ALOS Kyoto & Carbon (K&C) Initiative
9th Science Team Meeting

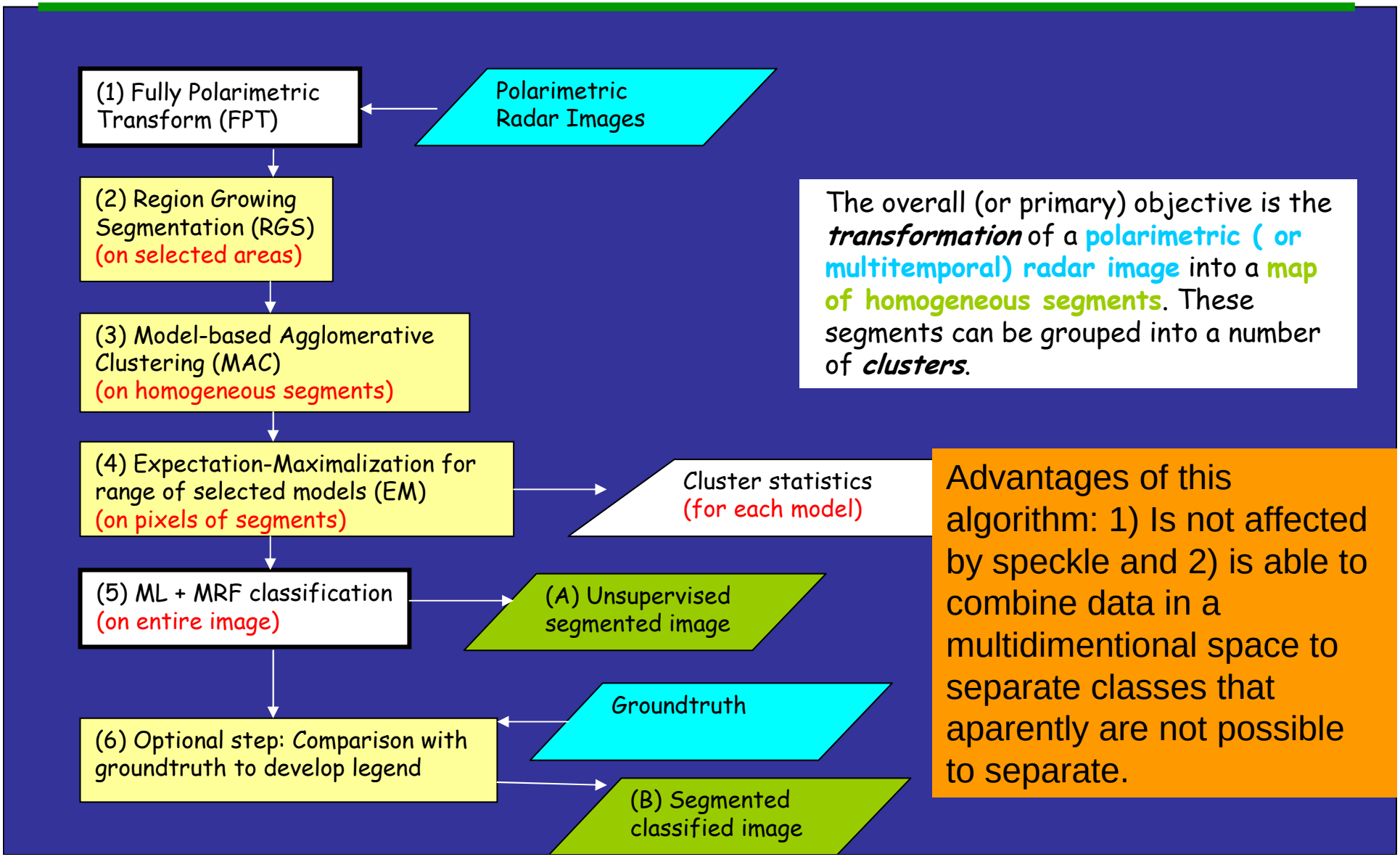
Marcela Quinones & Dirk Hoekman January 2008,Tokio

Contents

- Mapping approach – new developments & new products: Example maps based on PALSAR.
- Peat swamp forest product development. Mapping of forest structure and land Cover. Hydrological cycle in relation to Radar.
- Available data in archive
- Partnerships and collection of field and reference data for South East Asia and Guyana Shield.
- Data and product development plan

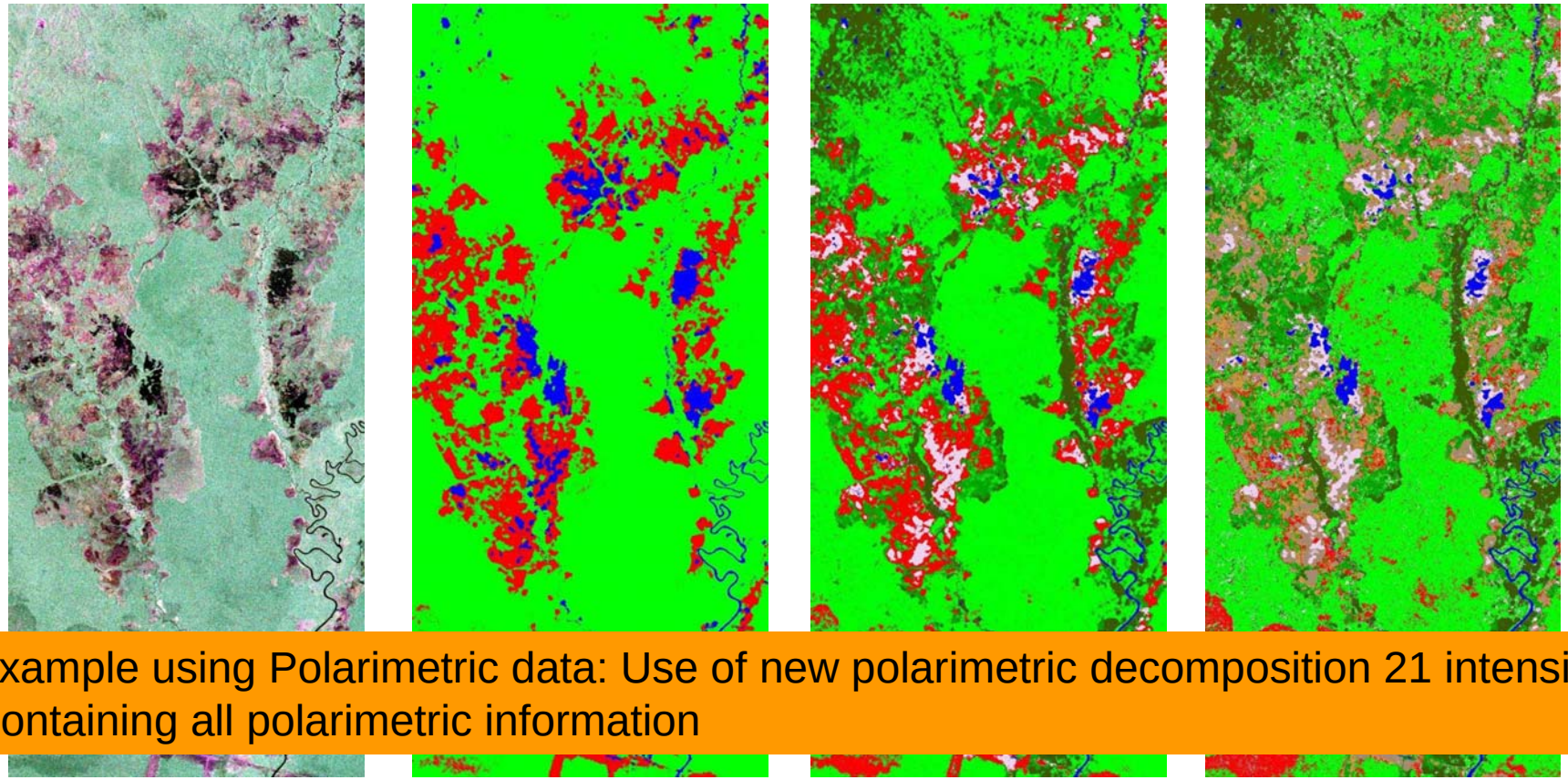
Mapping approach using innovative algorithm

Fundamental steps of the processing chain for unsupervised classification



Mapping approach –Example:

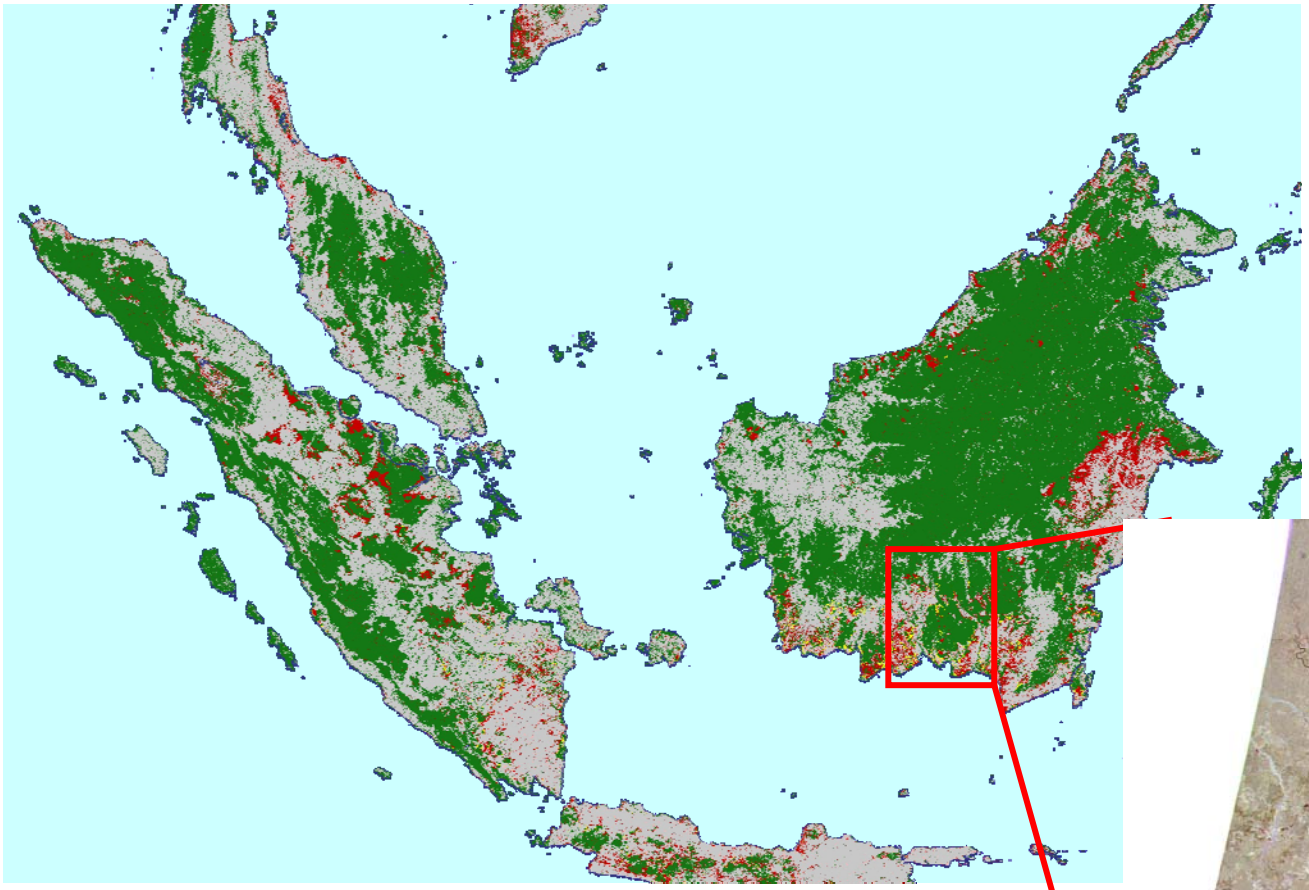
Central Kalimantan Alos PalSAR Dual_Pol FB



Example using Polarimetric data: Use of new polarimetric decomposition 21 intensities Containing all polarimetric information

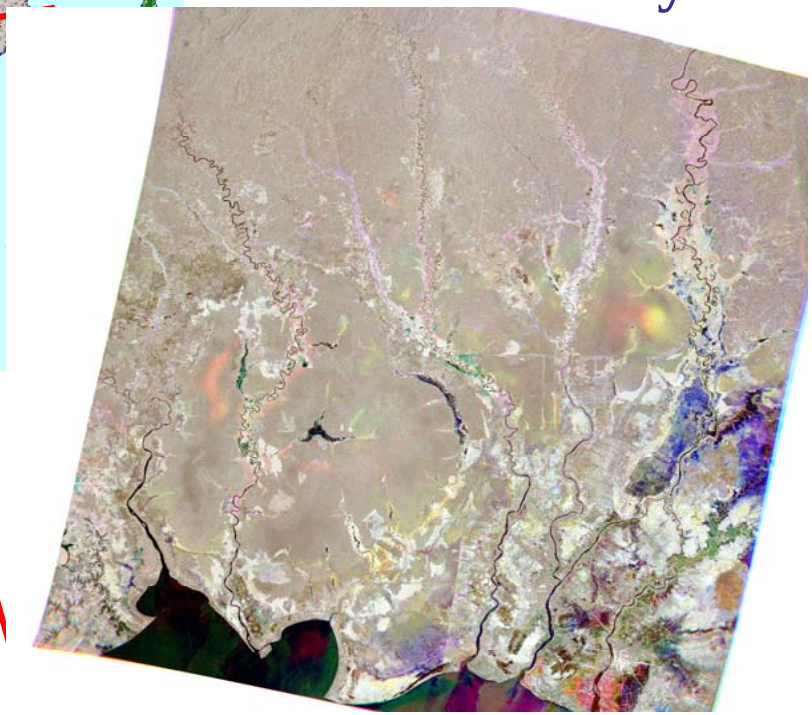
Example series of classification models: PalSAR dual-Pol input radar image composite (left); model 3 resulting in separation of forest and non-forest (mid-left); model 6 resulting in further separation of water and bare areas (mid-right); and model 12 adding classes such as herbaceous cover, shrub cover and open forest (right).

Mapping approach –Study Site:
Central Kalimantan



Data source

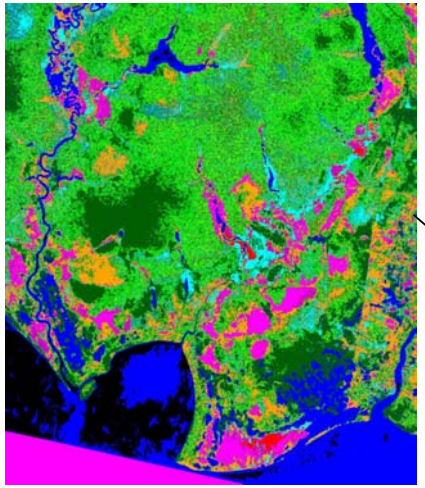
Alos PalSAR
L-HH
Temporal composite
Wet period
Dec-Mar-May



Complexity of the area required an special Stratify classification approach

Mapping approach: use of Forest non forest Mask

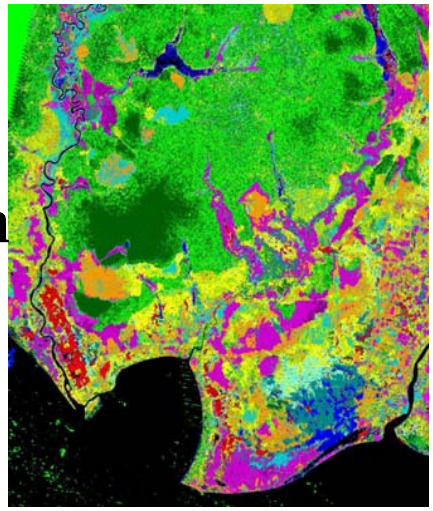
Non forest mask:
Create with LandSAT



Forest area classification

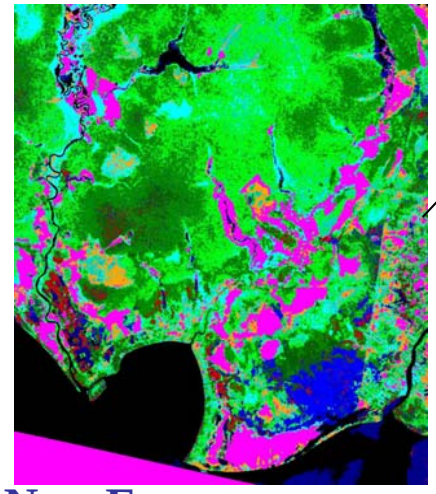
15 classes

combination



30 classes

Forest mask created with LandSAT

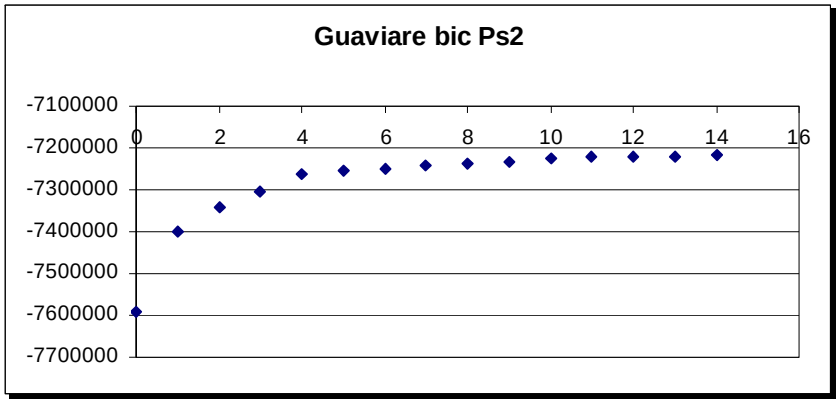


Non-Forest area classification

15 classes

Legend Definition and class labeling process:

