K&C Phase 3

APPLICATION OF ALOS PALSAR FOR ABOVE GROUND BIOMASS ESTIMATION IN SEVERAL TYPES OF WETLAND VEGETATION (PEAT SWAMP, SWAMP AND MANGROVE), DRYLAND FOREST AND PLANTATION FOREST IN INDONESIA

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Science Team meeting #16 – Phase 3 Kick-off
JAXA TKSC/RESTEC HQ, Tsukuba/Tokyo, October 17-21, 2011

background

Objective & schedule

Data anticipation

K&C Support

Study site

Focus/site

Shared data

Deliverables

Ground condition

On going: conlusion

On going: biomass

BACKGROUNDS

- **Based on Biogeography:**

1. **3 ecoregion:**
   - **(A) Sunda land: Java, Sumatra, and Kalimantan ,**
   - **(B) Wallacea" Sulawesi & Maluku**
   - **(C) Sahul : Papua.**
2. **Agro climatic. Physiographic, Lithologic type and Landforms: 414 land system (from very wet to very drought ecosystem).**

ECOSYSTEM TYPES

Forest ECOSYSTEM : ➔ 13 FOREST TYPES

1. **Peat swamp forest (PSF): ➔ ramin (*Gonystylus spp.*)**
2. **Swamp forest: meranti / dipterocarp**
3. **Mangrove: avicenia, barringtonia, bruguiera, rizhopora etc**
4. **Dry land forest**
5. **Mountain forest, sub-mount savana, kerangas, sub alpine, alpine etc**

CARBON POOLS

1. **Focus: above ground biomass (dry land forest) & Soil and peat in peat swamp forest**
2. **Now , the remote sensing technique allows land cover change assessment using time series of remotely sensed imageries ➔ quantitative approaches**
3. **It is very useful for carbon stock change analysis at landscape level (ecosystem level).**
4. **At this point, it is actually possible to calculate volume of carbon ➔ REDD/MRV at certain levell (Tier 1 or Tier 2).**

Project objectives and schedule

1. **Develop algorithm for estimating biomass stock at several types of forest ecosystem**
2. **To develop a sampling strategy for estimating biomass stock in several forest types in Indonesia (carbon pool)**
3. **Develop a forest classification scheme using ALOS PALSAR**
4. **Identify the stand factors affecting the backscatter behaviour (classif strategy)**

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DATA ANTICIPATION

- **ALOS PALSAR FBD (HH+HV) mosaics at 25 m pixel spacing (2007, 2008, 2009, 2010)**
- **JERS-1 SAR (HH) mosaics at 25m pixel spacing (mid 1990's)**
- **ALOS PALSAR ScanSAR (HH) mosaics at 100 m pixel**
- **AVNIR and PRISM**

GENERAL APPROACH

1. Pixel based based classification, subspace classification
2. Forest covers (category) development
3. Ground truth data collection: (field survey and/or existing field survey data – IHMB/other researches)
4. Identification of stand variables affecting the backscatter
5. Develop a forest classification scheme using PALSAR
6. Develop biomass estimation model using PALSAR.

SUPPORT OF K&C THEMATIC DRIVERS

(Carbon cycle science, International Conventions, Environmental Conservation)

1. Forest cover ➔ Sustainable forest management (annual harvesting)
2. Forest/ environmental conservation (spatial forest planning)
3. Carbon trade (REDD+, estimation carbon stock/ carbon pool)
4. Reforestation/forest restoration

.

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.

Project milestones and schedule

1. ***Variables of stand affecting backscatter char of PALSAR is identified - 2012/13***
2. ***Forest classification scheme - 2012/13***
3. ***Biomass estimation model -2013/14***
4. ***Accuracy assessment of biomass at each forest type & Validated Landcover Map 2013/14***

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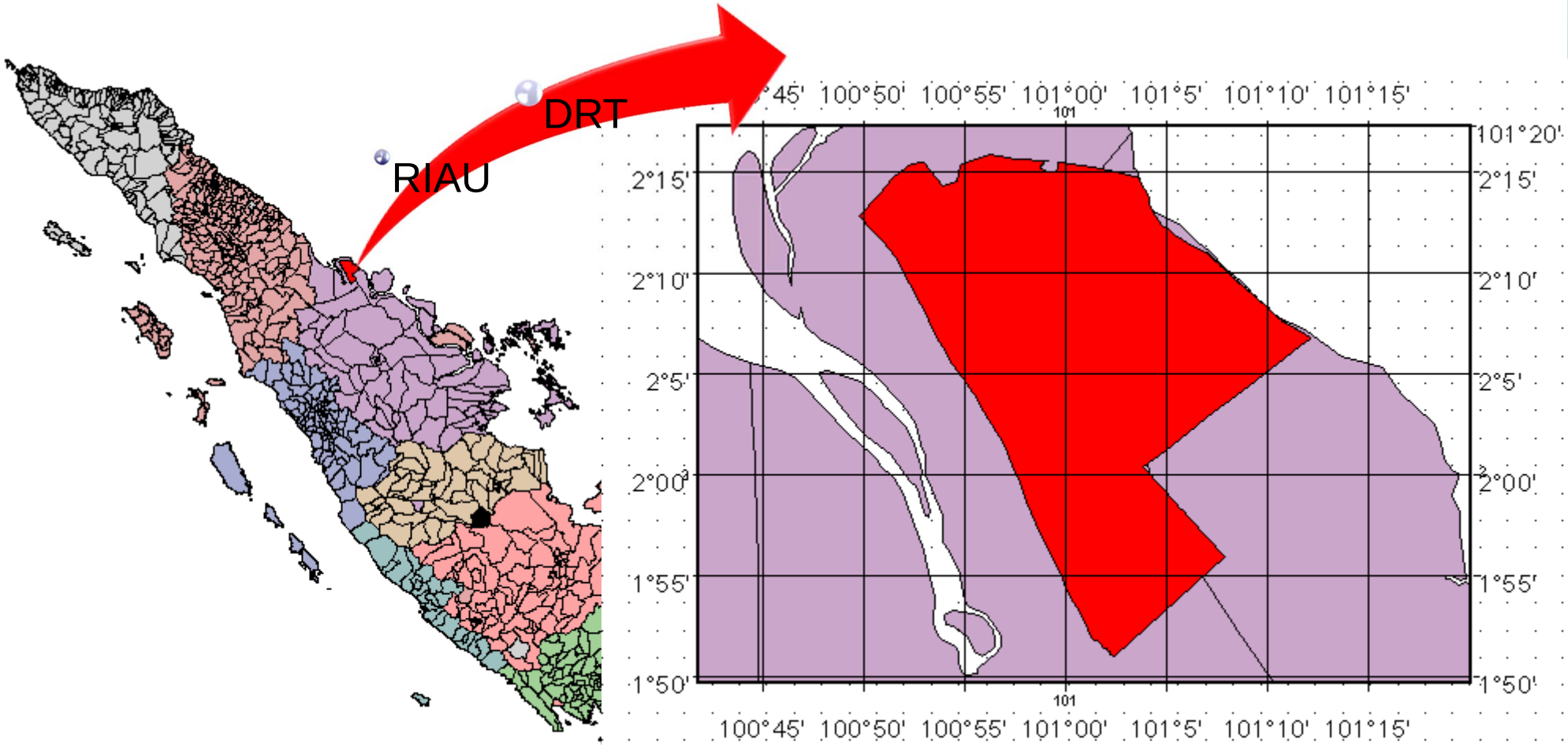
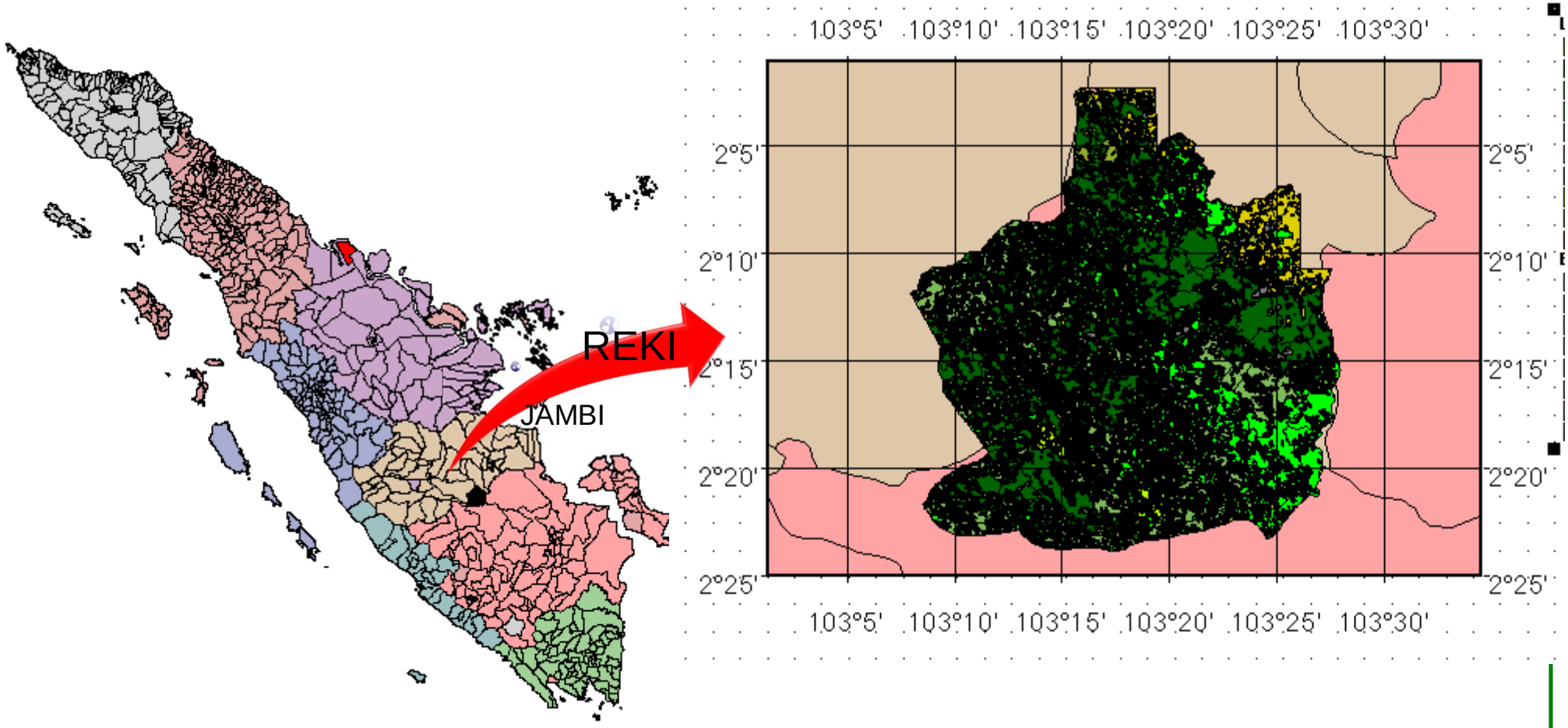
Project area(s)

1. Sumatera : 3 sites (North Sumatera, Riau, Jambi/South Sumatera)
2. Java : 3 site (KPH MADIUN, cilacap & Kebon

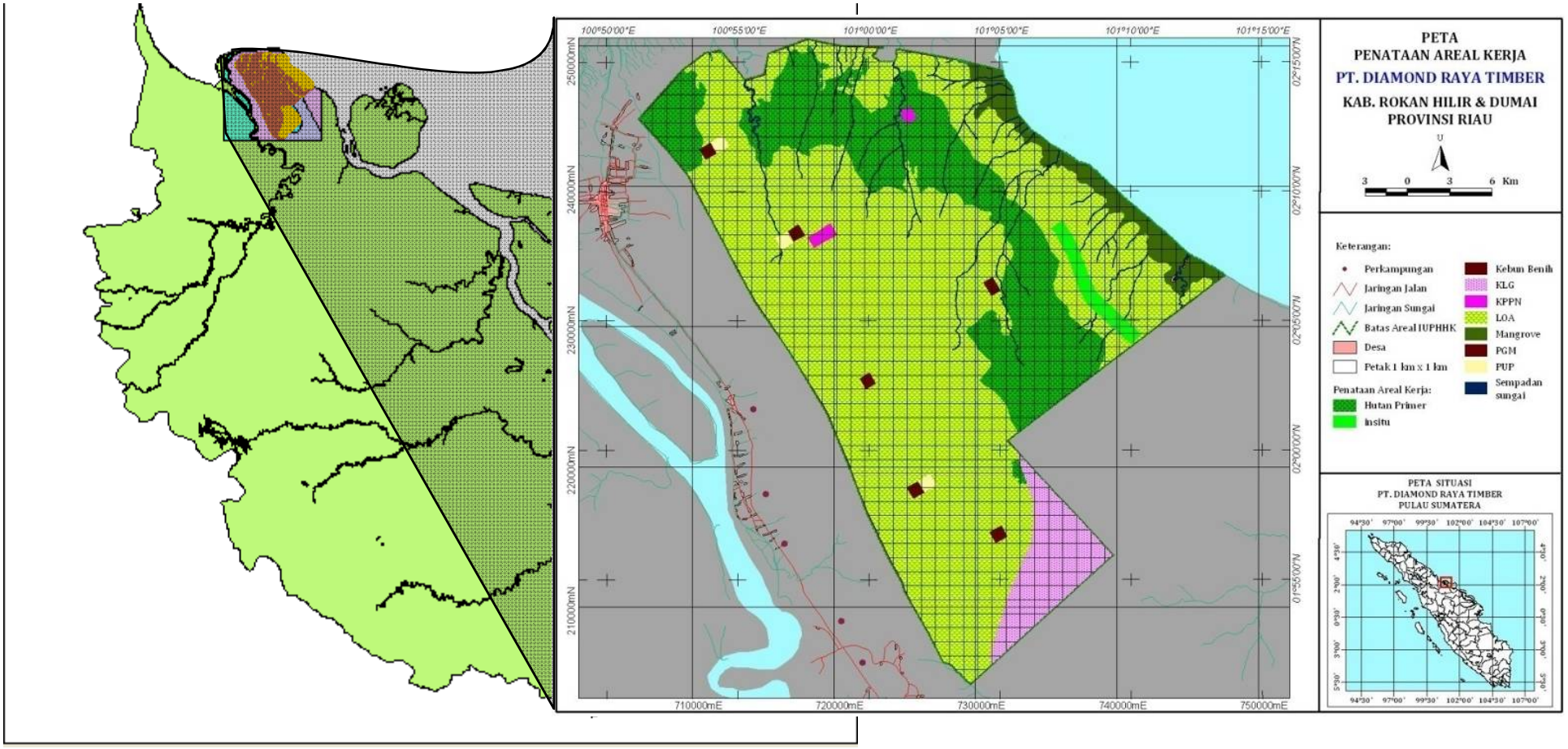
Study site 1: will be the peat swamp forest in Rokan Hilir District, Dumai Regency, Riau Province, located between 100º00' E and 102º00' E; and between 01º00' N and 03º 00' N



