Image processing manual using RapidEye and PALSAR around Milne Bay

1. General procedure of using ERDAS Imagine

1-1. Menu

Execute ERDAS Imagine click this icon (But this version is not latest).

This menu icon appears.

Viewer : to view import/create image

Import : to Import/Export from many type of formats

Data Perp : to make/subset image, mosaic and geocode

Composer : to prepare layout legend, title and so on for printing.

Interpreter : Most of analysis function are included in this menu.

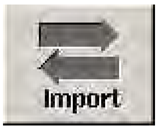
Classifier : For executing Unsupervised/Supervised classification.

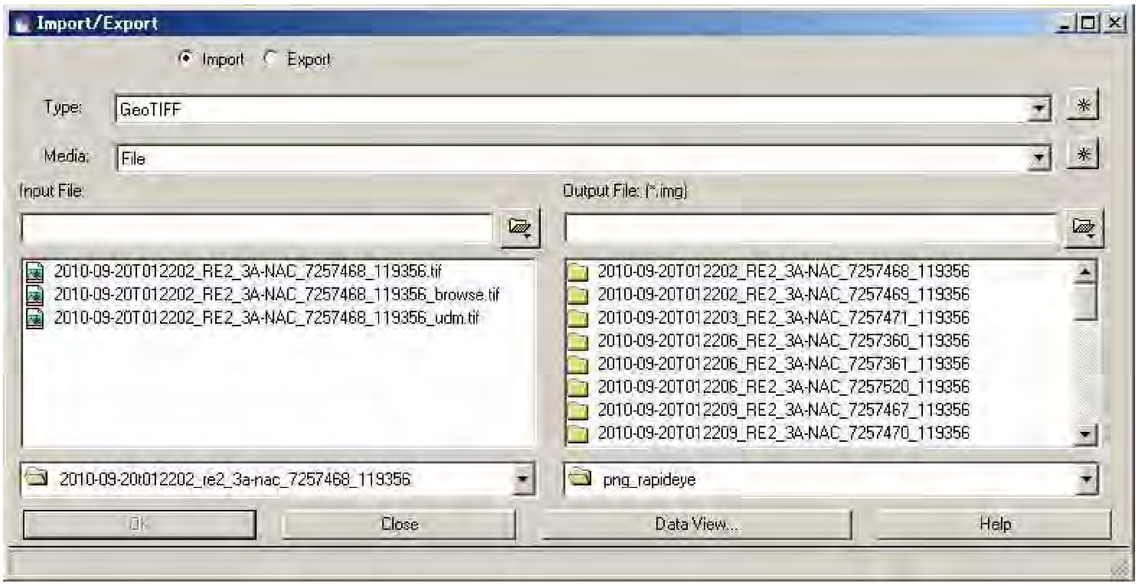
Modeler : to write a flowchart of commands for processing.

2. RapidEye data processing

2-1. Importing of Geotiff file

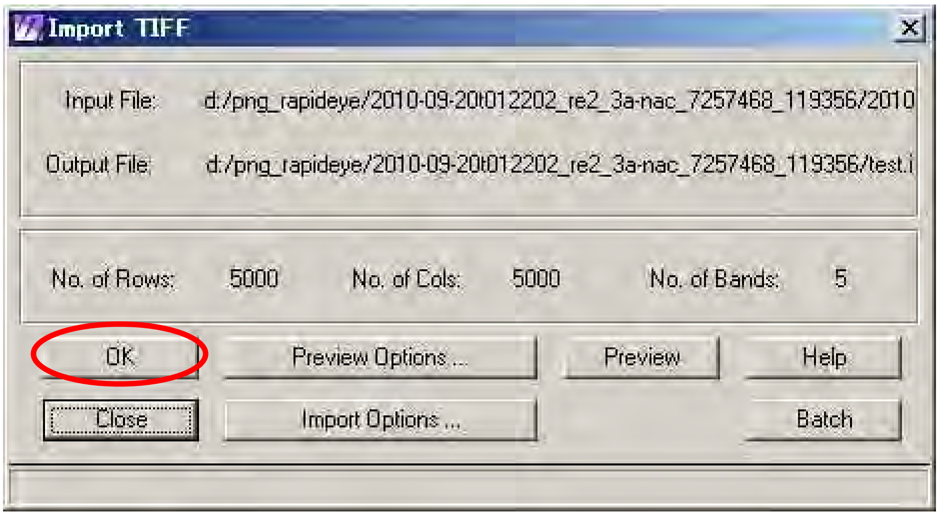
Open a Geotiff file in directory using Import menu





