ALOS

K&C Initiative
An international science collaboration led by JAXA

K&C Phase 3 – First Report

Use of ALOS PALSAR data for supporting forest carbon tracking in Sumatra island: Collaborative research between LAPAN and JAXA

PI : Dr. Orbita Roswintiarti
CI : Katmoko Ari,
Novie, Inggit, Mulia, Musyarofah

Remote Sensing Technology and Data Center
Indonesian National Institute of Aeronautics and Space (LAPAN)

Science Team meeting #19
RESTEC HQ, Kamiya-cho, Tokyo, April 9-12, 2013

Project objectives

To conduct the collaborative research on the use of ALOS PALSAR archives and the verification dataset in Sumatra island through:

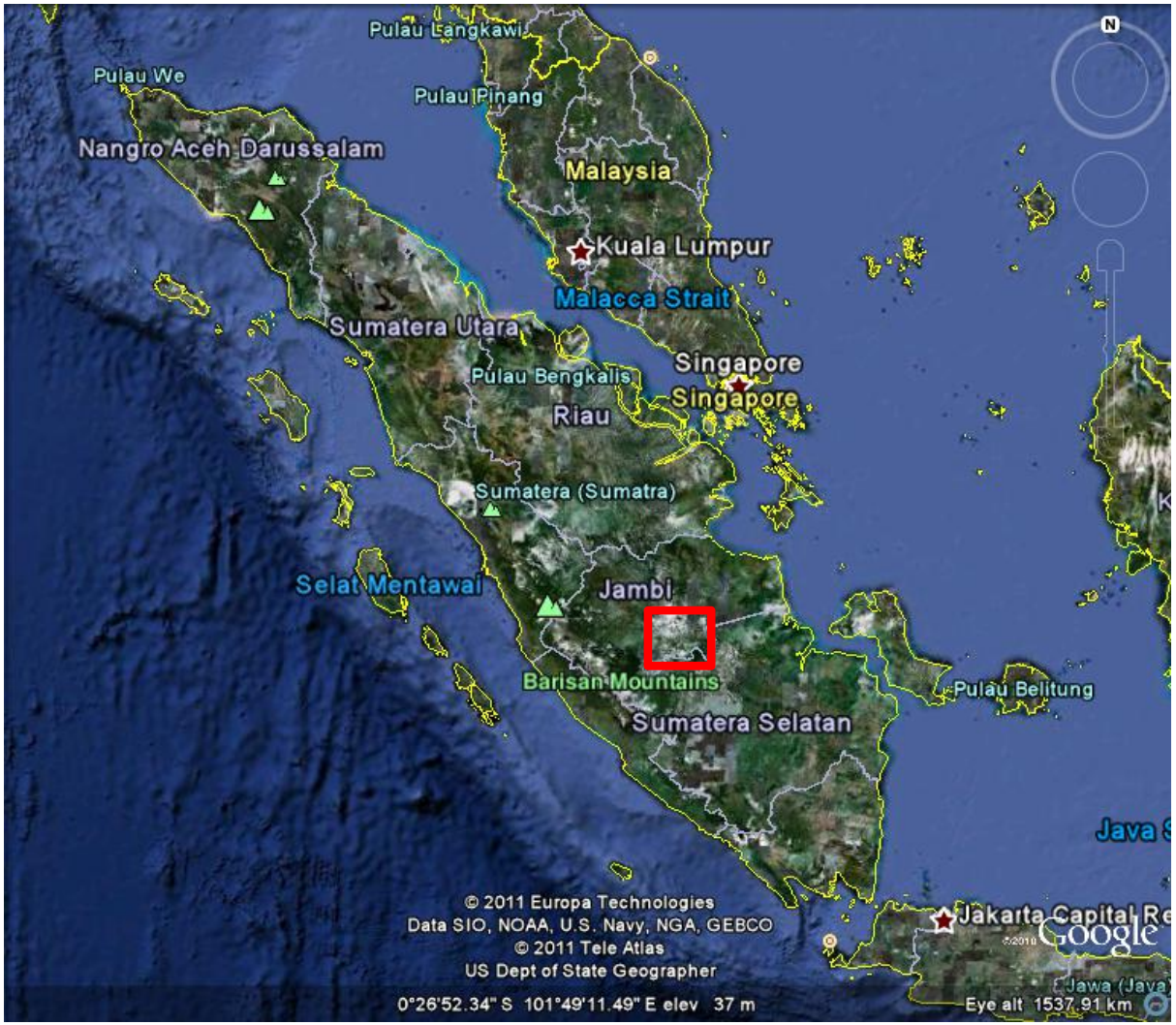
- the development of forest carbon tracking modellings
- capacity building
- data sharing
- ground-truth experiments
- information production
- workshop/seminar

The objective of this activity would synchronize with that of the **Group on Earth Observations Forest Carbon Tracking (GEO FCT)** initiative, particulary to support **forest carbon Measurement, Reporting, and Verification (MRV) system** for national REDD+ implementation.

Deliverables

- Validated products of the annual forest/non-forest change of Sumatra island.
- Annual Land Use/Land Use Change and Forestry (LULUCF) of Sumatra island for 2007-2010.

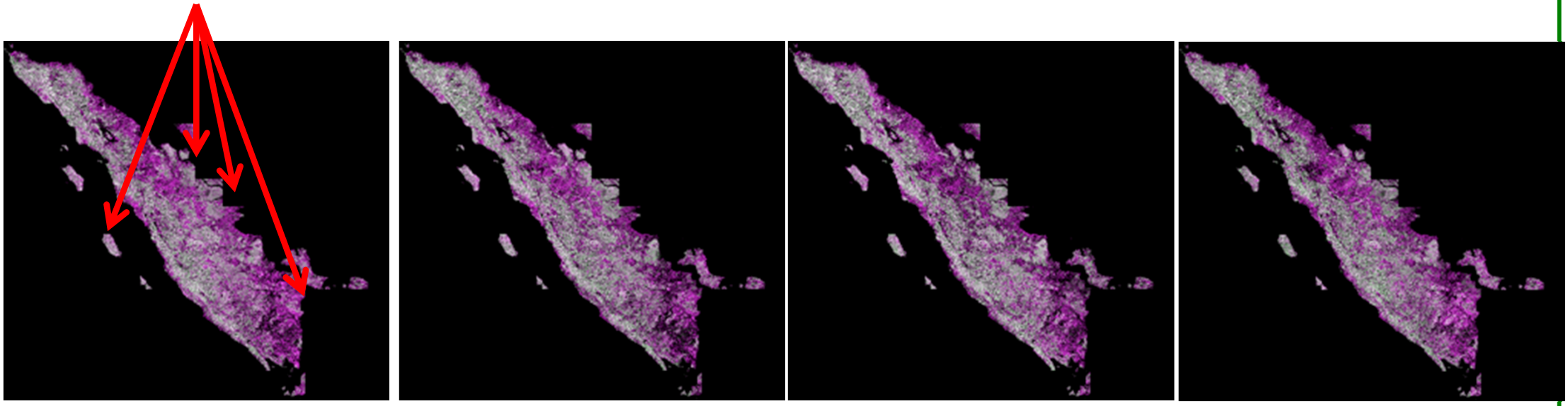
Area of Interest



- Geographic location: Sumatera island
- Local site(s):
  - Harapan Rain Forest, Jambi and South Sumatera Province

Datasets provided by JAXA

- PALSAR mosaic data, 25 m resolution, orthorectified and slope corrected
- HH and HV polarization
- 62 tiles x 4 year = 248 tiles
- (Missing tiles)



2007 2008 2009 2010

ALOS

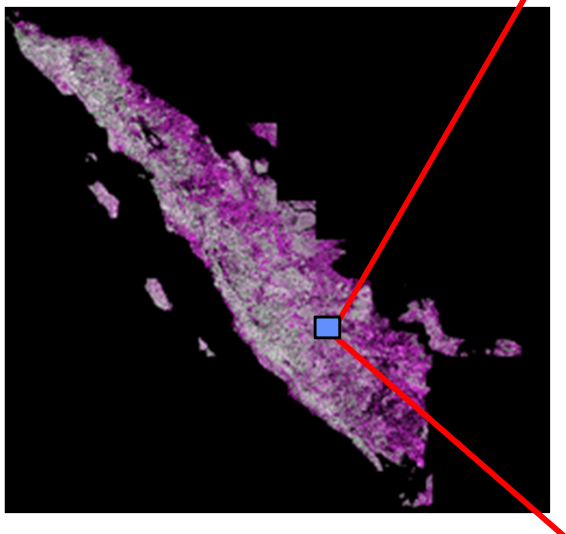
K&C Initiative

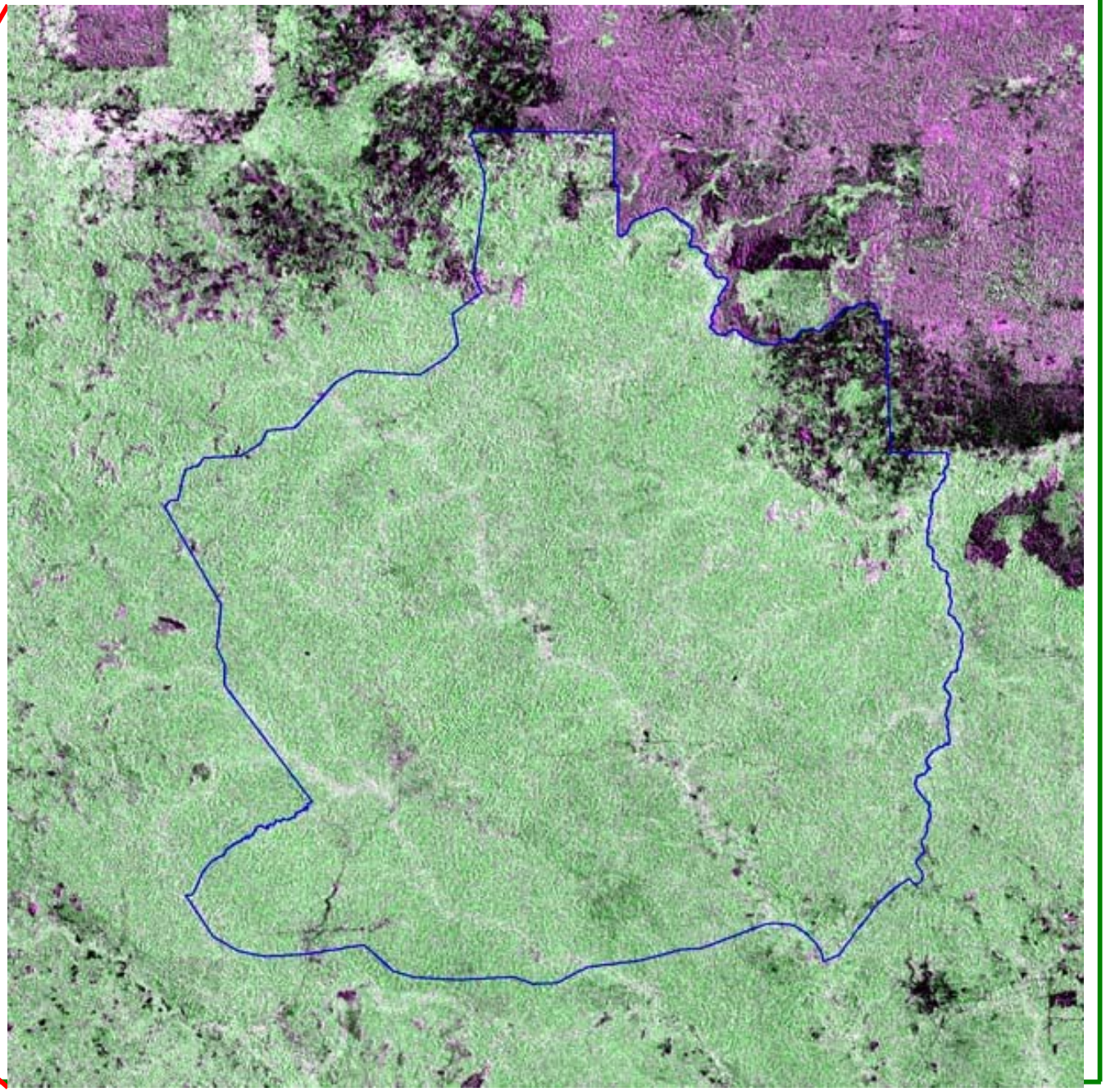
An international science collaboration led by JAXA

Local Site

Harapan Rain Forest

www.harapanrainforest.org





South Sumatera province	: 52.170 acres
Jambi province	: 46.385 acres
TOTAL	: 98.555 acres

ALOS

K&C Initiative
An international science collaboration led by JAXA

Harapan Rain Forest

PT. Restorasi Ekosistem Indonesia.