2. JAMBI & SOUTH SUMATERA (DRY LAND FOREST, PT REKI)

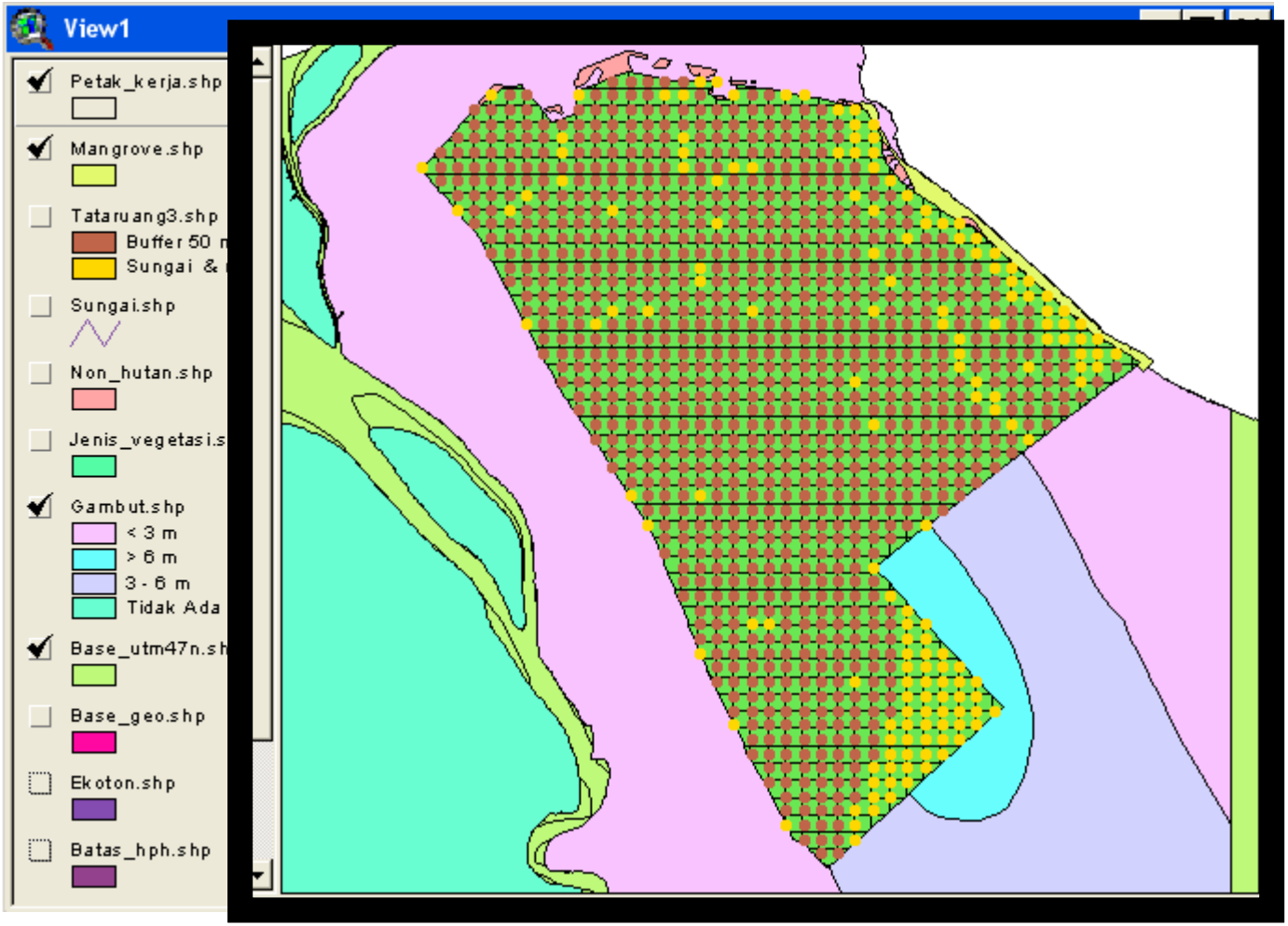


Site 1 DRT Concession Forest in Riau

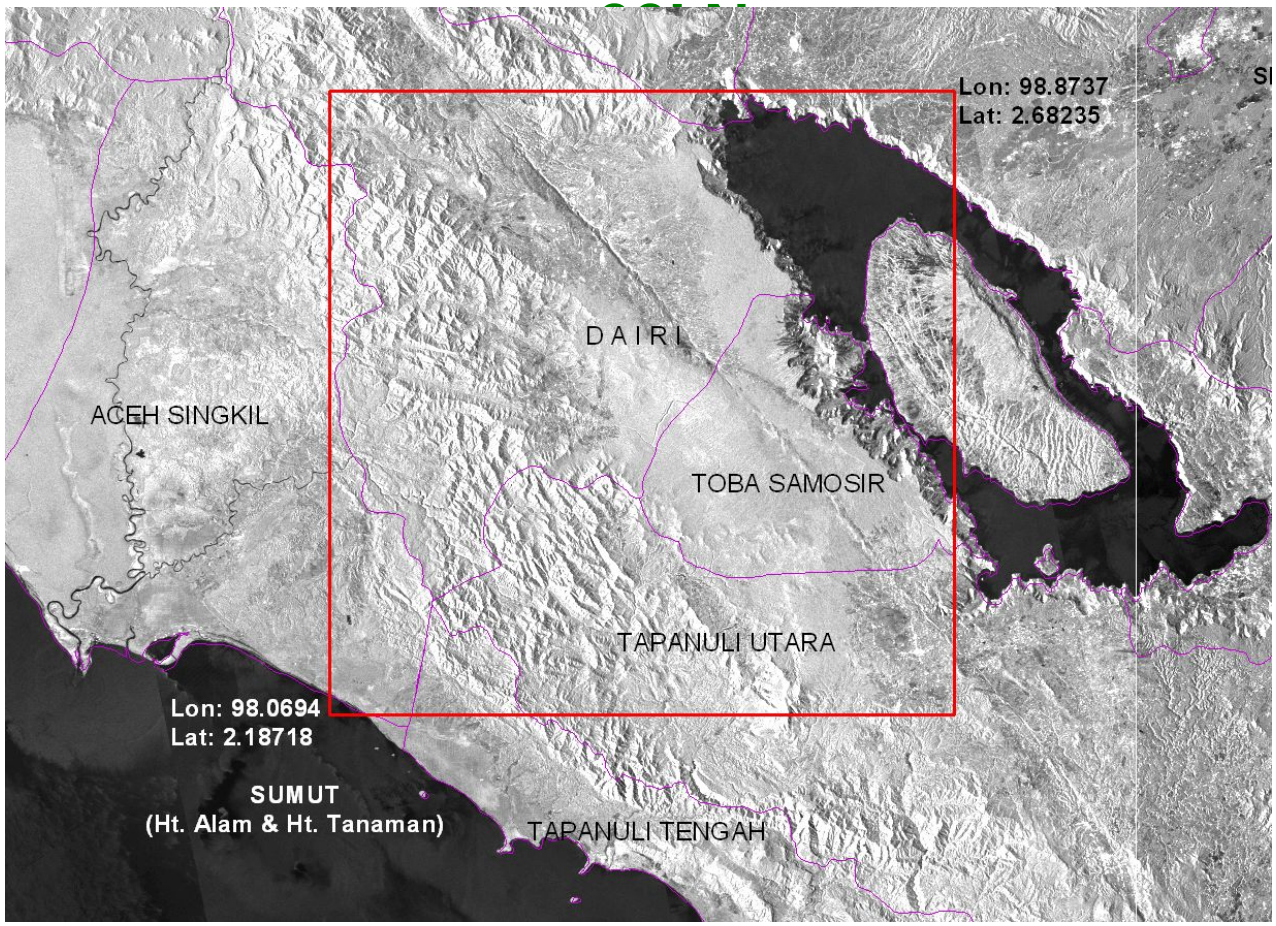


Field plot distribution

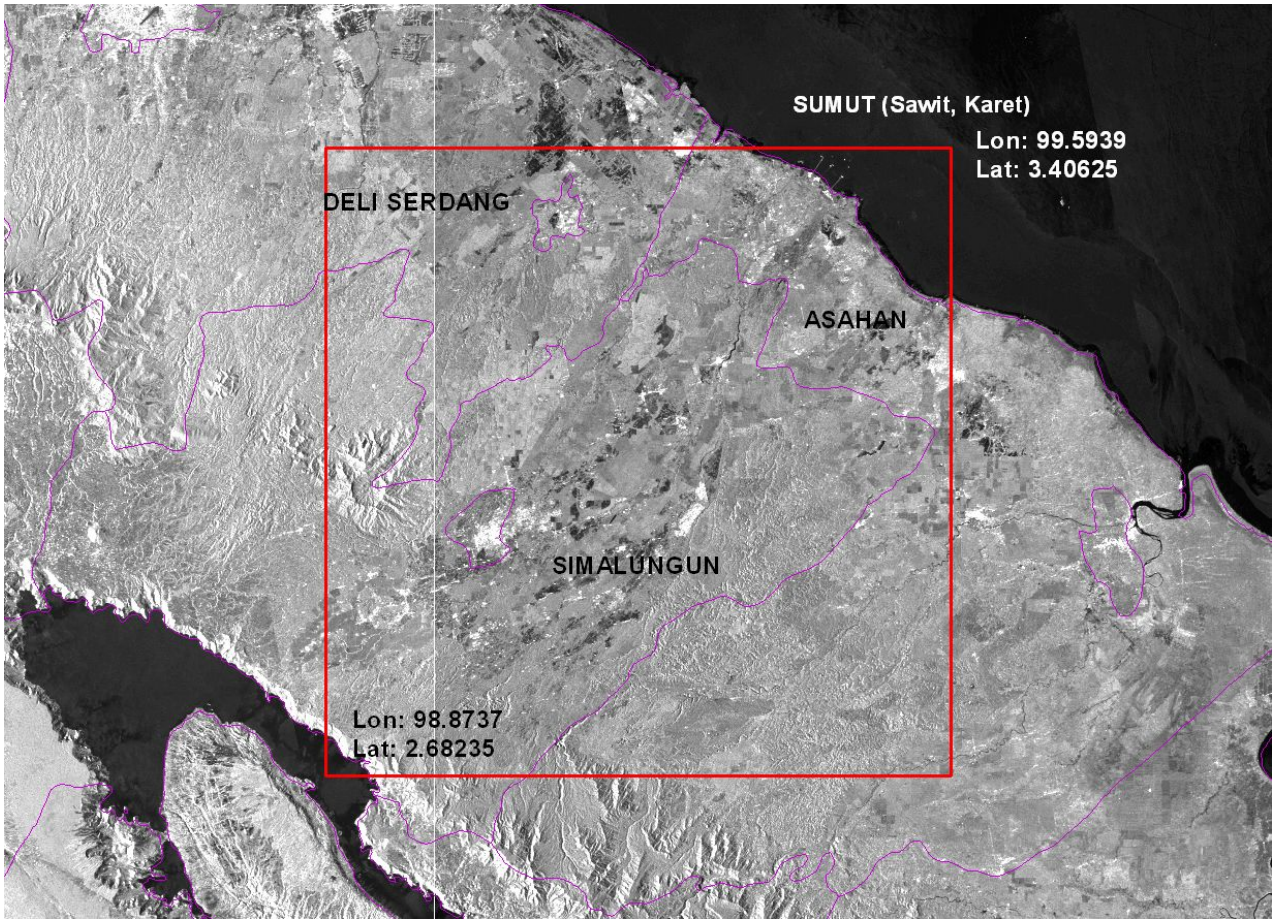
- Diamond Raya Timber Comp area (peat swamp forest).