Application of algorithm to images and creation of Path and BIC files



BIC = Bayesian Information Criterion: statistical measure of how good the classification is. Gives information. On What is optimal number of classes to retrieve information of image

Path file indicates the most common Vectors of classes for a certain pixel in the series of models/classifications

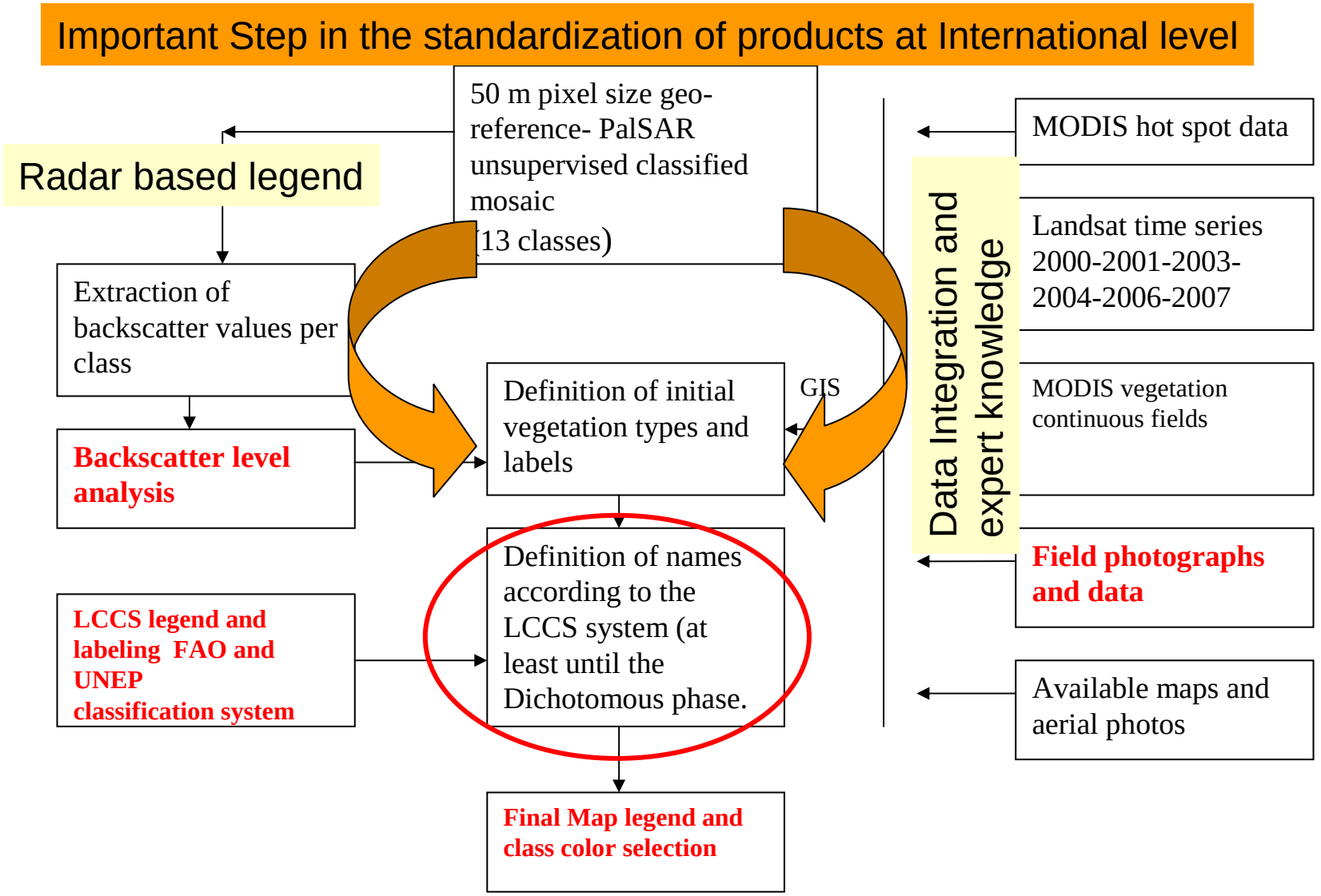
It gives an indication of which classes are closer statistically and how classes split and merge from one model to the next.

Aggregation of classes using field information

Creation of a radar based legend

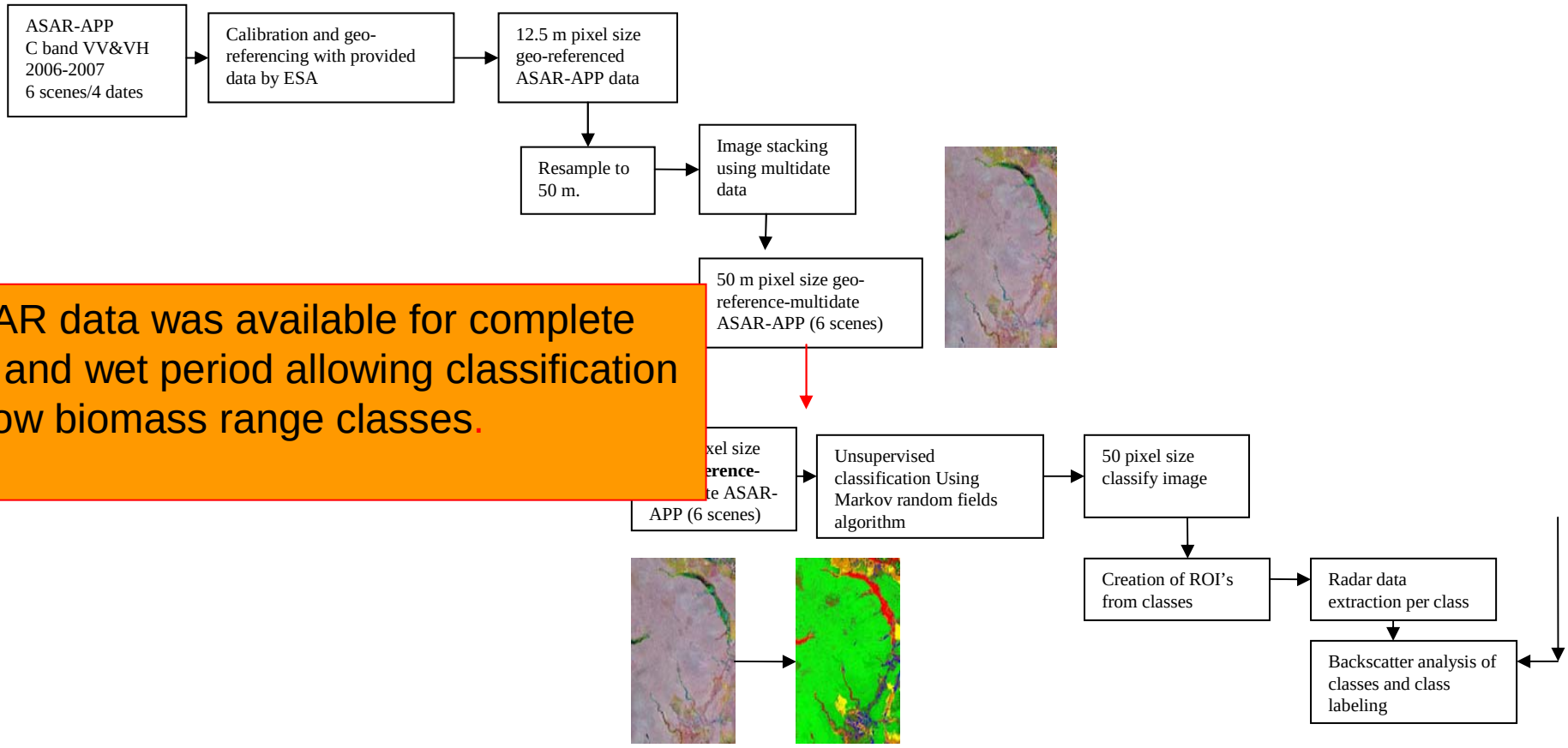
Model #	Path file														
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
3	1	0	0	0	0	0	1	1	1	1	1	1	2	2	2
4	2	2	2	0	0	0	1	1	1	2	2	2	3	3	3
5	3	0	0	0	0	1	1	2	2	3	3	0	4	4	4
6	4	0	0	0	3	1	1	2	2	4	4	3	5	5	5
7	0	0	0	6	3	1	1	2	2	4	4	3	5	5	5
8	0	0	0	6	3	1	1	2	2	4	4	7	7	5	5
9	0	0	0	7	4	1	1	2	3	5	5	8	8	6	6
10	0	9	9	7	4	1	1	2	3	5	5	8	8	6	6
11	0	10	10	8	5	4	1	2	3	6	6	9	9	7	7
12	0	11	11	9	5	4	1	2	3	8	8	6	10	7	7
13	0	11	11	9	5	4	1	2	3	8	8	6	10	7	12
14	0	11	13	9	13	4	1	2	3	5	8	6	10	7	12
15	0	11	14	9	13	4	1	2	3	5	8	6	10	7	12

Legend Definition and class labeling process: use of International legend systems to standardize products

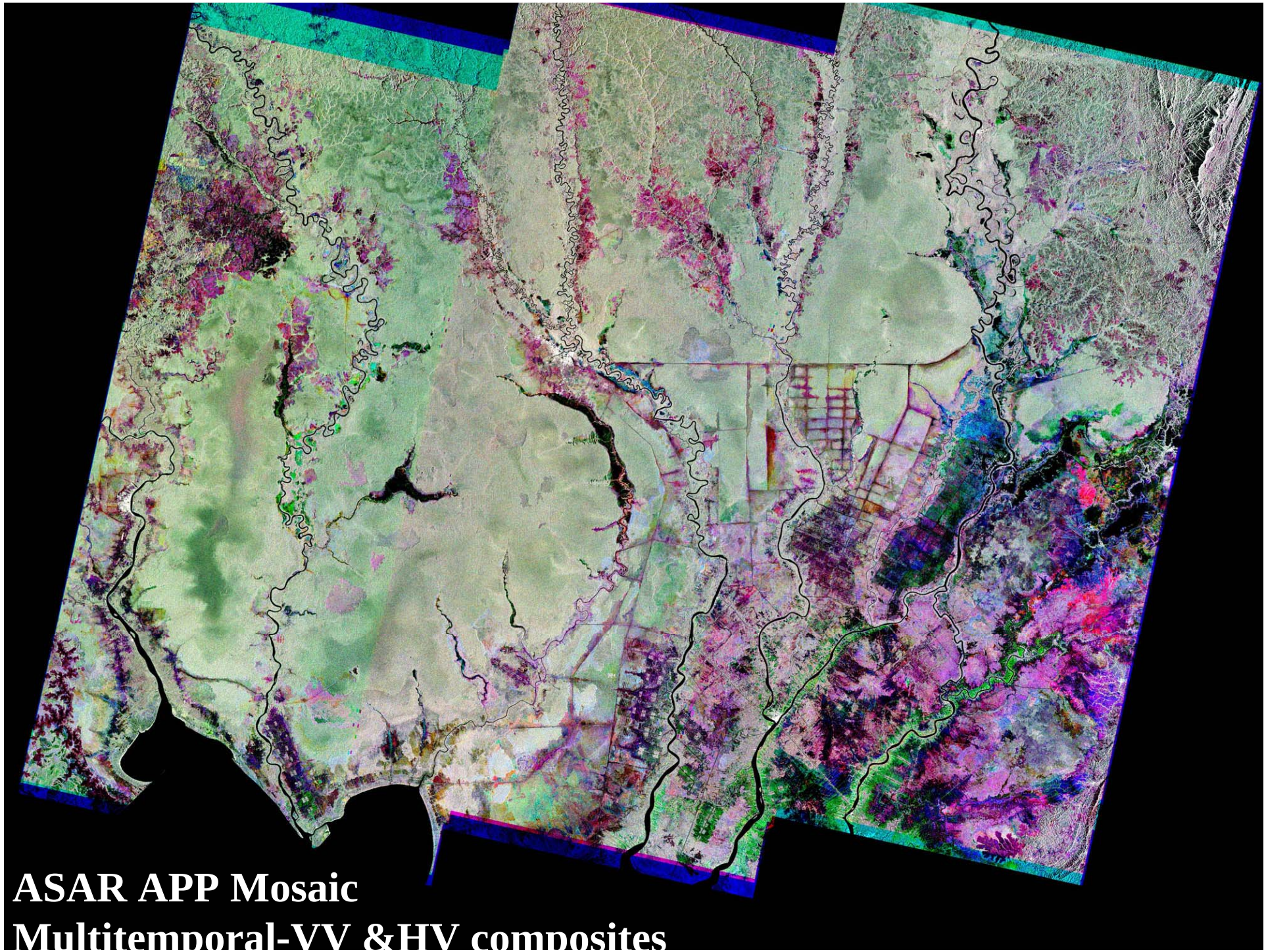


Integration of other Radar data to complement and increase accuracy: ASAR APP data processing:

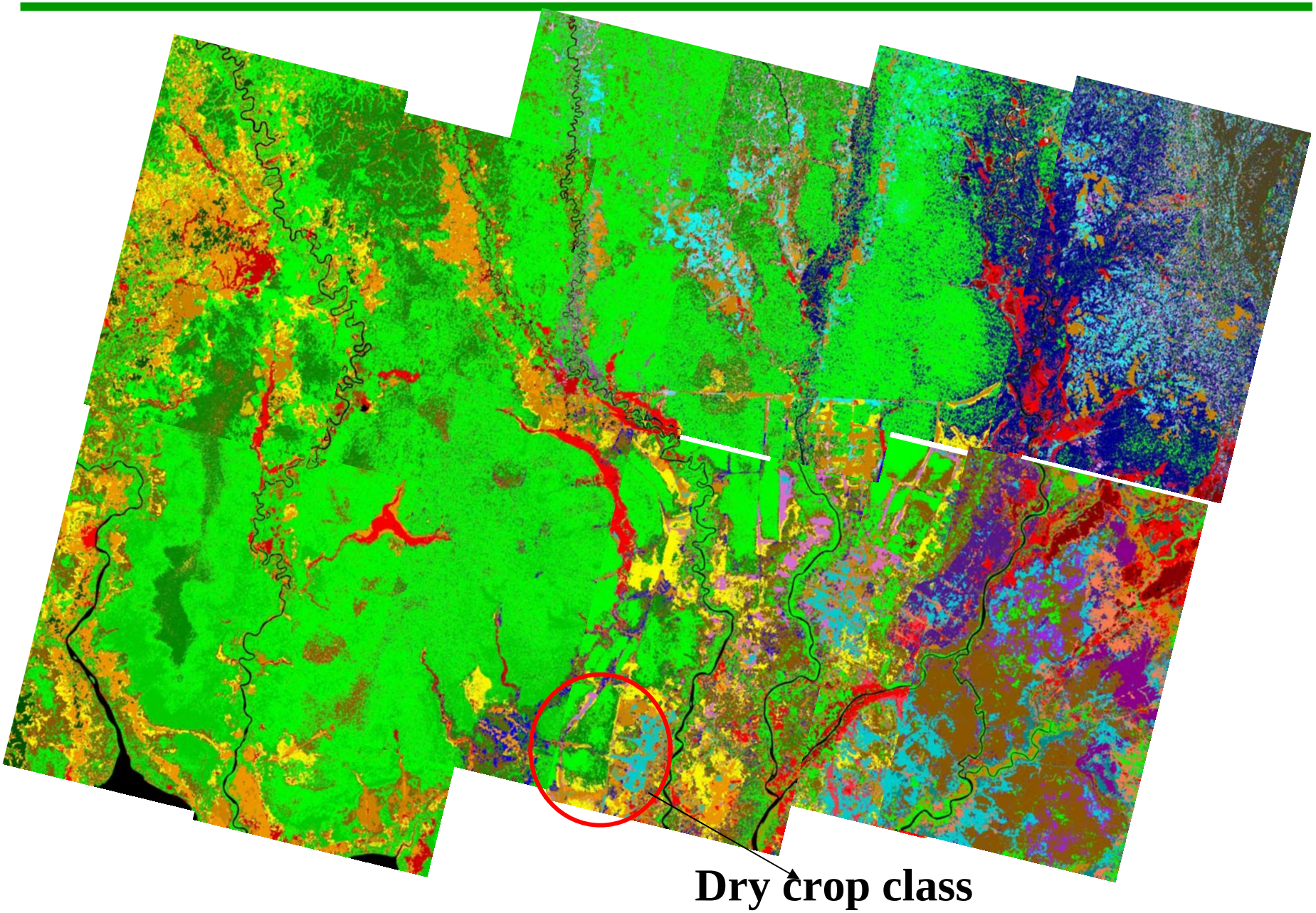
- 24 images (6 scenes and 4 dates 2 polarizaions/scene) calibrated and geo-referenced using standard procedures provided by ESA (European Space Agency).
- Images resample to 50 m and all dates and all polarizations per scene were use in the classification.

