Progress Report on

JICA Technical Cooperation Project & Grant Aid "Forest Preservation Programme

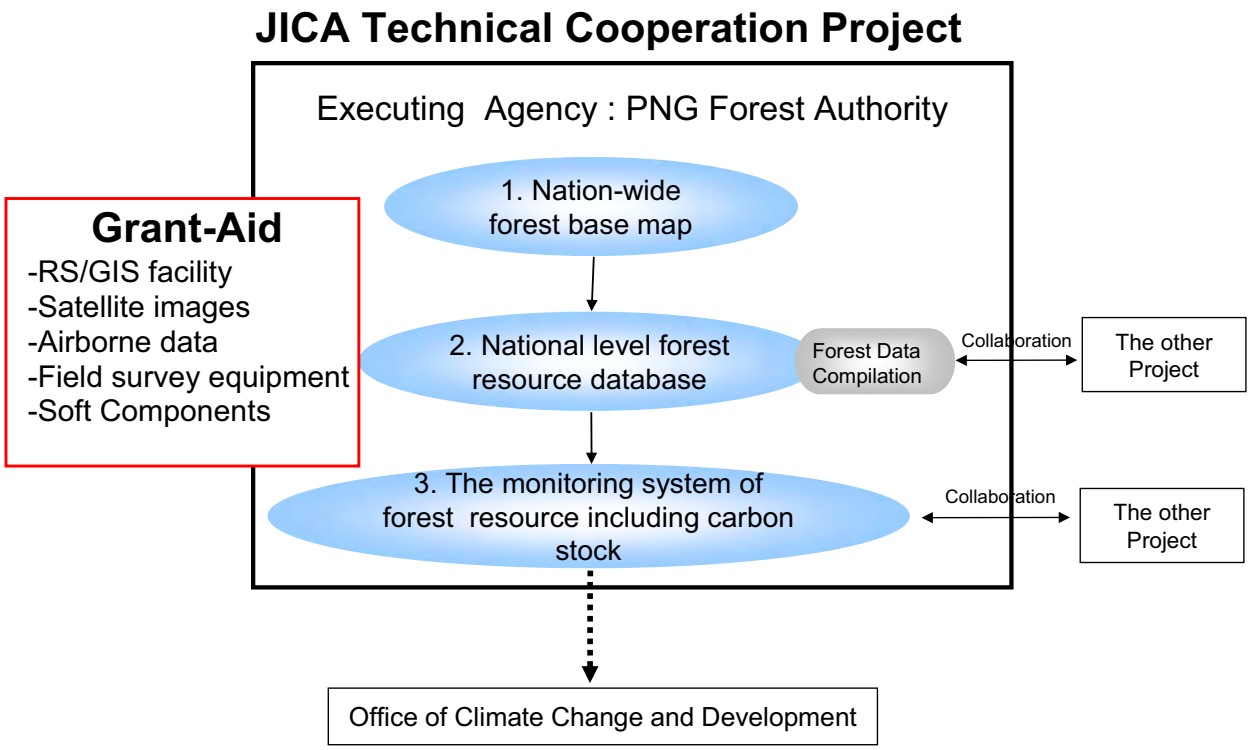
November 3rd, 2011

Table of Contents

Basic Information of Project/Programme

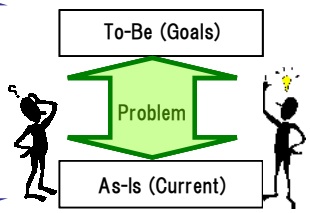
- Project Name:
  - Technical Cooperation:
    - Capacity Development of Forest Resource Monitoring for Addressing Climate Change
  - Grant Aid (Detail Design)
    - Japan's Grant Aid for "The Forest Preservation Programme"
- Ordering Parties:
  - Technical Cooperation:
    - Japan International Cooperation Agency (JICA)
  - Grant Aid (Detail Design)
    - Japan International Cooperation System (JICS)
- Work Period:
  - 2010 – Mar.2014
- Counterpart:
  - Papua New Guinea Forest Authority (PNGFA)

JICA Technical Cooperation and Grant Aid



Target Analysis for Forest Monitoring in PNG

【To-Be】	【To-Be】	【To-Be】
1. National forest resource basemap is developed & utilized	2. National level forest resource GIS/Database is developed & utilized	3. Carbon/Biomass stock is estimated.
【Problem】 ・PNGFA does not have data and facility to develop ・Need time to develop national level map	【Problem】 ・The work flow does not fit with FIMS any more ・Existing data are not well compiled into the system	【Problem】 ・More than 90 % of PNG land is customary land ・No access road to do field survey for whole country
【As-Is】 1. National level forest basemap is not developed since 1972	【As-Is】 2. FIMS (Forest Inventory Mapping System) is not updated since 1998	【As-Is】 3. Carbon stock estimation is necessary but no good data for it



Synergy/Demarcation of JICA TC and Grant-Aid 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

Forest Monitoring for PNG: Overall Concept

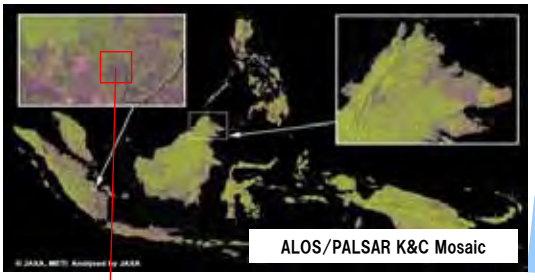
Background & Needs

National Level Forest Resource Monitoring
Forest Resource Basemap for Biomass/Carbon Estimation

Challenges & Countermeasures

Overall Comprehension using Radar Satellite (ALOS/PALSAR)
Biomass/Carbon Modeling & Estimation by Sampling Analysis

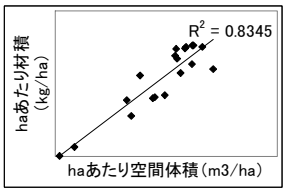
National Level ForestMonitoring with Radar Satellite



Nation-wide Expansion

Biomass/Carbon Modeling based on Spatial Volume

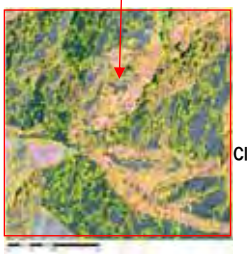
Tree Stand Volume



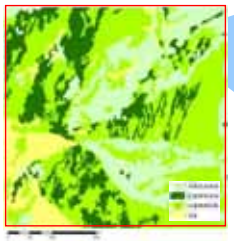
Relational Expression of Spatial Volume & Tree Stand Volume

Multi Platform Sensing

Forest Basemap Development with Optical Satellite

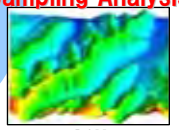


Classification

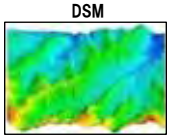


2D: Area of Forest/Vegetation Type

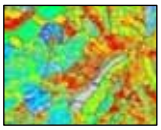
Sampling Analysis for Spatial Volume Estimation



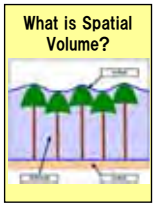
DSM



DTM



Spatial Volume



3D: Spatial Volume for Carbon

Forest Monitoring: Benchmark Map and Change Detection

Background & Needs

Accurate Forest Base-map for Forest Management & Development Planning
Sustainable Monitoring System for Forest Change (Deforestation) Detection

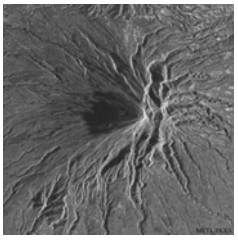
Challenges & Countermeasures

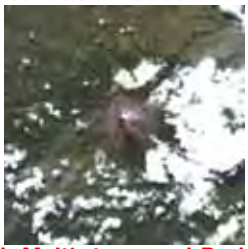
Developing Forest Base-map with Constellation of Optical Satellites
Change Detection with Multi-temporal Radar Image (ALOS/PALSAR)

Constellation of Optical Satellites

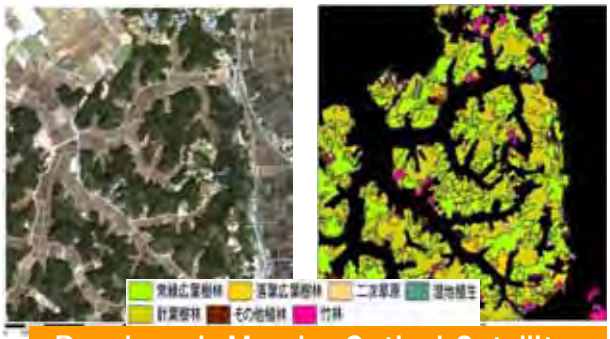
RapidEye A.G.

Weather-independent of Radar Satellite



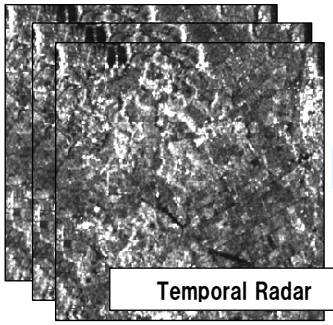


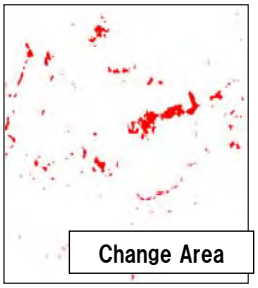
Vegetation Type Classification for Forest Benchmark map



Benchmark Map by Optical Satellite

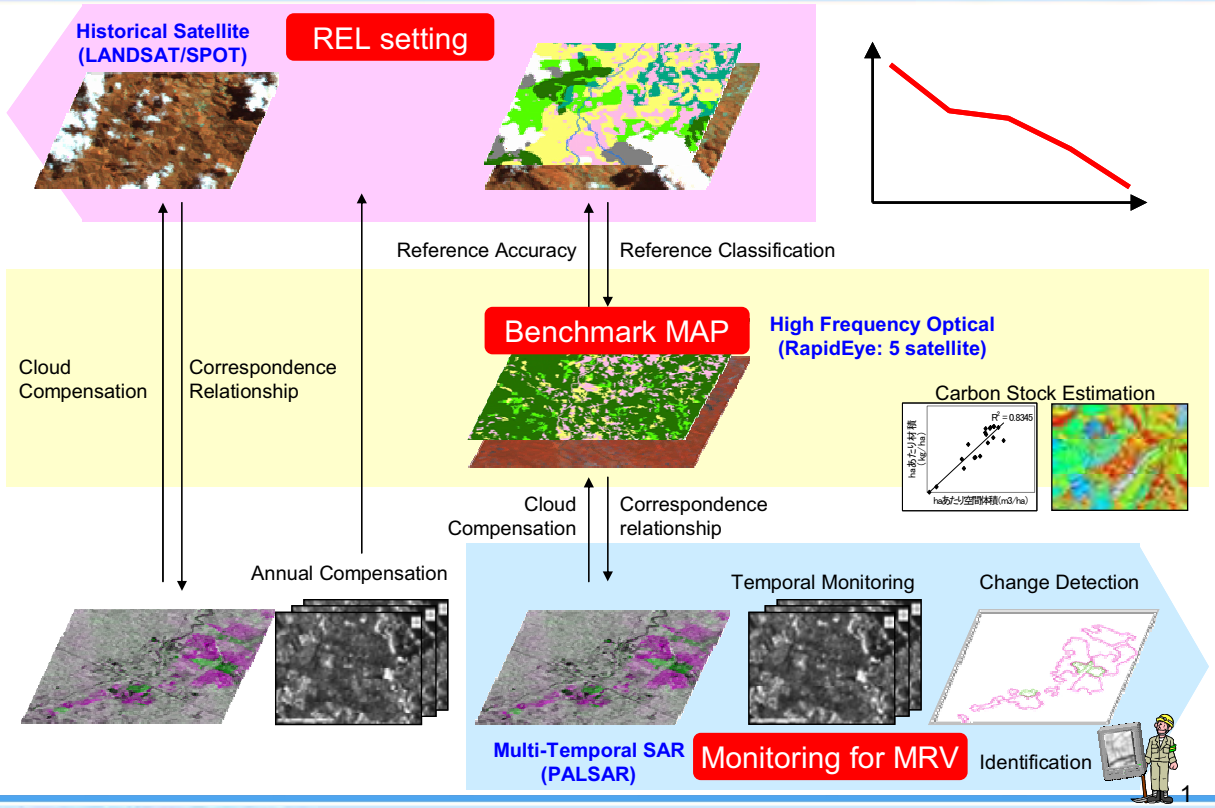
Change Detection with Multi-temporal Radar





Change Detection by Radar Satellite

Forest Monitoring Practice for REDD+



PNGFA/JICA Approach to Activity Data

GOFC-GOLD Sourcebook provides framework for comparing approaches to activity data

FOR DISCUSSION

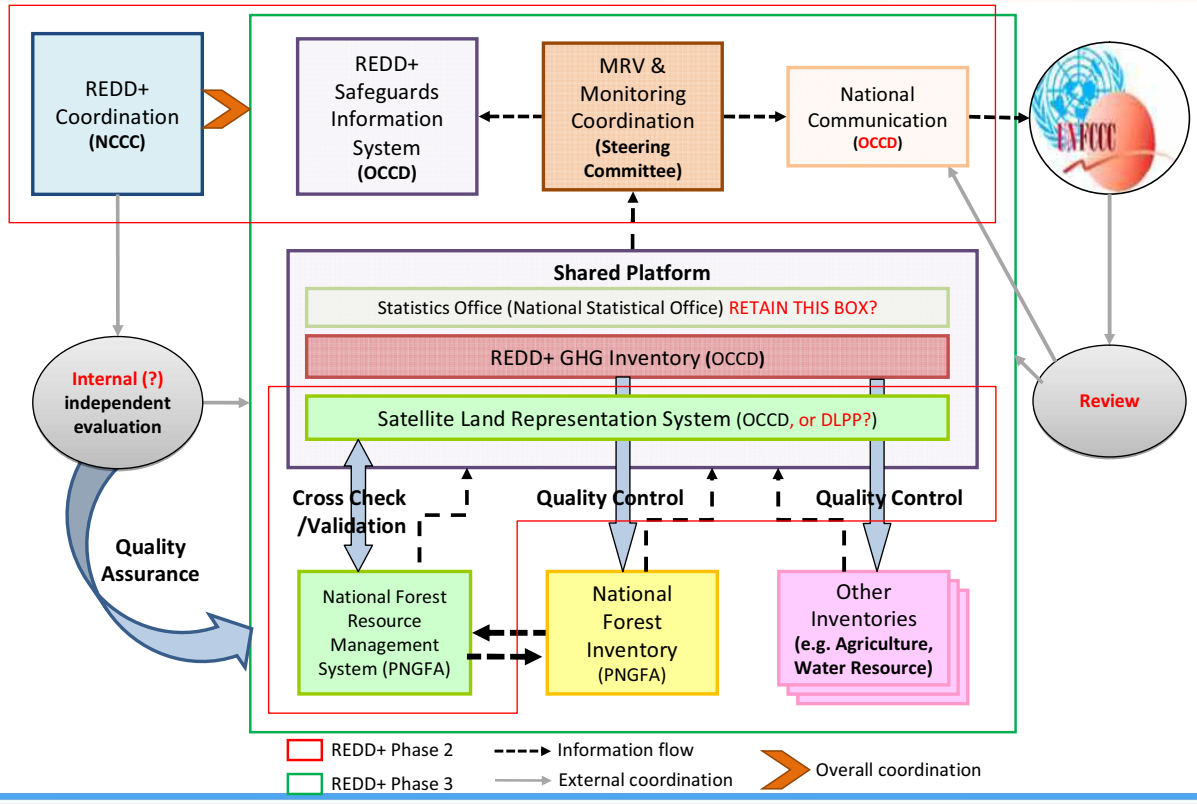
GOFC-GOLD Framework	Issues for consideration	PNGFA approach to National Level MRV
Step 1 Selection of the forest definition	• Is FAO definition sufficient • How to stratify	• Definitional issue: Forest definition and classification including Mangrove consistently applied in PINGRIS, FIM-S, and FAO-FRA National Report (parameters* for defining forest area) • Stratification: Aggregation level of forest classification to be determined; forest / non-forest, 6, 9, 15, or 36 major groups
Step 2 Designation of forest area for acquiring satellite data	• Wall-to-wall or forested areas only • A/Re-forestation requires wall-to-wall	• Satellite monitoring covers nation-wide land by wall-to-wall ✓ High rate of forest coverage in PNG ✓ Necessity of detecting A/Re-forestation and deforestation • Boundaries for reporting to be considered • 2010 Forest Base Map will be compared with 2002 status

Step 3 Selection of satellite imagery and coverage	• What required resolution, update frequency
	• How to get data feed to PNG
		• Nation-wide (to be soon procured)
		  • Optical: RapidEye at 6.5 meter res. (2010)
		  • SAR: ALOS/PALSAR (2007, 2010)
		• Partial coverage
		  • Airborne SAR and/or LiDAR (TBD)

