Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Applications of GIS and Remote Sensing for the Forest Resource Monitoring System including Carbon Stock

5th March 2014

Kiyoshi Suzuki
JICA Expert
Forest Inventory/Project Coordinator
JICA-PNGFA Project

Contents

1. Issues and Challenges in PNG

As-Is (Current)

1. National level Forest Basemap is not developed since 1972
2. Forest GIS (FIMS: Forest Inventory and Mapping System) is not updated since 1996
3. Existing forest related data is not sufficient for carbon estimation

JICA/PNGFA Project

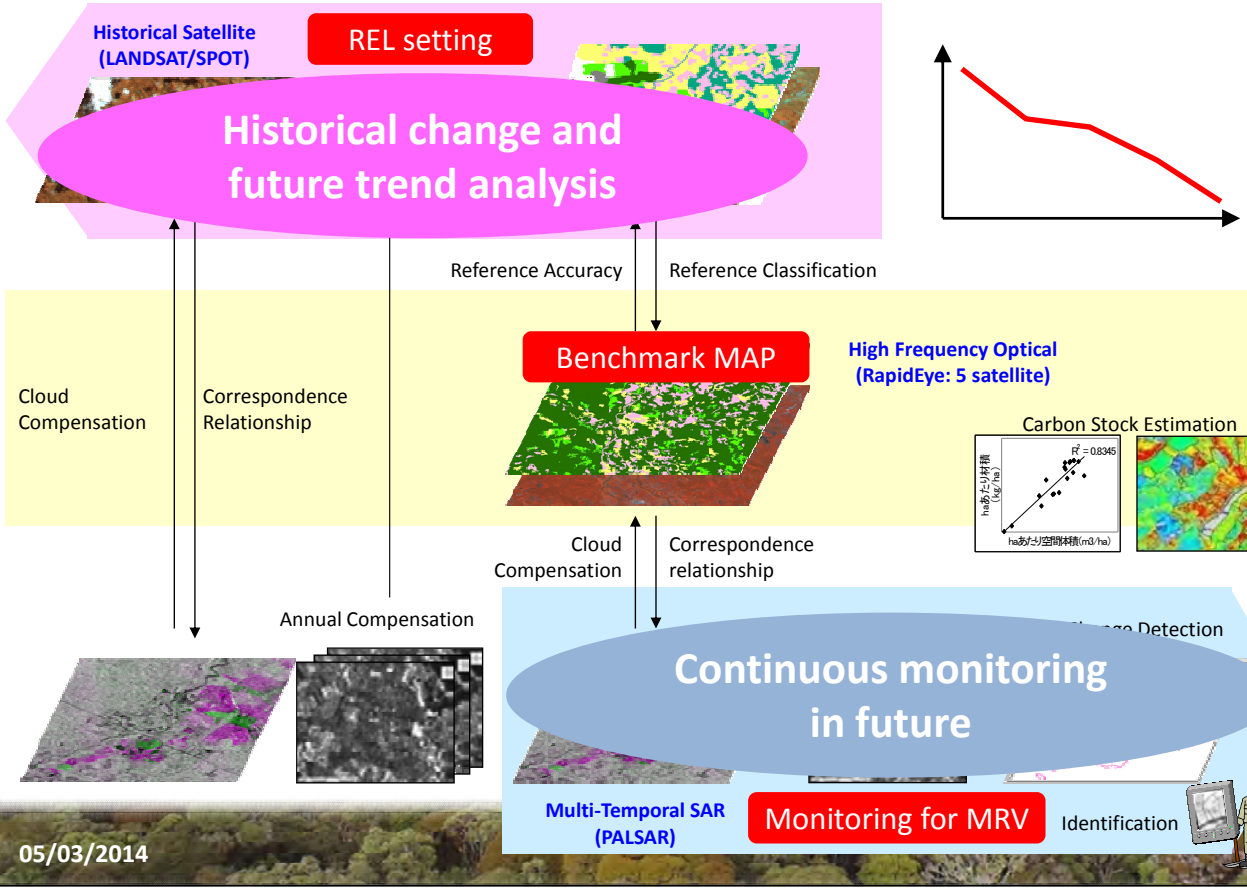
Challenges:

- **Vast forest area, but most are inaccessible to do forest survey for whole country**
- **Lack of funds to conduct full scale forest inventory**
- **97% of PNG land is customary land**
- **Physical structure of land – mountainous, etc.**

To-Be (Goals)

1. National level Forest Resource Basemap is developed and utilized
2. National level Forest Resource GIS/Database is developed and utilized
3. Forest Monitoring System including Carbon stock is designed/demonstrated

Necessity of Forest Monitoring



Project Activities for Forest Monitoring

Concept of Forest Monitoring for REDD+

Activity Data
Forest Area
change detection

x

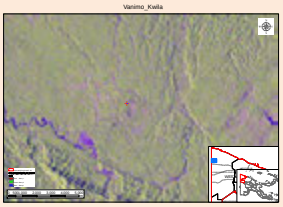
Emission Factor
Carbon content
by 5 carbon pools

=

Carbon Emission / Removal from Forest

Forest carbon estimation for FRA2015

Forest area change analysis



Field verification for Remote Sensing

Training and trial of forest carbon survey

Carbon analysis using airborne data

Activities of JICA-PNGFA Project

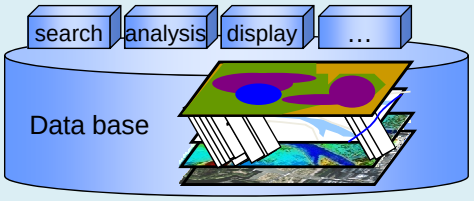
Conceptual Structure of Forest Monitoring of PNGFA

Country-level monitoring (Satellite)

Head Quarter

search | analysis | display | …

Data base

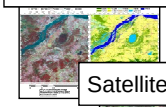


Data management & Monitoring on country level

Satellite Imagery

Conventional data (Logging operation map etc.)

Forest Basemap



Satellite Image

Instruction of field survey
Data-sharing

Report

Survey result

Area / Provincial Office

Field-level monitoring (Field survey)

GPS

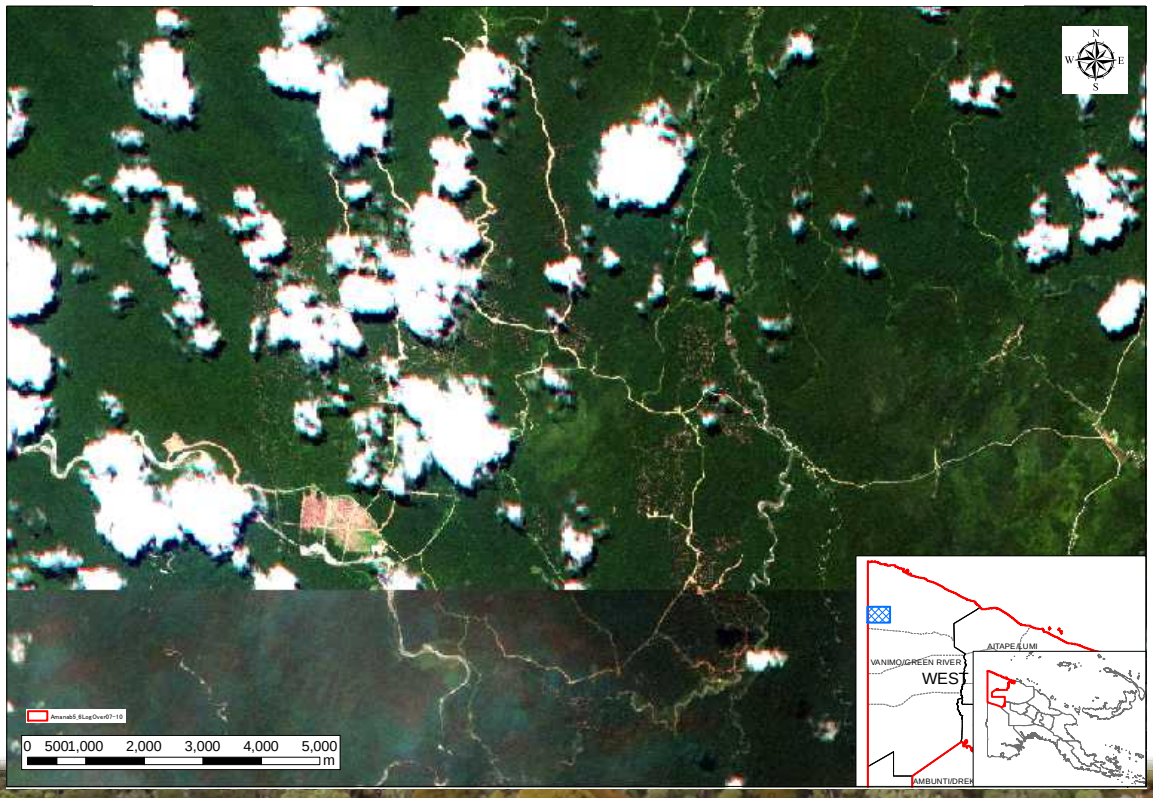
GIS

Local knowledge & information

Field Survey & Reporting

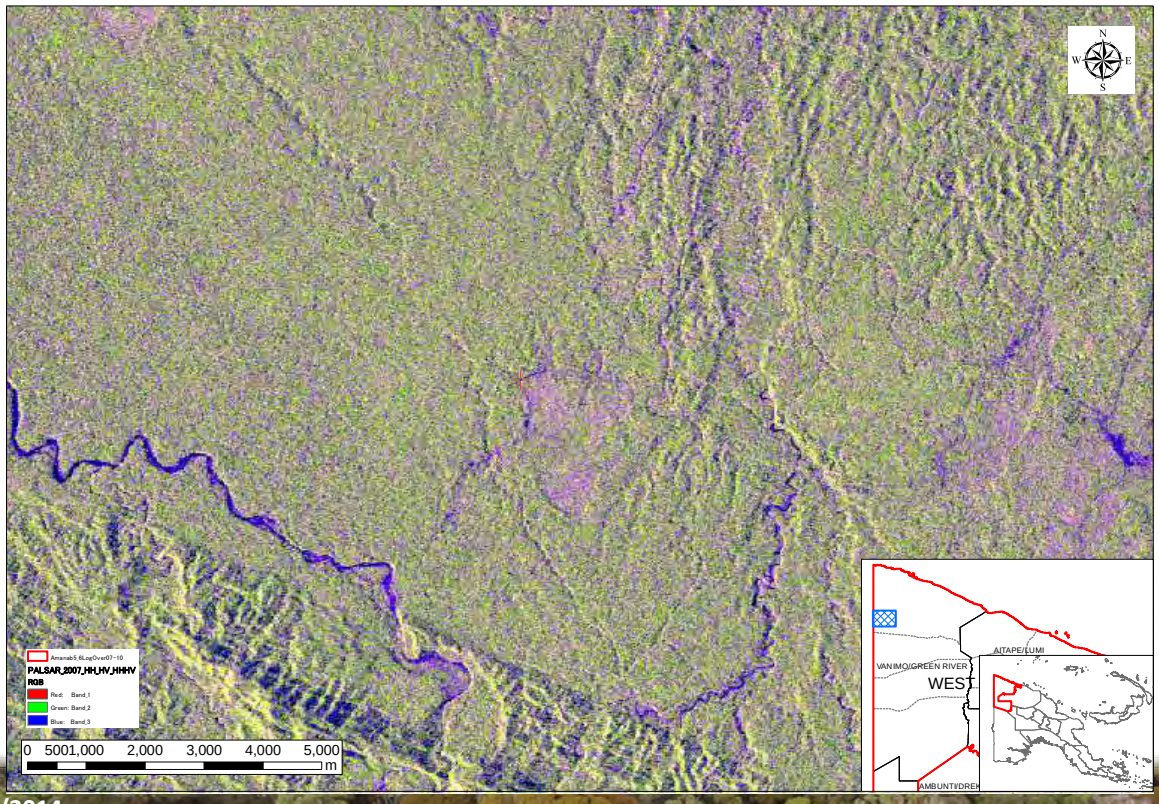
Forest Area Change Analysis

Optical satellite image (RapidEye) 2010



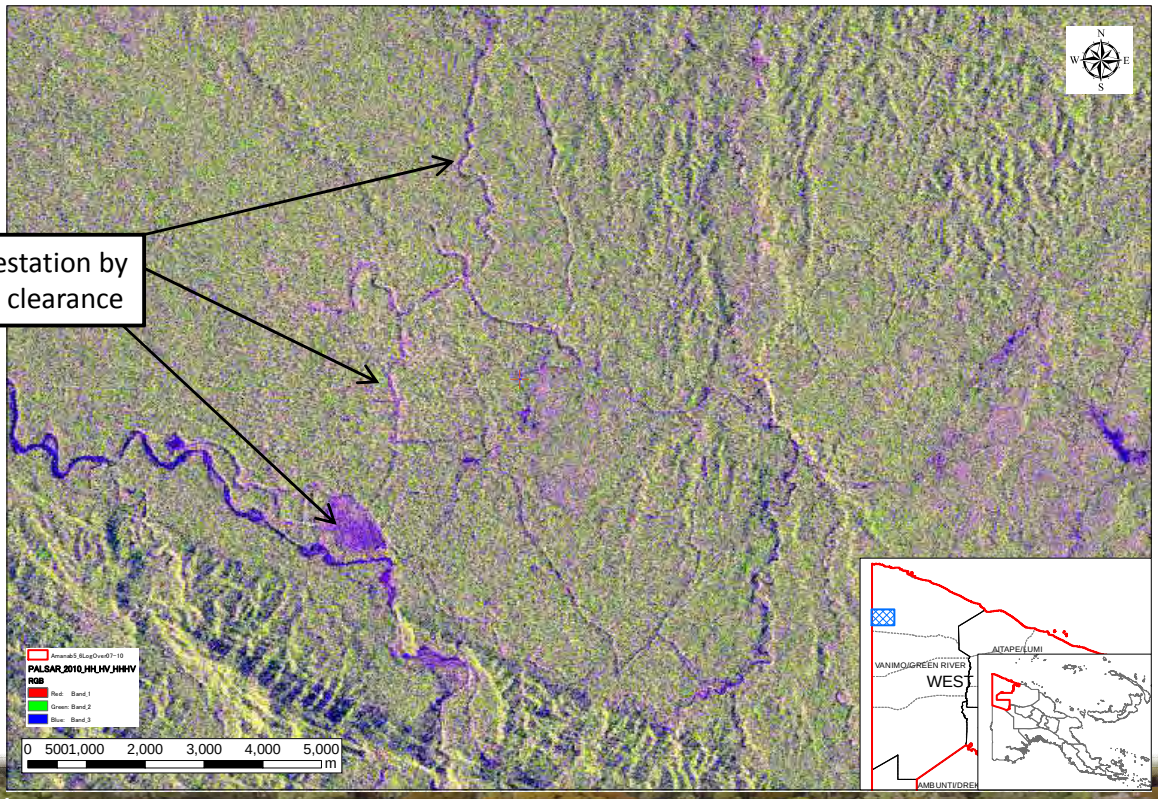
Forest Area Change Analysis

Cloud free satellite image (ALOS/PALSAR) **2007**



Forest Area Change Analysis

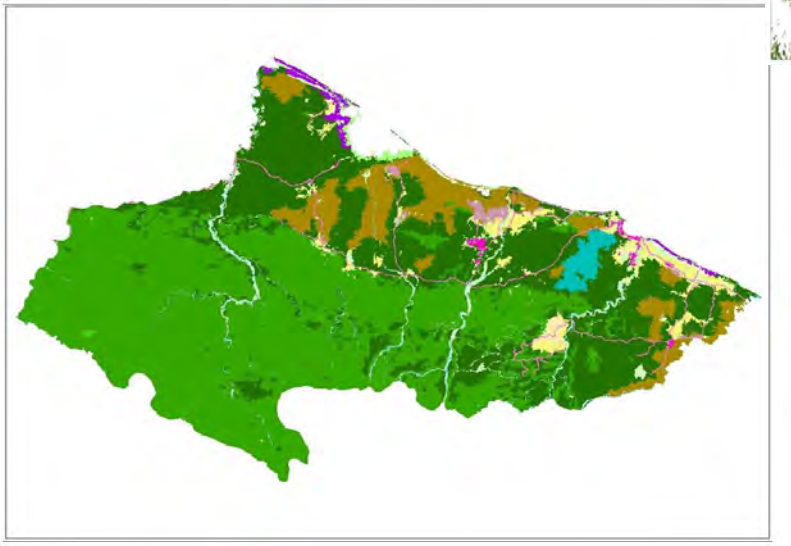
Cloud free satellite image (ALOS/PALSAR) **2010**

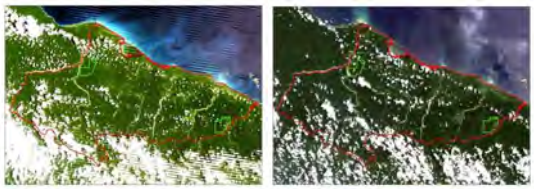


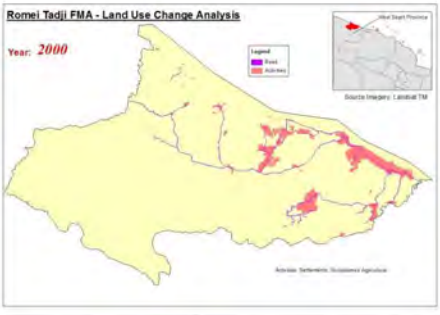
Forest Area Change Analysis

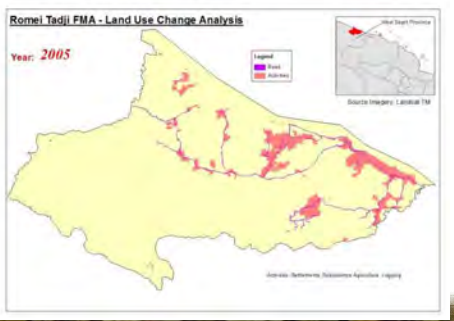
Romei Tadji FMA, West Sepik

2000-2005



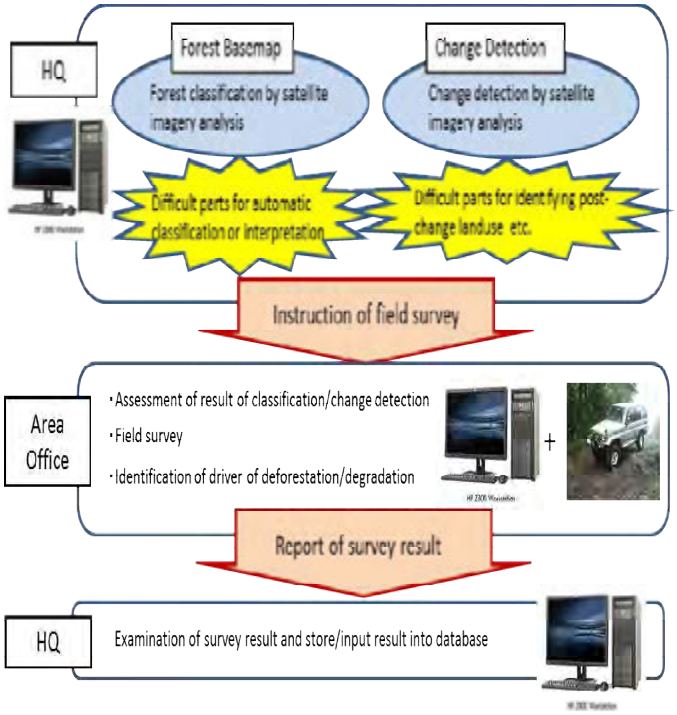






Field Verification for Remote Sensing

Concept of field verification



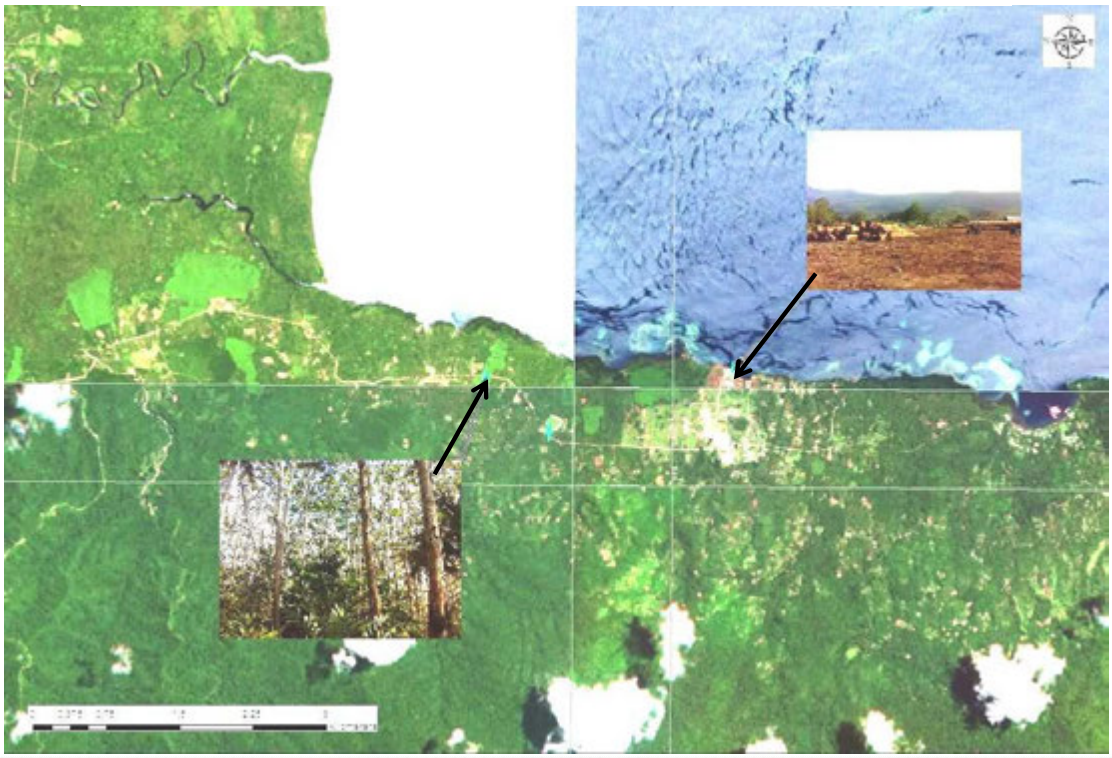
Training on field verification

Purpose	To develop the capacity of the relevant PNGFA officers to conduct field verification using GPS and GIS.
Period	March 2013
Participants	16 PNGFA officers - Area office - Plantation - Forest Research Institute (FRI)