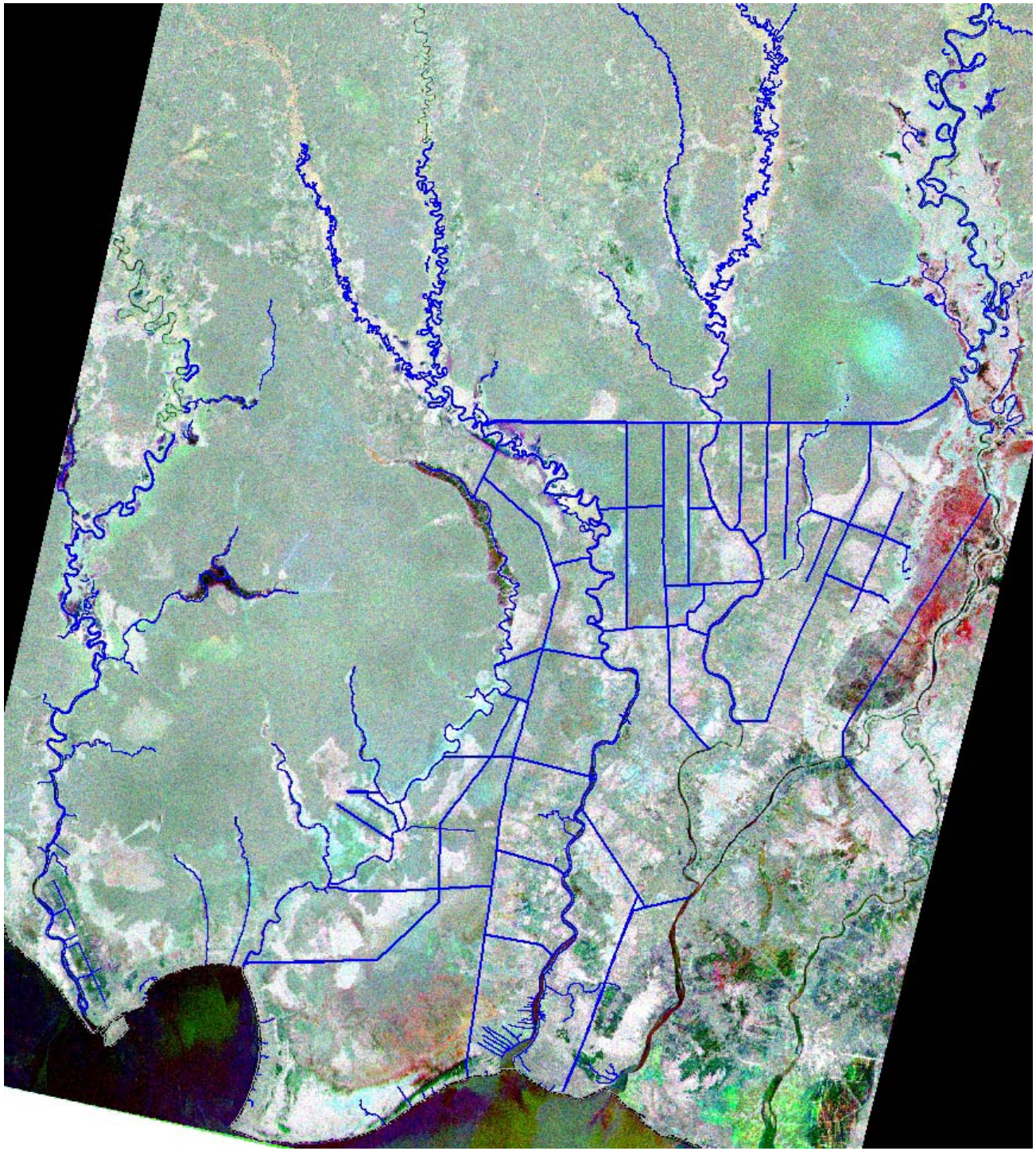


ASAR data was available for complete dry and wet period allowing classification of low biomass range classes.


ASAR APP Mosaic
Multitemporal-VV &HV composites

ASAR APP based, classification





PALSAR imagery used

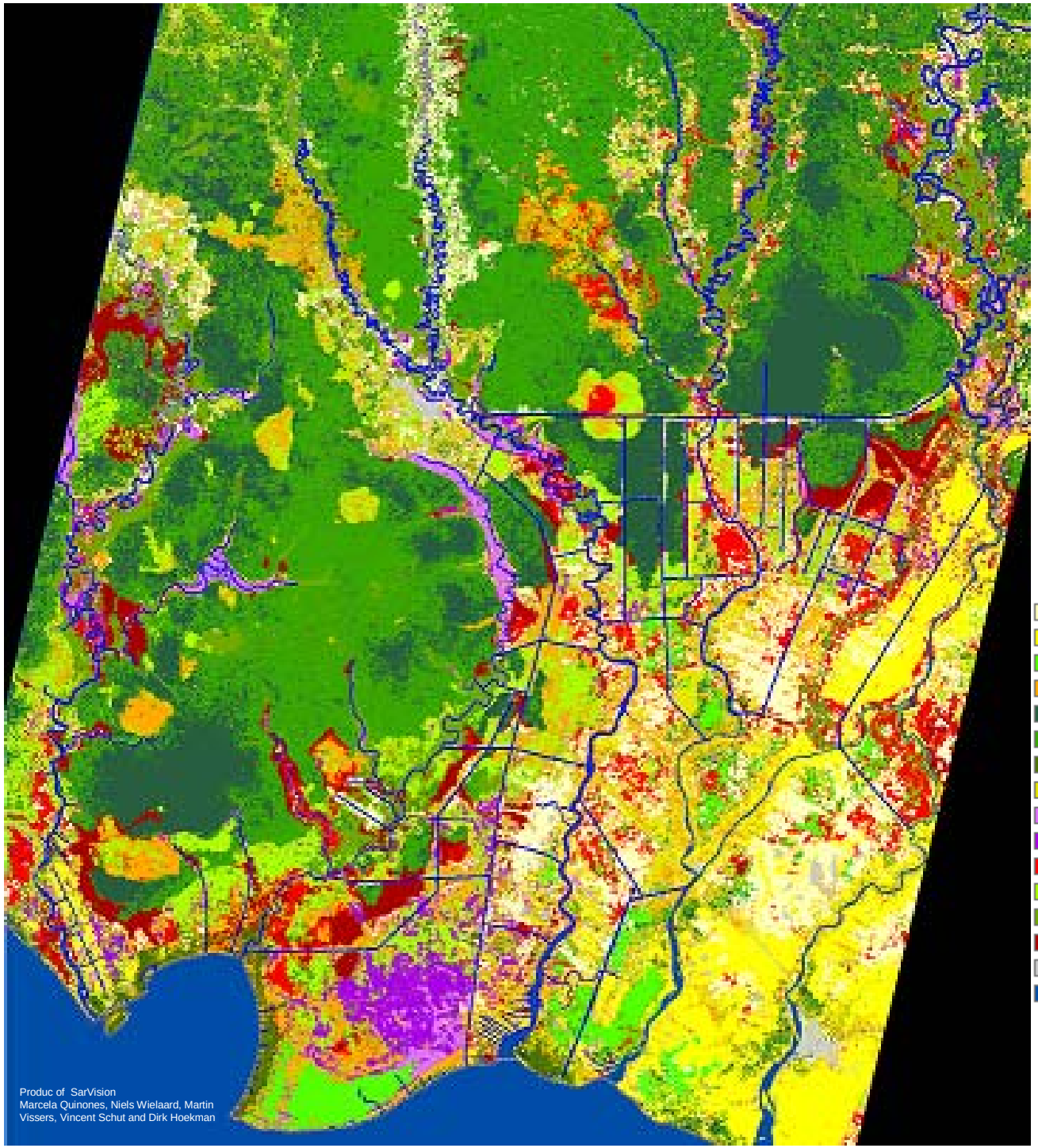
After registration to SRTM

SAR image dates:

2006-12-27

2007-02-11

2007-05-14



Land cover use map based on Fao legend

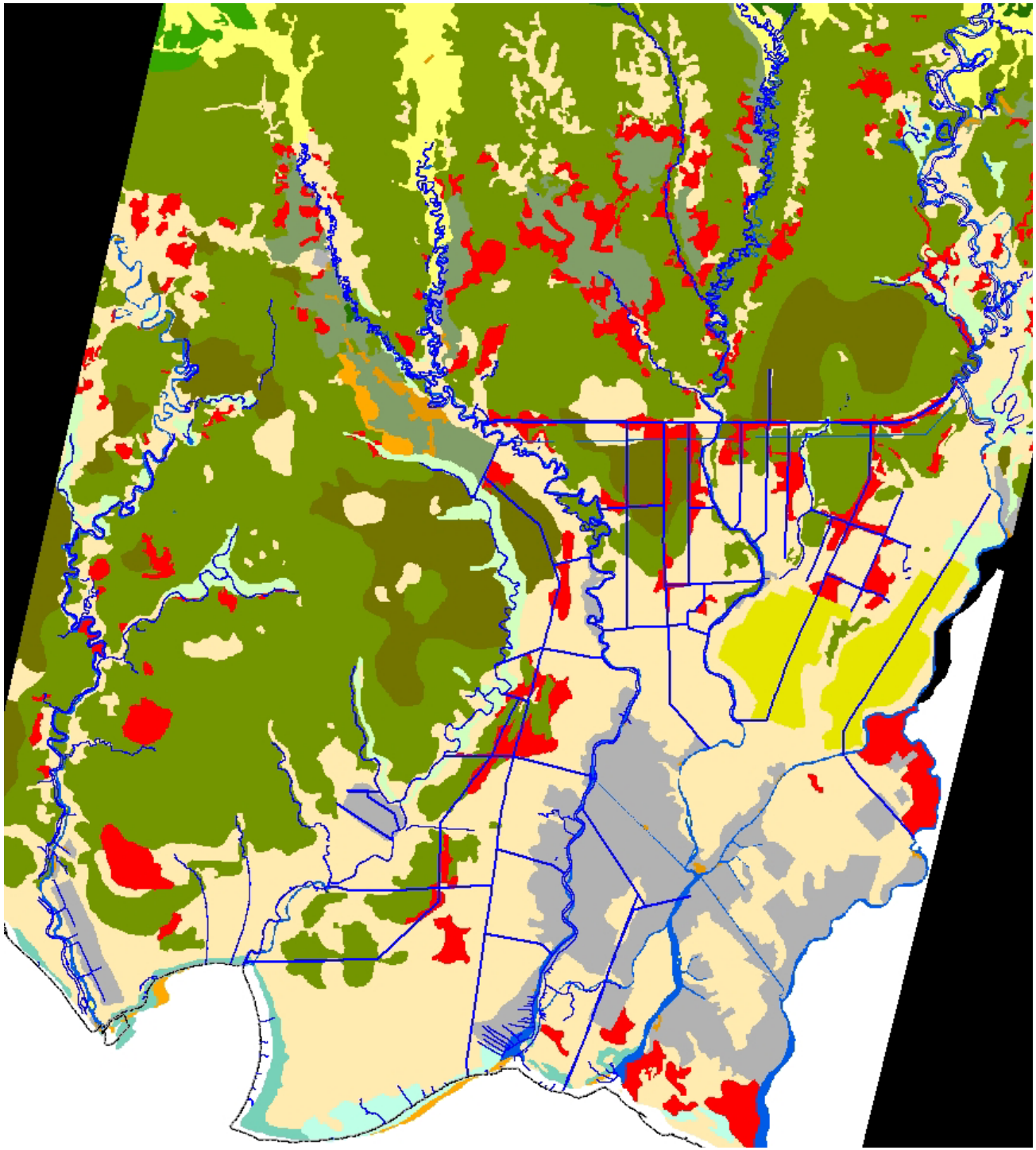
First product created for a High complex ecological Area, created sin only L-HH

2007 SarVision

PALSAR 50m

Legend:

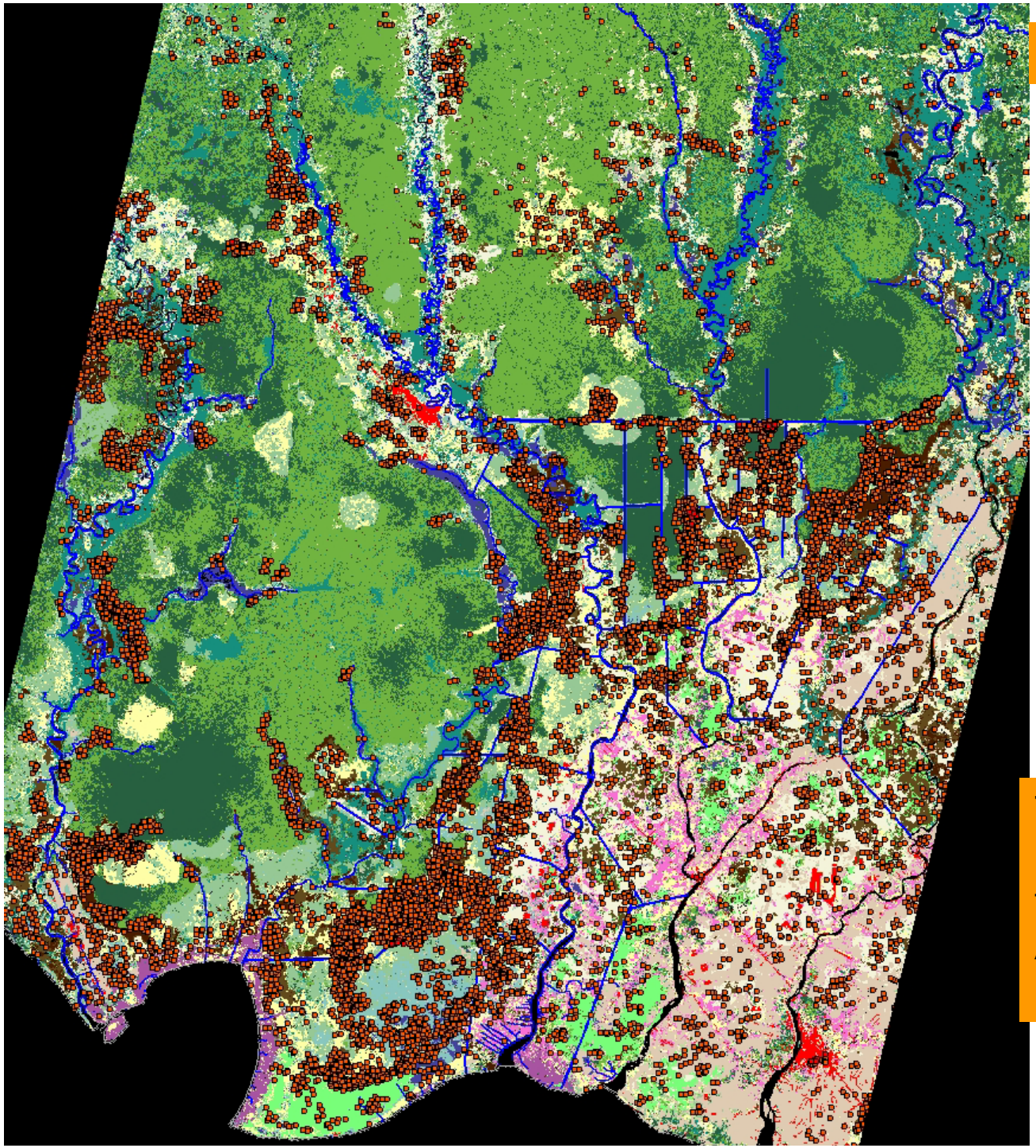
- Cropland - Dry land agriculture
- Cropland - Rice paddy fields
- Forest mosaics, degraded
- Grasslands and ferns (herbaceous)
- Lowland evergreen broadleaved forest (low pole swamp fore
- Lowland evergreen broadleaved forest (mixed swamp forest)
- Mangrove forest
- Mixed cropland and plantations
- Regularly flooded herbaceous cover (sedges)
- Regularly flooded shrub cover
- Shrub cover, burnt
- Shrubland and forest regrowth
- Swamp forest and woodland (riverine)
- Tree cover, burnt
- Urban
- Water bodies



2003 MoF / BAPPEDA official map

Legend:

Belukar rawa	Swamp bush (shrub cover)
Hutan lahan kering primer	Dry land forest primary
Hutan lahan kering sekunder	Dry land forest secondary
Hutan mangrove primer	Mangrove forest – primary
Hutan mangrove sekunder	Mangrove forest secondary
Hutan rawa primer	Swamp forest primary
Hutan rawa sekunder	Swamp forest secondary
Hutan tanaman	Plantation forest
Perkebunan	Horticulture (plantation cropland)
Permukiman	Settlement
Pertambangan	Mining area
Pertanian lahan kering	Dry land agriculture / bush
Rawa	Swamp (wetland)
Sawah	Rice paddy field (irrigated)
Semak / belukar	Bush (shrub cover)
Tanah terbuka	Bare land
Tidak teridentifikasi	Not identified , no data
Tubuh air	Water body



Sub-product of the LCU map

2006 – mid-2007 Fires

Fire hotspot data from MODIS and ATSR

NASA/ University of Maryland, ESA/ESRIN

Legend:

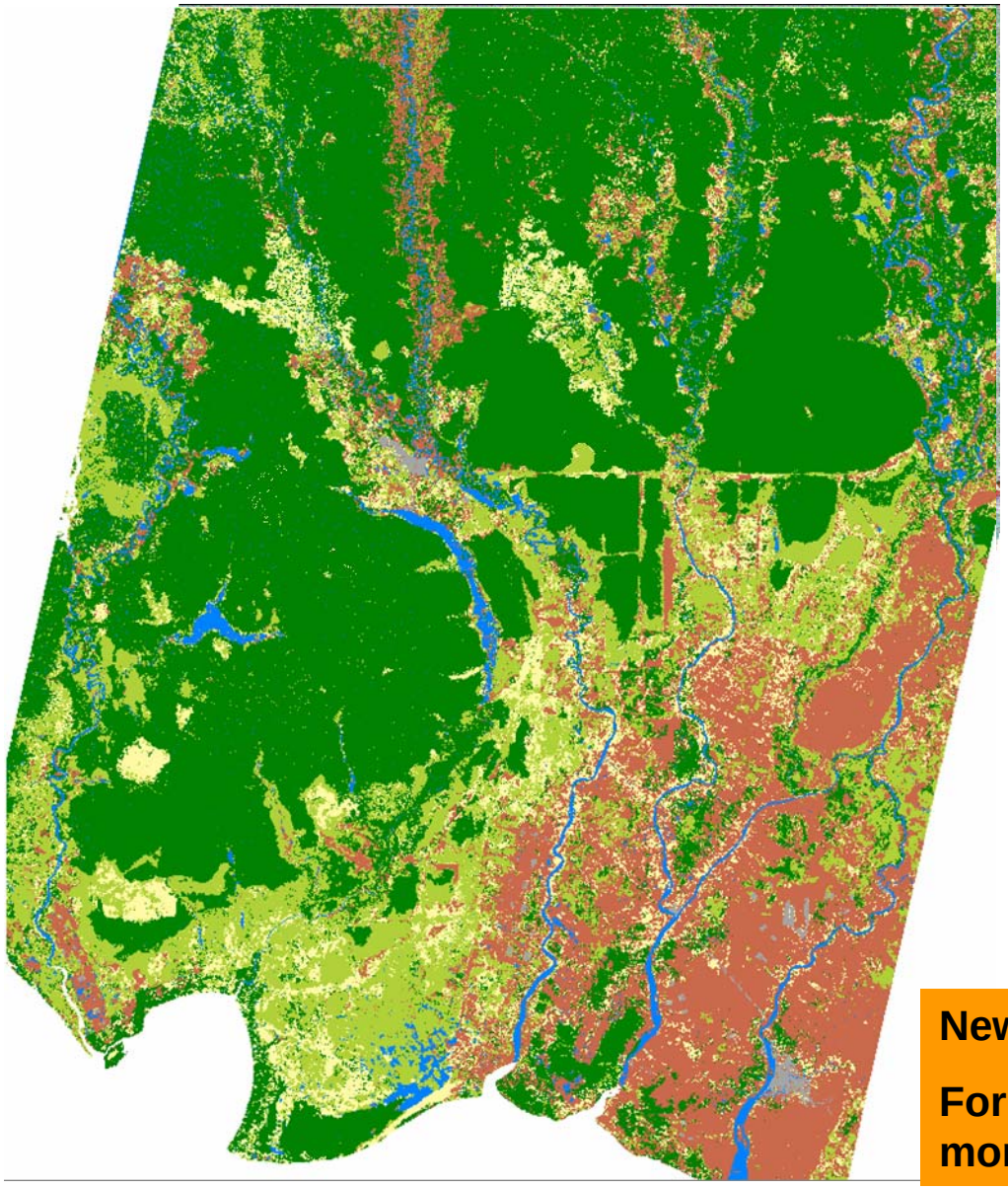
Red dots:

represents fire hotspot detected in the center of approx. 1km pixel

This type of products allows Monitoring of fire events, fire damage
And regeneration processes

A sub product of the Land cover classification: Use in REDD Monitoring

REDD:Reduce Emmisions from forest and degradation



Covering entire Indonesia

Used in Central Kalimantan by local government:

World's first avoided deforestation project for peatland carbon conservation

PALSAR radar imagery

May 2007, 100m detail

ALOS Advanced Land Observing Satellite

IPCC landcover

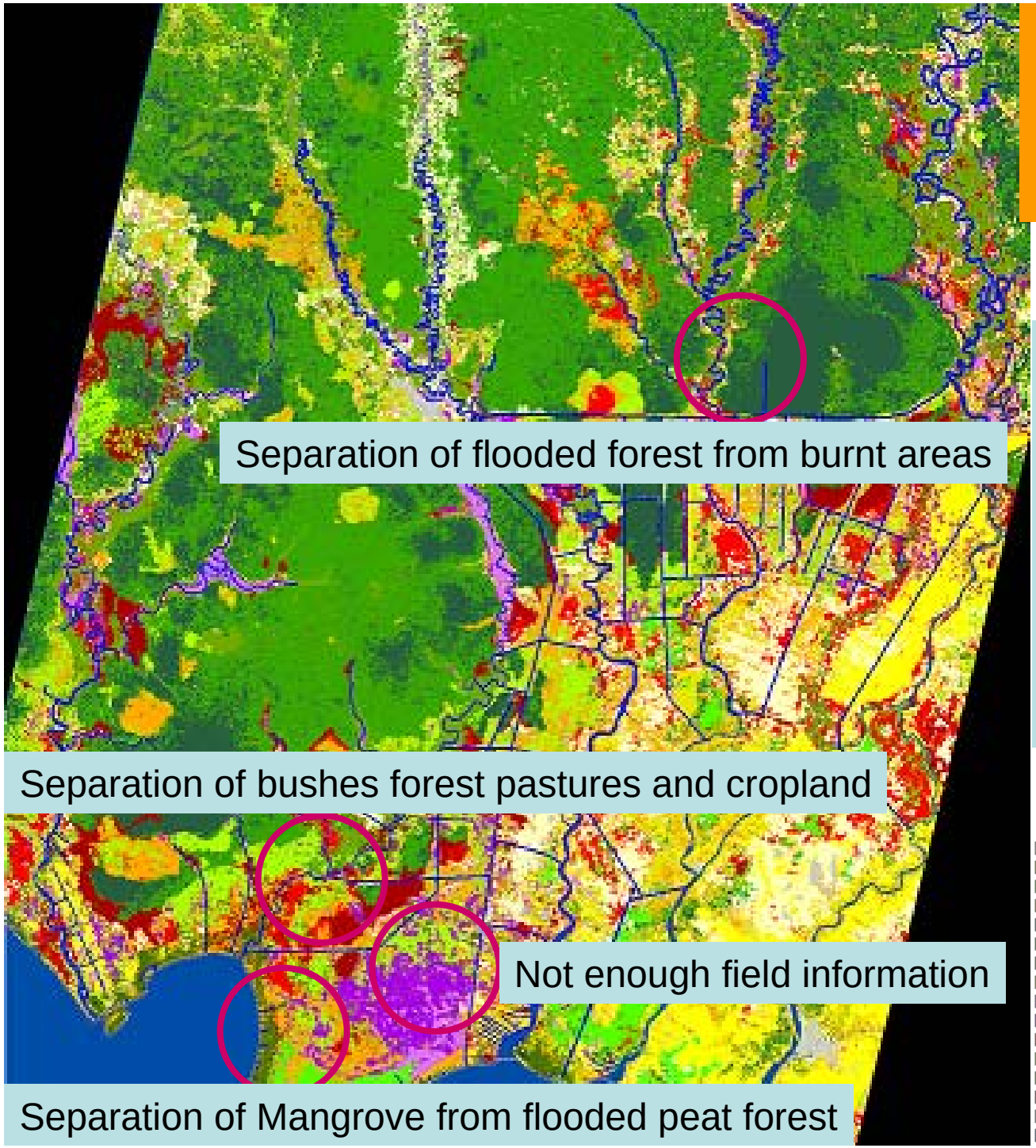
- Cropland
- Forest
- Grassland
- Settlement
- Shrubland
- Wetland

Carbon budget	
	Average estimate
Forest area	**613,000 hectare**
Carbon stock	**134,860,000 tons**

example

New land cover map every year

For accurate carbon accounting and monitoring



Some problems identify in In the classification process:

We expect to solve the confusion between classes:

- Use of HV data
- Use of at least one year data
- To include dry period information

- Cropland - Dry land agriculture
- Cropland - Rice paddy fields
- Forest mosaics, degraded
- Grasslands and ferns (herbaceous)
- Lowland evergreen broadleaved forest (low pole swamp forest)
- Lowland evergreen broadleaved forest (mixed swamp forest)
- Mangrove forest
- Mixed cropland and plantations
- Regularly flooded herbaceous cover (sedges)
- Regularly flooded shrub cover
- Shrub cover, burnt
- Shrubland and forest regrowth
- Swamp forest and woodland (riverine)
- Tree cover, burnt
- Urban
- Water bodies

Mapping approach: advantages

- Algorithm reveals intrinsic data structure
- It can be apply on time series as well as on polarimetric data
- It allows the integration of many layers of data allowing the mapping of ecologically complex areas that can be distinguish for instance by their water regime.
- Relevant incidence angle and topographic effects fall in separate sub-classes
- It allows aggregation of classes to match desired legend based on radar estadistics.
- Legend development according international standards:
- It allow the detection of missing ground truth.
- Combination with other type of radar data like ASAR APP increases mapping possibilities and accuracy

Status of Product development:
Main achievements

❑ Extensive ground data collection campaign in period July-October 2007, more than 2000 observation points. Field photos available

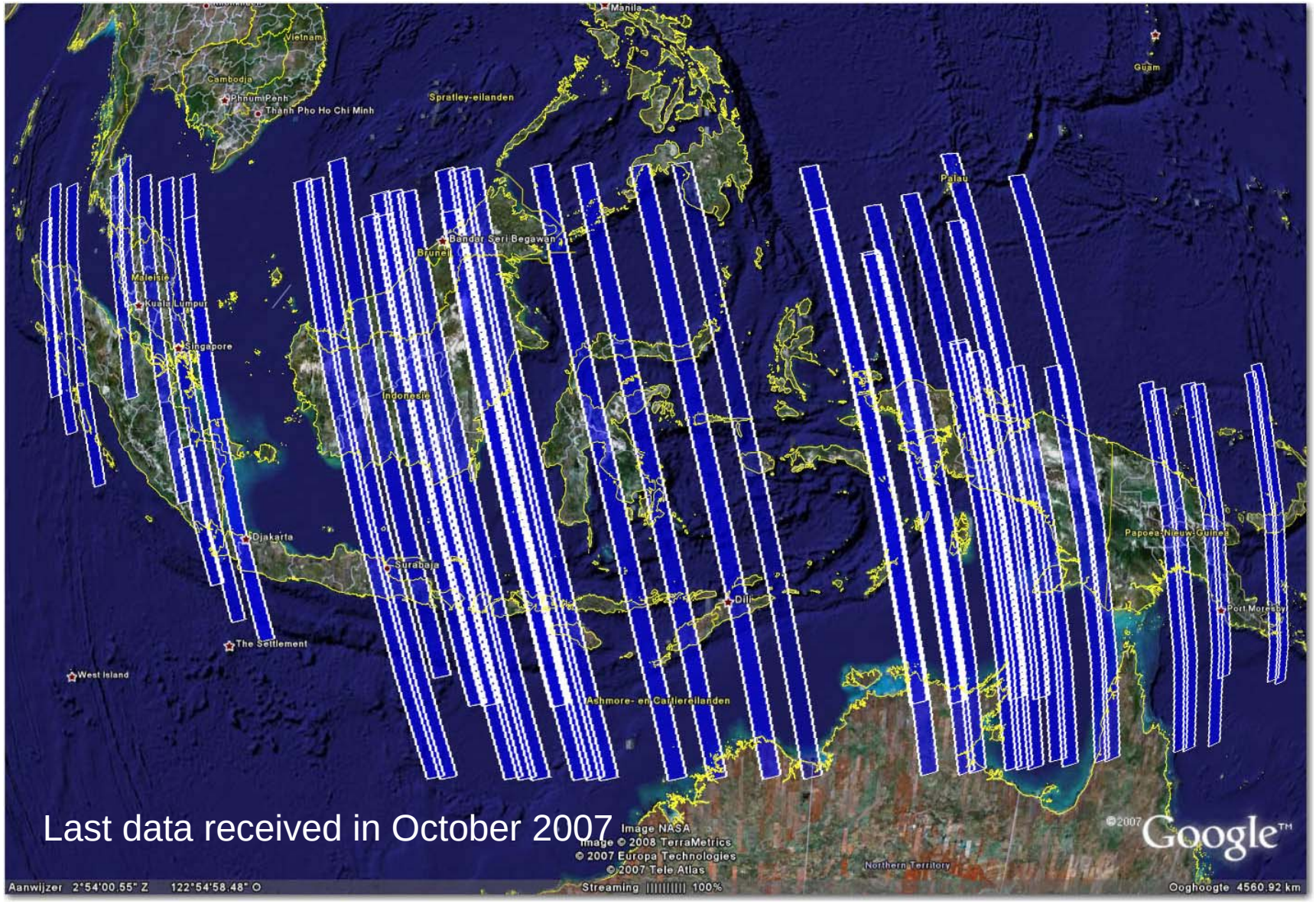
❑ First products for Central-Kalimantan available in October 2007 proved robustness of classification algorithm. (paper is in preparation to be submmited to IEEE)

❑ Collection of hydrological data after cycle 16 (January 2008) in the Mawas peat swamp allows calibration of hydrological features such as flooding and ground water level in combination with AlosPALSAR data. IMPORTANT data for peat water level evaluation in relation with radar.

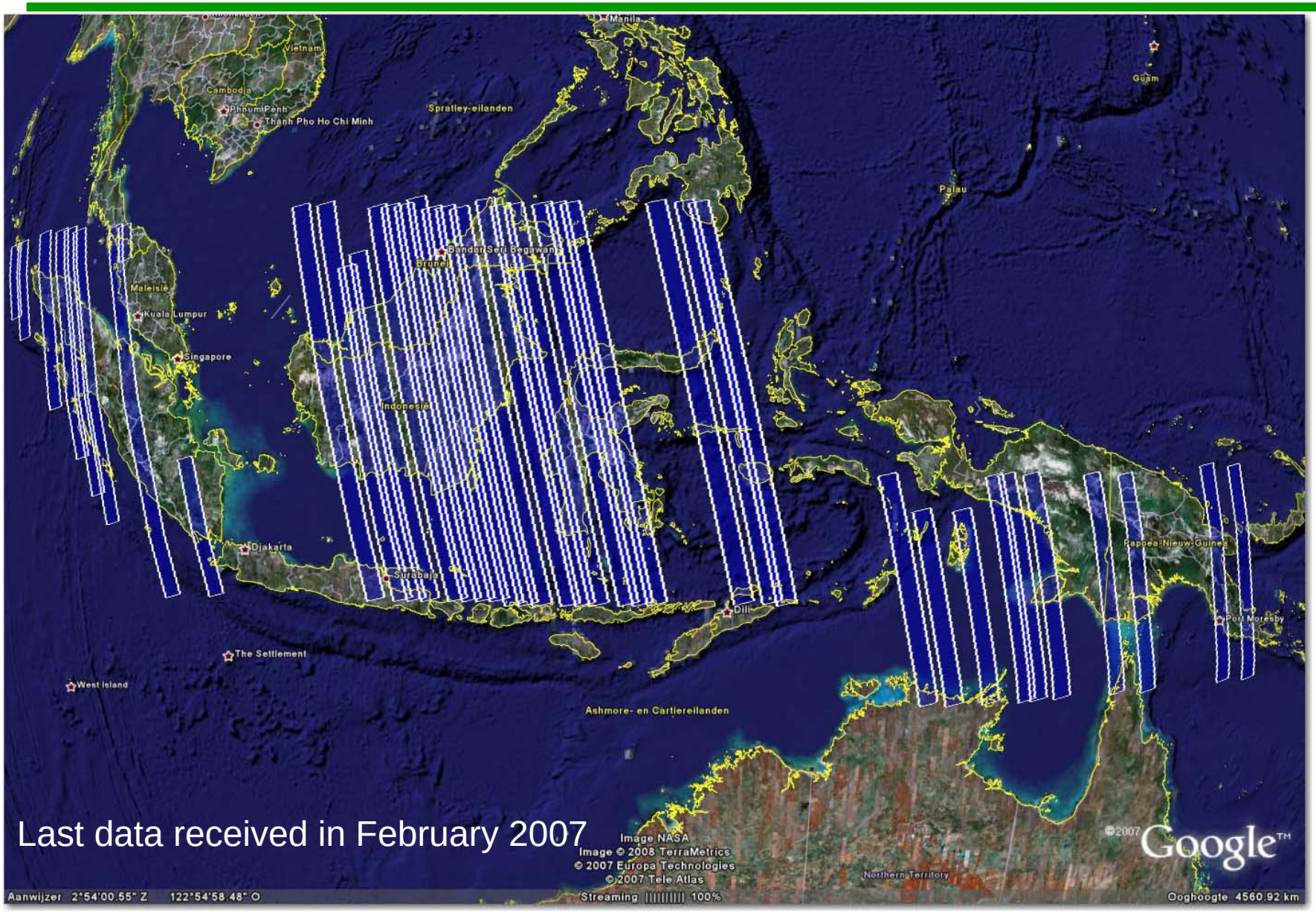
❑ First results encouraging: main cover types can be distinguished and different type of products can be created with high accuracy.