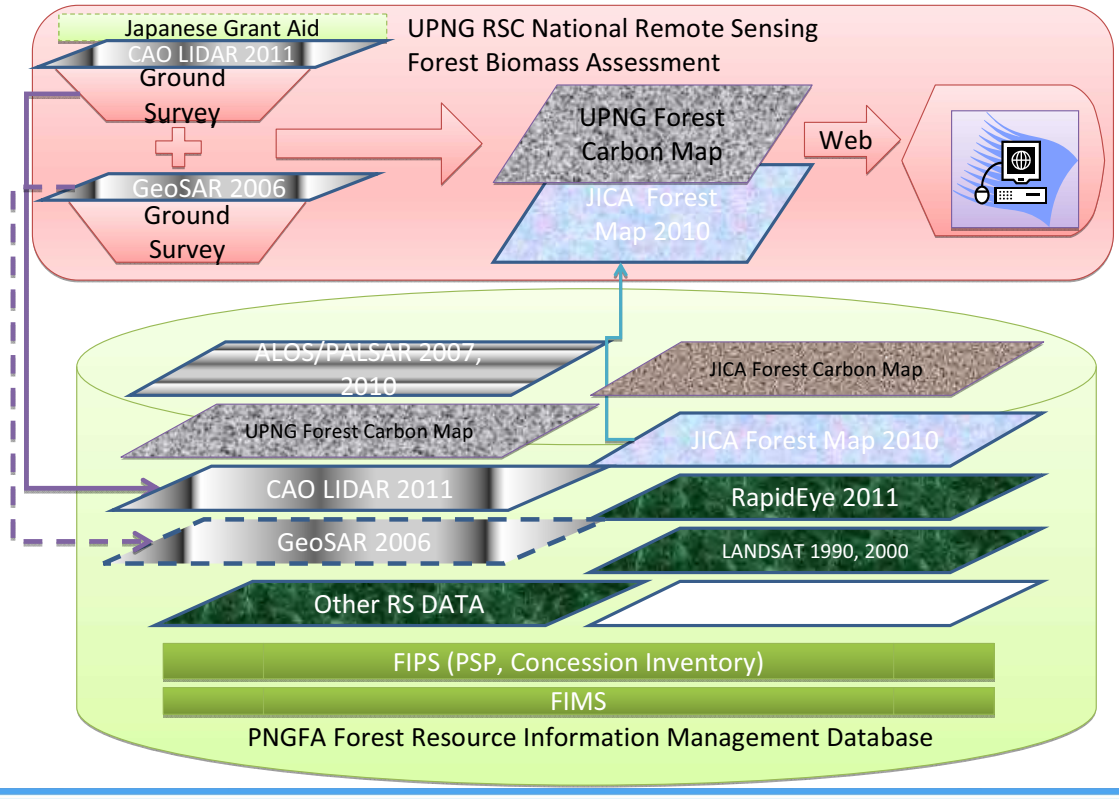
Step 4 Decisions for sampling versus wall to wall coverage	• Systematic vs. stratified sampling • How to identify 'hot-spots' for stratified sampling	• Wall-to-wall coverage since PINGRIS and FIM-S • Database ability and design to be considered using ISO-19000 Unified Modeling Language • Reports on resource monitoring, reports from FRI-PSPs, concessions and other projects to be fed ideally including all 5 carbon pools*
Step 5 Process and analyze the satellite data	• What methodology and software for data processing and change detection	• GIS: ArcGIS (to be soon procured) in order to build Forest Resource Information Management Database* • Remote Sensing: ERDAS IMAGINE (including ER Mapper), IDRISI/Land Change Modeler (on ArcGIS) and eCognition (to be soon procured) to compile 2010 Forest Base Map • Biomass and carbon estimated by "Spatial Volume*" from SAR/LiDAR data (to be considered and tested)

SOURCE: GOFC GOLD Source book, JICA Technical Cooperation, JICS/KKC Mission

Coordination with Other Organizations for Monitoring & MRV



Cooperation for Carbon Estimation with UPNG/EU



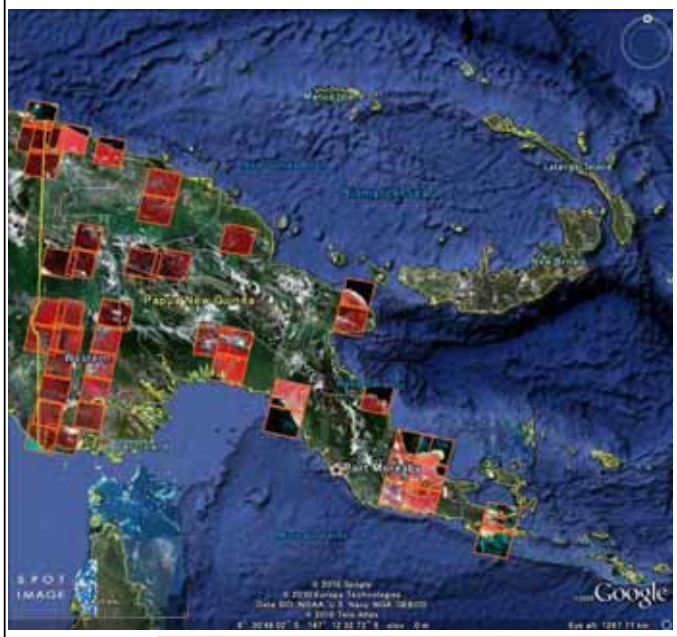
Procurement Items

Item		Qty (Mar)	Qty (July)	Qty (proposing)	Remarks
A) GIS related equipment; hardware/software					
A-1	Computer Hi-Tech (GIS Capacity)	14	24	32	Desktop PC
A-2	Laptop	12	15	18	Laptop PC
A-3	GPS (Mobile Mapper)	12	15	31	Portable GPS
A-4	A3 Printer (Color)	-	-	8	
A-5	A3 Scanner	-	-	8	
-	A1 Scanner	1	3	-	
A-6	A0 Scanner	-	-	3	
A-7	A0 Plotter	-	-	3	
A-8	Data Server	-	-	2	FA & FRI
-	ER Mapper license & backup software	2 x 5 year	3 x 3 year	-	Included in ERDAS Pro.
A-9	ERDAS	-	-	1 unit	Level & Extensions
A-10	eCognition	-	-	1 unit	Several license type
A-11	ArcGIS license	2 x 5 year	3 x 3 year	1 unit	Level & Extensions
A-12	ArcGIS Server	-	-	2 set	For data-sharing
A-13	Database Management System	-	-	2 set	MS SQL Server
A-14	Integrated Development Environment	-	-	3 set	MS Visual Studio
A-15	MapInfo Upgrade	1	1	1 set	Minimum upgrade
-	Satellite Imagery (SPOT/ALOS)	Whole country	Whole country	-	No archive
A-16	Satellite Imagery 2010 (ALOS/PALSAR)	-	-	Whole country	332 scene (tentative)
A-17	Satellite Imagery 2010 (RapidEye)	-	-	Whole country	1055 tile
A-18	Satellite Imagery 2007 (ALOS/PALSAR)	-	-	Whole country	332 scene (tentative)
A-19	Airborne RADAR Data			Sample area	DTM & DSM
A-20	Airborne LiDAR Data			Sample area	Validation/verification

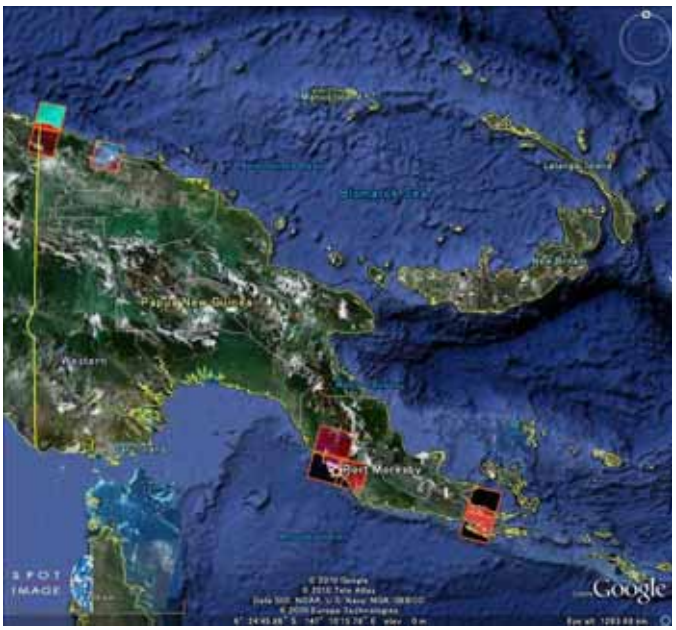
Due to the problem of ALOS, changed from 2012 to 2007 (Training items are not changed)

Challenging of RS in PNG: "Cloud"

SPOT4 2002



SPOT5 2008



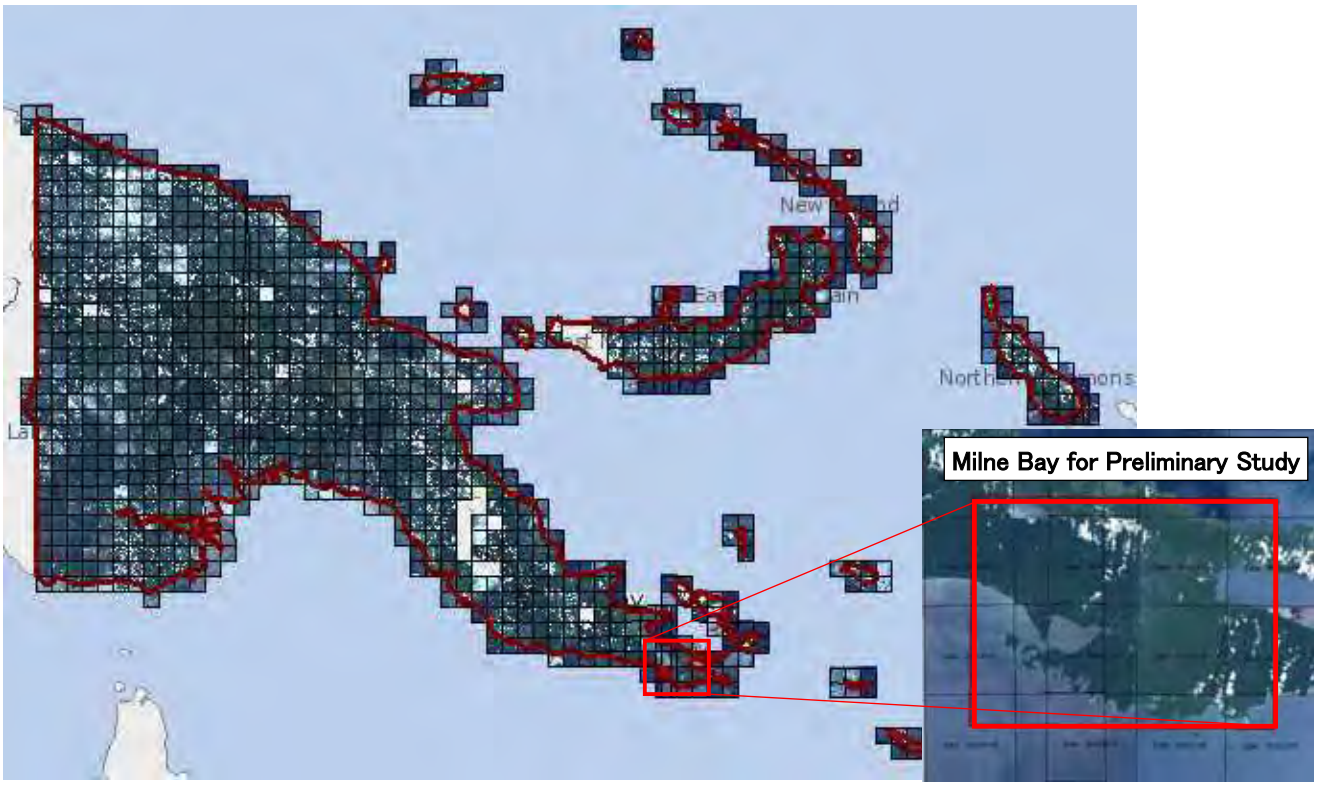
Even SPOT cannot cover whole country of PNG well and they cannot assure to collect good quality imagery within a year

Solution of RS in PNG: RapidEye Basic Information

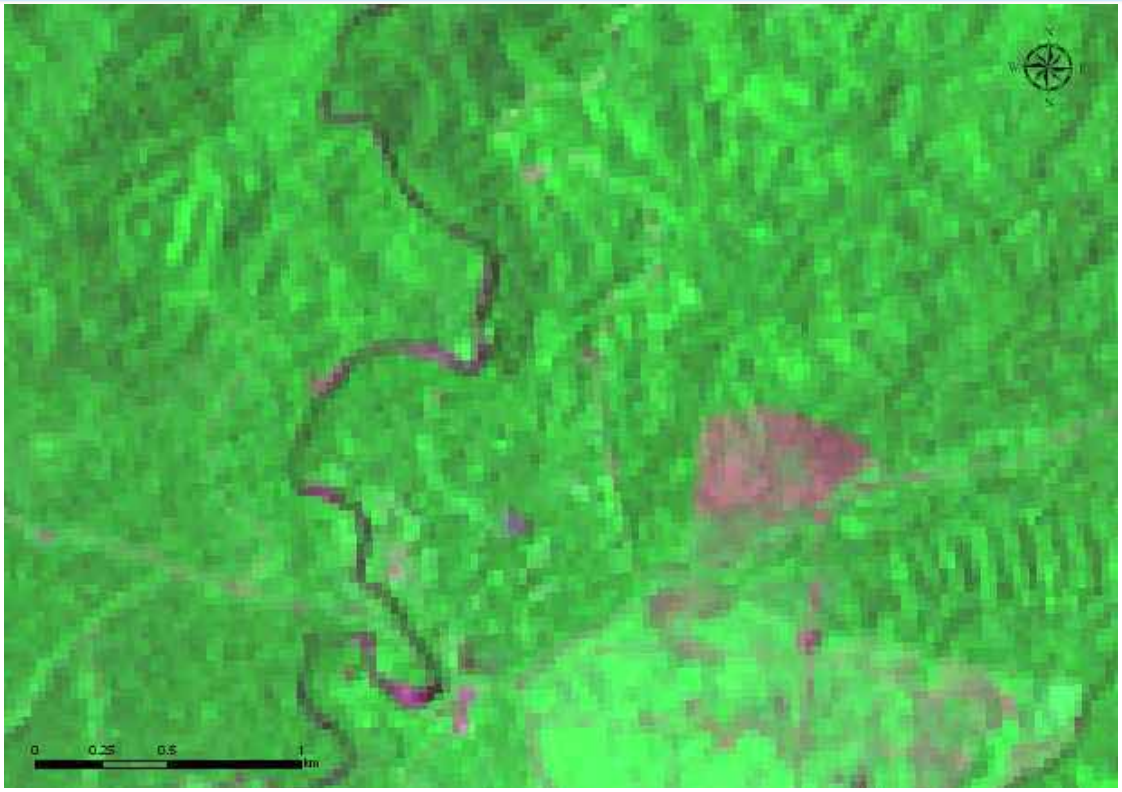
Orbit	620 km, sun synchronous
Number of Satellites	5
Spacecraft Mass	150 kg each
Image Data Downlink	>60 Mbps
Onboard Data Storage	>1500 km of image data
Max. Spacecraft Roll Angle	± 25 degrees
Payload Type	Push broom Optical Imager 5 Optical bands
Swath	78 km
Nadir Pixel Ground Sampling Distance	6.5 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

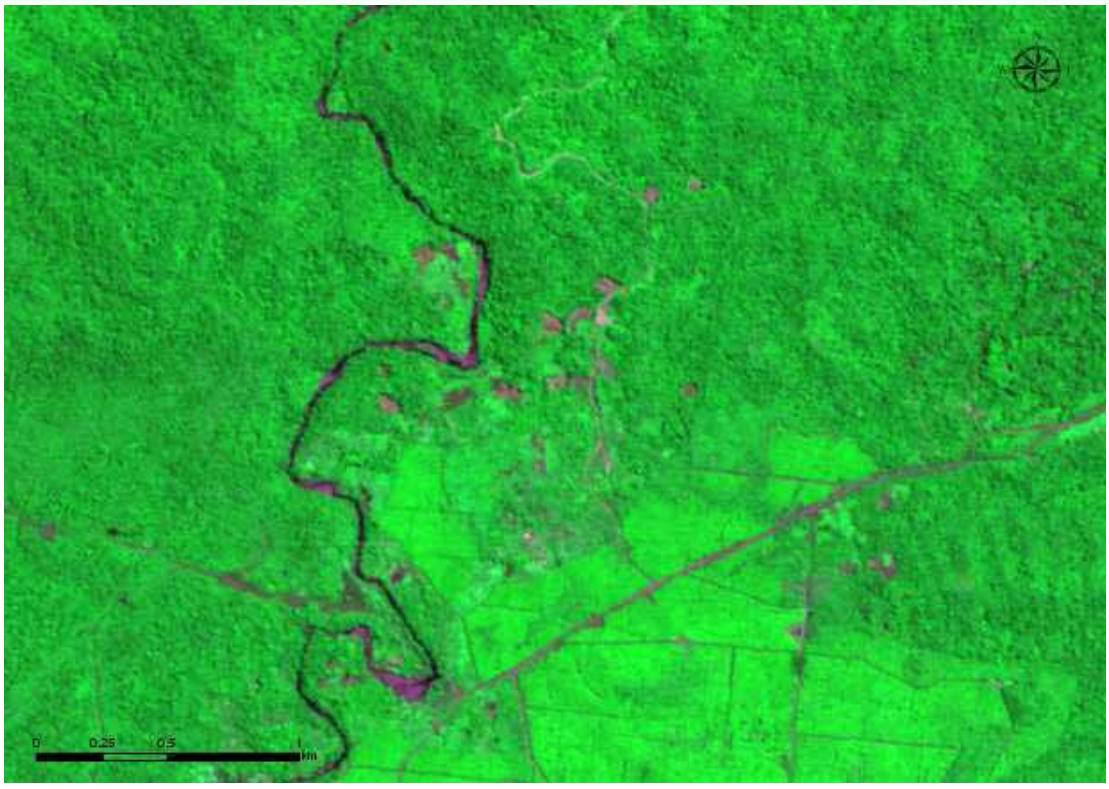
RapidEye Coverage over PNG (Jul. 2010 to Aug. 2011)