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

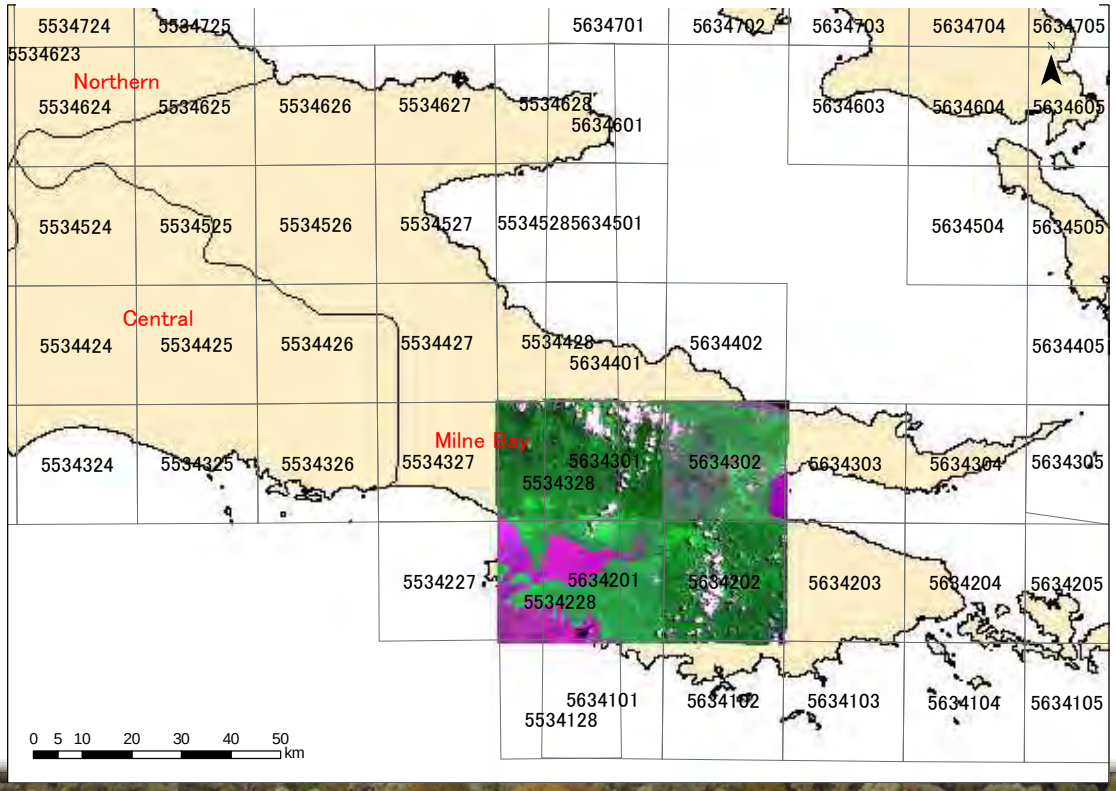
Field Verification for Remote Sensing

Satellite image (RapidEye) with pictures captured by GPS



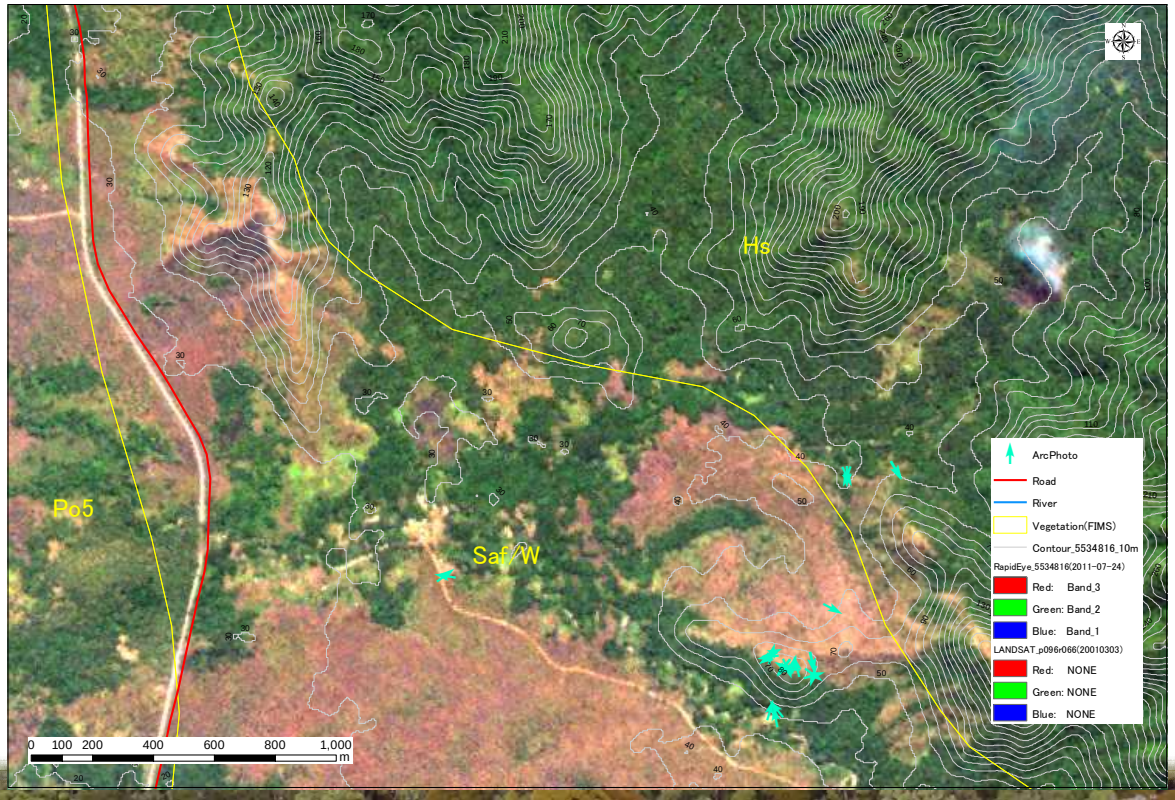
Field Verification for Remote Sensing

Satellite images and other data are ready for use



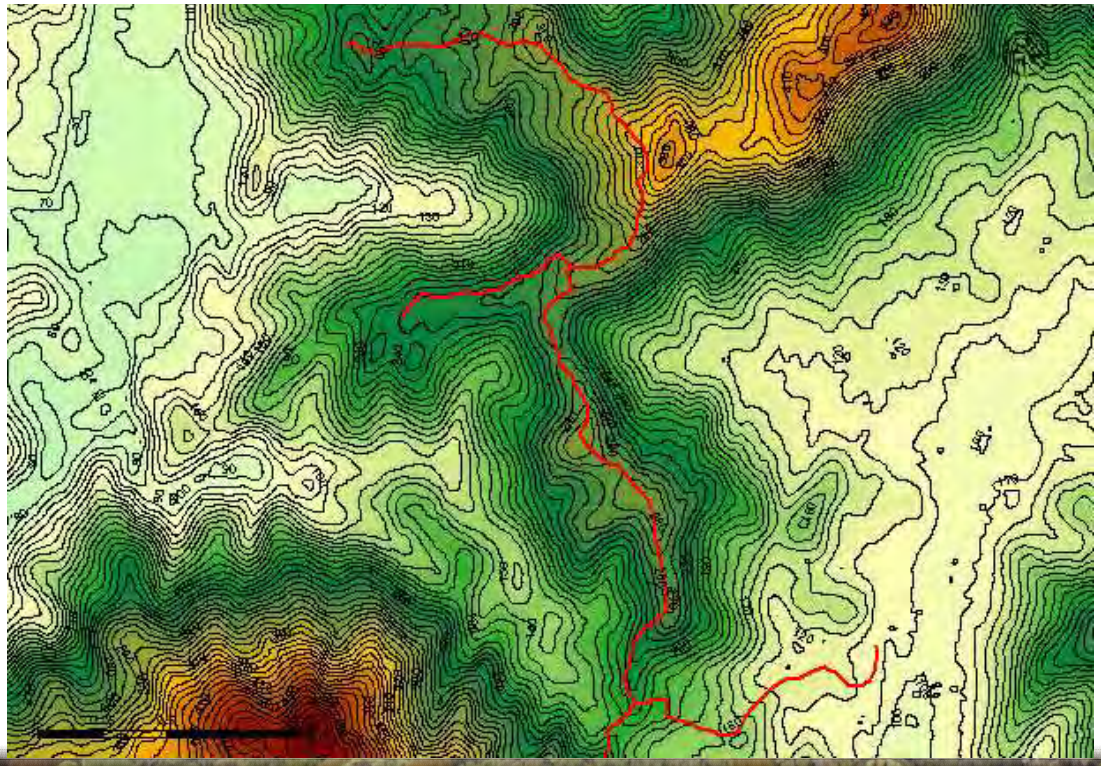
Field Verification for Remote Sensing

Satellite image with Vegetation and 10m Interval Contour



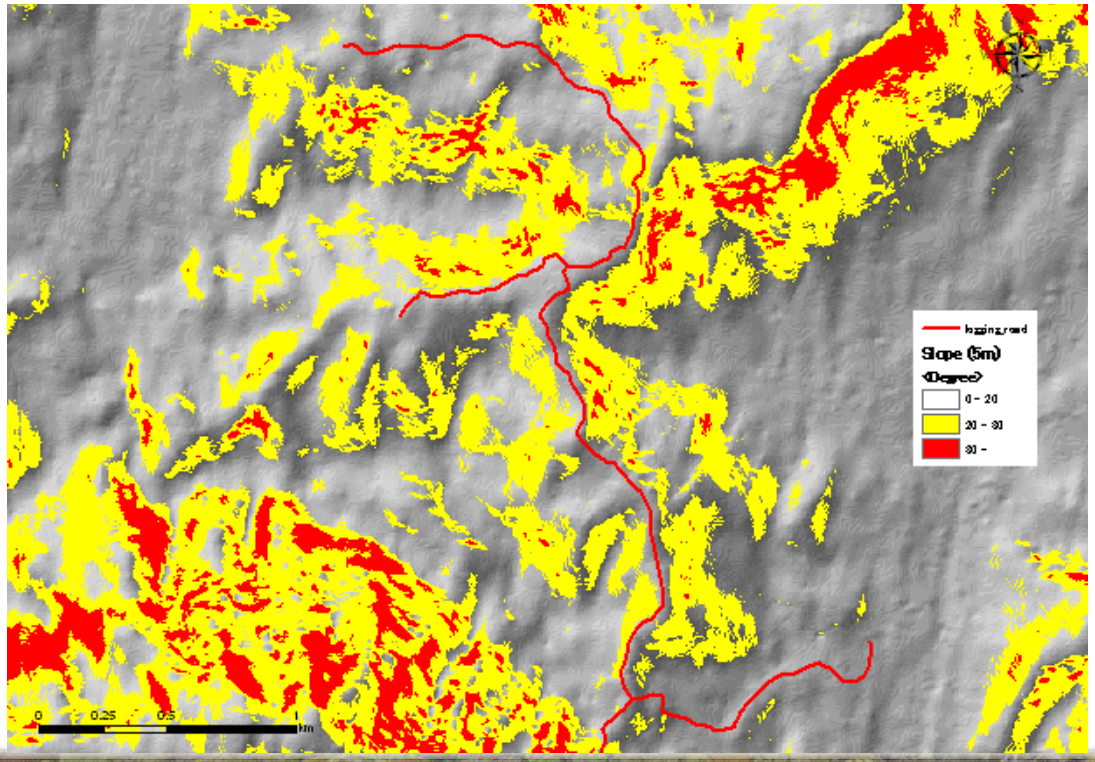
Field Verification for Remote Sensing

10m Interval Contour derived from Digital Elevation Model



Field Verification for Remote Sensing

Slope analysis derived from Digital Elevation Model



Training and Trial of Forest Carbon Survey

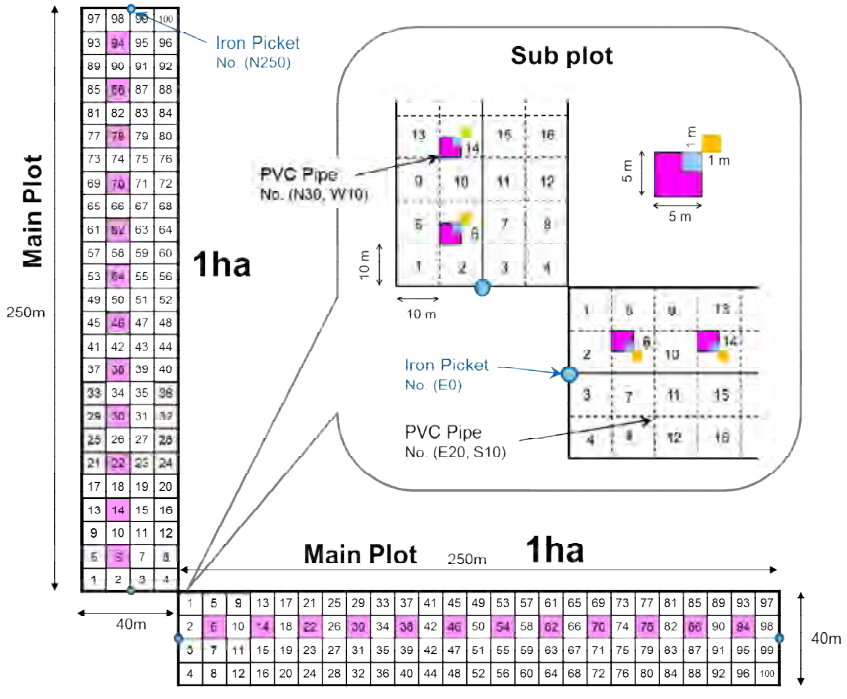
Training of forest carbon measurement

Purpose	To develop the capacity of the relevant PNGFA officers to conduct field measurement of above ground biomass, dead wood, litter and understory vegetation to estimate forest carbon.
Period	May 2012
Participants	16 PNGFA officers - HQ - Area office - Provincial office - FRI

Training of below ground biomass survey

Purpose	To develop the capacity of the officers of relevant organizations, especially FRI scientists, to conduct below ground biomass survey.
Period	September 2012
Participants	40 participants PNGFA - HQ - Area office - FRI Other organization - OCCD - UNITECH

Training and Trial of Forest Carbon Survey



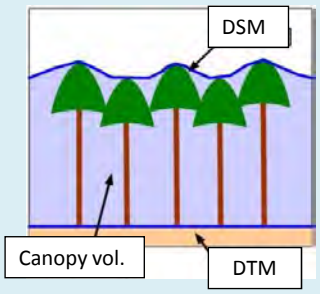
	Plot size	Measurement Object
Main plot (1ha)	40m x 250m	Live and dead standing wood, palms and vines
		Dead lying wood
Sub plot	5m x 5m	Live and dead standing wood
		Dead lying wood
	1m x 1m	Tree sapling
		Dead wood
	1m x 1m	Understory vegetation
		Litter

Training and Trial of Forest Carbon Survey

Carbon analysis using airborne data

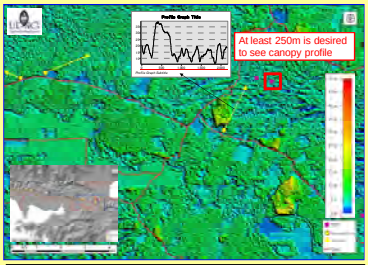
Canopy Volume

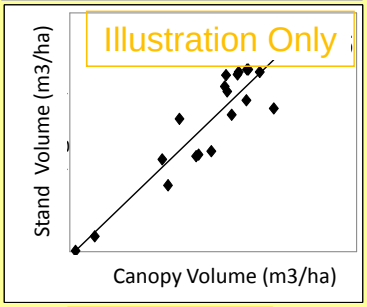
Airborne Survey Data
(GeoSAR & LiDAR)



DSM – DTM = Canopy Vol.

Correlation Analysis between Canopy Vol. and Stand Vol.

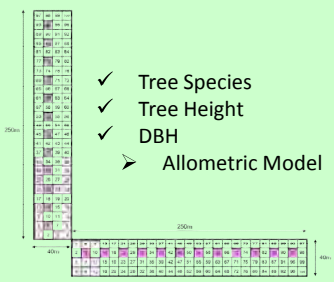




Carbon Stock Amount

Stand Volume

Field Survey



- ✓ Tree Species
- ✓ Tree Height
- ✓ DBH
  - ➢ Allometric Model

L shape plot design in consideration of GeoSAR

Forest carbon estimation for FRA2015

Area

Classification of Global Ecological Zone (FAO)

Translated and applied to

Area of Forest Base Map 2012

X

Biomass by carbon pool

IPCC 2006 Guidelines

Above Ground Biomass: Tier1 Default value
Below Ground Biomass: Tier1 Default value

Litter:
Dead wood:
Soil organic matter:
} Excluded for Tier 1 approach

calculation

Total Forest Biomass in PNG

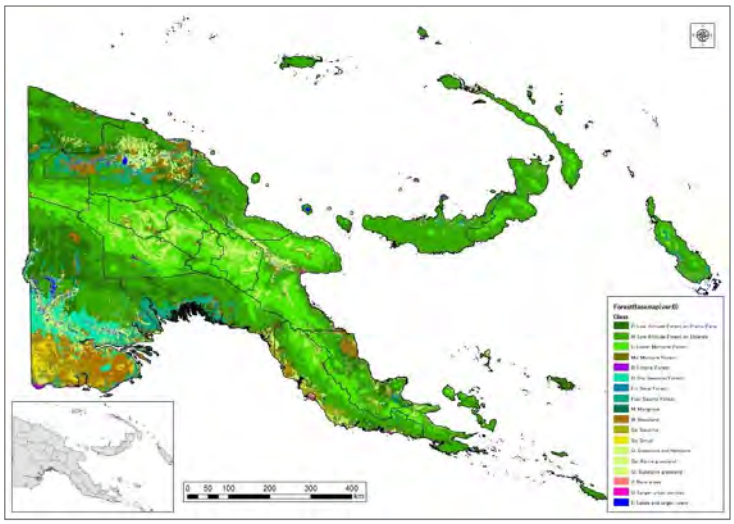
X 0.47 and 0.451 (IPCC default)

Total Forest Biomass Carbon Stock in PNG

Forest carbon estimation for FRA2015

- New Forest Base Map 2012 was developed using high resolution satellite imagery under JICA-PNGFA Project. Area of Forest types on Forest Base Map 2012 are calculated as in table below.

Forest Base Map 2012



Area of Forest types of Forest Base Map 2012

Forest type		Area (ha)
P	Low Altitude Forest on Plains & Fans	5,044,831
H	Low Altitude Forest on Uplands	15,060,791
L	Lower Montane Forest	8,443,151
Mo	Montane Forest	811,434
D	Dry Seasonal Forest	960,685
B	Littoral Forest	86,343
Fri	Seral Forest	155,027
Fsw	Swamp Forest	2,199,899
M	Mangrove Forest	649,604
W	Woodland	2,952,213
Sa	Savanna	655,446
Sc	Scrub	394,500

Forest carbon estimation for FRA2015

Forest Base Map 2012 (PNGFA/JICA)	Total Living Biomass (Mt)	CF	Total forest biomass carbon (Mt)
P	2,073.43		974.51
H	6,189.99		2,909.29
Fri	63.72		29.95
Fsw	904.16		424.95
D	214.42		100.78
B	19.27	0.47	9.06
W	491.25		230.89
Sa	64.23		30.19
Sc	38.66		18.17
L	1,501.19		705.56
Mo	144.27		67.81
M	185.84	0.451	83.8
Total	11,890.43		5,592.22

Summary

1. Forest monitoring is necessary to address REDD+.
2. JICA-PNGFA Project contributed some parts of forest monitoring system through its activities.
3. Forest area change analysis were conducted on trial basis. This activity is very important for PNGFA to conduct both historical analysis and future monitoring.
4. Training on field verification were conducted. Data for field verification is ready for use.
5. Training and trial on forest carbon survey were conducted.
6. Carbon analysis using airborne data were conducted.
7. Basemap results assisted forest biomass carbon calculation for FAO FRA2015. *FRA: Forest resource assessment

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Major Achievement of Japan Grant Aid

05th March 2014

Masamichi HARAGUCHI

Team Leader of Grant Aid Technical Assistant

Kokusai Kogyo Co., Ltd (KKC)

Contents

Full Cooperation of JICA Project & Grant Aid Program

JICA Technical Cooperation (T/C)

Objective:

To enhance the capacity of relevant institutions in PNG for monitoring of nation-wide forest resource including carbon stock to address climate change

Expected Output

1. Nation-wide forest base map
2. National level forest resource database
3. Monitoring system of forest resource including carbon stocks

Japan Grant Aid (JICS)

- ☐ Equipment
  - ✓ Remote Sensing GIS facility
  - ✓ Satellite Images
  - ✓ Airborne data
  - ✓ Field survey equipment
- ☐ Initial Training on installation & setting of equipment and data
- ☐ Technical Assistance (TA) for utilization of equipment and data
- ☐ On the Job Training (OJT) on RS/GIS software and data

Full Integration of JICA Technical Cooperation (TC) & Grant Aid Technical Assistance (TA)

JICA TC Analysis & Design Capacity Building	Grant Aid TA @PNG Processing Design	Grant Aid TA @JPN Mass Production
• Current situation analysis • User Needs & Assessment • Pilot/Demonstration Activity • Remote Sensing –Core-Analysis Design –Development Methodology • GIS Database –Current system Analysis –Basic System Design	• Expanding Area (Sub-National) • Remote Sensing –Processing Design –Mosaic/Standardization –Improvement Methodology • GIS Database –Detail System Design –Development System –Operational/Monitoring	• Expanding Area (National) • Remote Sensing –Mass Production –Compiling Data • GIS Database –Re-disign System –Re-develop System Training in Japan

JICA TC Application of Map/DB Operation of Map/DB	Grant Aid TA @PNG Work for Change Detection Implementation of System	Grant Aid TA @JPN Forest Basemap Forest Resource Database

Grant Aid Equipment Procurement
Remote Sensing/GIS-Database Facility
Satellite Imagery/Airborne Data
Field Survey Equipment

Contents of Technical Cooperation & Technical Assistance

TC3. Monitoring system of forest resource including carbon stocks

TA1: Creation of national forest base maps using remote sensing technologies

TC1: Nation-wide forest base map

TA2: Development/construction of a national-level forest GIS/Database

TC2:National level forest resource database

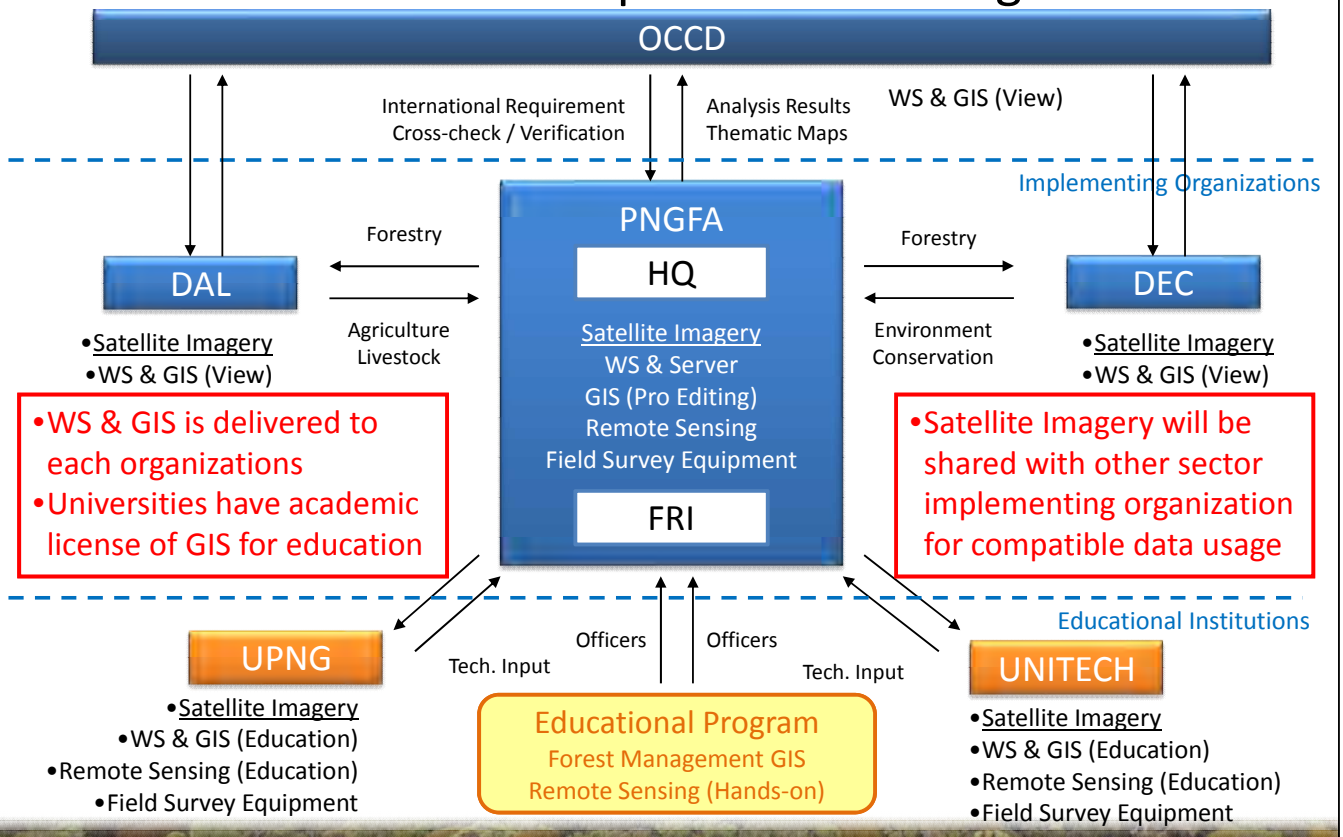
TA3: Estimation of carbon stock which would be essential information for the forest resource monitoring

Slide: 19-22

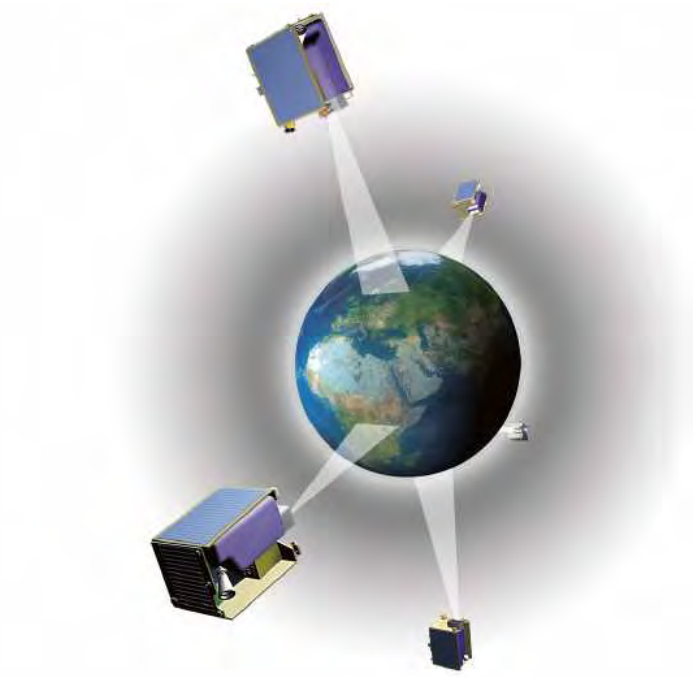
TA4: Formulation of a program to strengthen implementation capacity and to support educational institutions

Slide: 23-32

Distribution Plan & Cooperation with Organizations



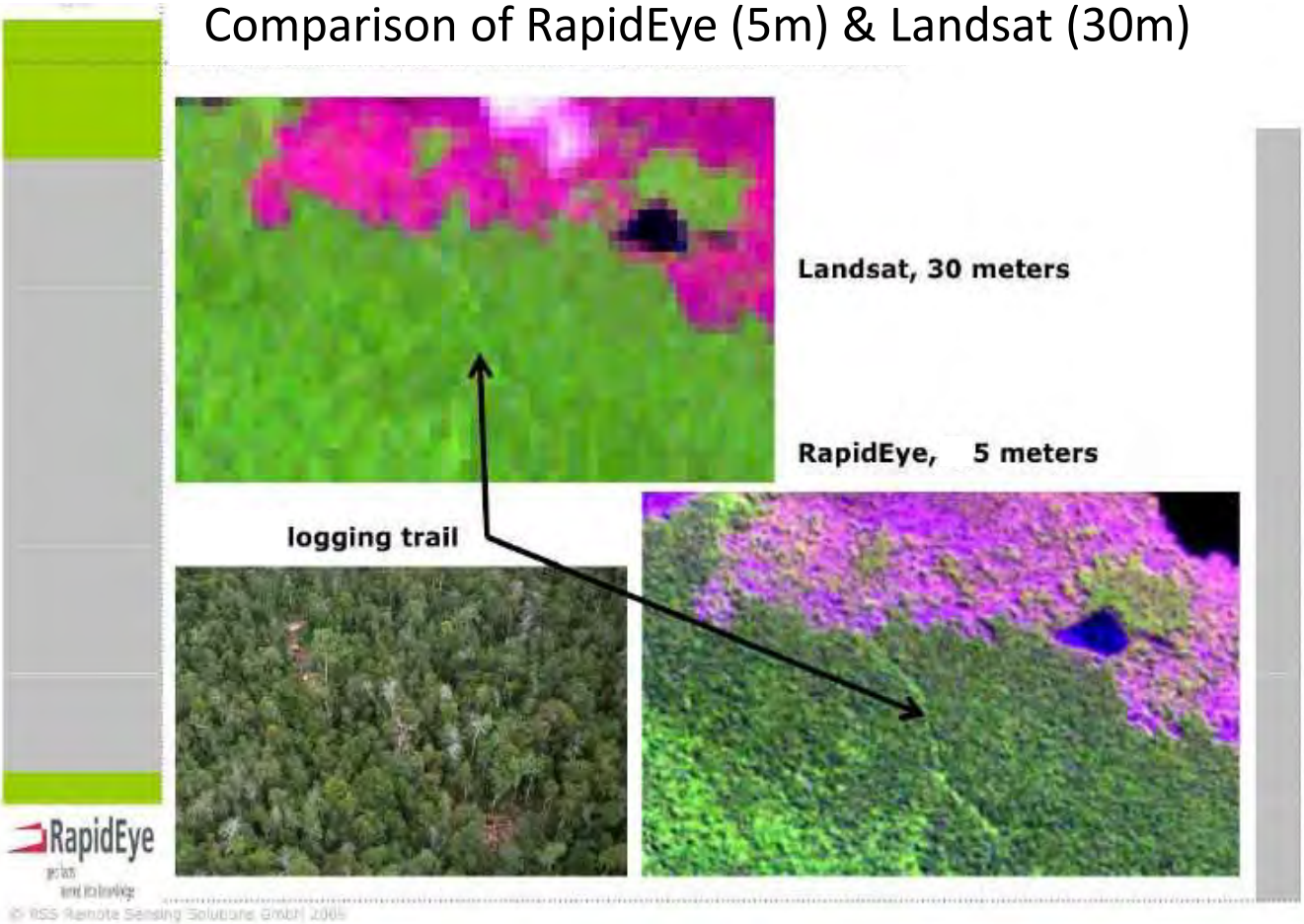
Satellite Imagery (Optical): RapidEye



Orbit	620 km, sun synchronous
Number of Satellites	5
Spacecraft Mass	150 kg each
Image Data Downlink	>60 Mbps
Onboard Data Storage	>1500 km of image data
Max. Spacecraft Roll Angle	± 25 degrees
Payload Type	Push broom Optical Imager 5 Optical bands
Swath	78 km
Nadir Pixel Ground Sampling Distance	6.5 m
Global Revisit Time	1 day
Average Repeat Period (Europe and North America)	<5 days
DEM Generation Capability	Yes
Mission Life	7 Years

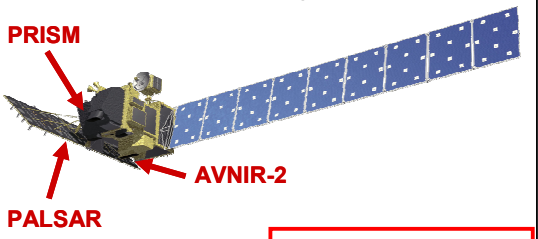
Ref. RapidEye Web

Comparison of RapidEye (5m) & Landsat (30m)



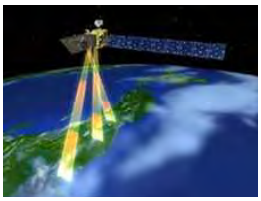
Satellite Imagery (Radar): ALOS/PALSAR (Japan)

ALOS: Advanced Land Observation Satellite

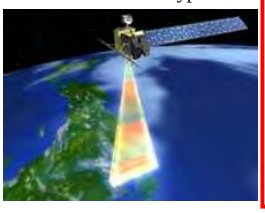


- ✓ Launch:
  Jan. 24, 2006 by H-2A Rocket #8
  > Stopped operation in Mar. 2011
- ✓ Objectives:
  ① Cartography (1/25,000 scale)
  ② Environmental Monitoring
  ③ Disaster/Forest Monitoring
- ✓ Three mission instruments:
  ①PRISM ②AVNIR-2 ③PALSAR

PRISM
Panchromatic Remote sensing Instrument for Stereo Mapping



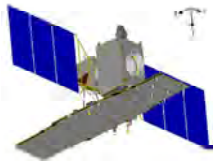
AVNIR-2
Advanced Visible & Near-Infra Red Radiometer type 2



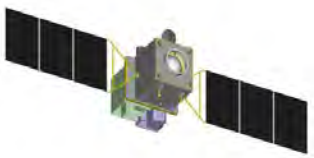
PALSAR
Phased Array type L-band Synthetic Aperture Radar

ALOS-2 (SAR) and ALOS-3 (Optical)

- National Land Monitoring and Managements
- Resources Managements
- Disaster/Forest Monitoring
- ALOS-2 is planed to be launch in 2013-14, and ALOS-3 is hoped in 2014-15 (TBD)