In cooperation with:

Burung Indonesia, RSPB, BirdLife International

The Royal Society for the Protection of Birds (RSPB)

Supported by:

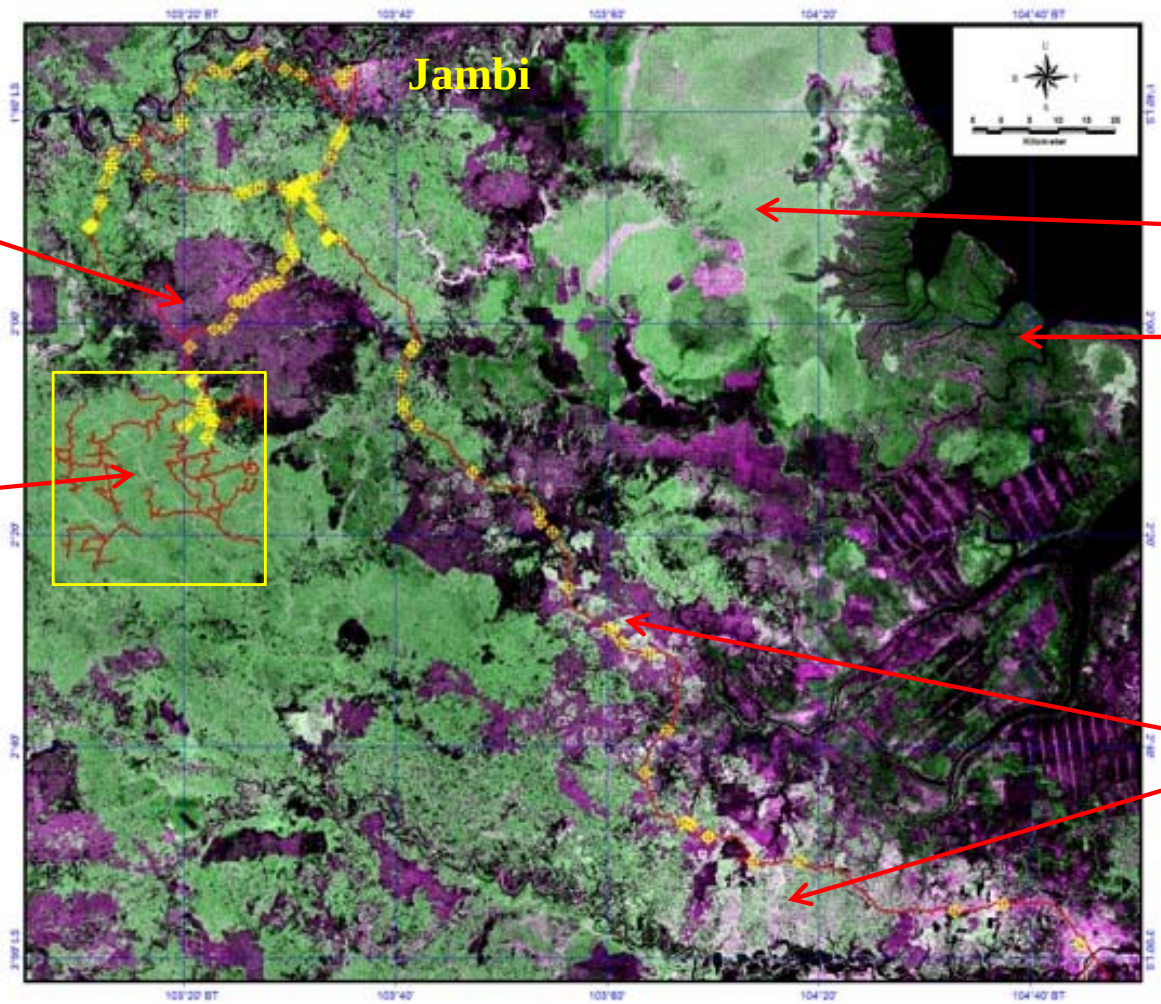
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, kfw Entwicklungsbank, NABU, Danida

- Forest Restoration
- Research & Cooperation
- Eco Tourism
- Community Partnership

(nurse nature and support indigenous people livelihood)

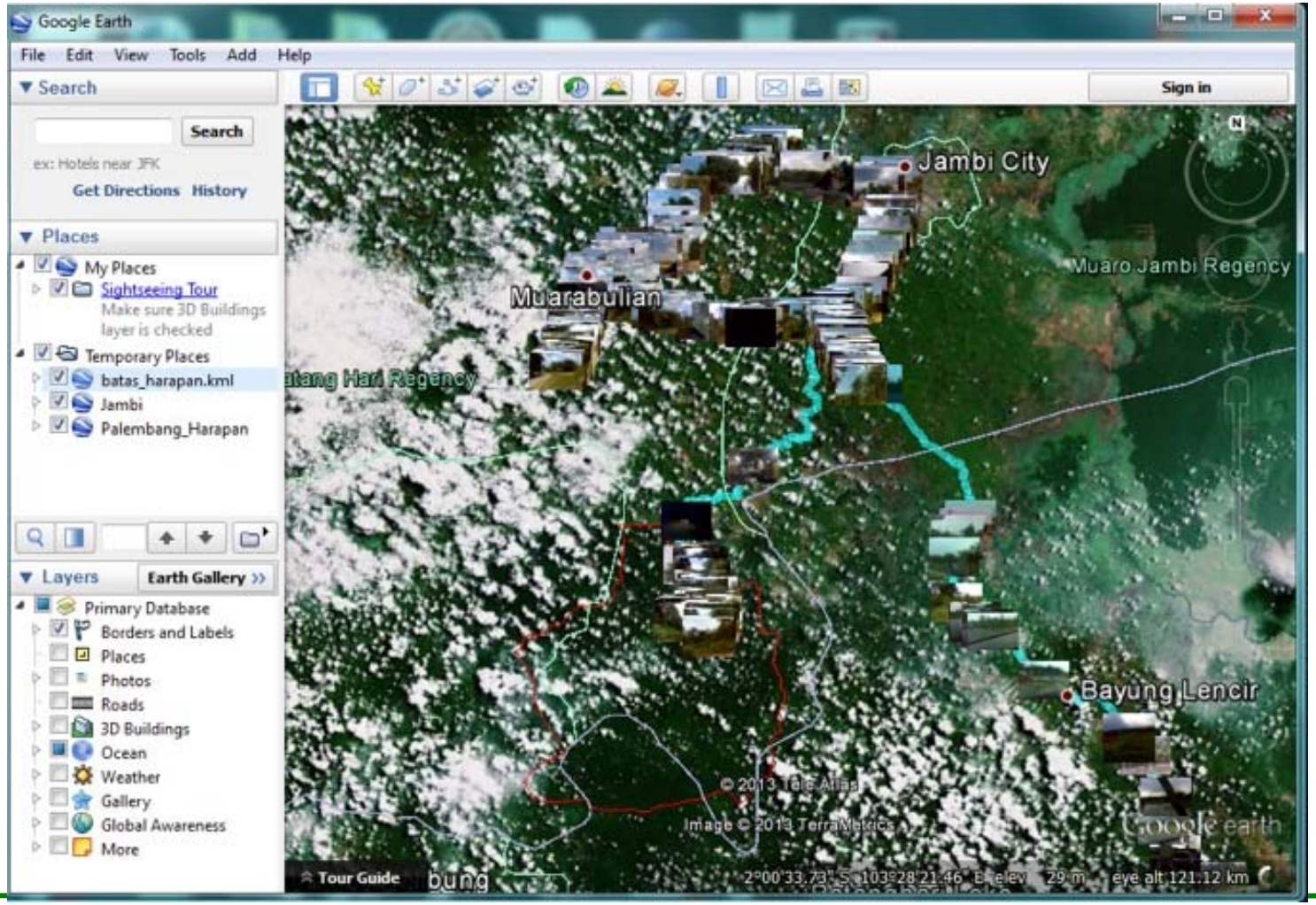
Field Survey Datasets

Harapan Rainforest and Jambi Area (March , 2013)



Field Survey Datasets

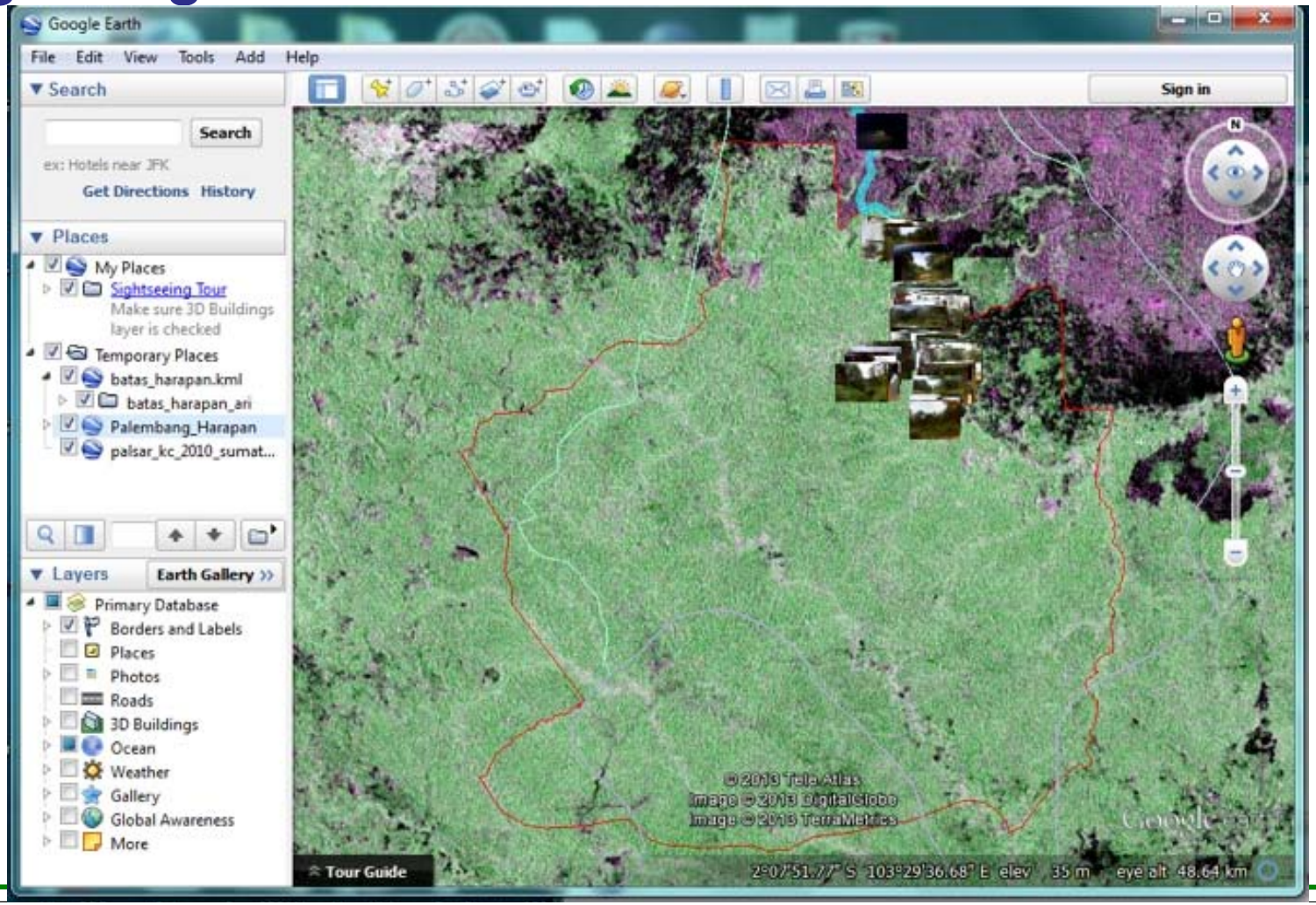
- Harapan Rainforest and Jambi Area
- Demo using Google Earth



Survey Datasets

- Harapan Rainforest and Jambi Area
- Demo using Google Earth

Overlay with Palsar data



ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Types

Forest

Oilpalm Plantation

Rubber

Shrubs

Shrubs with trees

Cropland

Baresoil

Methodology (LC classification and FNF classification)

INPUT DATA :
- ALOS PALSAR HH and HV
(25 m resolution, orthorectified, slope corrected)

Convert Digital Number to Gamma Naught

$$\gamma^0\,[\mathrm{dB}] = 10\log\langle DN^2\rangle - 83$$

$\langle\cdots\rangle$ = Averaging; Calibration factor

Select Training Samples and Testing Samples for each class

Change Training Sample or merge overlapped classes

Check Training Sample Separability in the HH-HV feature space

No good

good

Classification using :
- MLP
- Random Trees
- SVM

Accuracy assesment (using Testing Samples)

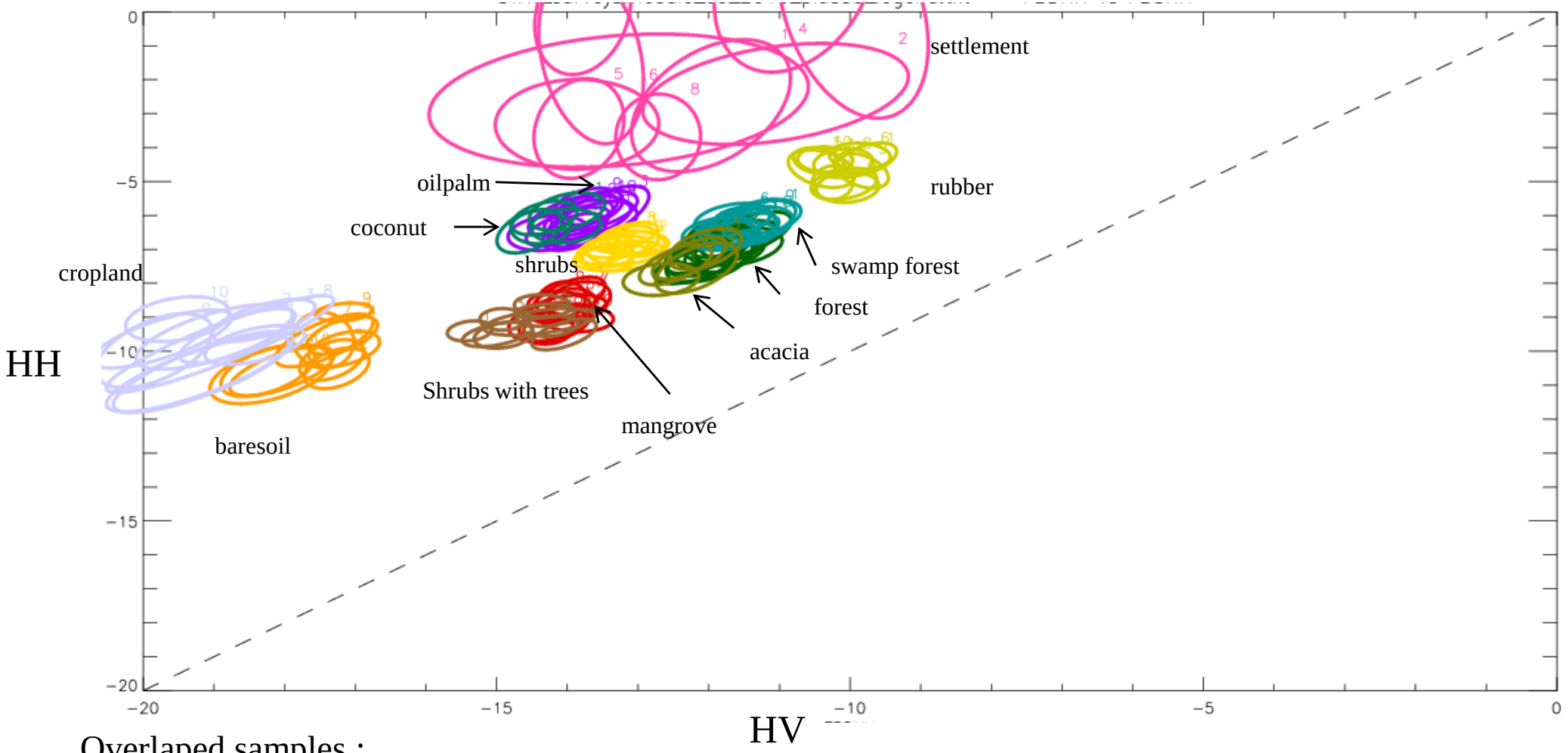
Land Cover Classification Map (9 classes)