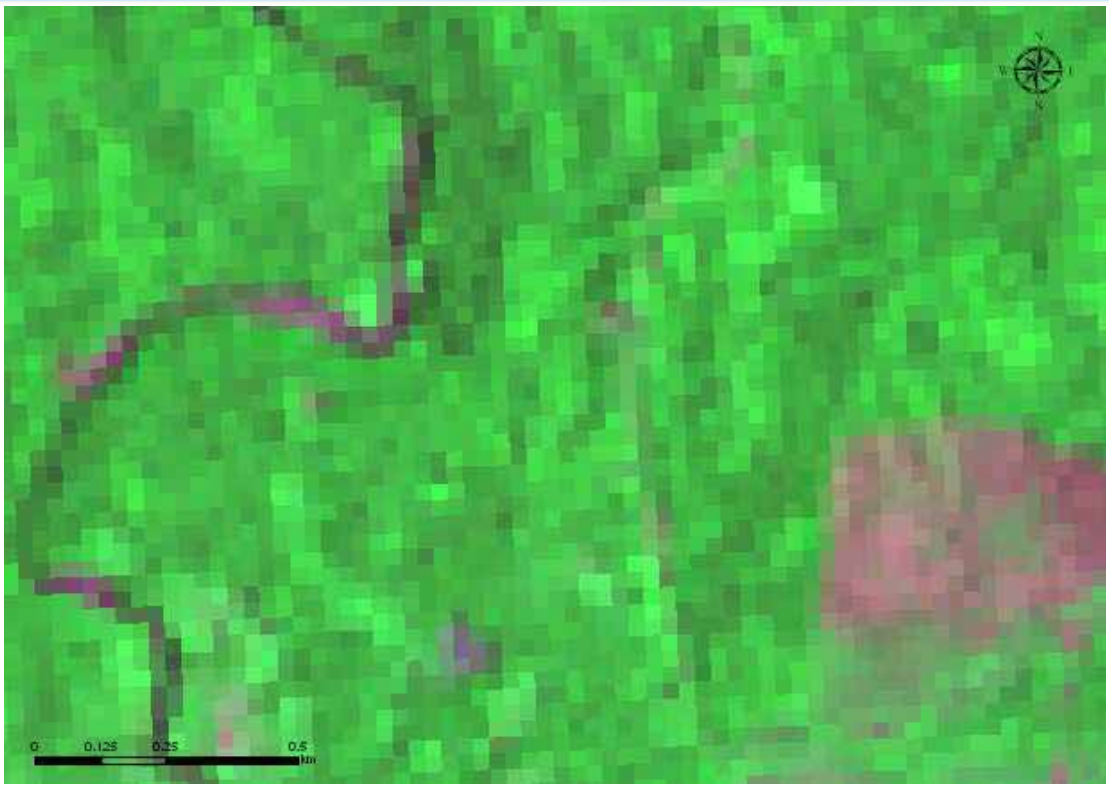
LANDSAT ETM+ 2000 (MS 30m Resolution) 1:10,000 Level



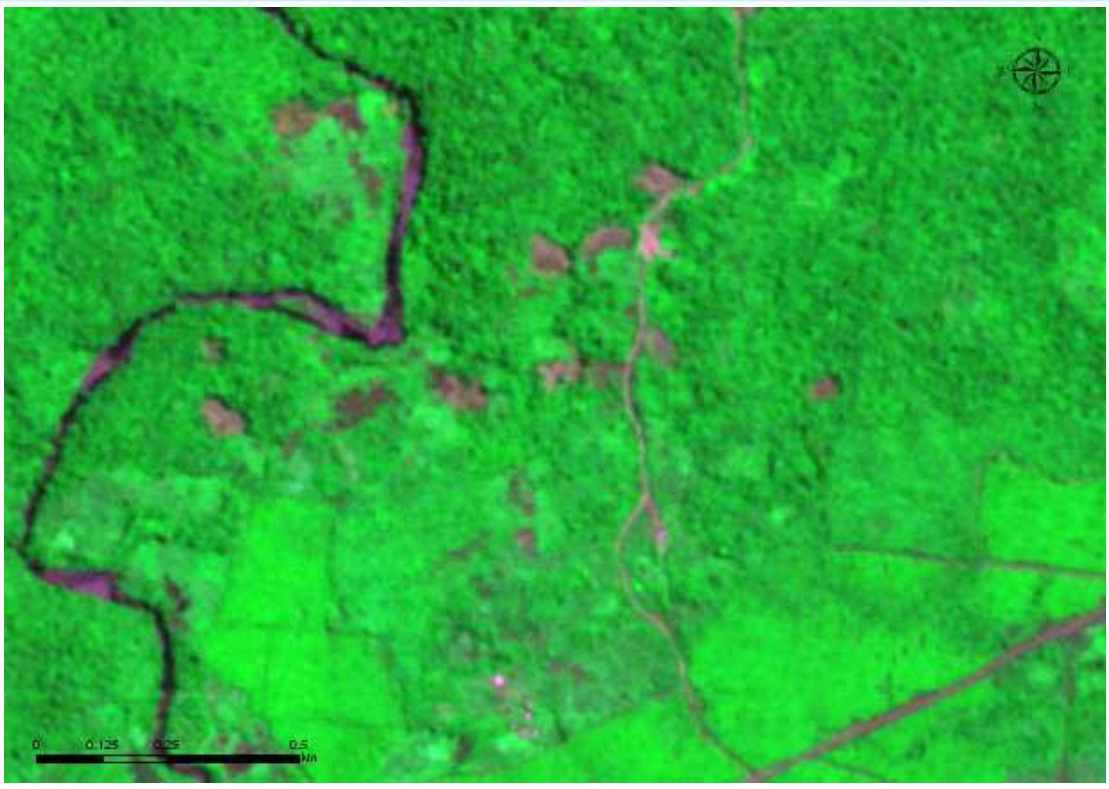
RapidEye MS 2010 (6.5m -> 5.0m Resolution) 1:10,000 Level



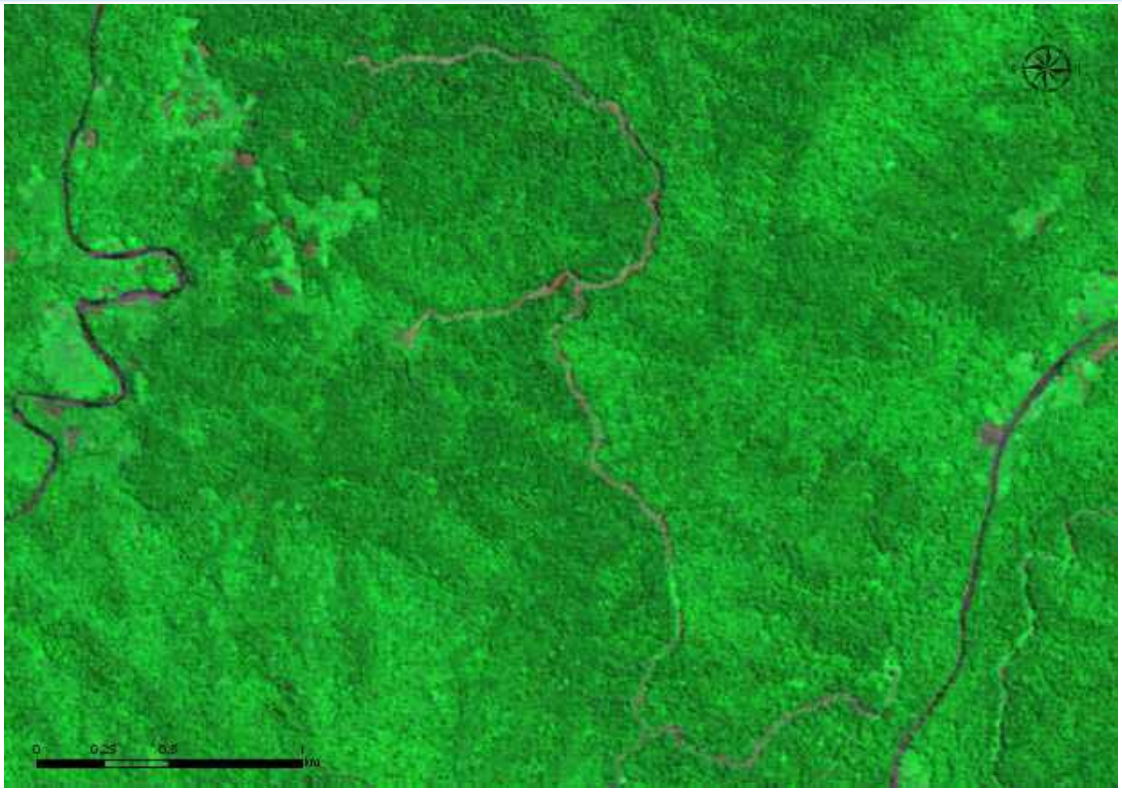
LANDSAT ETM+ 2000 (MS 30m Resolution) 1:5,000 Level



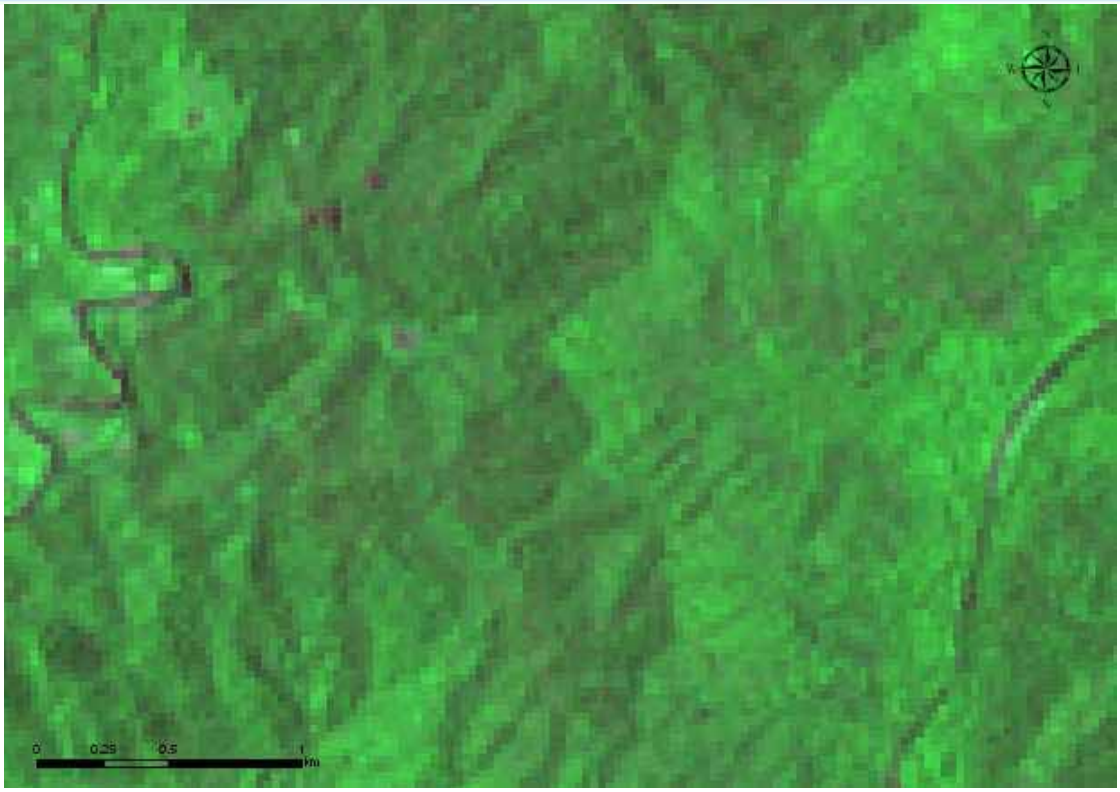
RapidEye MS 2010 (6.5m -> 5.0m Resolution) 1:5,000 Level



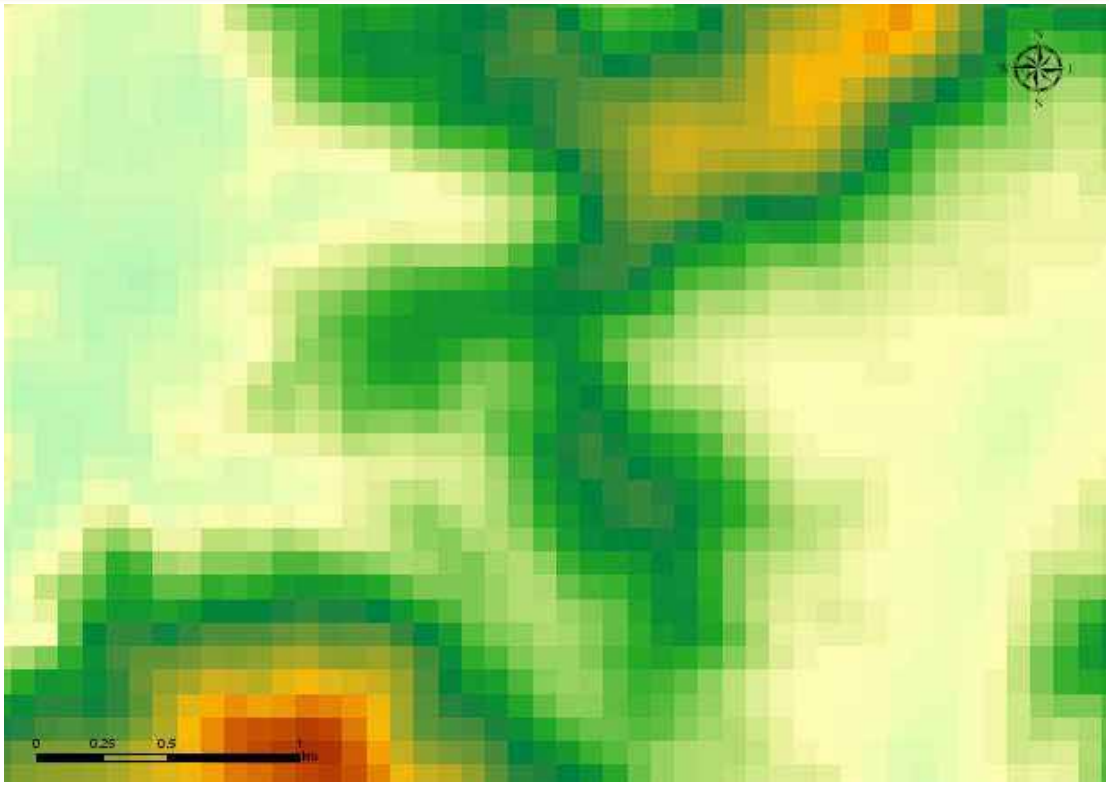
RapidEye MS 2010 (6.5m -> 5.0m Resolution) 1:10,000 Level



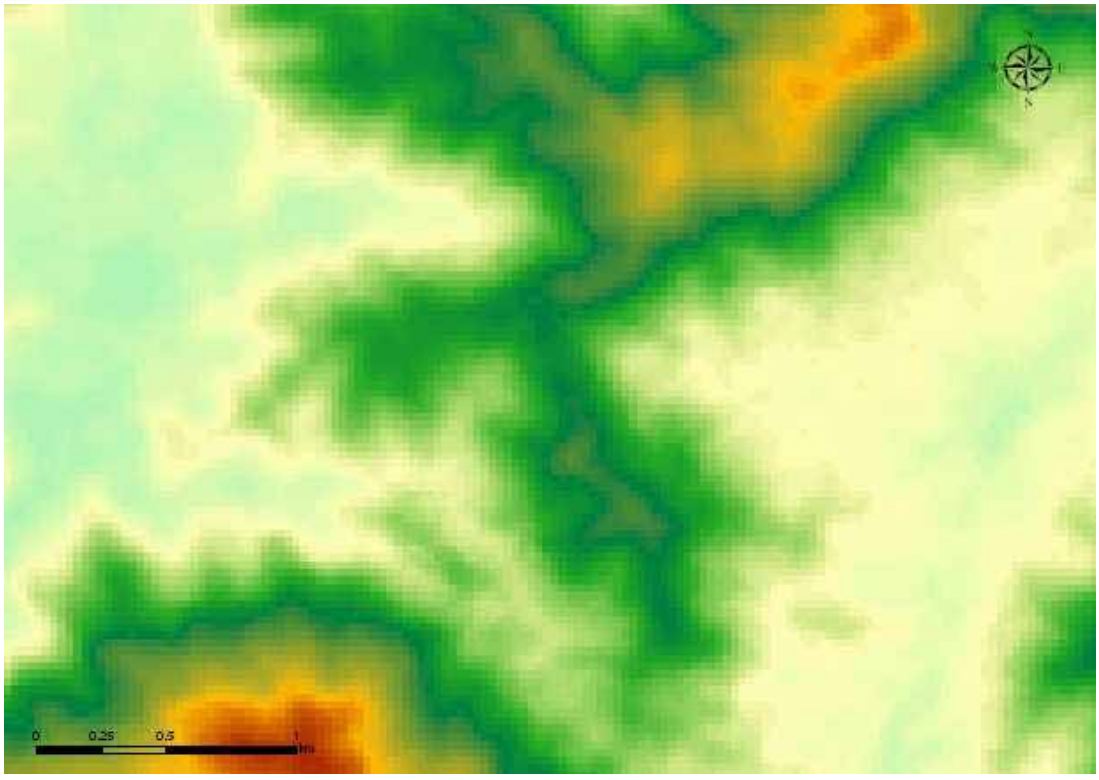
LANDSAT ETM+ 2000 (MS 30m Resolution) 1:10,000 Level