❑ Legend development techniques allows matching with Internationally used legends

Status peat swamp product development: Available Data: Fine beam Dual Pol

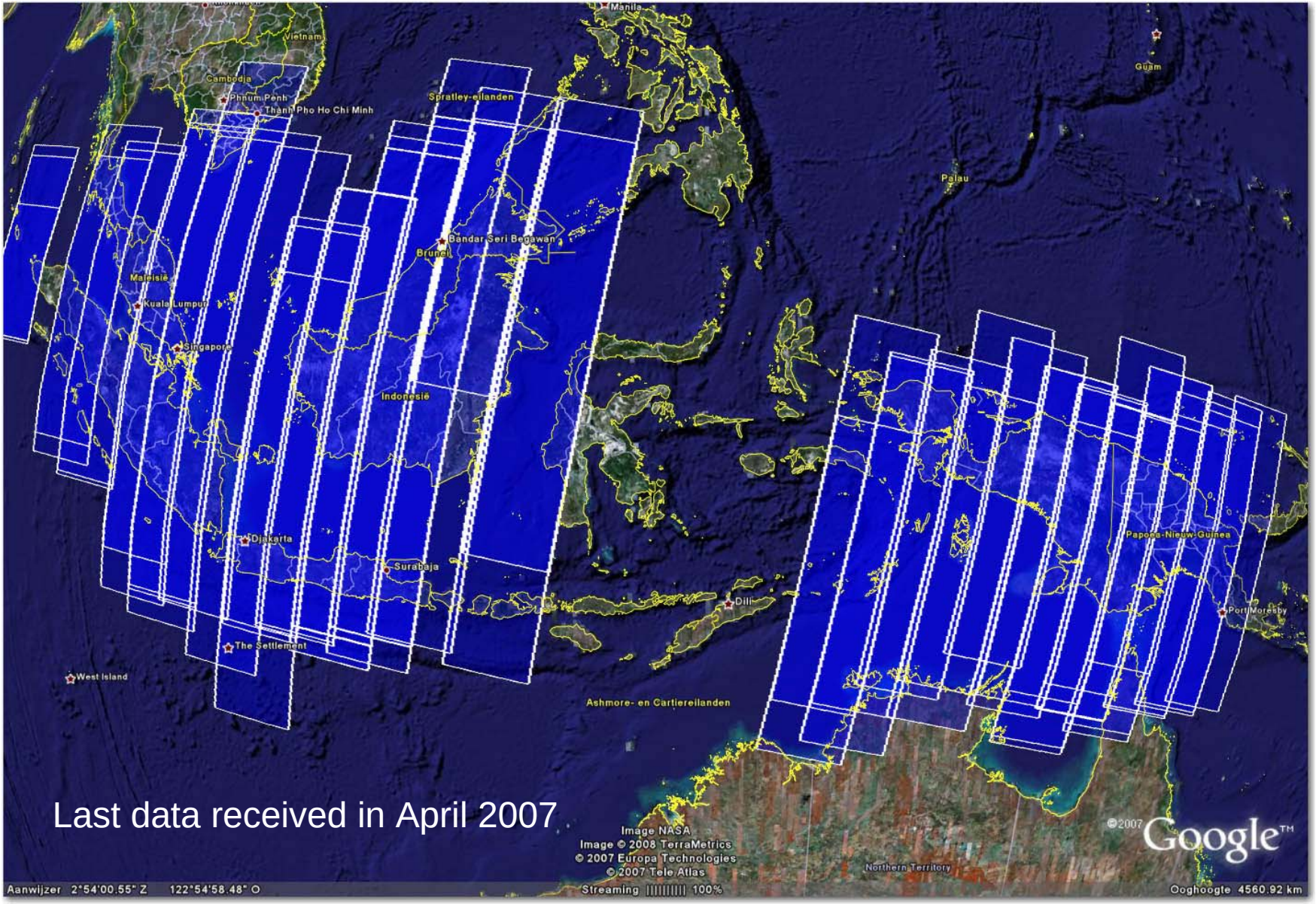


Status peat swamp product development: Available Data: Fine beam Single Pol



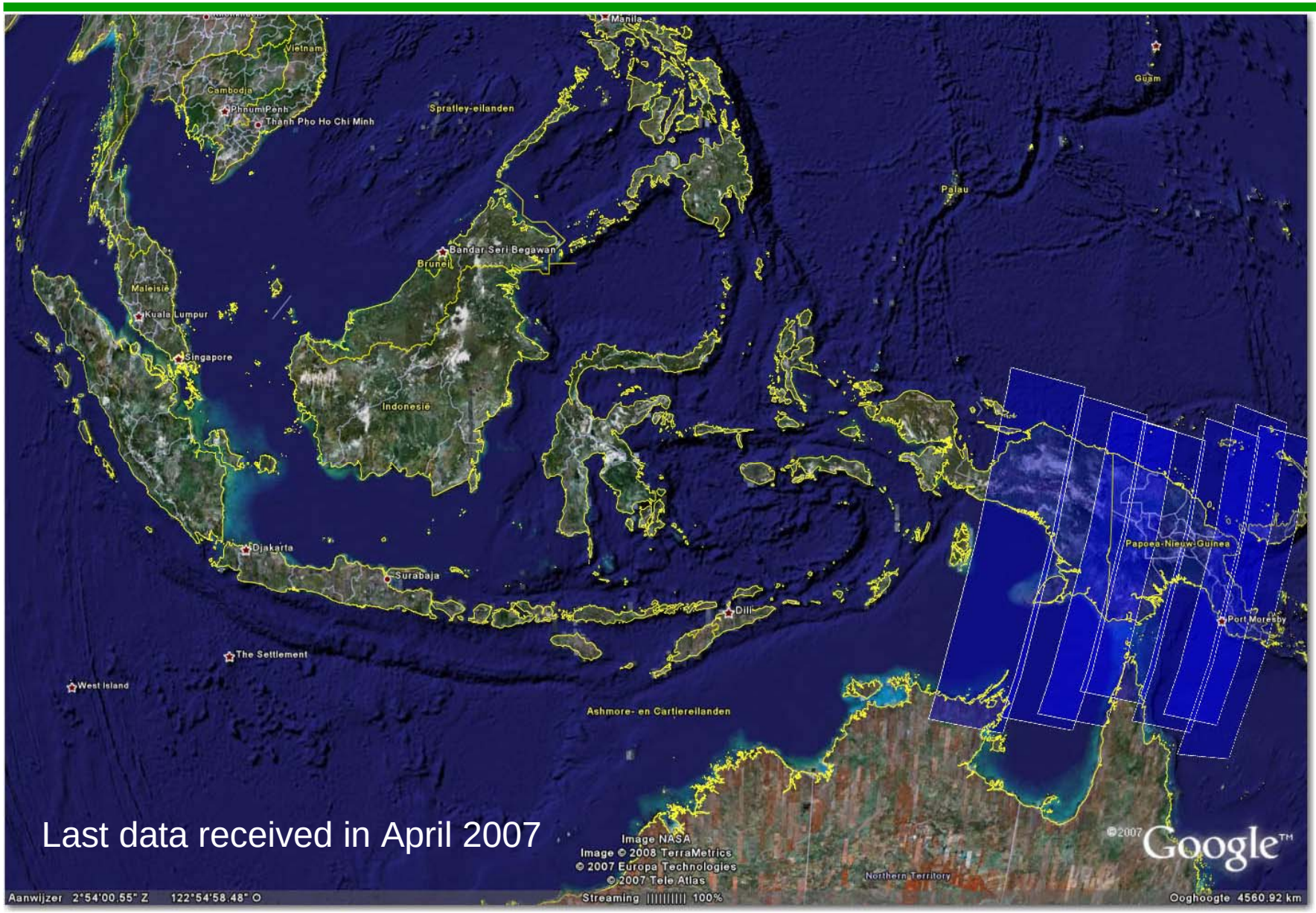
Last data received in February 2007

Status peat swamp product development: Available Data: Wide Beam 1 mode



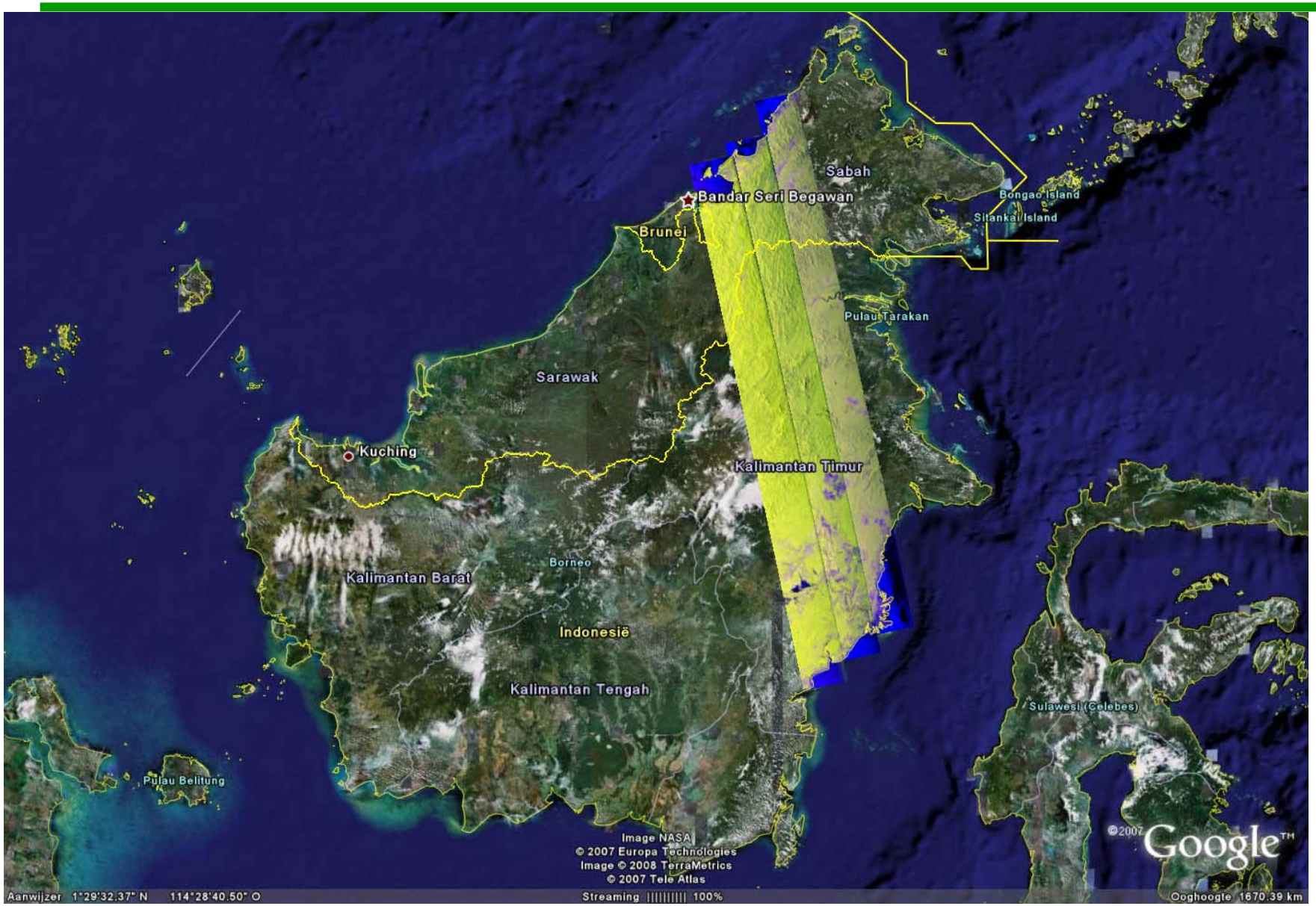
Last data received in April 2007

Status peat swamp product development: Available Data: Wide Beam 2 mode

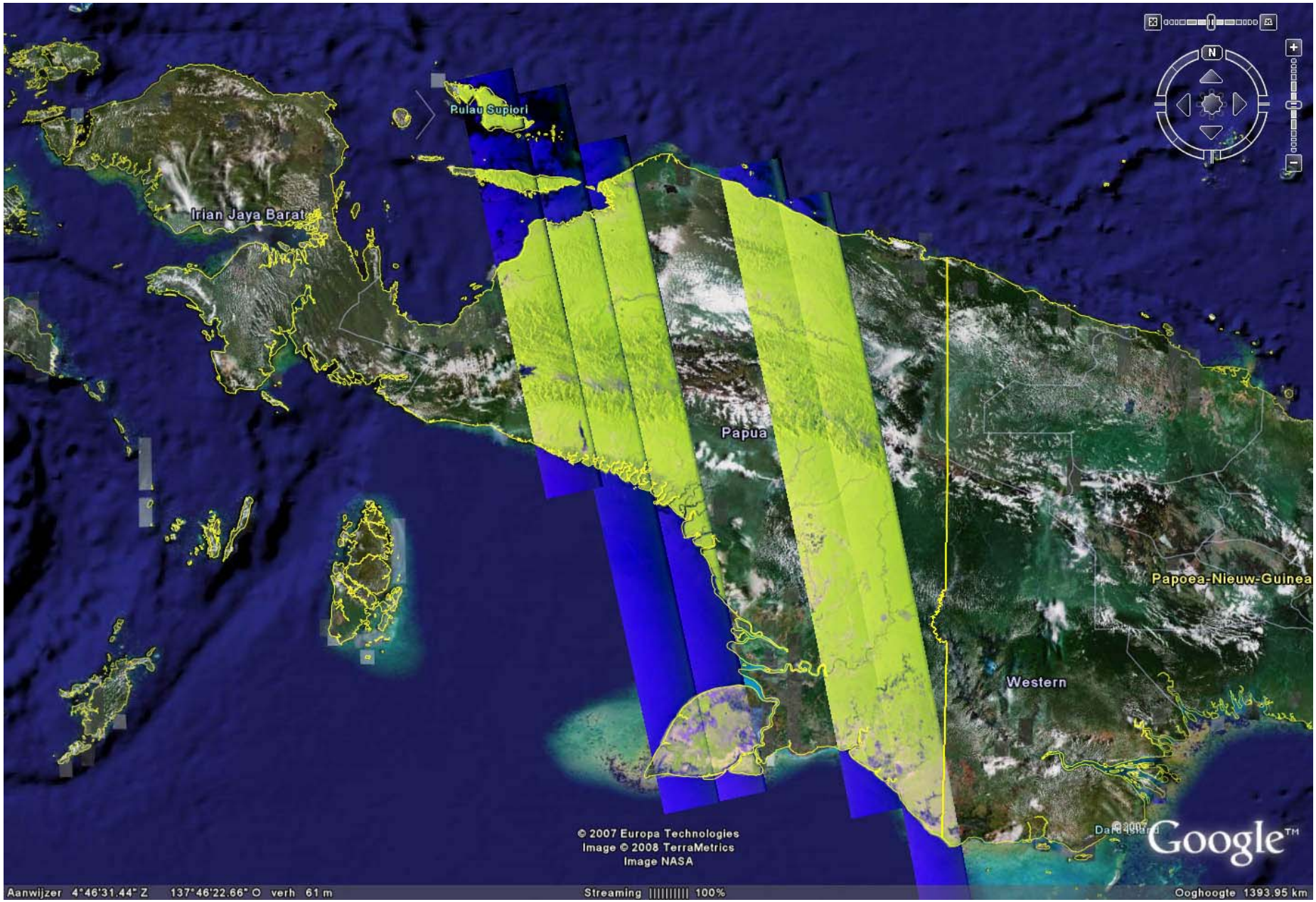


Last data received in April 2007

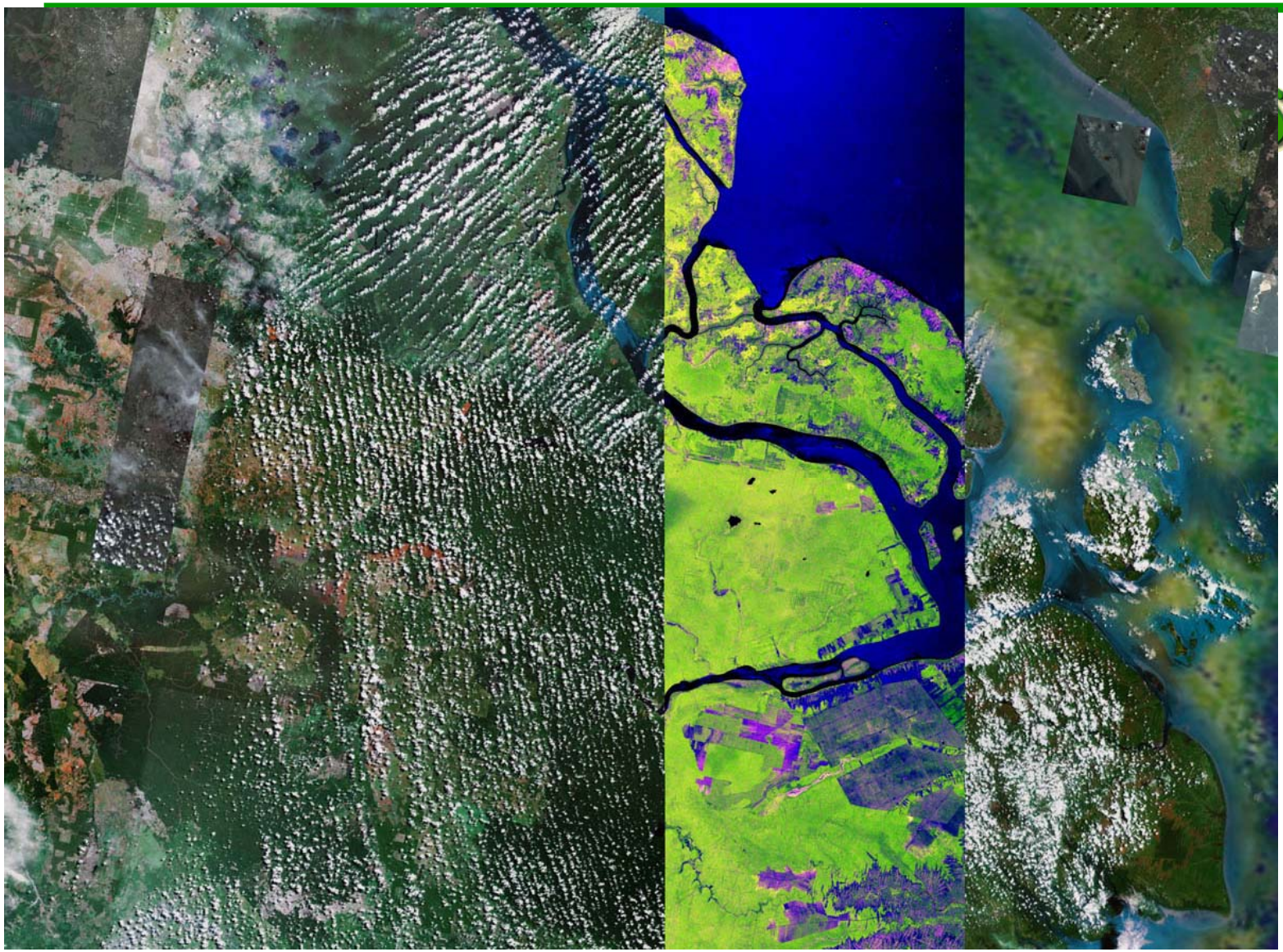
Status of Product development: Strip data processing in Kalimantan, Orthorectification software available



