JAXA's MRV
- current status and future envision -

Masanobu Shimada

Japan Aerospace Exploration Agency
Earth Observation Research Center

MRV symposium at Tokyo Forum
Feb. 17, 2011

- Concept
- Satellite data
- Data analysis: system correction and radar backscatters
  - Definiens and SVM
  - Validation
- Convert to the Biomass and Carbon
- Remarks in future
- Summary

MRV system

Necessary steps for MRV

1. Satellite Observation (remote sensing) and classification for the land use and land use changes
2. Ground truth data collection (LULUCF and biomass)
3. Estimation of Biomass or carbon as 1. x 2.
   Several models exist

1. Use the matured remote sensing method for the classification in several classes

JAXA's approach for MRV establishment

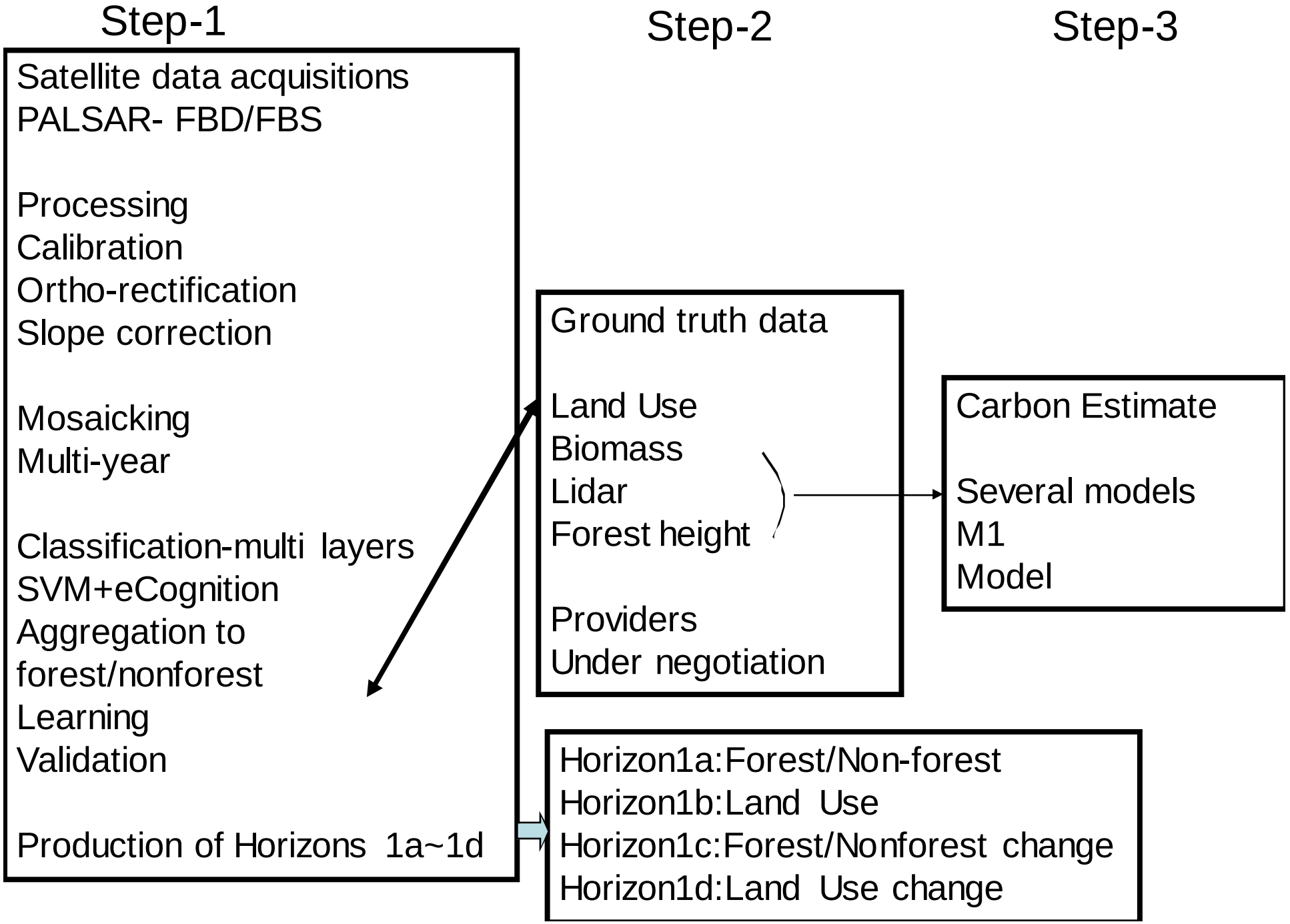
- Fully utilize the L-band SAR data archives (JERS-SAR and PALSAR) - time series analysis and complementally supported by the optical data.

- Goals:

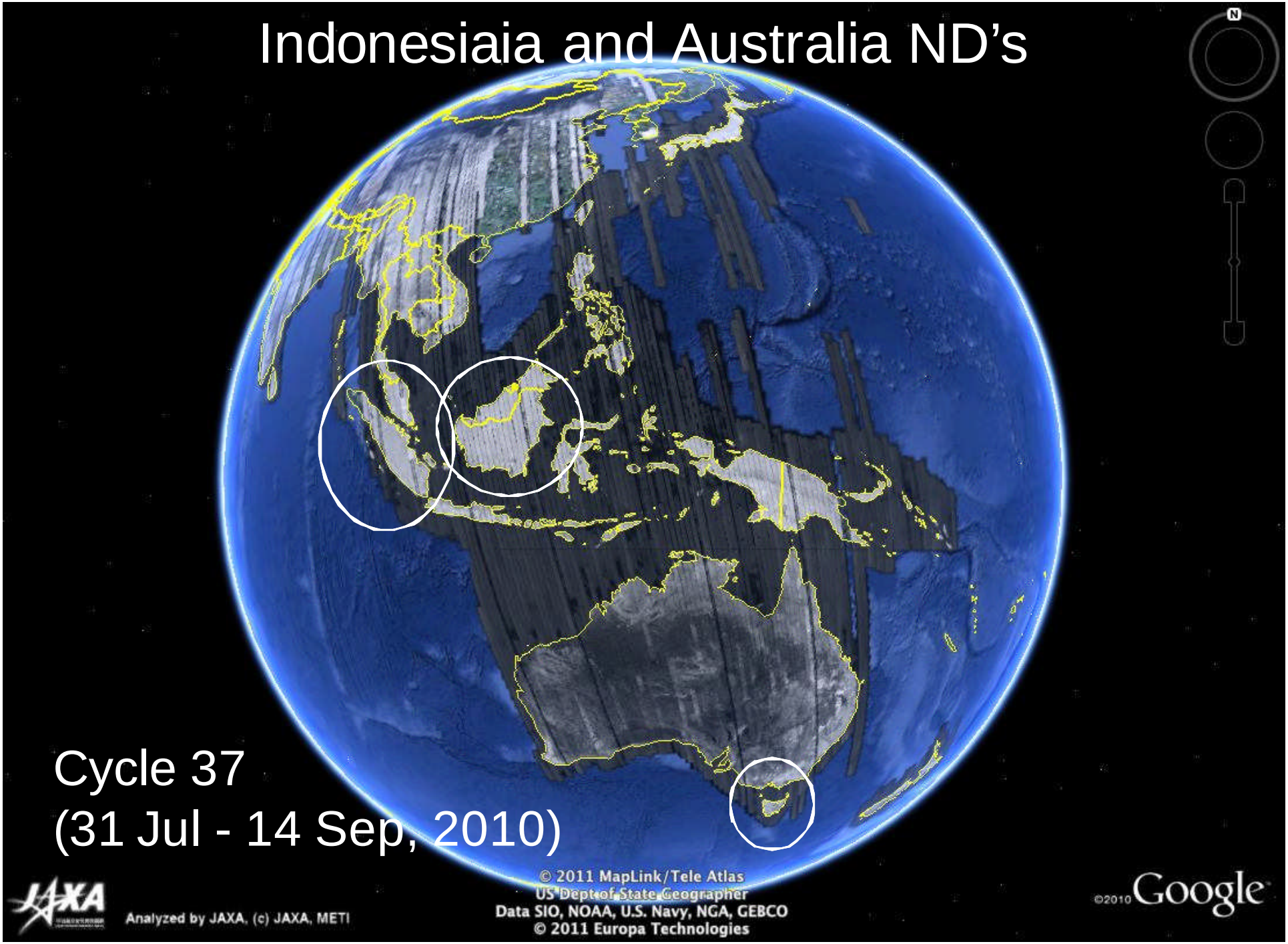
- Global Forest/Non-forest, Land use and their changes and the related carbon values

- Validate the products at the validation sites, i.e., Sumatra, Borneo and several test sites (.i.e., Riau province)