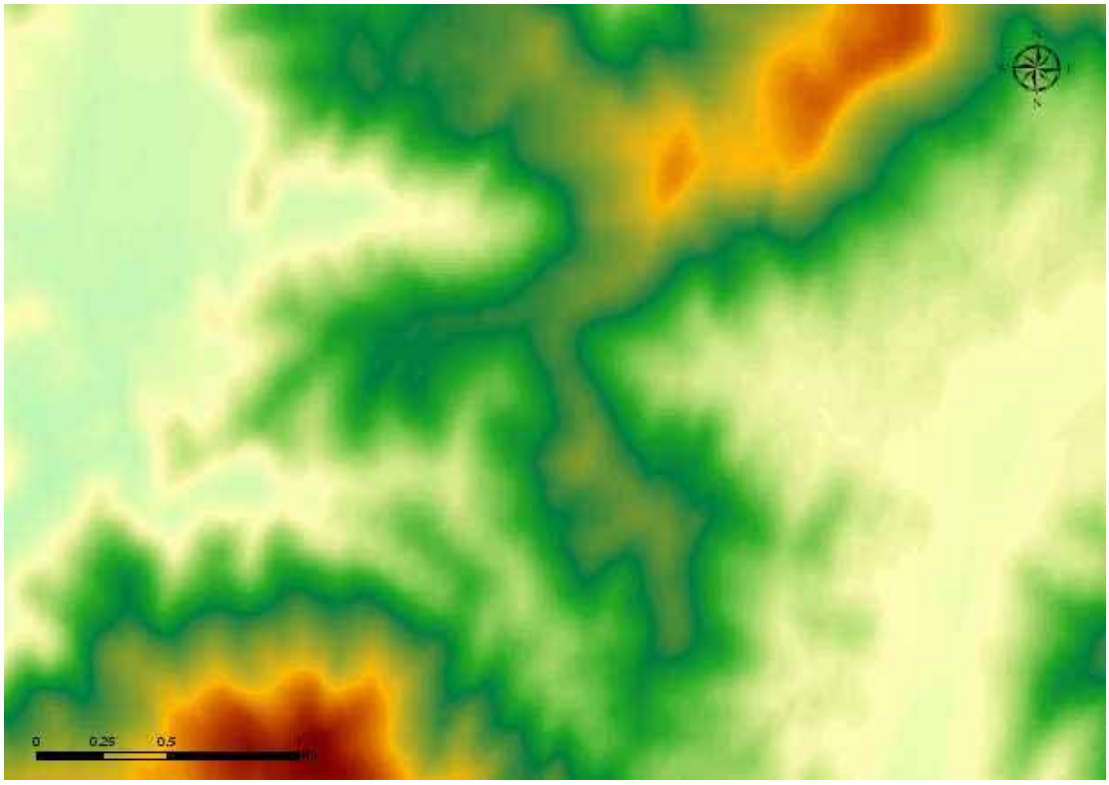
DEM(90m mesh): SRTM (Shuttle Radar Topographic Mission)



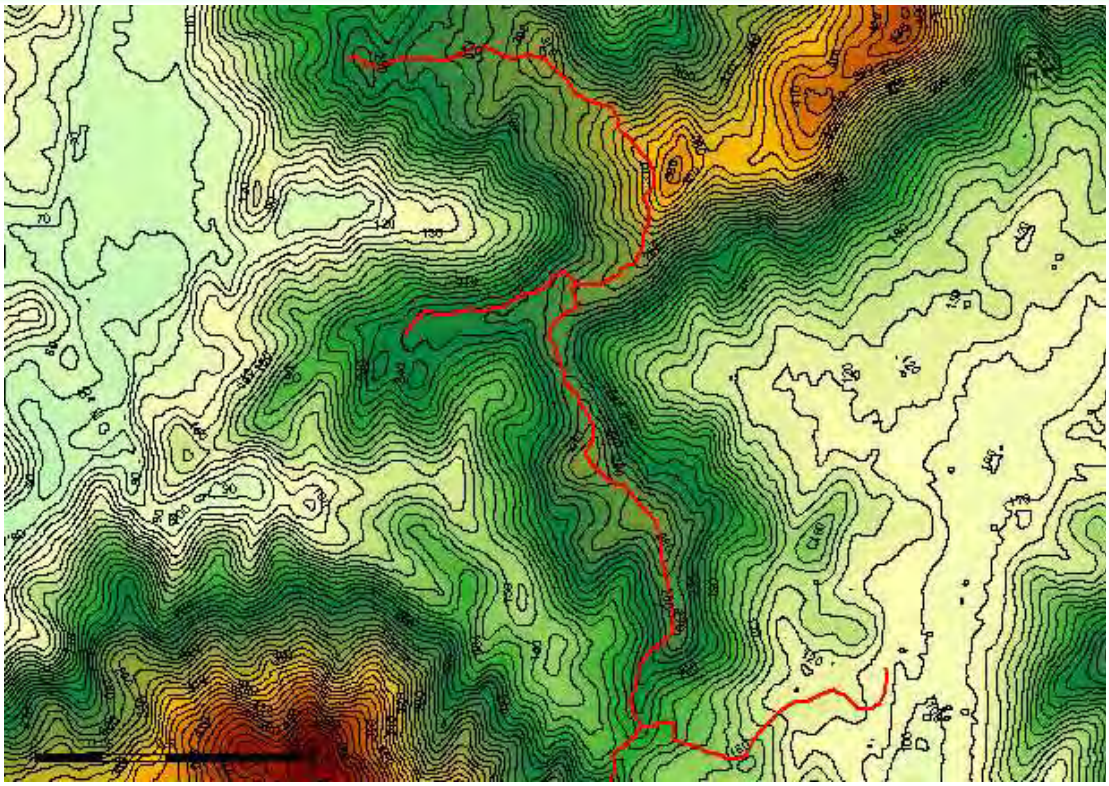
DEM(30m mesh): Terra/ASTER GDEM (ver.2)



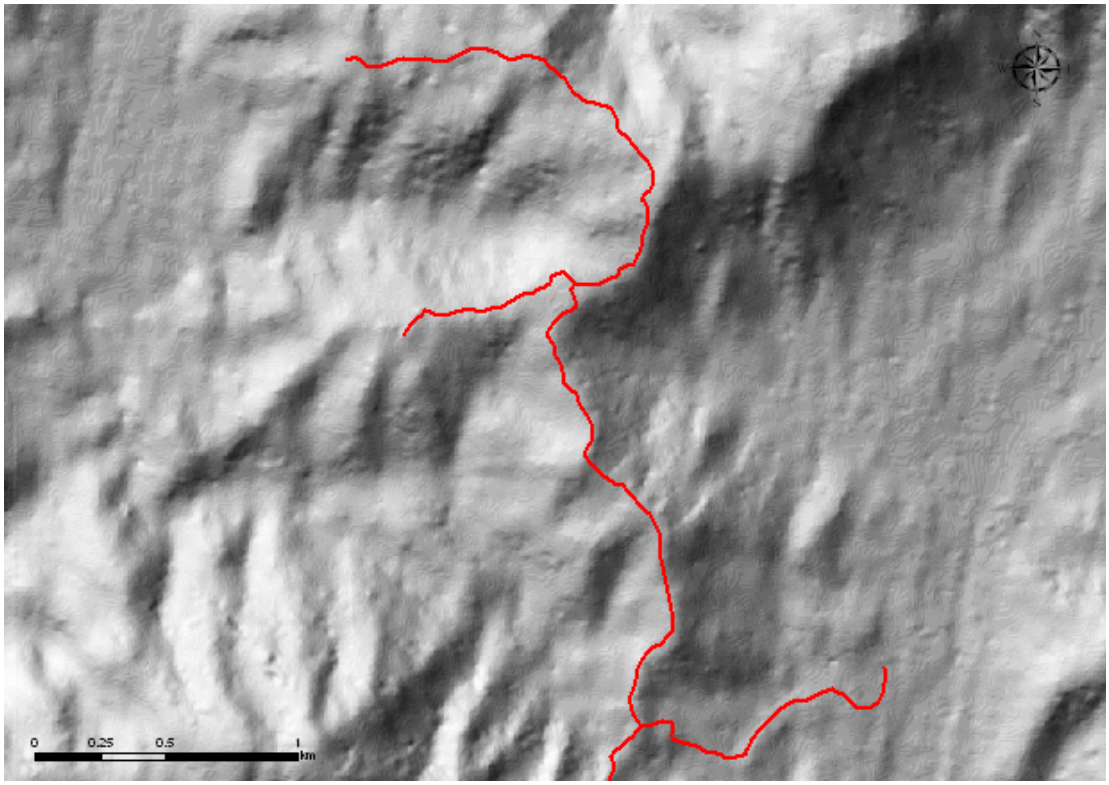
DEM(5m mesh): Airborne Radar



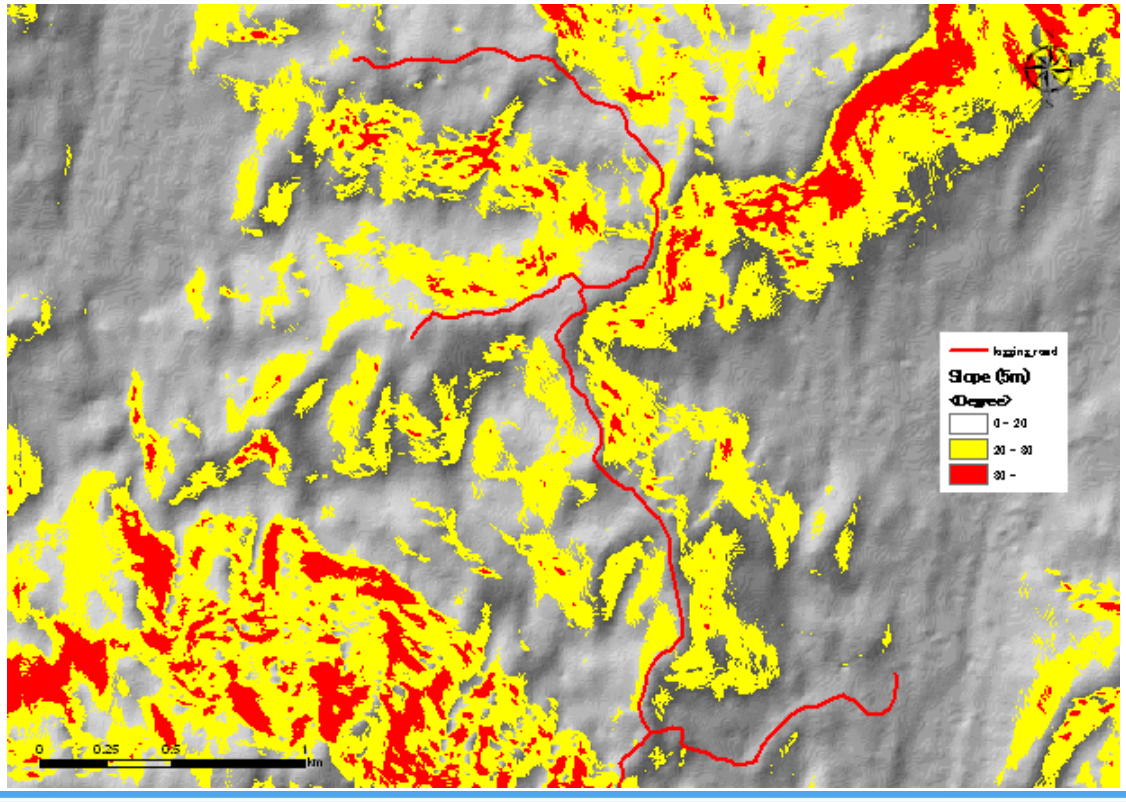
DEM derived contours (10m interval) & logging road



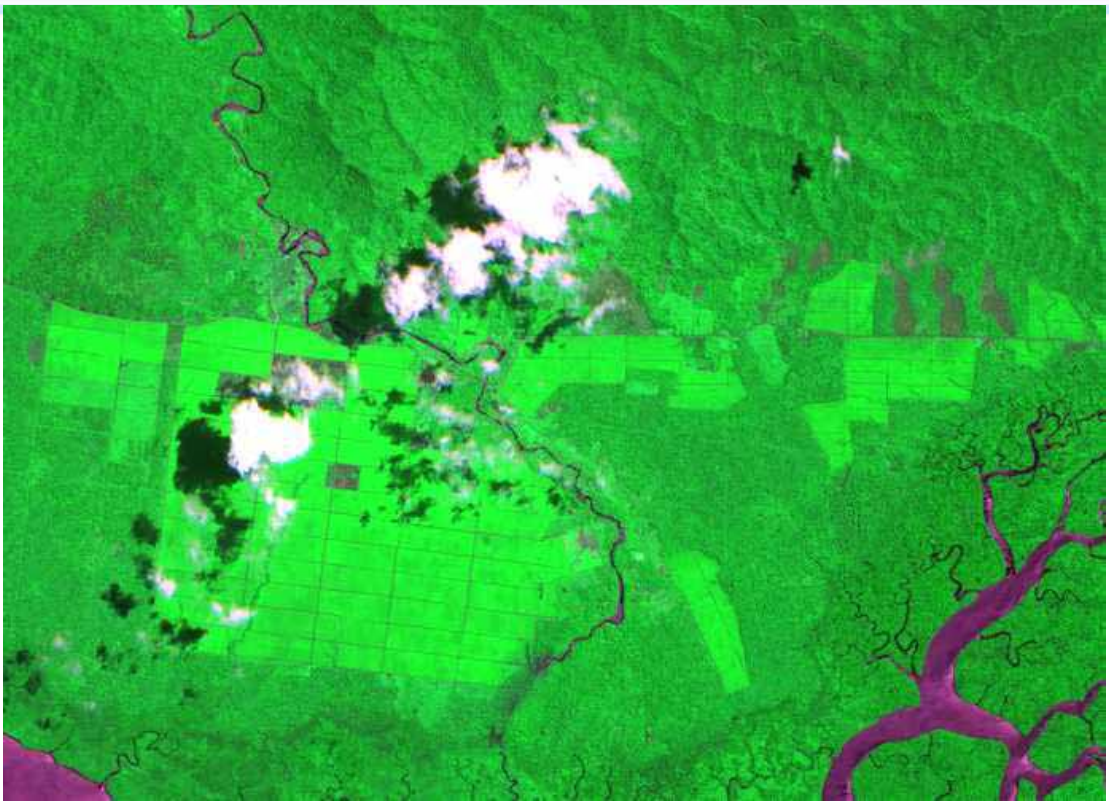
Hillshade(10m mesh) derived from DEM & logging road



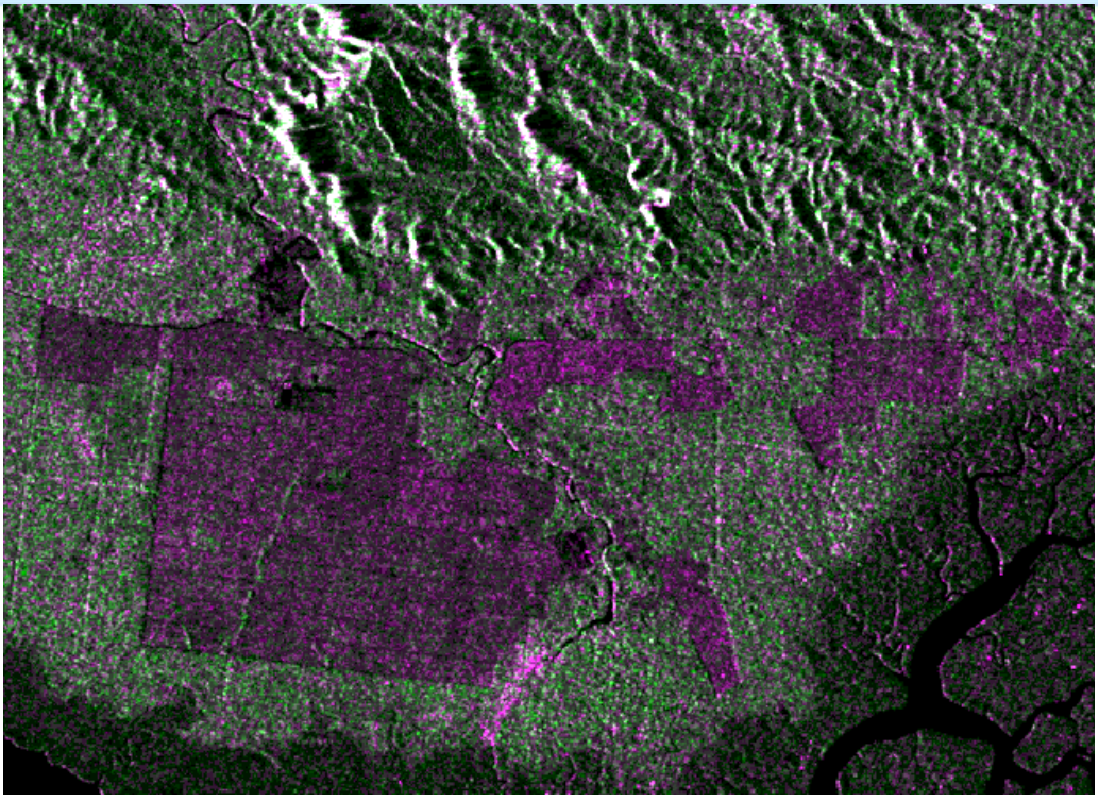
Slope (10m mesh) Analysis derived from DEM & logging road