Class Merging:
- Forest class
- Non Forest Class

Post-processing (Majority Filtering)

Forest - Non Forest Classification Map (2 classes)

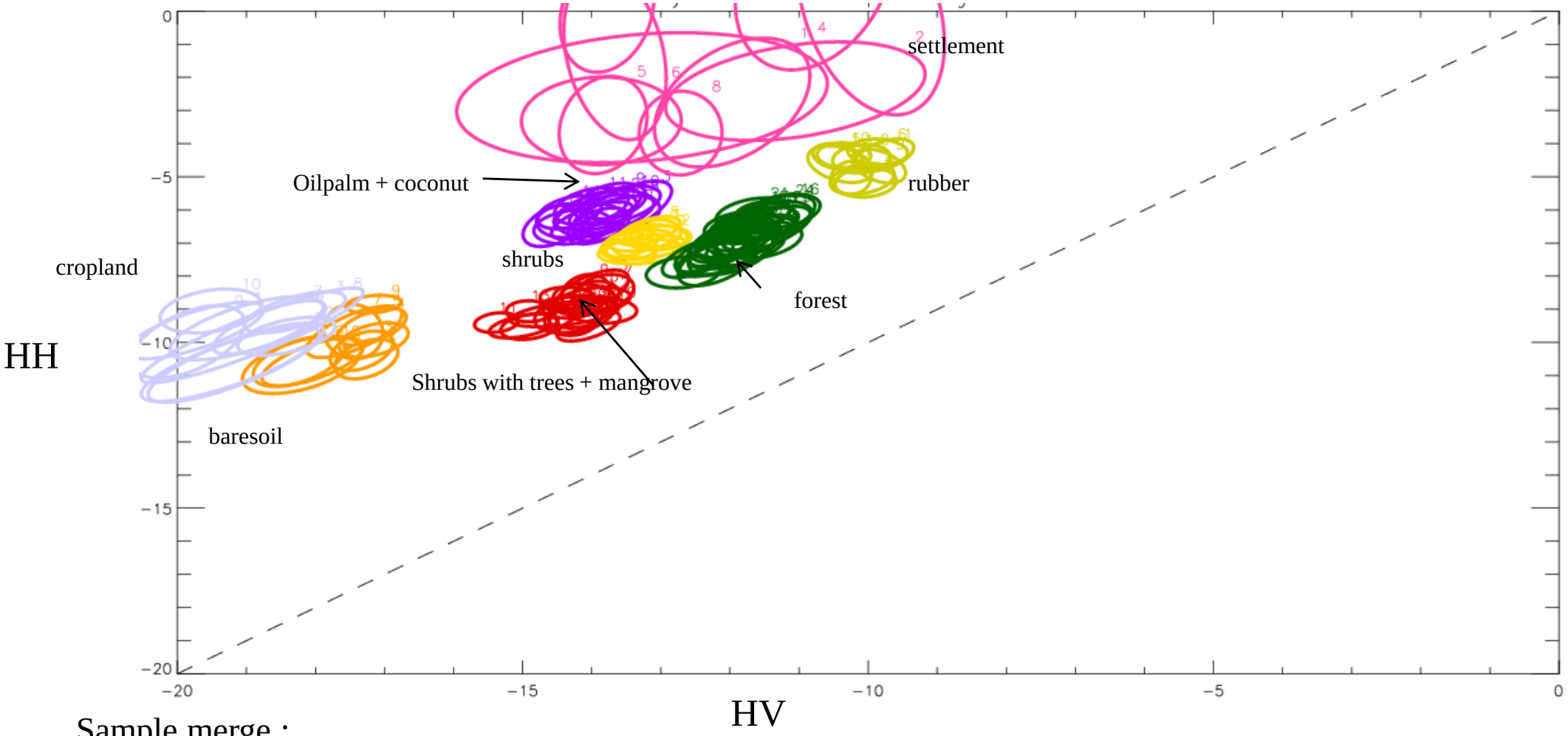
Training Sample Selection (1)



Overlaped samples :

- Oilpalm and coconut
- Forest, swamp forest, and acacia
- Mangrove and shrubs with trees

Training Sample Selection (2)

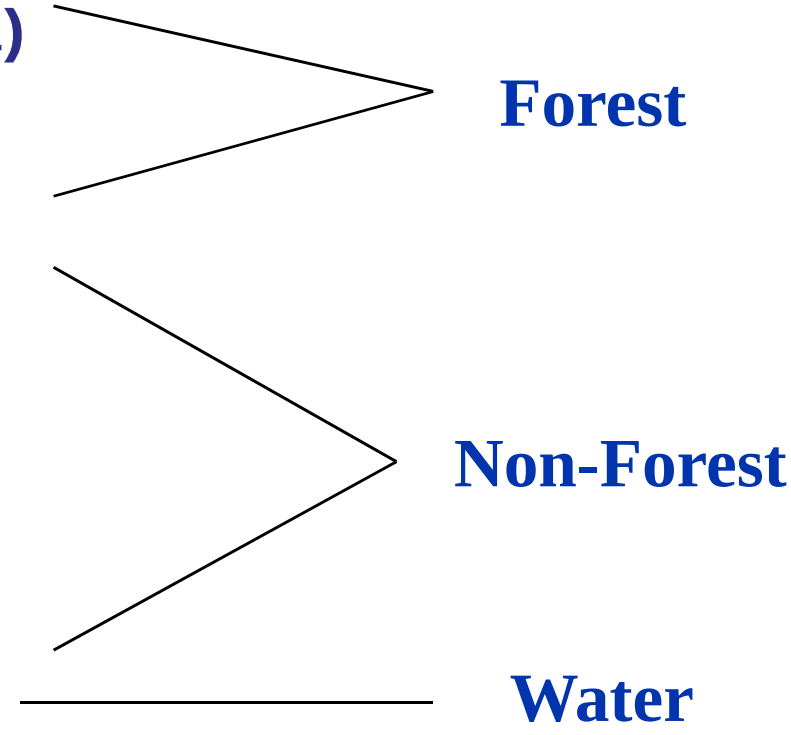


Sample merge :

- Oilpalm + coconut
- Forest + swamp forest + acacia
- Shrubs with trees + mangrove

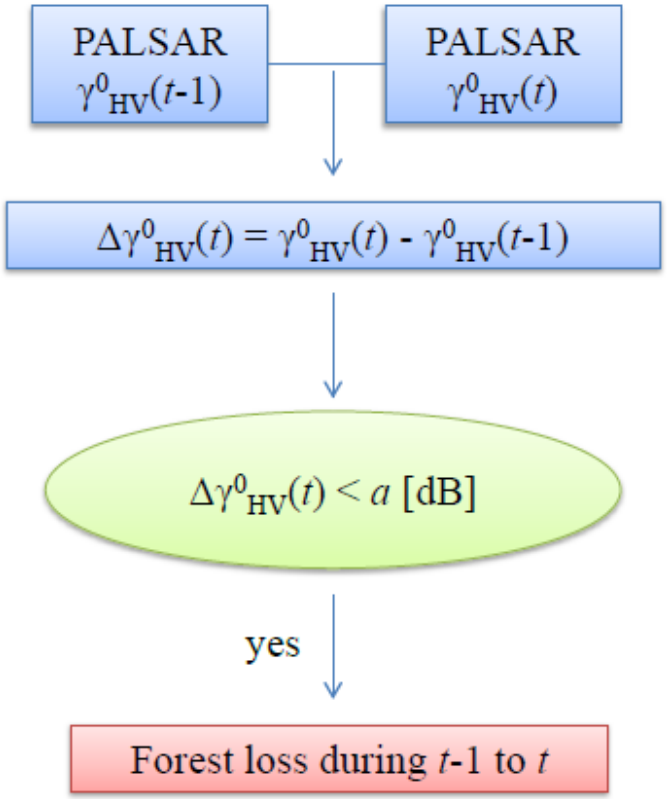
Class Merging Rules for Forest – Non Forest

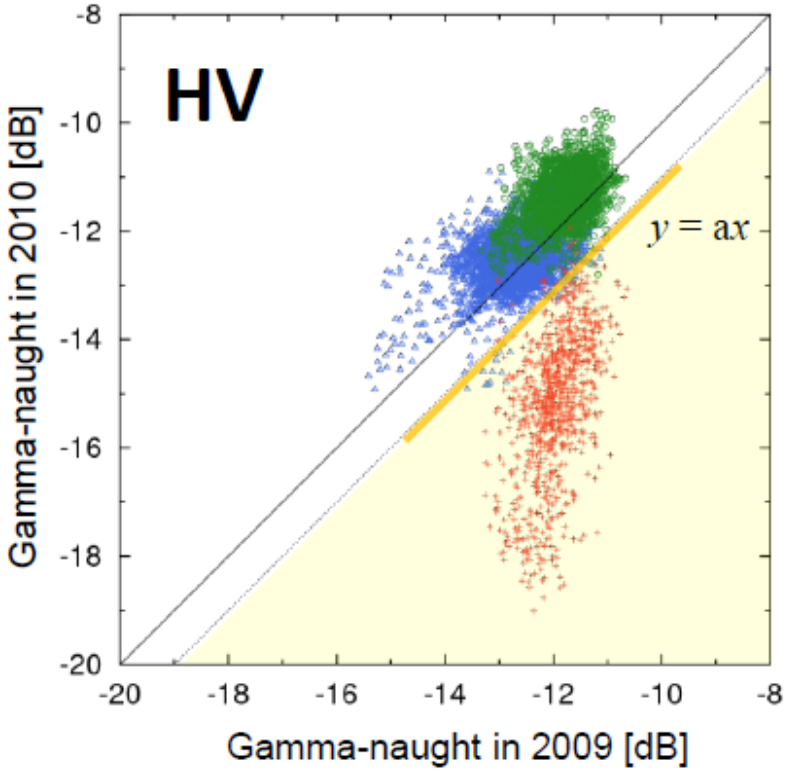
- Forest (forest, swamp forest, acacia)
- Rubber
- Mangrove + shrubs with trees
- Oilpalm + coconut
- Shrubs
- Cropland
- Baresoil
- Settlement
- Water



Methodology

Forest loss detection algorithm: thresholding





Red : Clear-cut during 2009-2010
Green : Natural forest
Blue : Acacia plantation

Source :
Forest change mapping using PALSAR Gamma-naught change

Takeshi Motohka (JAXA)
Takuya Ito (RESTEC)
Takahiro Otaki (RESTEC)

Results

- Ground truth data of area around Harapan Rain Forest (South Sumatera Province and Jambi Province)
- Land Cover Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest-Non Forest Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest Loss Map of Sumatera (2007~2008, 2008~2009, 2009~2010)

ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Classification Map of Jambi & Harapan, Year 2010

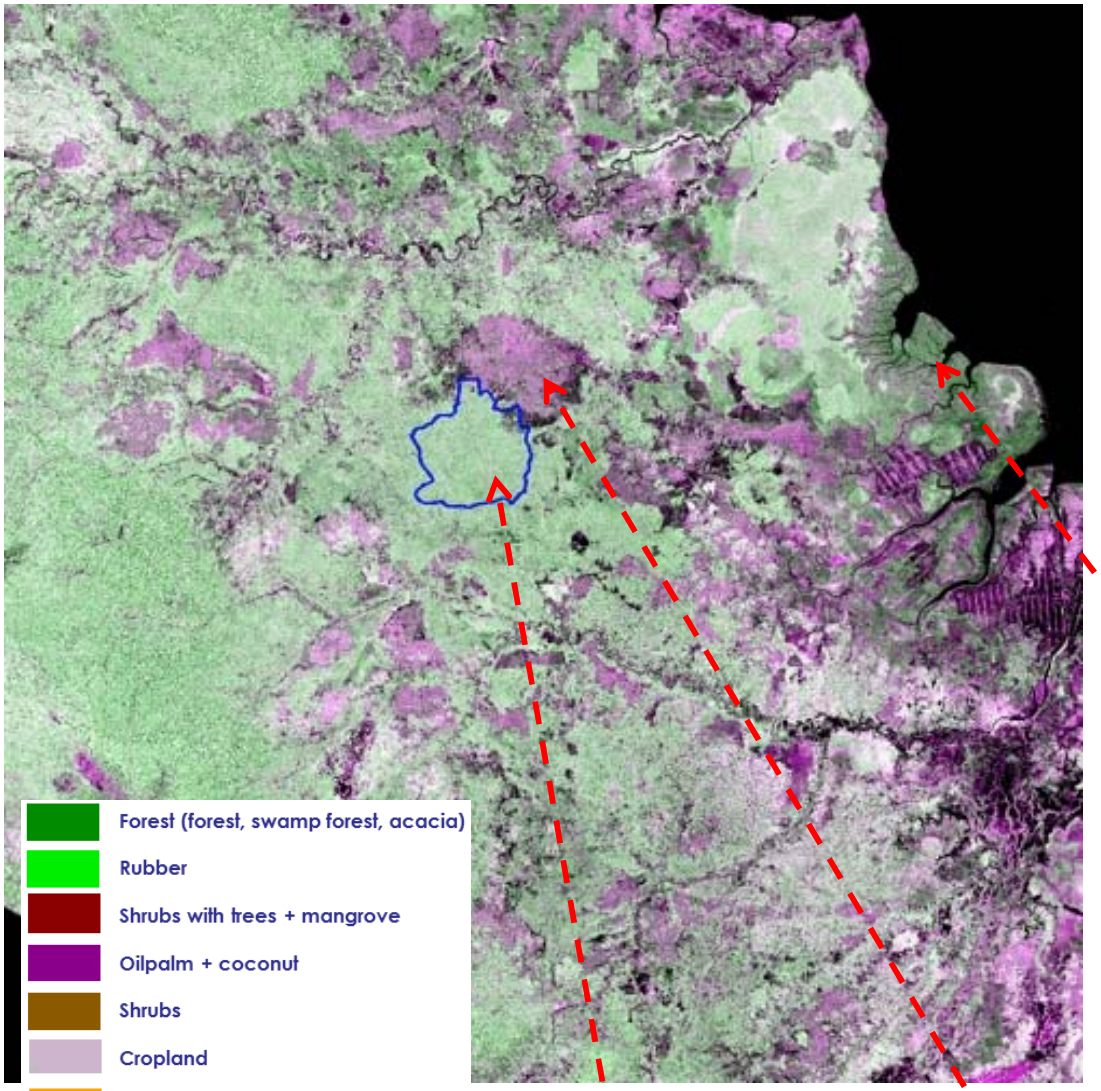
- Forest (forest, swamp forest, acacia)
- Rubber
- Shrubs with trees + mangrove
- Oilpalm + coconut
- Shrubs
- Cropland
- Baresoil
- Settlement
- Water