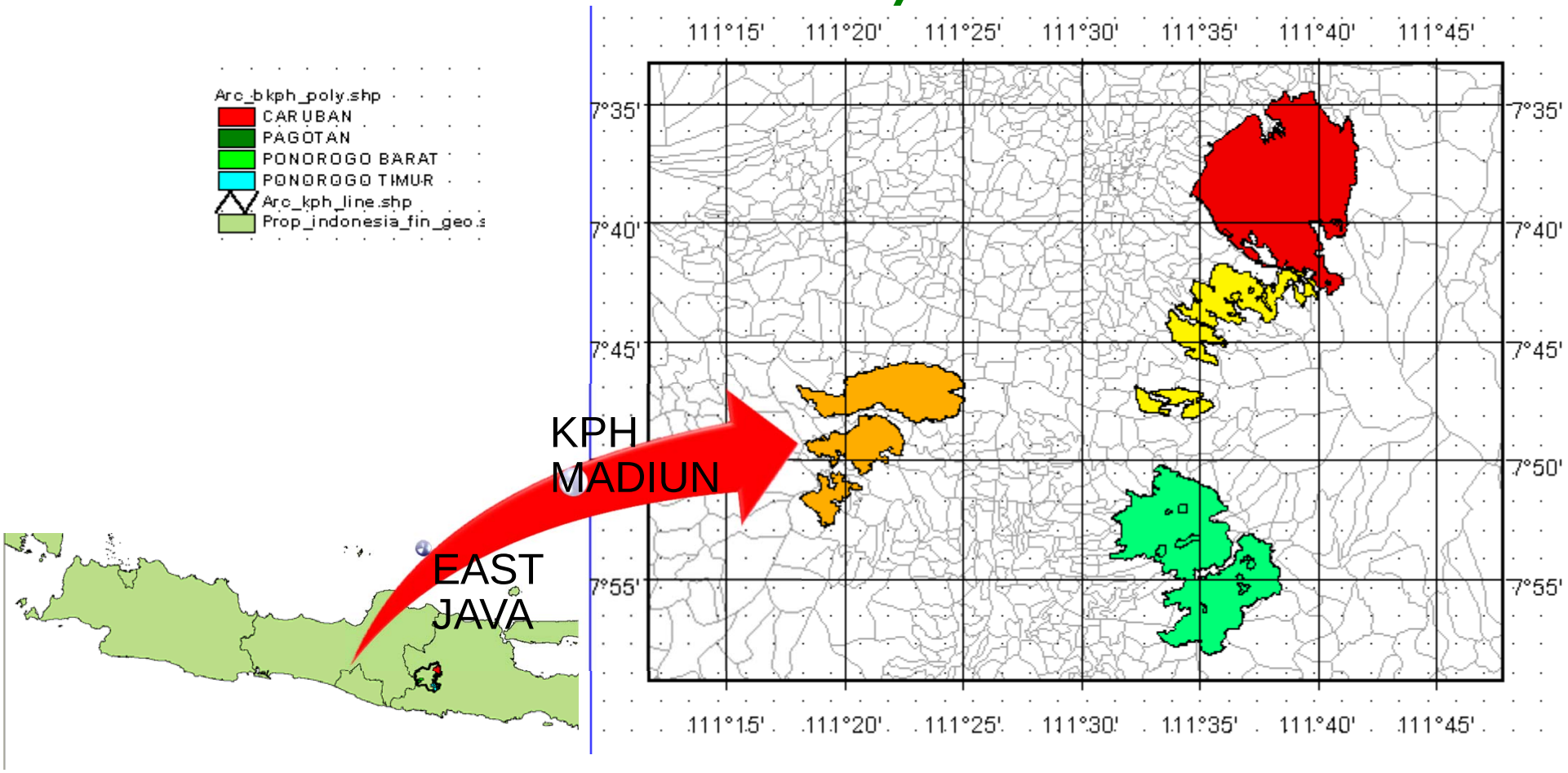
Study site 3: includes dryland forest and Eucalyptus plantation forest in North Sumatera), located between 98º00’ E and 99º00’ E; and between 2º00’ N and 03º



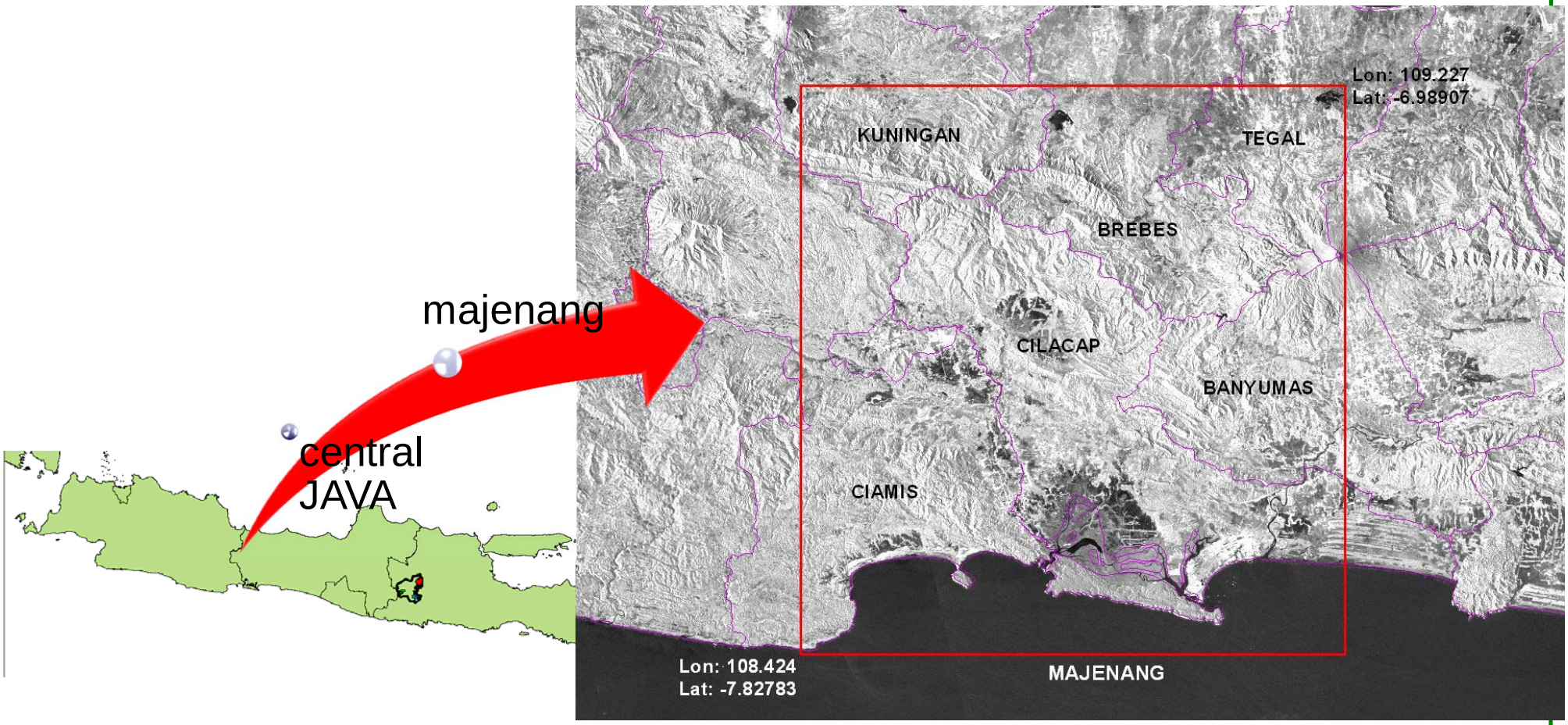
Study site 4: includes rubber and oil palm estate crop in North Sumatera,), located between 98º30' E and 100º00' E; and between 02º30' N and 04º 00' N



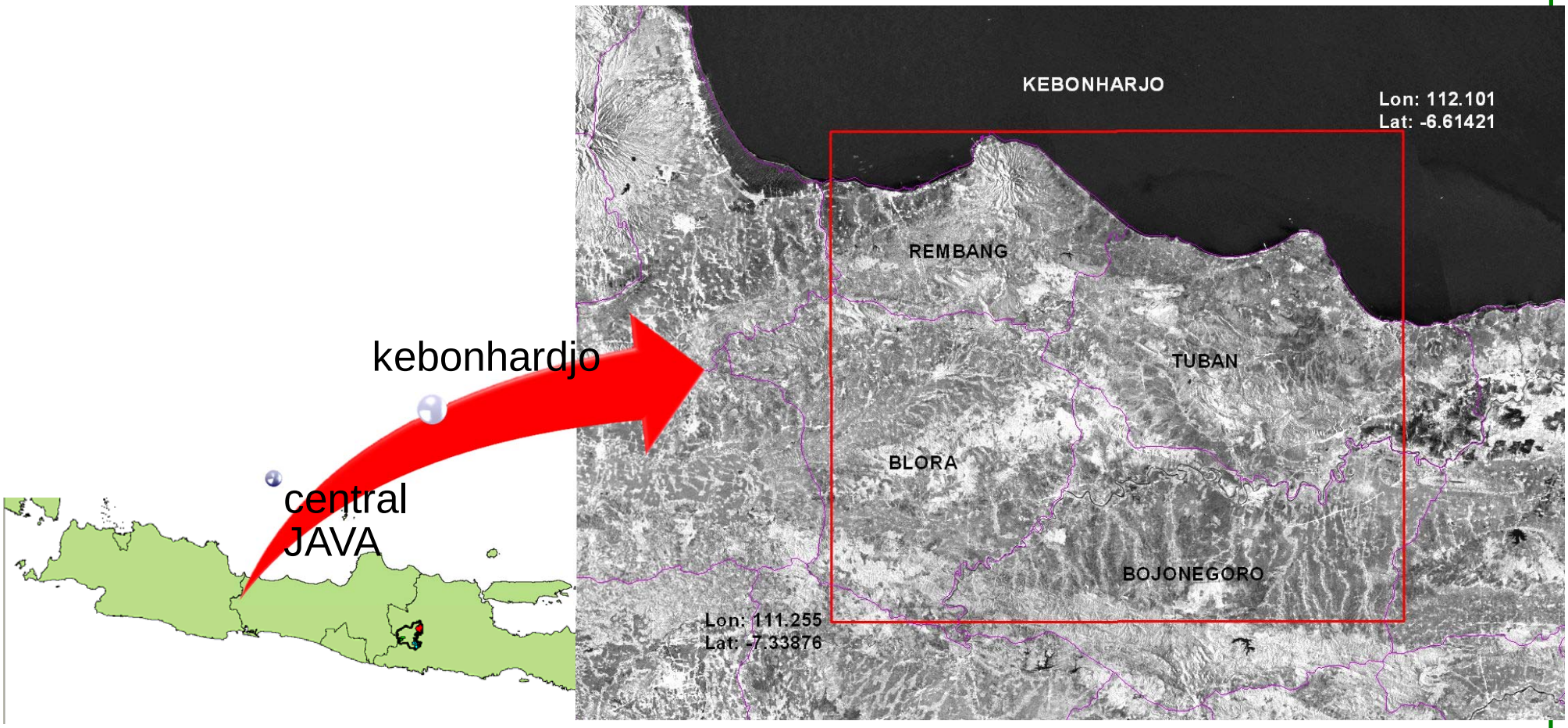
5. KPH MADIUN, EAST JAVA (TEAK PLANTATION FOREST)



6. MAJENANG, CENTRAL JAVA (MANGROVE FOREST)



7. kebonhardjo, CENTRAL JAVA (MANGROVE FOREST)



Support to JAXA's global forest mapping effort (Focus of the study)

1. Site 1 (DRT) : to improve the classification method for esimating biomas stock of peat swamp forest, delineating peat swamp forest ecosystem and mangrove
2. Site 2 (Jambi): improve classification method for biomass estimation of dryland forest and transition ecosystem (junggle rubber, rubber, oil palm)
3. site 3 (North Sumatera 1) the focus will be in developing algorithm to estimate biomass stock of dryland forest and Eucalyptus plantation forest

Support to JAXA's global forest mapping effort (Focus of the study)

4. site 4 (North Sumatra 2) the focus will be in developing algorithm to estimate biomass stock of rubber and oil palm estate crop in North Sumatera
5. Site 5 (Central Java) the focus will be in developing algorithm to delineate mangrove in Majenang
6. Site 6 (Madiun):in developing algorithm to estimate biomass stock of teak forest in Madiun (East Java)

List ground truth data that will be shared with JAXA:

1. Ground data of peat land forest in Senepis, Riau (Diamond Raya Timber) – approx 50 ~ 100 ground plot – uniformly distributed
2. Ground data in Teak Forest (Madiun East Java) – 38 plots
3. Ground data in dry land forest (30), Eucalyptus Plantation forest (30), Rubber (30) and Oil Palm (30) in North Sumatera
4. Validated map based on ALOS PALSAR (in some areas)

Data required

Study Sites	Main forest cover	Data required
Site 1	Peat land forest	• ALOS PALSAR FBD (HH+HV) mosaics at 25 m pixel spacing (2007, 2008, 2009, 2010) • JERS-1 SAR (HH) mosaics at 25m pixel spacing (mid 1990's) • ALOS PALSAR ScanSAR (HH) mosaics at 100 m pixel spacing (every cycle, non-gap filled. Foreseen over northern South America Central Africa, Insular SE-Asia, 2007-2010)
Site 2	Peat land and low land forest	Same as above
Site 3	Teak plantation	Same as above
Site 4	Teak and Mangrove	Same as above
Site 5	Dry land forest and Eucalyptus plantation forest	Same as above
Site 6	Rubber and oil palm	Same as above

Deliverables

1. Report of Classification scheme
2. Category developed and validated in forest ecosystem
3. Report of Biomass estimation models for each forest ecosystem
4. Reports on capability of PALSAR for biomass estimation and classification (ACCURACY ASSESSMENT)