ALOS-2: SAR Satellite

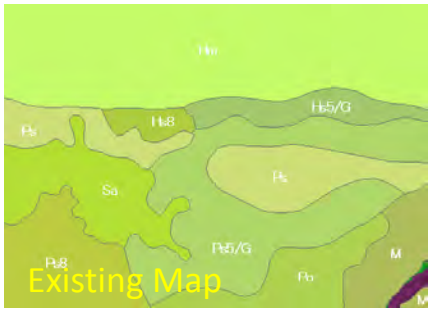


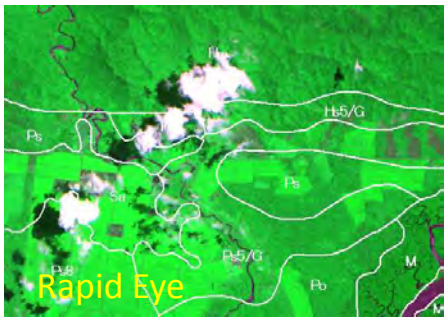
ALOS-3: Optical Satellite

Ref. JAXA Web

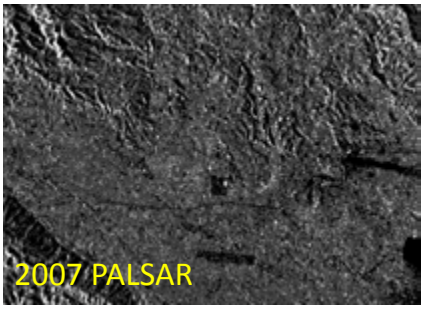
Cloud Compensation & Change Detection

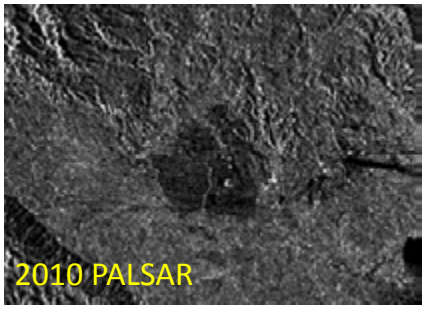
Cloud Compensation => Forest Basemap

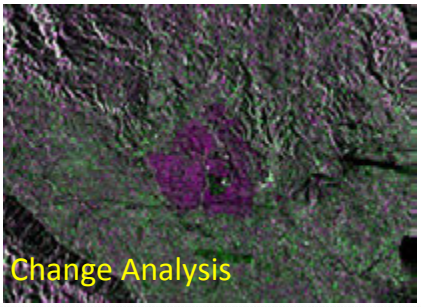




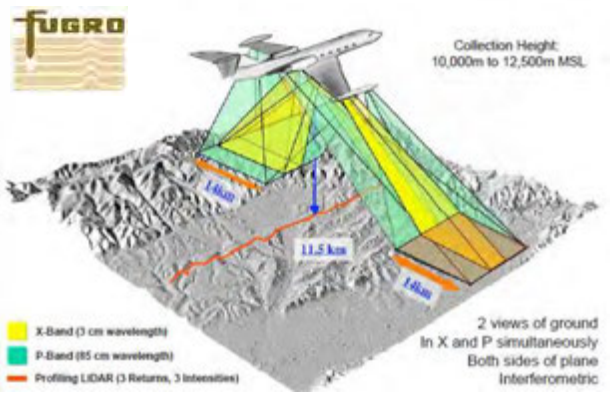
Change Detection => Forest Monitoring

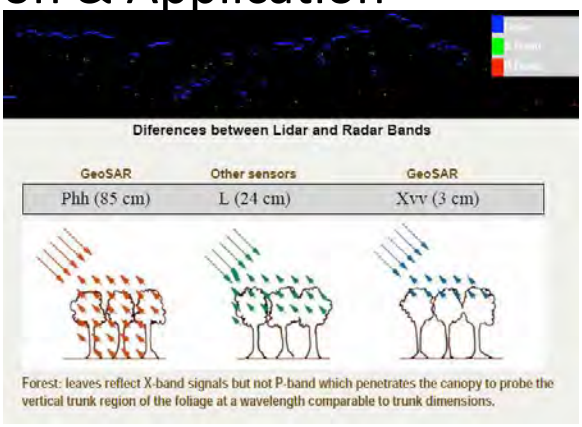


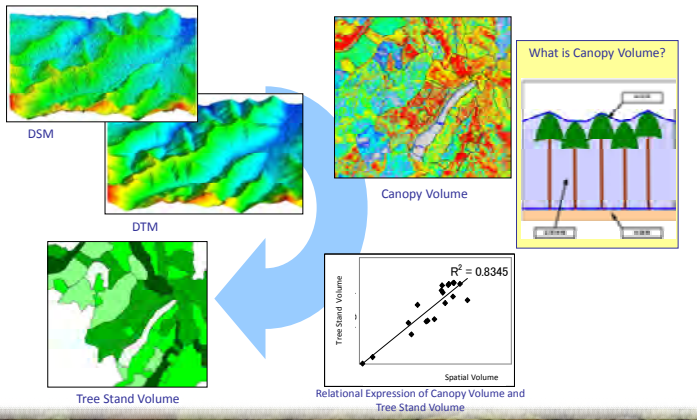


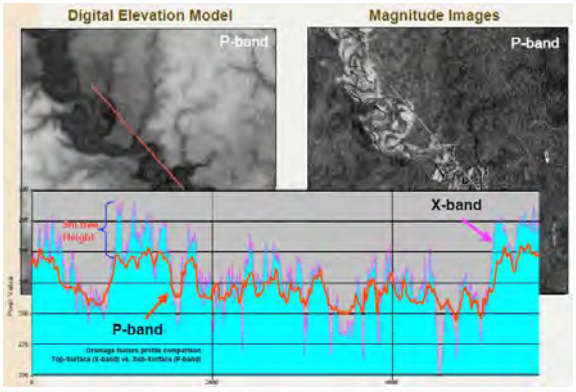


Airborne Data Collection & Application

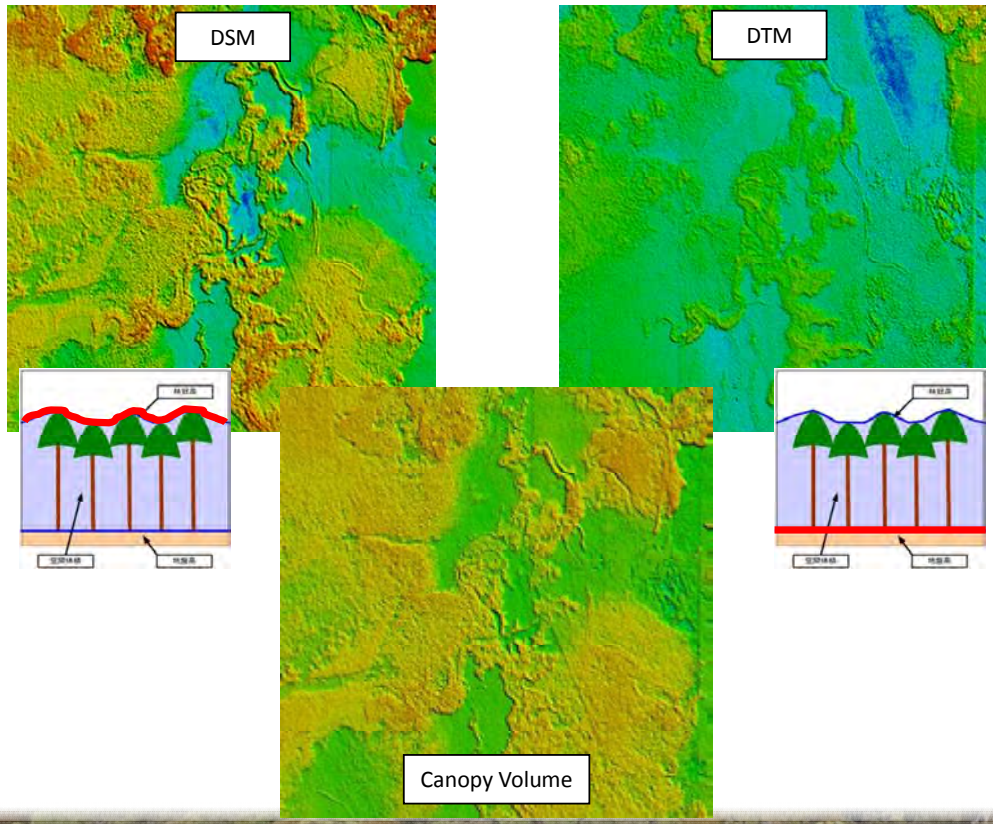








Digital Canopy Volume derived from Airborne Data



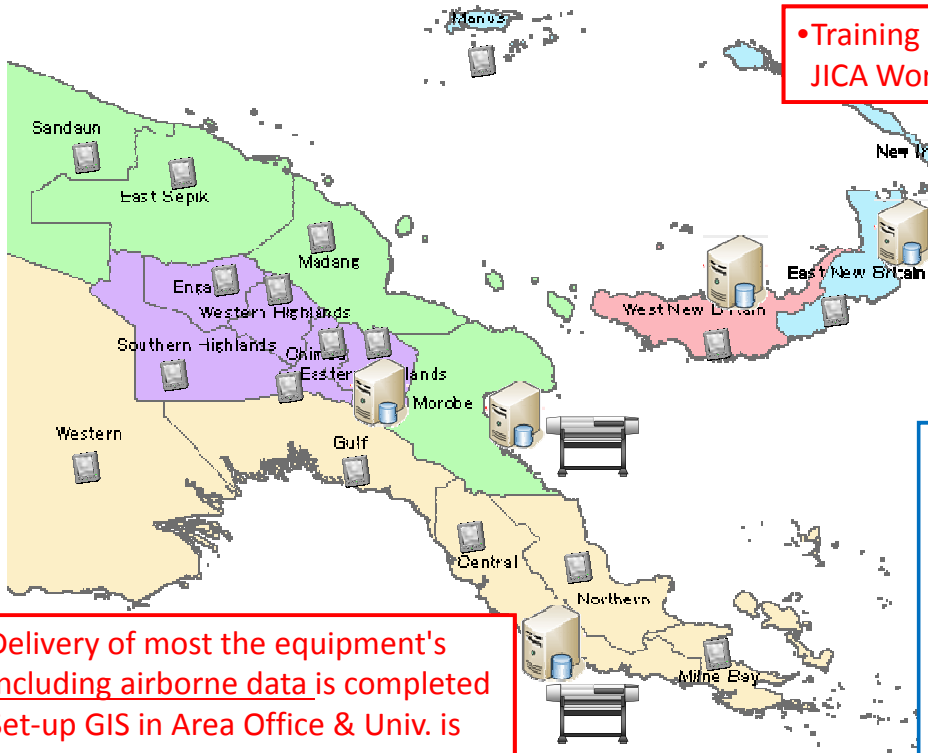
List of Procured Equipment (1/2)

Item No.	Item	Item (detail)	Total	PNGFA HQ	FRI	Region Office	Province Office	OCCD	DEC	DAL	Unitech	UPNG RSC
1	Desktop PC	Desktop PC	32	6	4	5	0	1	1	1	7	7
2	Laptop	Laptop PC	18	5	4	5	4	0	0	0	0	0
3	Potable GPS	Potable GPS	31	4	4	10	4	1	1	1	4	2
4	A3 Printer (Color)	A3 Printer (Color)	8	1	1	5	0	0	0	0	1	0
5	A3 Scanner	A3 Scanner	8	1	1	5	0	0	0	0	1	0
6	A0 Scanner	A0 Scanner	1	0	0	0	0	0	0	0	0	1
7	A0 Plotter	A0 Plotter & Scanner	3	1	1	0	0	0	0	0	1	0
8	Data Server	Data Server	2	1	1	0	0	0	0	0	0	0
Software/Satellite Imagery (to be installed)												
9	ERDAS	LPS	5	2	1	0	0	0	0	0	1	1
		IMAGINE (Pro)	5	2	1	0	0	0	0	0	1	1
		ATCOR	2	1	0	0	0	0	0	0	0	1
		AutoSync	2	1	0	0	0	0	0	0	0	1
		Radar Mapping Suite	2	1	0	0	0	0	0	0	0	1
		HEAK Core Level1(15 License/set)	2	0	0	0	0	0	0	0	1 15	1
		HEAK Photo-Level1(15 License/set)	2	0	0	0	0	0	0	0	1 15	1
10	eCognition	Architect	1	0	1	0	0	0	0	0	0	0
		Developer	2	1	1	0	0	0	0	0	0	0
		Server&Developer	1	1	0	0	0	0	0	0	0	0
11	ArcGIS license	ArcInfo	5	2	1	0	0	0	0	0	1	1
		ArcEditor	4	2	0	0	0	0	0	0	1	1
		ArcView	15	2	1	5	0	1	1	1	2	2
		Spatial Analyst	10	4	2	0	0	0	0	0	2	2
		3D Analyst	10	4	2	0	0	0	0	0	2	2
		ArcInfo Academic (30 License/set)	3	0	0	0	0	0	0	0	1 FD 1 LS	1
		3D AnalystAcademic (30 License)	3	0	0	0	0	0	0	0	1 FD 1 LS	1
		Spatial Analyst Academic (30 License)	3	0	0	0	0	0	0	0	1 FD 1 LS	1
12	ArcGIS Server	ArcGIS Server	2	1	1	0	0	0	0	0	0	0

List of Procured Equipment (2/2)

Item No.	Item	Item (detail)	Total	PNGFA HQ	FRI	Region Office	Province Office	OCCD	DEC	DAL	Unitech	UPNG RSC
13	MS SQL Server	MS SQL Server	2	1	1	0	0	0	0	0	0	0
14	MS Visual Studio	MS Visual Studio	3	2	1	0	0	0	0	0	0	0
15	MapInfo	MapInfo	1	1	0	0	0	0	0	0	0	0
16	Satellite Imagery	ALOS/PALSAR 2010	1	1	0	0	0	0	0	0	0	0
17		RapidEye 2010	1	1	0	0	0	0	0	0	0	0
18		ALOS/PALSAR 2007	1	1	0	0	0	0	0	0	0	0
19	Compass	Compass	30	3	4	19	0	0	0	0	4	0
20	Clinometer	Clinometer	30	3	4	19	0	0	0	0	4	0
21	Diameter Tapes (10m)	Diameter Tapes (10m)	30	3	4	19	0	0	0	0	4	0
22	Distance Tape (100m)	Distance Tape (100m)	30	3	4	19	0	0	0	0	4	0
23	Distance Tape (50m)	Distance Tape (50m)	30	3	4	19	0	0	0	0	4	0
24	Digital Camera	Digital Camera	15	5	3	5	0	0	0	0	1	1
25	Wedge Prism (Angle Count) Factor 1 & 2	Wedge Prism (BAF 1)	30	3	4	19	0	0	0	0	4	0
		Wedge Prism (BAF 2)	30	3	4	19	0	0	0	0	4	0
26	Hypsometer	Hypsometer	30	3	4	19	0	0	0	0	4	0
27	Densiometer	Densiometer	16	3	4	5	0	0	0	0	2	2
28	Shelf Storage	Shelf Storage	8	4	4	0	0	0	0	0	0	0
29	Cabinet (Vertical)	Cabinet (Vertical)	8	4	4	0	0	0	0	0	0	0
30	Cabinet (Horizontal)	Cabinet (Horizontal)	12	6	6	0	0	0	0	0	0	0
31	Projector sets	Projector sets	2	1	1	0	0	0	0	0	0	0
32	Portable Generator	Portable Generator	2	1	1	0	0	0	0	0	0	0

Equipment Delivery and Set-up, Training

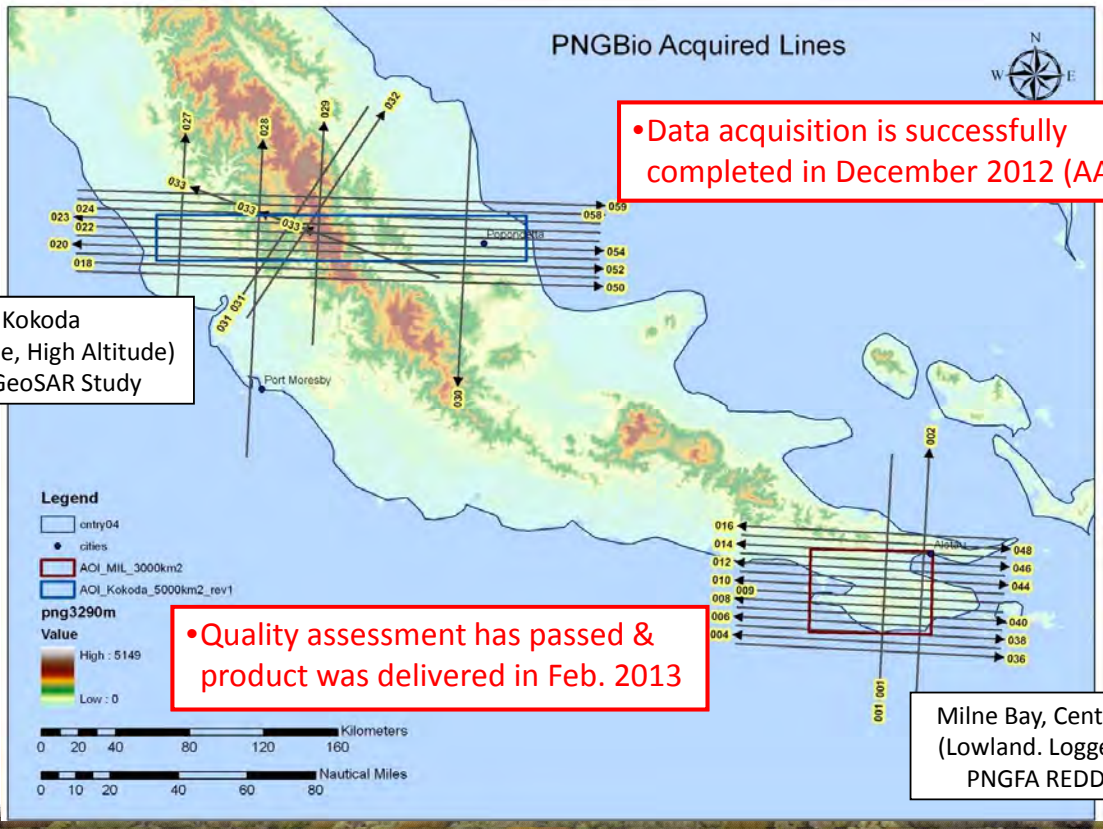


- Training of GPS was conducted in JICA Workshop in March, 2012

- Delivery of most the equipment's including airborne data is completed
- Set-up GIS in Area Office & Univ. is completed and training is started

Area Office
GIS
Desktop
Province Office
GPS
Laptop
HQ, FRI, UPNG, Unitech
Plotter & Scanner

Airborne Data Collection



- Data acquisition is successfully completed in December 2012 (AAM)

- Quality assessment has passed & product was delivered in Feb. 2013

Kokoda
(Montane, High Altitude)
DEC GeoSAR Study

Milne Bay, Central Suau
(Lowland. Logged over)
PNGFA REDD+ Pilot

Data Sharing: Property/Right & MoA

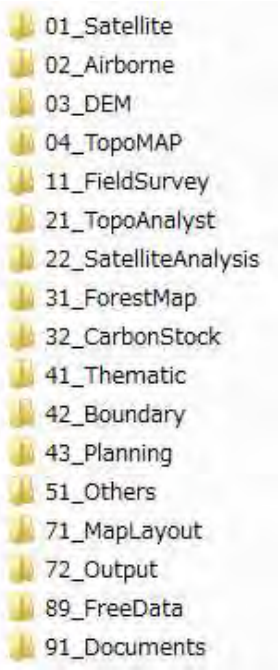
Org.	Item	PNGFA	FRI	Area Office	OCCD	DEC DAL	UPNG UNITECH	Other
PNGFA	FIMS (del. timber)	◎	○	×	×	×	×	×
	FIPS	◎	×	×	×	×	×	×
	PSP	×	◎	×	×	×	×	×
Japan GrantAid	RapidEye	◎	◎	○	×	○	○	×
	thematic map	◎	◎	○	○	○	○	○
	PALSAR	◎	○	×	×	×	×	×
	ortho & change	◎	◎	○	○	○	○	○
JICA	GeoEye & LiDAR	◎	○	×	×	×	×	×
NMB (MRA)	GeoSAR	◎	○	×	×	×	×	×
	processed data	◎	○	○	×	×	×	×
	TopoMAP	◎	◎	○	×	×	×	×
Open Data	LANDSAT	○	○	○	△	△	△	△
	ASTER G-DEM	○	○	○	△	△	△	△
	SRTM	○	○	○	△	△	△	△
	PNGRIS, Geobook, etc	◎	◎	○	△	△	△	△

MOA focus

◎ Main Data Owner　○ Licensed User　× Not Share (not allowed/necessary)　△ Possible to Share

Data & User Management (Trial Operating)

Server@HQ/FRI
D-Drive:WS@Area Office



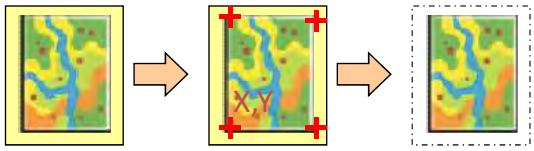
ICT Support
- Backup → ○
- Manage ← ○

JICA Support
- Read/View → ○
- Copy → ○
- Write/Update ← ○

Users
- Read/View → ○
- Copy → ×
- Write/Update ← ×

Topo Map Scanning: Using A0 Plotter/Scanner for GIS

Workflow



Scan Georectify Edgecut

File Naming Rule

File	File Naming Rule
Scanned images	TOPOs＋Sheet No.＋Sheet Name
Georectified images	TOPOr＋Sheet No.＋Sheet Name
Edgecut images	TOPO＋Sheet No.＋Sheet Name

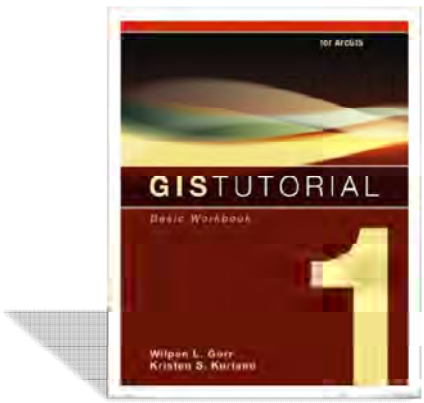
Index Map of Topographic Map

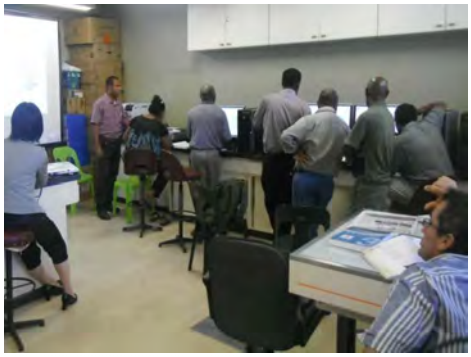
Enable to gain quick access to the maps

Training Program for Universities and Institute

Contents:

- Introduction to ArcGIS
- Map design
- GIS outputs
- File geodatabase
- Spatial data
- Digitizing
- Geoprocessing
- Spatial analysis
- Introduction to ArcGIS 3D Analyst
- Analyzing raster data
- Creating surface
- Analyzing topographic surface
- Analyzing distance
- Suitability analysis
- Hydrological analysis
- Ecotope mapping





Current Situation and Potential for Future: Group2

Organization	Division	Provision of TA	Current situation	Future possibility
UNITECH	Forestry	GIS/RS training program was implemented in Dec. 2012 (10 people)	Stagnation due to poor infrastructure conditions caused by delayed transfer to the facility as scheduled	Entry of graduates of the training program, cooperation and collaboration for mass production
	Surveying & Land Studies	Nothing in particular: Request for TA to the Forestry	The procured PCs, GIS & RS teaching materials are effectively utilized in their education and research activities	TA to the Dept. of Forestry & candidate subcontractor in mass production operation
UPNG	Remote Sensing Center	Nothing in particular: Advice on GIS/RS training program	The procured large plotter/scanner is effectively utilized	Technical exchange for past satellite data analysis and airborne data analysis
	Environmental Science & Geography	Formulation GIS/RS training program (4 people)	New classes were started, which are popular among the students.	Cooperate with graduates, subcontract for mass production

Current Situation and Potential for Future: Group1&3

Organization	Division	Provision of technical assistance	Current situation	Future possibility
PNGFA	Area Office	Mar. 2013 Ground Truth WS Oct. to Dec. 2013 Agriculture information development WS	Acquired basic skills for handling satellite data and GIS in the farmland information development WS. Expected to utilize the skills in the future	Practice of monitoring in coordination with local areas (ground truth, information collection)
OCCD		Nothing in particular: WS in 2012	The procured GIS is utilized some time because they have OSS equipment from UN-REDD/FAO.	Cross-validation of forest info necessary for international reports
DEC		Nothing in particular: WS in 2012	The equipment is not utilized due to lack of understanding but considered to utilize it after MTG with PNGFA	Management & planning, updating & sharing of info of protection areas & wetlands
DAL		Nothing in particular: WS in 2012	The equipment is not utilized due to the issue of command channel but considered to utilize it after MTG with PNGFA	Development of detailed agriculture info (crops, etc.), collection of info on plantations

Addressing Emission Factor with Airborne Data

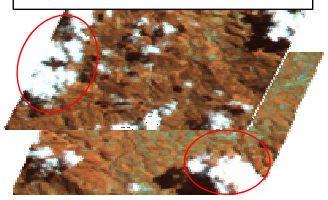
ACTIVITY DATA x **EMISSION FACTOR** = CO2 Emission

- ✓ Satellite Monitoring
- ✓ Area and area change

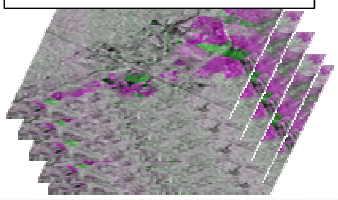
- ✓ Inventory Survey
- ✓ Information on carbon stocks associated with each land category

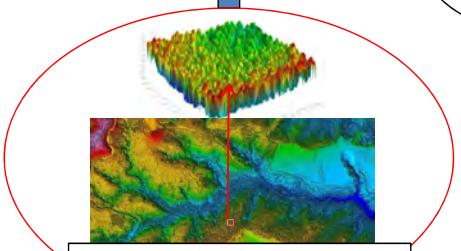
- **It is very difficult to implement field survey for a large number/wide**
- It is not easy to measure tree height accurately
- **We would like some compensating method.**

Optical Satellite



Radar/SAR Satellite





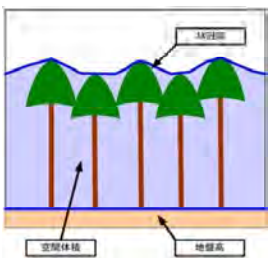
Airborne LiDAR/SAR

LiDAR:
Light
Detection
And
Ranging

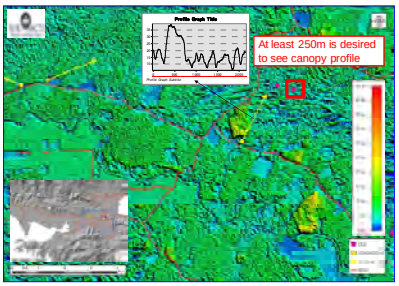
Overview of Demonstration of Carbon Stock Estimation

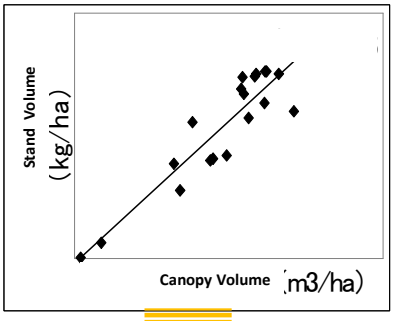
Airborne Survey (GeoSAR & LiDAR)