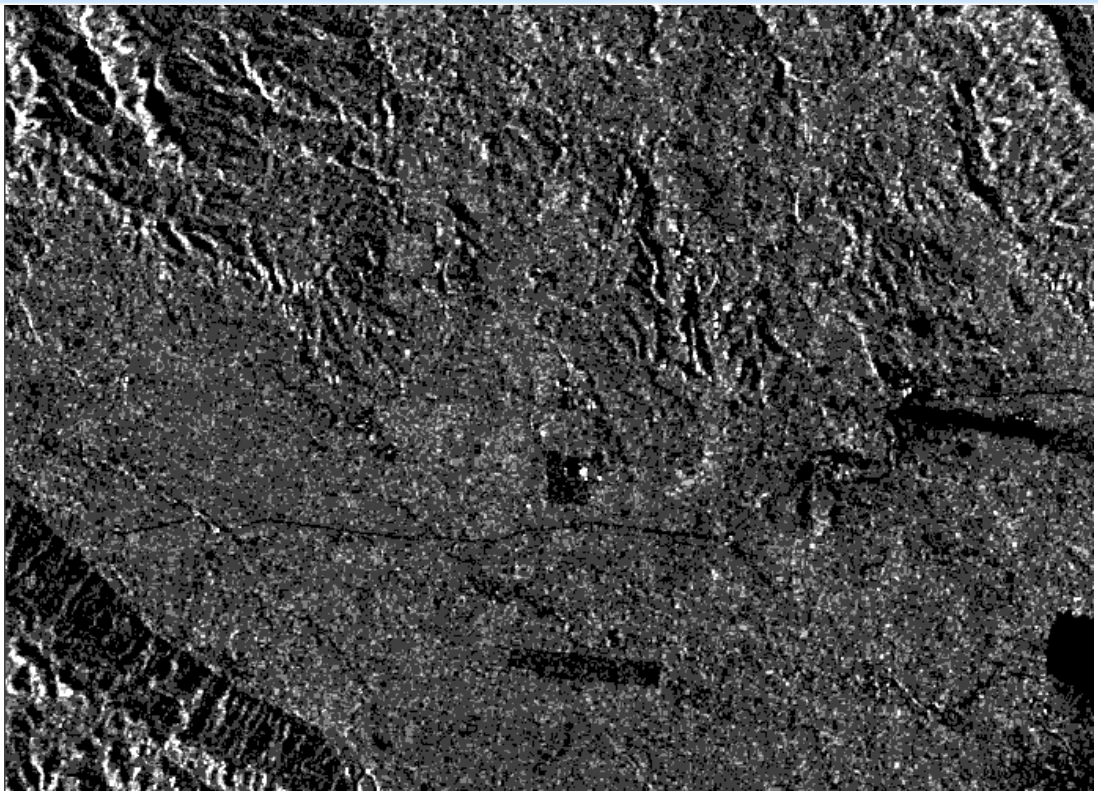
RapidEye 2010 (with Cloud)



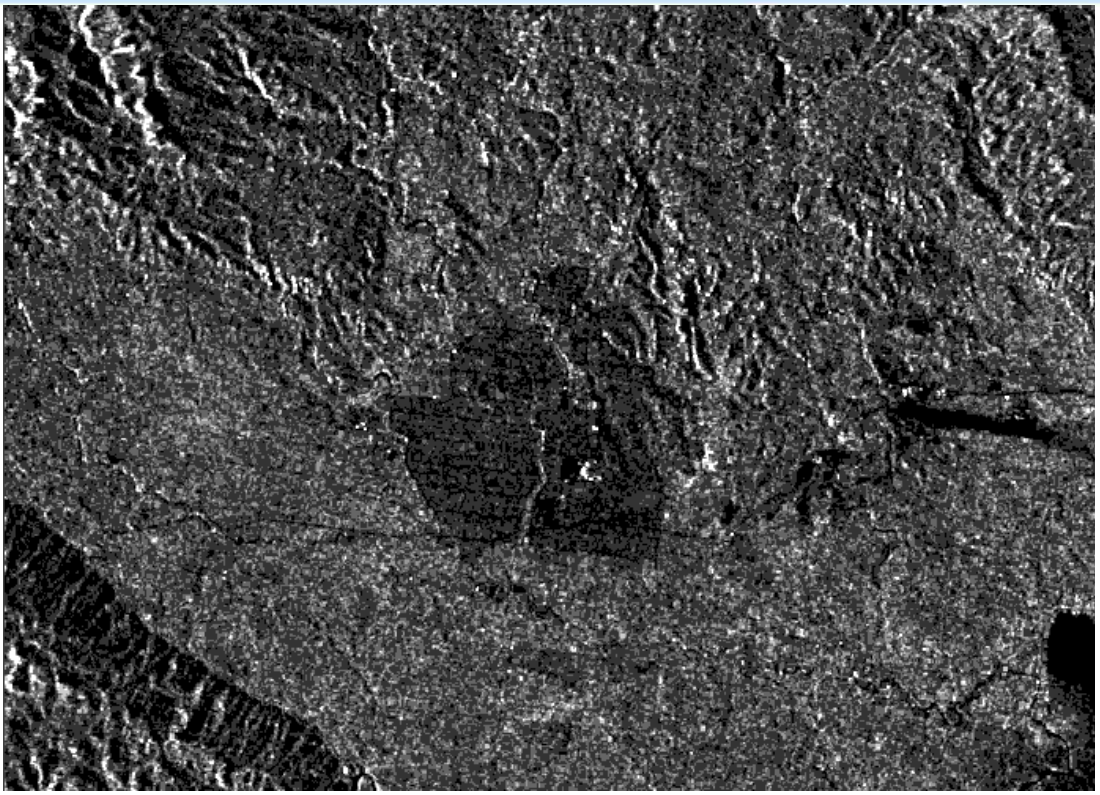
ALOS/PALSAR 2010 (No Cloud)



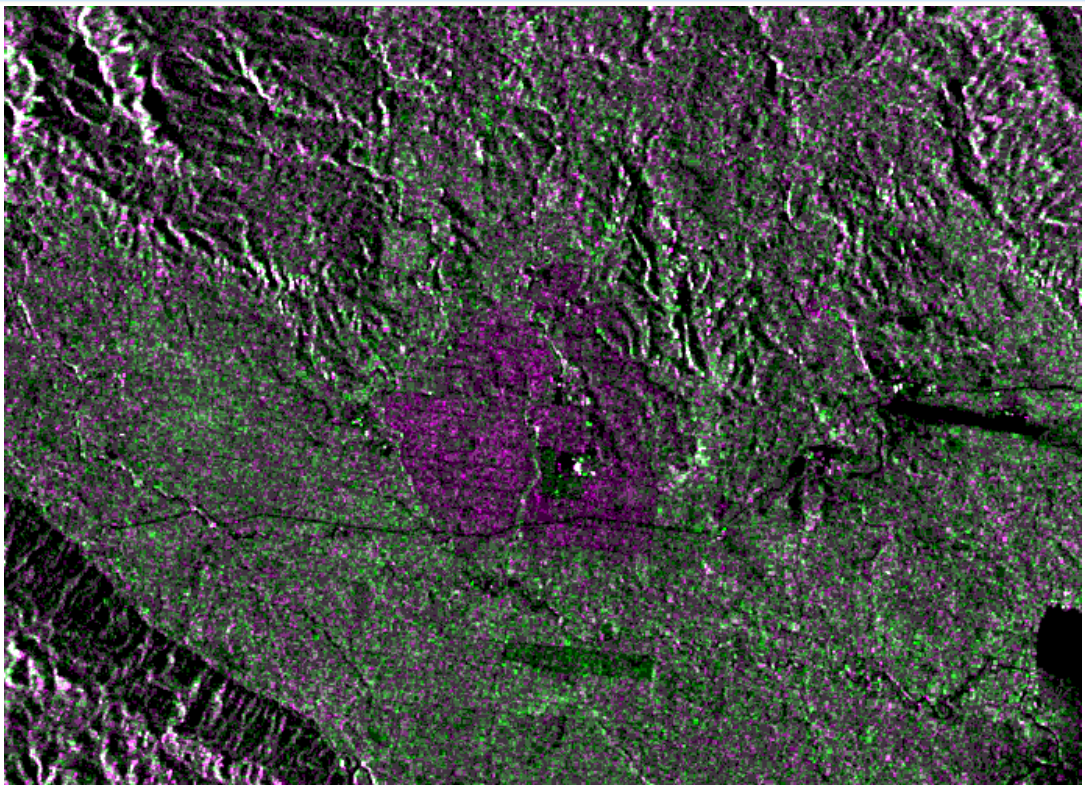
ALOS/PALSAR 2007



ALOS/PALSAR 2010

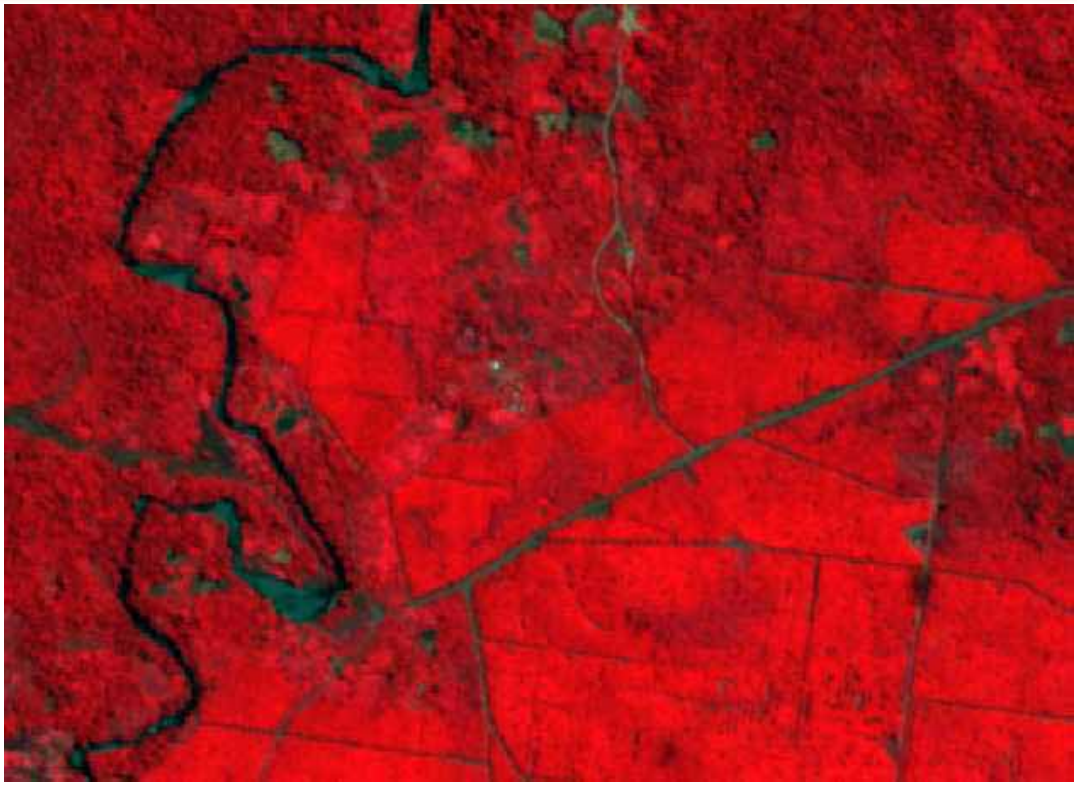


Change Detection by ALOS/PALSAR

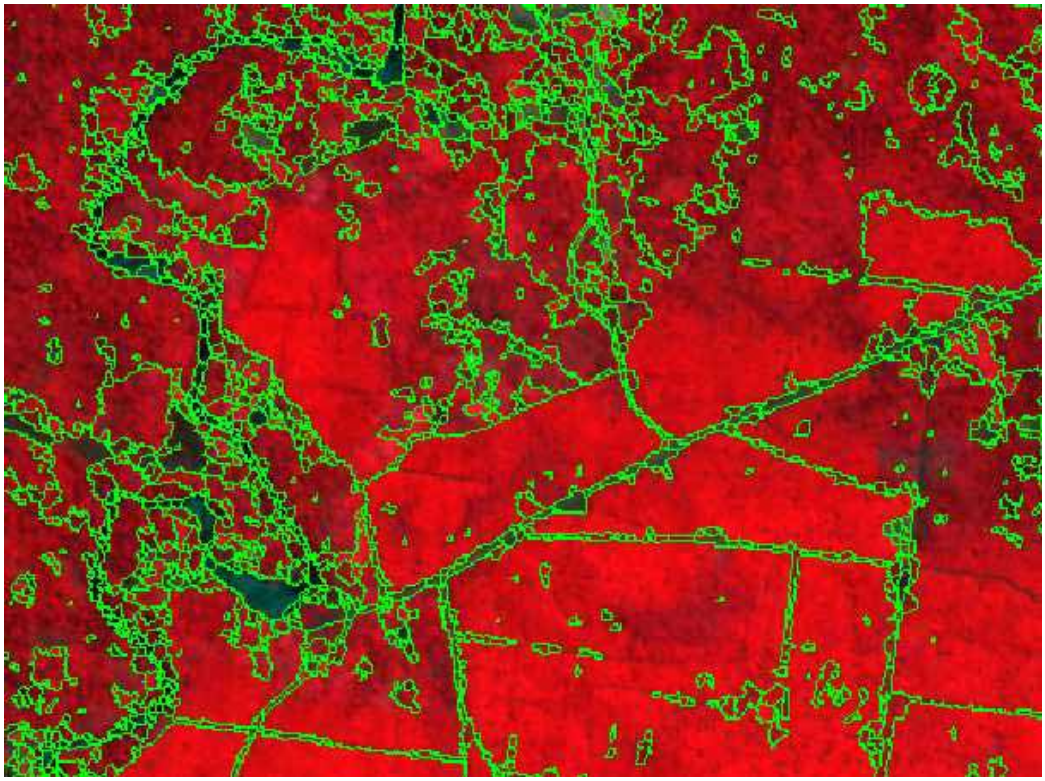


Feature Identification by RapidEye 2010

RapidEye False Color Image (Before Segmentation)



RapidEye False Color Image (After Segmentation)



Comparing Class items of PNG and international standard

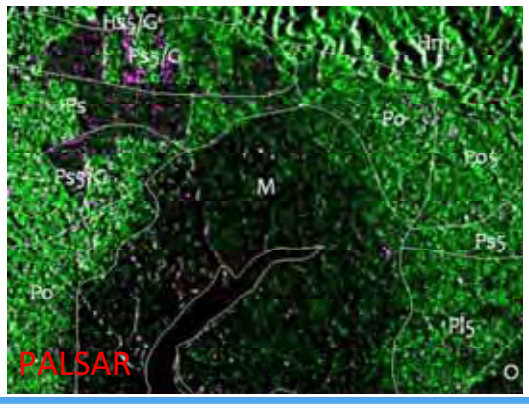
IPCC GL-AFOLU	UPNG	Structural formation	Vegetation type	Condition	Code	
Forest lands		Forest	Low Altitude Forest on Planins and Fans	below 1000m	Pl	Large to medium crowned forest
					Po	Open forest
					Ps	Small crowned forest
			Low Altitude Forest on Uplands	below 1000m	Hl	Large crowned forest
					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 taitensi
			Lower Montane Forest	above 1000m	L	Small crowned forest
					LAr	Small crowned forest with Araucaria common
					LN	Small crowned forest with Nothofagus
					Lc	Small crowned forest with conifers
					Ls	Very small crowned fores
					LsCp	Very small crowned forest with Casuarina papuana
					LsN	Very small crowned forest with Nothofagus
			Montane Forest	above 300m	Mo	Very small crowned forest
			Dry Seasonal Forest		D	Dry evergreen forest
			Litoral Forest		B	Mixed forest
					BCe	Forest with Casuarina equisetifolia
					BMl	Forest with Melaleuca leucadendron
			Seral Forest		Fri	Riverine mixed successions
					FriCg	Reverine successions with Casuarina grandis
					FriK	Riverine successions with Eucalyptus deglupta
					FriTb	Riverine successions with Terminalia brassii
					Fv	Volcanic
			Swamp Forest		Fsw	Mixed swamp forest
					FswC	Swamp forest with Campnosperma
					FswMl	Swamp forest with Melaleuca leucadendron
					FswTb	Swamp foresl with Terminalia brassii

Comparing Class items of PNG and international standard

IPCC GL-AFOLU	UPNG	Structural formation	Vegetation type	Code	
Grassland		Woodland		W	Woodland
				Wri	Riverine successions dominated by woodland
				WriCg	Riverine successions with Casuarina grandis
				Wv	Volcanic successions dominated by woodland
				Wsw	Swamp woodland
				WswMl	Swamp woodland with Melaleuca leucadendron
		Savanna		Sa	Savanna
				Saf	Savanna with galley forest
				SaMl	Savanna with Melaleuca leucadendron
		Scrub		Sc	Scrub
				ScBc	Scrub with Melaleuca leucadendron
				Scv	Volcanic successions dominated by scrub
		Grassland and Herbland		G	Grassland
				Ga	Alpine grassland
				Gi	Subalpine grassland
				Gf	Grassland with some forest
				Gr	Grassland reverting to forest
				Grf	Grassland reverting to forest with some forest
				Gsw	Swamp grassland
				Gri	Riverine successions dominated by grass
				Gv	Volcanic successions dominated by grass
				Hsw	Herbaceous swamp
Forest		Estuarine Communities		M	Mangrove
Cropland		Other Non-vegetation and areas dominated by land use		O	PNGRIS agricultural land use intensity classes 0-4
Wetlands				E	Lakes and large rivers
Other Land				Z	Bare areas
Settlements				U	Larger urban centres