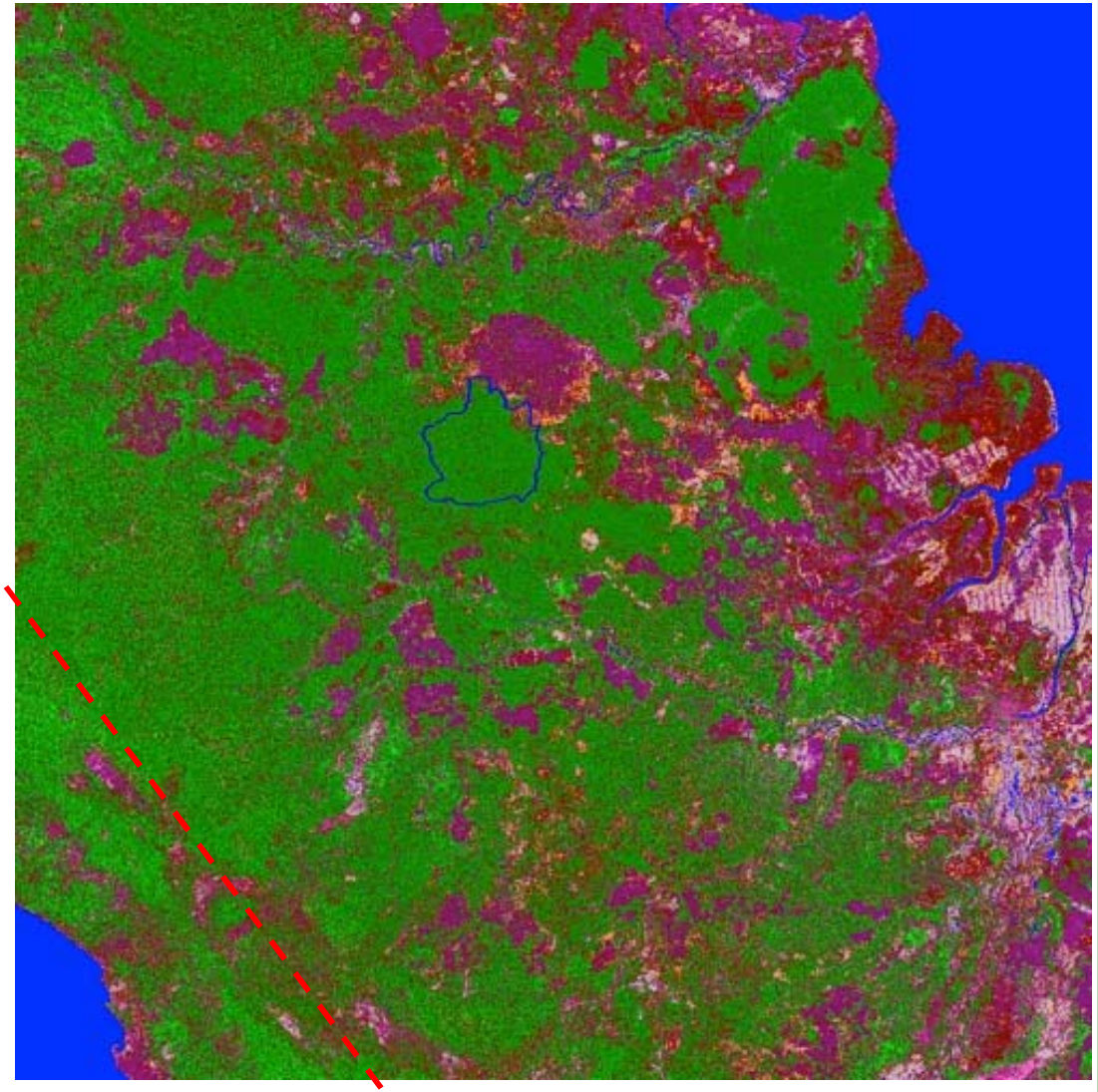
ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Classification Map of Jambi & Harapan, Year 2010





- Forest (forest, swamp forest, acacia)
- Rubber
- Shrubs with trees + mangrove
- Oilpalm + coconut
- Shrubs
- Cropland
- Baresoil
- Settlement
- Water

Harapan forest

Oilpalm plantation

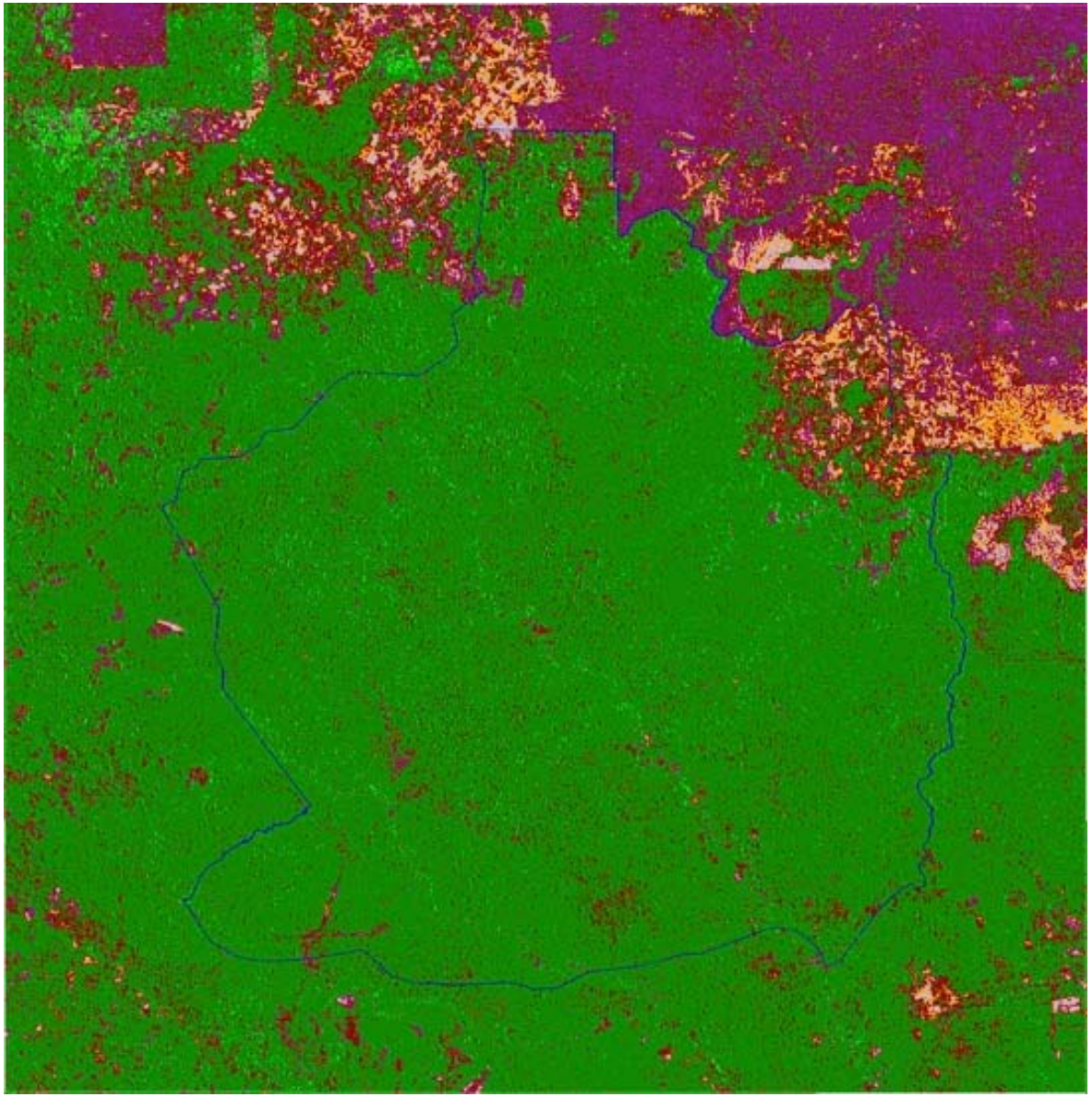
Mangrove

ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Classification Map of Harapan Forest, Year 2010



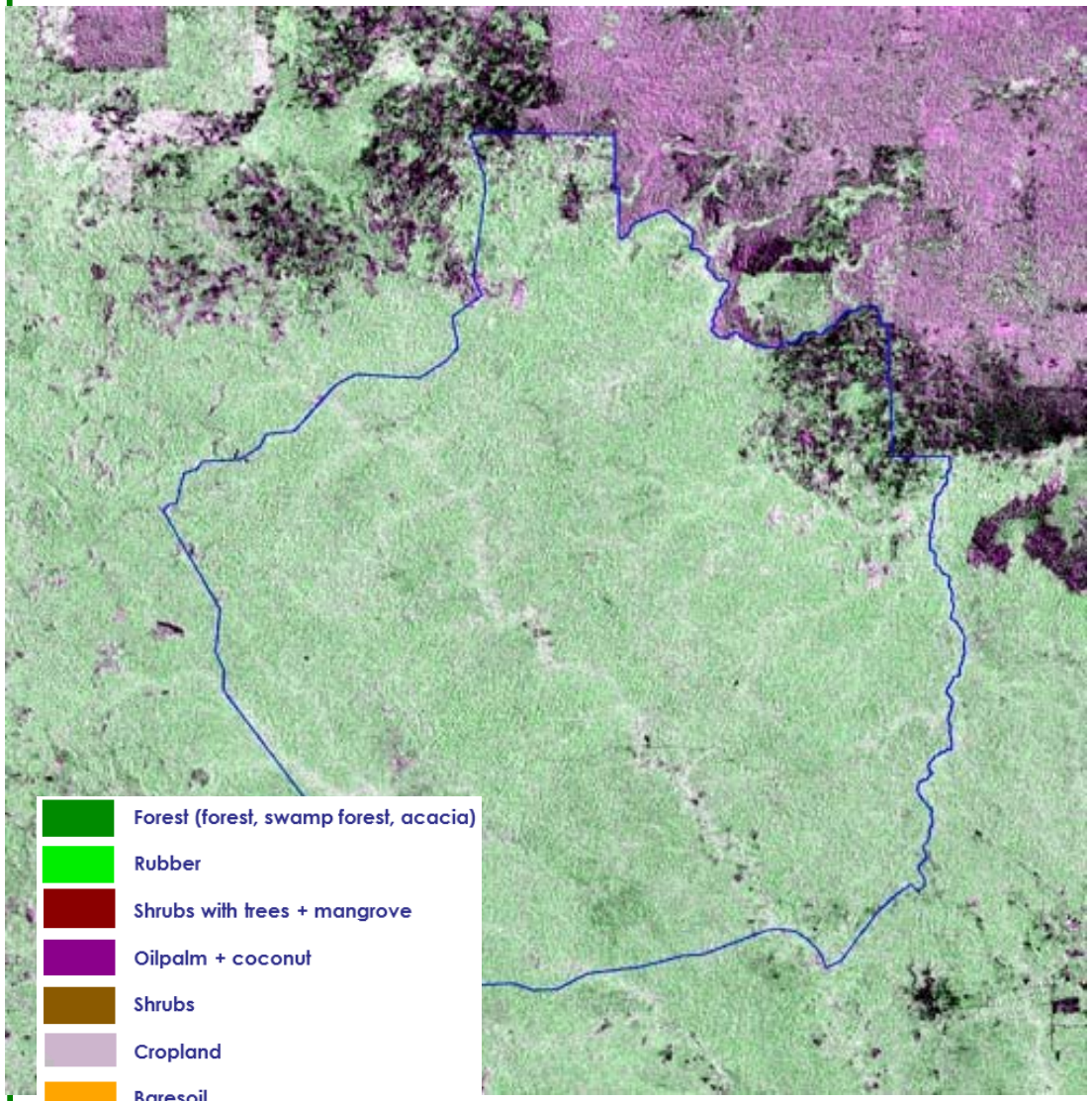
- Forest (forest, swamp forest, acacia)
- Rubber
- Shrubs with trees + mangrove
- Oilpalm + coconut
- Shrubs
- Cropland
- Baresoil
- Settlement
- Water