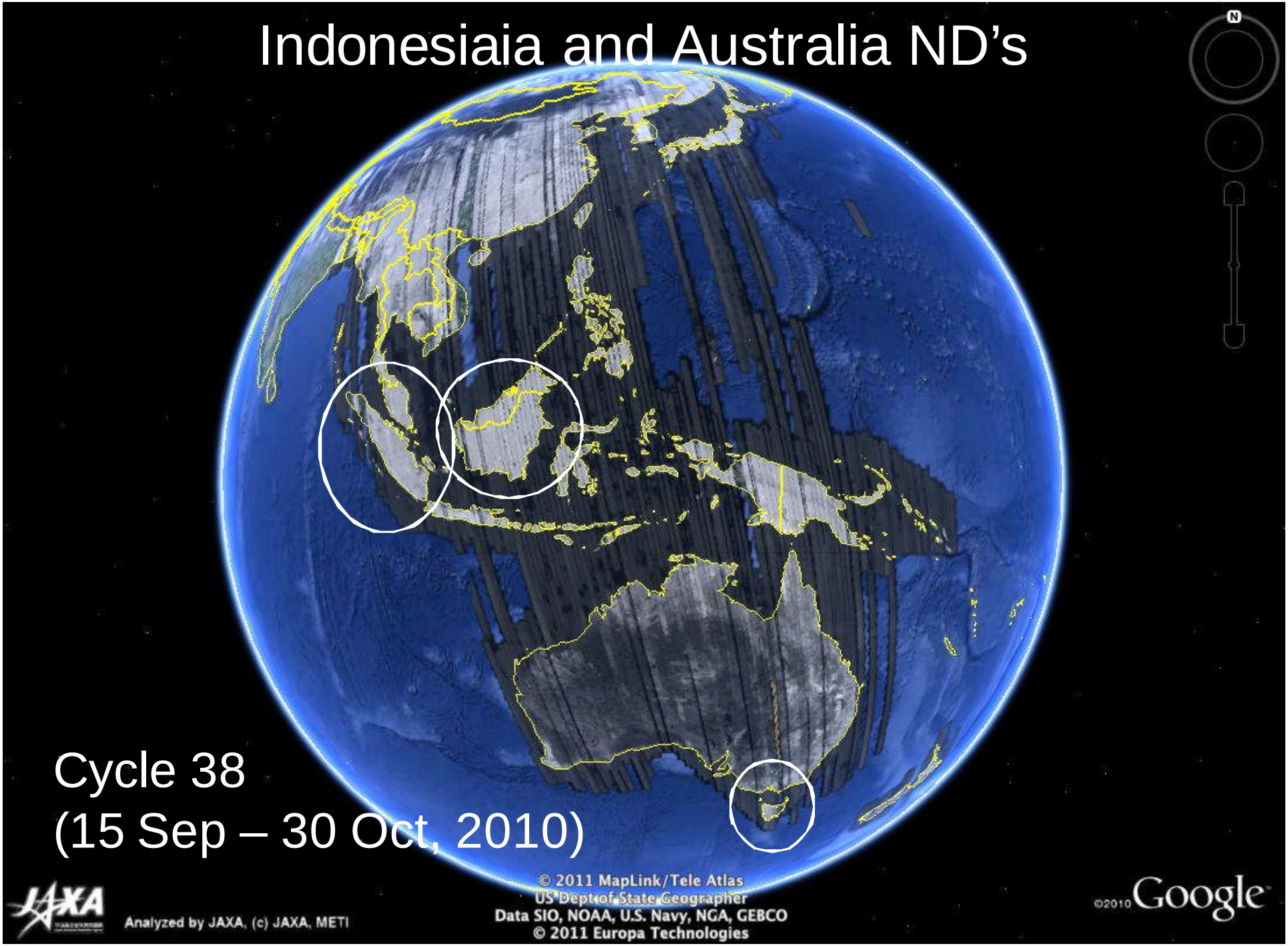
- Use the ALOS/PALSAR as the main sensor


Step-1
Step-2
Step-3
Satellite data acquisitions
PALSAR- FBD/FBS
Processing
Calibration
Ortho-rectification
Slope correction
Mosaicking
Multi-year
Classification-multi layers
SVM+eCognition
Aggregation to
forest/nonforest
Learning
Validation
Production of Horizons 1a~1d
Ground truth data
Land Use
Biomass
Lidar
Forest height
Providers
Under negotiation
Carbon Estimate
Several models
M1
Model
Horizon1a:Forest/Non-forest
Horizon1b:Land Use
Horizon1c:Forest/Nonforest change
Horizon1d:Land Use change