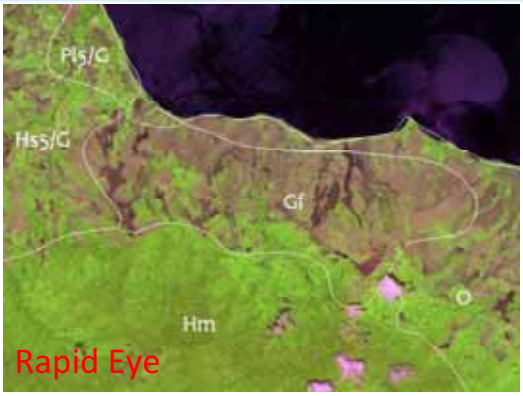
Interpretation Practice

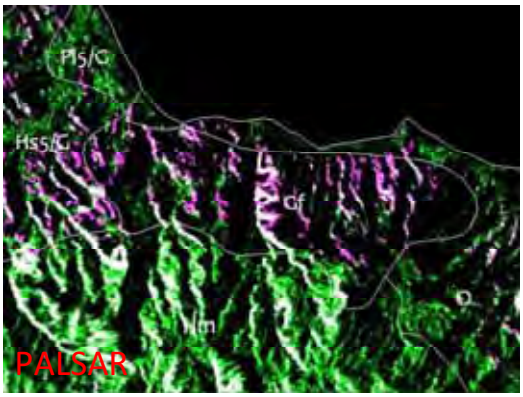
Sample 1 : M - Mangrove



Interpretation Practice

Sample 2 : Gf - Glassland with some forest





Interpretation Practice for Classification

Structural formation	Vegetation type	Shape (Crown)	Color	Shape	Size	Pattern	Texture	Shade	Circum-stance
Forest	Low Altitude Forest on Plains and Fans "P" (<1,000m)		Mixed			Relatively regular Scattered crown	Relatively regular, fine in Natural (RGB 4:5:2) Image of RapidEye		Along coast, flat topography, lower elevation (<50-100) than H
	Low Altitude Forest on Uplands "H" (<1,000m)					vary	vary in RapidEye in Natural Image (RGB 4:5:2) of RapidEye		Upland, hilly/ aspects/ slope, higher elevation (>50-100) than P, Mountain range
	Lower Montane Forest (>1,000m) "L"		(Dark when Intact, lighter after disturbance)			Relatively regular,	(Dense, thick, undulating canopy) (RGB452)		(1,000 m demarcation is not very visible) (Inaccessible areas)

Interpretation Practice for Classification

	Montane Forest "Mo" (>3,000m)								
	Dry Seasonal Forest								
	"D"								
	Litoral Forest "B"			sparsely, patchily scattered Crown Open canopy	Medium	Regular crowns	Relatively regular, fine in Natural		Sign of settlement and gardening Often within 150-200m from coast line
	Seral Forest (River line) "Fri"		Lighter green		Vary in small area	Mixed	Mixed		Along river (can be mixed with gardening)
	Swamp Forest "Fsw"								
Woodland "W"									

Scope of Forest Resource Information Management Database

The forest resource information management DB shall be made accessible from other applications including those for image analysis

A GIS application which expands the functions of FIMS and FIPS

GIS

To be used as the basis of the information management in the forestry administration in PNG

Forest resource information management database

Data sharing with administrative institutions, such as PNGFA, and other donors

Storage

Integration/adoption of GUI

Integration

Data on forest cover maps, ground surveys, carbon accumulation, etc.

FIMS

FIPS

Composition of Database System

GIS
(Client PCs)

Integration of the functions

ArcGIS Desktop

Intra-net

FIMS

FRDB (server)

Data integration

FIPS

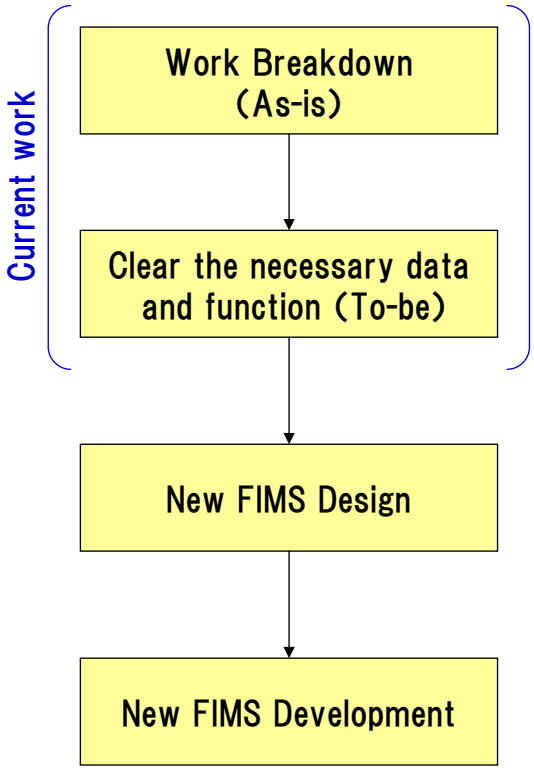
ArcGIS Server＋SQL Server

FRDB will be made accessible from other PCs and applications through the infra-net

Storage

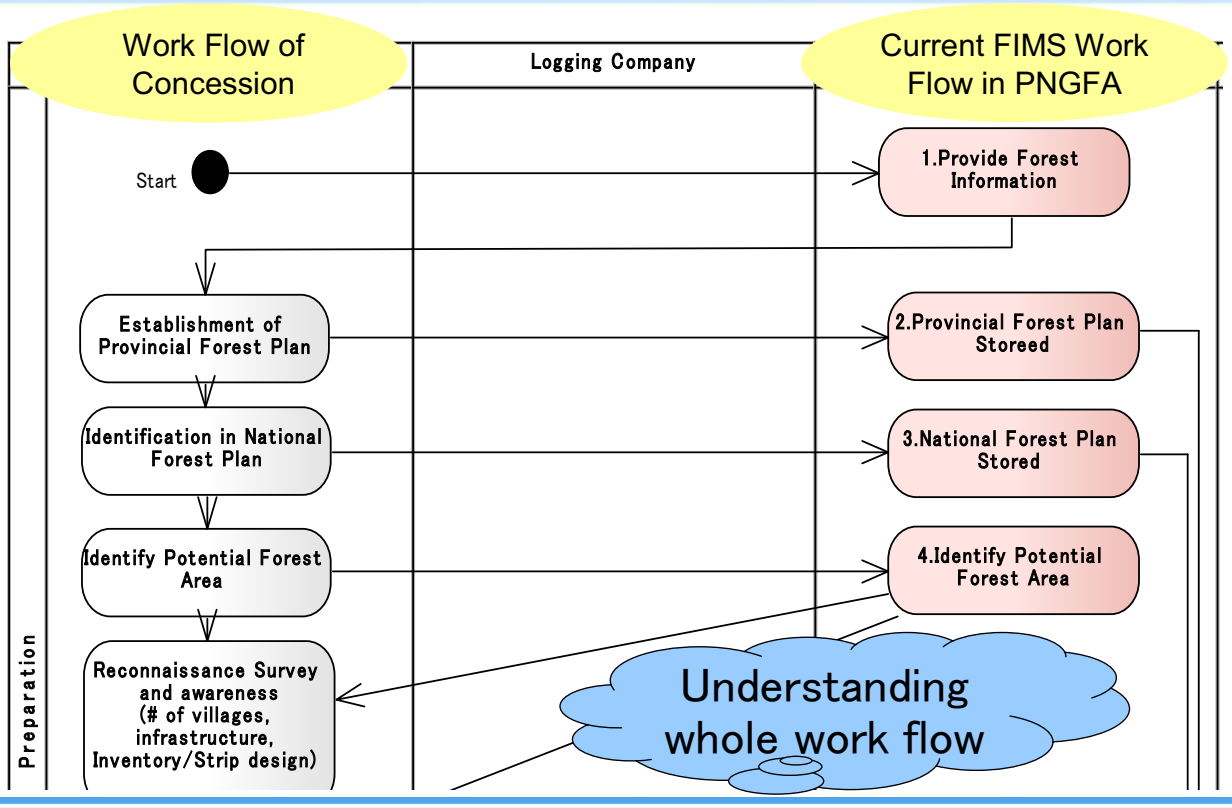
Satellite image, data collected with airplanes, forest cover maps, data from ground surveys, data on carbon accumulation and other data

Development of Forest Inventory and Mapping System (FIMS)



- Procedure of 2 steps
  - 1.Discussion about whole work flow of concession by participation all concerned staffs.
  - 2.Confirmation of content of individual work by staffs in charge of each work.
- Effect of Work Breakdown
  - All concerned stuffs can understand whole work flow of concession.
  - Problems of current work are cleared and shared by all concerned staffs.
  - Best solutions for the whole system (work) can be examined by all concerned staffs.
  - Improved FIMS is developed.

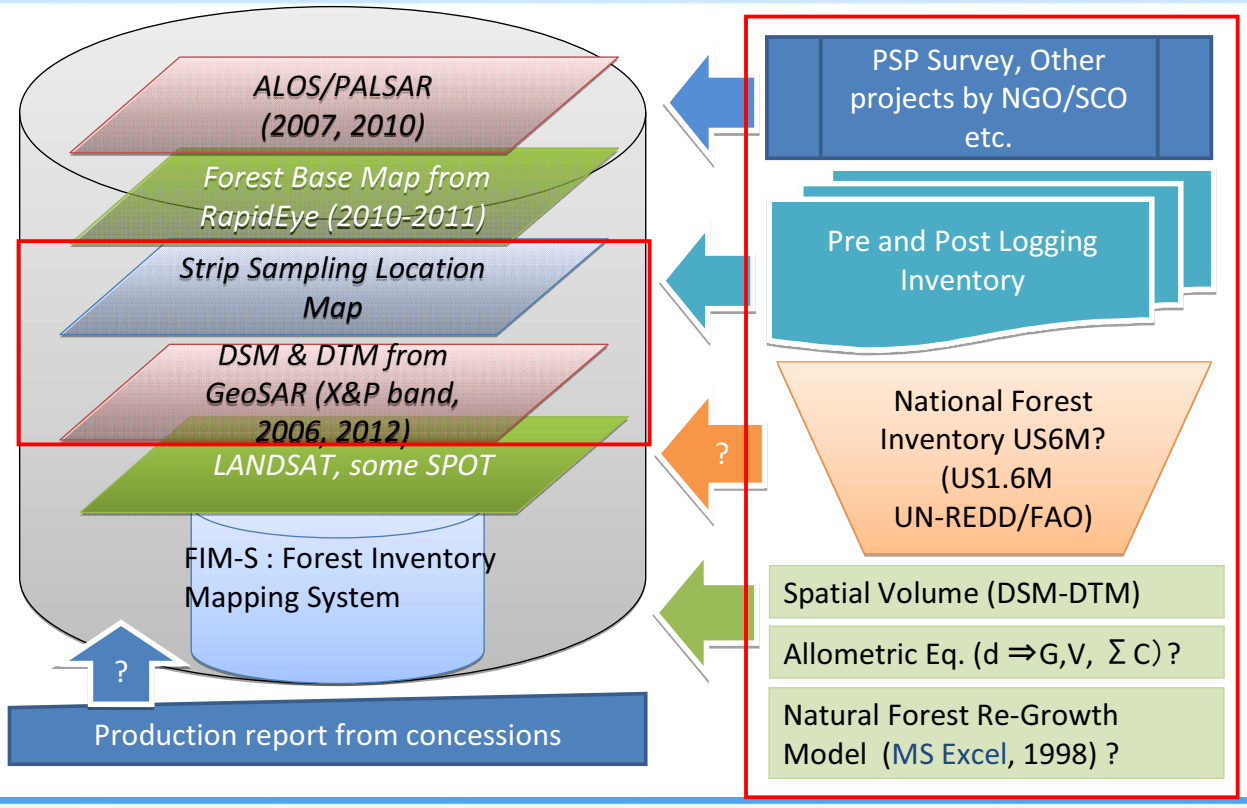
Sample of Work Breakdown 1



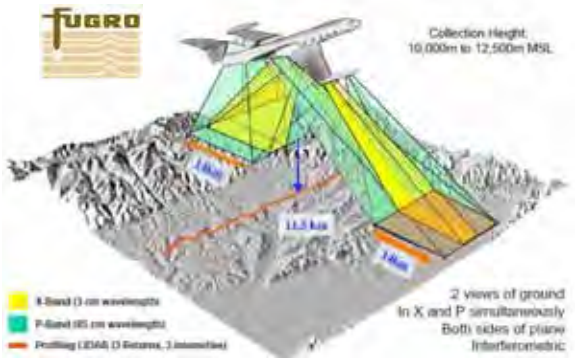
Sample of Work Breakdown 2

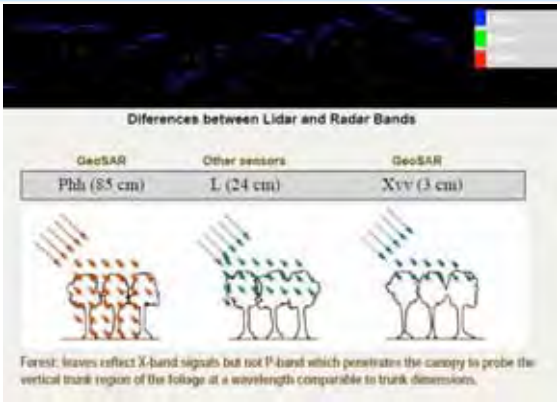
	No.	1	2	…
Use case (As Is)	Work	Sequence for Provide Forest Information (FIMS)	Sequence for Provincial Forest Plan	…
	Who	FIMS administrator to Senior Plan Supervisor	Senior Plan Supervisor	…
	When	Every five years (It takes a couple of hours each provinces)	Every five years based on Section 49 of Forestry Act 1991 (as amended)	…
	for What	To make Provincial Forest Plan	Requirement of the Act. Review of plan..	…
	Input Information	Protected area data from DEC Logged area from Company	Relevant stakeholders consultations. Previous Provincial Forest Plans. Paper Maps and spreadsheet data of each province	…
	Output Data	Paper Maps Spreadsheet data (each province)	Revised Provincial Forest Plan. New concession area Expired concession area Protected area	…
	Function	Mapinfo Access	Map stored in FIMS. #New concession area (new) #Expired concession area (update) #Protected area (not often)	…
Improvement items (TO BE)		Viewing & Printing (not editing) for Managers using Local Area Network	Detail Understanding of Individual work	

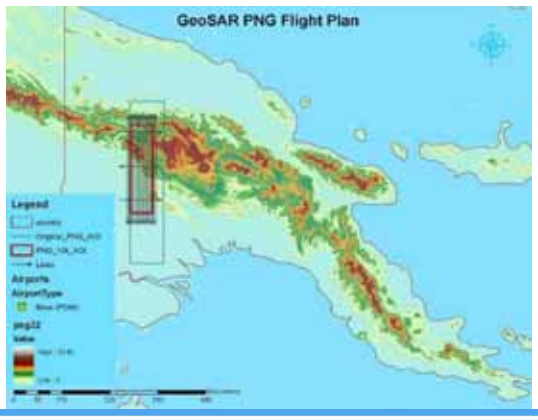
Maximum Utilizing of Existing Data of PNGFA

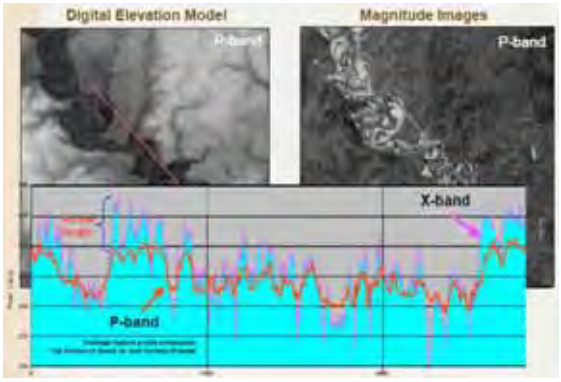


Key Item for Carbon Stock Est. (Tree Height for Wide Area)

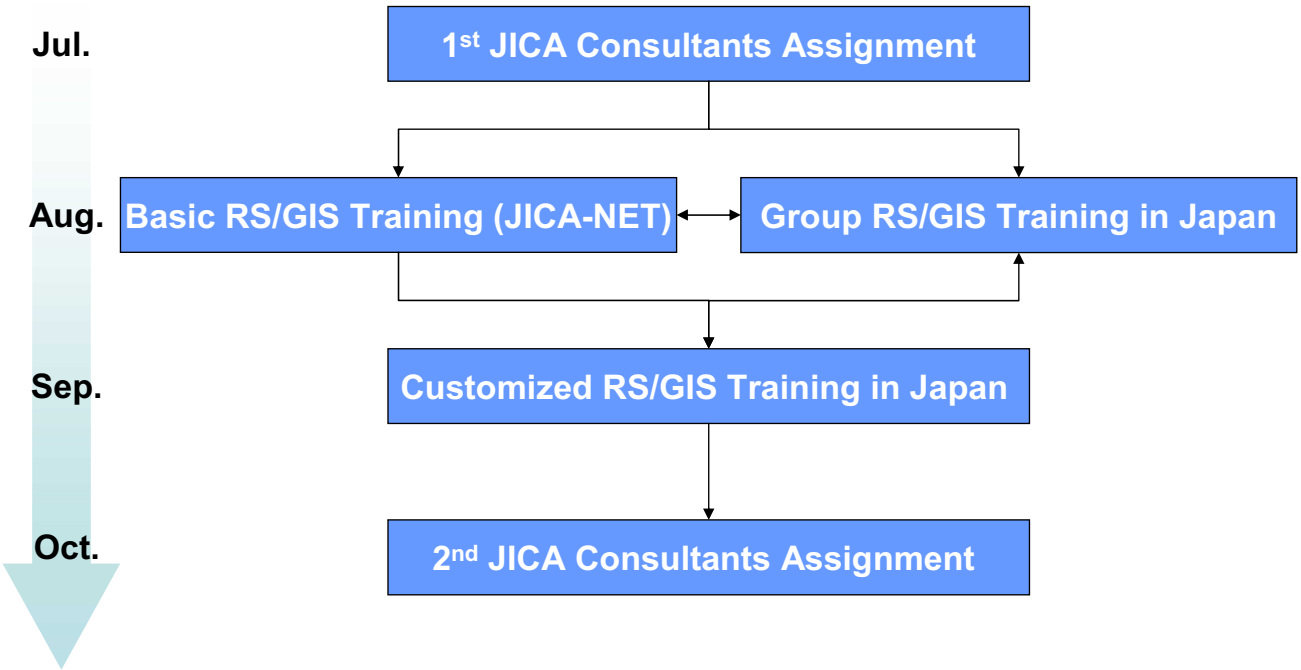








Progress of Capacity Building Activity



Basic RS/GIS Training (Lecture): JICA-NET

- To get basic RS/GIS knowledge as preparation for OJT
- More than 108 people participate in total, 7 people join more than 7 times
- Concentrating training for trainees in Japan as preparation for activities

Group RS/GIS Training in Japan

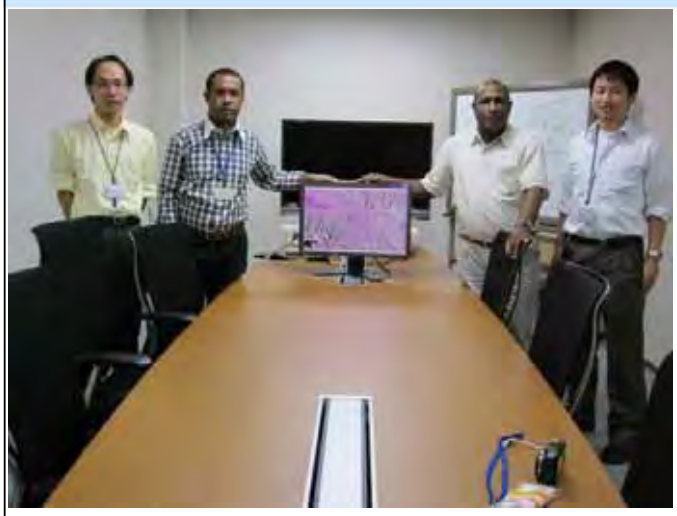
- Program Objective

  Participants are expected to acquire the skills and knowledge for using remote sensing with the aim of understanding forest resources in their own countries on the basis of international discussion of REDD.