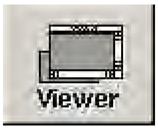
In Import/export select Geotiff file as input file. In Output file create new file with file extension "*.img" for using in ERDAS Imagine

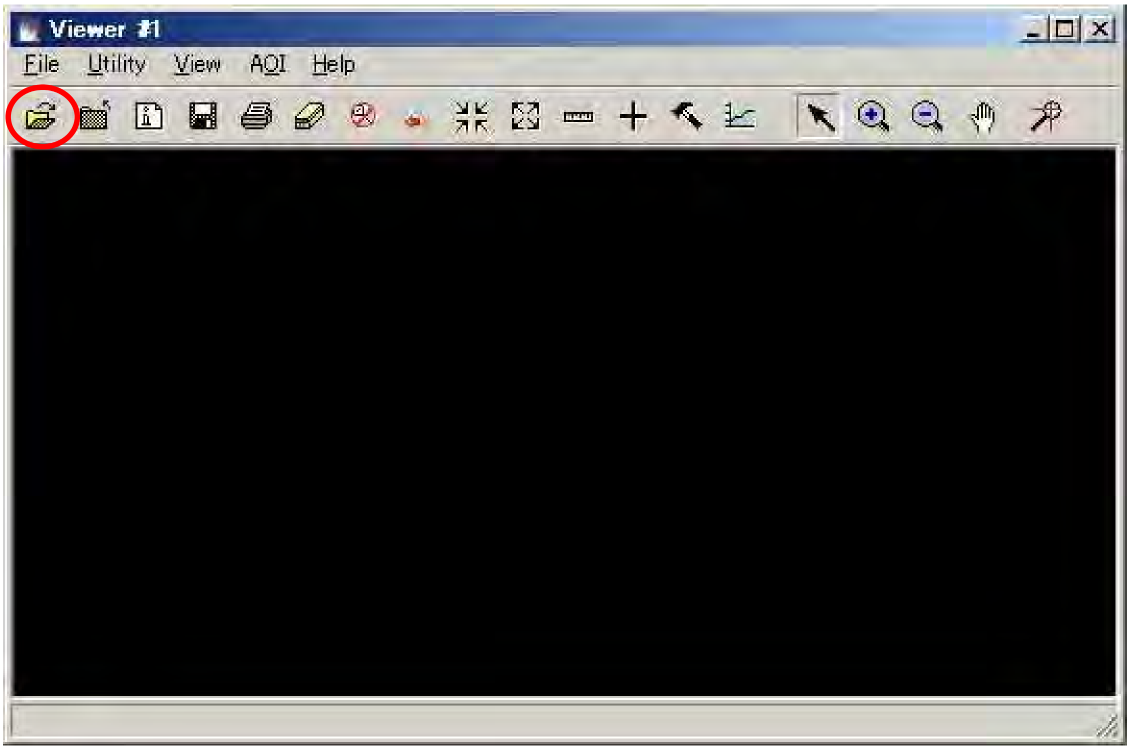
NB: For input TIFF dialogue options, accept the default settings.