THANK YOU VERY MUCH

COMMENTS AND SUGGESSTION ARE appreciated

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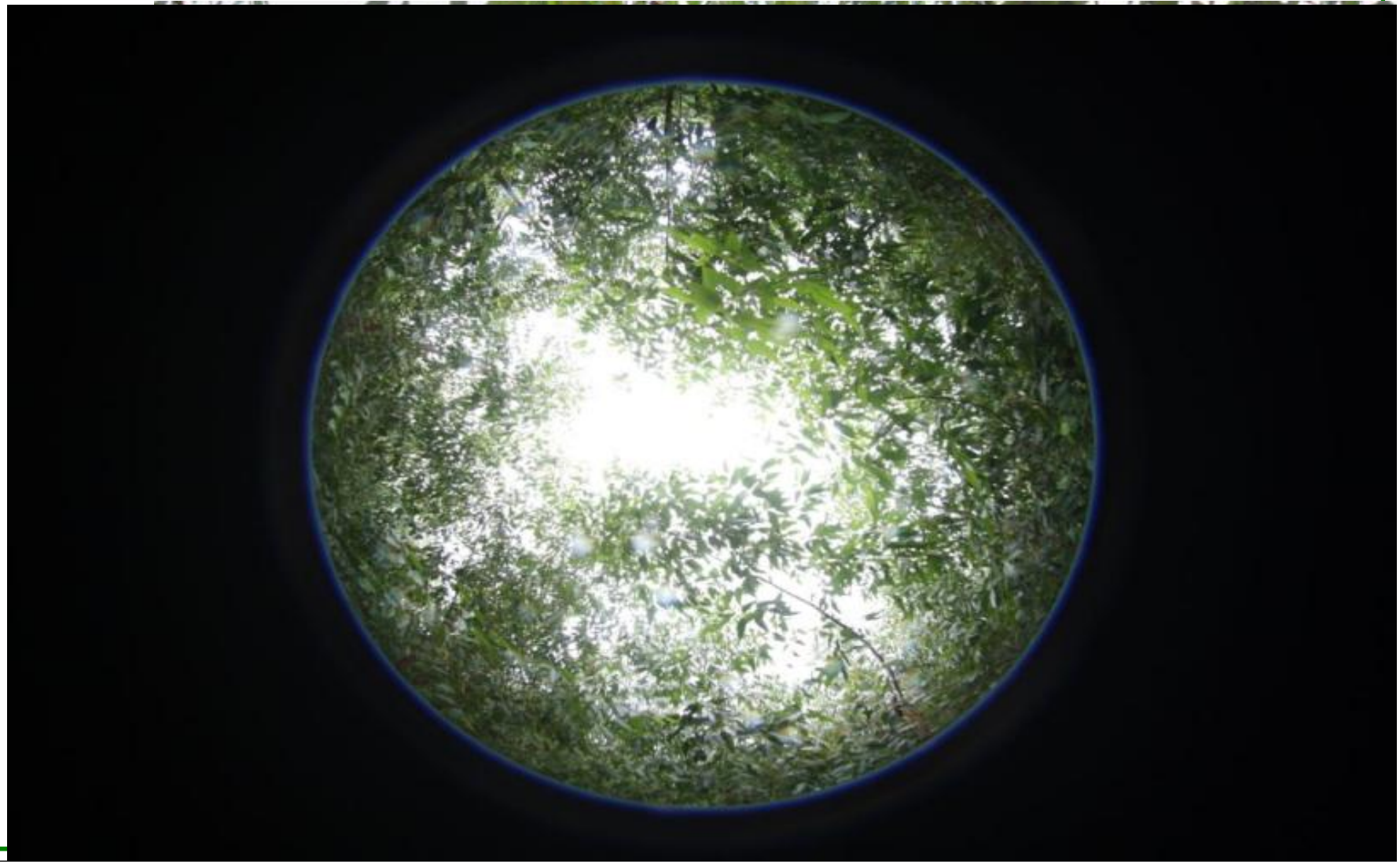

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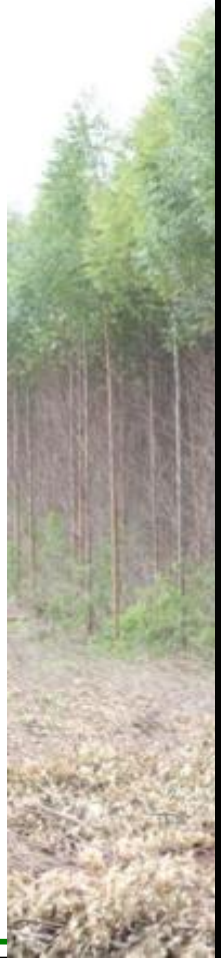

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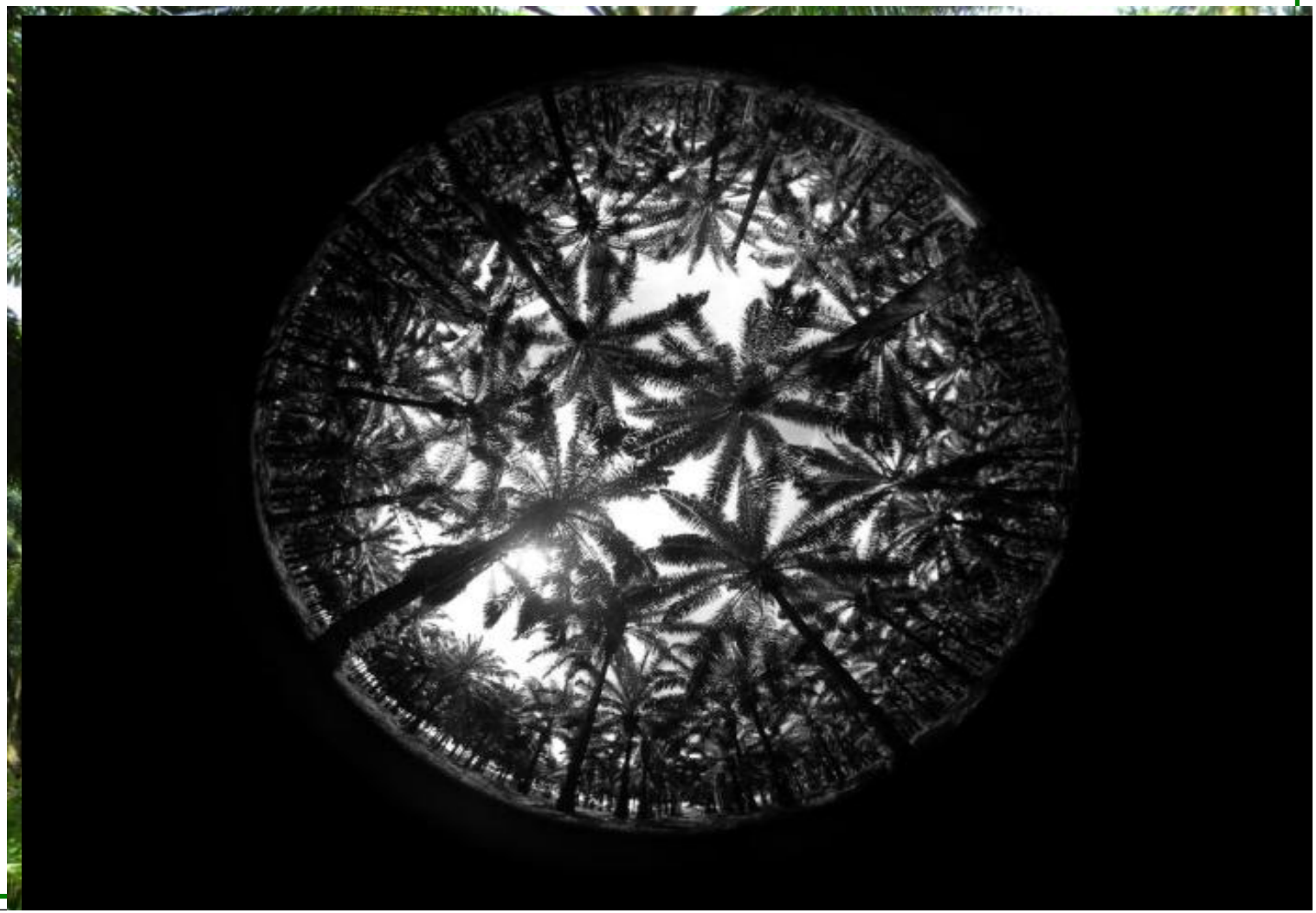


CONCLUSION ON NATURAL FOREST

1. BACKSCATTER MAGNITUDE AND VARIATION ARE AFFECTED BY STAND VARIABLES
2. ON THE 6.25M-RES ➔ BASAL AREA, BIOMASS AND HEIGHT CLASSES
3. ON THE 50-M RES, BASAL AREA AND TREE BIOMASS

CONCLUSION ON FOREST PLANTATION

1. ON PALSAR 50-M RES → VARIATION OF BACKSCATTER → TREE HEIGHT
2. ON PALSAR 6.25-M, → BY STAND DENSITY AND CROWN COVERAGE.
3. ON PALSAR 6.25-M → 3 CLASSES WITH 85%
4. ON PALSAR 50-M, CAN ONLY BE CLASSIFIED INTO 2 CLASSES WITH 61.7%

CONCLUSION ON RUBBER

1. **BACKSCATTER MAG OF RUBBER IS AFFECTED BY:**
   - ↓ **DBH SIZE AND BASAL AREA FOR ALOS 50-M**
   - ↓ **DBH SIZE, RATIO TREE-DISTANCE AND CROWN AREA AND BIOMASS VOLUME FOR ALOS 12.5-M**
2. **ON 50-M AND 12.5-M, 3 CLASSES CAN BE IDENTIFIED WITH 75% ACC AND 72% ACC**

CONCLUSION ON OIL PALM

3. BACKSCATTER MAG OF OILPALM IS AFFECTED BY:
   - CROWN DIAMETER FOR ALOS 50-M → 2 CLASSES → 92%
   - TREE HEIGHT FOR 12.5-M → 3 CLASSES → 65%
4. BACKSCATTER IN HIGHER RES → MUCH NOISE NO SIGNIFICANT IMPROVEMENT FOR CLASSIFICATION

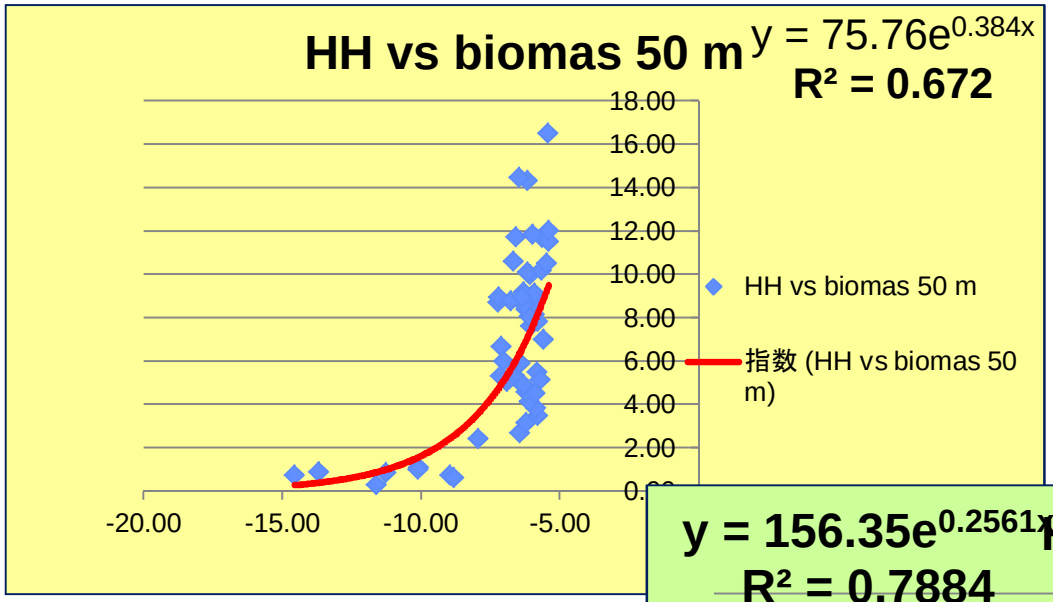
CONCLUSION ON BIOMASS ESTIMATION MODEL

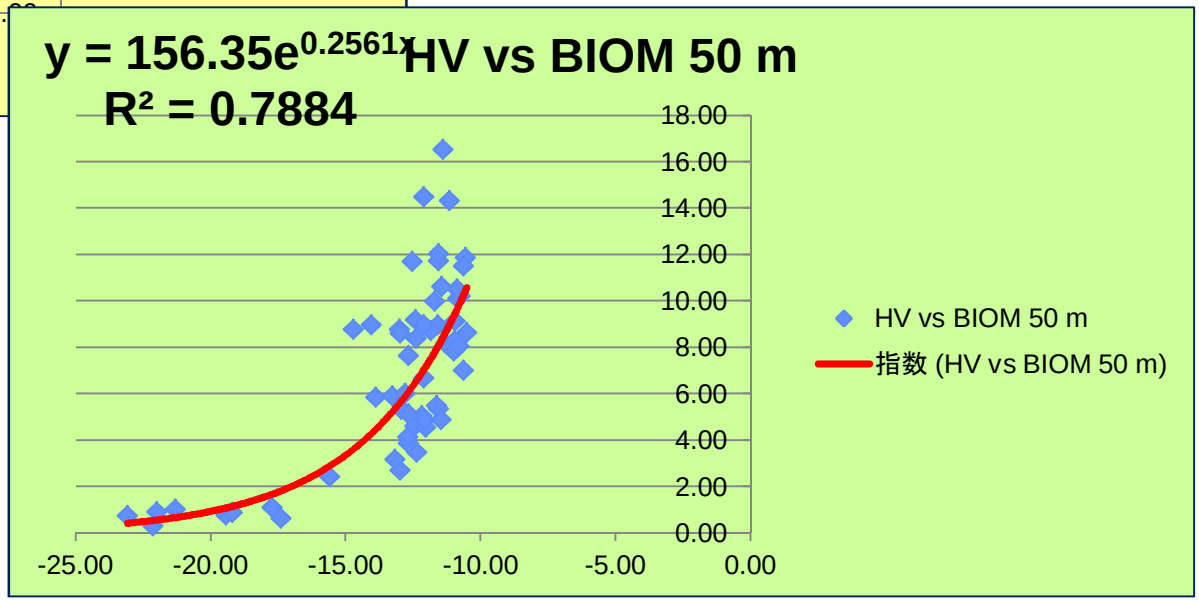
1. **Biomass (carbon stock), particularly RUBBER BIOMASS could be estimated using ALOS PALSAR DATA either using original (raw) data or backscatter ¥data**
2. **OIL PALM AND NATURAL FOREST tend to have a good relationship with the backscatter value of ALOS PALSAR ➔ NEED TO BE MORE EVALUATED.**

FURTHER DATA EXPLORATION

1. **NATURAL FOREST, FOREST PLANTATION AND OIL PALM → need to be more EXAMINED → LACK OF DATA VARIATION**
2. **GOOD DATA RECORDS → RUBBER → BIOMASS ESTIMATION**