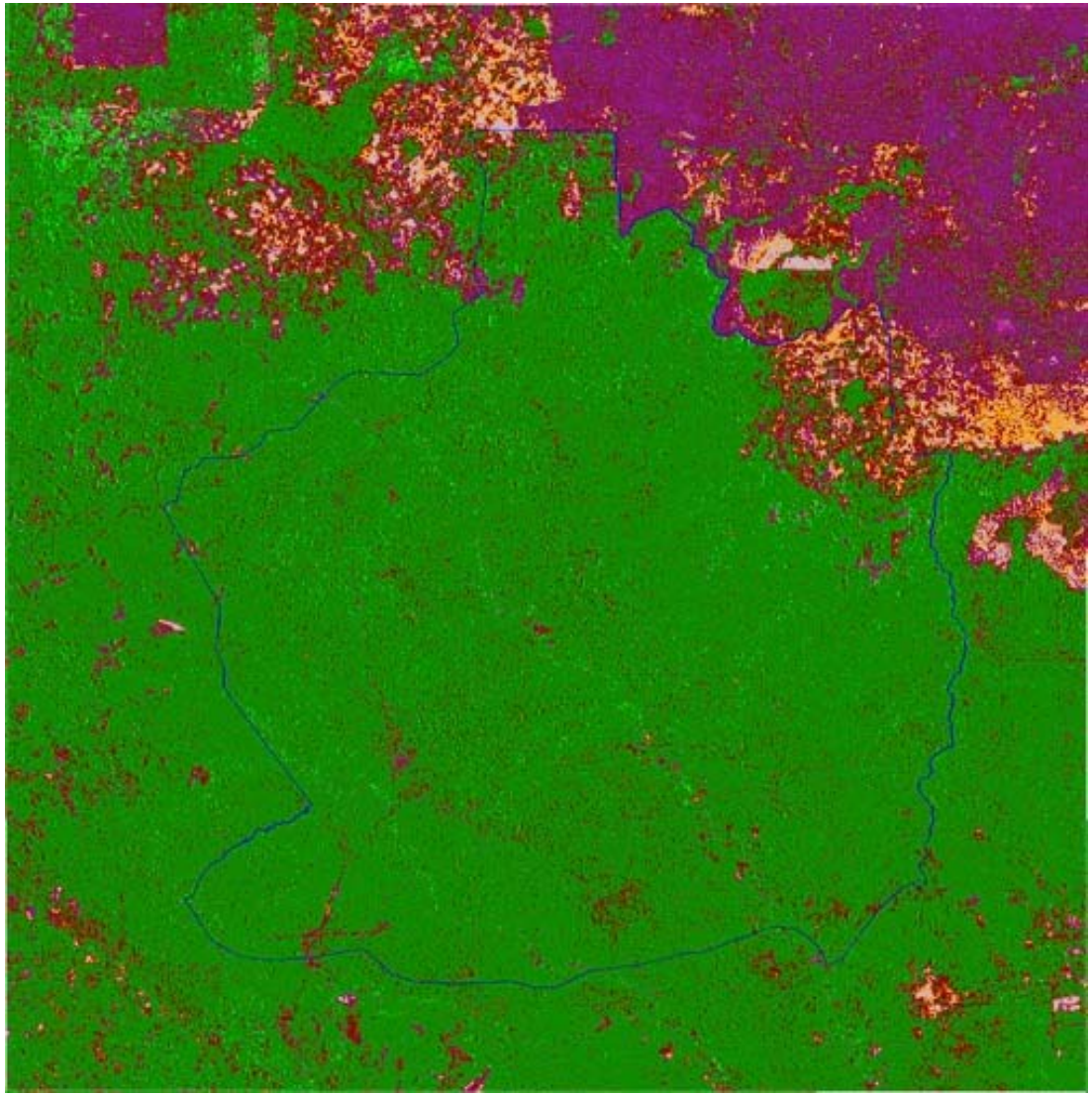
ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Classification Map of Harapan Forest, Year 2010





Classification Results Comparison by Classifier Types

Classifier	Classification Accuracy (%)							
	LC 9 classes				FNF			
	2007	2008	2009	**2010**	2007	2008	2009	**2010**
MLP (Multi Layer Perceptron)	80.87	84.92	77.72	87.66				
Random Trees	83.00	86.58	80.48	**88.93**				
SVM (Support Vector Machine)	81.22	85.36	78.75	87.78				

- 9 classes : forest, mangrove + shrubs, oilpalm + coconut, baresoil, settlement, shrubs, cropland, rubber, water
- MLP, Random Trees, SVM classifier : using OpenCV software library (pixel based) + phyton
- Training samples : 4000 ~ 6000 pixels per class (60 % for training, 40% for testing)
- Ubuntu Linux, 64 bits

Confusion Matrix and Accuracies %
(2010, Random Trees Classifier)

Overall Accuracy = 88.933 %
Kappa Coefficient = 0.8686

Reference Data

Classification Map

	Forest	Rubber	Mangrove + shrubs with trees	Oilpalm + coconut	Shrubs	Cropland	Baresoil	Settlement	Water	User's accuracy
Forest	4428	49	47	24	294	0	0	35	0	90.79
Rubber	87	1314	0	0	0	0	0	43	0	91.00
Mangrove + shrubs with trees	108	0	2259	7	21	2	5	0	0	94.05
Oilpalm + coconut	20	0	39	1908	182	11	0	116	0	83.83
Shrubs	154	0	71	182	689	0	0	1	0	62.81
Cropland	0	0	0	0	0	1234	172	0	0	87.77
Baresoil	0	0	5	0	0	64	341	0	0	83.17
Settlement	7	26	0	65	1	0	0	1014	0	91.11
Water	0	0	0	0	0	0	0	0	1583	100.00
Producer's accuracy	**92.17**	**94.60**	**93.91**	**87.28**	**58.05**	**94.13**	**65.83**	**83.87**	**100.00**	

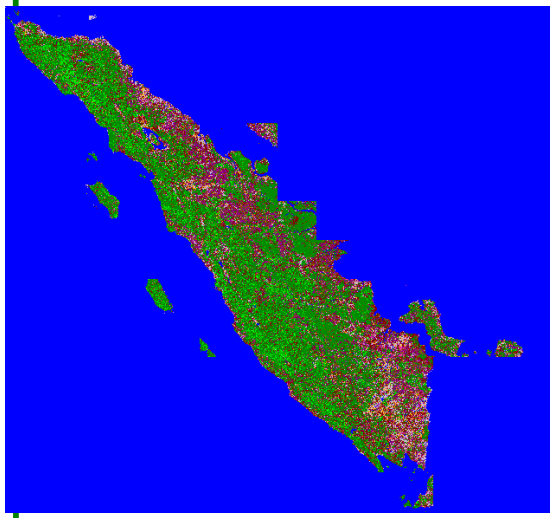
ALOS

K&C Initiative

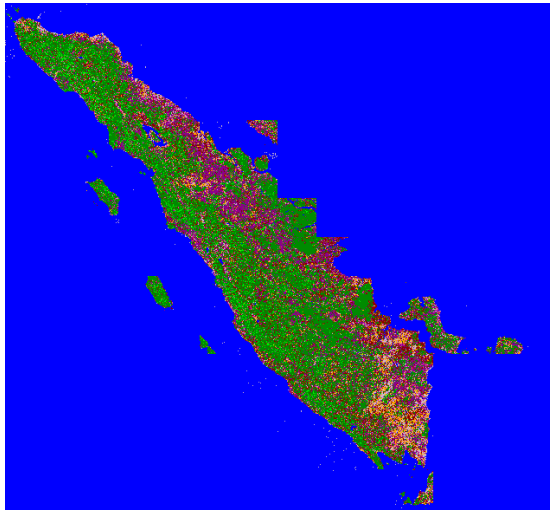
An international science collaboration led by JAXA

Land Cover Classification Map of Sumatera

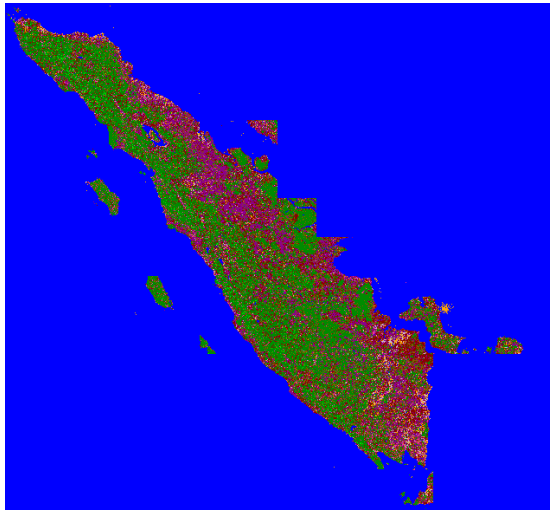
Random Trees Classifier



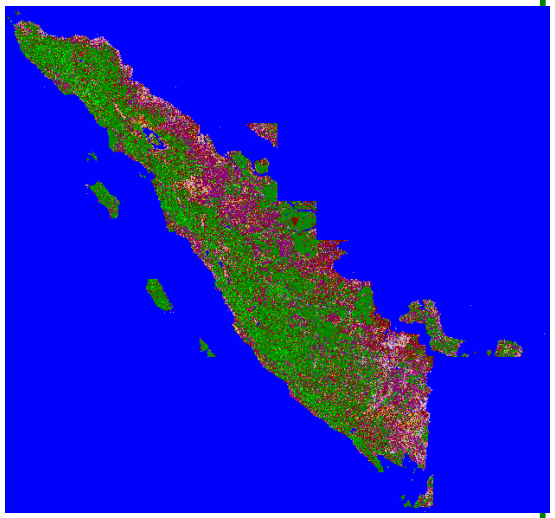
2007



2008

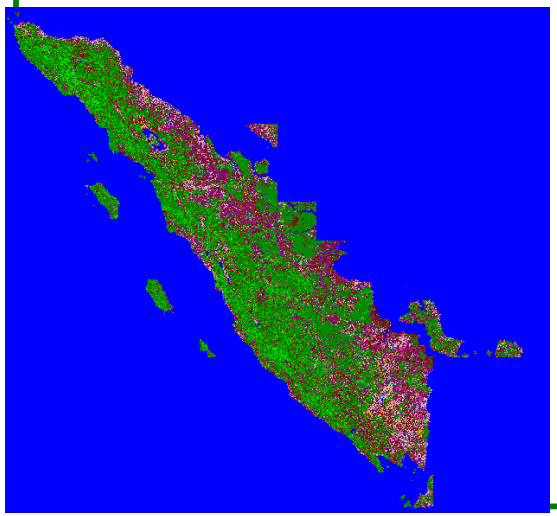


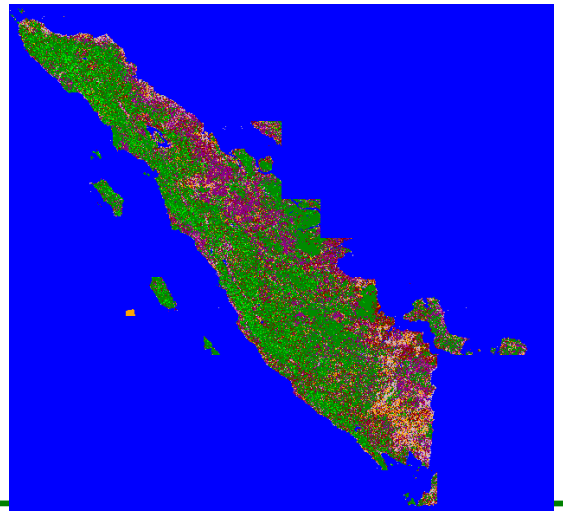
2009

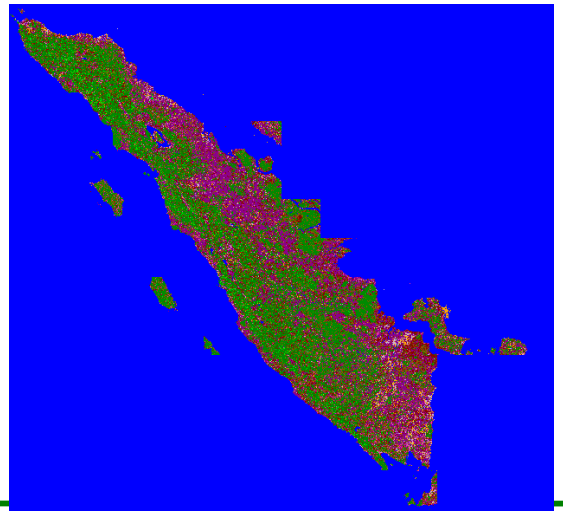


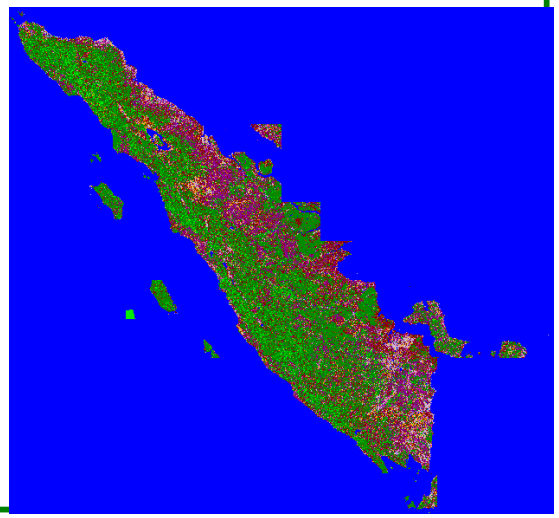
2010

SVM Classifier







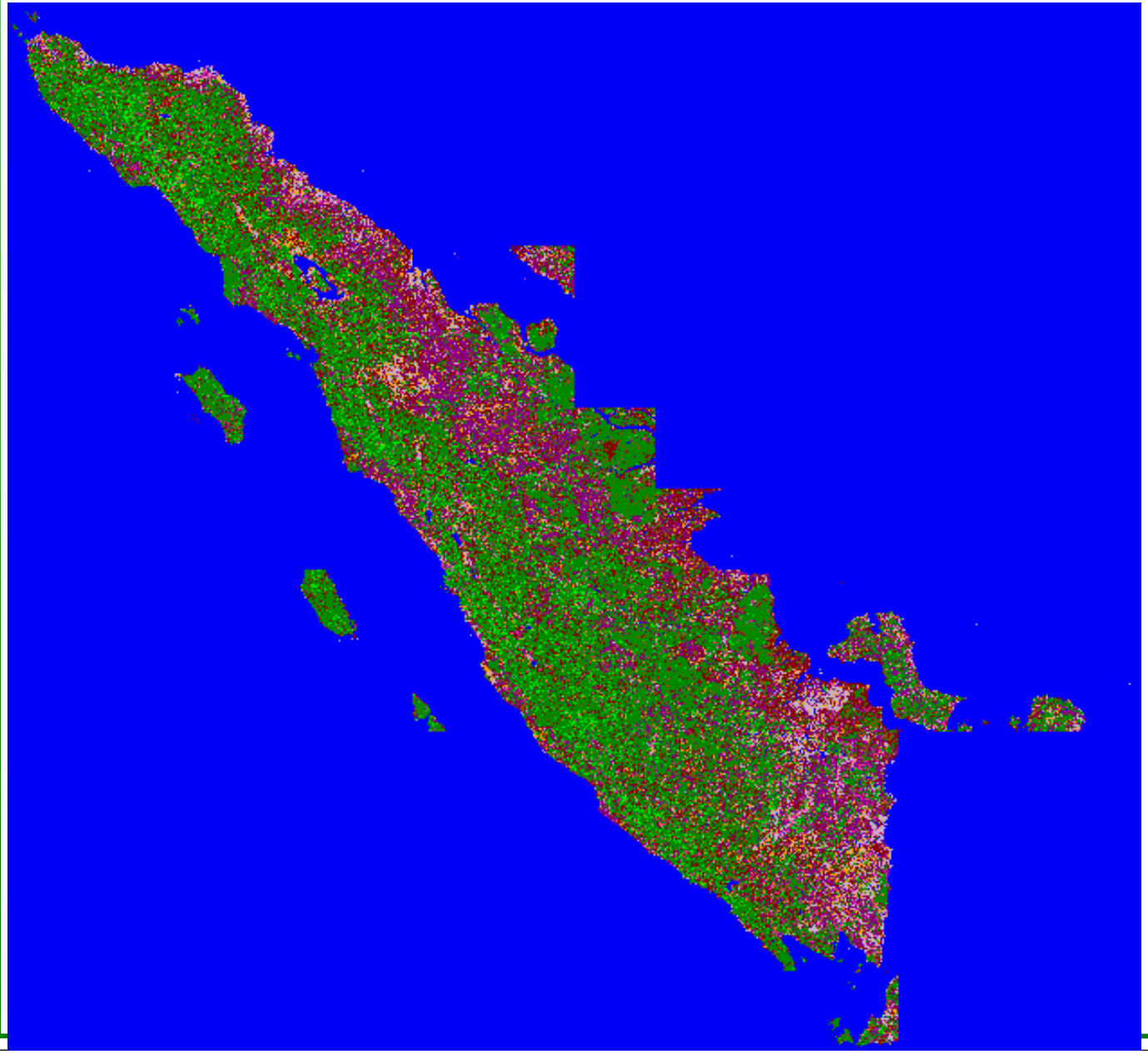


ALOS

K&C Initiative

An international science collaboration led by JAXA

Land Cover Classification Map of Sumatera, Year 2010, RTrees



- Forest (forest, swamp forest, acacia)
- Rubber
- Shrubs with trees + mangrove
- Oilpalm + coconut
- Shrubs
- Cropland
- Baresoil
- Settlement
- Water