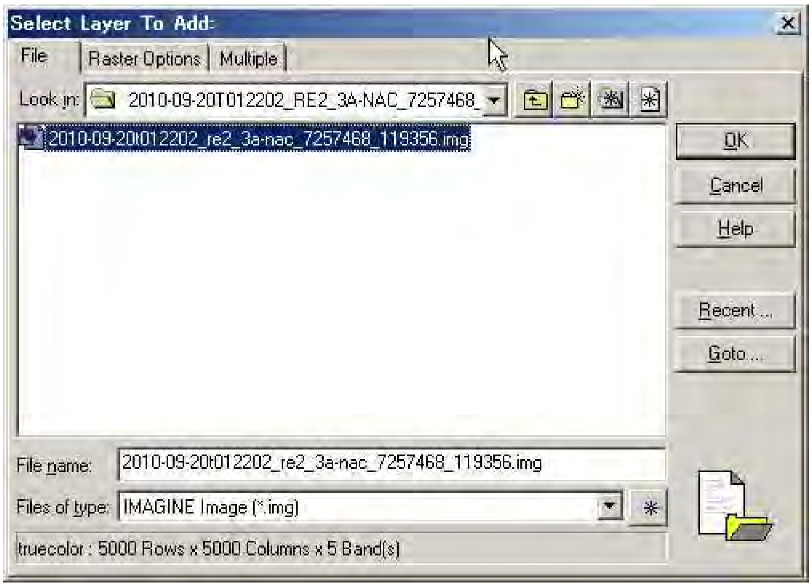
The process creates two (2) files with extensions "*.img" and "*.rrd".

To display the imported image click Viewer menu and select file and open.

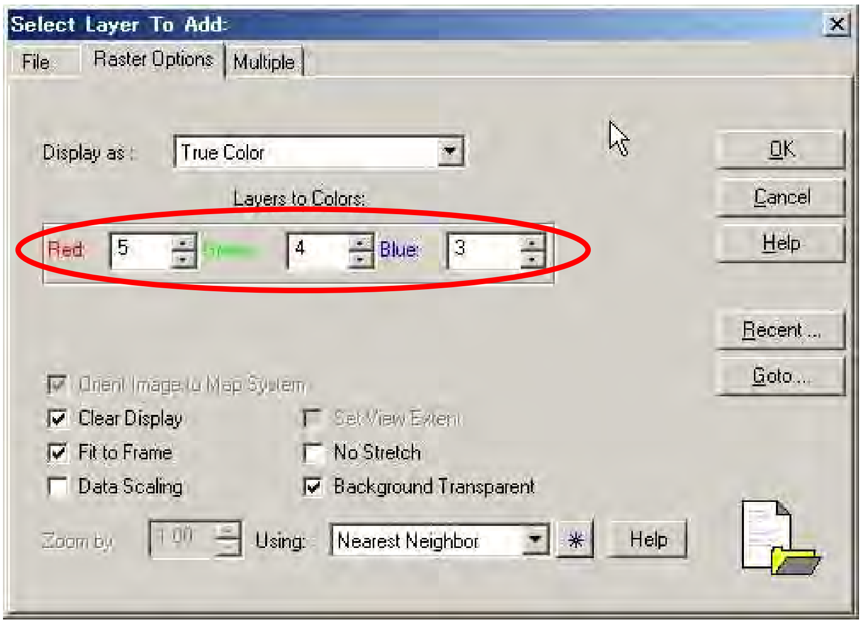




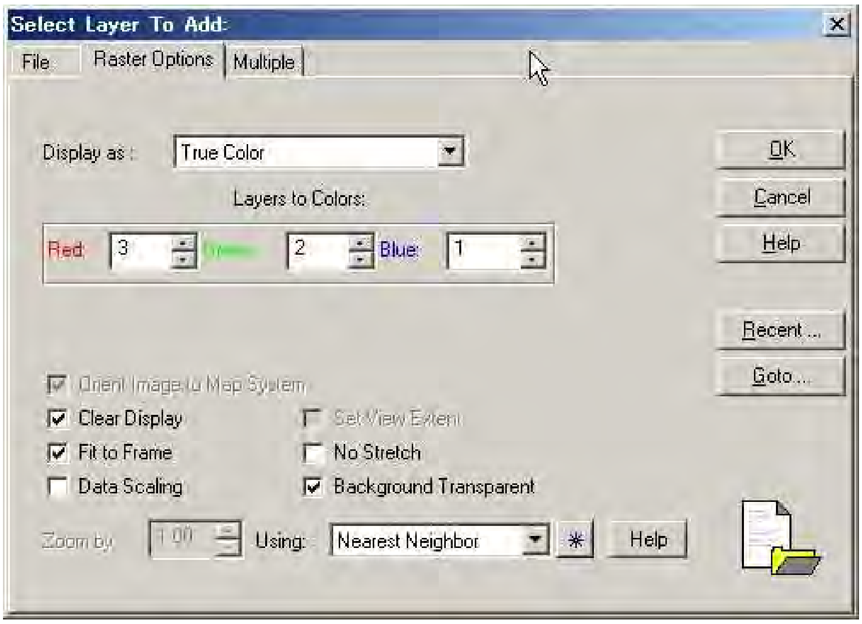
In [Select layer to add] choose imported image