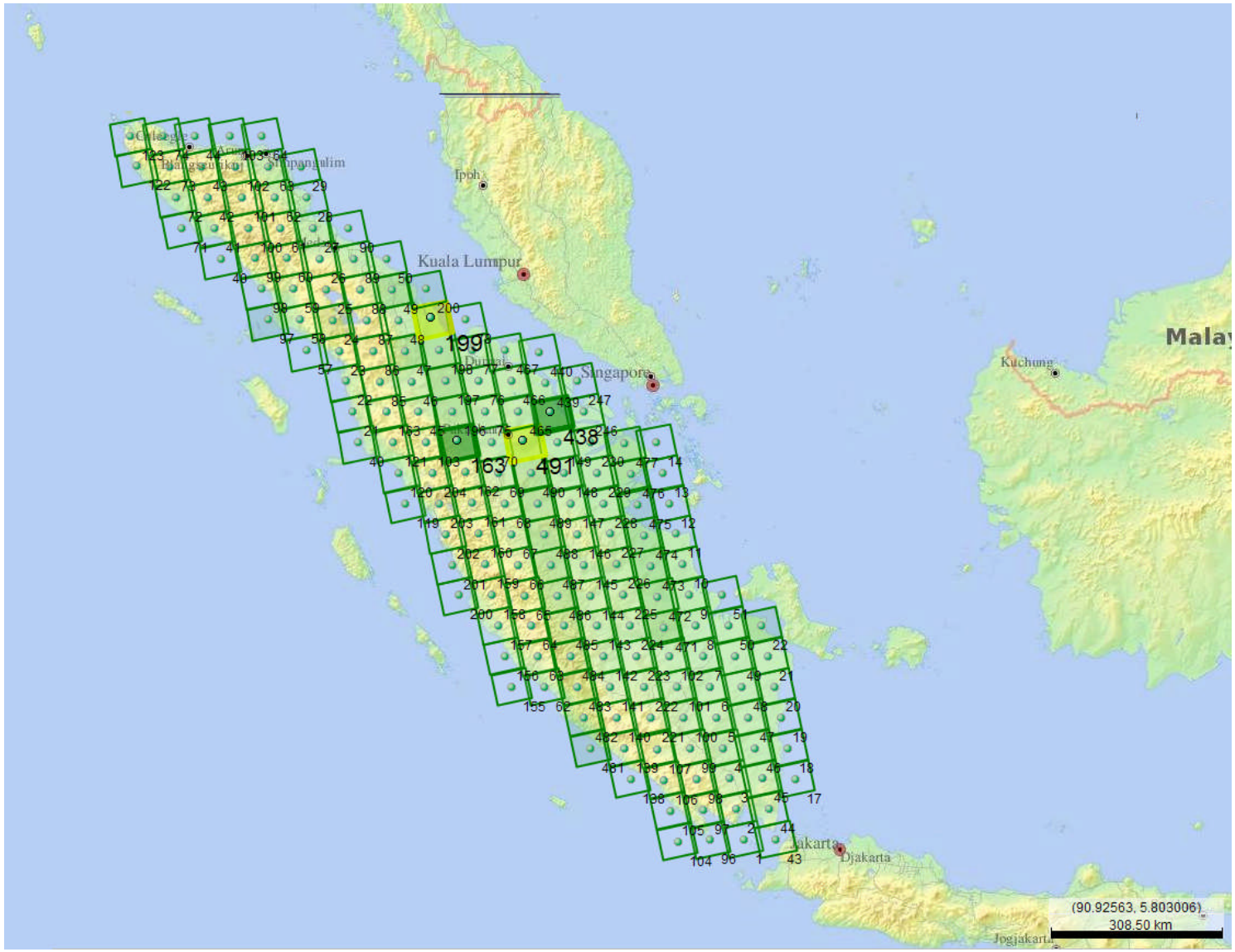
Indonesiaia and Australia ND's



Indonesiaia and Australia ND's



1) Sumatra/PALSAR



Essential components for SAR data analysis

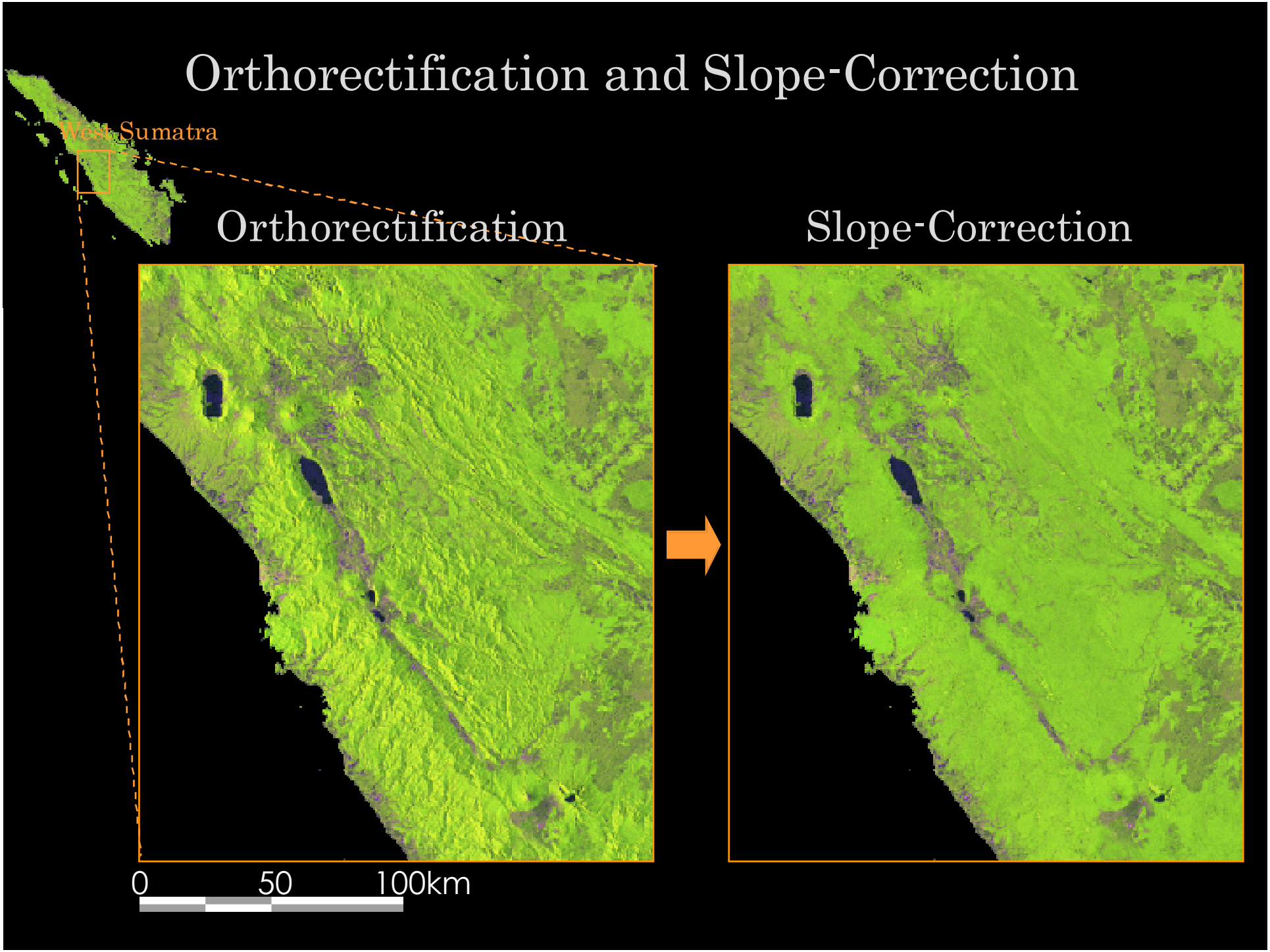
Radiometric slope correction

Needs high accuracy DEM

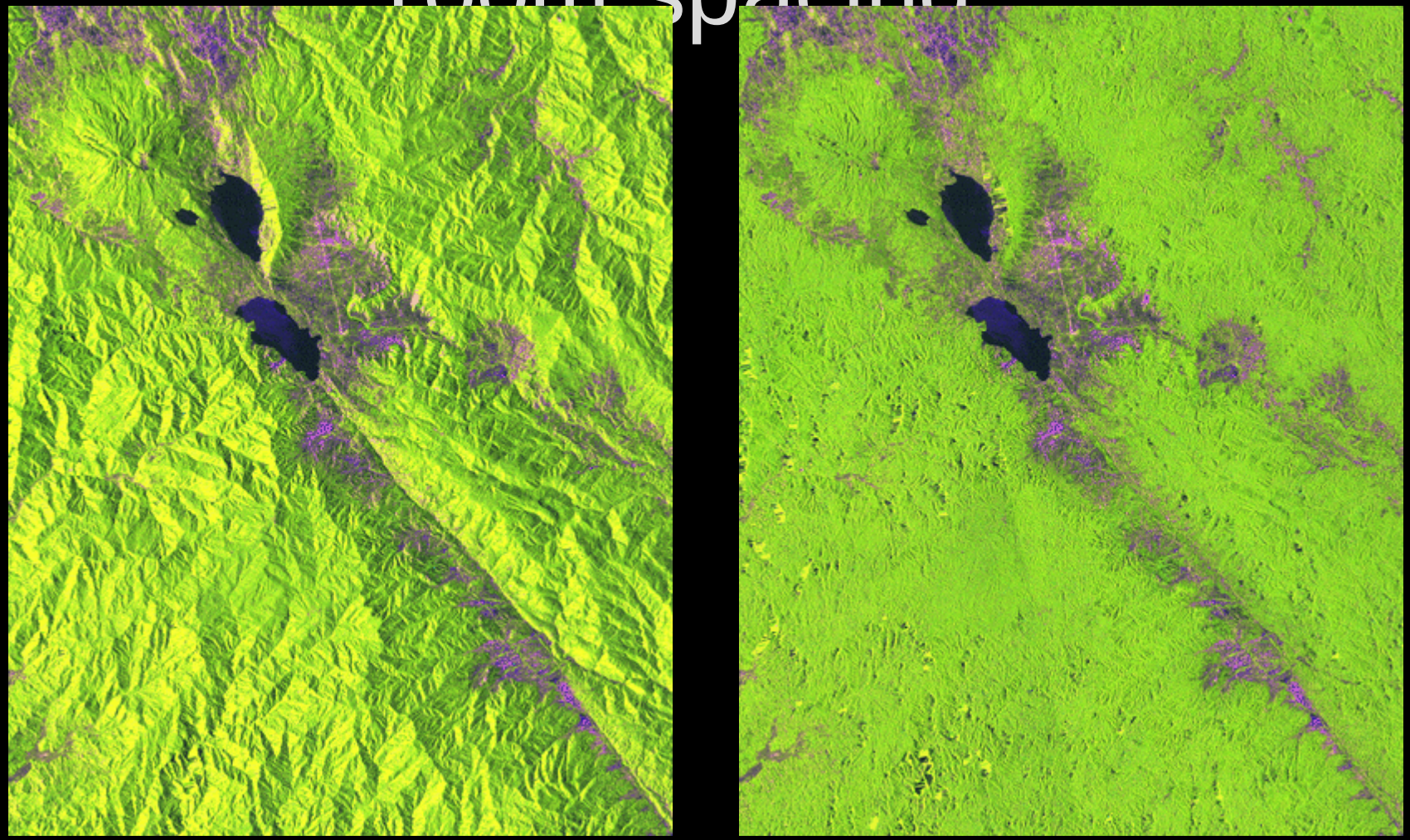
Ortho-rectification

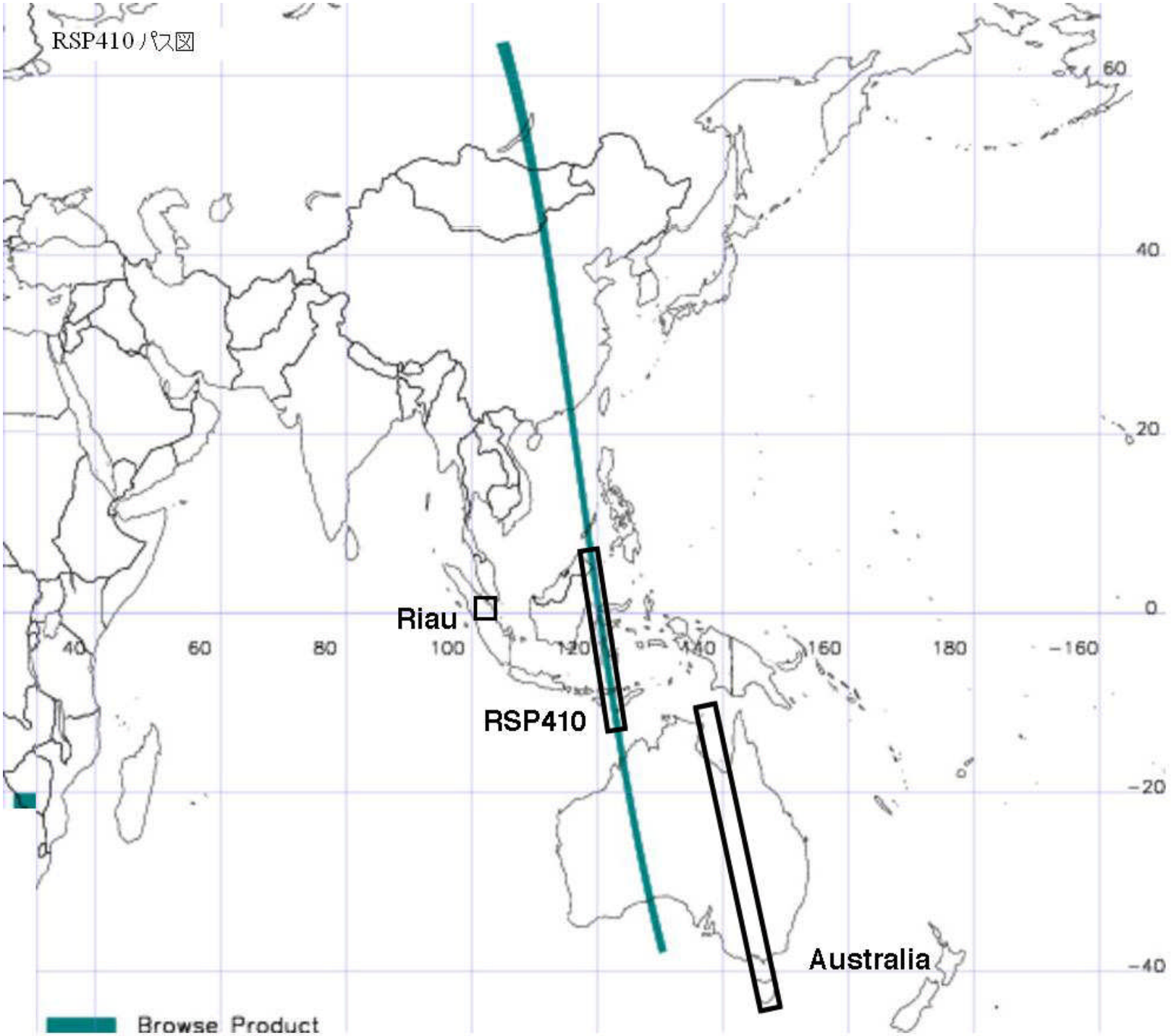
Needs accurate Doppler and range shift model depending on the DEM

Orthorectification and Slope-Correction



100m spacing




RSP410パス図
60
40
20
0
-20
-40
40
60
80
100
120
140
160
180
-160
Riau
RSP410
Australia
Browse Product