Canopy Volume



Correlation Analysis of Canopy Volume and Stand Volume





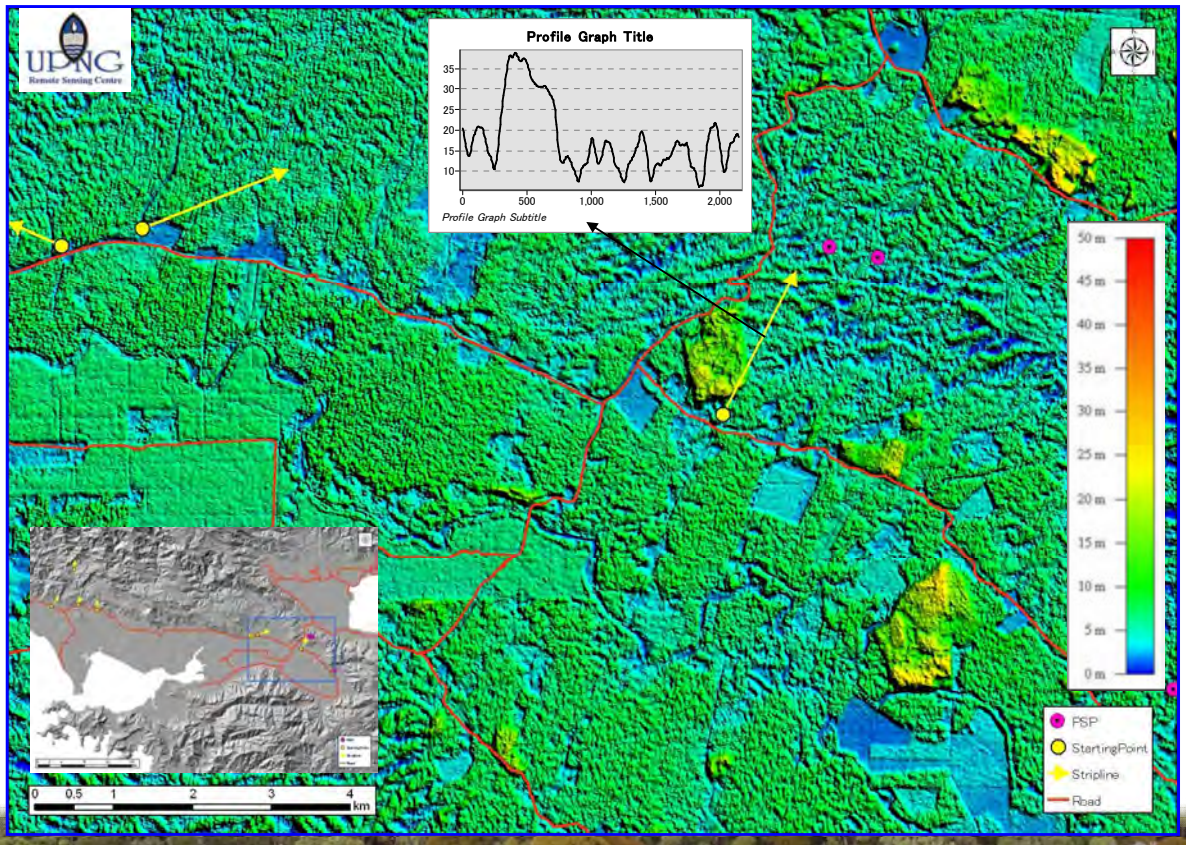
Carbon Stock Amount

Field Survey

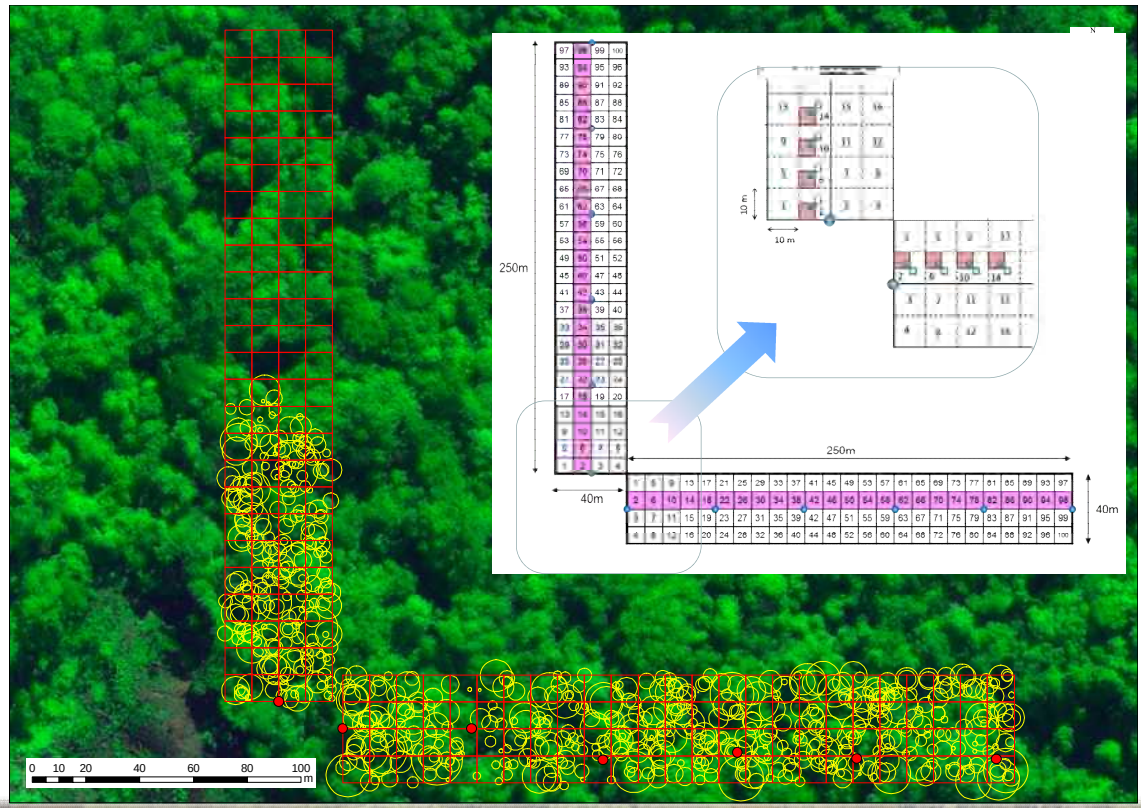
Stand Volume

- ✓ **Tree Species**
- ✓ **Tree Height**
- ✓ **DBH**
  - ➢ **Allometric Model**

Digital Canopy Volume derived from Airborne Radar

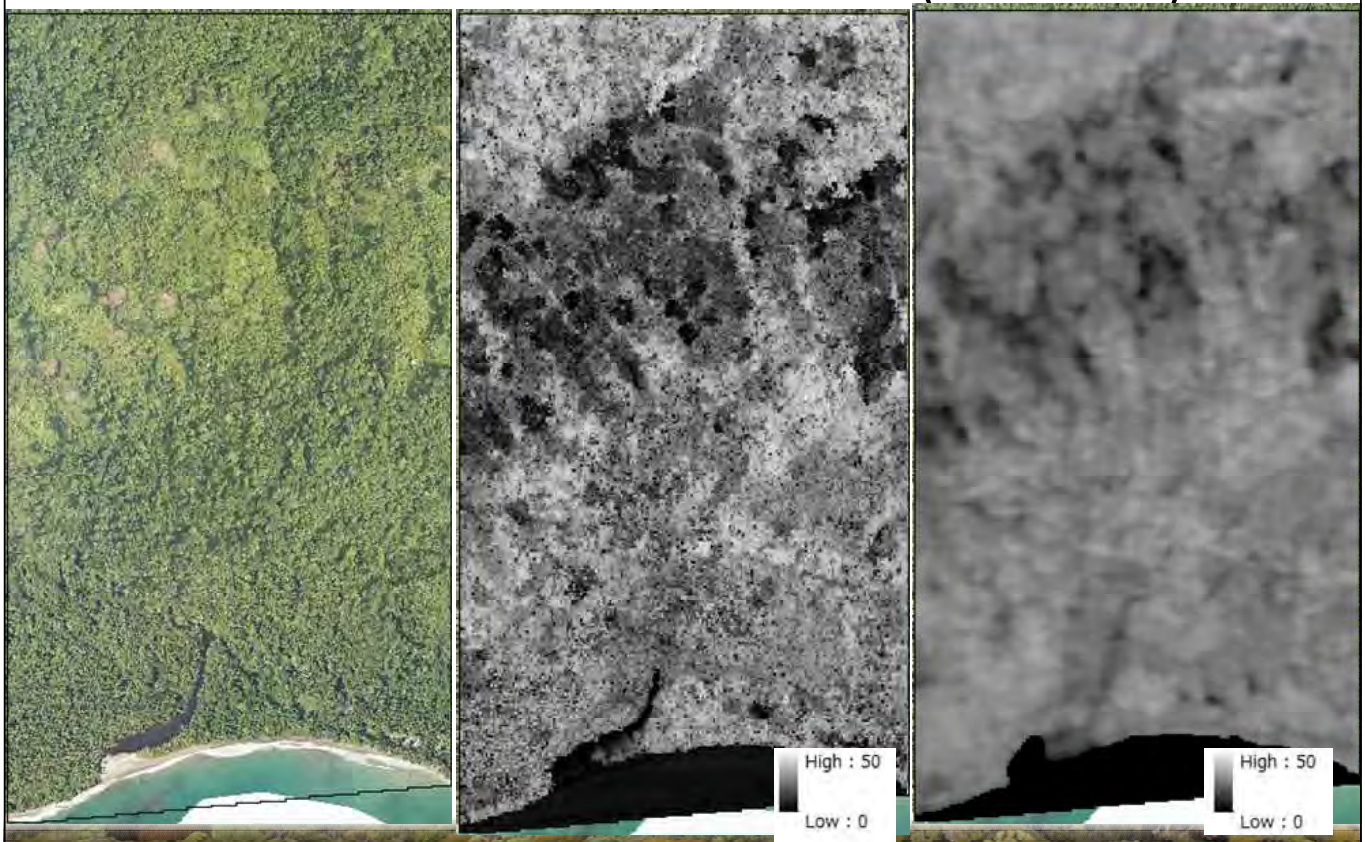


Detail Plot Survey for Canopy Volume Estimation

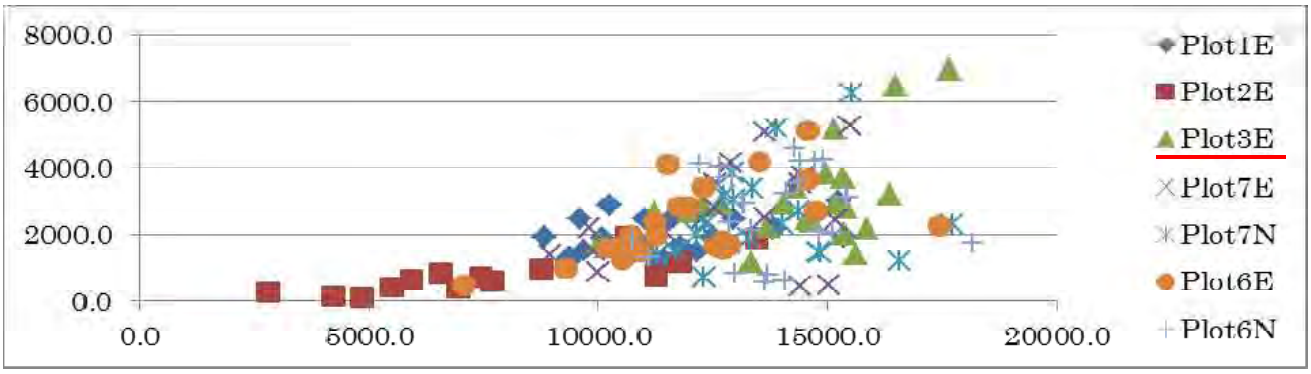


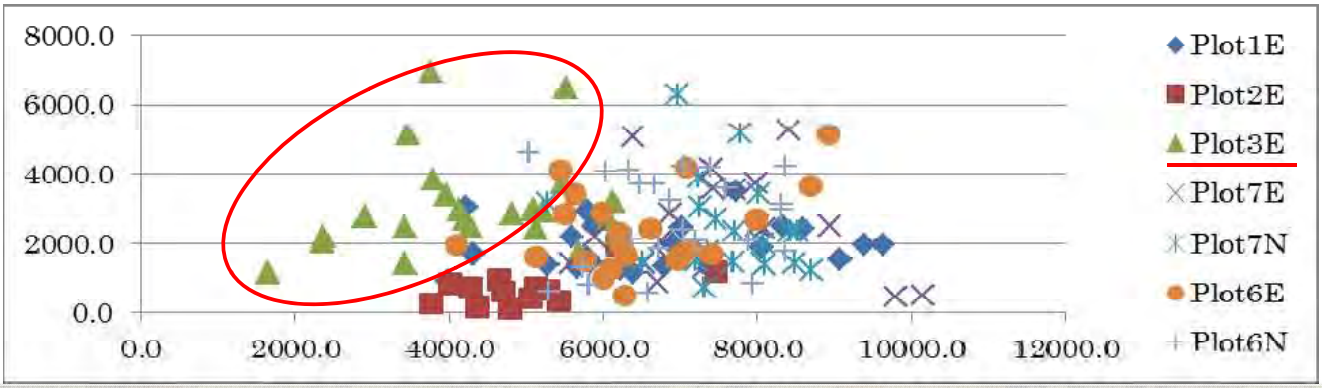
Geo-Eye Imagery and Ground-based Survey by PNGFA May 2012

Assessment of LiDAR & GeoSAR (Plain Area)

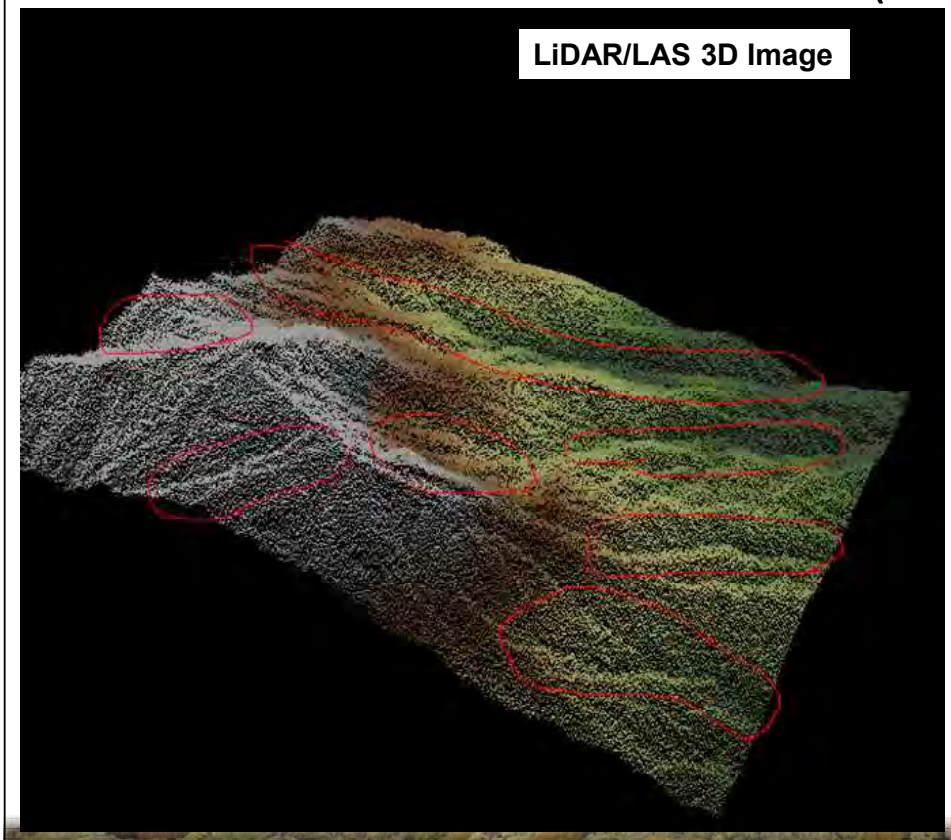


Correlation Analysis between Canopy Volume & Biomass

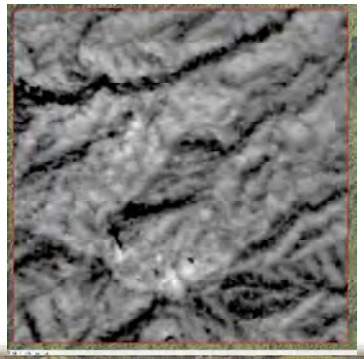




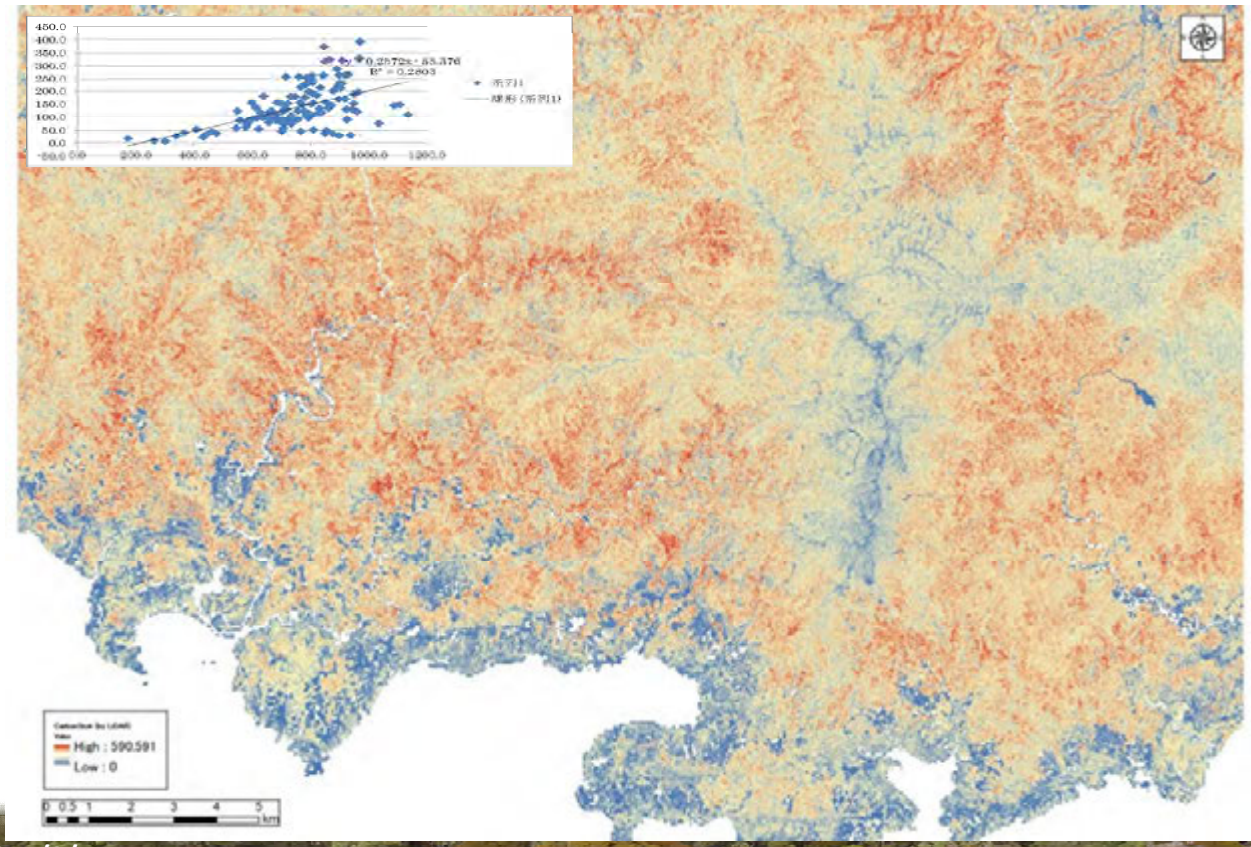
Assessment of LiDAR & GeoSAR (Montane Area)



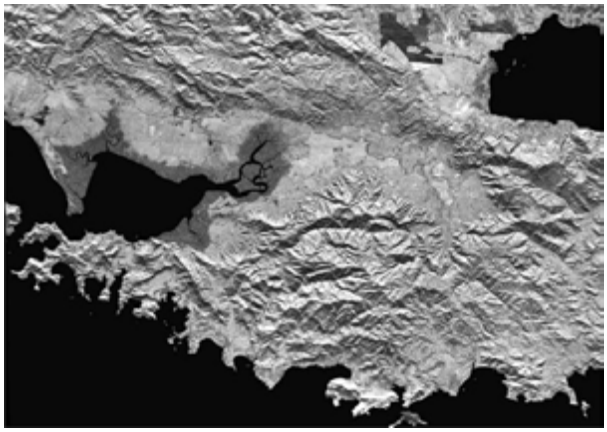
TreeHight_GeoSAR2012

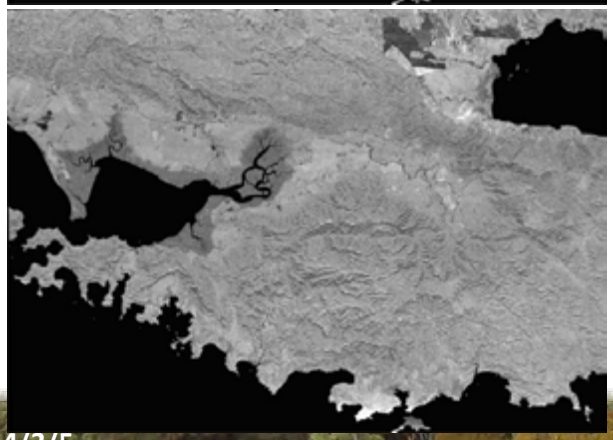


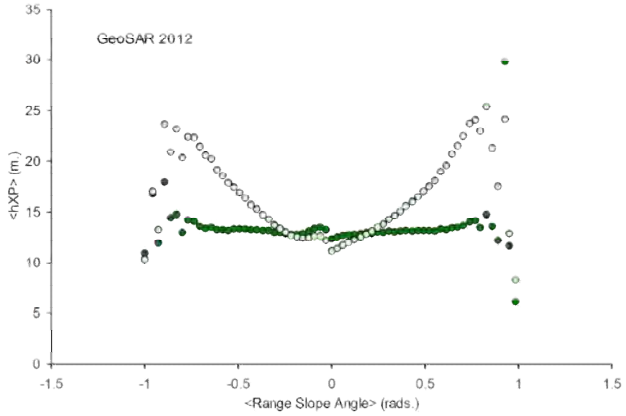
Estimated Carbon Stock by LiDAR Canopy Volume

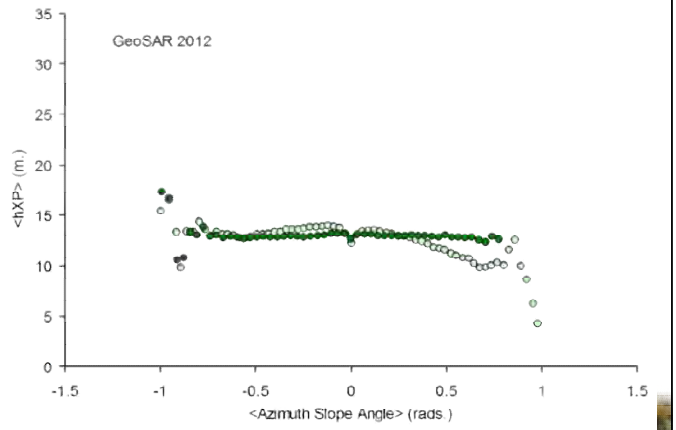


GeoSAR Terrain Illumination Correction









Suggestions for Improving Canopy Volume Estimation

- Analyze with GeoSAR Terrain Illumination Corrected Data
- Analyze based on Slope and Vegetation Type Clusters
- Analyze with Canopy Cover & Crown Density Info by Ground Survey & Densiometer
- Analyze with National Forest Inventory Info in the Future
- Analyze with the Classification of Secondary Forest and Forest Degradation Level
- Improve the Pre-Processing of Path/Swath Coordination (by Data Provider)

Summary

- JICA Project & Grant Aid Program are cooperated & Integrated
- Equipment were distributed as plan mostly (some changed)
- Satellite Image (Optical/Radar), Airborne Data were collected
- Equipment were distributed as plan mostly (some changed)
- Airborne Data was collected as planned (take time though)
- Data Sharing: Property/Right & MoA will be agreed later
- Data & User Management are on trial operation (with S.R.O)
- Technical Assistance was implemented and completed in Dec.
  - TA4: Topo Map Scanning was completed, Training Program for UPNG, UNITECH & FRI were conducted
  - TA3: Canopy Volume Estimation for Carbon Stock was demonstrated and recommendation are arranged

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Tenkyu tru (Picture: setting Grant Aid equipment's)

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Evaluation Outline of the Current Project and Concept of Next JICA T/C Project

Tatsuya Watanabe

Chief Advisor

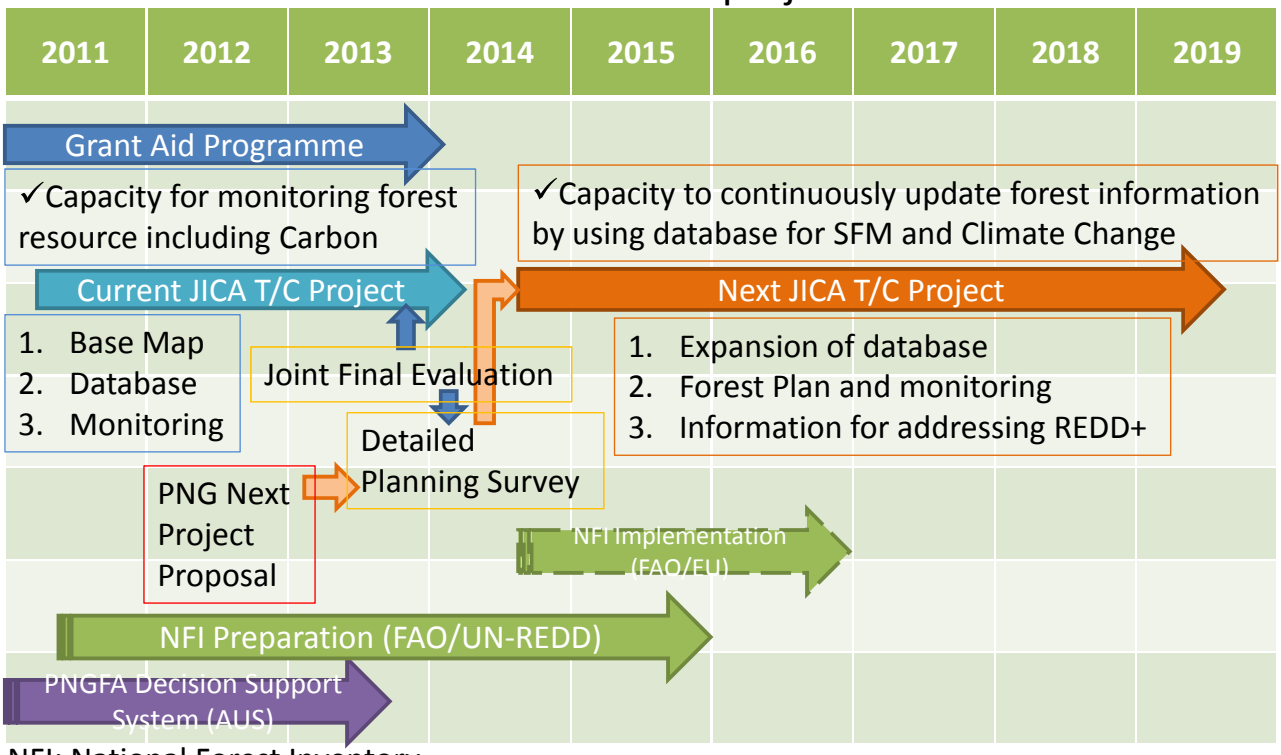
JICA PNGFA Project

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Contents

1. Sequence for terminal evaluation and new project formulation
2. Outline of the JICA Project Joint Evaluation
3. Evaluation comments taken account or incorporated into new project formulation
4. Overall Concept of the new Project

1. Sequence for terminal evaluation and new project formulation in the timeframe of JICA and relevant projects in 2011-2019



NFI: National Forest Inventory

2. Outline of the JICA Project Joint Evaluation

1. Objectives of terminal evaluation

To review whether objectives can be achieved by the time of termination of the project period and to give recommendations and lessons learned for a future relevant activities.

2. Members of Joint Evaluation Team

[Japanese side]

- **Mr. Hiroki Miyazono, Leader of Japanese-side Review Team, Senior Advisor, JICA**
- **Mr. Toshihiro Shima, Forestry Agency, Ministry of Agriculture, Forestry and Fisheries**
- **Mr. Hiroyuki Miyazaki, Global Environment Department, JICA**
- **Ms. Asako Takimoto, Social Development Department, Global Link Management Inc.**

[PNG side]

- **Mr. Michael Gigmai, Leader of PNG-side Review Team, Foreign Aid Division (Bilateral), Department of National Planning and Monitoring**
- **Mr. Michael Ketava, Monitoring and Evaluation Division, Department of National Planning and Monitoring**
- **Mr. Wakai Digine, Infrastructure and Economic Division , Department of National Planning and Monitoring**

✓ Schedule

- 3 October -23 October 2013

3. Evaluation comments taken account or incorporated into new project formulation

1. The next project can include activities necessary to enhance the current project activities → **Project Purpose**
2. More inputs needed to base map improvement and estimation of national level carbon stock change and reference emission level → **New Output 1**
3. Application of the project's products to forest management planning and other multipurpose usage → **New Output 2**
4. More field level C/P training and establishing data collection and exchange system with provincial offices → **New Output 2**
5. How to maximize the impact of the project achievement is still concern (Publicity issue) → **New activities**
6. Seamless transition to the next project → **Sorry, too late!**

4. Overall Concept of the new Project

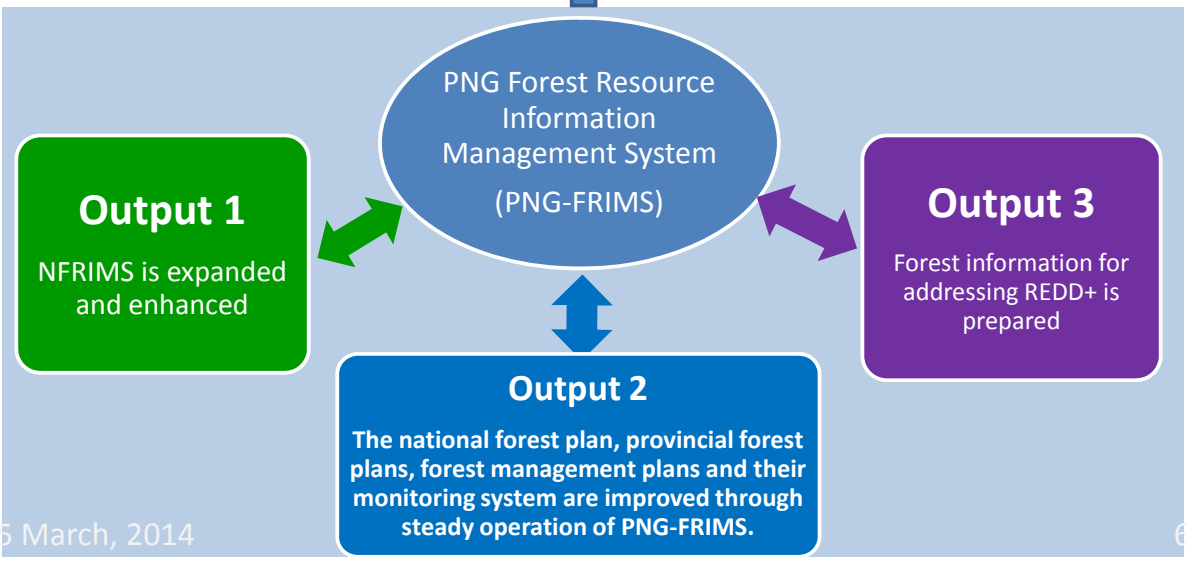
Project Period: 5 years (from 2014 to 2019)

Overall Goal

Forests in PNG are conserved and managed in a sustainable manner, while at the same time, mitigation and adaptation measures against climate change are promoted.