In [Raster Options] display as True Color and set color combination as indicated below.



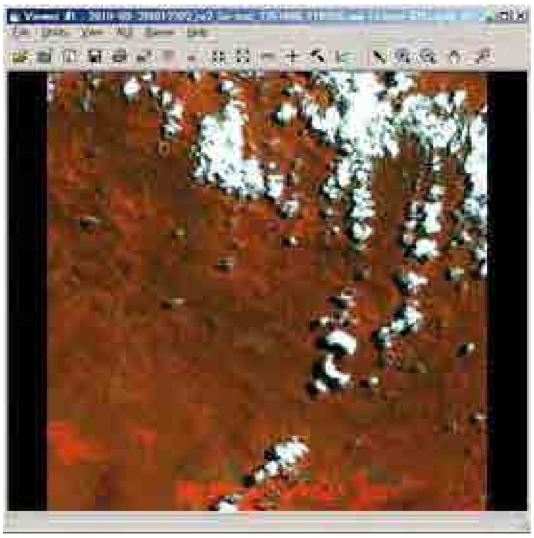
To display an image in photogrammetric (natural color) set color combination as below

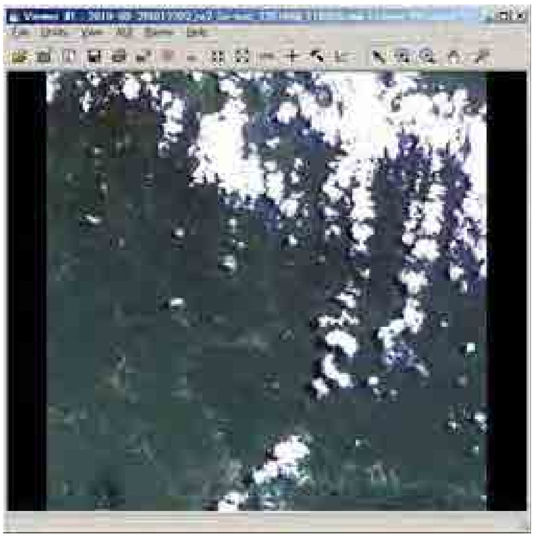


To display entire image tick the Fit to frame option

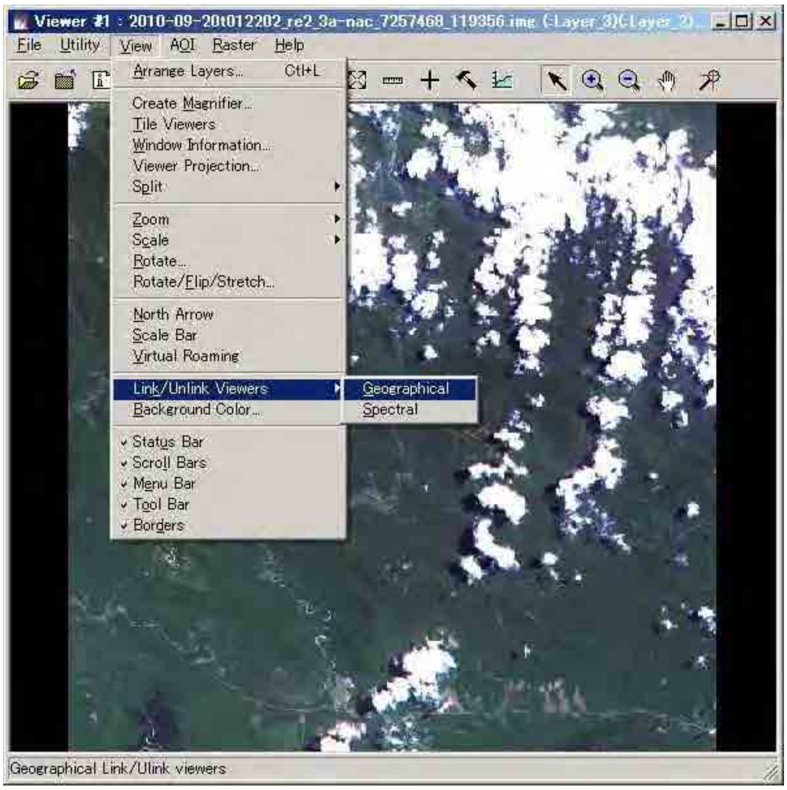
To view no data area (in black) tick Background Transparent option to make the image transparent