Geometric accuracies

Co-registration: 0.261,0.277

Accuracy: 34.14: Landsat-mosaic
Accuracy: 11.00:CR-mosaic

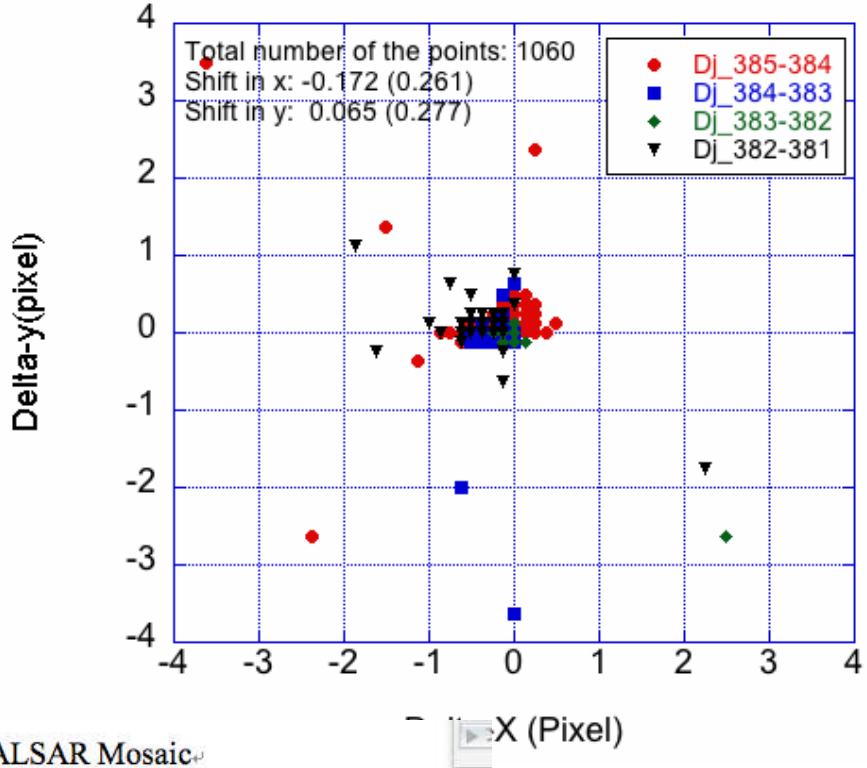


Table IV Summary of Geolocation RMSE of the JAXA PALSAR Mosaic

Area	Northing RMSE (m)	Easting RMSE (m)	Total RMSE (m)	No. of GCPs
Japan (2007)	22.81(-112.9,43.8)	34.20(-114.2,69.9)	41.11(0.0,119.3)	104
Borneo-Jawa (2007)	23.13(-76.7,71.1)	32.15(-94.5,49.4)	39.61(0.0,98.0)	104
Sumatra (2007)	27.98(-96.9,65.8)	30.03(-86.3,60.7)	41.05(0.0,129.8)	70
Philippine (2007)	17.19(-35.67,35.66)	16.86(-26.89,33.23)	24.08(0.48,43.56)	49
Philippine (2009)	22.83(-54.90,74.90)	29.34(-75.18,39.54)	37.17(0.02,98.39)	101
Borneo-Jawa (2009)	24.79(-62.75,71.95)	30.23(-79.32,26.33)	39.09(0.0,85.42)	83
Sumatra (2009)	26.42(-50.9,67.1)	32.99(-131.9,39.7)	42.26(0.0,131.9)	83
Japan (2009)	26.46(-55.8,52.3)	33.26(-90.0,61.3)	42.50(0.0,99.8)	69
Indochina (2009)	27.96(-52.5,72.9)	30.60(-92.8,75.5)	41.45(0.0,118.0)	89
Central Africa (2008)	24.30(-46.7,47.4)	21.16(-48.2,42.3)	32.22(2.9,63.0)	131
Central Africa (2009)	16.52(-35.17,30.81)	16.20(-39.16,35.88)	23.14(2.73,44.36)	147
Sulawesi (2007)	17.01(-35.14,31.79)	15.44(-30.68,37.59)	22.98(2.30,43.27)	68
Sulawesi (2009)	15.38(-33.76,33.74)	16.21(-41.20,34.76)	22.35(0.85,45.16)	67
Australia (2009)	19.66(-44.41,30.90)	18.91(-41.28,48.26)	27.28(2.35,58.44)	218
All	22.35	25.81	34.14	1393

Note: The numbers in brackets represent the minimum and maximum values respectively.

1) Land Use classification -1

Land Use classification

Target area: Sumatra, Borneo and the others

Method : SVM (Nicolas Long´ep´e, Preesan Rakwatin, Osamu Isoguchi, **M. Shimada**, Yumiko Uryu, "Assessment of ALOS PALSAR 50m Orthorectified FBD Data for Regional Land Cover Classificationby using Support Vector Machines," IEEE Trans. GRS, in presss.)

Data: PALSAR data 50m resolution web based dataset for 2007 and 2009

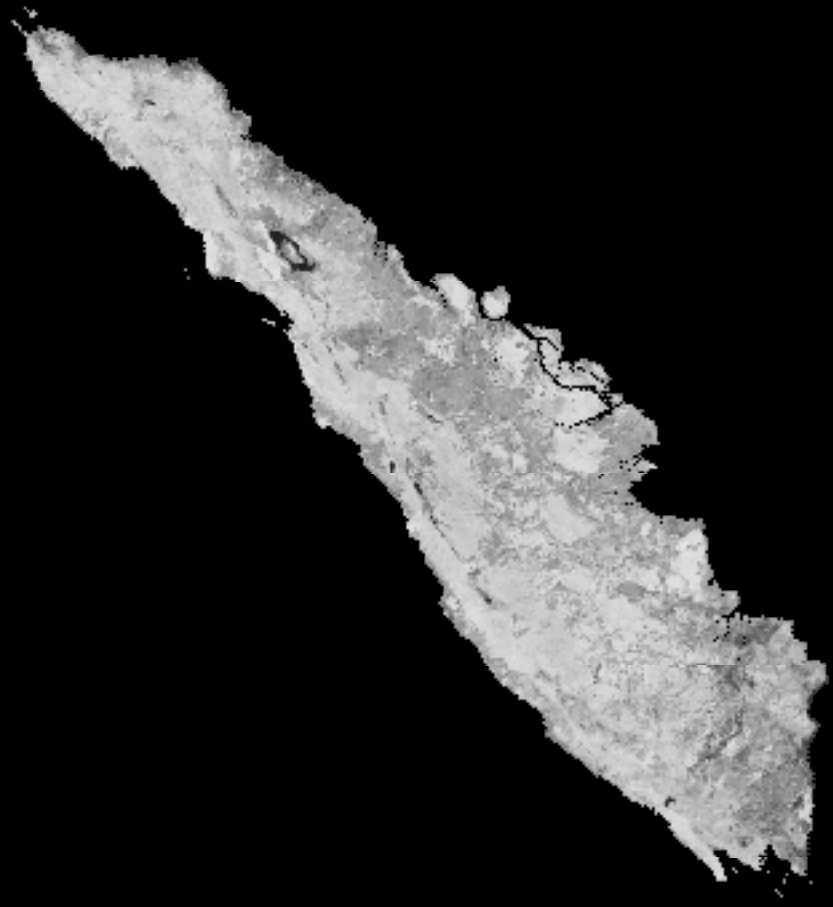
DEM: SRTM3 (90 m resolution)

Training data: provided by WWF for Riau province of Sumatra

Mosaic Product Example (Sumatra 2009)

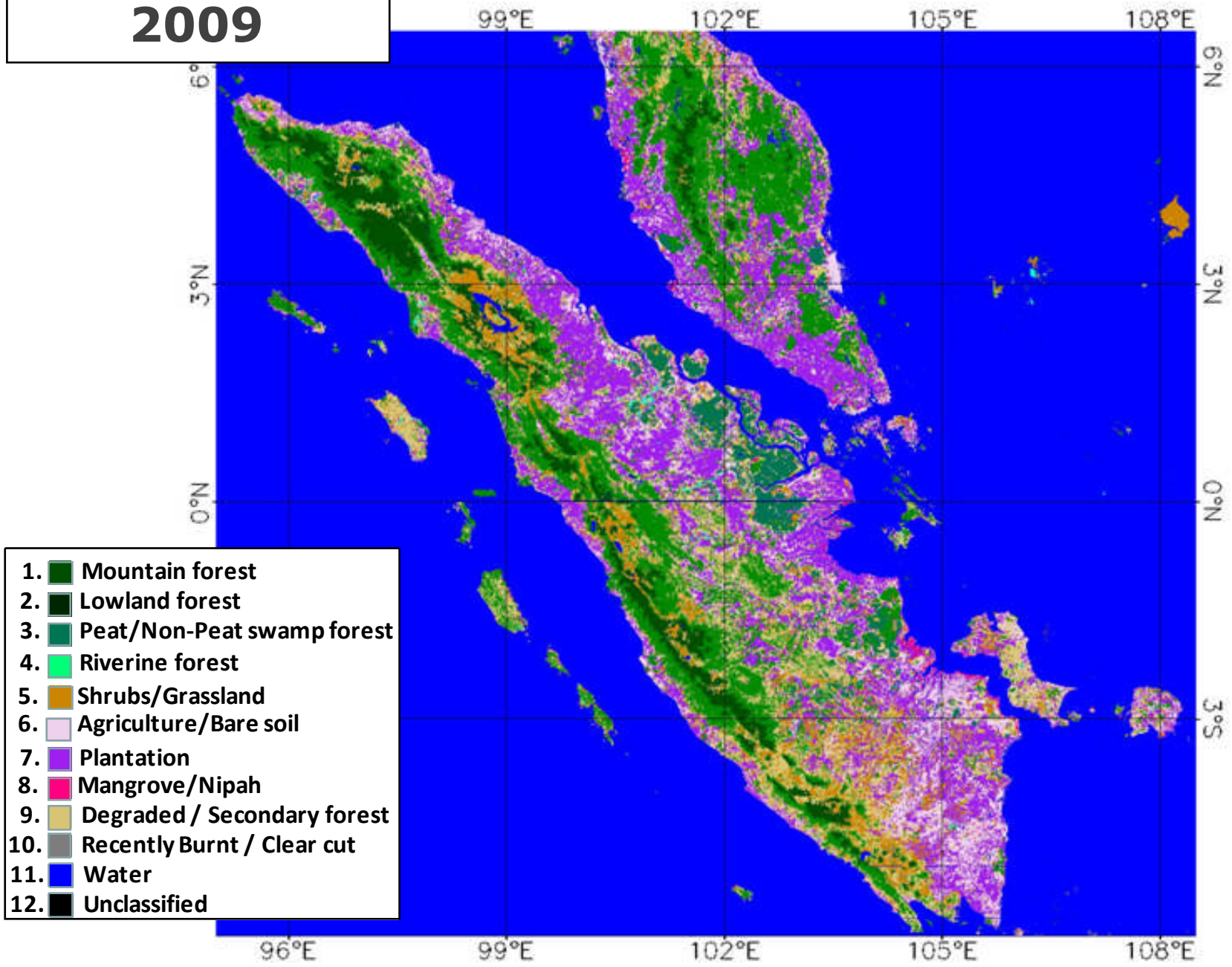
1) Slope-Corrected Mosaic (HH)