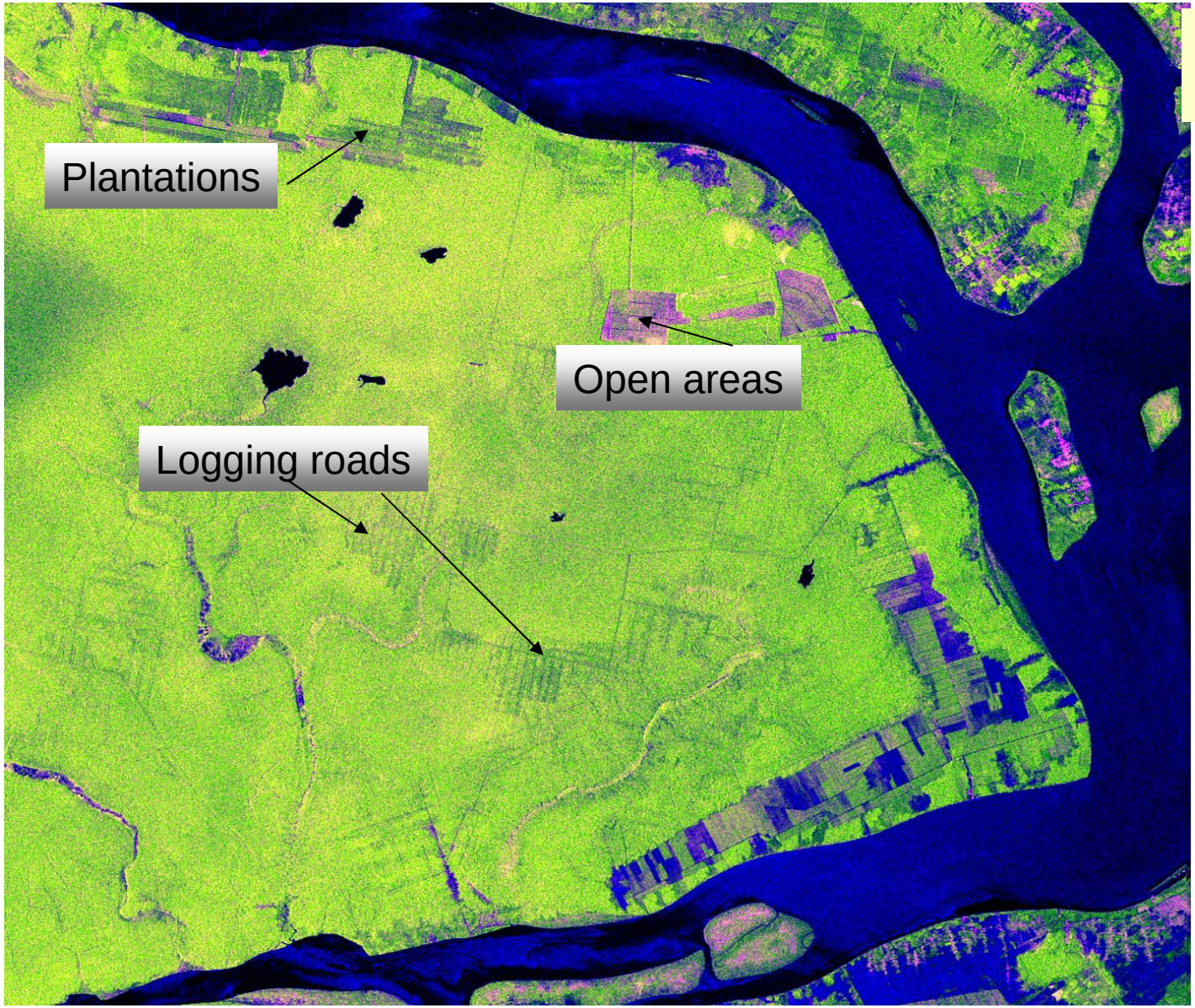
Status of Product development:
Strip data processing in PNG, example



Status of Product development:
Example in RIAU peninsula, comparison with available Google earth

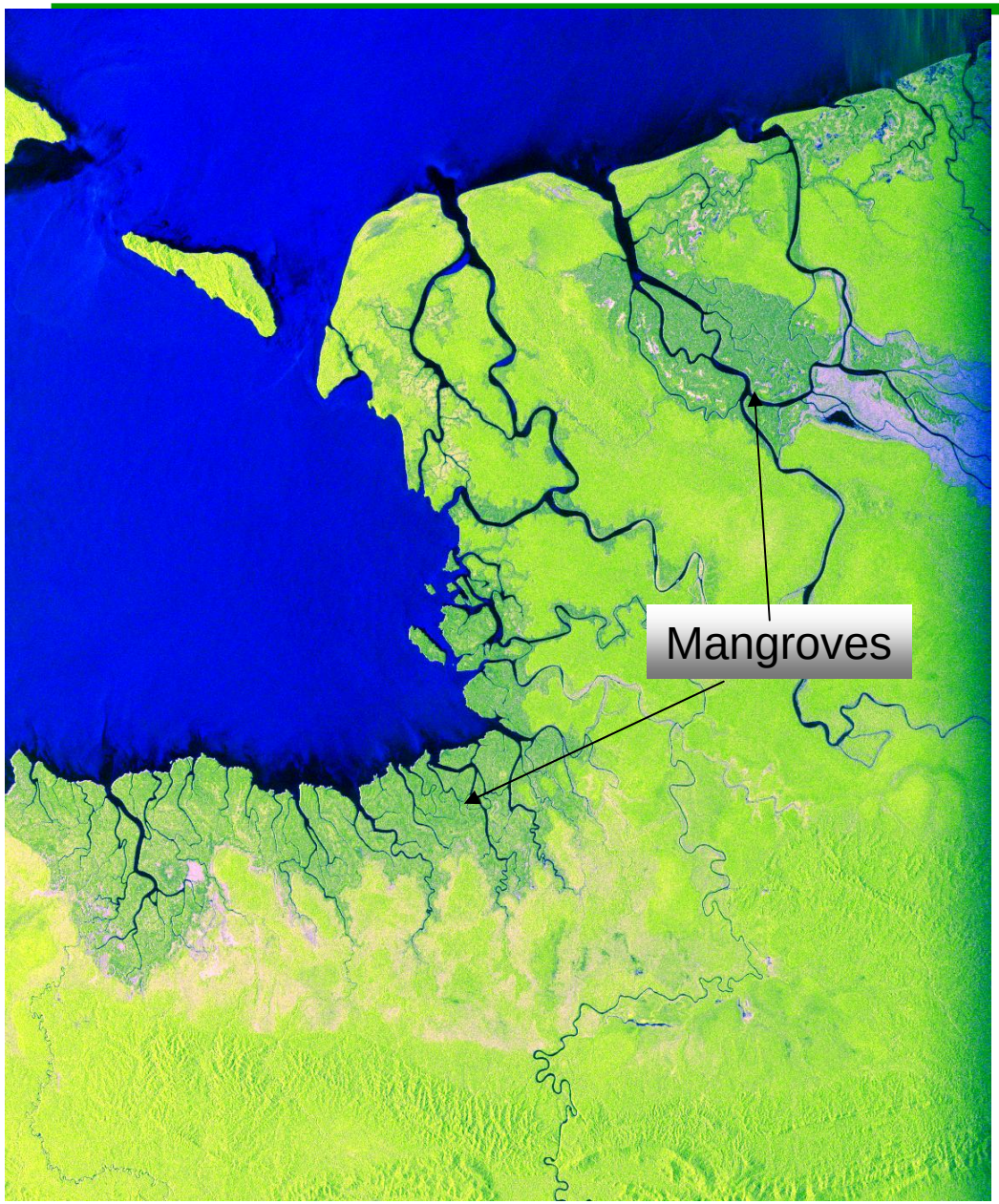


Status of Product development: Example in RIAU peninsula,



Land use observations in RIAU

Status of Product development: mangroves in PNG



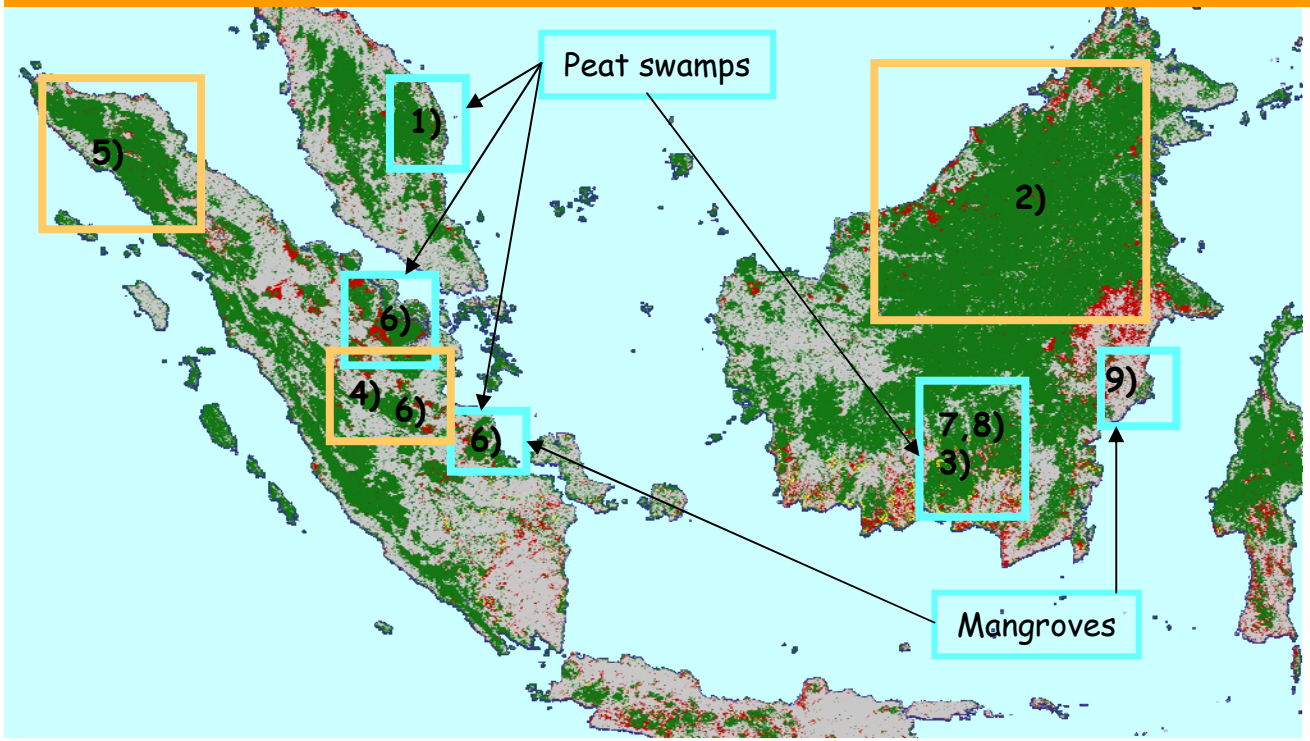
Dual polarization allow
Characterization of Mangrove areas

In this espect we will search coperation with Richard for the mangrove classification, searching for physical explanations.
This will be made on the frame of the L and P band ESA.

Status on product development: Partners and Data Users in Insular South East Asia

Field work support B3&C1

1) MACRES, Forest Research Institute Malaysia (FRIM)
2) Heart-of-Borneo – WWF (Indonesia/Malaysia/Brunei)
3) Indonesian Ministry of Forestry
4) (To be confirmed) Univ. Bogor (IPB) (oil palm)
5) Leuser park – Leuser Int. Foundation
6) Riau/Jambi, Kampar peninsula – Eyes-on-the-forest WWF, Wetlands Int., Delft Hydr and Leicester Univ.
7) Central Kalimantan Peat Programme (peat swamps)– BOS, WWF, Wetlands Int., Delft Hydr, Winrock, Leicester Univ.
8) ESA/INDREX – BOS sites
9) Mahakam delta (mangroves) - WUR

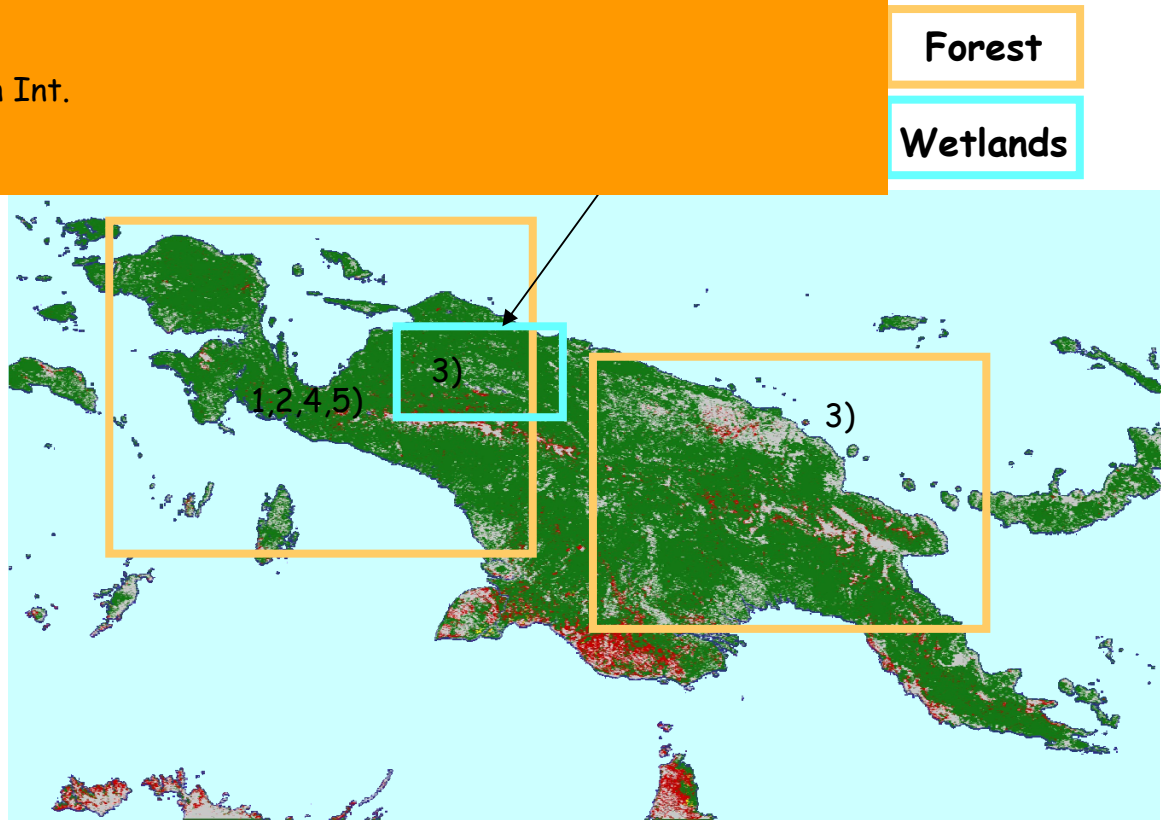


Status peat swamp product development: Partners and Data Users in PNG

SarVision in actively searching for processing funding in colaboration with all this organzations

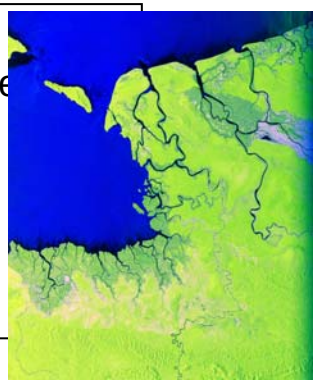
Field work support B3&C1

1) Indonesian Ministry of Forestry
2) Eyes-on-the-forest WWF (2008?)
3) Mamberamo basin (and PNG) – Conservation Int.
4) Papua Govn. (in process)
5) Greenpeace

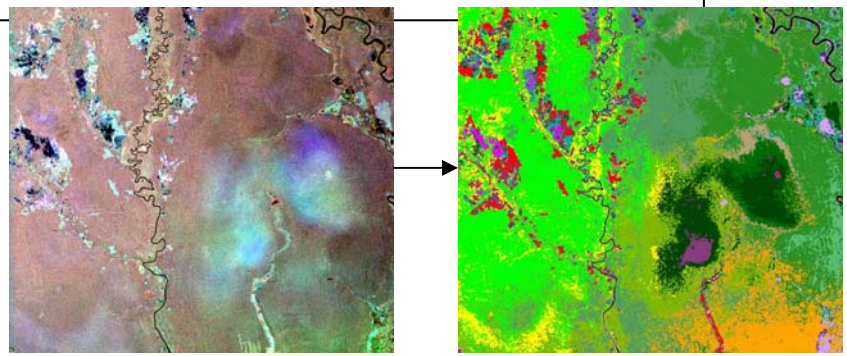


Production schedule and product description: South East Asia

Product name:	W7- Mangrove extent and properties
Description:	Map of extent, and anthropogenic change. Prototype area Indone
PALSAR mode:	ScanSAR
Observation cycles:	7-16 (10 cycles)
Production schedule:	Mar-Aug 2008 (Phase 2: Large representative areas) Aug-Dec 2008 (Phase 3: Entire prototype area)
Est. date of delivery:	January 2009