To compare visible (natural color) image and infrared image select Viewer to open second viewer to compare the two images. In second Viewer click file and open. In Select layer to add, select the same imported file. In Raster options, display as True color with color combination as above. (The two images are displayed as below)



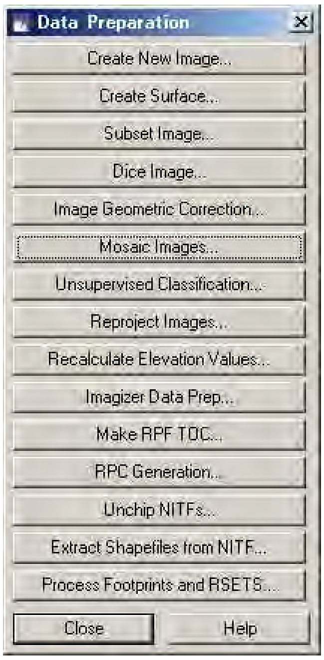


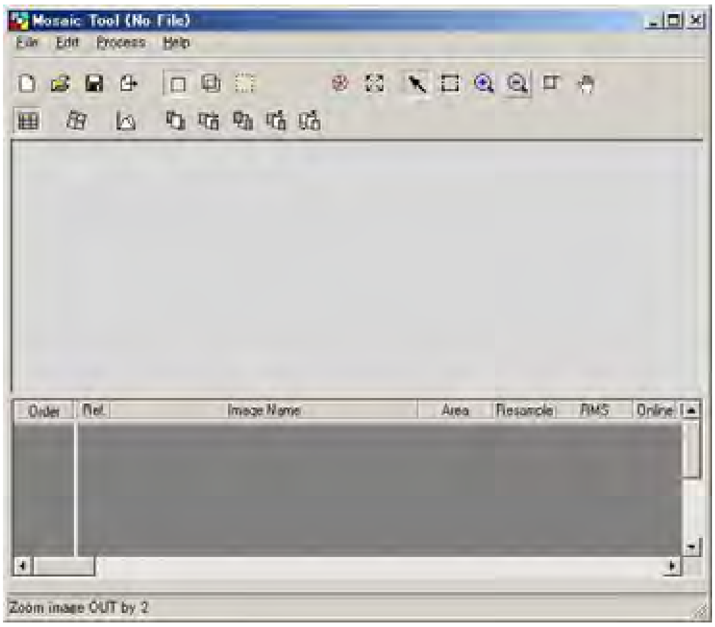
The left image shows difference of forest area.
The right images shows natural color (using for mapping.)
To view two (2) images at same time (simultaneously) in Viewer menu, select view option and click link/unlink viewers and choose geographical.