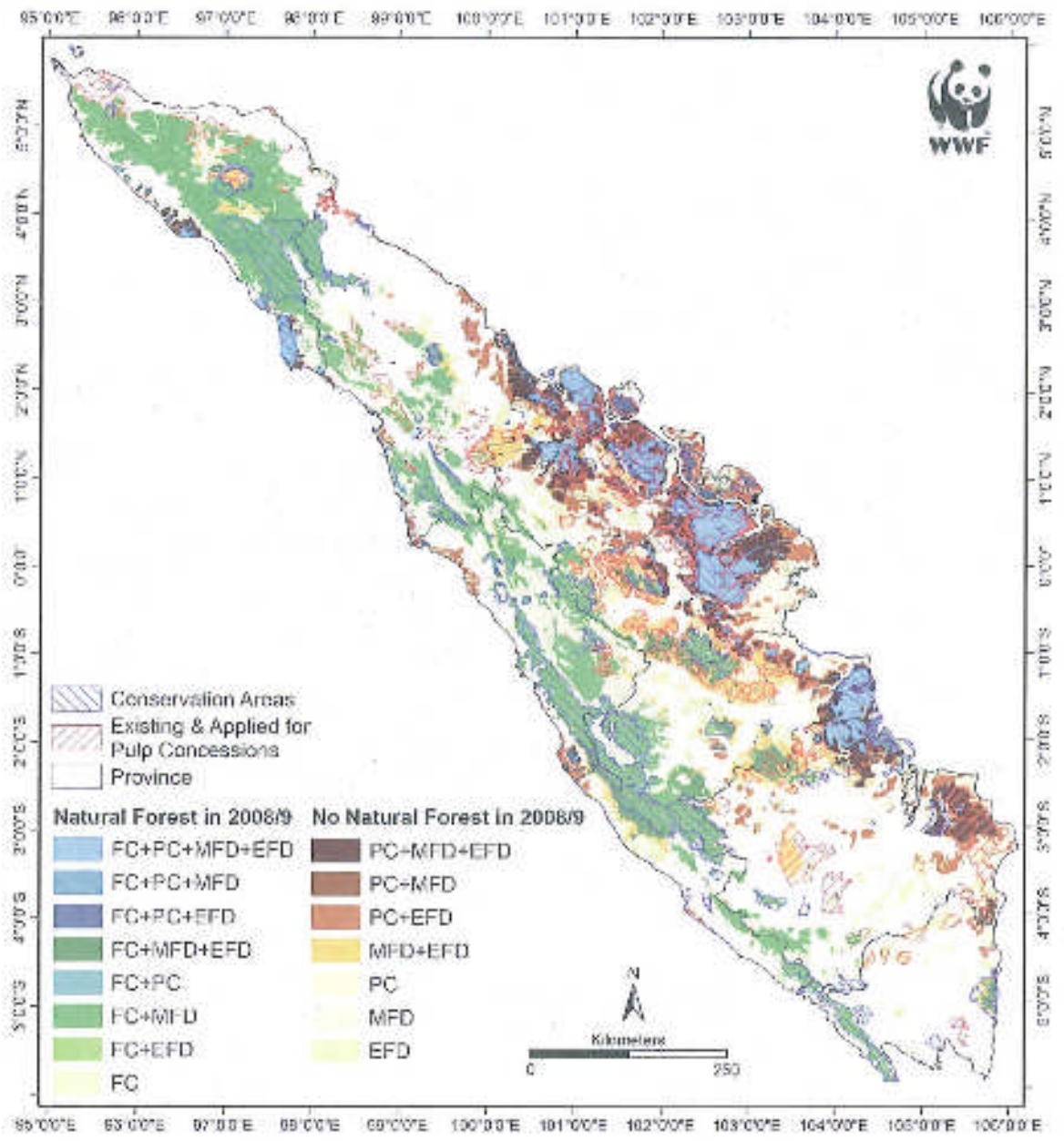
2) Slope-Corrected Mosaic (HV)



SUMATRA 2009

Land use (horizon 1b)





Courtesy to WWF

ESTIMATION RESULT: Across Sumatra 2009 2/2

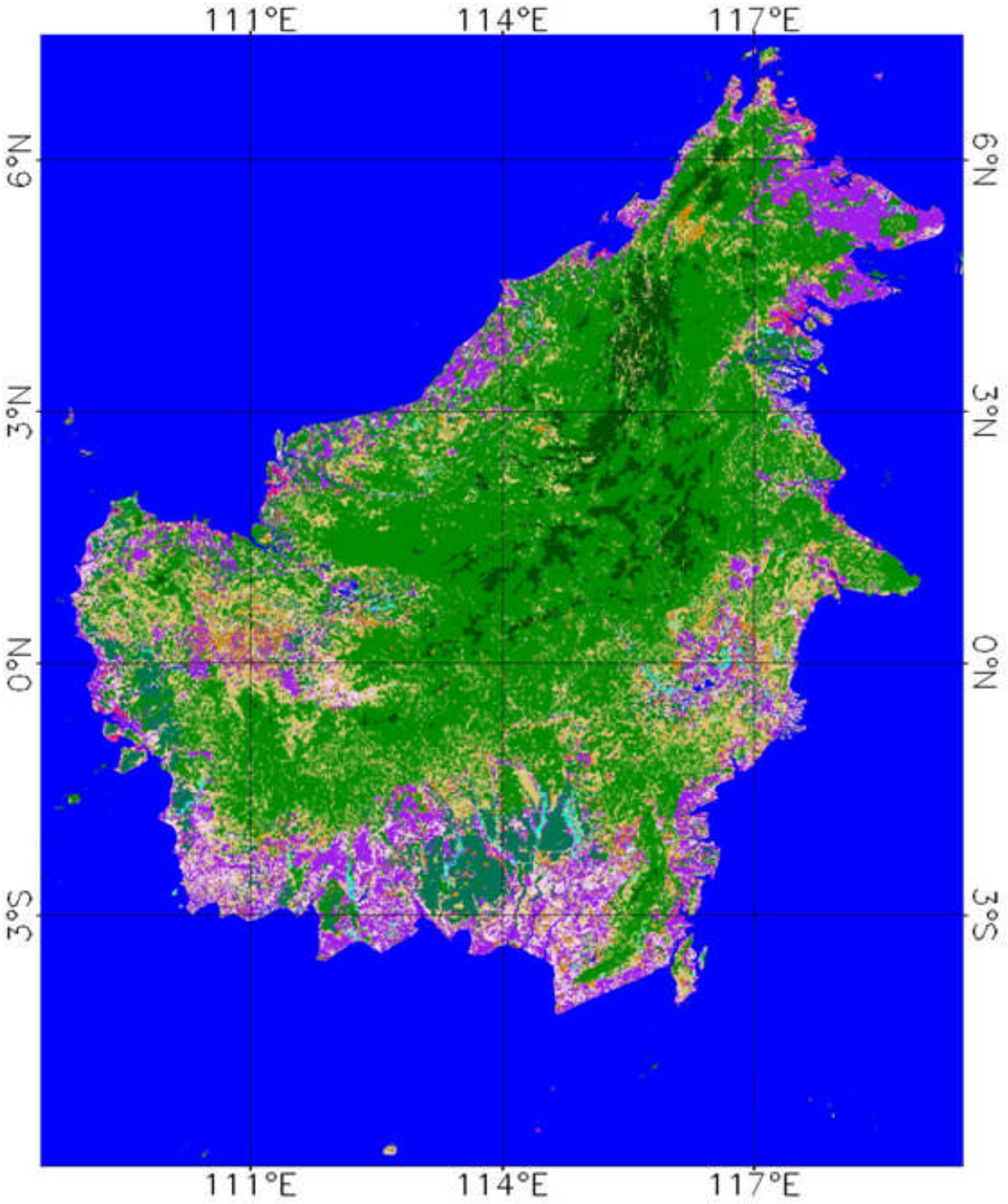
Overall Accuracy 83.5 %

		WWF		User Accuracy
		Non-Natural Forest	Natural Forest	
JAXA	Non-Natural Forest	82.4 %	16.0 %	68.2 %
	Natural Forest	17.6 %	84.0 %	92.0%

Overall Accuracy 82.2 %

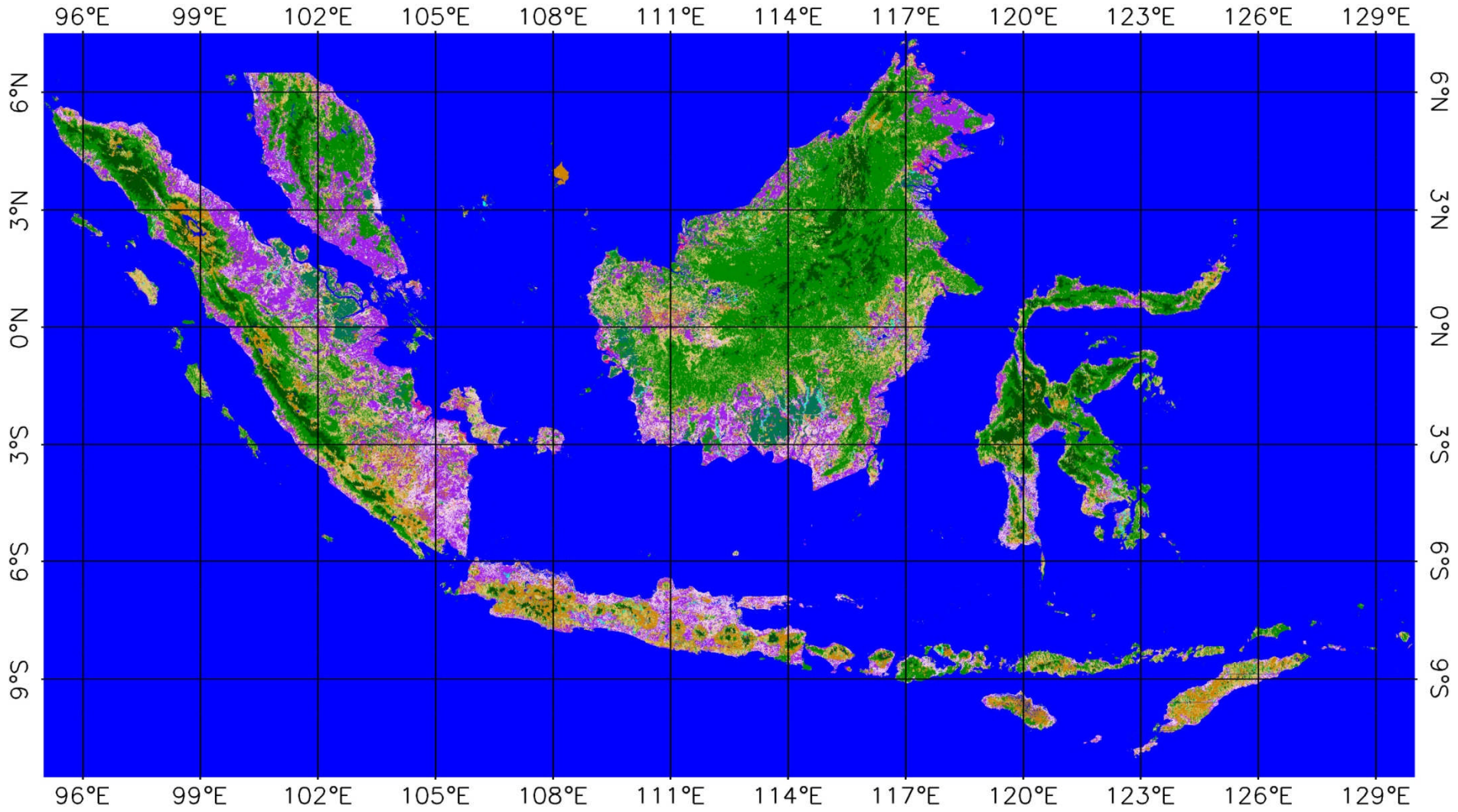
		WWF				User Accuracy
		Natural Forest	Natural Forest on Swampy	Mangrove Forest	Non-Forest	
JAXA	Natural Forest	86.5 %	21.3 %	1.6 %	13.5 %	64.4 %
	Natural Forest on Swampy	0.4 %	58.0 %	2.3 %	2.2 %	65.8 %
	Mangrove Forest	0.0 %	0.3 %	15.7 %	0.3 %	50.3 %
	Non-Forest	13.1 %	20.4 %	80.3 %	84.0 %	92.0 %