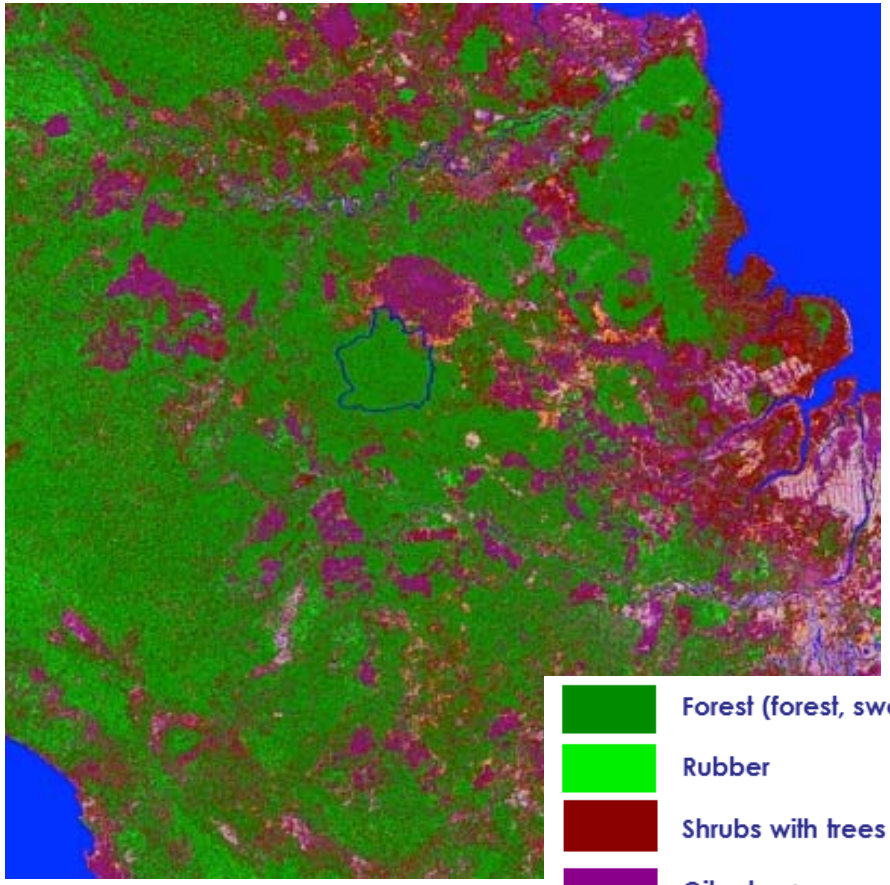
Results

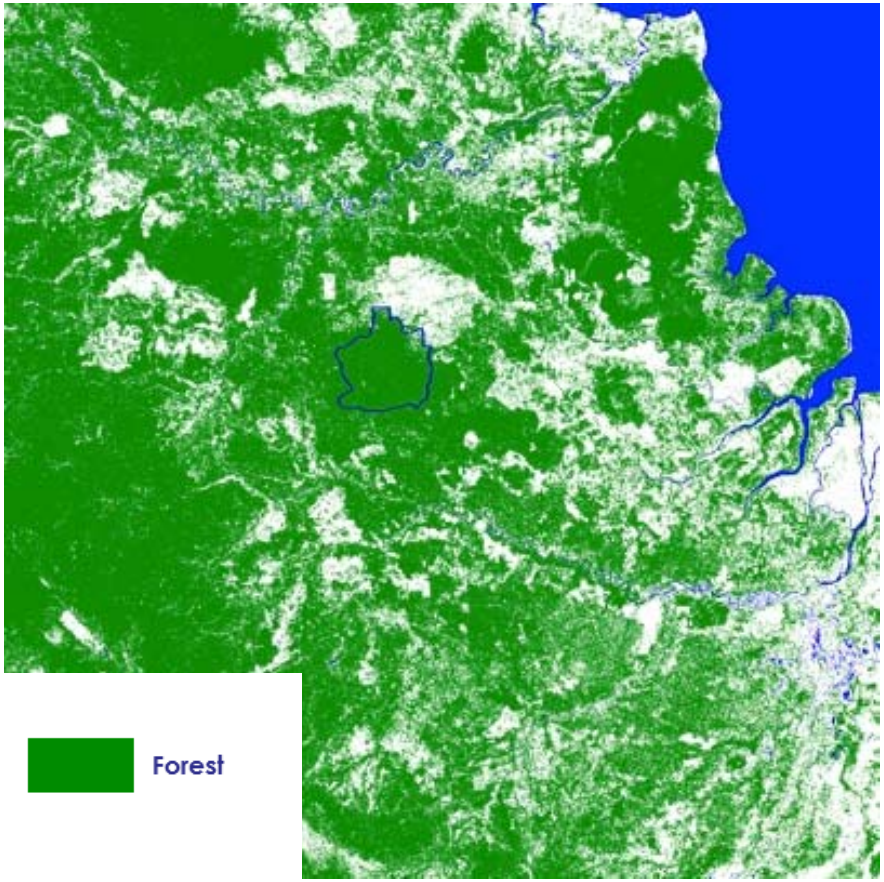
- Ground truth data of area around Harapan Rain Forest (South Sumatera Province and Jambi Province)
- Land Cover Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest-Non Forest Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest Loss Map of Sumatera (2007~2008, 2008~2009, 2009~2010)

ALOS

K&C Initiative
An international science collaboration led by JAXA

Forest-Non Forest Classification Map of Jambi & Harapan, 2010





Forest (forest, swamp forest, acacia)
Rubber
Shrubs with trees + mangrove
Oilpalm + coconut
Shrubs
Cropland
Baresoil
Settlement
Water

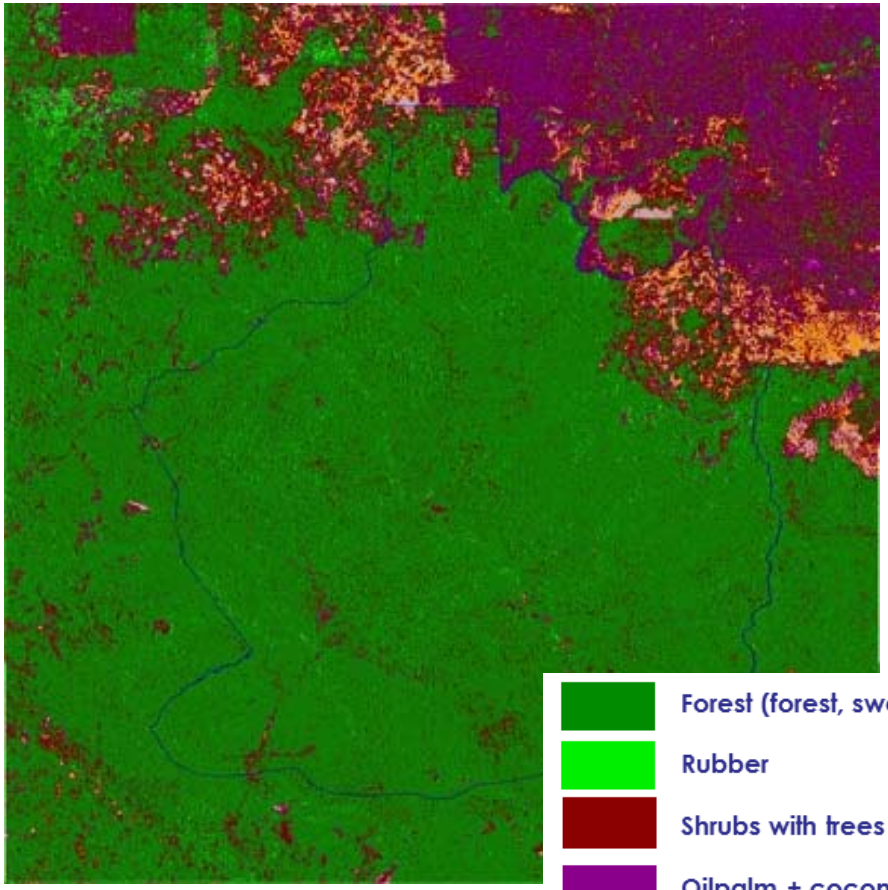
Forest
Non-Forest
Water

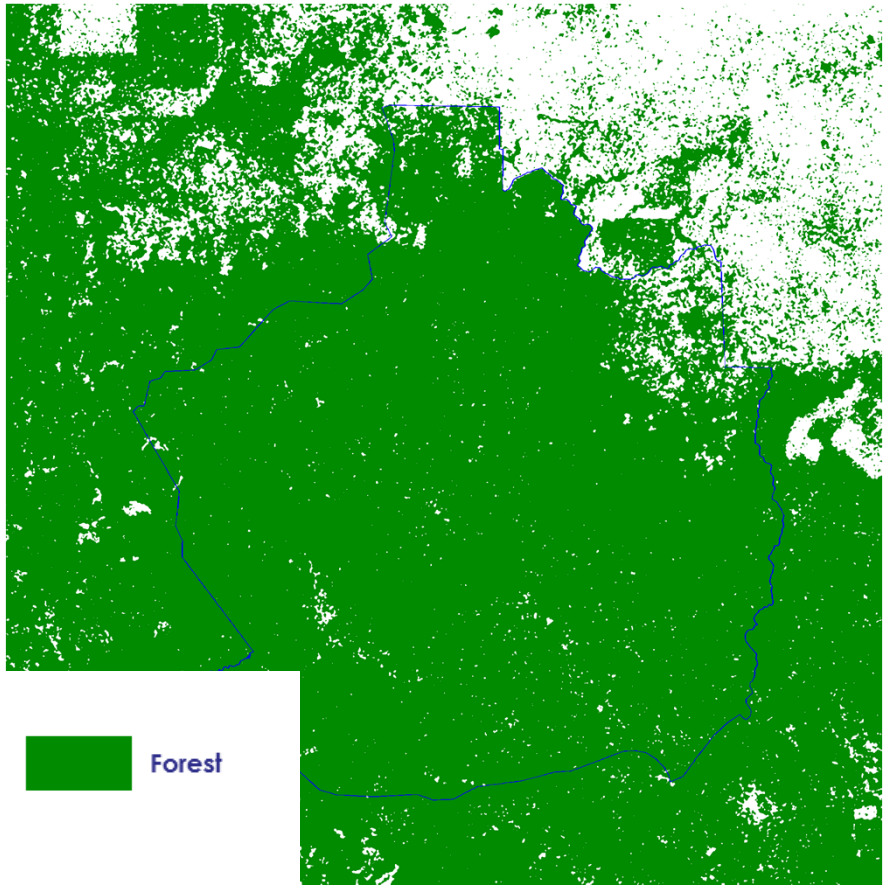
ALOS

K&C Initiative

An international science collaboration led by JAXA

Forest-Non Forest Classification Map of Harapan Forest, 2010





Forest (forest, swamp forest, acacia)

Rubber

Shrubs with trees + mangrove

Oilpalm + coconut

Shrubs

Cropland

Baresoil

Settlement

Water

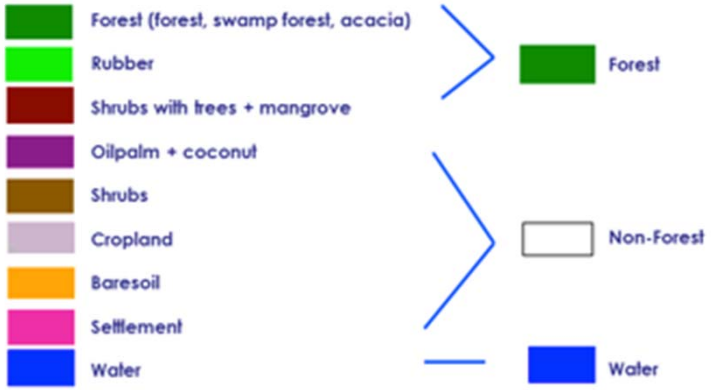
Forest

Non-Forest

Water

Classification Results Comparison by Classifier Types

Classifier	Classification Accuracy (%)							
	LC 9 classes				FNF			
	2007	2008	2009	**2010**	2007	2008	2009	**2010**
MLP (Multi Layer Perceptron)	80.87	84.92	77.72	87.66	93.87	93.03	83.81	94.99
Random Trees	83.00	86.58	80.48	**88.93**	95.22	94.22	85.77	**95.46**
SVM (Support Vector Machine)	81.22	85.36	78.75	87.78	94.81	93.60	84.86	95.23