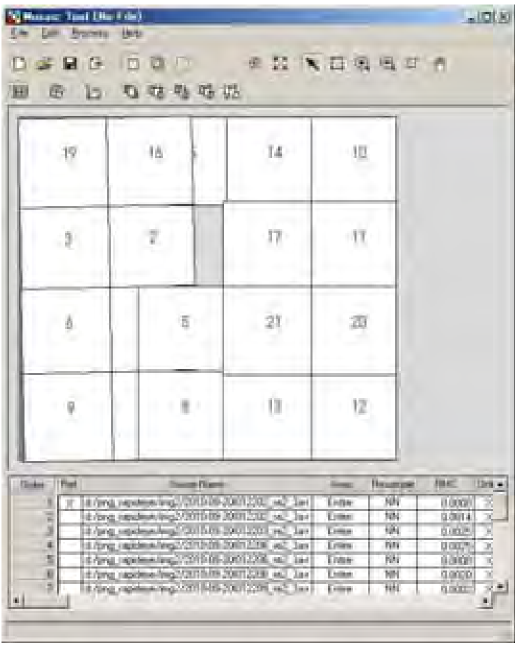


2-5. Mosaicing Of RapidEye Image by ERDAS Imagine

Select Data Prep menu and click Mosaic images and Mosaic tool. In Edit option select Add images and choose the imported images (*.img) of interest that will join each other.(The images are assigned Id numbers for reference). In process menu select Preview mosaic to check before mosaicing or select Run mosaic to continue Mosaic process. If Run mosaic then save the Output file in *.img format and wait for mosaic process to complete. Check the final mosaic by selecting Viewer menu and Open file and and choose saved mosaic file in *.img format.







Mosaic index information

Bottom view is final/complete mosaic image.

2-4. Geometric Correction (Pre-processing)

Prepare two imported images as;