Project Purpose

Capacity of the PNGFA to continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.



Thank you
Tenkyu tru
Arigatou gozaimashita

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Forest definition and forest classification

Rabbie Inzing Lalo & Gewa Gamoga

PNG Forest Authority
Forest Policy & Planning Directorate

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Learning outcomes

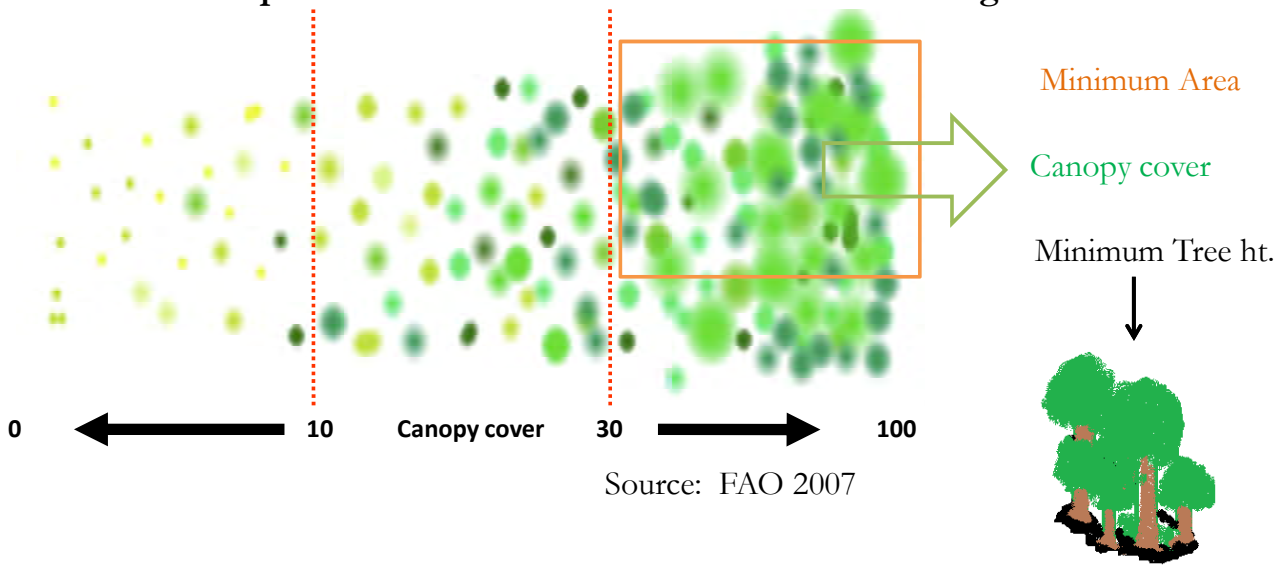
After this presentation you will learn the basics about:

1. Forest definition
2. Land Cover / Land Use
3. Forest classification
4. Importance of forest definition
5. Challenges of forest definition

Questions, Answers & Comments

Forest Definition

This landscape seen from above shows the tree crowns as green dots.



Source: FAO 2007

Narration: *It is difficult to find just one definition of a forest. In nature there is a continuum of woody vegetation, from open woody vegetation on the left, to closed woody vegetation on the right. Where the forest starts and open woody vegetation, or savanna, ends is an arbitrary definition. This is illustrated with red lines in the graph.*
(http://www.cifor.cgiar.org/fctoolbox/download/Topic-4-Section-A.pdf.)

Forest Definition…

FAO's definition of a forest

- Minimum land area is 0.5 hectares
- Minimum canopy cover is 10%
- Minimum height is 5 metres

Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use.

Explanatory notes

1. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters *in situ*.
2. Includes areas with young trees that have not yet reached but which are expected to reach a canopy cover of 10 percent and tree height of 5 meters. It also includes areas that are temporarily unstocked due to clear-cutting as part of a forest management practice or natural disasters, and which are expected to be regenerated within 5 years. Local conditions may, in exceptional cases, justify that a longer time frame is used.

http://www.fao.org/docrep/014/am665e/am665e00.pdf

Forest Definition…

PNG NFITWG Committees & JICA Tech. Team have assisted in defining PNG 's Forest definition.

PNG's definition of a forest is a:

- ***"land spanning more than 1 hectare, with trees higher than 3 meters and the canopy cover of more than 10 percent (%)"***.

- This does not include land that is predominantly under agricultural or urban land use.

Land Cover / Land Use

Land cover indicates the physical land type & its area such as forest, other wooded land, grasslands, wetlands, open water, bare areas etc...

There are two primary methods for capturing information on **land cover**: field survey and analysis of remotely sensed imagery.

Land use is a description of how people utilize the land. Socio-economic activity - urban and agricultural land uses are two of the most commonly known land use classes

http://en.wikipedia.org/wiki/Land_cover
http://oceanservice.noaa.gov/facts/lclu.html

Land Cover / Land Use…

Land Use Hierarchical rules was invented in order of preferences as follows *(Gamoga per.com. 2014)* :

1. Settlement 10%
2. Cropland 20%
3. Forestland 30%
4. Grassland 30%
5. Wetland 30%

% assigned based on land use definition. For example a 1ha. forest/plot area with ≥10% covered by settlement is considered settlement. Next option is cropland & so forth.

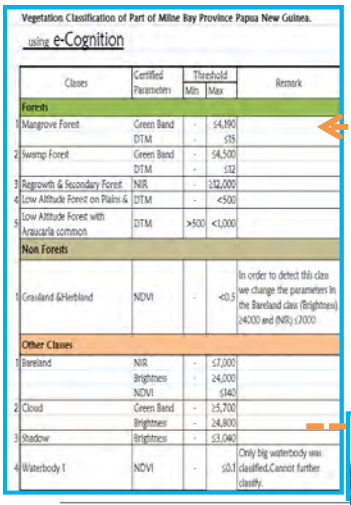
This is in consistent with our forest definition where land predominantly under agriculture or urban land use is excluded.

Forest classification

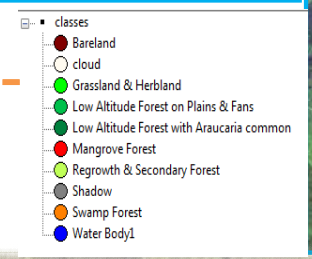
• Arranging different forest types into their rightful classes

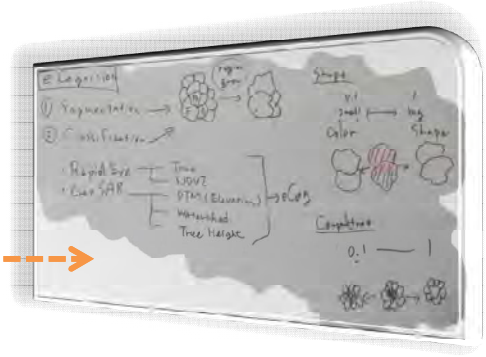
• Under the JICA/PNGFA project we classified 12 different forest types using GIS, RS technologies, human interpretation work and Ground truthing

1.Low Altitude Forest on Plains & Fans
2.Low Altitude Forest on Uplands
3.Lower Montane Forest
4.Montane Forest
5.Dry Seasonal Forest
6.Littoral Forest
7.Seral Forest
8.Swamp Forest
9.Mangrove Forest
10.Woodland
11.Savanna
12.Scrub

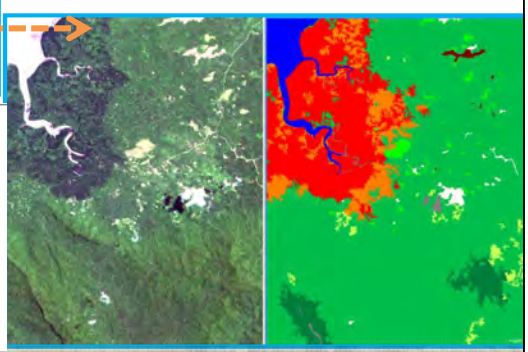

Vegetation Classification of Part of Milne Bay Province Papua New Guinea.
using e-Cognition

Classes	Certified Parameters	Threshold Min	Threshold Max	Remark
Forests				
1 Mangrove Forest	Green Band	-	≤4,190	
	DTM	-	≤35	
2 Swamp Forest	Green Band	-	≤4,500	
	DTM	-	≤32	
3 Regrowth & Secondary Forest	NIR	-	≥12,000	
4 Low Altitude Forest on Plains &	DTM	-	<500	
5 Low Altitude Forest with Araucaria common	DTM	>500	<1,000	
Non Forests				
1 Grassland &Herbland	NDVI	-	<0.5	In order to detect this class we change the parameters in the Bareland class (Brightness) ≥4000 and (NIR) ≤7000
Other Classes				
1 Bareland	NIR	-	≤7,000	
	Brightness	-	≥4,000	
	NDVI		≤140	
2 Cloud	Green Band	-	≥5,700	
	Brightness	-	≥4,800	
3 Shadow	Brightness	-	≤3,040	
4 Waterbody 1	NDVI	-	≤0.1	Only big waterbody was classified.Cannot further classify.





Object based classification (eCognition Software)



Importance of forest definition

1. Foundation for any forestry related work;
2. Differentiate landuse and forest area;
3. Differentiate non-forest and forest area;
4. Consistency in reporting and research work;
5. Country specific & very useful for interested stakeholders' to use;
6. Assist and guide forestry projects and on-going donor projects.

Challenges of forest definition

1. Method of sampling and data analysis will vary according to forest types;
2. Natural forest versus planted forest;
3. Other wooded areas versus actual forest areas;
4. Some RS satellite imageries and GIS classification work cannot differentiate between certain forest types following the forest definition.

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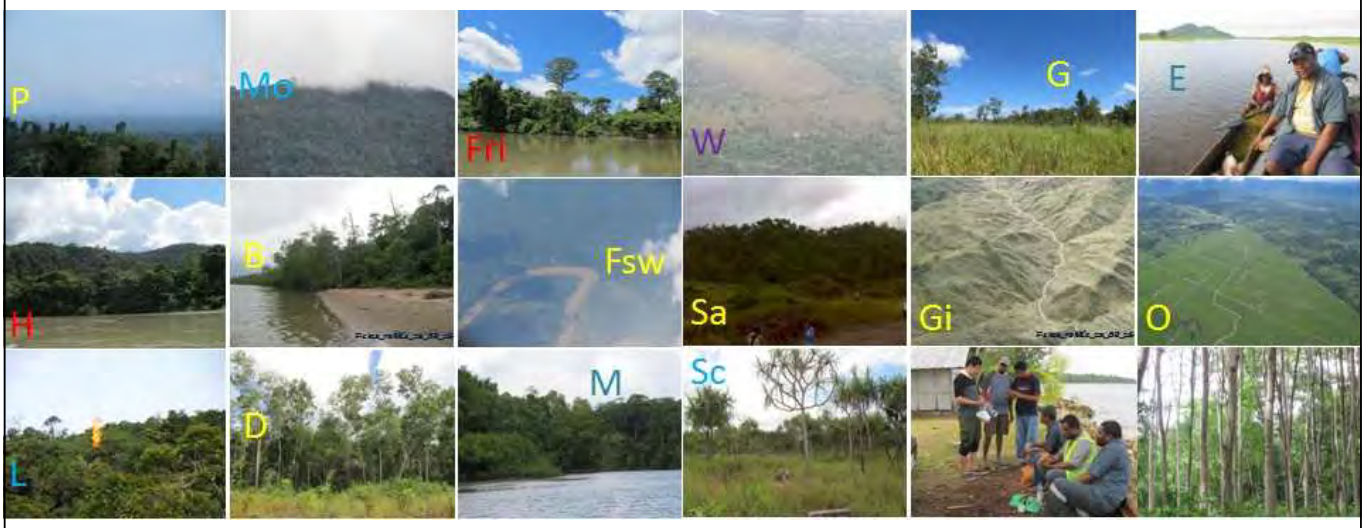

Thank you for your attention!

Closing Ceremony and final Workshop for Project Completion
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Holiday Inn Hotel, Port Moresby, PNG

Applied Data and Technology to develop Forest Base Map

06th March 2014

Masamichi HARAGUCHI

Team Leader of JICA Short-term Consultants
Kokusai Kogyo Co., Ltd (KKC)

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Contents

Classification Target by Satellite Remote Sensing

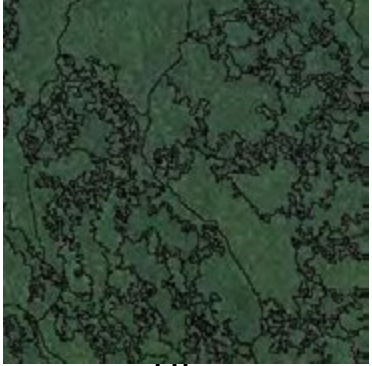
IPCC 2006 GL AFOLU	FAO FRA2010 PNG CR	Forest and Non-forest in Forest Base Map 2010	No.	Vegetation type in Forest Base Map 2010	Condition	Code
Forest land	Forest	Forest	1	Low Altitude Forest on Plains and Fans	below 1,000m	P
			2	Low Altitude Forest on Uplands	below 1,000m	H
			3	Lower Montane Forest	above 1,000m	L
			4	Montane Forest	above 3,000m	Mo
			5	Dry Seasonal Forest	in Western Prov.	D
			6	Littoral Forest		B
			7	Seral Forest		Fri
			8	Swamp Forest		Fsw
Depending on national definition of forest and thresholds chosen	Other wooded land (Non Forest)		9	Woodland		W
			10	Savanna		Sa
			11	Scrub		Sc
Grassland	Other land	Non-forest	12	Grassland and Herbland		G
			13	Alpine grassland	above 3,200m	Ga
			14	Subalpine grassland	2,500m - 3,200m	Gi
Forest land	Forest	Forest	15	Mangrove		M
Cropland	Other land	Non-forest	16	Agricultural Land Use		O
Wetlands	Inland Water Bodies		17	Lakes and larger rivers		E
Other Land	Other land		18	Bare areas		Z
Settlements			19	Settlements and larger urban centres		U
Forest land	Forest	Forest	20	Forest Plantation		-
Depending on national definition of forest and thresholds chosen	Other land	Non-forest	21	Plantation other than forest plantation		-

Classification Target by Satellite Remote Sensing

2	Low Altitude Forest on Uplands

Remote sensing (Satellite) ⟷ **Interpretation (Aerial photo)**

Hl	Large crowned forest
Hm	Medium crowned forest
HmAr	Medium crowned forest with Araucaria common
Hmd	Medium crowned depauperate/damaged forest
Hme	Medium crowned forest with an even canopy
Hs	Small crowned forest
Hse	Small crowned forest with an even canopy
HsAr	Small crowned forest with Araucaria common
HsCa	Small crowned forest with Castanopsis
HsCp	Small crowned forest with Casuarina papuana
HsN	Small crowned forest with Nothofagus
HsRt	Small crowned forest with Rhus taitensis

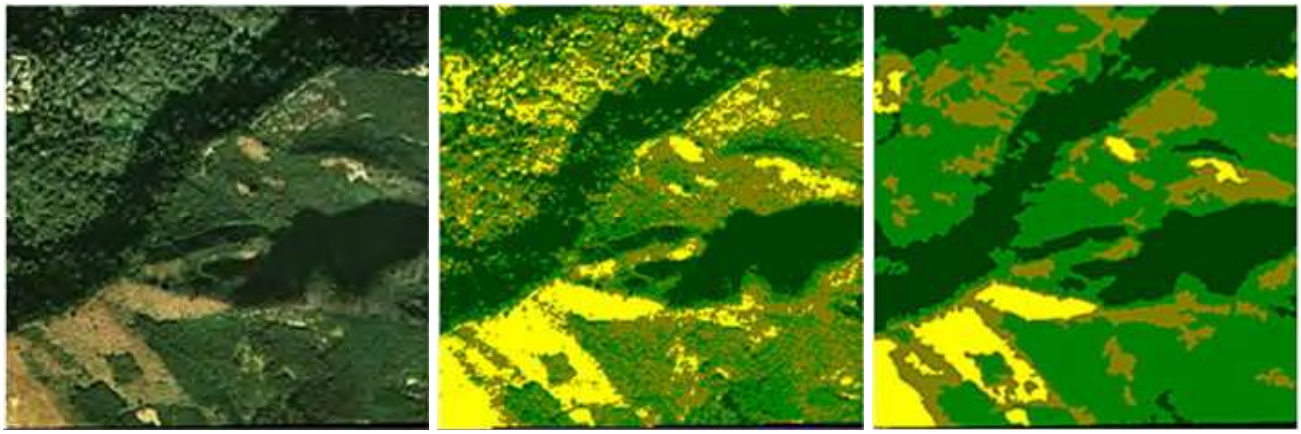


Hl
(Large crowned forest)

Hm
(Medium crowned forest)

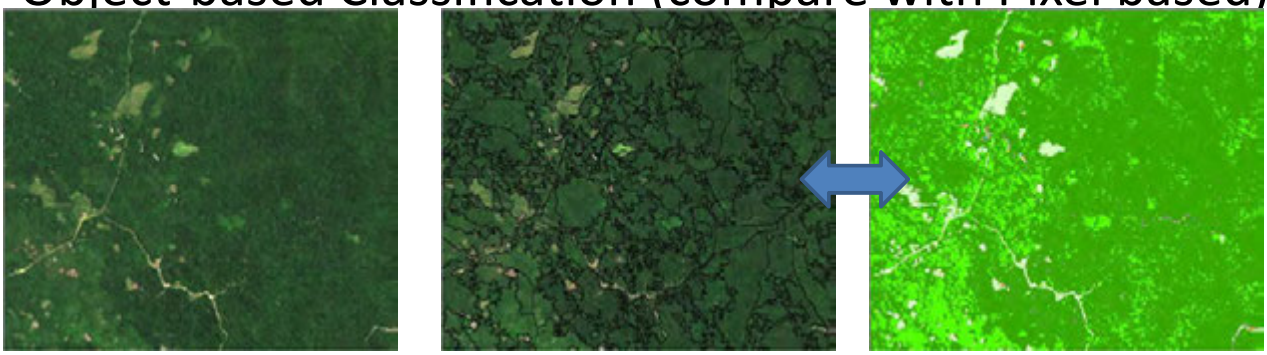
Hs
(Small crowned forest)

Object-based Classification (compare with Pixel based)



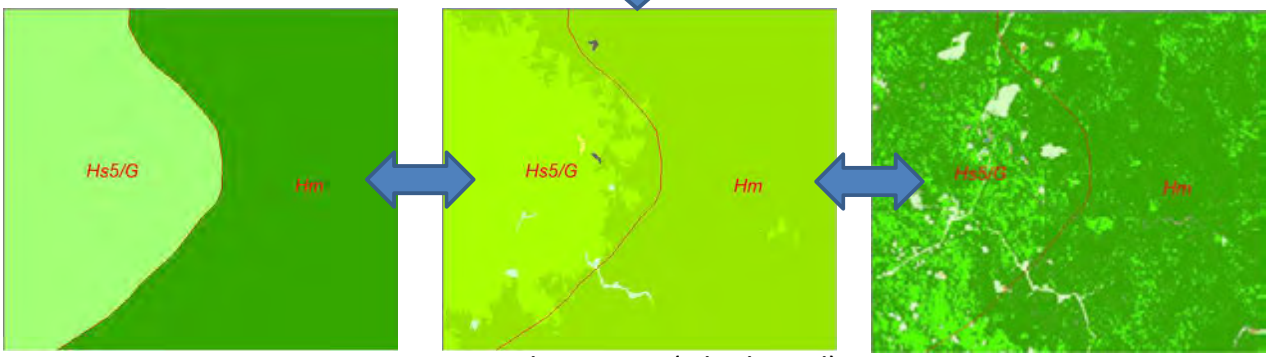
Original Image | Pixel-Based Classification | Object-Based Classification

Object-based Classification (compare with Pixel based)



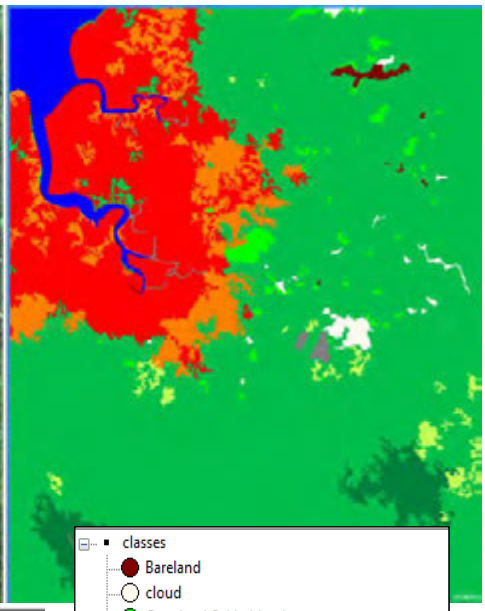
RapidEye image | eCognition segmentation | Pixel-based classification

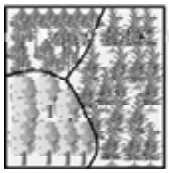
1:25,000 Level



FIMS vegetation | Forest base map (Obj. based) | Forest base map (Pxl. based)

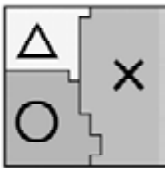
Object-based (eCognition) Classification Training (in Japan)





(a) Forest

(b) Pixel based classification

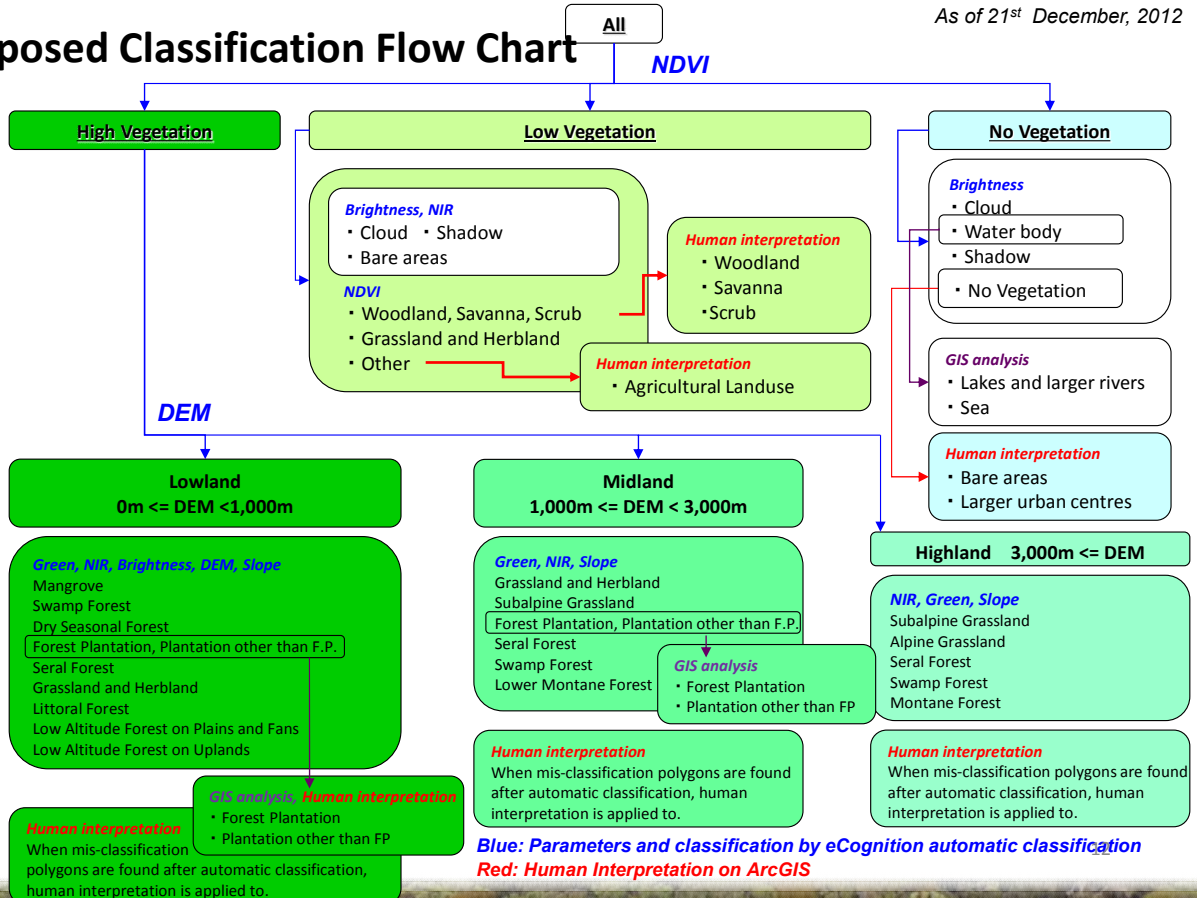


(c) Object based classification

- Create classes
- Input data (images)
- Threshold of parameters
- Procedure of processing

Proposed Classification Flow Chart

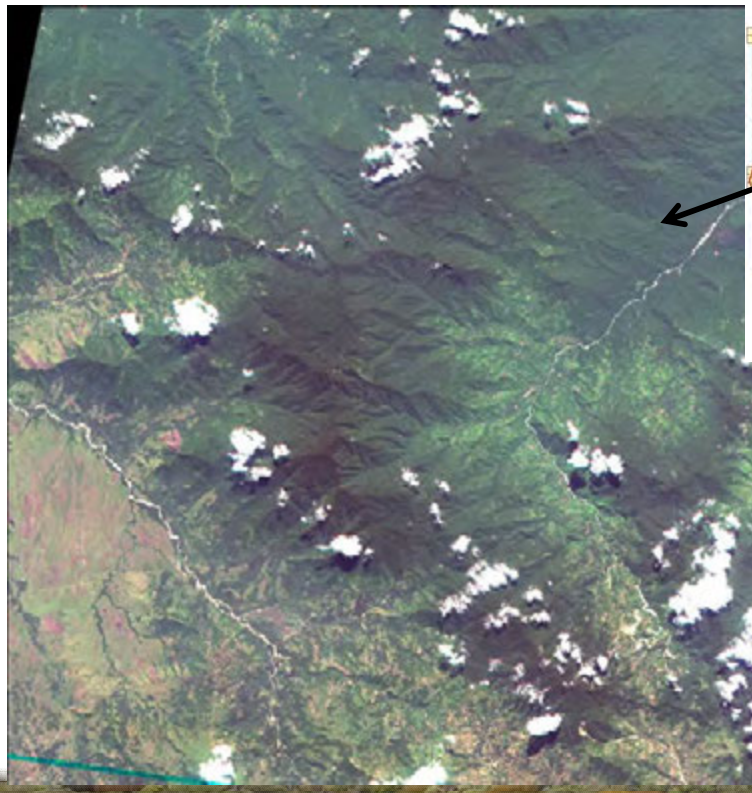
As of 21st December, 2012

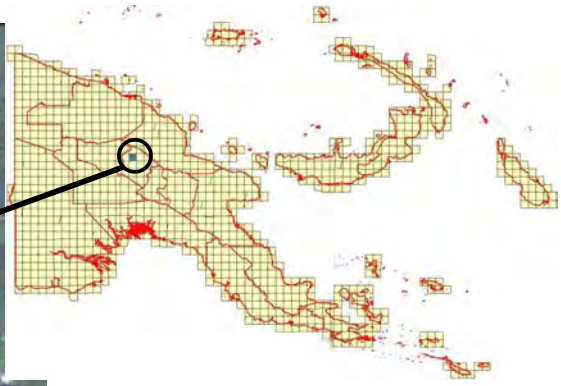


Blue: Parameters and classification by eCognition automatic classification

Red: Human Interpretation on ArcGIS

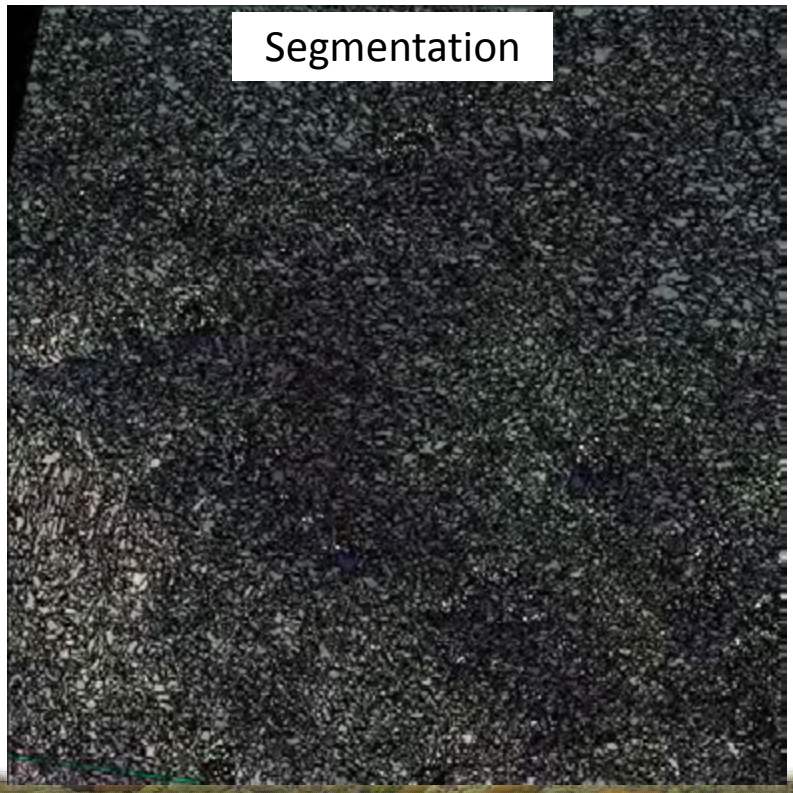
Proposed Classification Procedure (Demo)