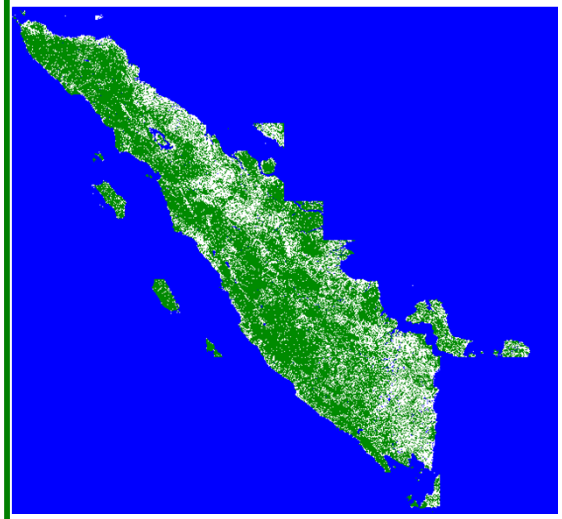
ALOS

K&C Initiative

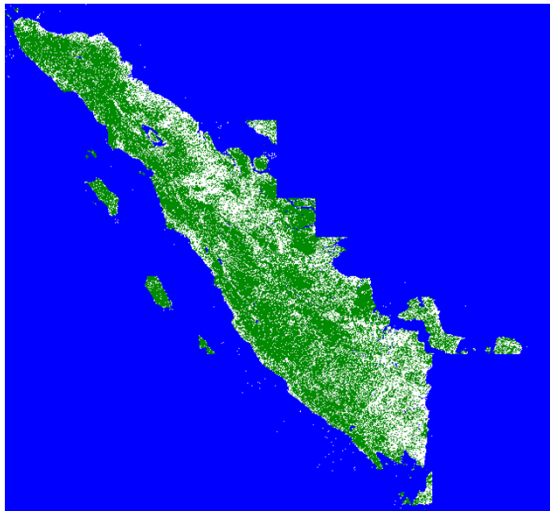
An international science collaboration led by JAXA

Forest-Non Forest Classification Map of Sumatera

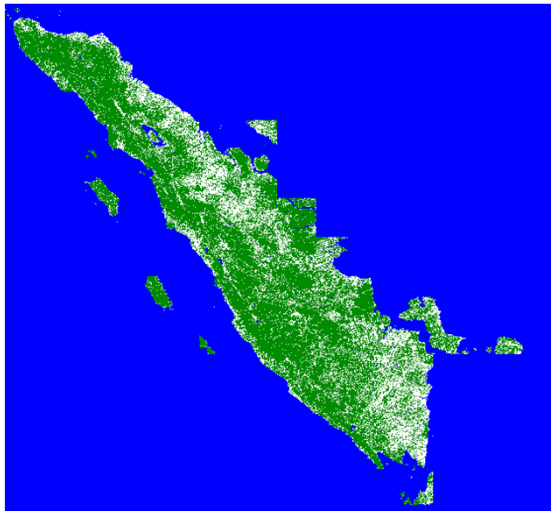
Using Random Trees Classifier



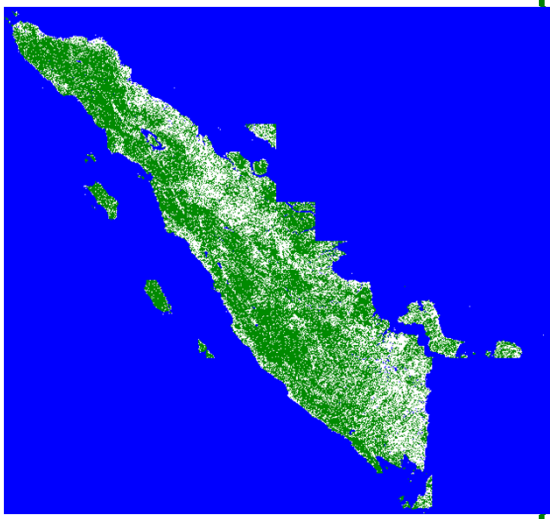
2007



2008



2009



2010

Results

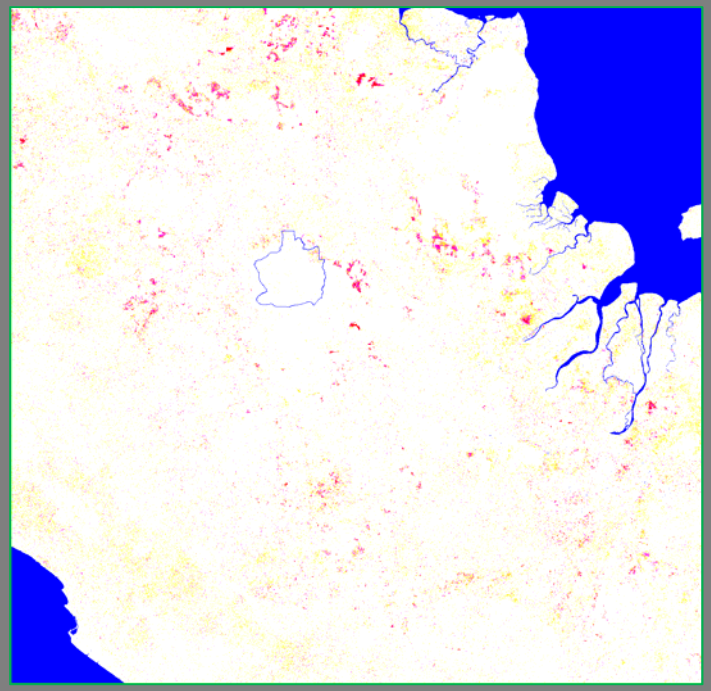
- Ground truth data of area around Harapan Rain Forest (South Sumatera Province and Jambi Province)
- Land Cover Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest-Non Forest Classification Map of Sumatera (2007, 2008, 2009, 2010)
- Forest Loss Map of Sumatera (2007~2008, 2008~2009, 2009~2010)

ALOS

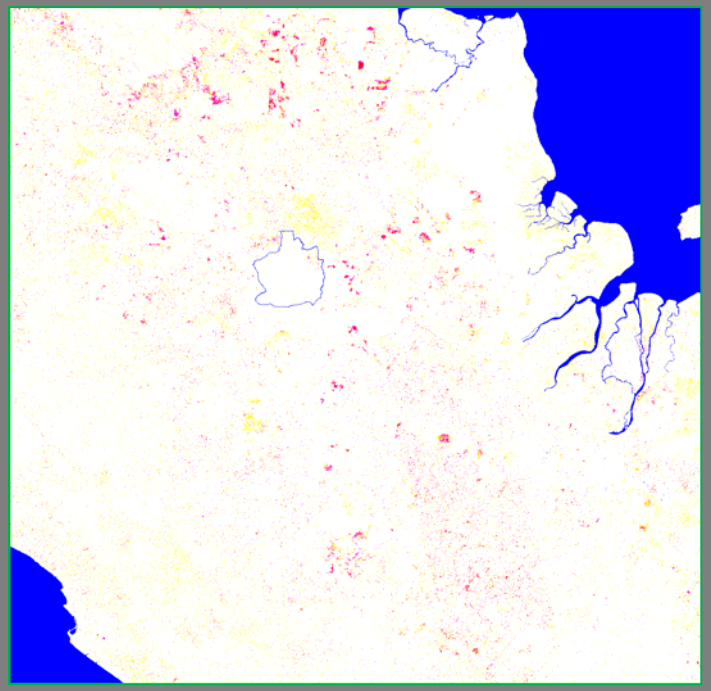
K&C Initiative

An international science collaboration led by JAXA

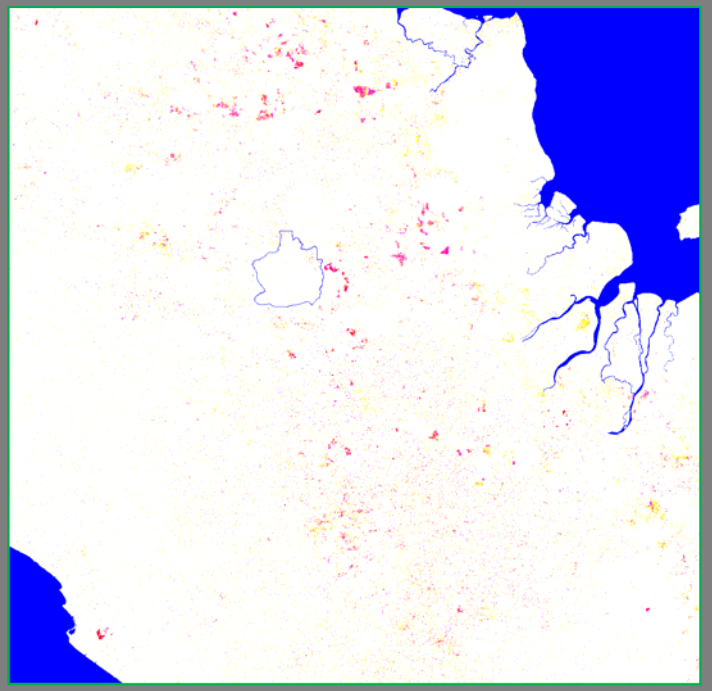
Forest Loss Map of Jambi & Harapan Area (2007~2008, 2008~2009, and 2009~2010)



2007~2008



2008~2009



2009~2010

Threshold

-1 dB

-2 dB

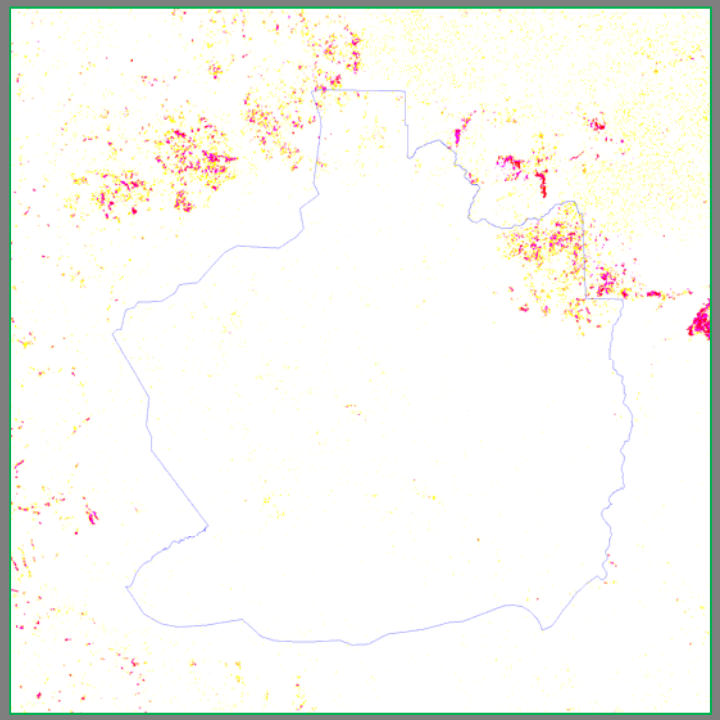
-3 dB

ALOS

K&C Initiative

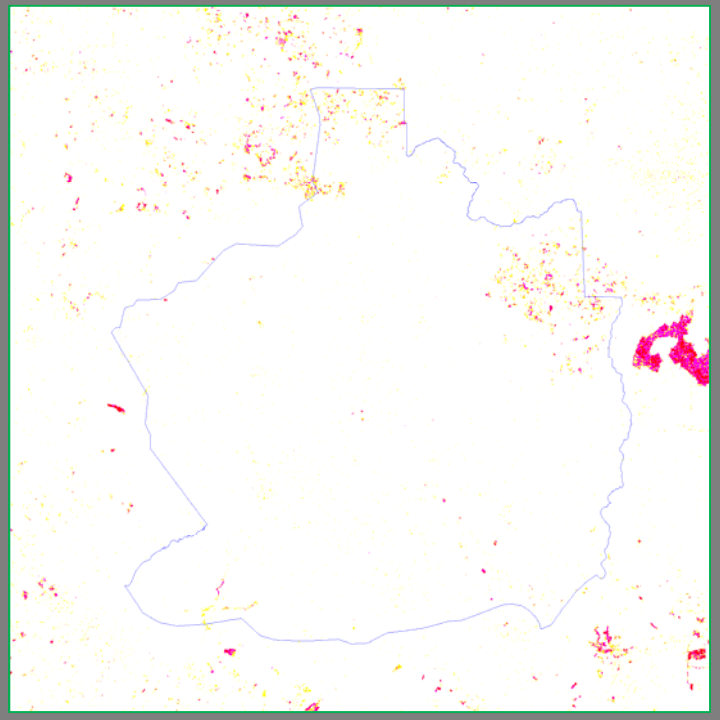
An international science collaboration led by JAXA

Forest Loss Map of Harapan Rain Forest Area (2007~2008, 2008~2009, and 2009~2010)



2007~2008

2008~2009



2009~2010

Threshold

-1 dB

-2 dB

-3 dB

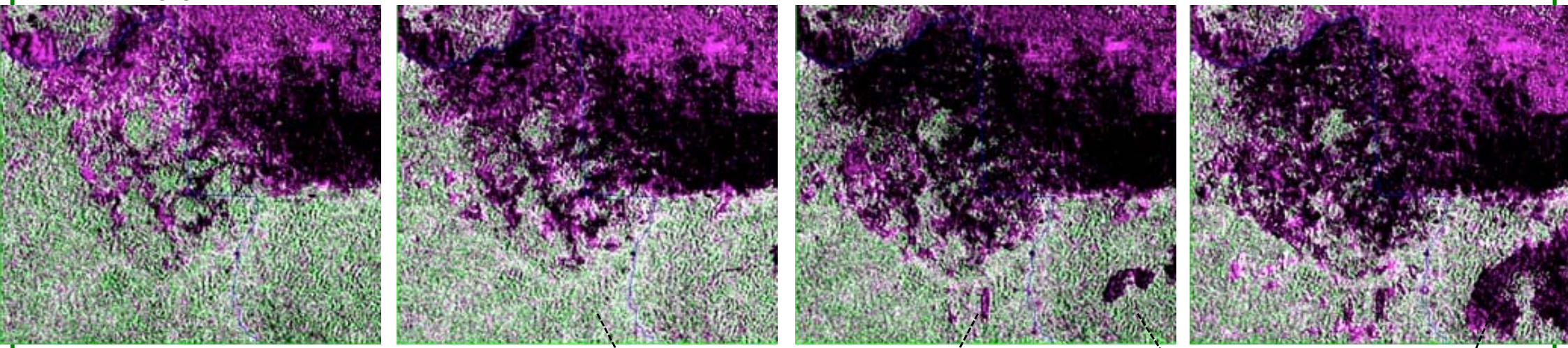
ALOS

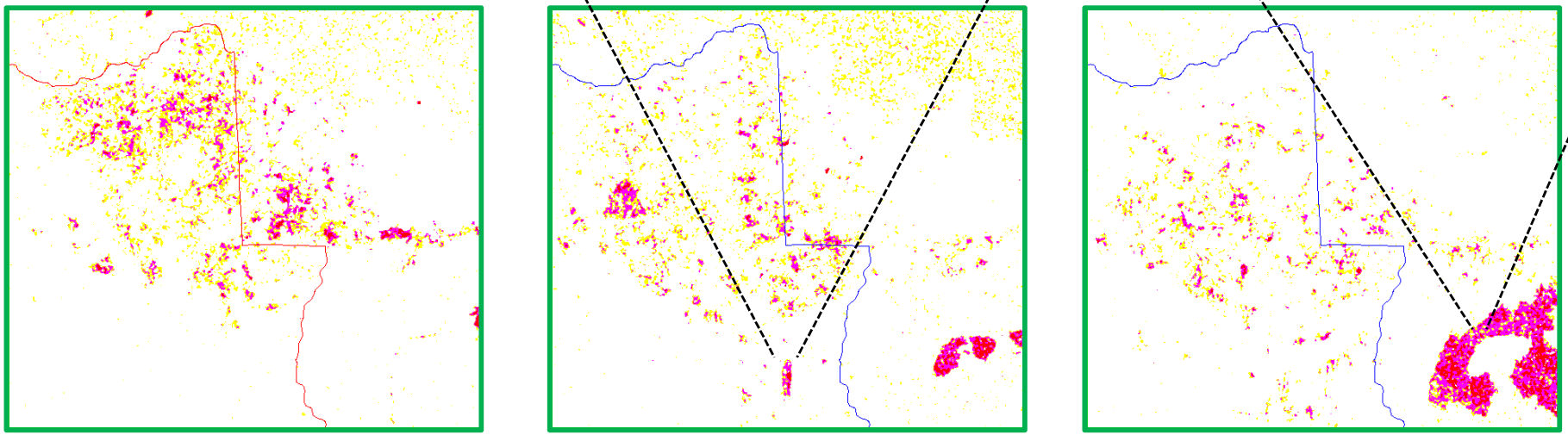
K&C Initiative

An international science collaboration led by JAXA

Forest Loss Map of Harapan Rain Forest Area (zoom)