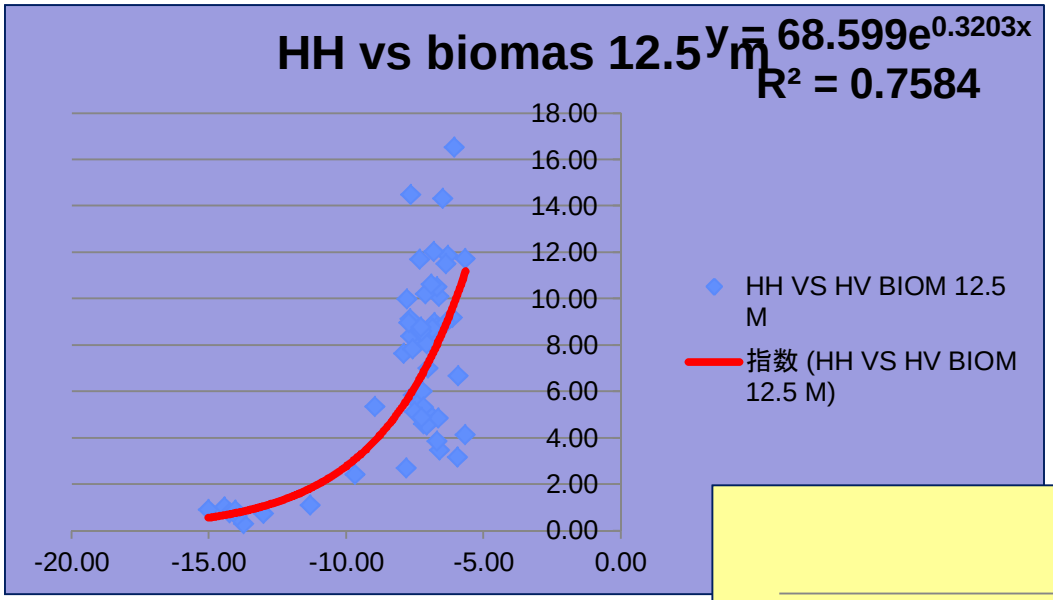
Rubber BIOMASS ESTIMATION using 50-m res



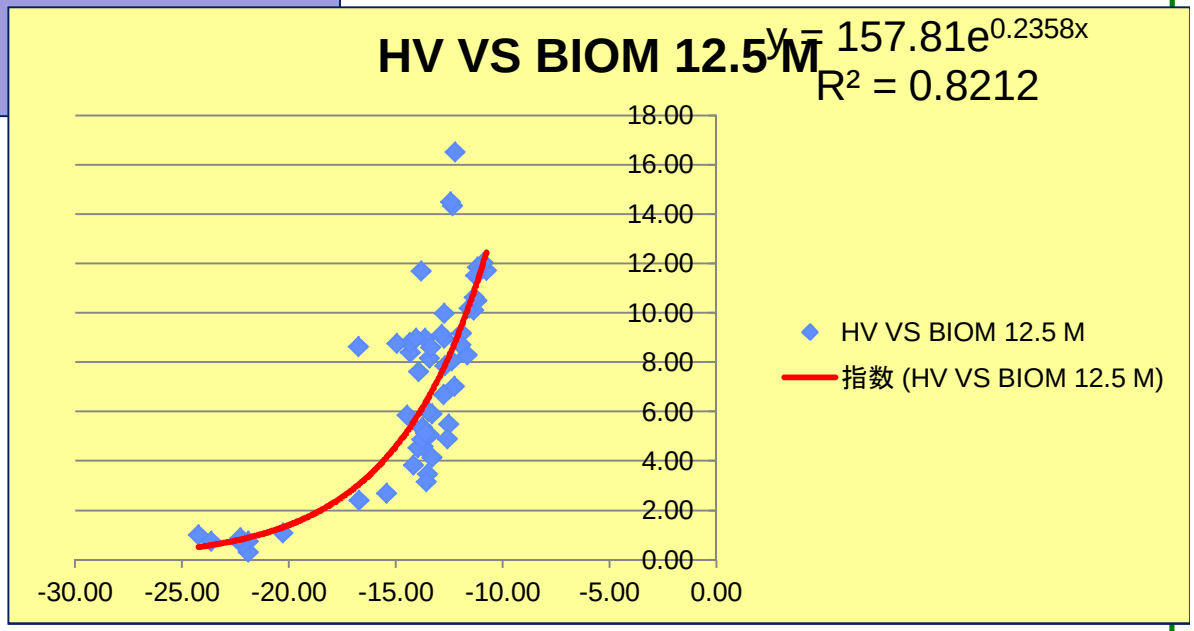


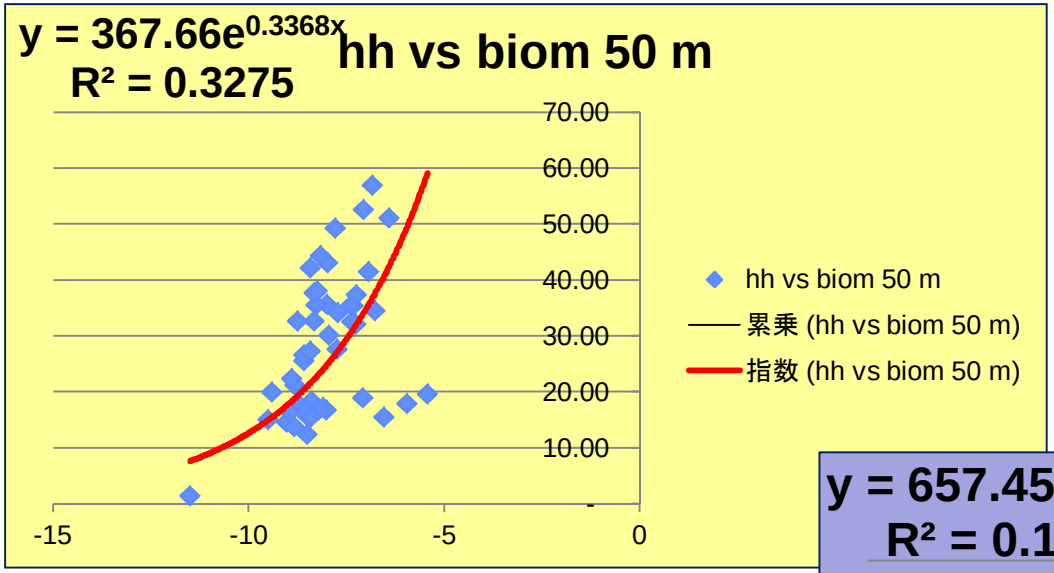
Good model can be developed using 50-m res

Rubber BIOMASS ESTIMATIONusing 12.5 m res



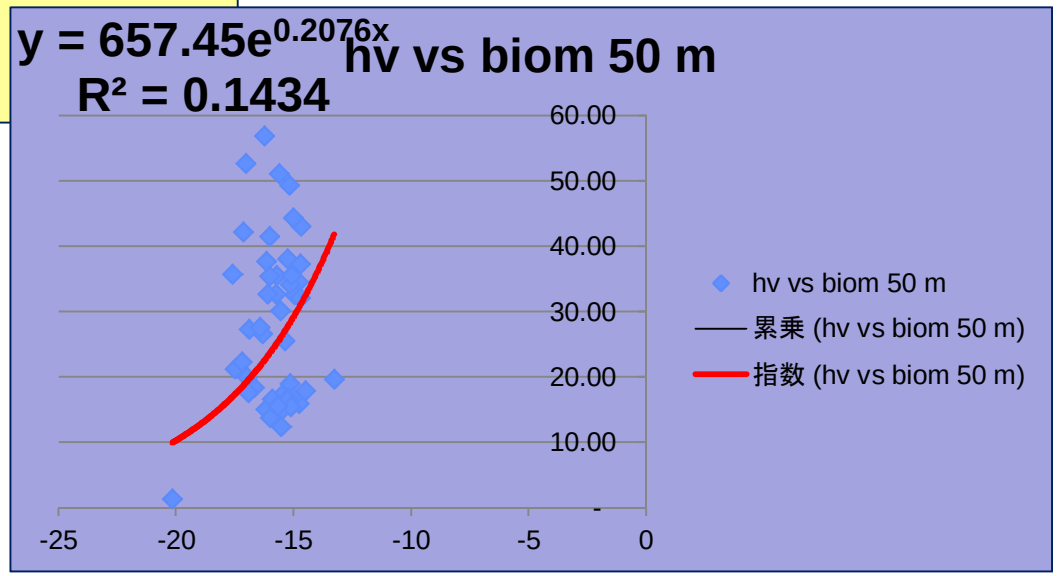
Better models are provide using 12.5 res

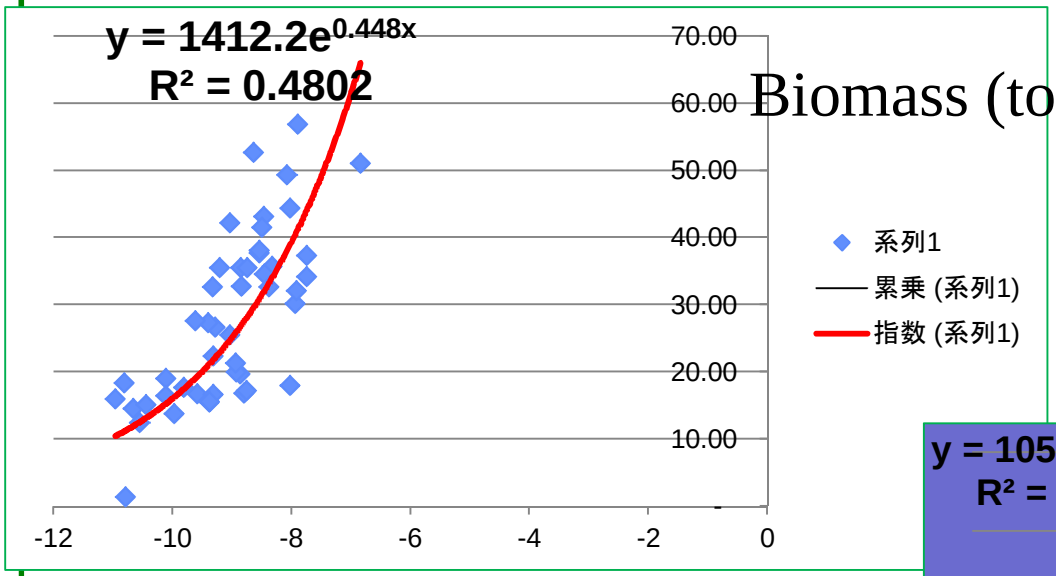




Lack of data variation

Oil palm BIOMASS ESTIMATION using 50-m res

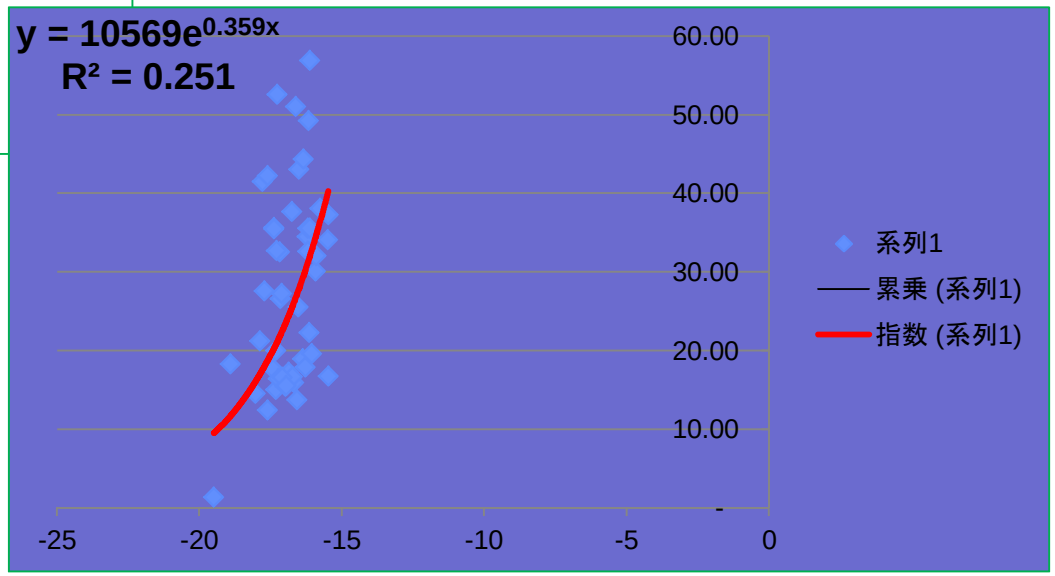




Biomass (ton/ha)

Lack of data variation

Oil palm BIOMASS ESTIMATION using 12.5 m res

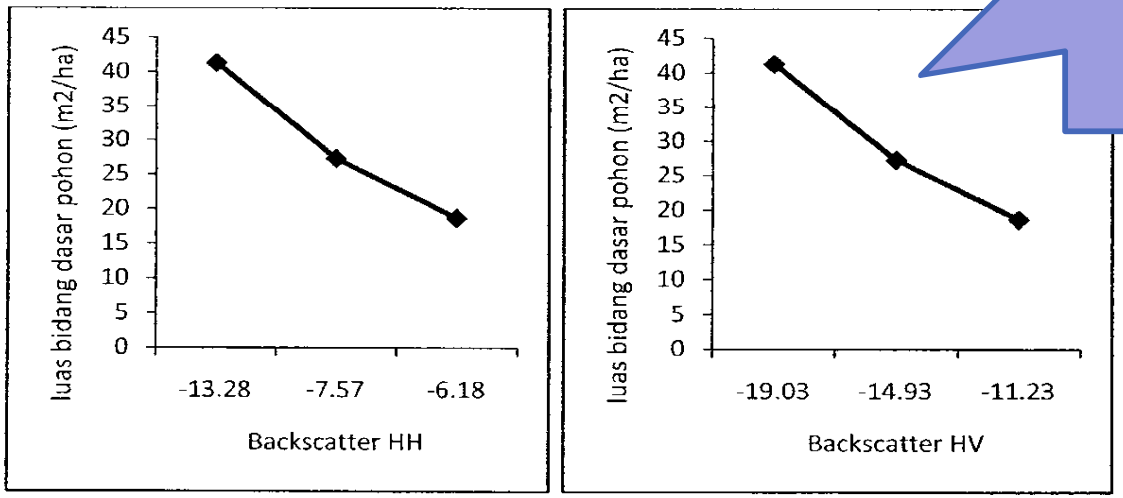


		Predicted Group Membership			
	Class	1	2	3	To
	1	50,0	50,0	0	
%	2	2,4	92,9	4,8	
	3	0	0	100,0	