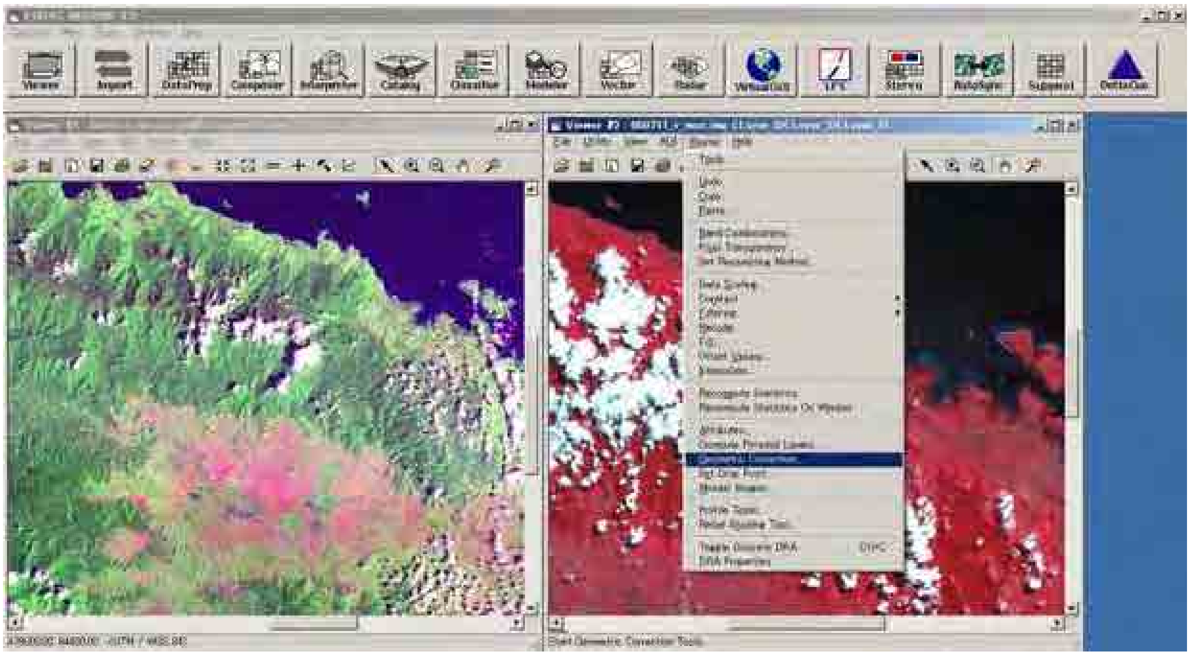
Viewer 1: Show orthorectified image

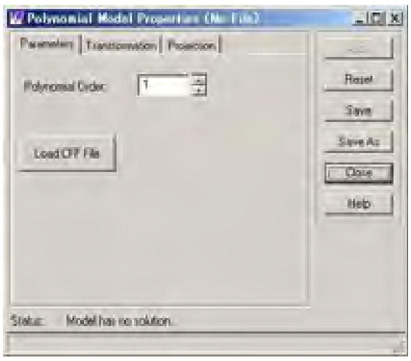
Viewer 2: Show not orthorectified image

In Viewer 2 select Raster menu and choose Geometric Correction. Set Geometric Model and apply Polynomial. In Polynomial Model Properties accept the default values.

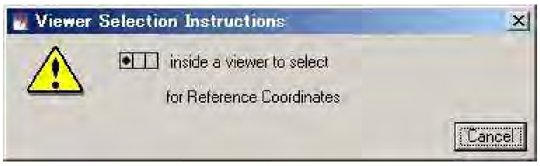
In GCP Tool Reference Setup select Existing viewer. In Viewer Selection Instructions click on a point in Viewer 1 and the Reference Map Information appears for information.

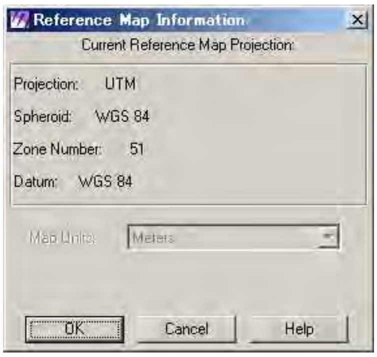
Select a minimum of nine (9) or ten (10) GCPs. Check RMS Error and Control Point Error. Both errors should be less than pixel size (normally 100) in Viewer 1.