BORNEO 2009



1. Mountain forest
2. Lowland forest
3. Peat/Non-Peat swamp forest
4. Riverine forest
5. Shrubs/Grassland
6. Agriculture/Bare soil
7. Plantation
8. Mangrove/Nipah
9. Degraded / Secondary forest
10. Recently Burnt / Clear cut
11. Water
12. Unclassified

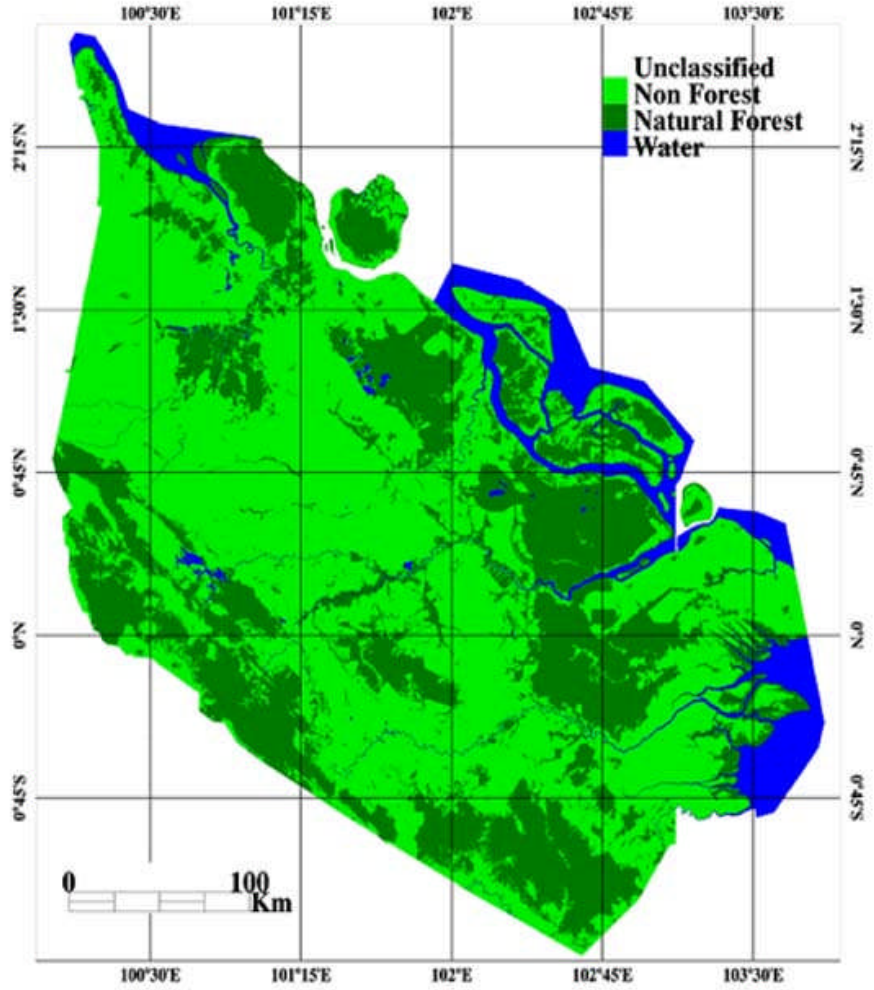
ESTIMATION RESULT : All Indonesia 2009



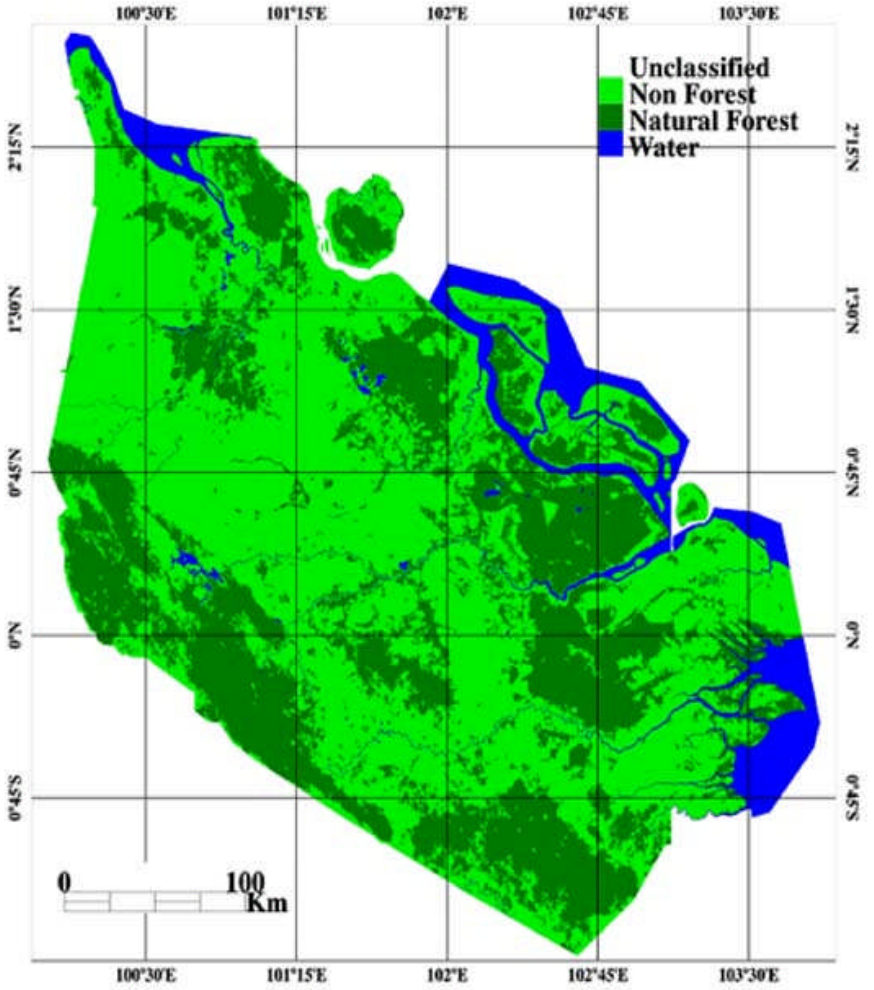
– Forest classification at 50m resolution over Riau province, Indonesia

  – Size: 102 178 km²
    40.871.201 pix. (86.5 %)

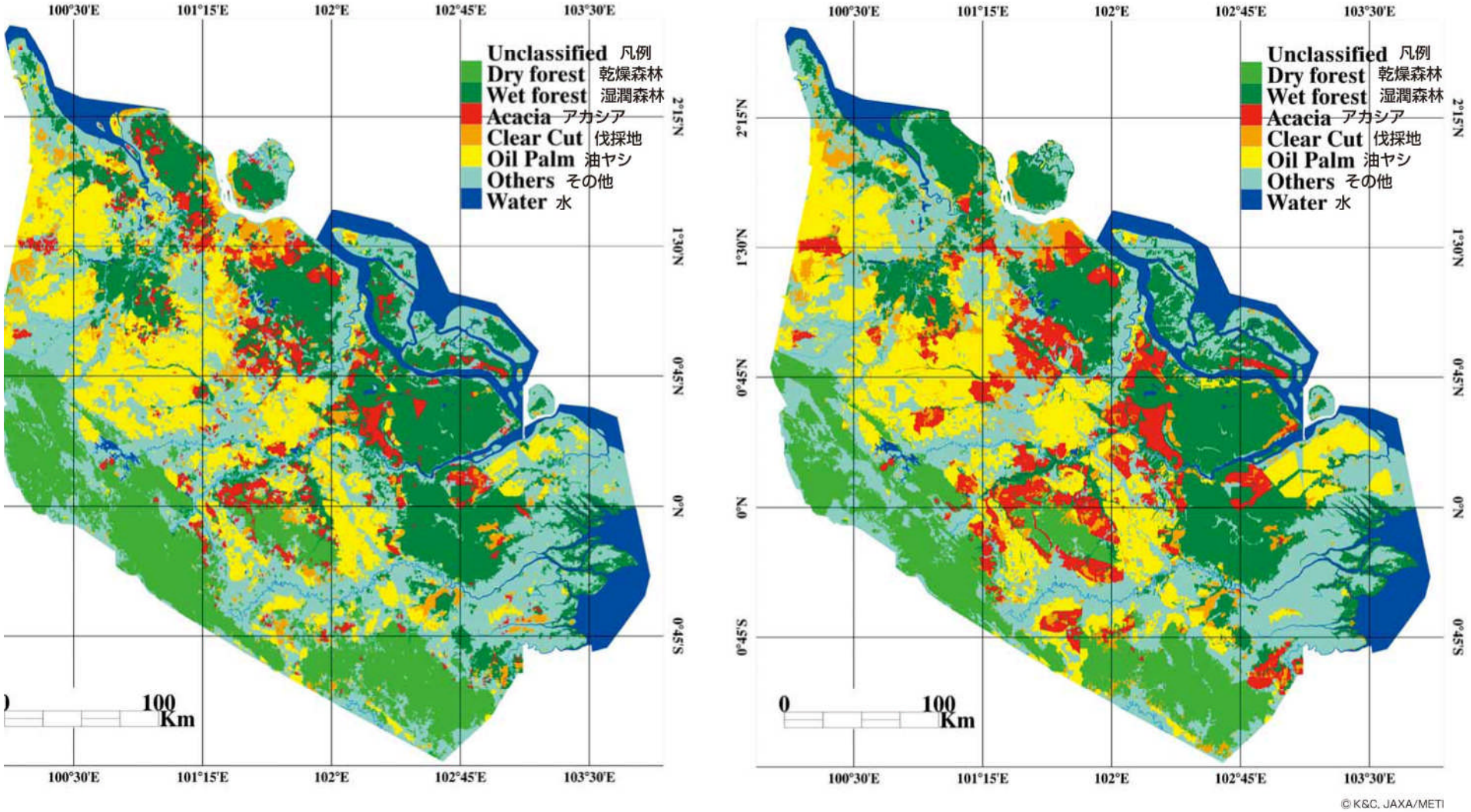
Accuracy 35.338.102 /



Landsat-based estimation



ALOS/PALSAR based map (v1.31)



ıre1: Left: Land cover classification based on automatic classification of 2007 ALOS PALSAR data
Right: Land cover classification based on manual interpretation of 2007 Landsat data (reference data set)

：左は 2007 年に ALOS/PALSAR のデータで自動分類された土地被覆分類、右は 2007 年に Landsat データ（参照データ）で手動分析された土地被覆分類。

Summary

- Systematic global observation using ALOS/PALSAR is under way.
- Land use classification accuracy using the calibrated SAR data is under evaluation. SVM gives higher accuracy than the segment based thresh-holding for forest/non-forest classification.

