)
Peat swamp forest	$AGB = 0.65 * \exp(-1.239 + 1.98 * \ln(D) + 0.207 * \ln(D)^2 - 0.0281 * \ln(D)^2)$	Chave et al. (2005)
Mangrove forest	$AGB = 0.251 \rho D^{2.46}$	Komiyama et al. (2007)



Phase 3 Product:

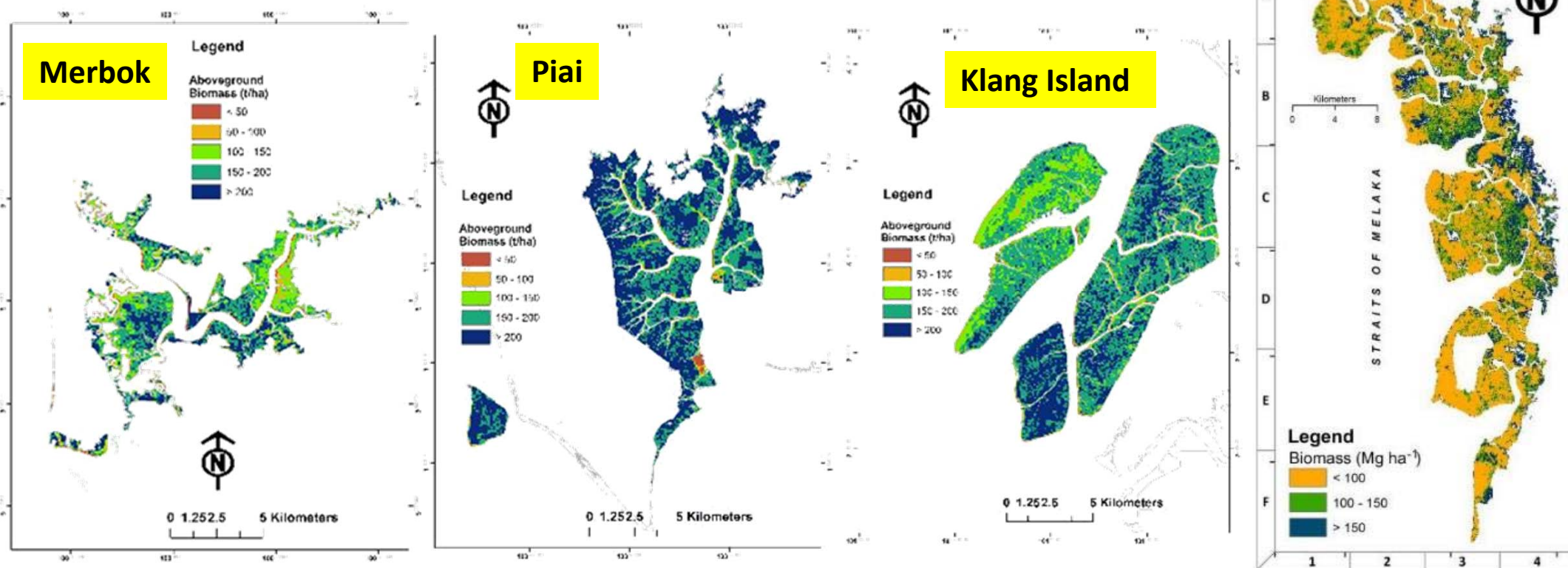
Biomass map over lowland and hill dipterocarp forests P. M'sia (2010)

Image Stat.	Biomass (Mg ha ⁻¹)
Min	51.3
Max	579.6
Mean	275.5
Std. Dev.	252.8

Total AGB: 1,297,504,548.67 Mg
1.3 Billion Mg

Phase 4 Biomass Map (2015)
COMING SOON

Biomass in mangroves in Peninsular Malaysia (2010): K&C Phase 3



Total AGB for the mangroves in Peninsular Malaysia, which has an extent of about **115,108 ha** was at **11,441,795 Mg** with an average of 99.4 Mg ha^{-1} and at RMSE of 34 Mg ha^{-1} .



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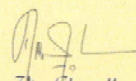
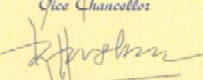


It is hereby certified that

HAMDAN BIN OMAR

*having fulfilled the requirement prescribed by the Senate
has been awarded the*

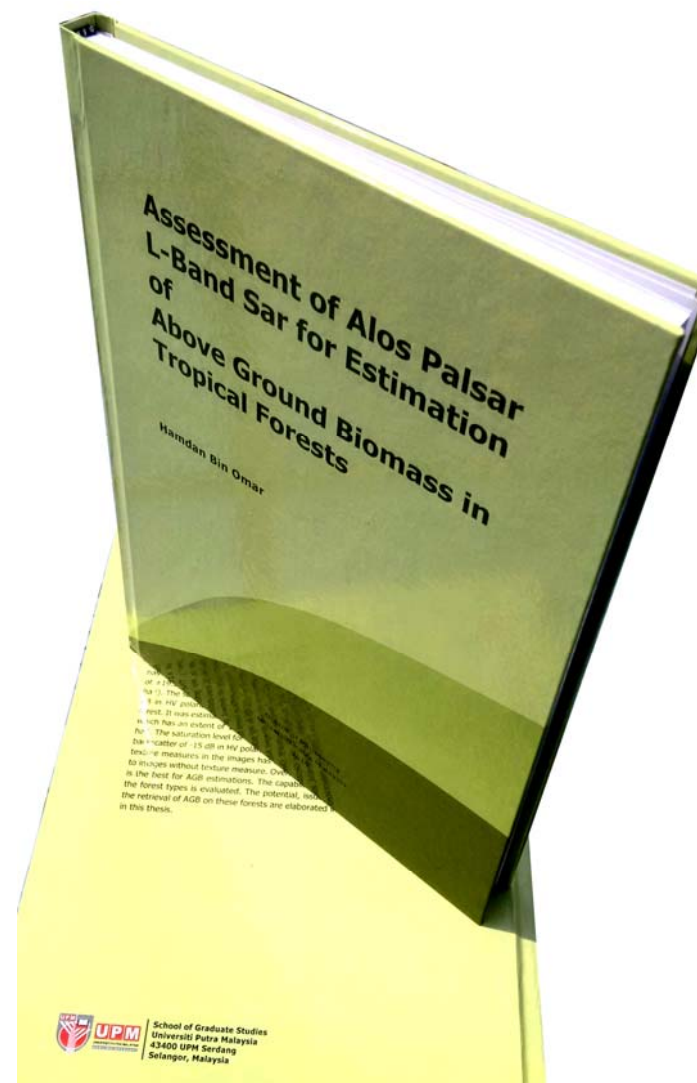
Doctor of Philosophy


Vice Chancellor

Registrar

PH001026



Senate Approval Date: 25 June 2015



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Thank you

Terima kasih

ありがとうございます