- Overall Goal

  Each participant's belonging organizations take actions based on the action plans, in order to build the system for monitoring of forest resources using remote sensing in the countries concerned.

Customized RS/GIS Training in Japan



- **TO UNDERSTAND THE WHOLE PICTURE OF FUTURE ACTIVITIES** THROUGH THE INTRODUCTION OF CASE EXAMPLE OF JAPANESE REDD & RELATED SUPPORT
- **TO BE ABLE TO PREPARE AND ORGANISE BASIC INFORMATION** FOR IMPLEMENTATION OF THE FUTURE PROJECT THROUGH PRACTICAL WORK OF FOREST COVER CLASSIFICATIONS USING REMOTE SENSING TECHNOLOGY AND ACTUAL DATA OF PNG.

Thank you (We are PNG First Astronauts)

International Technical Seminar
Toward developing a framework of global REDD+
-Scaling up of demonstration activities and integrating players' roles –

REDD+ Readiness Activities by Papua New Guinea Forest Authority

7th February 2012
at Waseda University, Tokyo, Japan

Constin Bigol

Bruno Kuroh

National Forest Service, PNG Forest Authority

Papua New Guinea

Contents of this presentation

1. PNG and its Forest
2. Role of PNG Forest Authority (PNGFA)
3. Rate of Causes of Deforestation and Forest Degradation
4. Activities initiated by PNGFA
5. Proposed REDD+ activities
6. Forestry concessions and REDD+ pilots
7. Challenges and Possible Solutions for PNG
   - JICA Technical Cooperation & Grant Aid -
8. Satellite Remote Sensing for Activity Data
9. Canopy Volume Estimation for Emission Factor
10. Field survey implemented by Forest Research Institute (FRI)
11. New National Forest Resource Management Database

1. PNG and its forest (1)

1. PNG and its forest (2)

	Papua New Guinea	Remarks	Comparison to Japan
Population	6.1 million	800+ Languages	1/20
Land Area	45 million ha		X 1.2
Forest Area 1990 2010	 32 million ha 29 million ha	 3 million ha decrease in 20 years	X 1.2
Of which - Planted Forest	 90 thousand ha		1/100
Growing Stock	2.7 billion m3	÷ 90m3/ha	

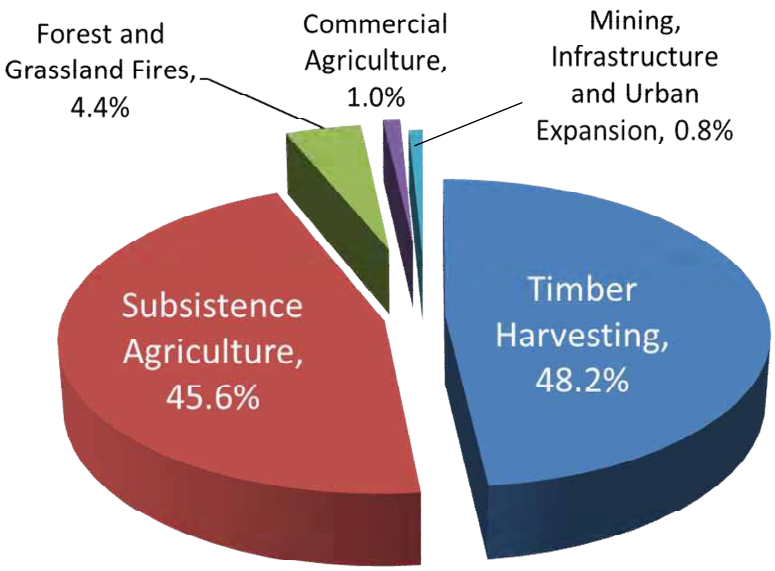
Source: UN-REDD National Programme Document, FAO FRA 2010 National Report, etc.

2. Role of PNG Forest Authority (PNGFA)

- PNGFA is mandated to manage forest resources. Its operations are governed by the;
  - The National Forest Development Guidelines 2009
  - The 1991 Forest Policy,
  - Forestry Act 1991 (as amended),
  - 2008-2012 PNGFA Corporate Plan
  - Forest Regulations,
  - National Forest Plans (19 Provincial Forest Plans)
  - PNG LCOP and
  - 24 Key Standards
  - Forestry and Climate Change Framework for Action 2009-2015

3. Rate and Causes of Deforestation and Forest Degradation in PNG

- 1.41% of PNG's forest were being deforested or degraded per year.
- The major causes of deforestation and forest degradation in PNG have been logging and subsistence agriculture.



Shearman et al, 2008

4. Activities initiated by PNGFA

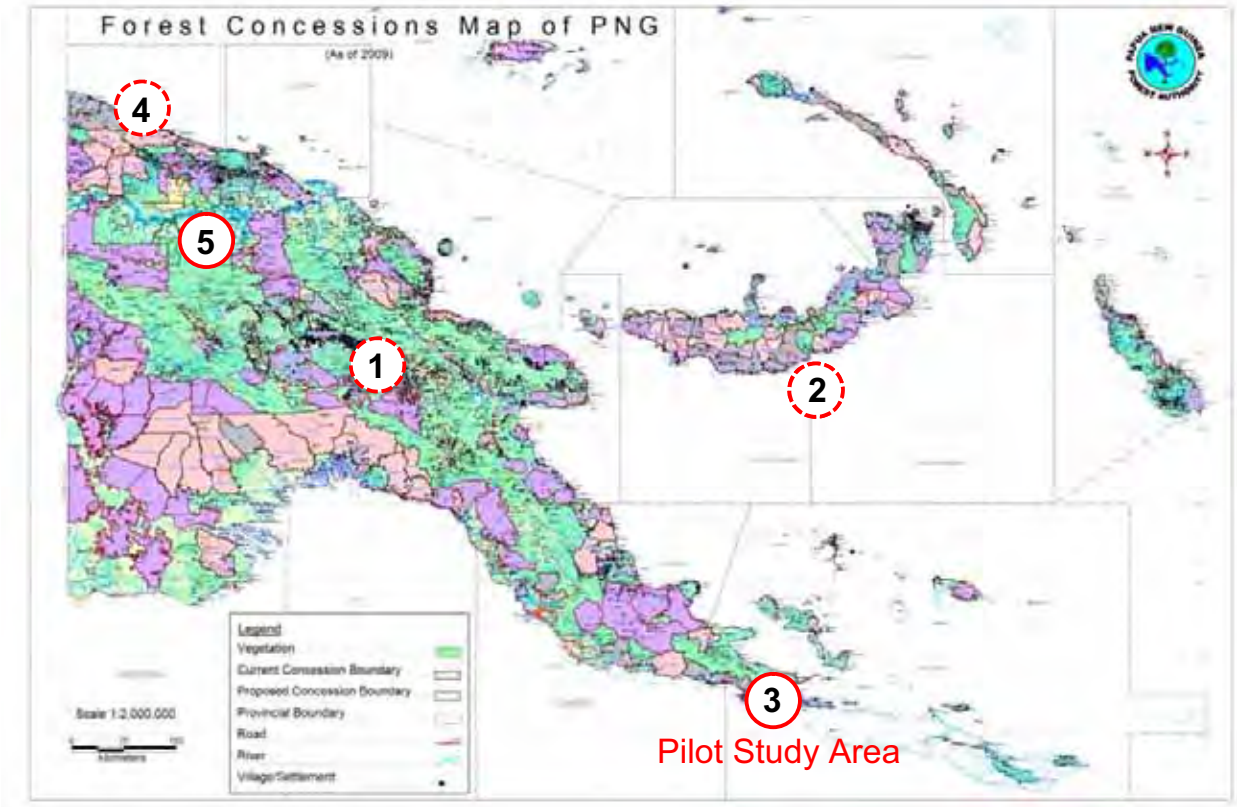
Between 2007-2011, the PNGFA has initiated the following activities to address REDD+ initiatives :

	Activities
Review of Provincial Forest Plans	After COP 13 in Bali, Indonesia in 2007, the PNGFA began reviewing all the 19 Provincial Forest Plans to include REDD+ initiatives in the Plans
Restructure of the PNGFA	In 2008/2009, a major restructure was conducted which saw the creation of new Branch and Program Unit to address climate change issues
New Policy Initiatives	Forestry and Climate Change Framework for Action 2009-2015 which is focusing on REDD+ initiatives was established in 2009
Selection of REDD+ Pilot Sites	The PNGFA in 2008 initiated a small working group comprising of the staff from Universities (UPNG and UNITECH) and PNGFA including FRI (Forest Research Institute) to select pilot provinces and possible pilot sites
Selection of REDD+ Activities	The small working group proposed suitable activities for each Pilot Site

5. Proposed REDD+ Activities in PNG

	Province	Vegetation Type	Proposed Activities
1	Eastern Highlands	Glass land Lower Montane Forest	•Afforestation of grassland areas (10,000 – 20,000 ha) •Forest conservation (5,000 – 10,000 ha)
2	West New Britain	Low Altitude Forest on Uplands	•Secondary Forest Management (100,000 – 150,000 ha) •Afforestation / Reforestation (40,000 – 50,000 ha)
3	Milne Bay	Low Altitude Forest on Uplands	•Reduced Impact Logging (60,000 ha)
4	West Sepik	Glass land Low Altitude Forest on Plains and Fans	•Afforestation / Reforestation (40,000 – 50,000 ha) •Forest Conservation (100,000 – 200,000 ha)
5	East Sepik	Low Altitude Forest on Uplands	•Conversion of proposed logging Area to REDD+ Pilot Area (343,900 ha) •REDD+ activities will be determined after a development option study

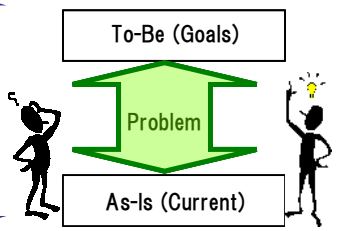
6. Current and Proposed Forestry Concessions with the Proposed REDD+ Pilots in PNG



7. Challenges and Possible Solutions for PNG

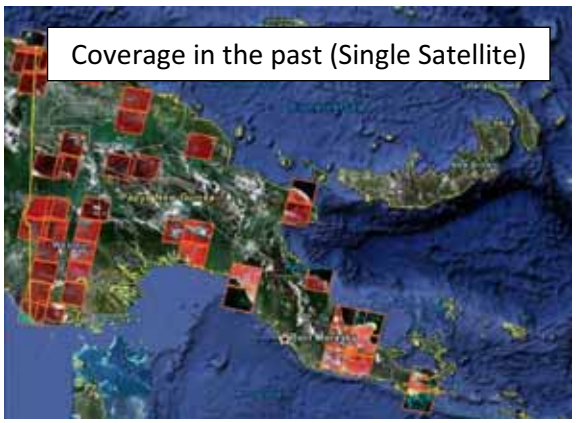
- JICA Technical Cooperation & Grant Aid -

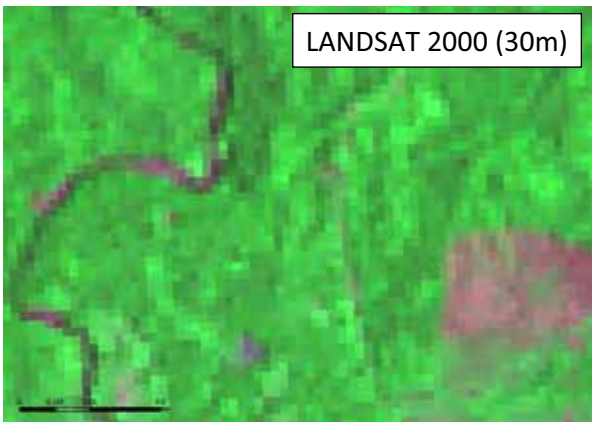
【To-Be】 1. National forest resource basemap is developed & utilized	【To-Be】 2. National level forest resource GIS/Database is developed & utilized	【To-Be】 3. Carbon/Biomass stock is estimated.
【Problem】 ・PNGFA does not have data and facility to develop ・Need time to develop national level map	【Problem】 ・The work flow does not fit with FIMS any more ・Existing data are not well compiled into the system	【Problem】 ・More than 90 % of PNG land is customary land ・No access road to do field survey for whole country
【As-Is】 1. National level forest basemap is not developed since 1972	【As-Is】 2. FIMS (Forest Inventory Mapping System) is not updated since 1998	【As-Is】 3. Carbon stock estimation is necessary but no good data for it

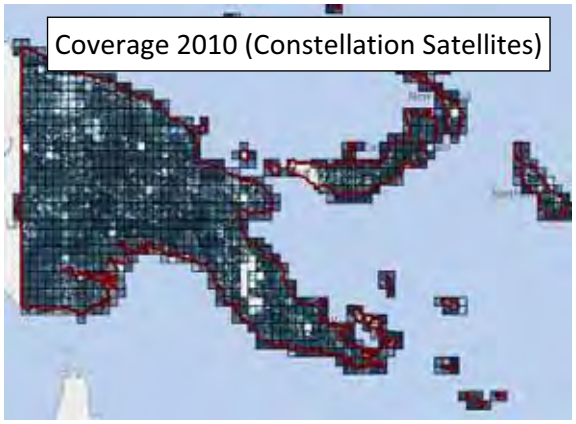


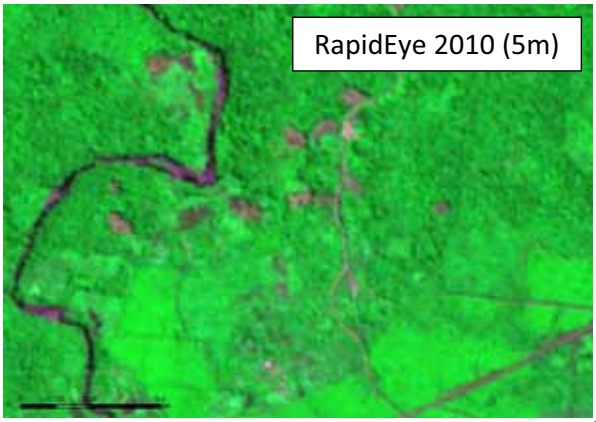
8. Satellite Remote Sensing for Activity Data (1)

-Satellite Coverage and Example of Landcover (logged over area)-







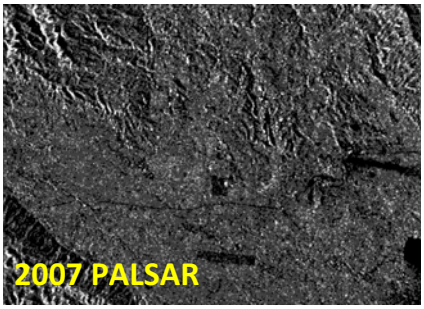


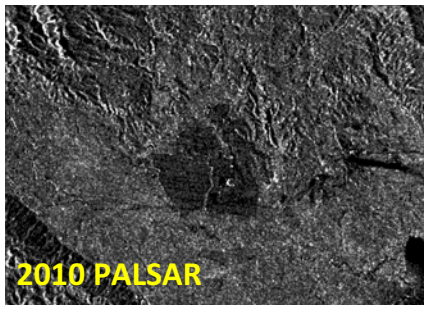
8. Satellite Remote Sensing for Activity Data (2)

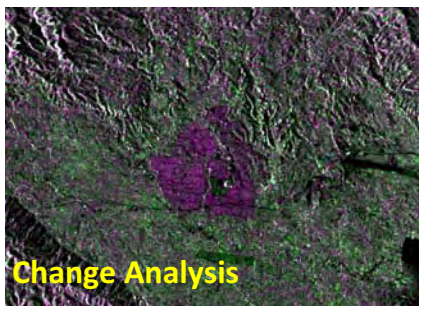
- Basemap Development & Change Detection (2D Area Base) -

Interpretation Practice for Basemap Development => Land-cover Classification

Preliminary Process/Analysis for Change Detection => Land-cover Monitoring



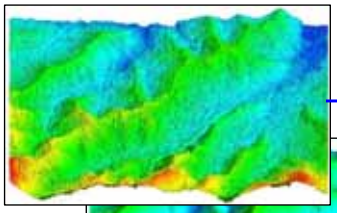


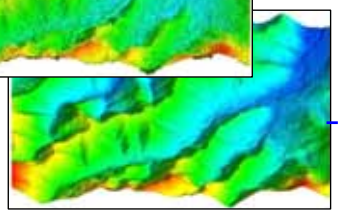


9. Canopy Volume Estimation for Emission Factor (1)

- It is difficult to implement field survey for wide area (land-owner issue & accessibility)
- It is difficult to measure tree height accurately in forest due to high density of forest
- In addition to 2D area analysis by satellite, 3D volume analysis by airborne is desired

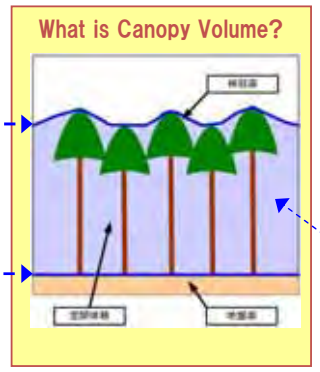
Digital Surface Model (DSM)

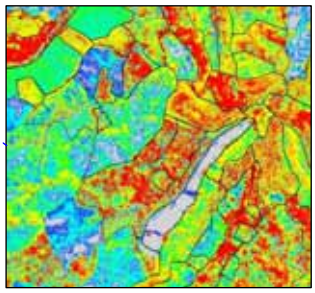




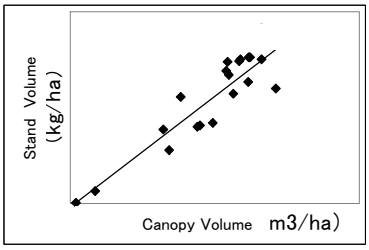
Digital Terrain Model (DTM)

What is Canopy Volume?