91,1% *of original grouped cases correctly classified.*

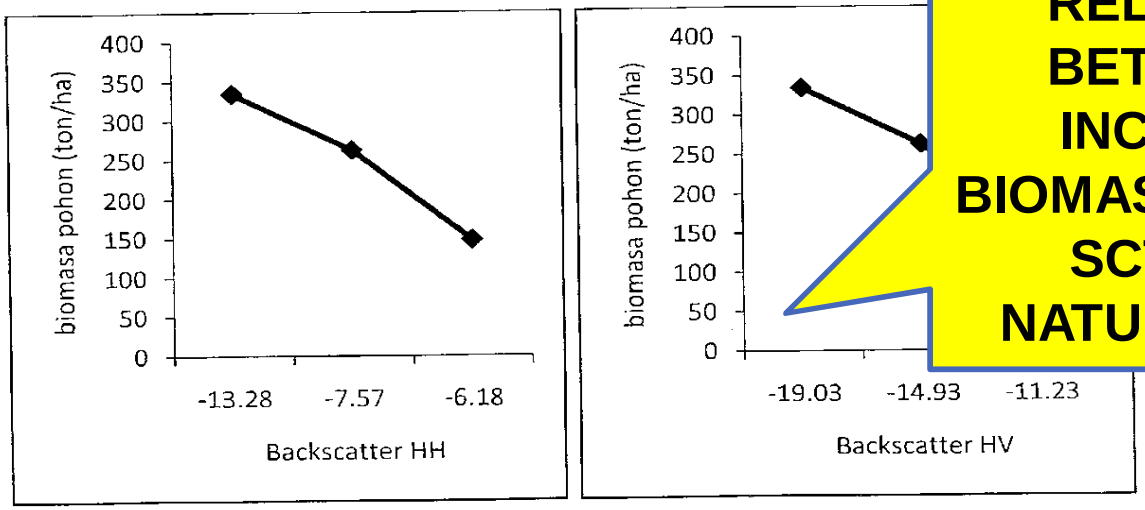
THERE IS RELATIONSHIP BETWEEN THE INCREASE OF BASAL AREA AND BACK SCTATTER IN NATURAL FOREST

Basal area



BIOMASS vs Backscatter of HH & HV

Tree biomass

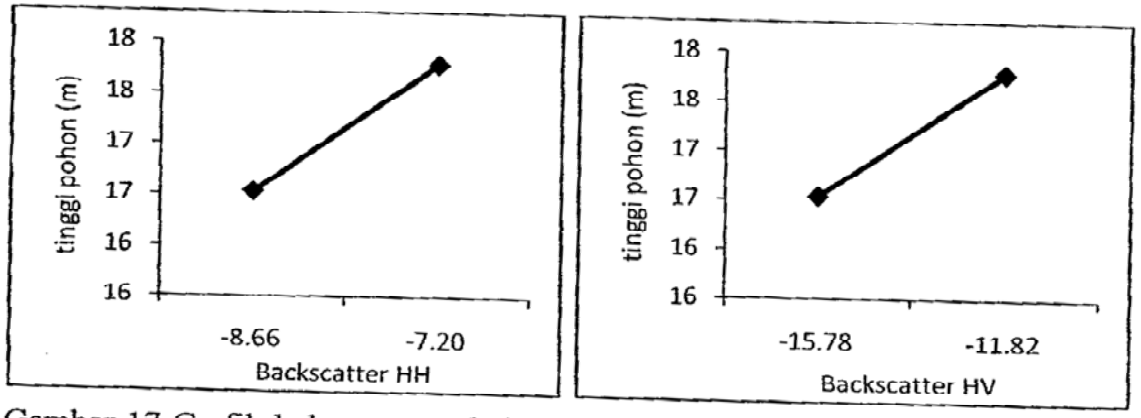


THERE IS RELATIONSHIP BETWEEN THE INCREASE OF BIOMASS AND BACK SCTATTER IN NATURAL FOREST

BIOMASS vs Backscatter of HH & HV

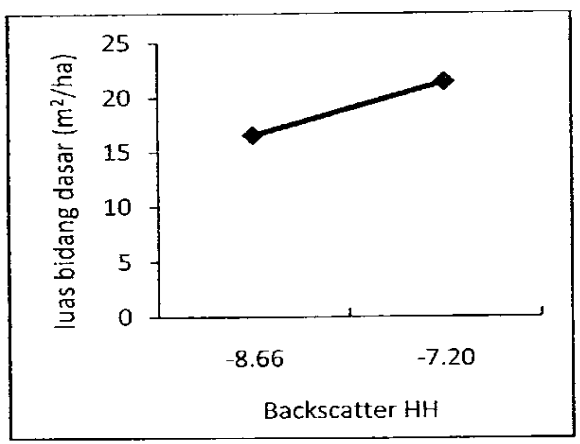
MANY NOISE ➔ ONLY 2 CLASSES

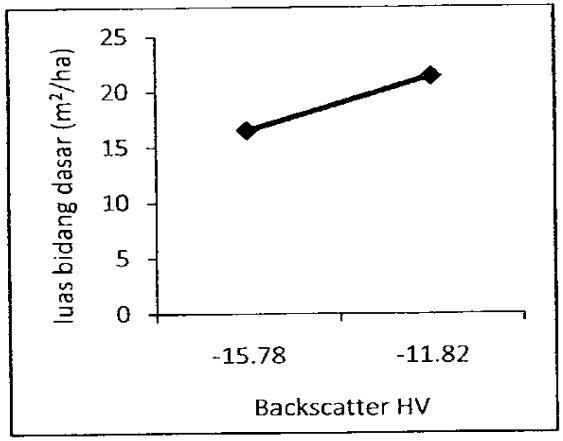
Tree height



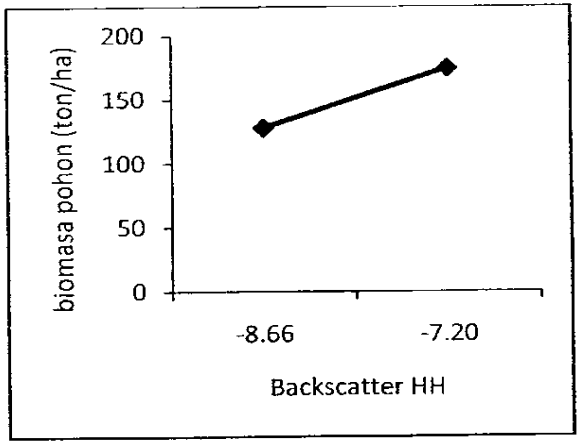
Gambar 17 Grafik hubungan peubah tegakan dengan nilai *backscatter* pada citra ALOS PALSAR resolusi 6,25 meter.