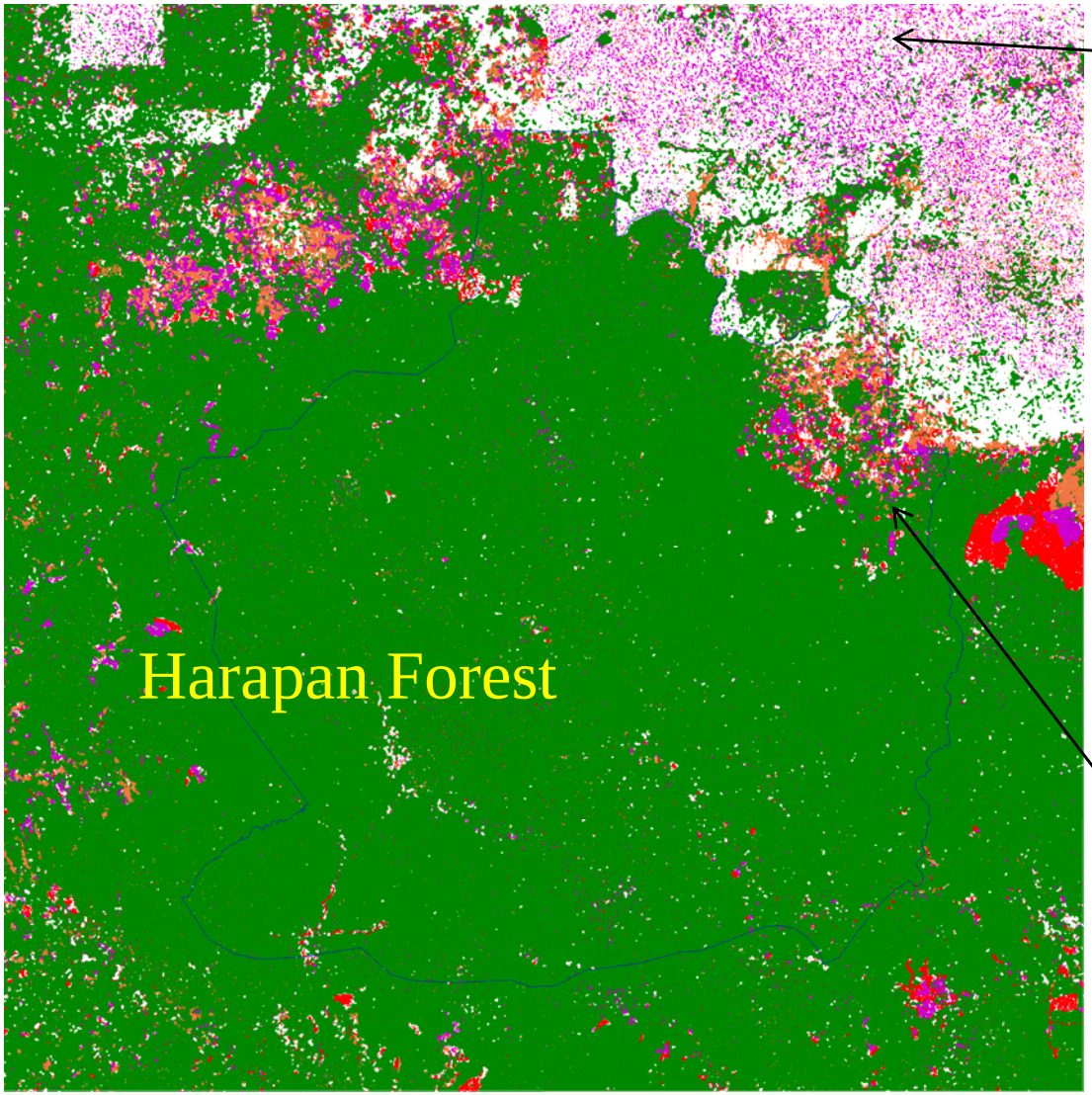
2007 2008 2009 2010





2007~2008 2008~2009 2009~2010

Forest-Non Forest Map + Forest Loss Map in Harapan



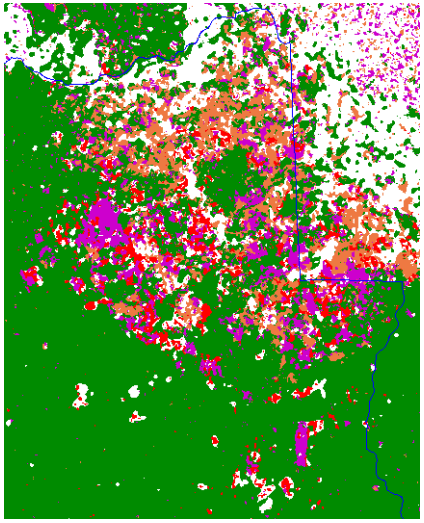
Non-forest

DF 2007~2008
DF 2008~2009
DF 2009~2010

Threshold = -1 dB

Cut down and burned, and then planted with palm trees by forest encroachers (occupying up to 17,000 acres of land)

Cut down and burned, then planted with palm trees by forest encroachers

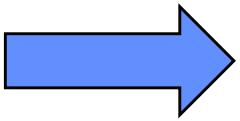


DF 2007~2008
DF 2008~2009
DF 2009~2010

Sunday, April 7, 2013

Tragis: Perambah Bacok Dua Petugas Keamanan PT LAJ di Jambi (UPDATE)

Sebagaimana di Kab. Tebo, Kelompok perambah terorganisir yang mengatasnamakan SPI juga beramai-ramai masuk ke Hutan Harapan dan menguasai lahan semau mereka. Hutan ditebangi dan dibakari lalu lahannya dikuasai (Lihat foto). Di Hutan Harapan mereka melakukan penyanderaan staf REKI, menyerang pos jaga berkali-kali dan seringkali mengancam akan menyerbu ke kamp Hutan Harapan. Kelompok ini juga kerap membentuk opini menyesatkan terhadap Hutan Harapan.



Source :
harapanrainforest.blogspot.com

Forest-Non Forest Map + Forest Loss Map in Harapan & Jambi Area

DF 2007~2008
DF 2008~2009
DF 2009~2010

Threshold = -1 dB

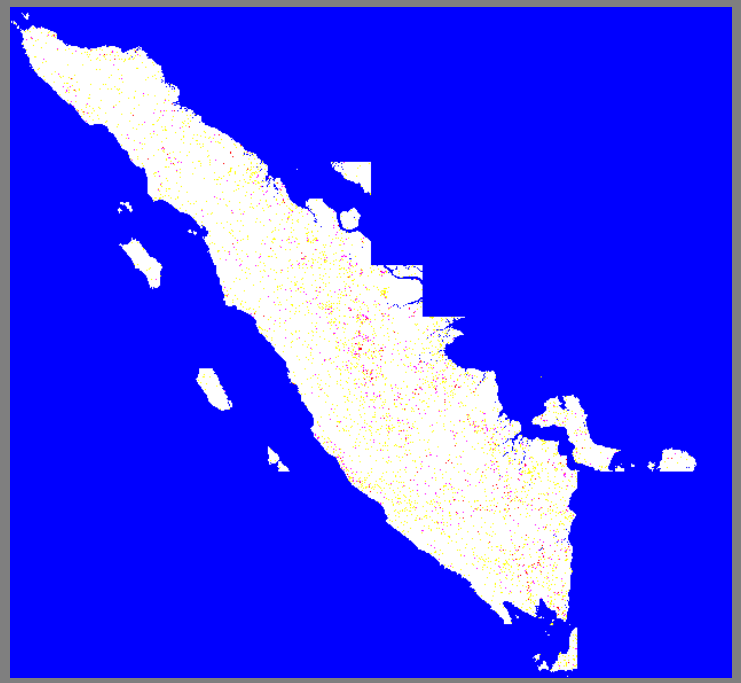
Harapan Forest

ALOS

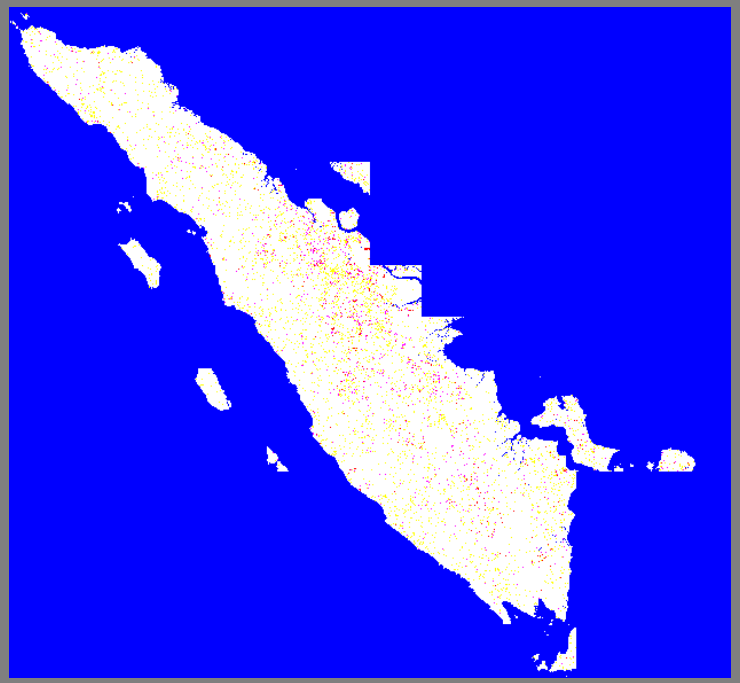
K&C Initiative

An international science collaboration led by JAXA

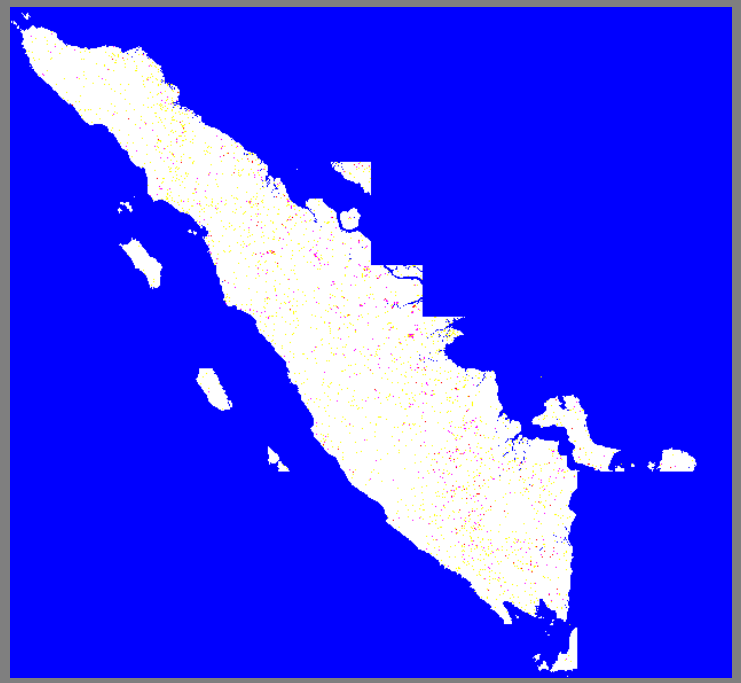
Forest Loss Map of Sumatera (2007~2008, 2008~2009, and 2009~2010)



2007~2008



2008~2009



2009~2010

Threshold

-1 dB

-2 dB

-3 dB

Conclusions and Future Works

Conclusions

1. LAPAN's progress report using Sumatera Datasets (2007~2010) : generation of Land Cover Maps, Forest-Non Forest Maps, Forest Loss Maps.
2. LC Maps and FNF Maps were generated experimentally using three classifiers (MLP, Random Trees, SVM), with training and testing samples were defined mainly based on field survey information on Harapan Forest and Jambi area.
3. The best classification result was obtained using Random Trees classifier, with accuracy 88.93% for LC Map (9 classes) and 95.46% for FNF Map. However, "salt and pepper" classification results were obtained due to speckle noise and pixel based classifiers.
4. Oilpalm plantation can be identified accurately using PALSAR data.
5. Forest loss detection using simple threshold can provide consistent result. (We use threshold= -1dB)

Conclusions and Future Works

- Future Works

1. Additional training samples from other areas of Sumatera island.
2. LC classification, and FNF classification need further analysis and verification.
3. Include image segmentation step and/or additional features, such as texture, optical data, etc.
4. Reorder missing data tiles.

THANK YOU