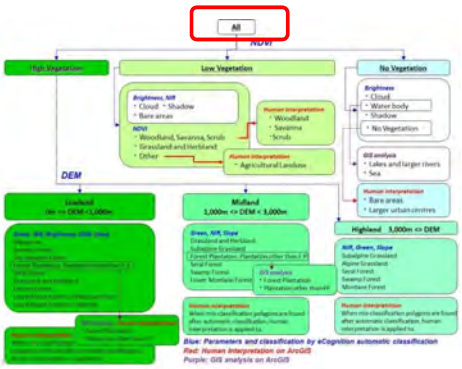




Location : Western Highlands

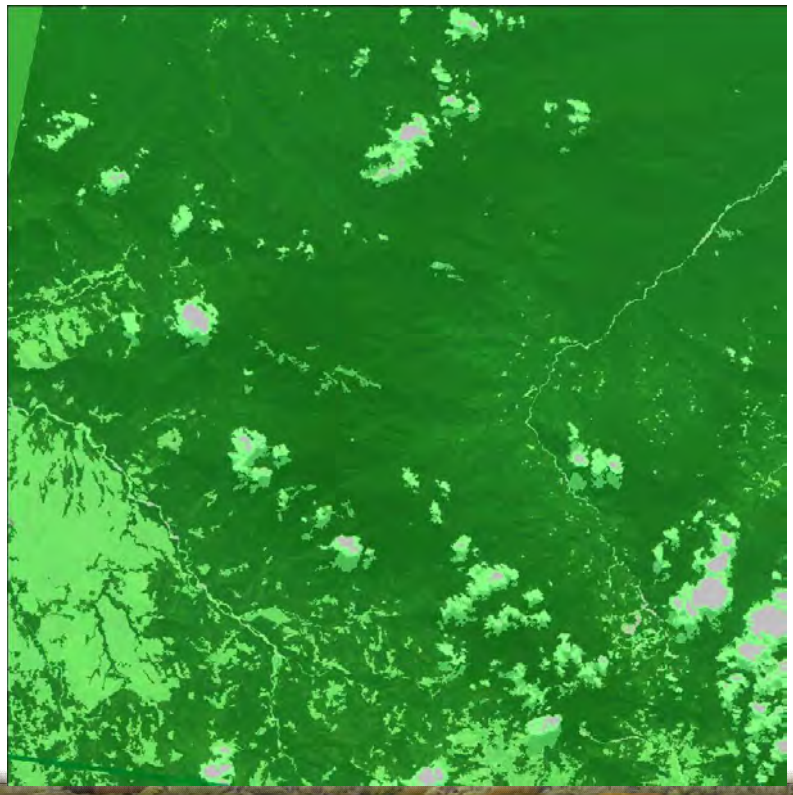
Proposed Classification Procedure (Demo)

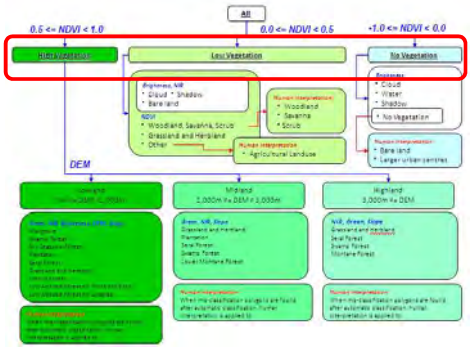




Proposed Classification Procedure (Demo)

1st : Vegetation area using NDVI

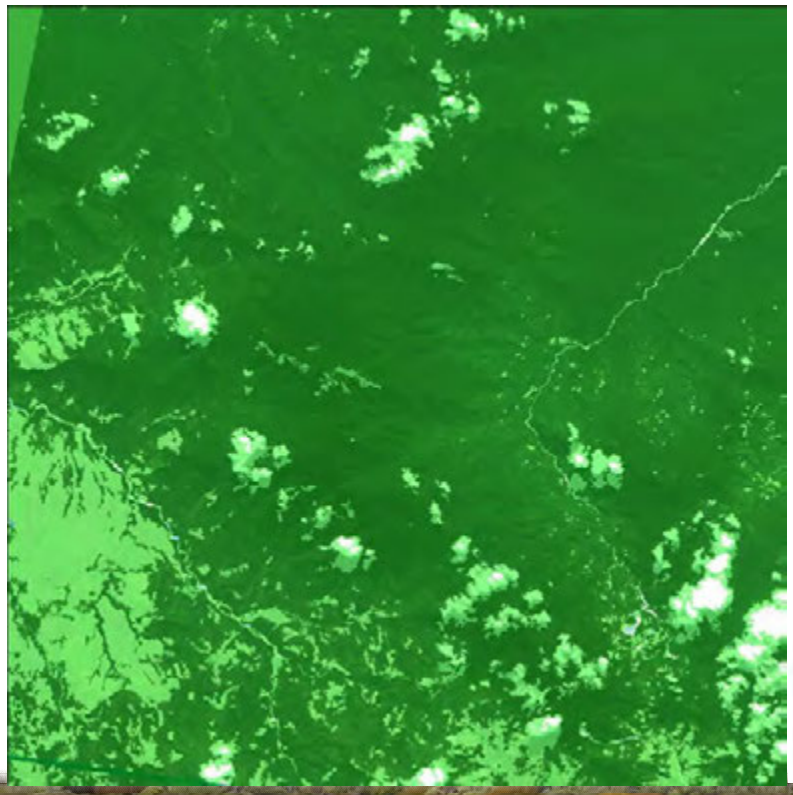


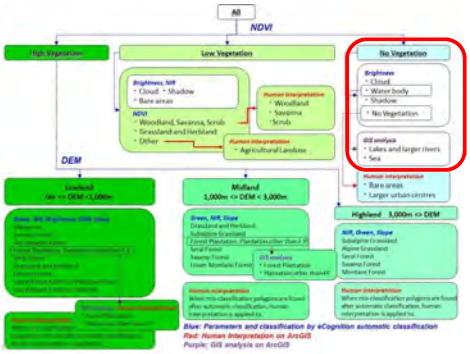


High Veg.
Low Veg.
No Veg.

Proposed Classification Procedure (Demo)

2nd : Classification of No Vegetation area

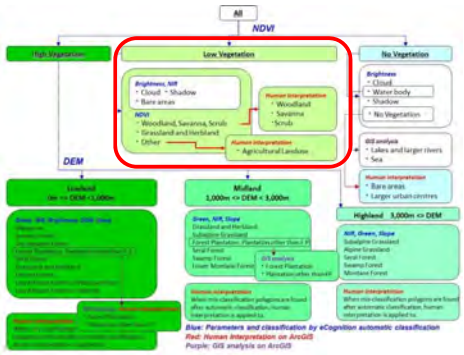




Cloud
High Veg.
Low Veg.
No Veg.
Shadow
Waterbody

Proposed Classification Procedure (Demo)

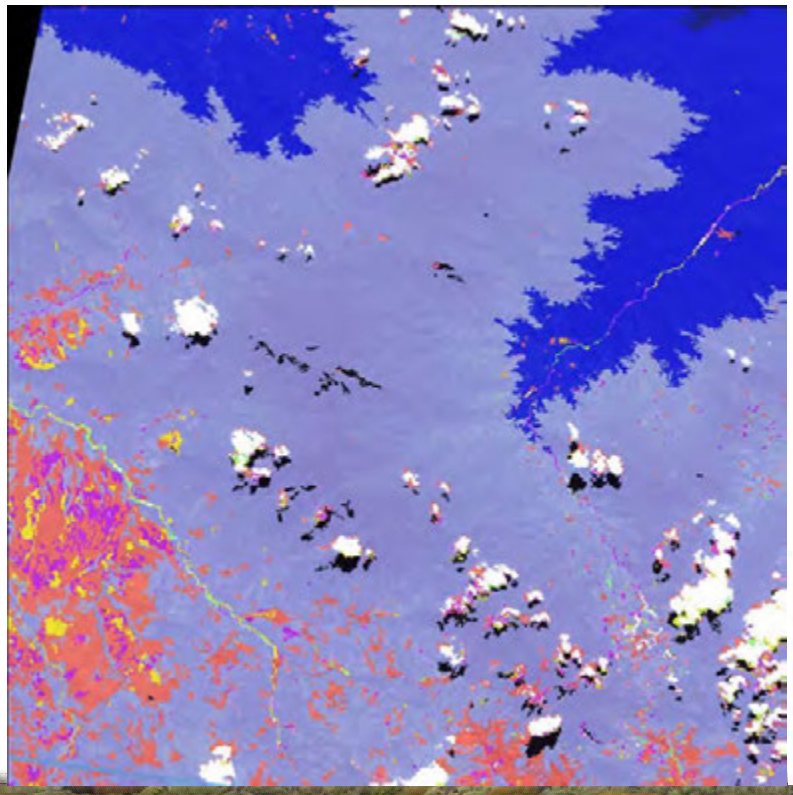
3rd : Classification of Low Vegetation area

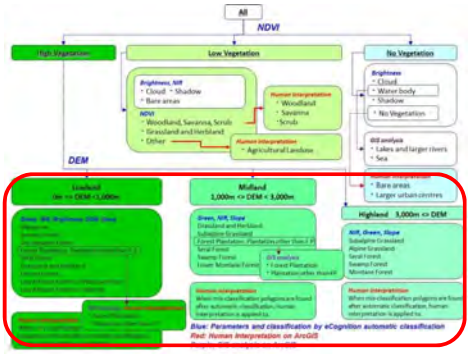


- Bareland
- Cloud
- Glassland and Harbland
- High Veg.
- Shadow
- Waterbody
- Woodland, Savanna, Scrub

Proposed Classification Procedure (Demo)

4th : Classification of High Vegetation area

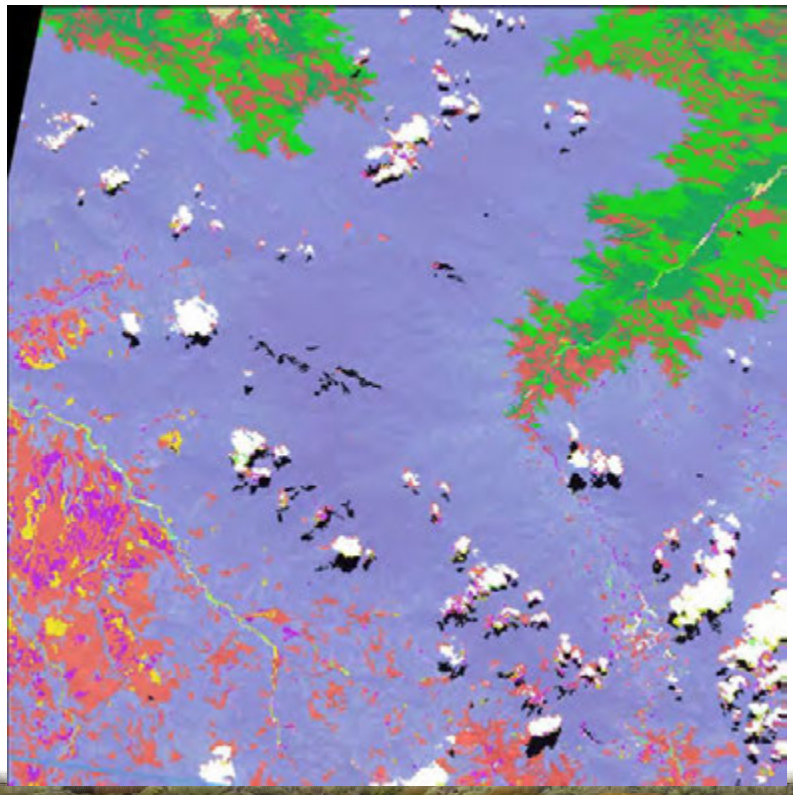


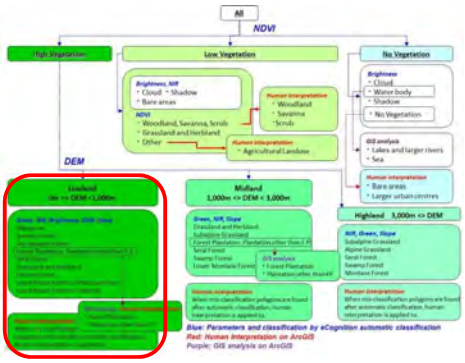


- Bareland
- Cloud
- Glassland and Harbland
- High_DEM0500
- High_DEM1000
- High_DEM3000
- High_DEM5000
- Shadow
- Waterbody
- Woodland, Savanna, Scrub

Proposed Classification Procedure (Demo)

5th : Classification of High Vegetation area

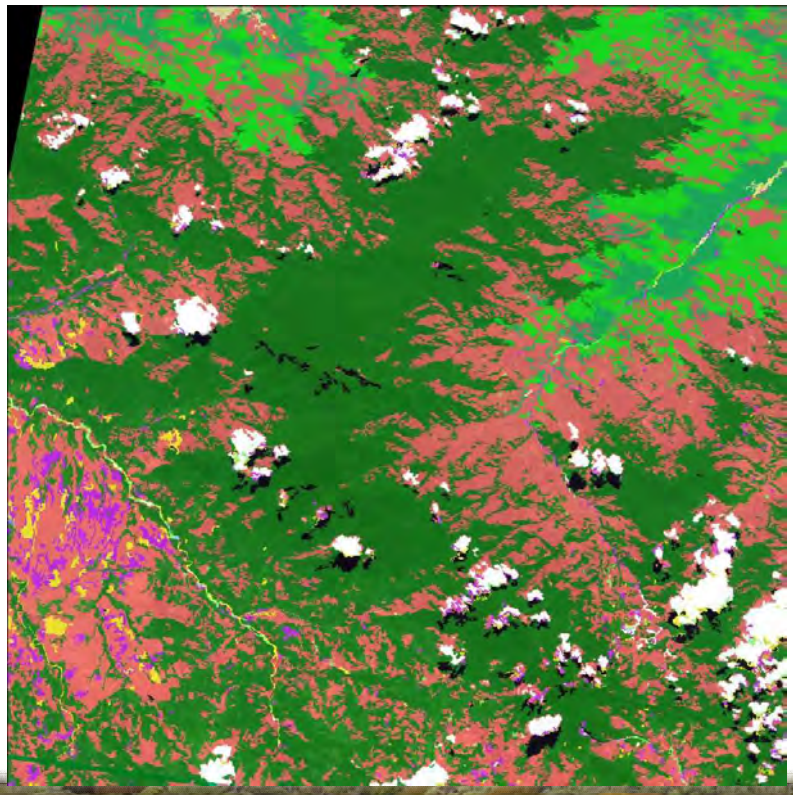


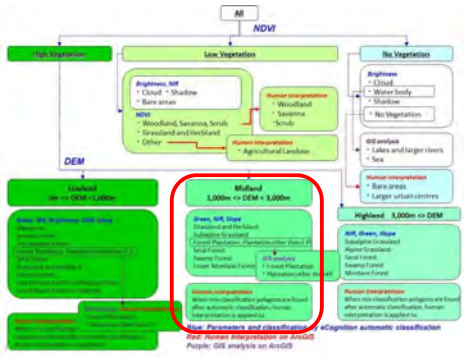


- Bareland
- Cloud
- Dry Seasonal Forest
- Glassland and Harbland
- Litoral
- Low Alt. Forest Plains
- Low Alt. Forest Uplands
- Lower Montane Forest
- Mangrove
- Montane Forest
- Plantation
- Seral(Riverline)
- Shadow
- Swamp
- Waterbody
- Woodland, Savanna, Scrub

Proposed Classification Procedure (Demo)

6th : Classification of High Vegetation area





- Bareland
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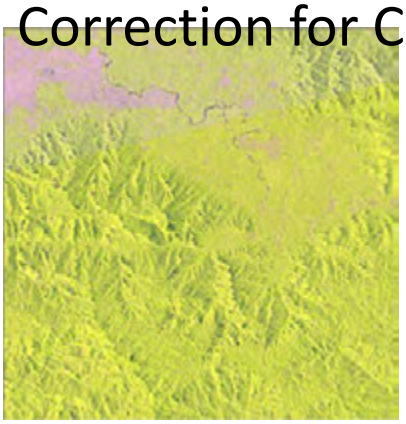
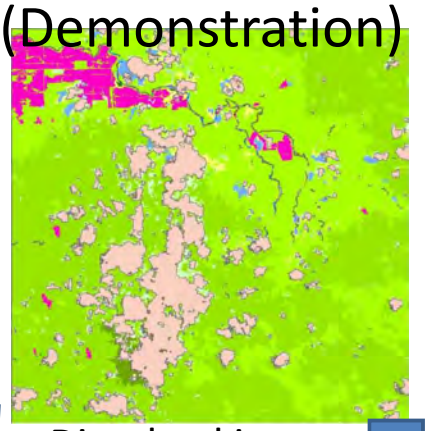
- Montane Forest
- Plantation
- Seral(Riverline)
- Shadow
- Swamp
- Waterbody
- Woodland, Savanna, Scrub

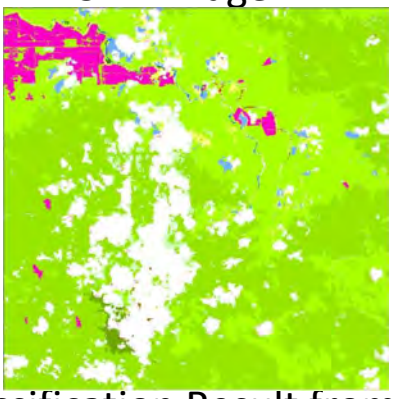
Correction for Cloud Area (Demonstration)



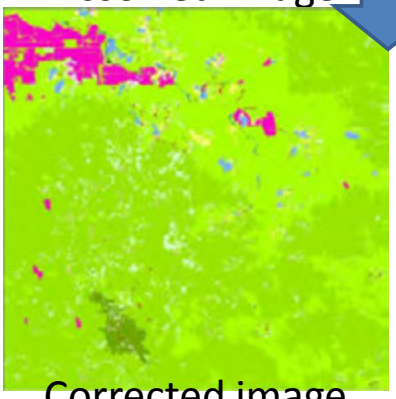
PALSAR image



Dissolved image

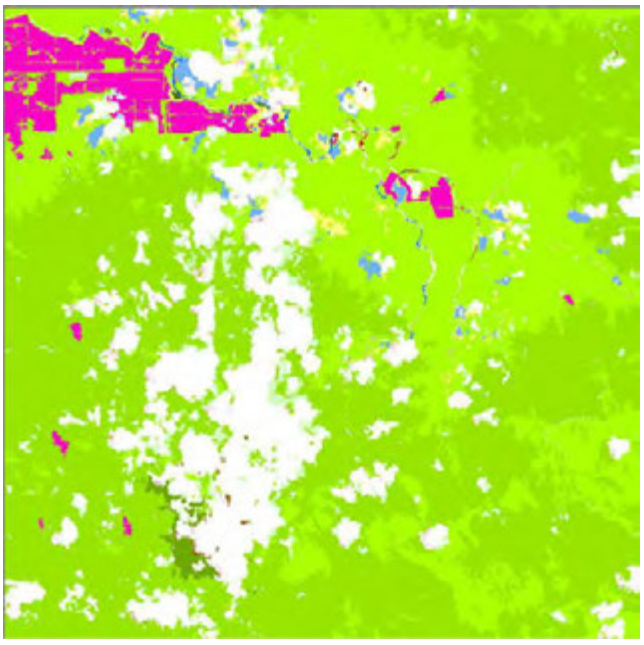


Classification Result from RapidEye

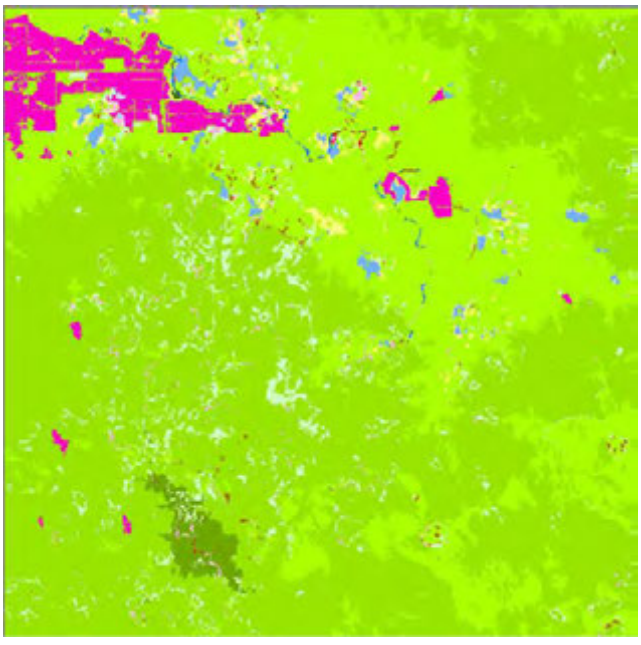


Corrected image

Correction for Cloud Area (Demonstration)



Classification

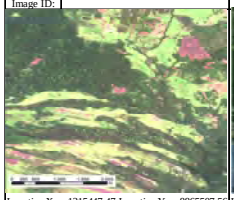
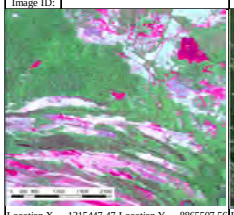


Corrected cloud cover Classification

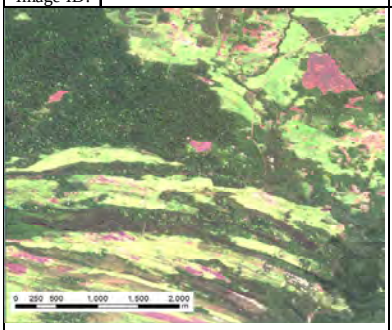
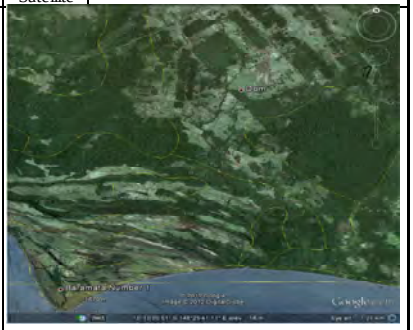
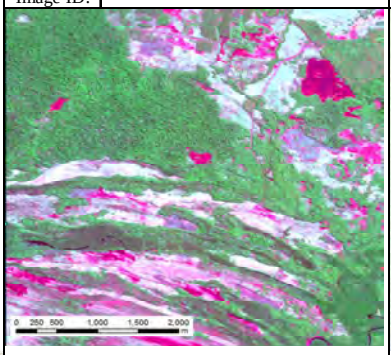
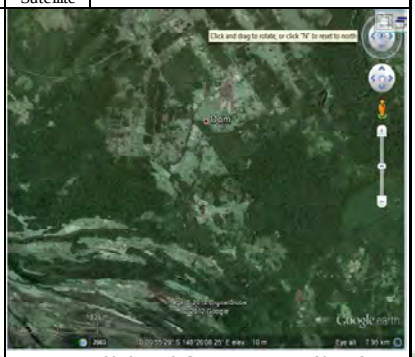
Interpretation Exercise for Classification

Structural formation		Grassland and Herbland "G"
Vegetation type		Grassland
Definition of FIMS		Grasses, sedges, herbs and very low woody shrubs. Generally less than 3m tall. Scattered trees may be present.
Characteristics of RapidEye image	Shape (Crown)	-
	Color	Reddish brown (RGB452)
	Shape	NA
	Size	NA
	Pattern	NA
	Texture	Matt
	Shade	-
	Circum-stance	Sign of settlement and gardening and areas Often contains burnt patches
eCognition	1st condition	
	2nd condition	
	3rd condition	
	4th condition	

RapidEye sample images

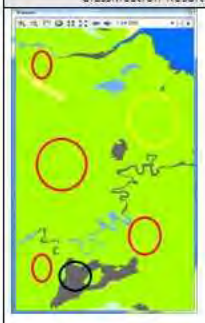
Rapid Eye (Color: B: G: R:)	Google Earth image
Image ID:	Satellite
	
Location X 1315447.47 Location Y 8865507.56 Date: Scale:	Location X 10°10'45.40"S Location Y 148°25'29.42"E Date: 11/26/2003 Elevation: 3-20m asl
Rapid Eye (Color: B: G: R:)	Google Earth image
Image ID:	Satellite
	
Location X 1315447.47 Location Y 8865507.56 Date: Scale:	Location X 10°10'45.40"S Location Y 148°25'29.42"E Date: 11/26/2003 Elevation: 3-20m asl

Comments

Rapid Eye (Color: B: G: R:)	Google Earth image
Image ID:	Satellite
	
Location X 1315447.47 Location Y 8865507.56 Date: Scale:	Location X 10°10'45.40"S Location Y 148°25'29.42"E Date: 11/26/2003 Elevation: 3-20m asl
Rapid Eye (Color: B: G: R:)	Google Earth image
Image ID:	Satellite
	
Location X 1315447.47 Location Y 8865507.56 Date: Scale:	Location X 10°10'45.40"S Location Y 148°25'29.42"E Date: 11/26/2003 Elevation: 3-20m asl

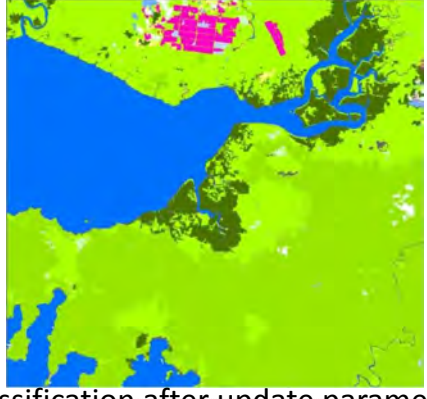
Assesment of Automatic Classification Result

Tile ID	5534626	Officer(s)	Elizabeth Kaldong
Province	Milne Bay	Region	Southern
Veg. Type			
Acq. Date	02/03/2011	Doc. Date	30/11/2012

Classification Result	Rapid Eye image
	
FIMS	Parameters
	

Comments	This polygon (red) is classified as low alt. forest plains but it is grassland. The second polygon (yellow) is classified as low alt. forest plains but is mangrove forest. The third polygon (black) is classified as shadow but it is bare land.