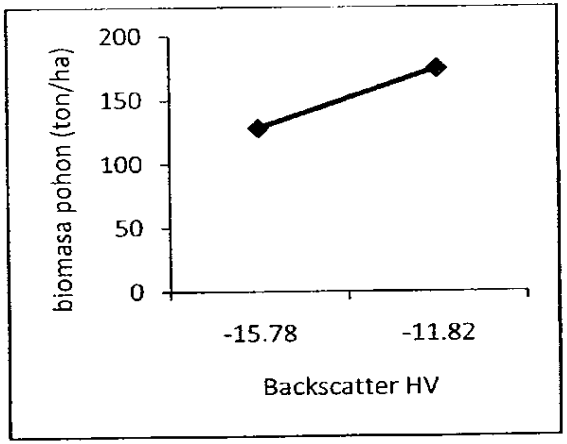
Basal area



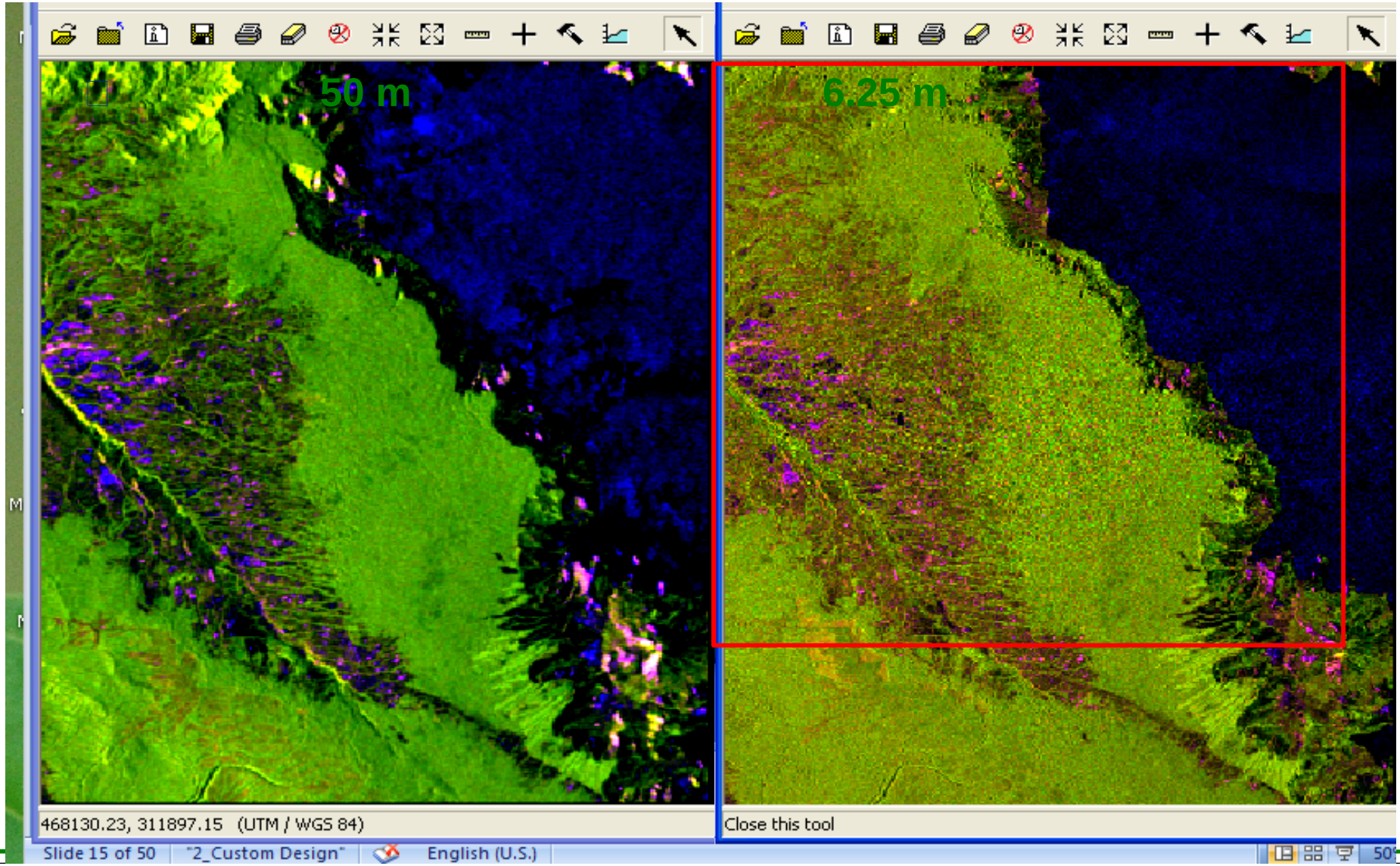


Tree biomass





ALOS PALSAR 2008: HIGH LAND NATURAL TROPICAL



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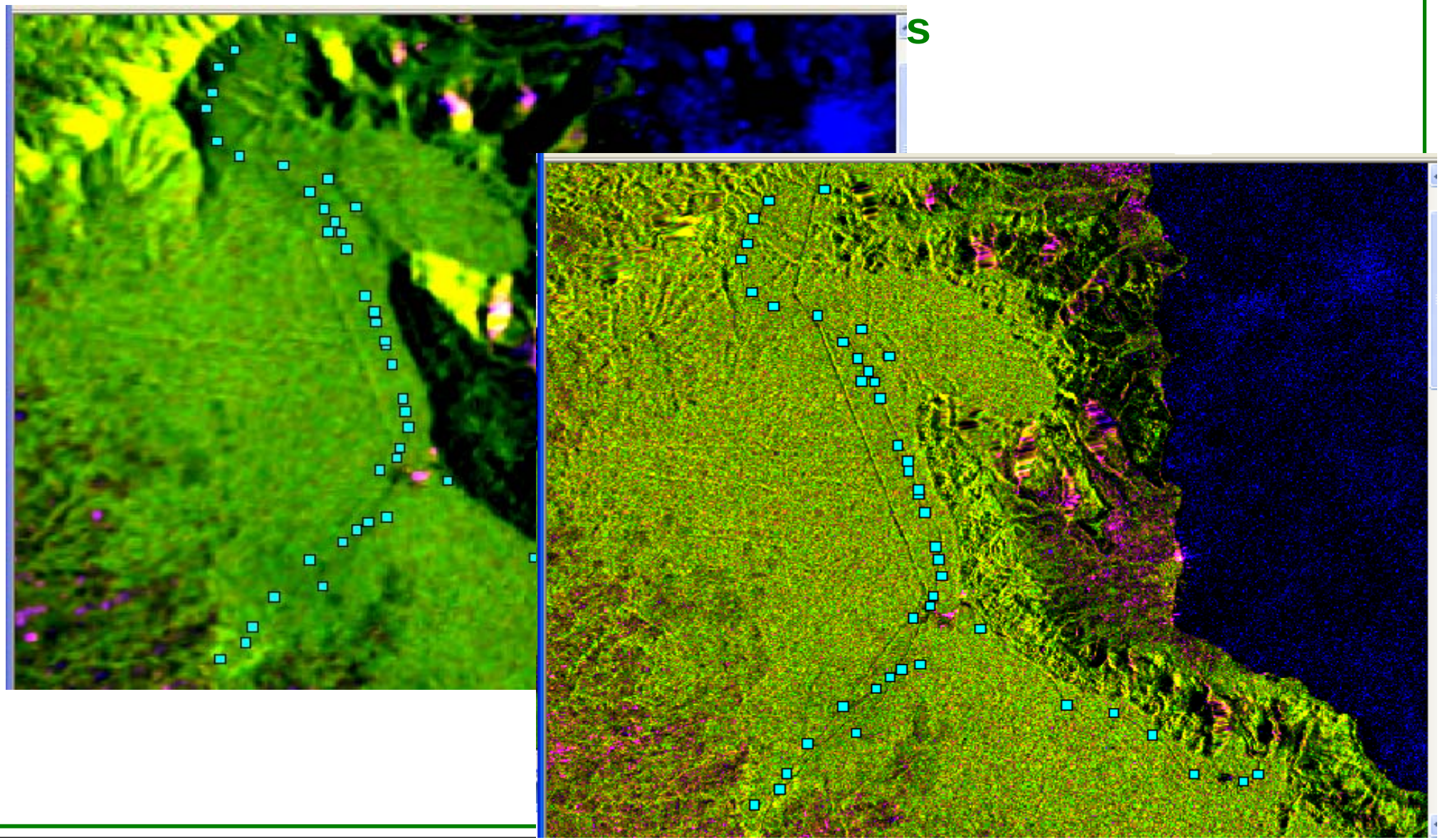
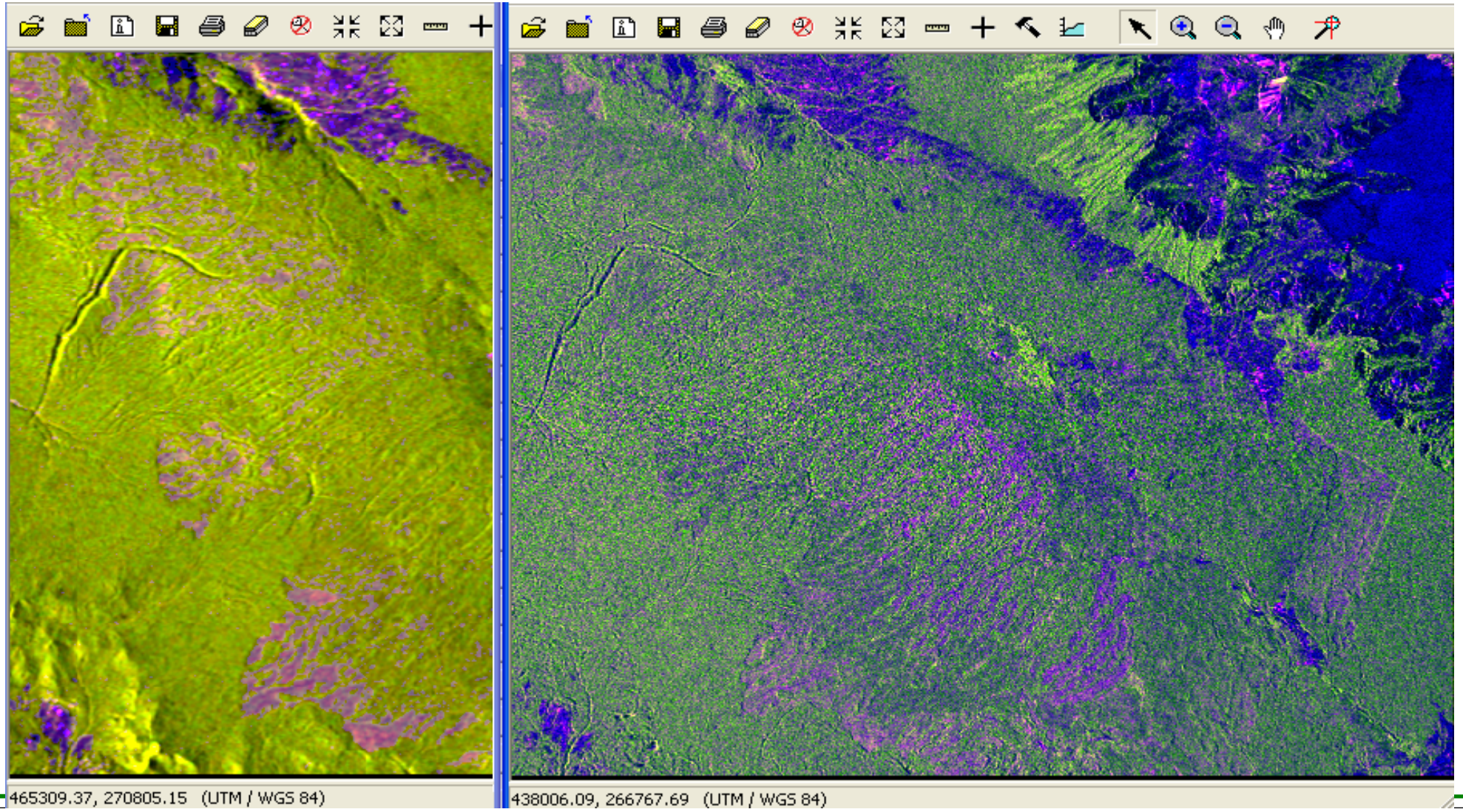
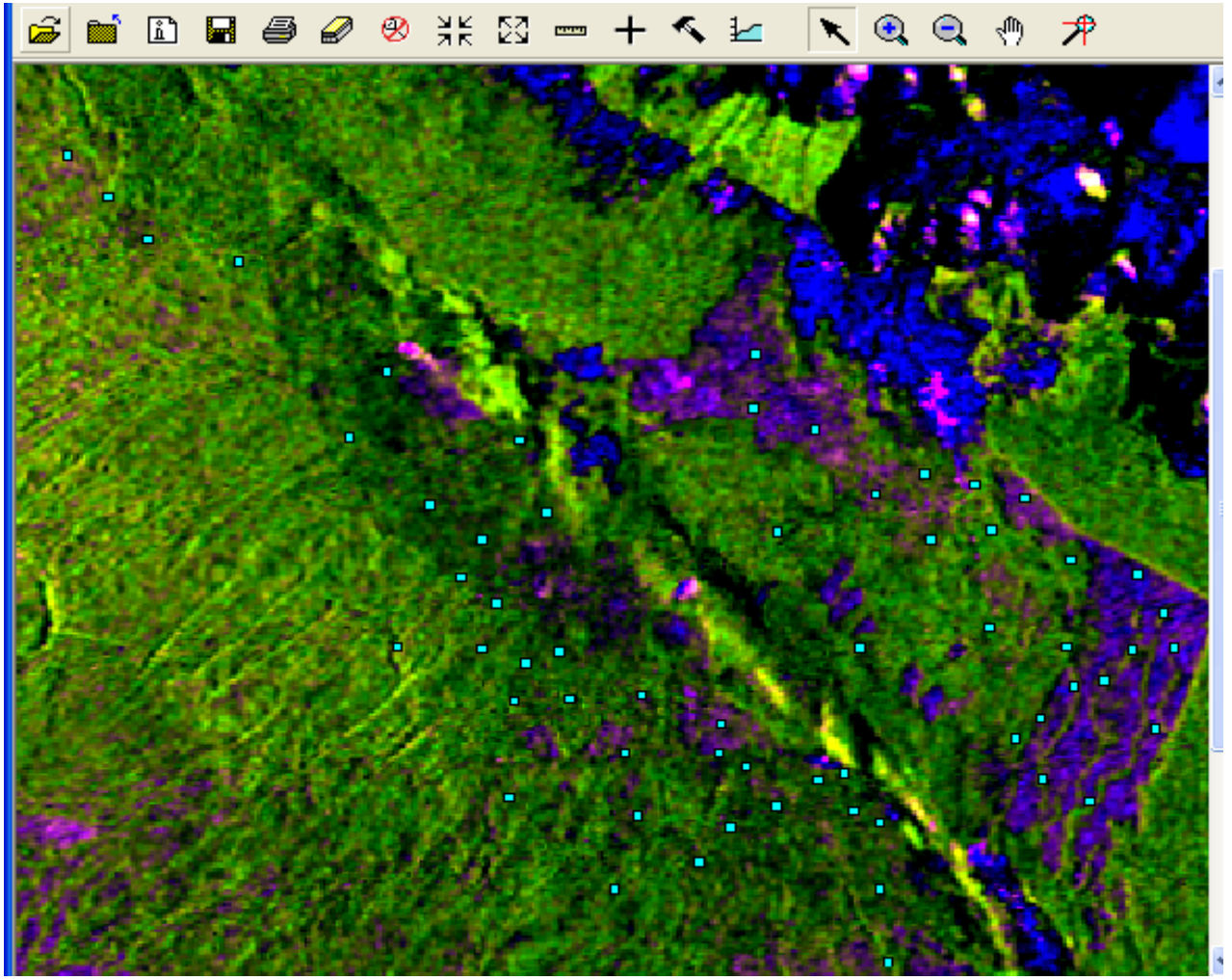


PLANTATION FOREST (EUC. GRANDIS)



GROUND PLOTS OF EUCALYPTUS FOREST PLANTATION

- 50 M
- 6.25 M



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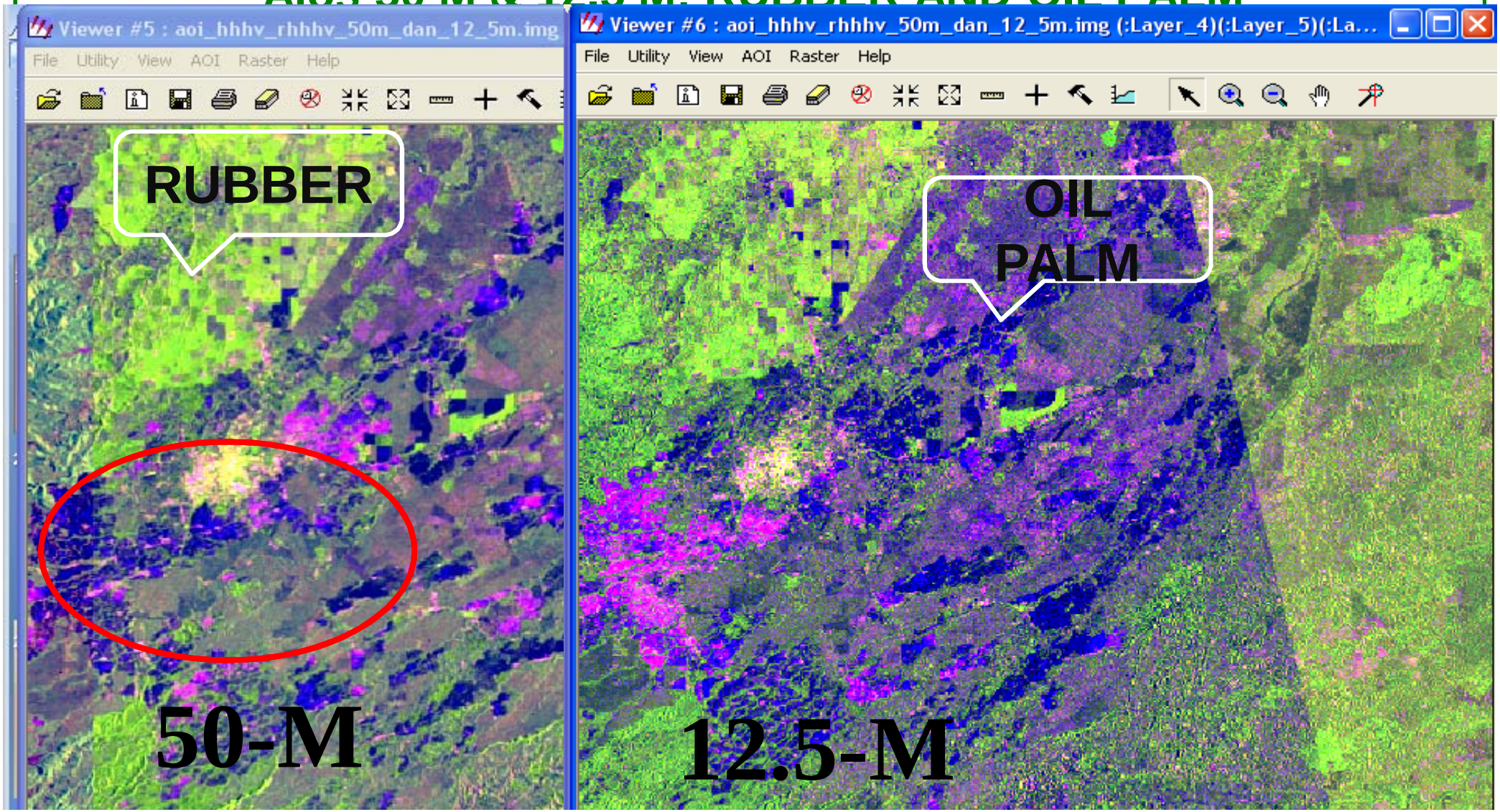
Alos 50 M & 12.5 M: RUBBER AND OIL PALM