- Conversion from the forest land use to biomass is th next issue. (Next issue)

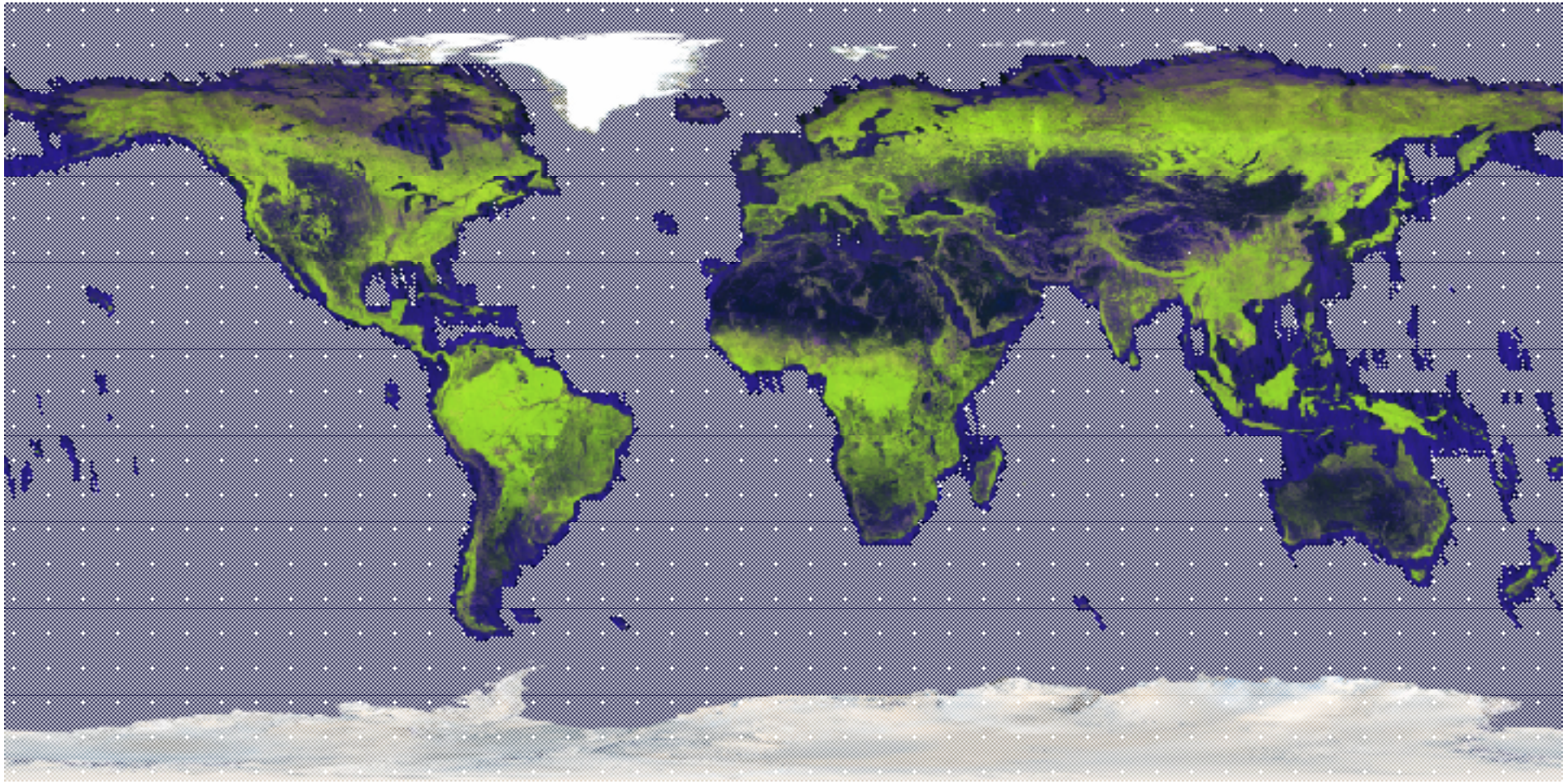
- Collection of the training dataset as well as biomass are important for MRV.

Global forest monitoring system using 18 year SAR dataset (JERS-1 SAR ~ ALOS/PALSAR)

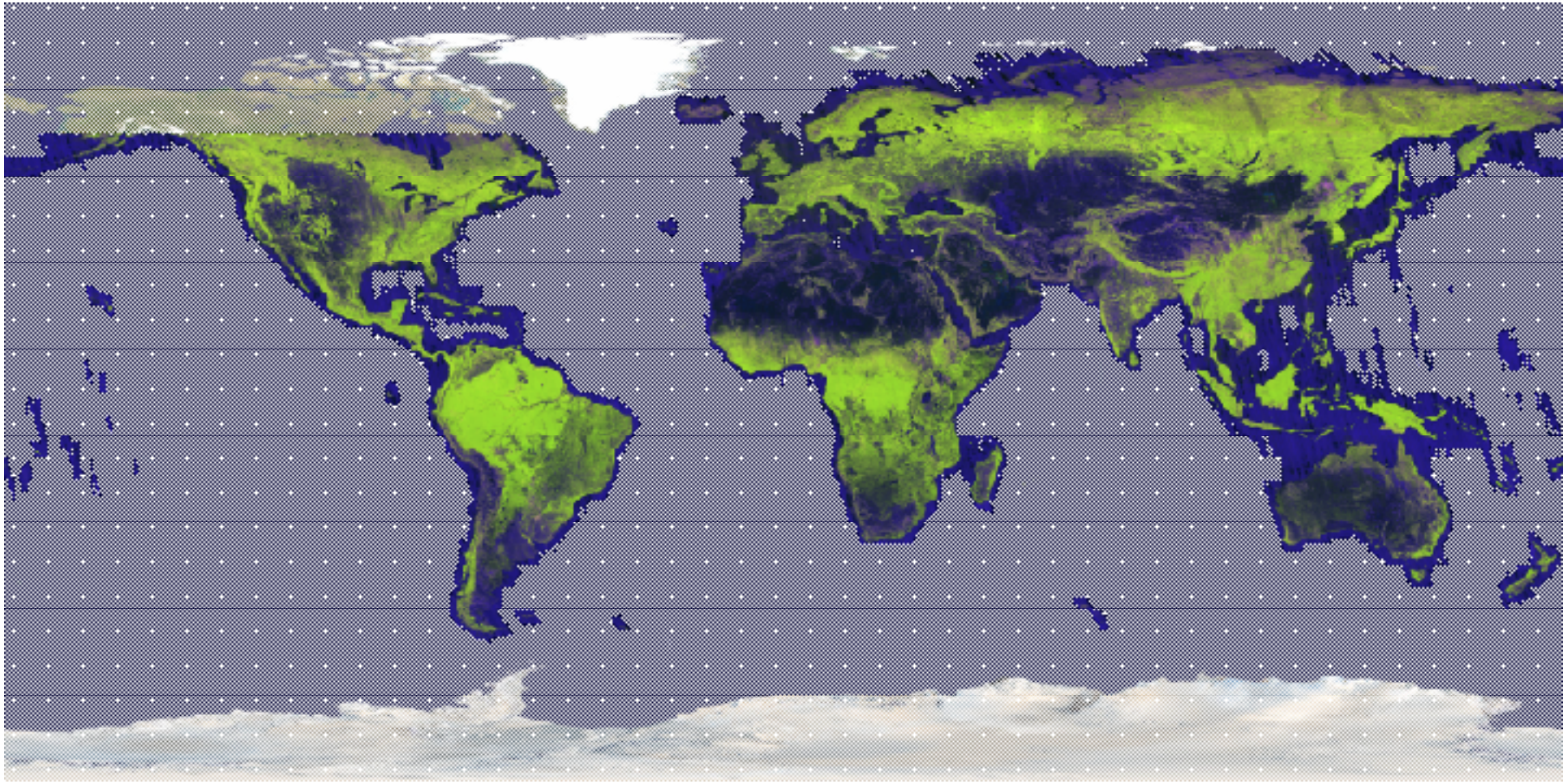
Product: Ortho-rectified and slope corrected high resolution global forestry data (**gamma-naught, classification, (biomass)**)

Resolution: **10m**
Sensor: JERS-1 SAR/ALOS-PALSAR
Reprocessing all the EORC/JAXA SAR archives
Dates: 1994-1996-1998~2007,2009
Products:**Horizon1/2 + Mosaic**
Aug. E, 2010