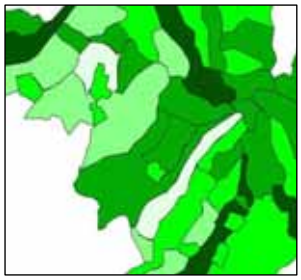




Canopy Volume



Correlation Analysis of Canopy Volume and Stand Volume



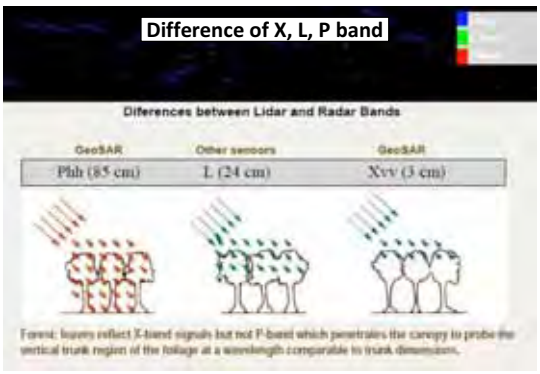
Stand Volume

9. Canopy Volume Estimation for Emission Factor (2)

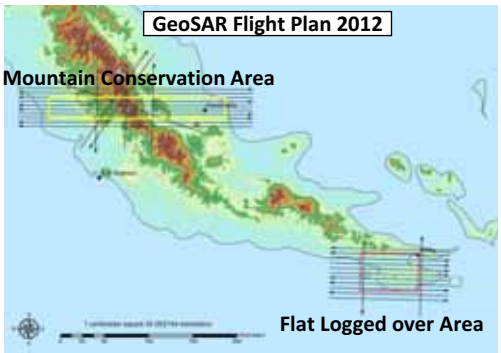
- GeoSAR X-band and P-band DEM were collected for whole mainland of PNG in 2006
- Necessary for calibration using existing PNGFA inventory and some additional data
- New GeoSAR will be collected for sample areas over REDD+ pilot activities in 2012

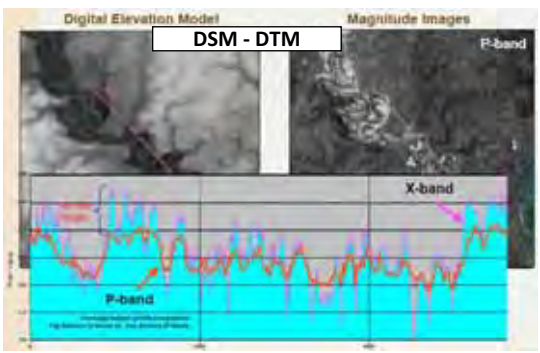
GeoSAR Surveying

Difference of X, L, P band



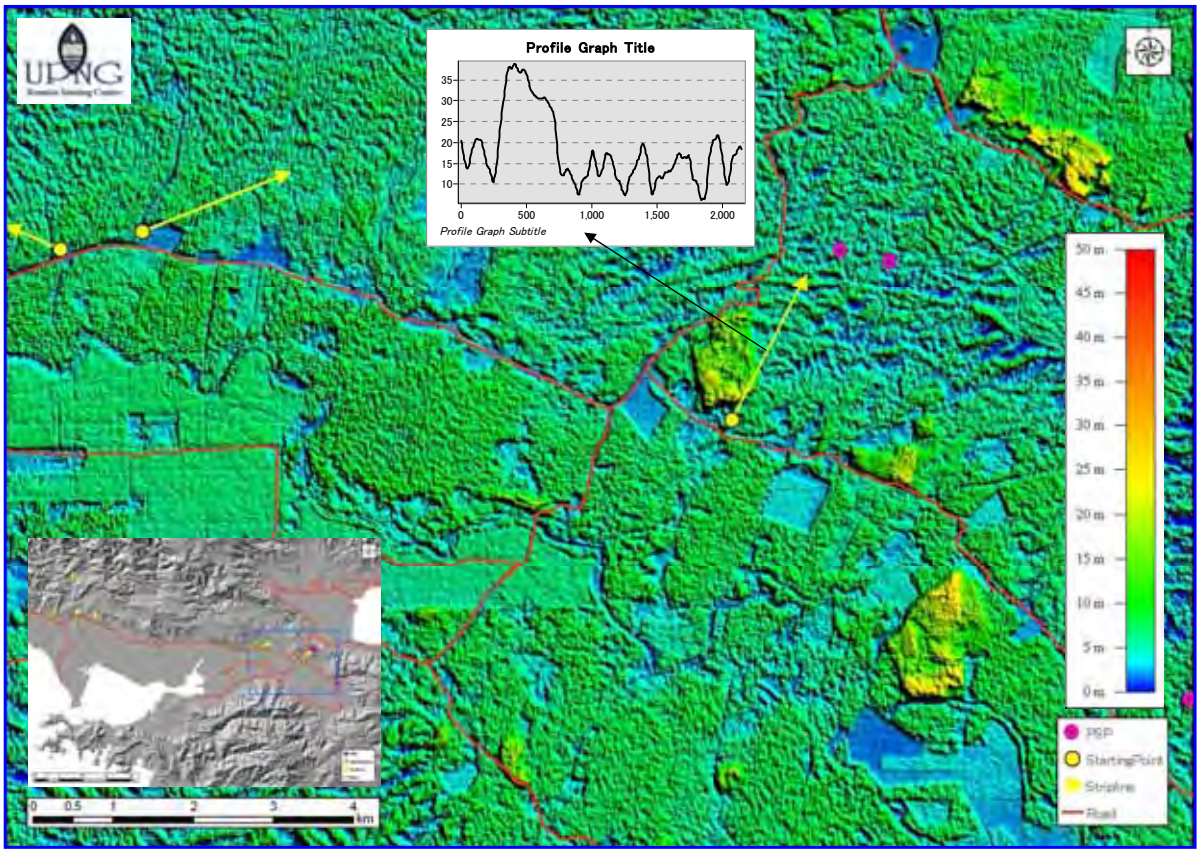
GeoSAR Flight Plan 2012





9. Canopy Volume Estimation for EF (3)

- Result of trial process/analysis of existing GeoSAR 2006 -



10. Biomass/Carbon Survey implemented by Forest Research Institute (FRI)

PSP PINFORM Model – growth simulation Application of Reduced Impact Logging

- Harvesting Scenario testing and forecasting sustainability

Soil and litter sampling covering PSP to date

- 18 PSP (Permanent Sample Plot) covering 7 provinces , 634 soil samples and 168 litter
- Soil carbon 45.2- 113.0 tC/ha from some part of PNG (Kui, Danar- Madang Province and Watut – Morobe Province)

Carbon estimates from PSP and Inventory

- PSP estimates by J.Fox et 2010, 66.3MgC/ha logged forest and 106.3MgC/ha in unlogged forest
- Methodology Testing in West New Britain- Circular Plots, 179.55 tC/ha (trees>5cm)

10. Biomass/Carbon Survey implemented by Forest Research Institute (FRI)

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10. Biomass/Carbon Survey implemented by Forest Research Institute (FRI)

Mean total soil carbon stock with standard deviations in the parenthesis

Site	Sample No	Total Carbon stock (t/ha)
Kui	11	45.22 (11.28)
Danar 1	12	55.92 (5.56)
Danar 3	12	31.27 (8.55)
Watut 3	12	112.95 (21.38)
Watut 7	9	102.78 (22.78)

- **Feasibility Study with Max Plank Institute in 2007**
  - 2 Province, 5 plots , 26 quadrats
  - 26 Litter, 56 soils (224)
  - 8 months -Complete
- **ACIAR/FRI 2008-2009**

  13 plots were done in 5 provinces; 4 in Manus, 2 in West New Britain, 2 in Western Province,3 in Oro Province and 2 in East New Britain.
  - 634 soil samples and 168 litter samples were collected from 144 quadrates. Homgenised and await chemical analyses

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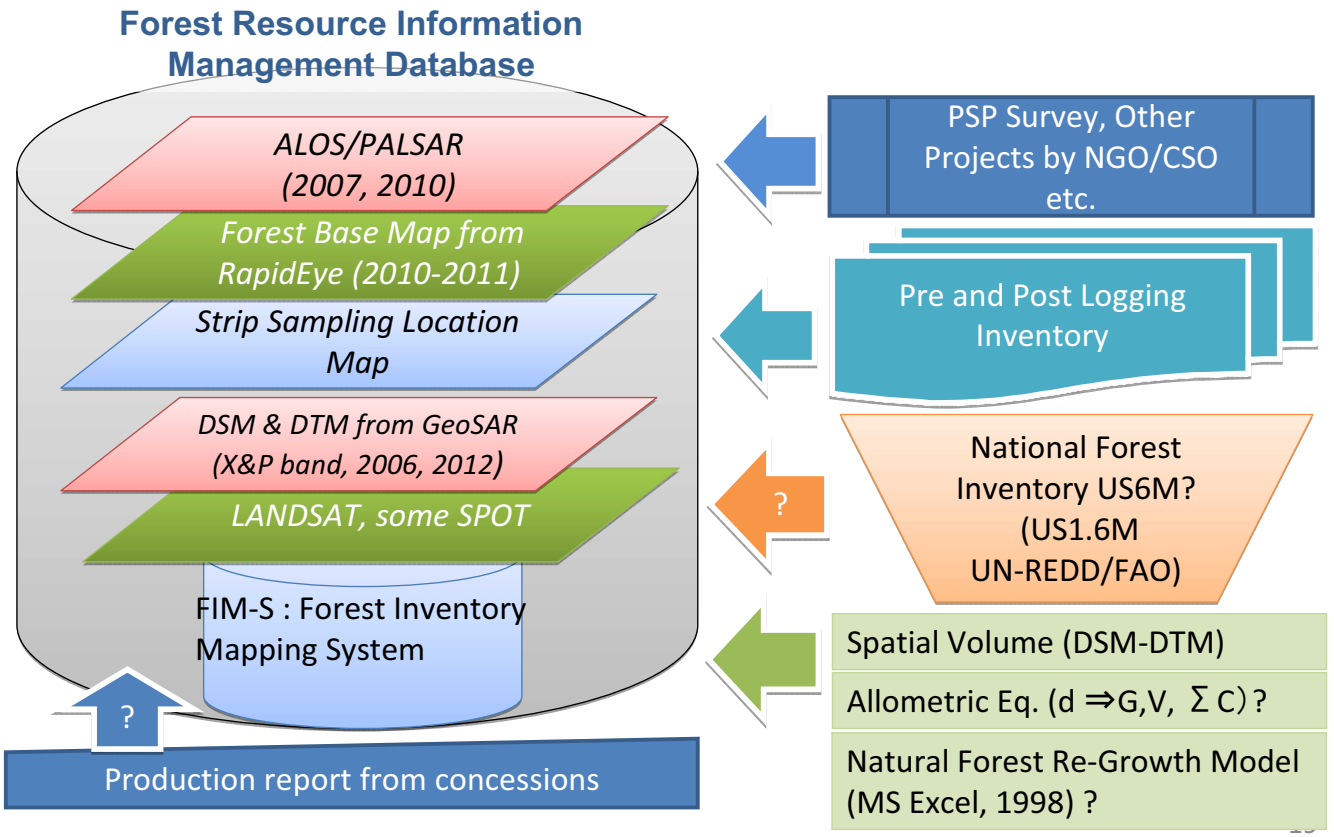
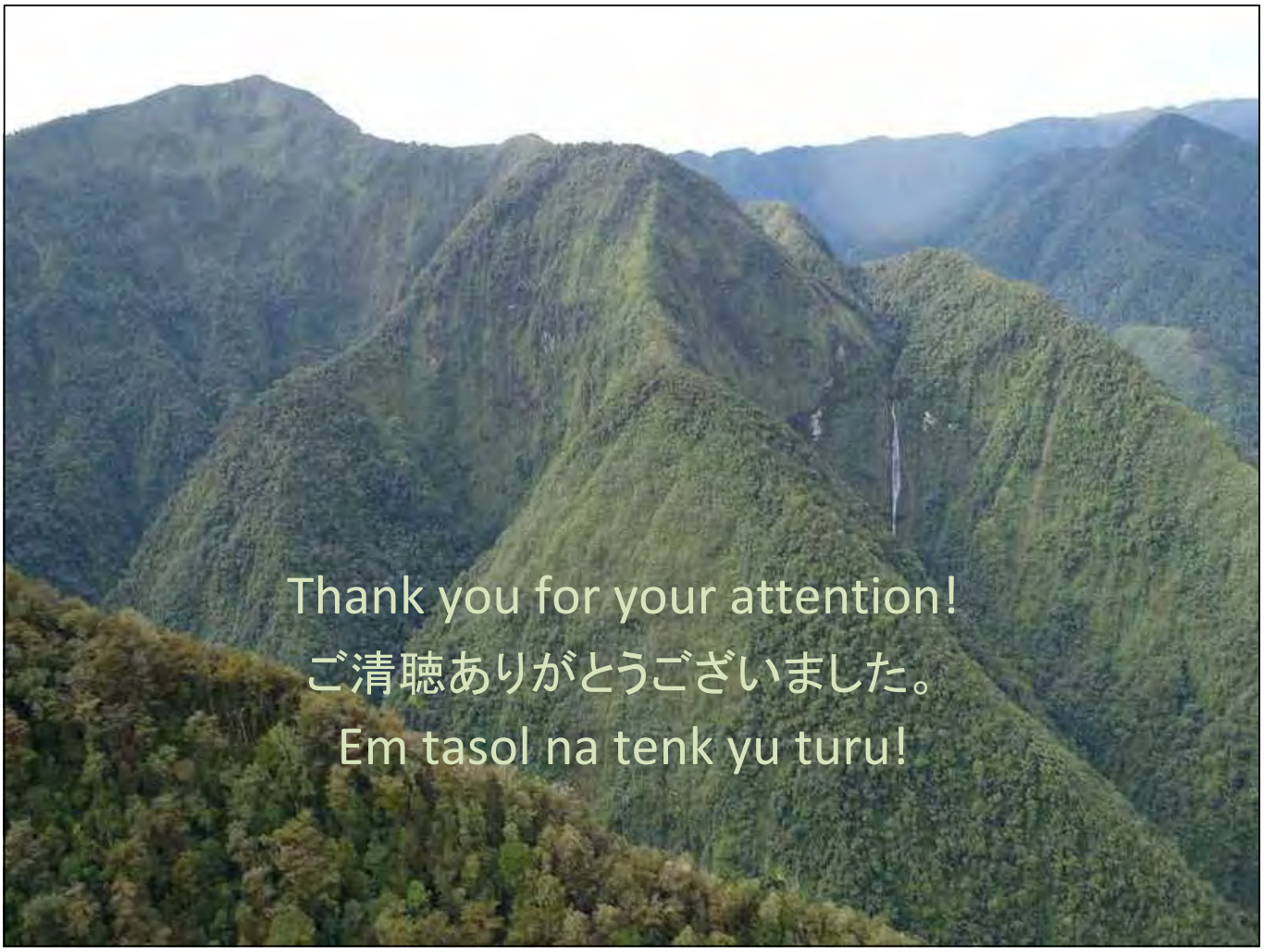
11. Conceptual Chart of New National Forest Resource Management Database to be built by 2014



Summary

- The vast extent of forest in PNG has been significantly declined for more than a couple of decades.
- PNG Forest Authority has been mandated to address Forest Monitoring and to manage REDD+ Pilot activities
- Full utilization of Remote Sensing is the only practical solution in PNG for collecting activity data
- Canopy volume estimation method is a promising technique for capturing emission factor (biomass and carbon) in PNG forest for REDD+.
- The Readiness activities will also have brought tremendous capacity development for Sustainable Forest Management in PNG.
- Foreign supports include Japanese Grant Aid and JICA Technical Cooperation.


Thank you for your attention!
ご清聴ありがとうございました。
Em tasol na tenk yu turu!