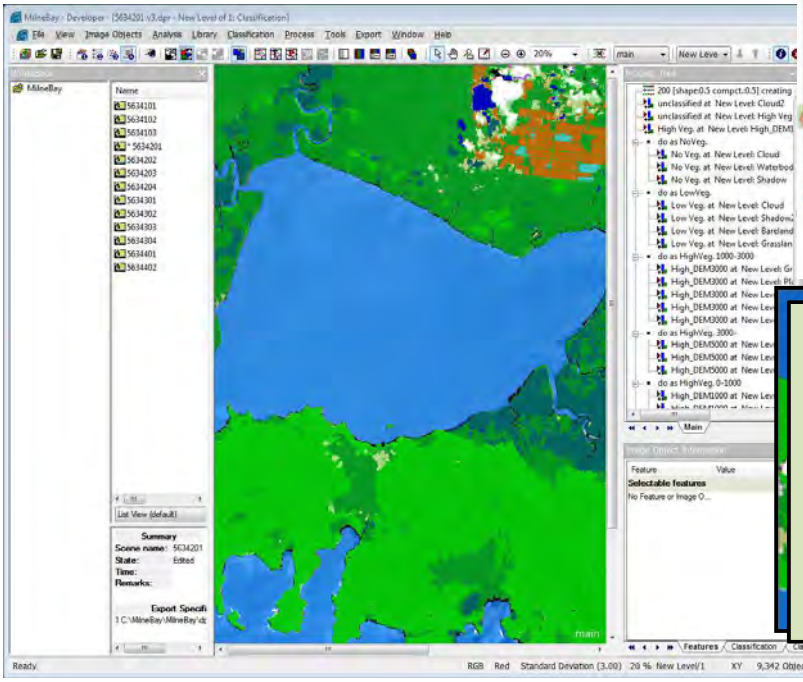
Classification before update parameters

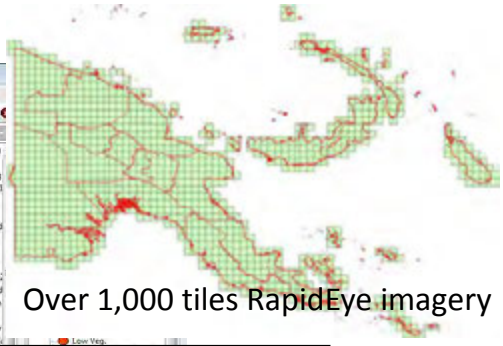


Classification after update parameters

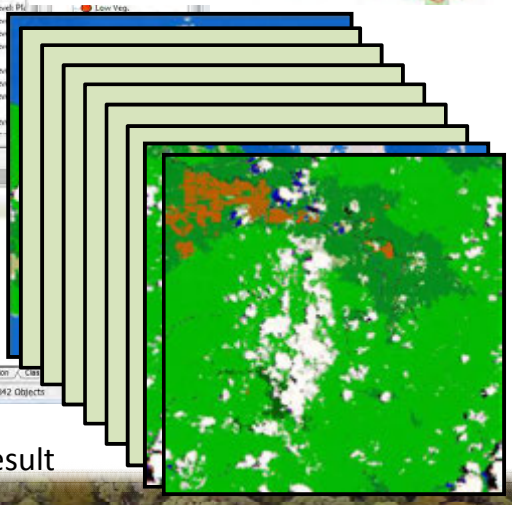
Mass Production based on Classification Flow &CP Input

Forest classification by eCognition software





Over 1,000 tiles RapidEye imagery



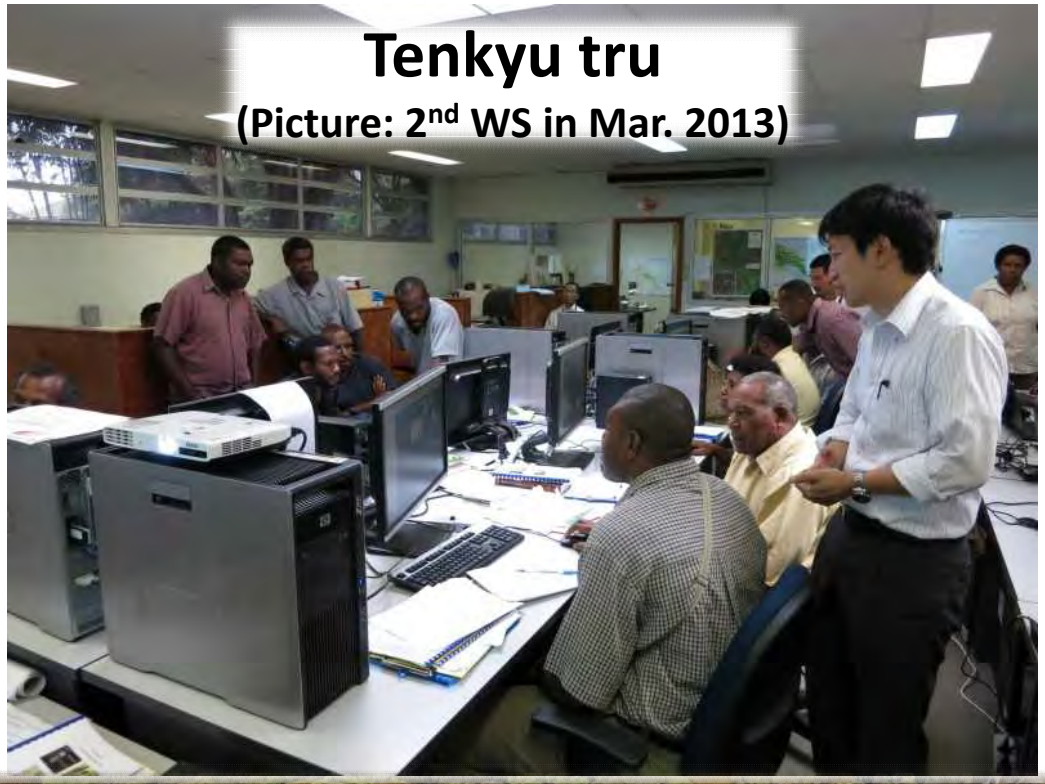
Automatic classification result

Summary

- Classification Target by Satellite RS was identified
- Object-based Classification was applied for the project
- Object-based Classification Training was conducted in Japan
- Classification Flow Chart was developed and applied
- Classification Procedure was applied and demonstrated
  - Segmentation & Vegetation Classification (by eCognition)
- Cloud Area was corrected by using ALOS/PALSAR(Radar)
- Interpretation Capacity of C/Ps were improved (IC Card)
- Automatic Classification Results were assessed by C/P
- Mass Production for PNG Foret Basemap was conducted

Tenkyu tru

(Picture: 2nd WS in Mar. 2013)



Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Ground Truth for Remote Sensing

Samuel Gibson

Officer – Forest Inventory
Forest Policy and Planning Directorate
PNG Forest Authority

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Outline

1 What is Ground truthing(GT)?

2 Purpose - Importance to Remote Sensing.

3 Ground truth and PNG Forest Base Map development.

4 Workflow of GT work developed by JICA and KKC

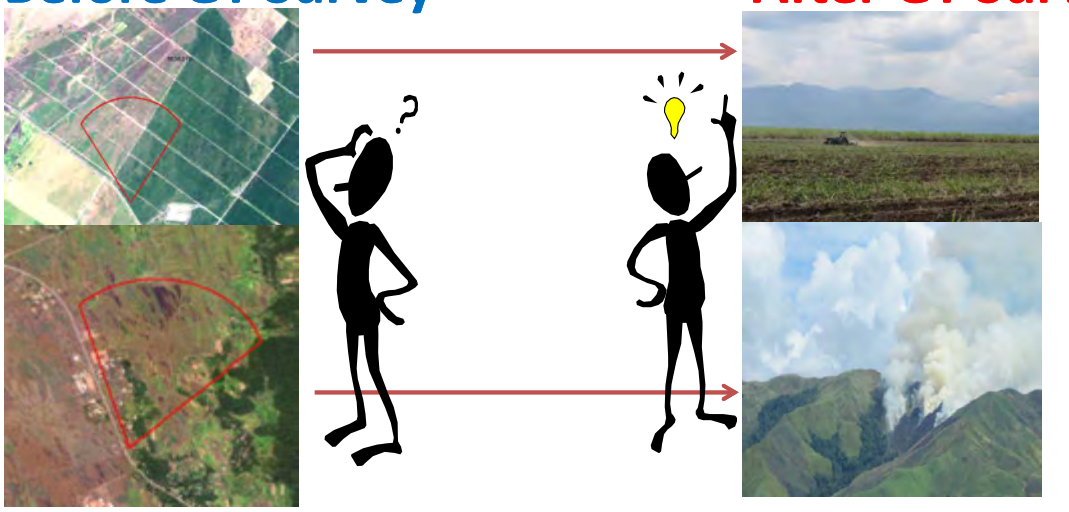
5 Results - Comparison of Satellite data with
- Field ground data – existing vegetation.
- Field observation on Land use change.

6 Summary and future work

1.What is Ground Truthing(GT)?

Ground truthing is the act of authenticating or verifying a captured remotely sensed or satellite image by way of physically visiting the site and collecting on site field data for comparison with the image of the same location.

Before GT Survey **After GT Survey**



Satellite image with direction(red cone) of photo taken

On site field photo taken by GPS Camera

Same agriculture areas with settlement and burnt out area in Ramu - Madang.

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2. Purpose of Ground truthing

To delineate the different vegetation and forest type in the area of interest. Satellite imagery data will not always give a detail answer to your query on the AOI

Build up level of confidence and common understanding with PNGFA and Japan counterpart officers. Interpreting Satellite data must be consistent to all who have knowledge of AOI.

Enable capacity of field officers from regional and provincial officers to be able to undertake GT work where when requested. Several officers have some exposure to GIS work and GPS use which is essential for all field officers nationwide.

3. Ground Truthing and the PNG Forest Base Map development

Introduction

- Ground truthing is important to confirm present status of forest and vegetation cover.
- During the JICA PNGFA project ground truth work was very crucial and it was undertaken to have an insight of the what the current status of the forest especially the four main regions of PNG.
- These four region possess some very typical vegetation type and their existence over the years are affected by human natural activities.
- Some of mono species of forest in these region and also changes to density of forest (e.g. Forest to Woodland or Woodland to Savanna and grassland).Based on what PNGRIS/FIMS has shown us over the years.

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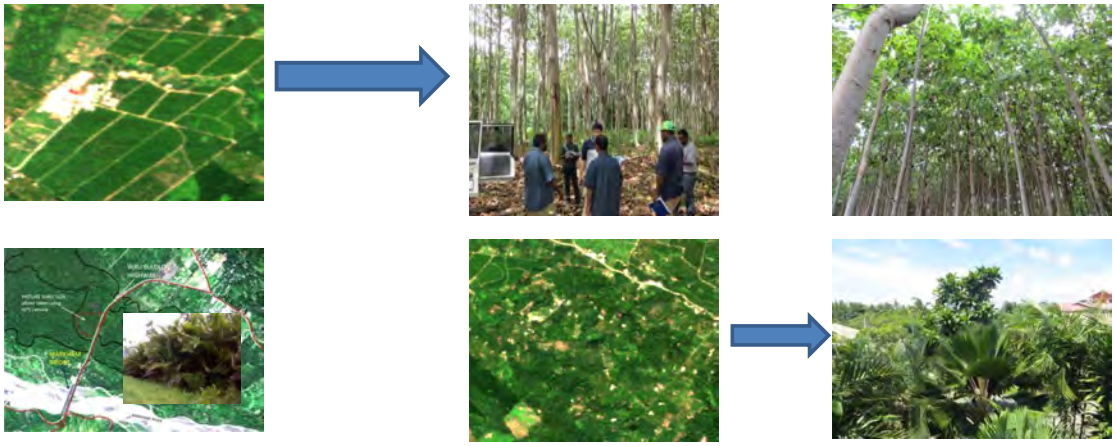
Summary of Ground truth work

A total of six (6) ground truth were conducted with the assistance from JICA and KKC with data prepared from Satellite image.

Forest Definition for Forest and other Wooded was also defined for the country and ground truth was also conducted in Western Province and Central province for this purpose.

Province/Region	Participants	Area of Interest (AOI)
1. Highlands	JICA/PNGFA/KKC	Highlands Forest type/Landuse
2. Western	JICA/PNGFA	Delineate Dry evergreen forest/Savannah
3. Central	JICA/PNGFA/KKC	Woodland/Grassland and Savannah
4. Morobe	JICA/PNGFA/FRI/KKC	Upland Forest (Hm)/Agriculture/Montane
5.East New Britain	PNGFA/KKC-JICA	Agriculture and forest plantation from Forest
6.Manus	PNGFA	Natural mono stand of Calophyllum/Hm

Most important point is:
Consider from Remote Sensing at first!
(That means to consider
how to classify by imagery)



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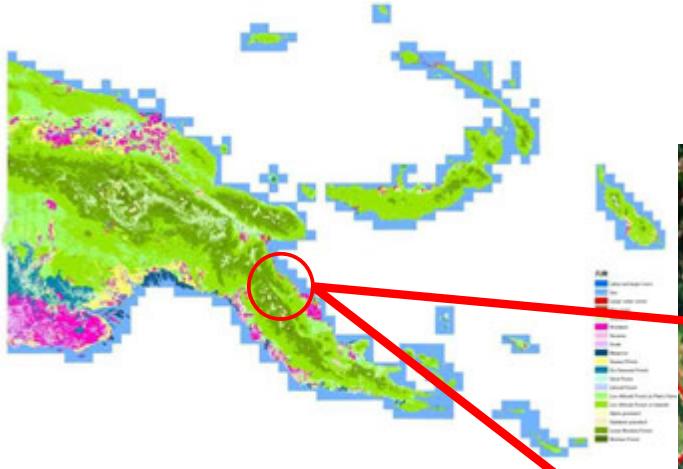
4.Work Flow of GT work

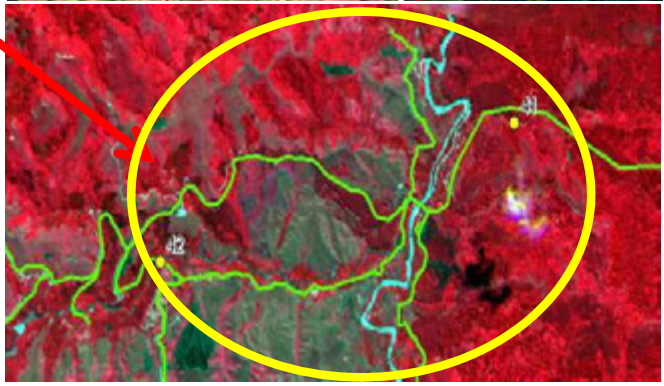
1. Select Vegetation Type	• Which vegetation type do you want to check on the field for classification? • Which vegetation type is difficult to distinguish on imagery?
2. Select Areas	• In which area is there typical vegetation type you selected? • In which area are there same vegetation type?
3. Select Points	• What POI to check for color and texture of imagery? • Select some points for each not only vegetation types but also patterns of color and texture.
4. Create Maps	• Selected points, imagery, FIMS . Load and counter should be put on a map with legend, scale, direction and grid line.
5. Prepare Materials	• Maps, GPS with camera, Survey sheets, Tools for measurement, Binocular, etc.

No.	Vegetation type in Forest Base Map 2010	Condition	Code
1	Low Altitude Forest on Plains and Fans	below 1,000m	P
2	Low Altitude Forest on Uplands	below 1,000m	H
3	Lower Montane Forest	above 1,000m	L
4	Montane Forest	above 3,000m	M
5	Dry Seasonal Forest	in Western Prov.	D
6	Littoral Forest		B
7	Seral Forest		Fri
8	Swamp Forest		Fsw
9	Woodland		W
10	Savanna		Sa
11	Scrub		Sc
12	Grassland and Herbland		G
13	Alpine grassland	above 3,200m	Ga
14	Subalpine grassland	2,500m - 3,200m	Gi
15	Mangrove		M
16	Agricultural Land Use		O
17	Lakes and larger rivers		E
18	Bare areas		Z
19	Settlements and larger urban centres		U
20	Forest Plantation		-
21	Plantation other than forest plantation		-

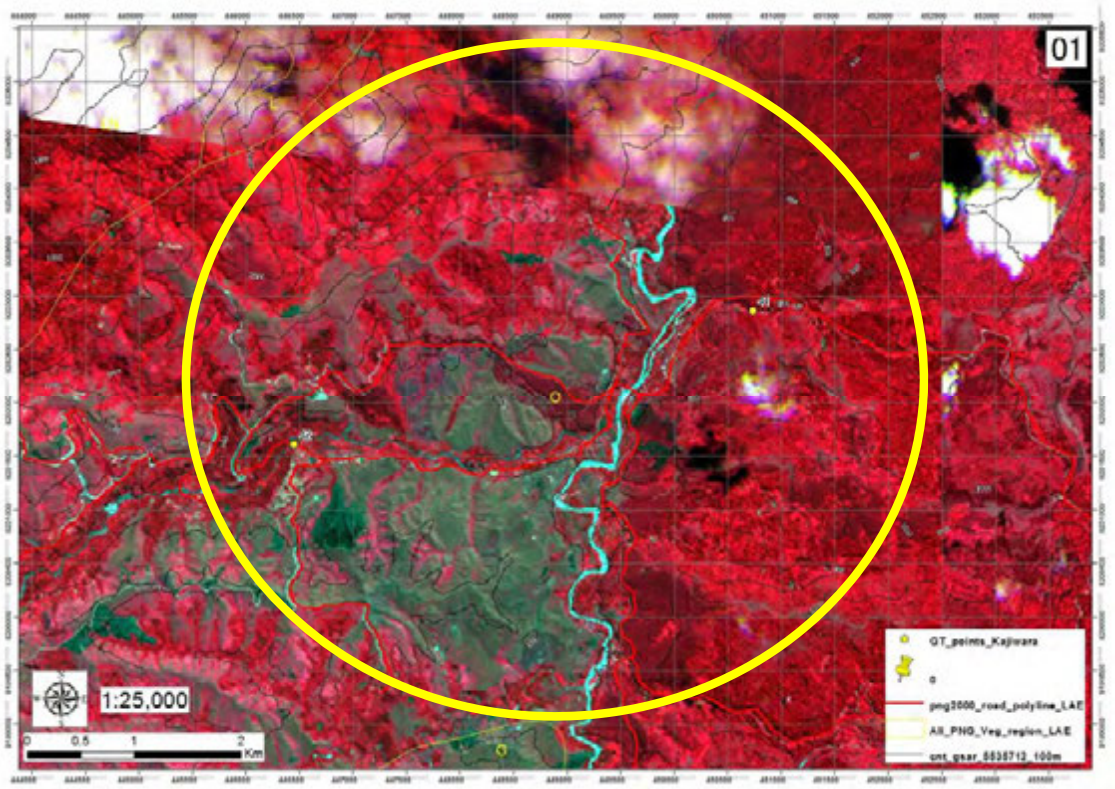


E.g. Some area in Morobe Province

True Colour R:3 G:2 B:1



False Colour R:5 G:3 B:2



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Work Flow of GT work

1. Select Vegetation Type

- Which vegetation type do you want to check on the field for classification?
- Which vegetation type is difficult to distinguish on imagery?

2. Select Areas

- In which area is there typical vegetation type you selected?
- In which area you are unable to identify vegetation type?

3. Select Points

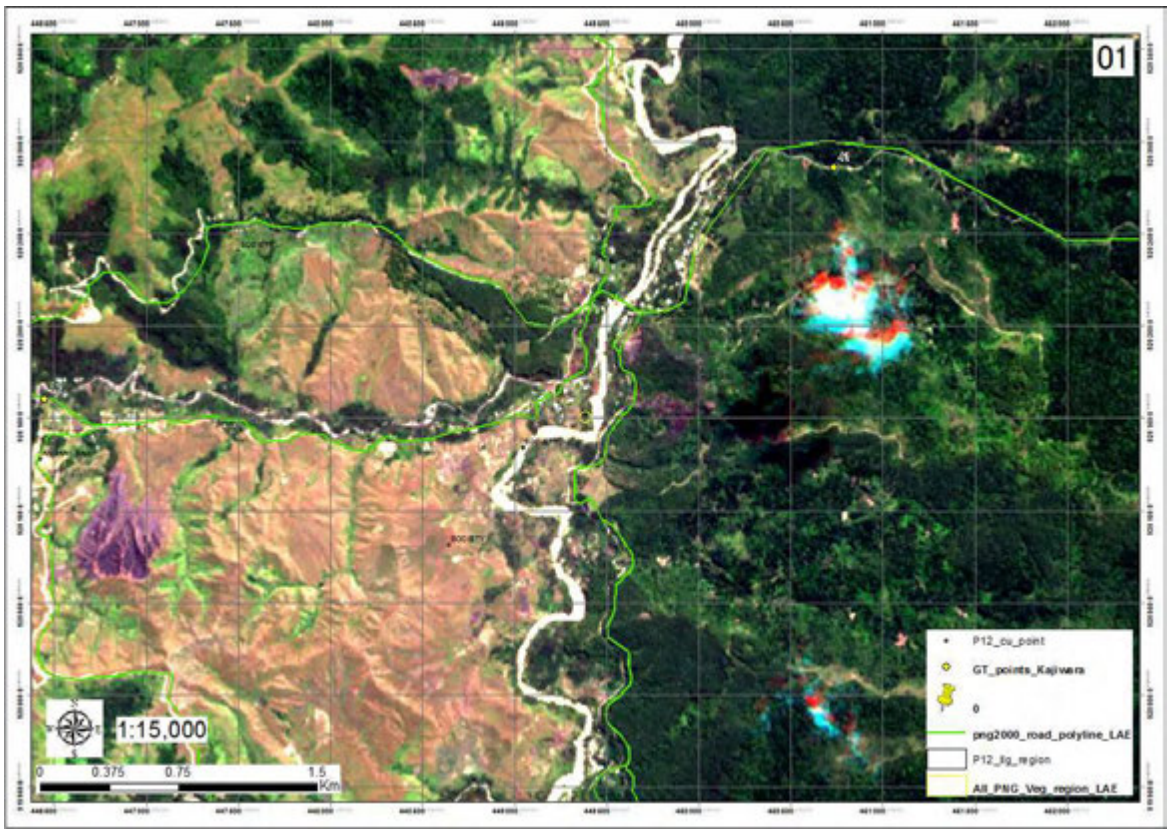
- What POI to check for color and texture of imagery?
- Select some points for each not only vegetation types but also patterns of color and texture.

4. Create Maps

- Selected points, imagery, FIMS . Load and counter should be put on a map with legend, scale, direction and grid line.

5. Prepare Materials

- Maps, GPS with camera, Survey sheets, Tools for measurement, Binocular, etc.



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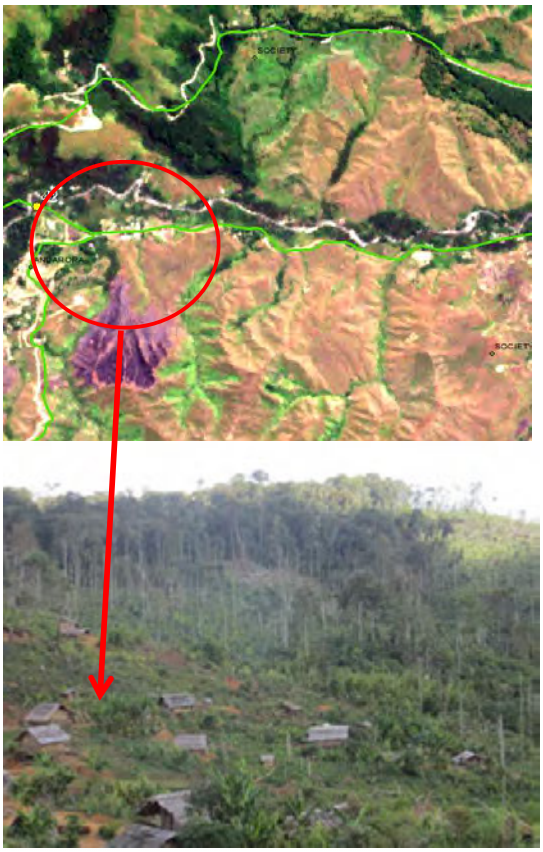
5.



What to do in the field during GT

Before you leave for the site (AOI) create a format of reporting or collecting information that can support the device you use

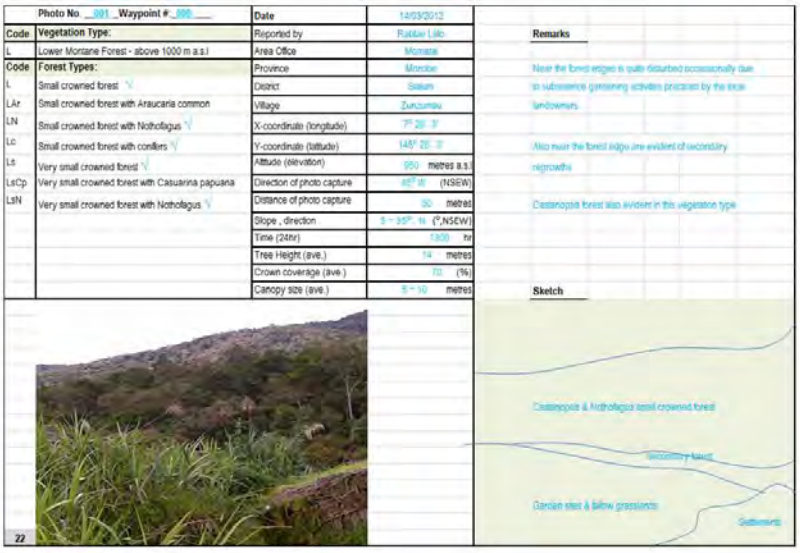


Photo No. 001 Waypoint # 000		Date	14/03/2012	
Code	Vegetation Type:	Reported by	Rubber Lalo	Remarks
L	Lower Montane Forest - above 1000 m a.s.l	Area Office	Moresby	
Code	Forest Types:	Province	Morobe	Near the forest edges is quite disturbed occasionally due
L	Small crowned forest	District	Salam	to subsistence gardening activities practiced by the local
LAr	Small crowned forest with Araucaria common	Village	Zurzumau	landowners.
LN	Small crowned forest with Nothofagus	X-coordinate (longitude)	7° 28' 3"	
Lc	Small crowned forest with conifers	Y-coordinate (latitude)	148° 28' 3"	Also near the forest edge are evident of secondary
Ls	Very small crowned forest	Altitude (elevation)	950 metres a.s.l.	regrowths
LsCp	Very small crowned forest with Casuarina papuana	Direction of photo capture	45° W (NSEW)	
LsN	Very small crowned forest with Nothofagus	Distance of photo capture	50 metres	Castanopsis forest also evident in this vegetation type
		Slope , direction	5 ~ 35° N (°,NSEW)	
		Time (24hr)	1400 hr	
		Tree Height (ave.)	14 metres	
		Crown coverage (ave.)	70 (%)	
		Canopy size (ave.)	5 ~ 10 metres	Sketch

22

Example of how to fill a Field Truthing Report Sheet

Created by R. Lalo
PNGFA, HQ.

In this way, it is easier to understand the type of data you can use later and also share with other people who do not have any idea at all of what a forest or vegetation type is all about.

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Ground Truth equipments

Field recording sheets, tape measure, length tape, height pole, GPS with Camera, Camera with GPS, Suunto Clinometer, Suunto Compass.

Binoculars- for tree Id and confirmation

Camera with GPS

6.Summary

Through this JICA and Japan Grant aid Project;

- Ground truthing was very crucial to ensure that Satellite data was interpreted with less difficulty and more consistency
- PNGFA CP officers have developed the capacity to relate Remote Sensing data to GT data where a more systematic approach is used through the workflow developed
- So far Field officers who attended various workshops by JICA are able to communicate in simple GIS language through use of GPS and GIS with PFO, RO and HQ and other relevant stake holder offices within provinces thus collecting vital data to add to our PNGFA database.

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Challenges/Future work

- Not many provinces were visited (GT) due to PNGFA counter funding and workload at HQ doing GIS and RS work.
- Time spent on GT was only to accessible areas by road, sea and air with little access to bush tracks, villages and remote locations due to sensitive landownership issues
- **Ground truthing is and will be an on going activity** to improve the Base Map currently developed and also add value to the monitoring work by means of verifying field base features observed through remote sensing.
- As the role out of GIS computers to Provincial offices **the work on GT should be eased through field office base and Capacity of field officers should be enhanced to do GT instead of HQ officers**

Acknowledgement

This work would not be made possible without the effort of the following people;

1. Japan International Cooperation Agency (JICA) and KKC
2. The PNGFA Counterpart officers; Perry Malan, Rabbie Lalo, Patrick La'a and Elizabeth Kaidong with assistance from Jehu Antiko and Oala Iuda.
3. PNGFA Management especially, Dr. Turia and Mr. C Bigol for their tireless Leadership role.
4. Lastly, NFS Provincial/Regional office & FRI field officers as participants in the Ground Truth for Remote Sensing work throughout the country.