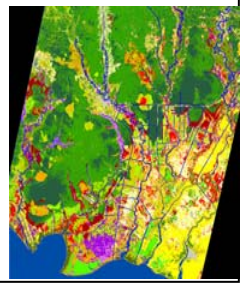


Product name:	W8- Tropical peat swamp forests
Description:	Map of extent, vegetation and hydrological characteristics, and disturbance (total area: ~27 m ha). Prototype area Indonesia
PALSAR mode:	ScanSAR
Observation cycles:	7-16 (10 cycles)
Production schedule:	Mar-Aug 2008 (Phase 2: Large representative areas) Aug-Dec 2008 (Phase 3: Entire prototype area)
Est. date of delivery:	January 2009

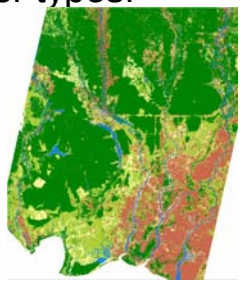


Production schedule and product description: South East Asia

Product name:	Wx- Mamberamo basin, New Guinea
Description:	Map of vegetation characteristics, including Sago swamp forests, (total area: ~8 m ha). Previously unmapped
PALSAR mode:	ScanSAR
Observation cycles:	7-16 (10 cycles)
Production schedule:	Mar-Aug 2008 (Phase 2: Large representative areas) Aug-Dec 2008 (Phase 3: Entire prototype area)
Est. date of delivery:	January 2009



Product name:	F5/F8- Tropical forest and land cover change monitoring
Description:	Yearly updates of forest cover (types) and basic land cover types. Prototype area Indonesia and PNG
PALSAR mode:	FBS, FBD
Observation cycles:	9, 13, 17, 21
Production schedule:	Jan-Jun 2008 (Phase 2: Large representative areas) Aug-Dec 2008 (Phase 3: Entire prototype area)
Est. date of delivery:	January 2009



Status of Product development:
Impact of results on the User community

•Land Cover Map of high accuracy is being use for different applications by local and Regional governments in central Kalimantan.

•Governor of PNG is supporting the initiative in order to incorporate products on his management plans. Action is being taken.

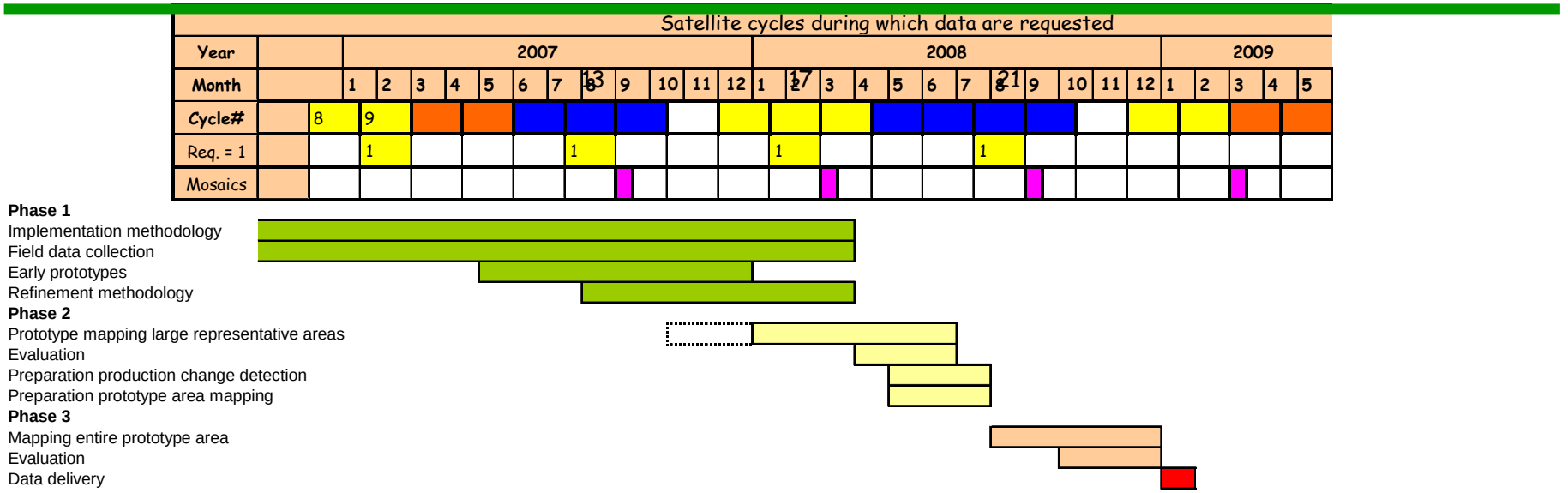
•SarVision will give priority to this areas where users are active and enthusiastic on the Use of Alos-PalSAR products.

•Systematic processing and coverage of regions will support decision making at National Level both Indonesia and Guyana

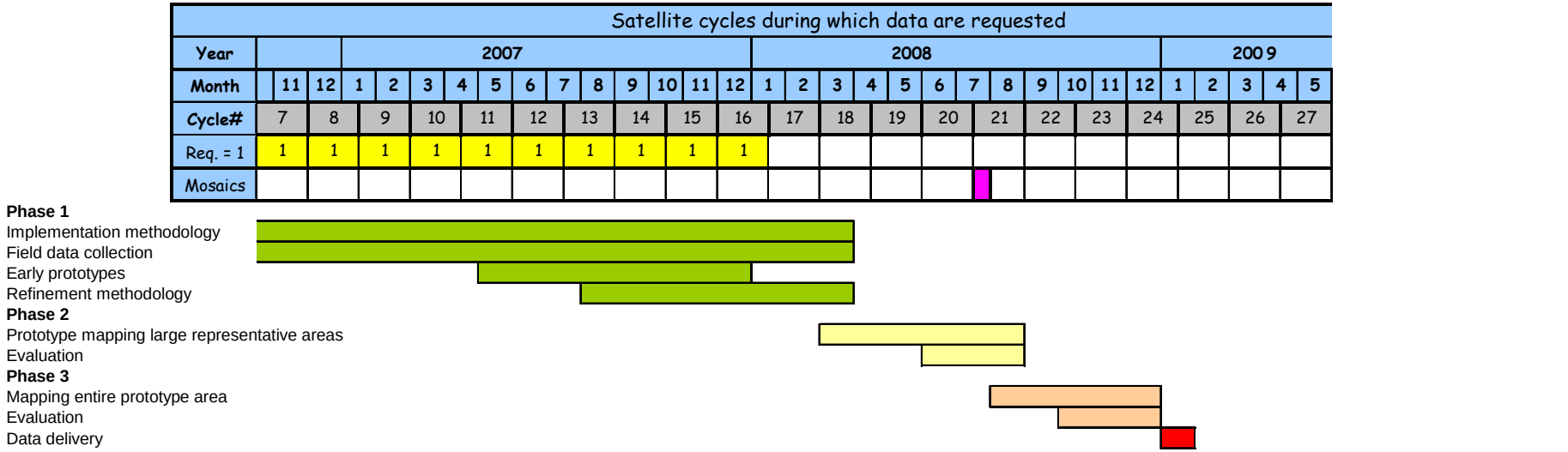
•In countries like Colombia, Venezuela and Guyana Local communities and Government Institutions are expecting results from Guyana Shield to incorporate immediately into their planning and management

Status of Product development: Schedule

Data delivery is delayed:

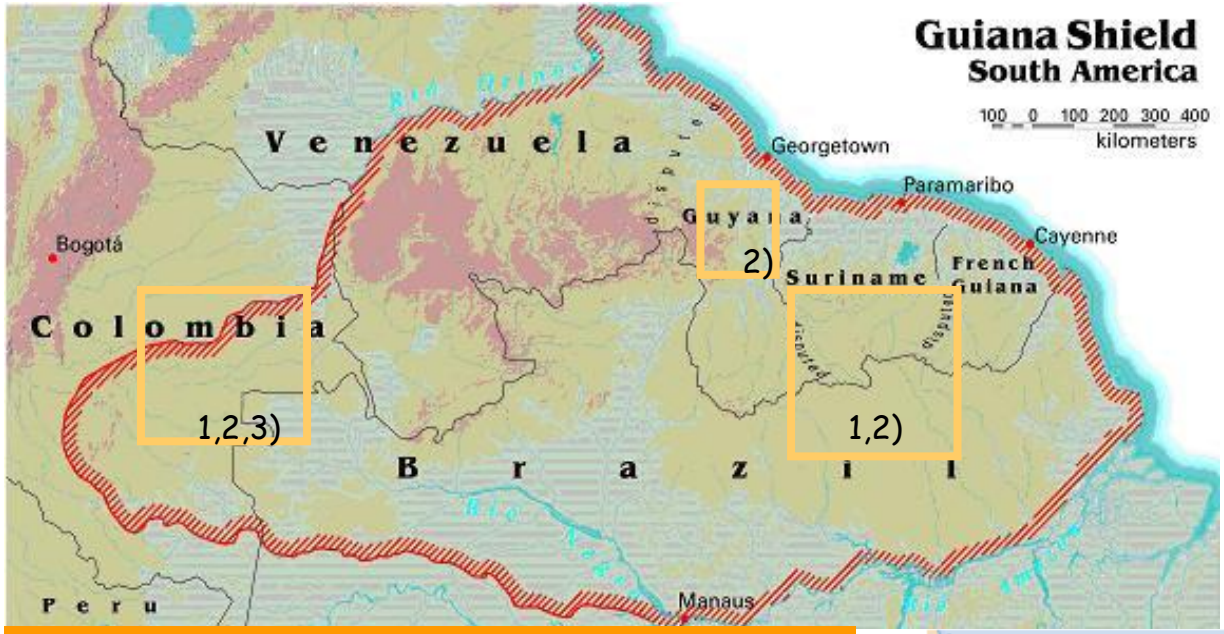


Delay in data delivery may have an effect on final data delivery



USE of Alos PalSAR for the Guiana Shield Initiative

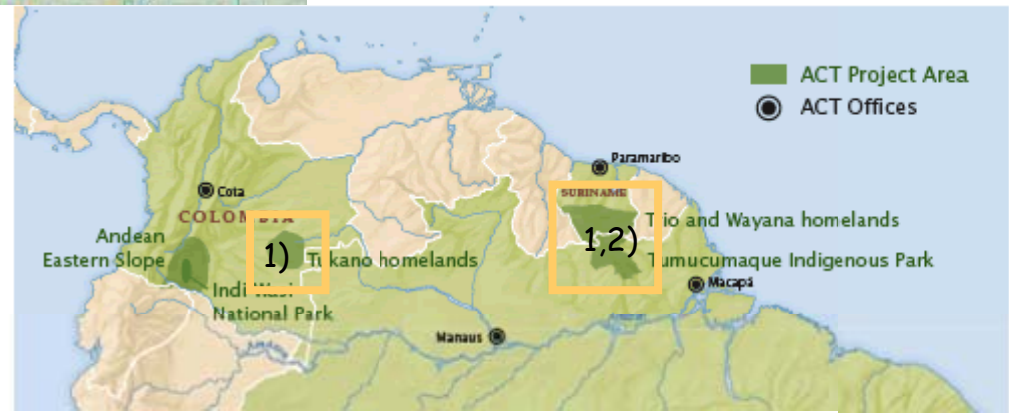
Search of cooperation with Laura Hess,



Field work support part of G1 / Guiana Shield

1) ACT- Tumucumaque (Brazil/Surinam/Colombia)
2) Guiana Shield Initiative (IES)- Test sites Matavén (Colombia), Iwokrama (Guyana), Suriname
3) Colombian Amazon and Llanos: Instituto Alexander von Humboldt, Sinchi, Parques Naturales

•Data will be use by local governments to support National Environmental policies:
•In Colombia for instance a regional monitoring system needs to be implemented by SINCHI and the Natural Park System,



Local indigenous communities and farmers will profit from products for local resource management

Forest

Wetlands

Use of Alos PalSAR in tropical lowland rain forest Monitoring.

Monitoring products needed for land cover and ecosystem monitoring according to users in the Amazon Basin (Guyana Shield Initiative).

	Medium resolution	High resolution
Scale	1:250.000	1:50.000
Frequency	Every 6 months	Every 6 months
Product	**Cover Change detection maps.**	**Cover Change detection maps**
Use	Flooding conditions, Land cover change; Detection of deforestation and regeneration Ecosystem fragmentation Infraestructure delelopment (roads) and Urban expantion	Flooding pulses and water balance, •Land cover change; •Detection of deforestation and regeneration for local management •Illegal activities in Natural Parks •Ecosystem fragmentation
Objective	Insert in the environmental indicator system at regional and National level Use in land use modelling	Empower of local communities and indigenous people to manage their reserves. For Natural Park System management and monitoring of illegal activities

Alos PalSAR
Wide swath scan mode

Alos PalSAR fine bea
Dual-Pol or Full-Pol c
High resolution

Some possible future applications of Alos PalSAR to fulfill mapping information needs in countries with lowland tropical forest.

Actual and Future research topics

Subject	Scale	Objective	Frequency
Soil degradation	1:50.000	**Study changes in soil quality**, production capacity, erosion, acidification, infiltration, and porosity. Changes in soil density.	Annually
Biomass	1:50.000	Changes in biomass levels and mapping. National reporting. **International responsibilities for Kyoto protocol**.	Annually
Fires	1.50.000	**Causes and dynamics**. Input for prediction modelling.	Annually
Illegal crops	1.50.000	Detection of illegal cropping in national parks.	Twice a year
Flooding pulses	1.50.000	Climate change indicator and importance for local fishery and other economical activities	Twice a year
Water bodies and Varzeas	1:50.000	**Monitoring and behaviour of wetlands**. **International agreements (*Ramsar* convention) and indicator of climate change.** Locally important for fishery activities.	Twice a year

Alos PalSAR hig-res Dual-pol, Full-Pol and Wide swath scan mode

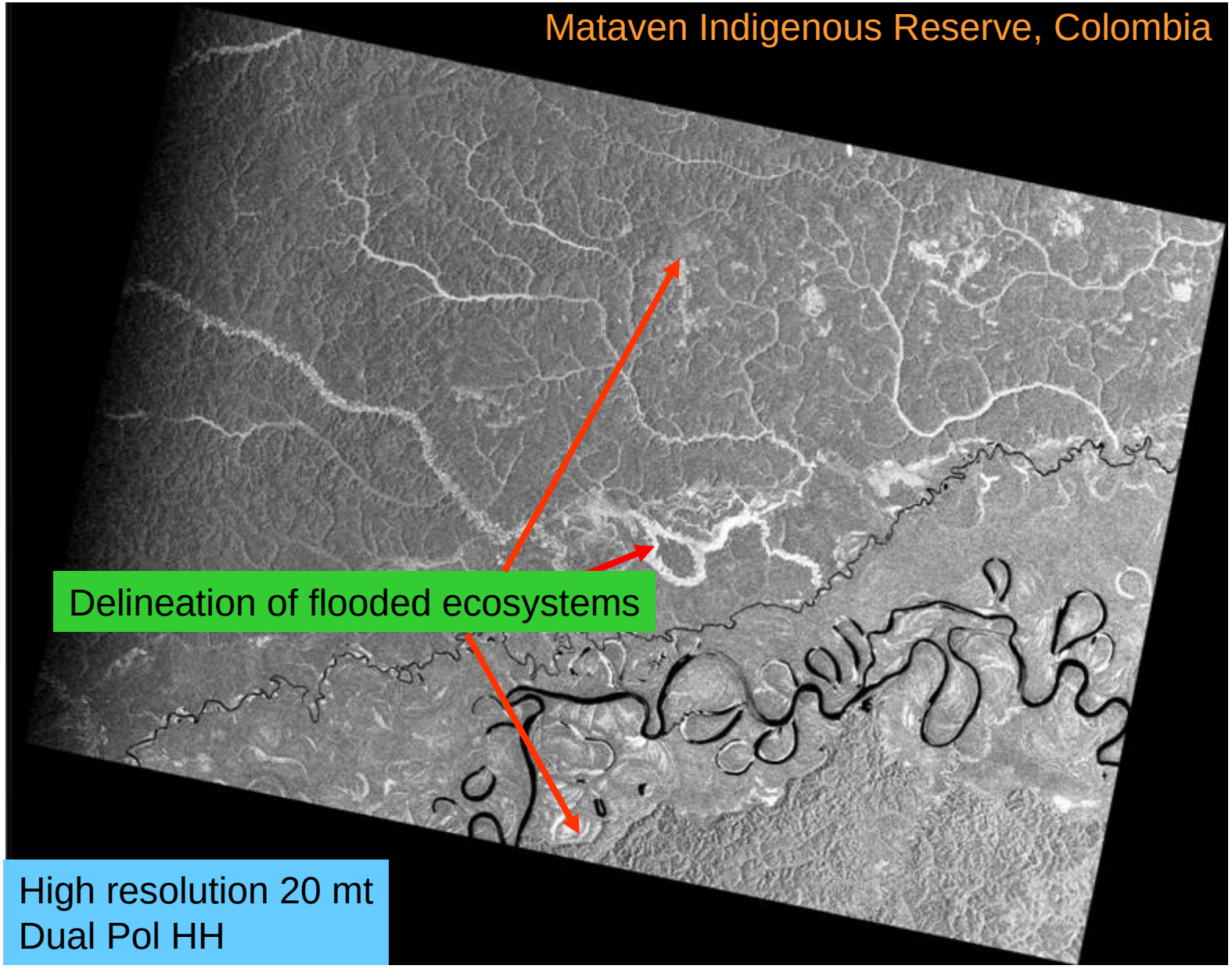
Important applications: USE of Alos PALSAR Dual POL or Full-Pol for ecosystem Mapping