ALOS

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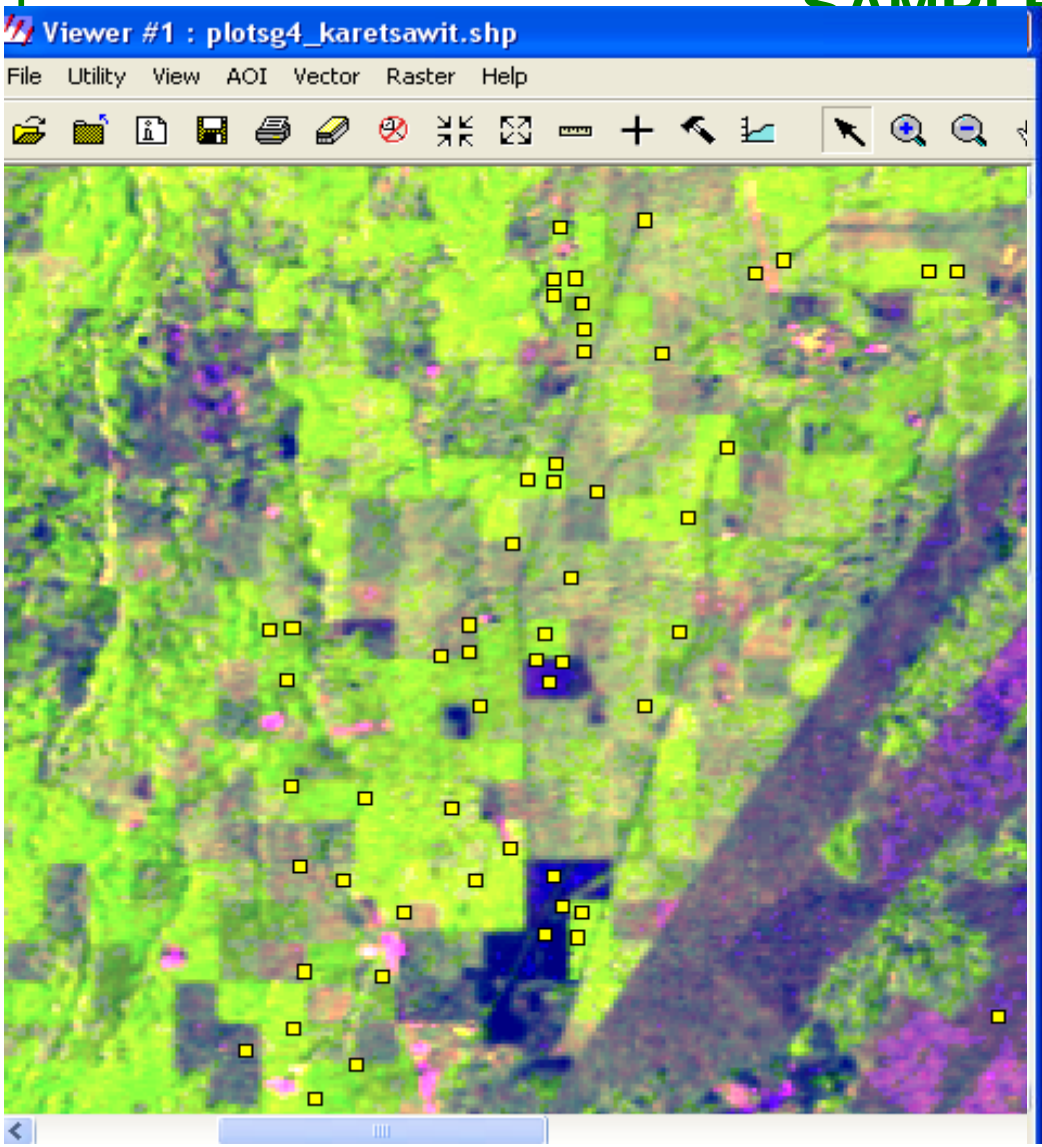
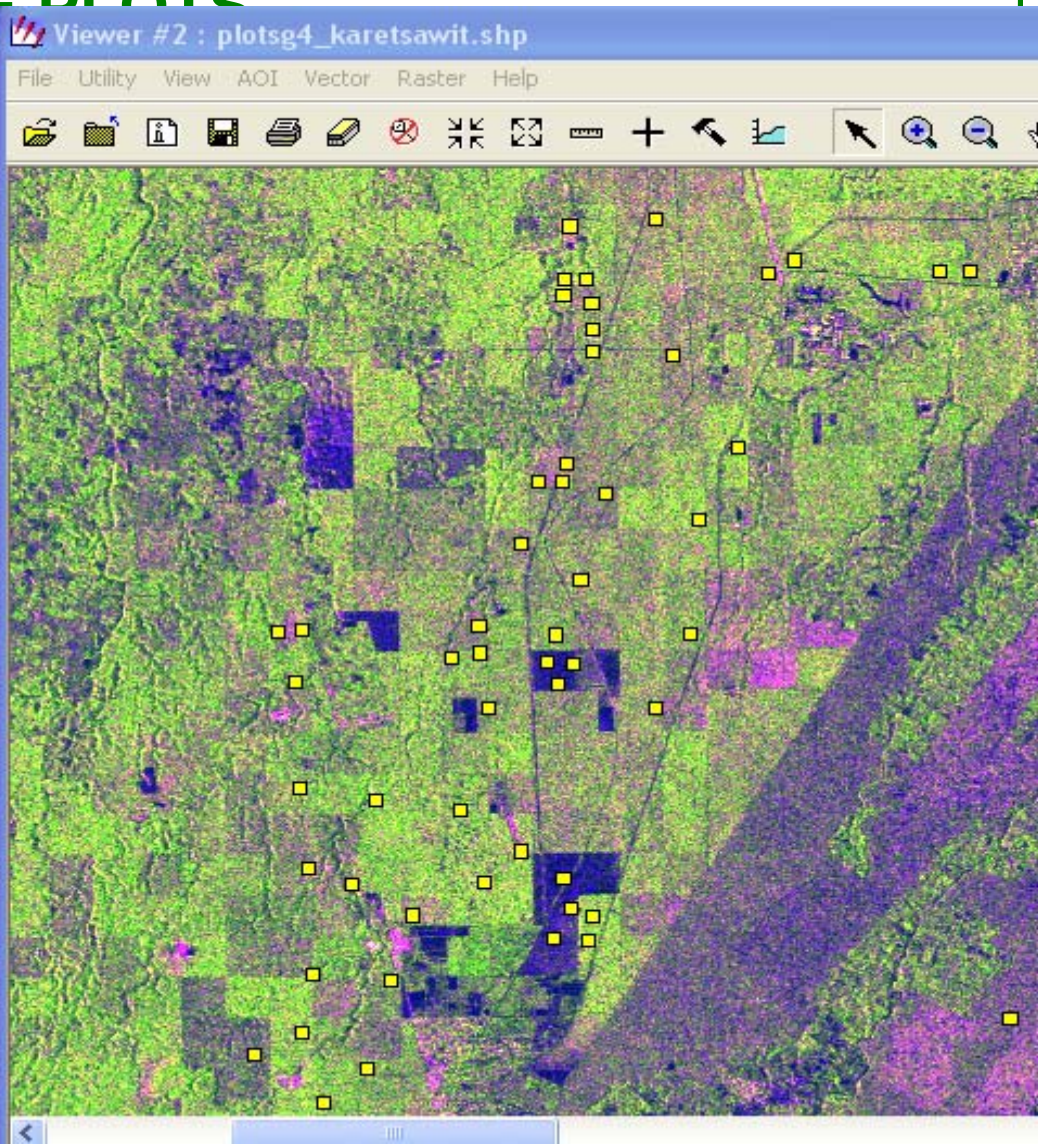
SAMPLE PLOTS





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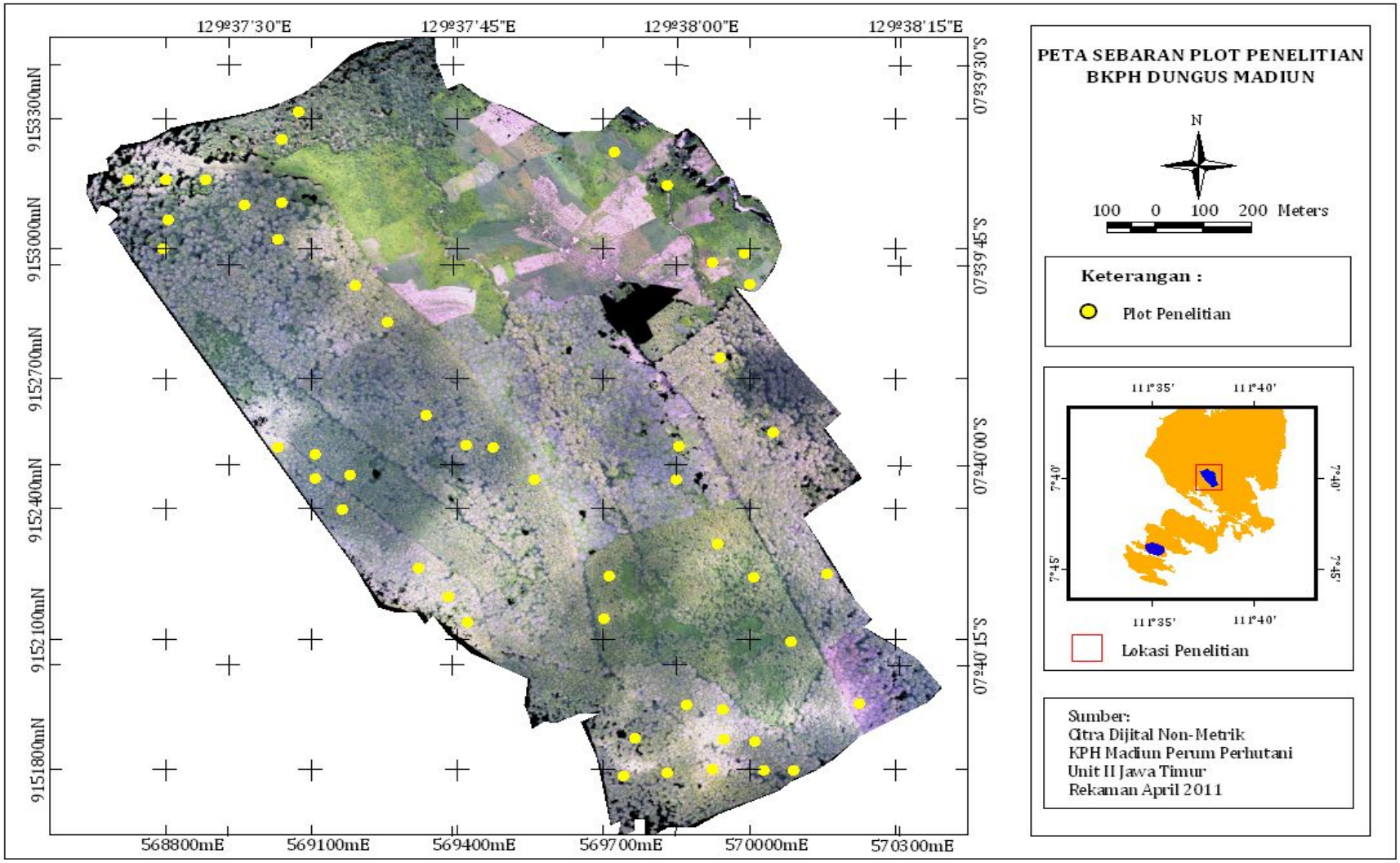
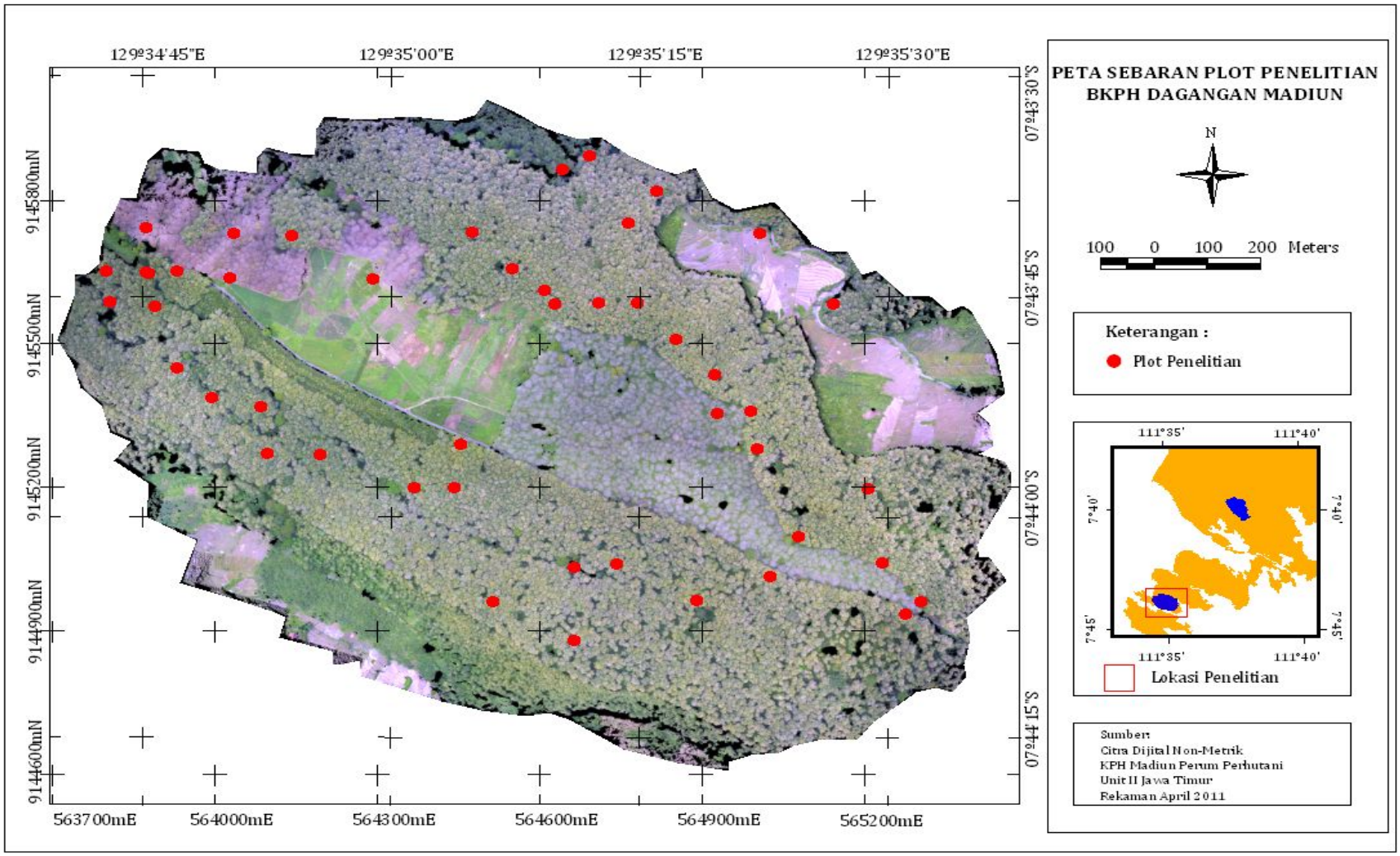
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