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Thankyou and Questions please...!sgibson@pngfa.gov.pg /327 7828

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG

Demarcation of Agriculture Land Use

Mr. Jehu Antiko
Assistant Cartographer
Inventory & Mapping Branch
Policy and Planning/PNG Forest Authority
Email: jantiko@gov.pngfa.pg

Mr. Oala Iuda
Local Technical (GIS) Assistant
Capacity Development on Forest Resource Monitoring for Addressing Climate Change
JICA-PNG FA Project
Email: oiuda12@gmail.com

JICA-PNGFA PROJECT for Capacity Development on Forest Resource Monitoring for Addressing Climate Change

Presentation outline

Part 1

Introduction
i. Purpose
ii. Workshop

Part 2

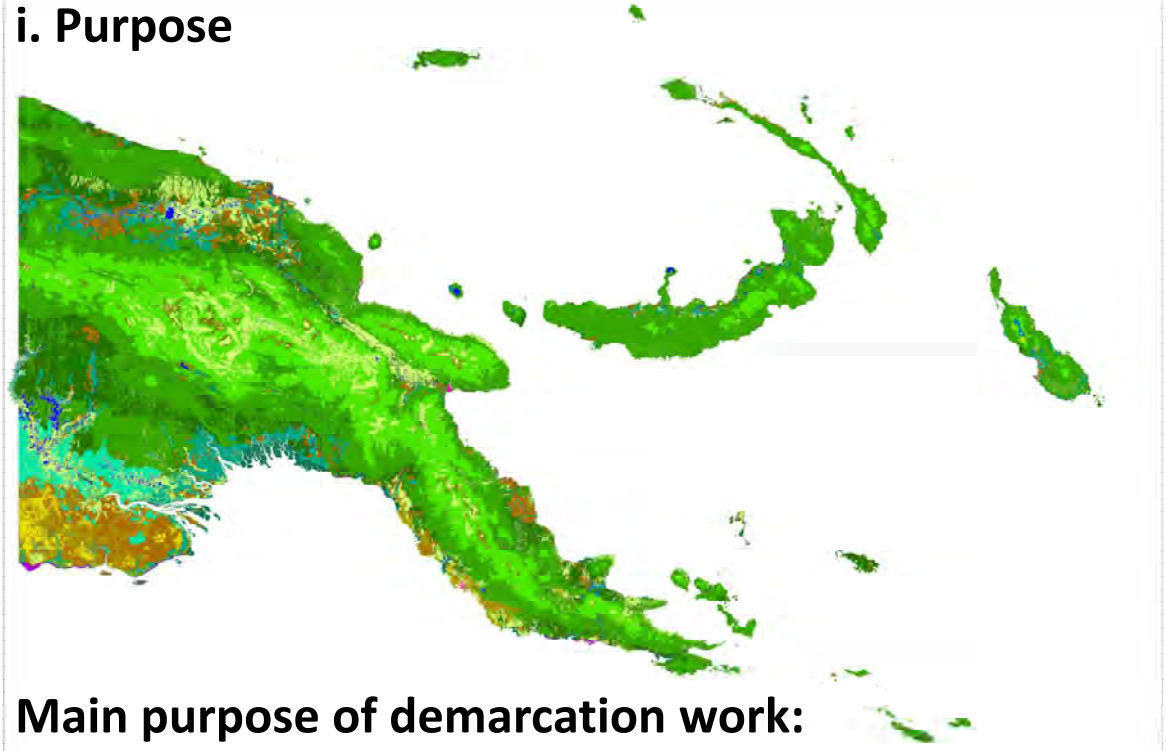
Methods
i. Heads-up Digitizing
ii. Imagery and web applications
iii. MASP and PNGRIS
iv. Editing and classification

Part 3

Results and Recommendation
i. Graph Showing Comparison Between Existing PNG Agriculture Datasets
ii. Challenges/ Constrains
iii. Recommendations

Part 1 Introduction

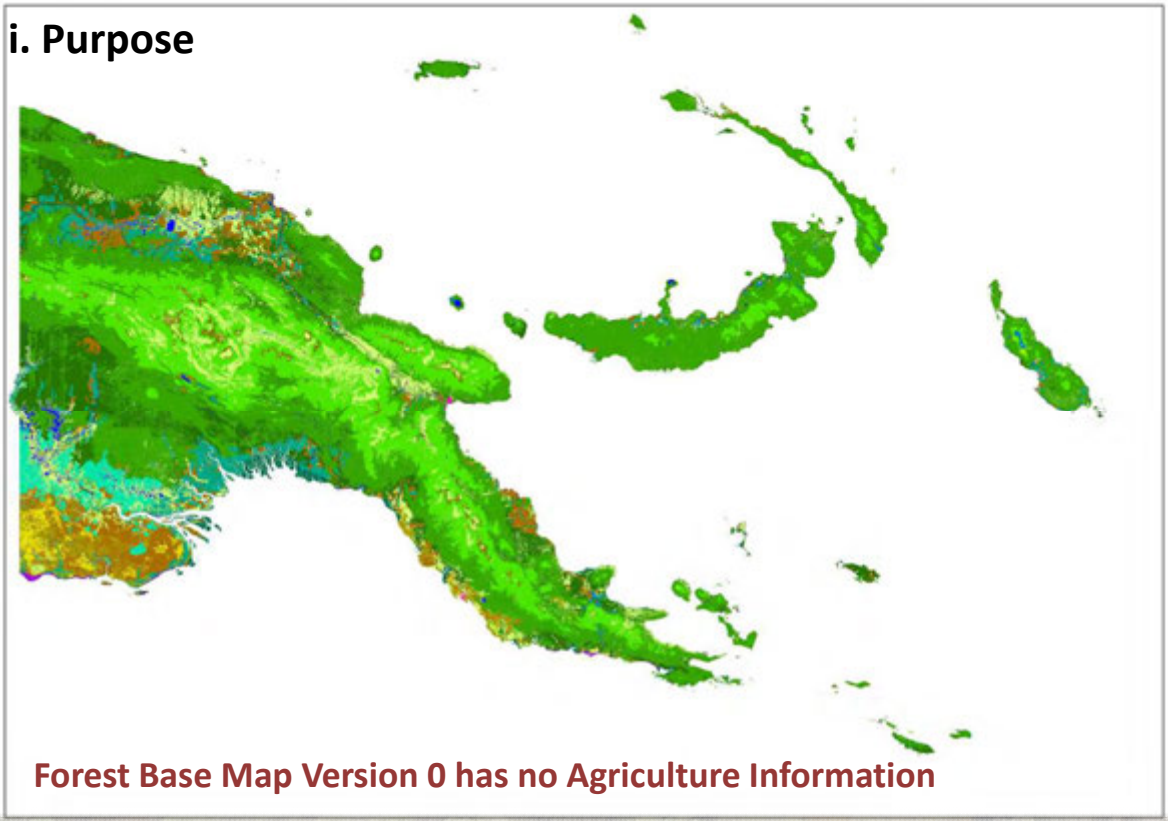
i. Purpose



Main purpose of demarcation work:
Improvement of Forest Base Map Version 0

Part 1 Introduction

i. Purpose



Forest Base Map Version 0 has no Agriculture Information

Part 1 Introduction

ii. Workshop

Duration: Two weeks for each Region (5).

- Southern Region, Momase and Highlands
- Region, New Guinea Islands Region, Area West.

Participants: PNGFA Regional/Area Officers.

FRI Officers

Activities: 1. Refresher course on ArcGIS and GPS used.

2. Digitizing possible Agricultural areas.

Part 1 Introduction

ii. Workshop

Agricultural Land use Definitions

Definitions were derived from:

- Actual Field Work Perspective
- \+
- GIS and Remote Sensing Perspective
- \+
- Relevant Literature; MASP and PNGRIS (FIMS)

Agricultural Land use definitions and codes were used only for workshop purposes.

Definitions

Subsistence (SUB)–Agricultural Land-use which has the following attributes: Located closer to rural settings (place) where the produce is mainly for consumption and smaller in size. Usually subsistence gardening are scattered, with irregular shapes, pattern and rough textures on a satellite image. Subsistence Land use activities include fallow areas as well.

Commercial (COM) – Agricultural Land use areas that are manage by small holders (Block owners) mostly for monetary benefits (coffee, cocoa, banana..) as identified thru MASP and confirm by local knowledge. Such land uses cover a smaller area and may have smooth/rough texture and irregular patterns in a satellite image.

Mixed (MIX) – Agricultural Land use areas which have both subsistence and commercial activities coexisting. These Land use types are identified thru local knowledge. Mixed Agricultural Land use activities have irregular shapes and pattern and a rough texture on satellite images.

Uncertain (AUN) – Uncertain Agricultural land use has the following attributes: Agricultural Land use areas where the types of agricultural activities are not clearly identifiable.
Agricultural Land use areas which cannot be identified in Google Maps, Bing Maps and RapidEye Images due to heavy cloud cover or poor image resolution. Local knowledge about area of interest is limited thus cannot confirm.

Grazing (GRZ) – Agricultural Land use areas that have extensive grassland which are used for cattle grazing. Grazing areas usually have regular patterns and smooth texture on a satellite image.

Part 1 ii. Workshop: Agricultural Land use, Plantation classification and code allocation

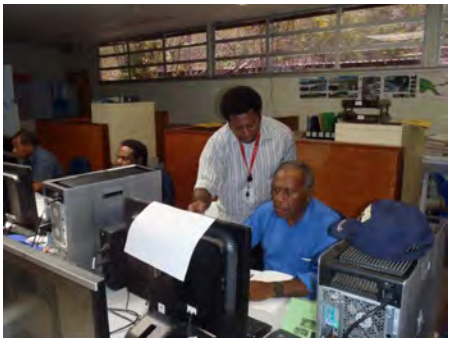
- Possible agricultural land
  - Agriculture [AGR] (managed by smallholder/individual)
    - Subsistence [SUB] (e.g. Kaukau, Taro)
    - Commercial [COM] (e.g. Oil palm, Coco)
    - Mixed [MIX] (Commercial and subsistence)
    - Cattle grazing [GRZ]
    - Uncertain [AUN]
  - Plantation [PLT] (managed by company/state)
    - Agriculture Plantation [PAG] (e.g. Oil palm, Coconut)
    - Uncertain [PUN]
    - Forest Plantation [PFR] (e.g. Kamarere, Balsa)

Agricultural Land use definitions and codes were used only for workshop purposes.

Part 2: Methods

i. Heads-up Digitizing or On-Screen Digitizing

GIS technique of extracting features from raster or imagery through the use of GIS software and computer hardware

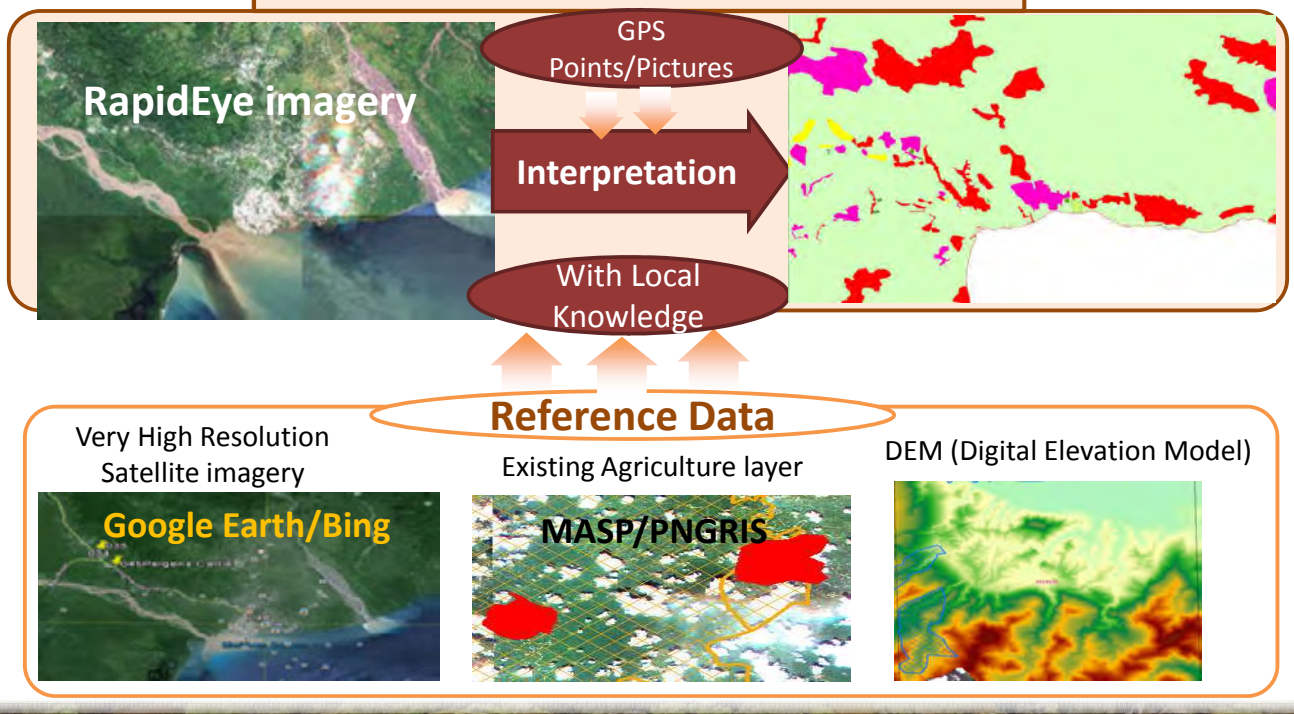


Mapping Standards
Digitizing Scale: 1: 50 000 to 1: 30 000
Coordinate System: Universal Transvers Mercator
Zone: 54, 55, 56 and 57
Datum: World Geodetic System (WGS) 1984
Units: Meters

Part 2: Methods

ii. Imagery and web applications

Demarcation of Agriculture Land use



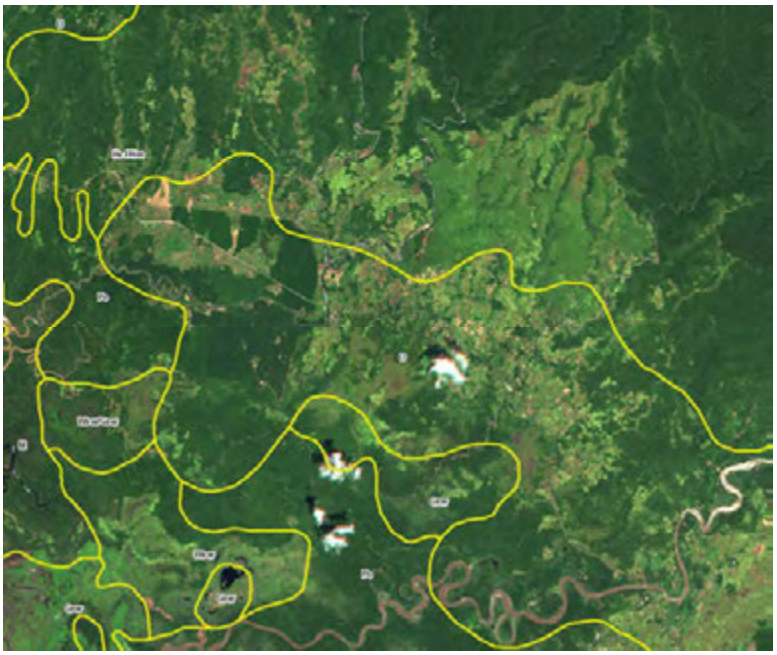
Part 2 Methods

iii. MASP and PNGRIS

PNGRIS: Papua New Guinea Resource Information System.

Contains information on natural resources, land use cover and population distribution.

Eg. Land use areas, Forest areas , Urban areas, Population distribution.

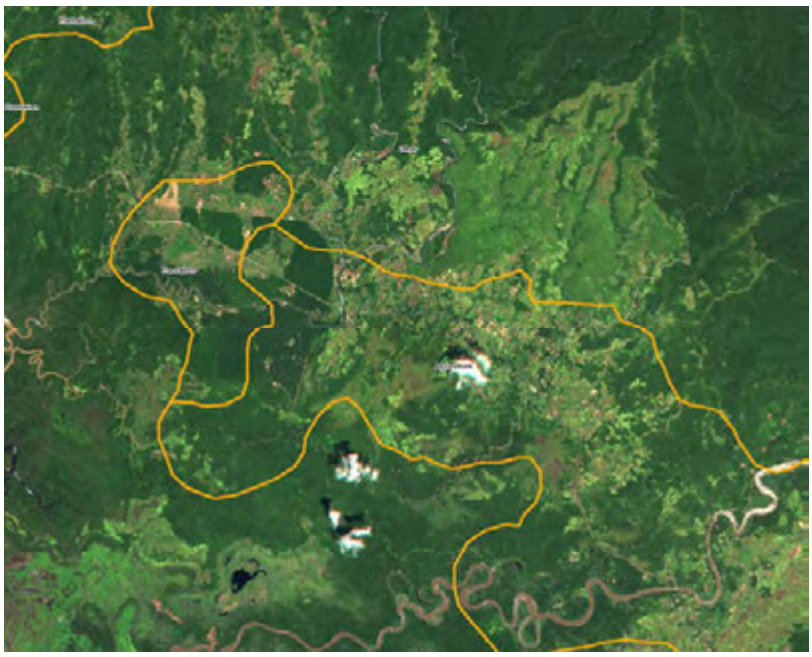


Part 2 Methods

iii. MASP and PNGRIS

MASP: Mapping Agriculture Systems Project

MASP Contains Land use types. Eg. Agriculture, Plantation, Other, Urban.



- MASP and PNGRIS are not perfect.
- Land Use activities are dynamic and change over time.
- MASP and PNGRIS can be used as reference layers.

Part 2: Methods

iv. Editing and classification

Digitizing Errors
- Slivers: Small overlaps between polygons.
- Spelling error of land use classes, Miss coding
- Selection of non-agricultural areas.

→ **Error Correction Techniques**
- Geometry Check
- Topology Check
- Spelling Check

↓

Classification and Dissolving of Agriculture Land use Classes

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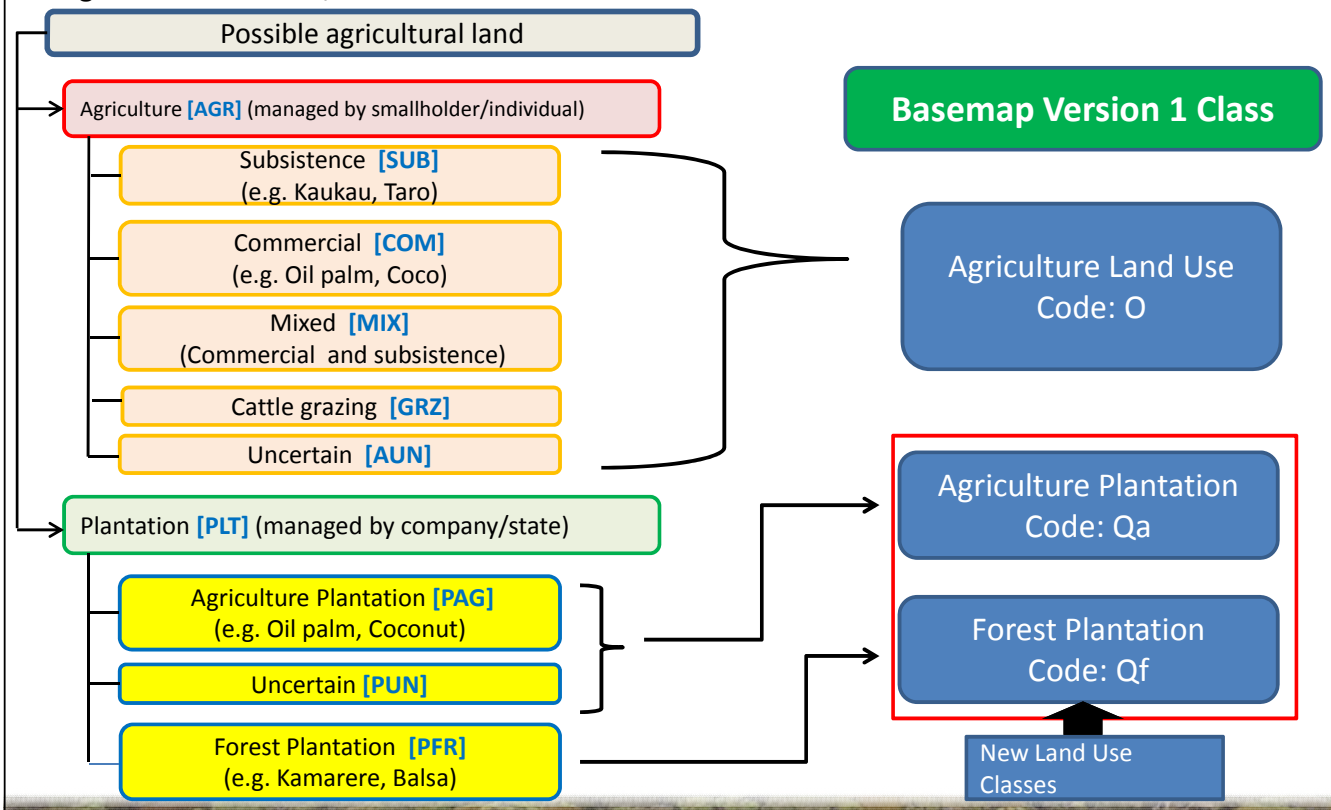
Integration to Basemap Version 0

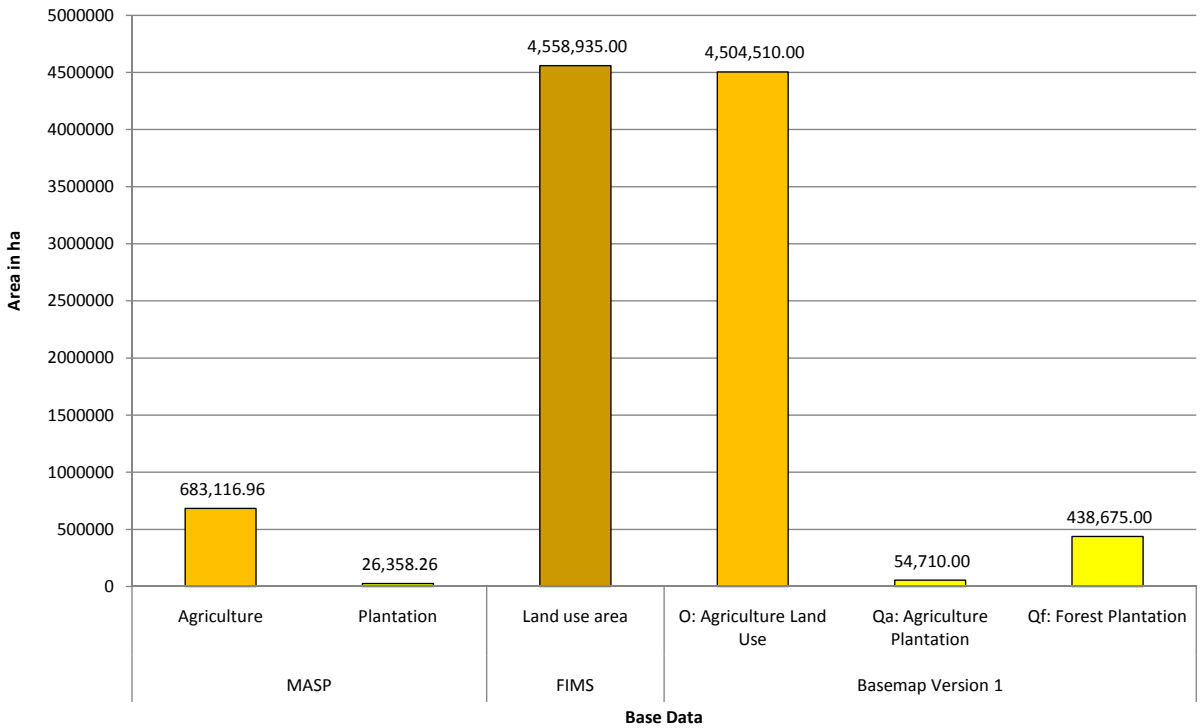
Part 2: Methods iv. Editing and classification

Agricultural Land use, Plantation classification and code allocation



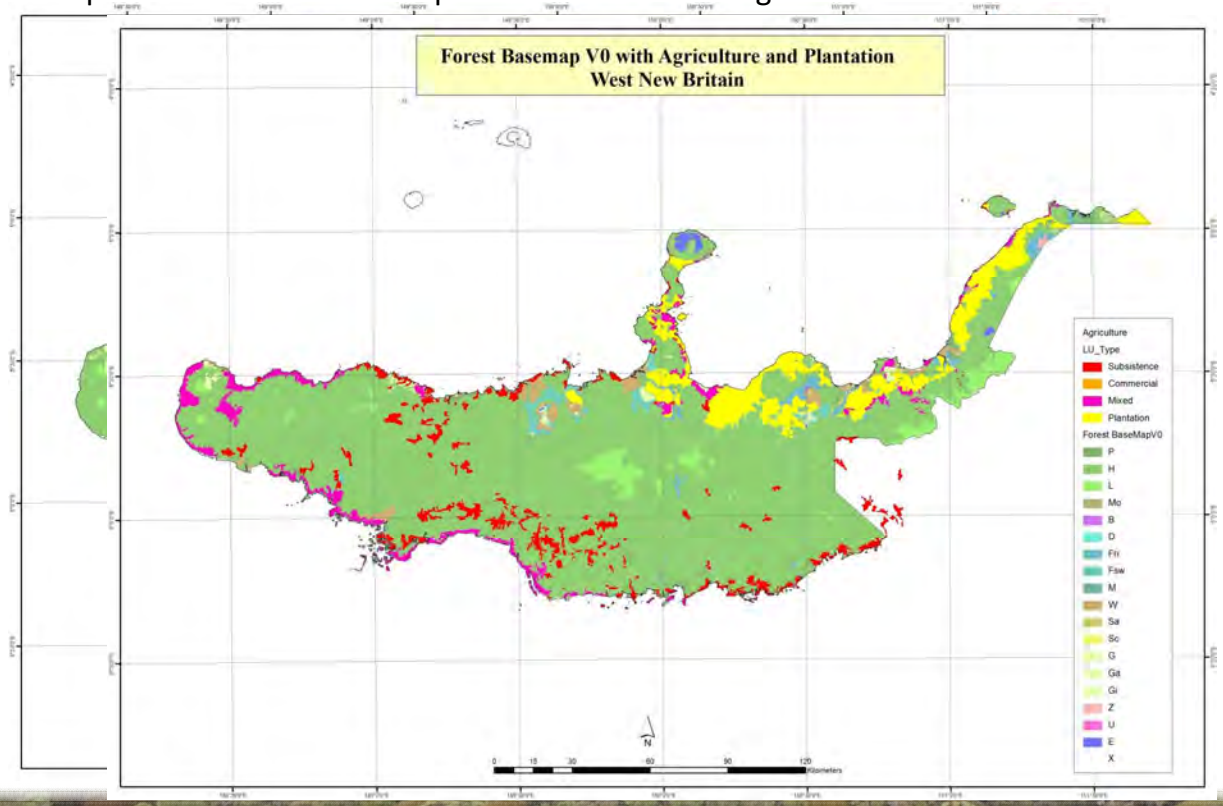
Part 3: Results and Recommendation

i. Graph Showing Comparison Between Existing PNG Agriculture Datasets



Part 3: Results and Recommendation

Comparison of Forest Basemap V0 before and after Agriculture Land Use Demarcation



Part 3 Results and Recommendation

ii. Challenges/ Constrains

Time Limitation

Two weeks given for Workshop

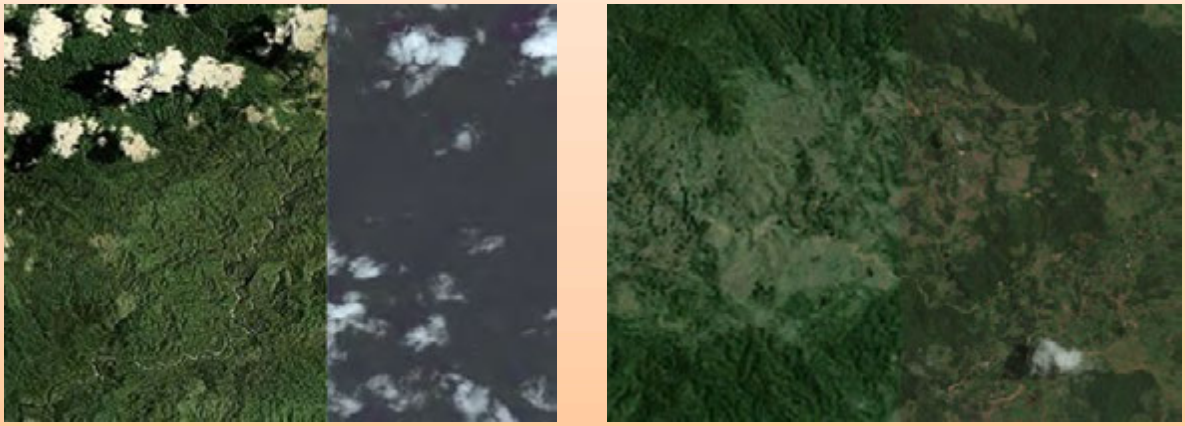
Cloud cover in RapidEye and Bing Map

RapidEye

Bing Map

Part 3 Results and Recommendation
ii. Challenges/ Constrains

Poor image resolution in Google and Bing Maps (e.g. Landsat image 30m resolution in some areas)



Bing Map

Google Map

30m Resolution

Part 3Results and Recommendation
iii. Recommendations

1. More ground truth activities needed to verify uncertain areas.
2. Adequate time must be set for Agriculture Land use demarcation.
3. Participants must be taught on basic use of GIS software before demarcation of Land Use boundaries.
4. Integration of RapidEye Imagery with Google Earth to improve Demarcation Performance.

Closing Ceremony and final Workshop for Project Completion
5th - 6th March 2014
Holiday Inn Hotel, Port Moresby, PNG