Products needed for Ecosystem management and conservation,

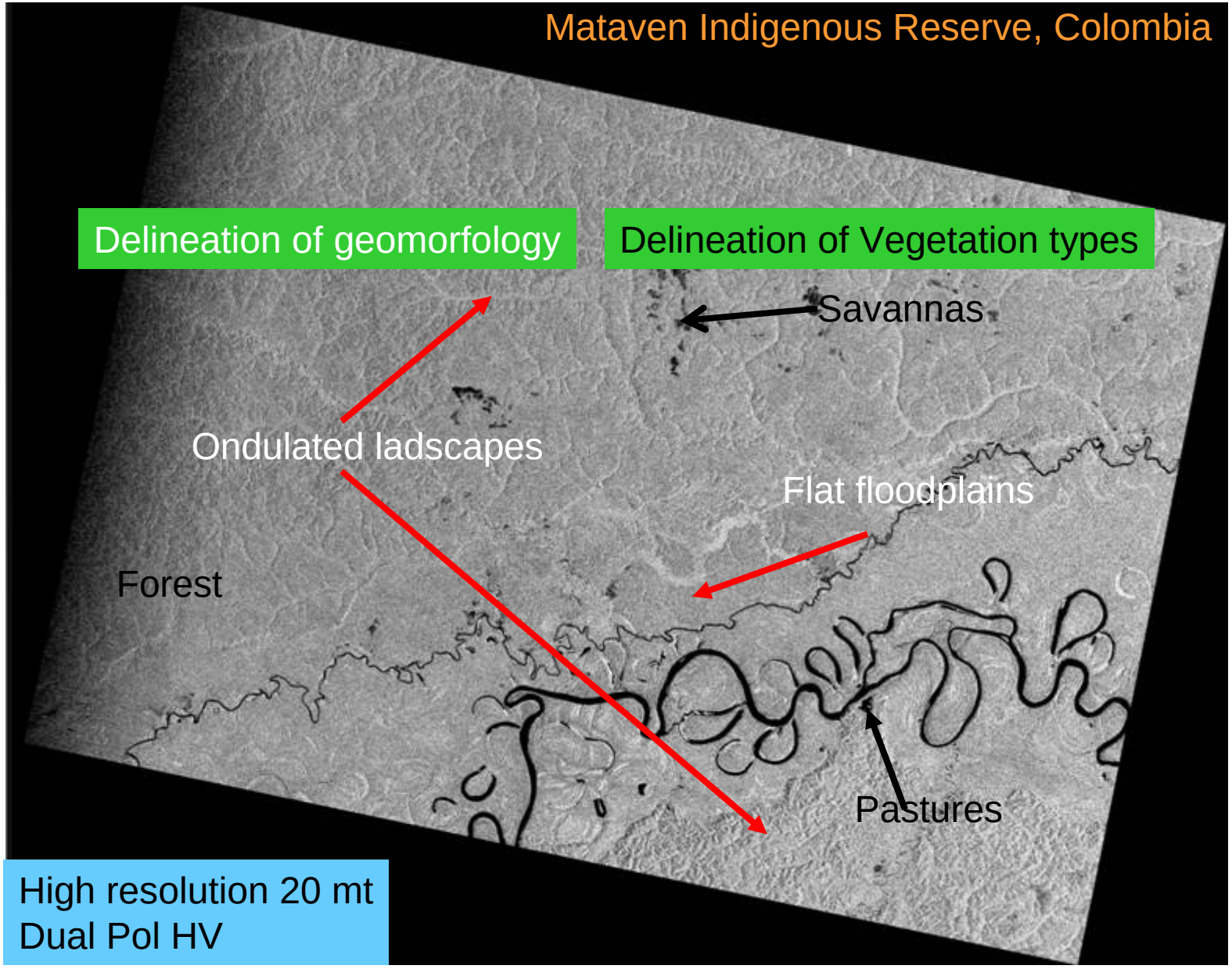
	Scale	Frequency	Use	Objective
Geo-morphological map	1:100.000	One time	Risk analysis	Input for modelling and ecosystem mapping
Ecosystem Map	1:100.000 1:50.000	Updated every 5 years	Fragmentation & connectivity of ecosystems. Conservation and Natural Park design.	Insert into biodiversity indicator system and early alert system for biodiversity loss.

Ecosystem definition is based on, climate conditions, landscape characterization (soil and geomorphology), Vegetation types (structures), and flooding conditions.

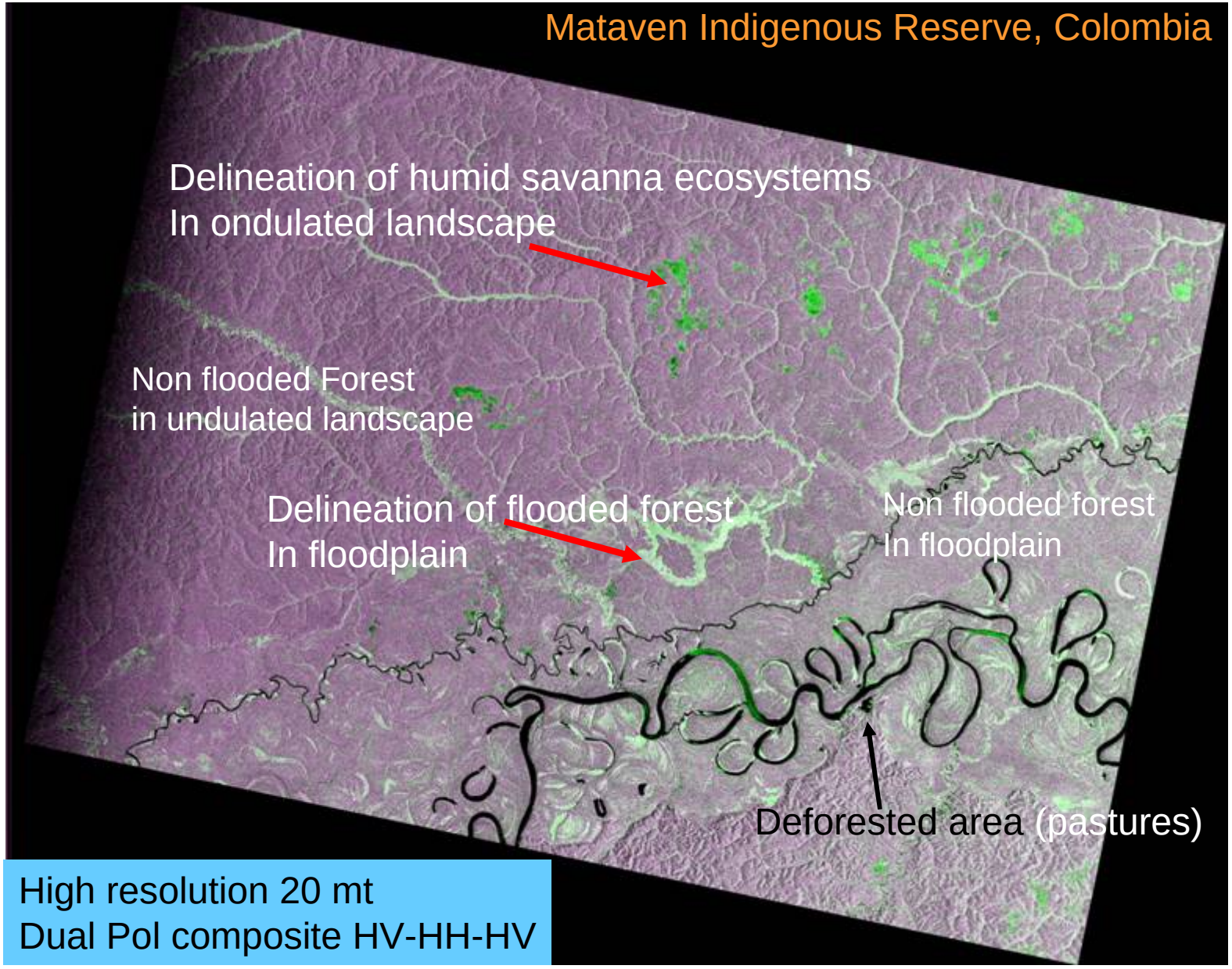
- SRTM data for geo-morphology mapping
- Alos PalSAR can help to do ecosystem mapping



Ideal to separate wet (flooded) from dry (non-flooded) ecosystems

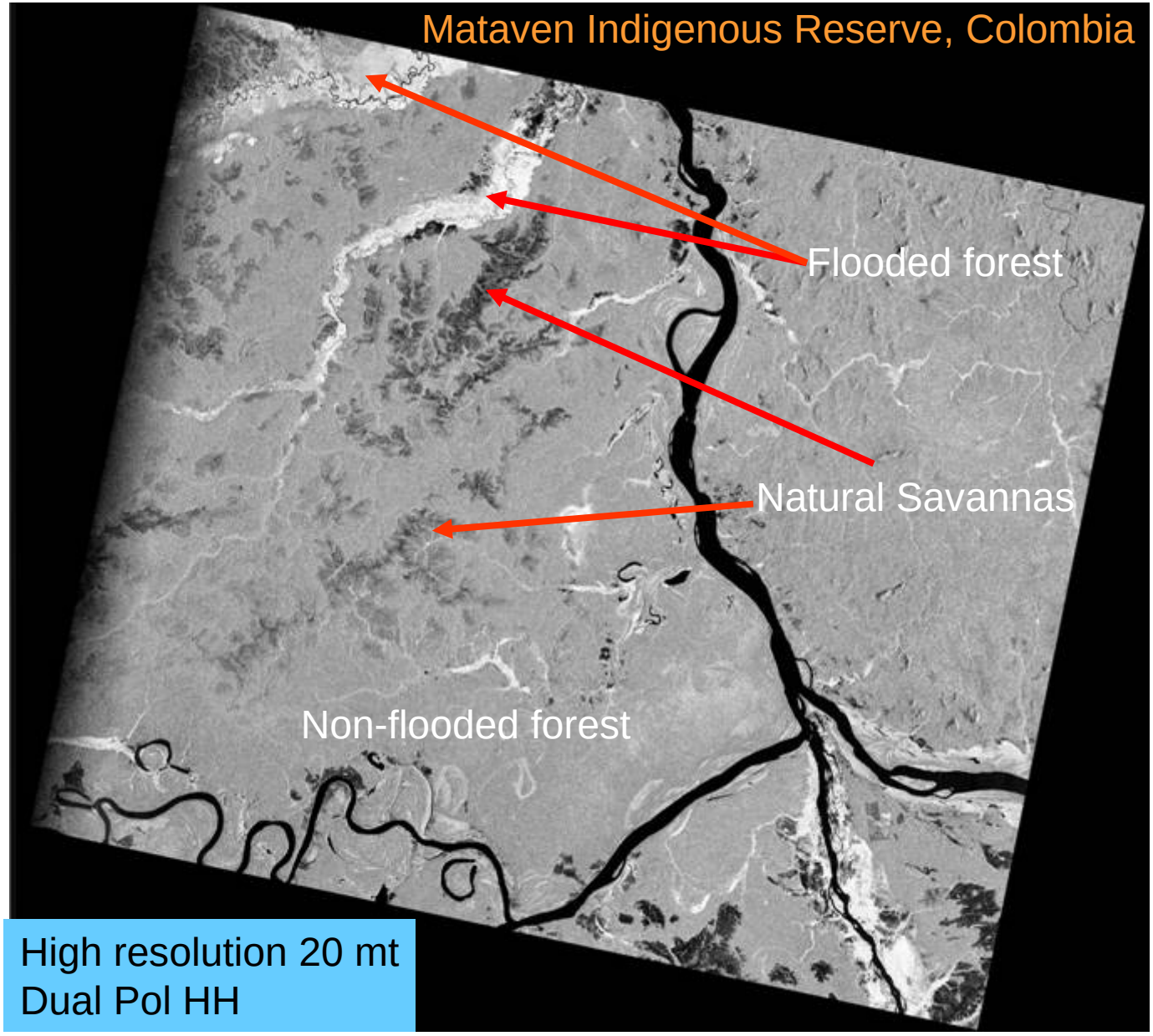


Integration with SRTM data will help definition of geomorphologic classes and therefore landscapes



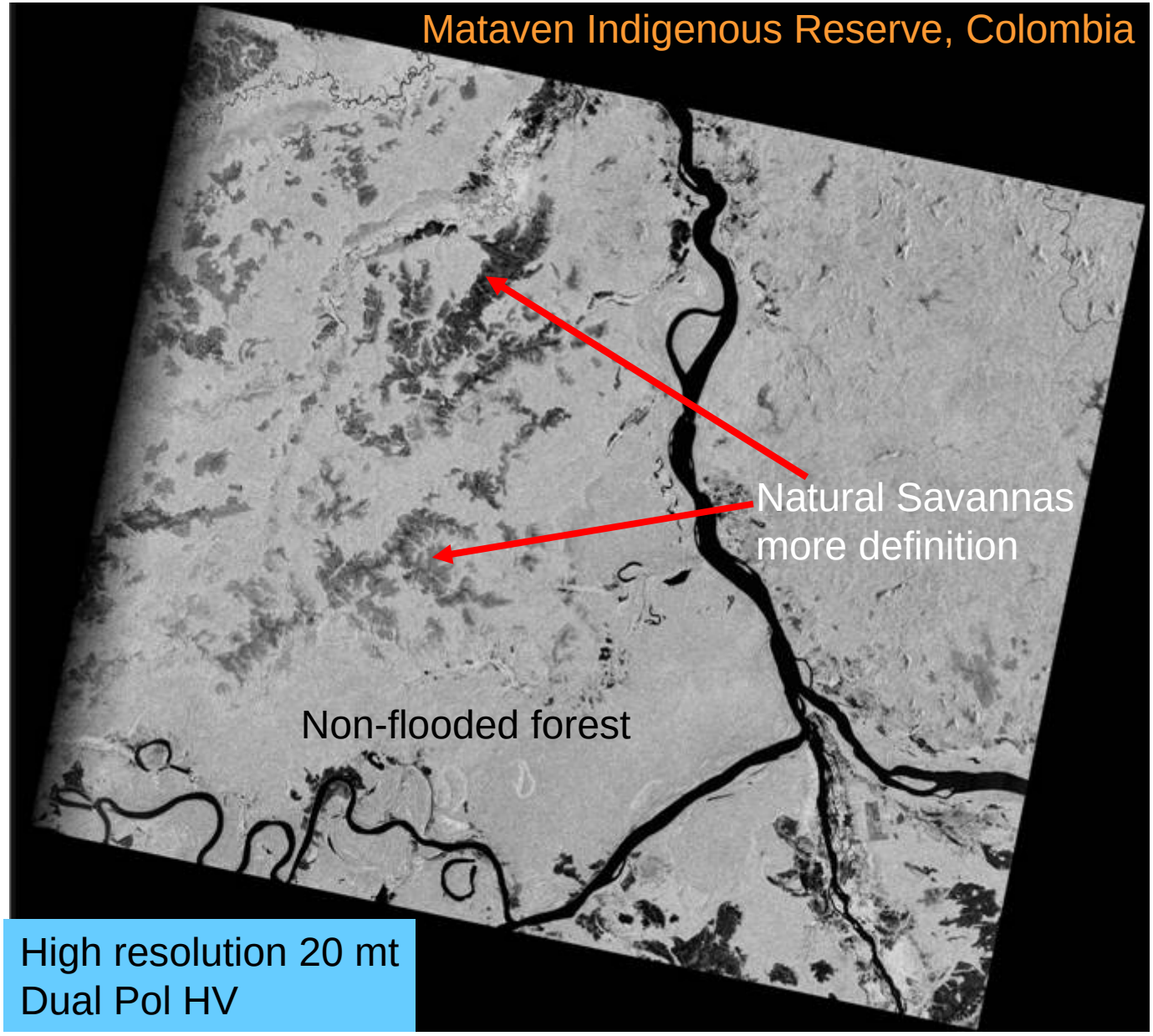
High resolution 20 mt
Dual Pol composite HV-HH-HV

Polarization composites or temporal composites will enhance differences between ecosystems



High resolution 20 mt
Dual Pol HH

Distintion between different ecosystems in flat terrain


Mataven Indigenous Reserve, Colombia
Natural Savannas
more definition
Non-flooded forest
High resolution 20 mt
Dual Pol HV

Summary

•Classification Algorithm has reach maturity and we are ready to process high quantity data

•Data processing is still on time, but we are waiting to have at least one year data in orfer to classify with high accuracy.

•Field data collection is being intensive and great deal undrestanding the ecosystems and cover change dynamics, wich is of crucial importance for high accuaracy mapping.

•All Products created by SarVision are developed in cooperation with local users and are being evaluated at this moment for management.

•Development of International standard products (REDD monitoring) are of crucial importance. Quality of data should be carefully assess before introducing to users.