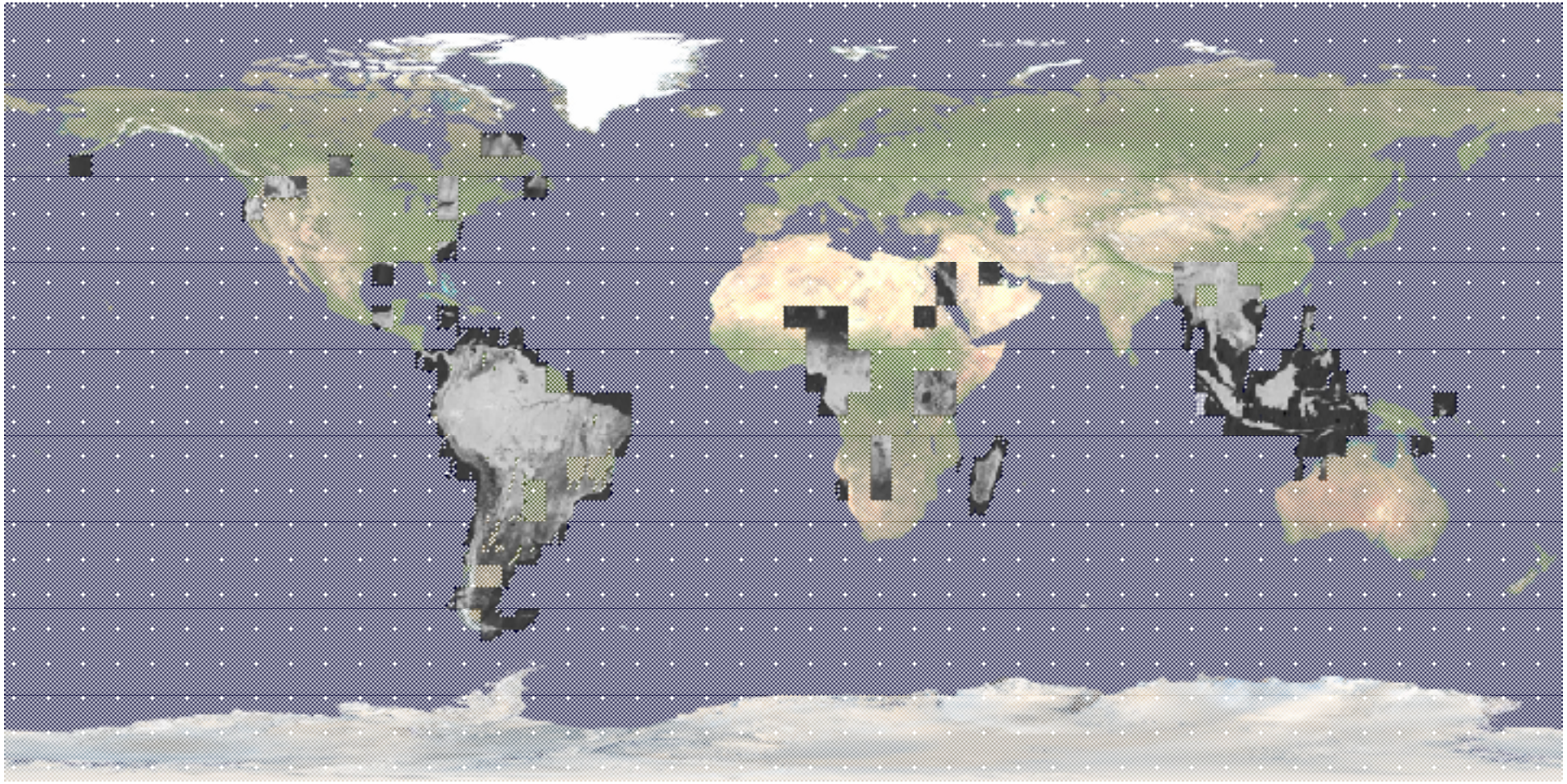
10m Global Mosaic 2009



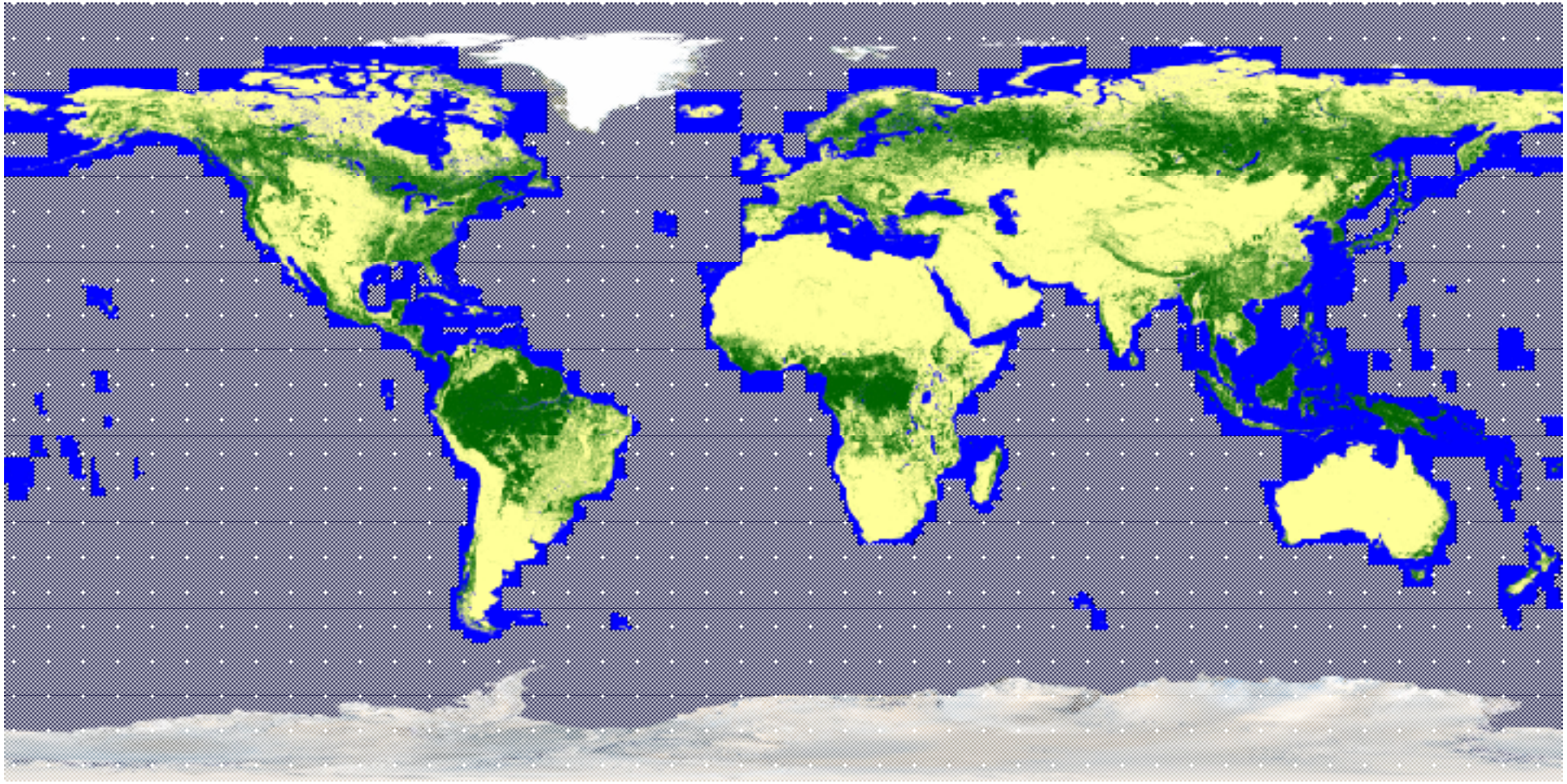
10m Global Mosaic 2007



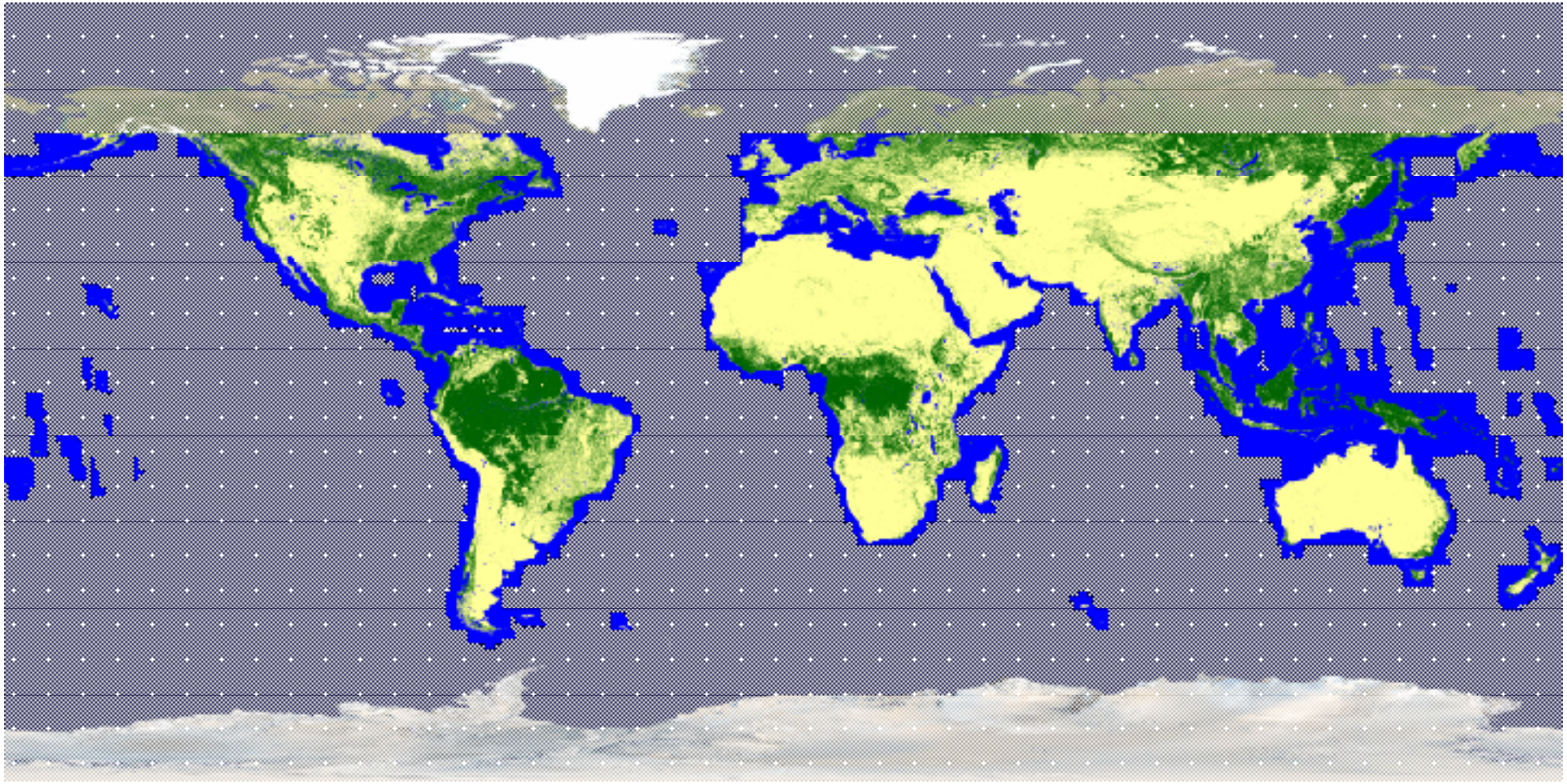
10m Global Mosaic 1995



10m Forest/Non-Forest Map 2009



10m Forest/Non-Forest Map 2007



10m Forest/Non-Forest Map 1995