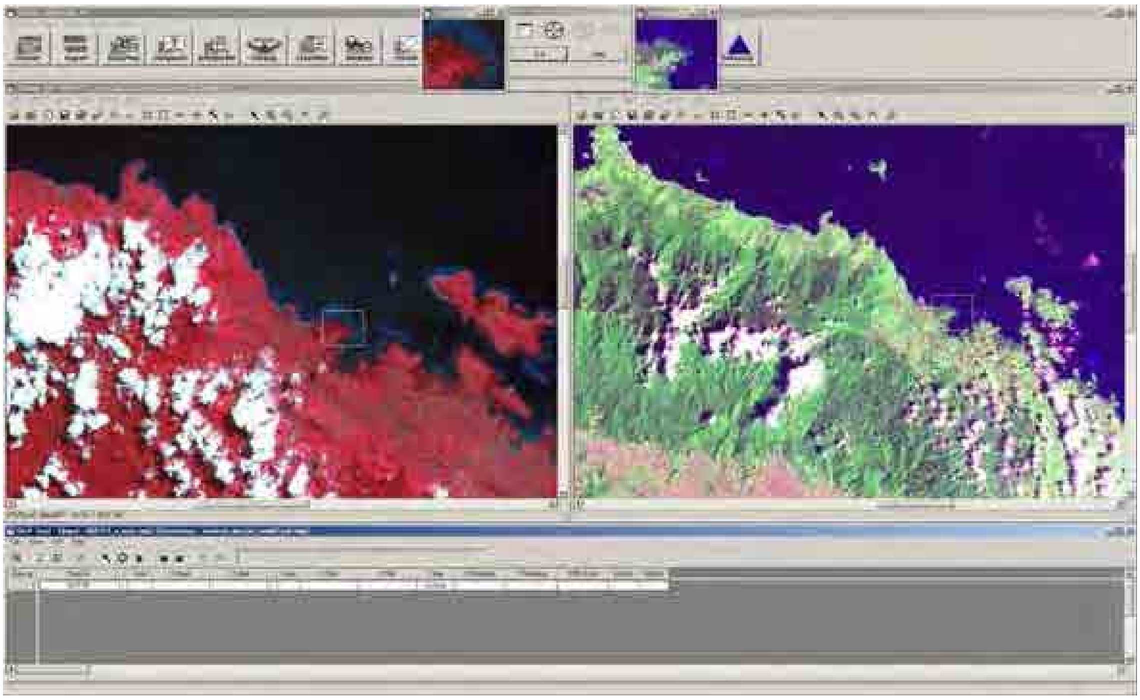




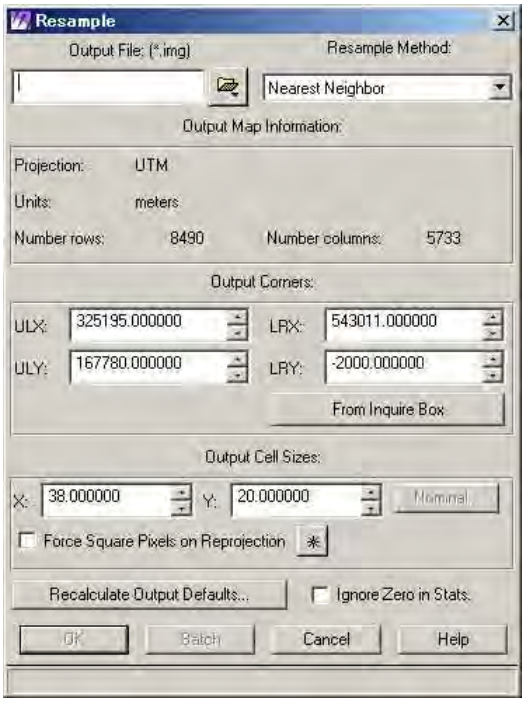

GCP Tool Reference Setup
Collect Reference Points From:
Existing Viewer
Image Layer (New Viewer)
Vector Layer (New Viewer)
Annotation Layer (New Viewer)
GCP File (.gcc)
ASCII File
Digitizing Tablet (Current Configuration)
Digitizing Tablet (New Configuration)
Keyboard Only
OK
Cancel
Help


Viewer Selection Instructions
inside a viewer to select
for Reference Coordinates
Cancel

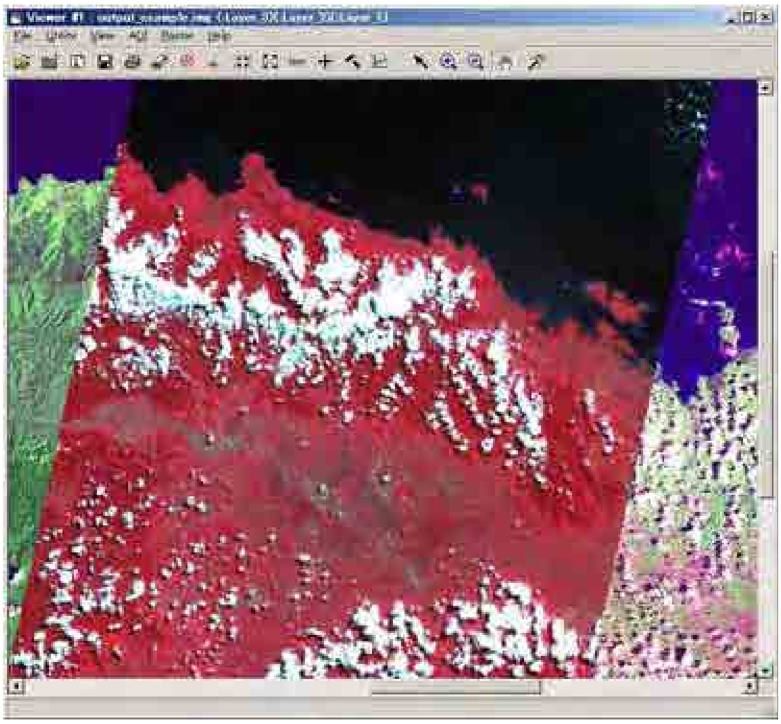

Reference Map Information
Current Reference Map Projection:
Projection: UTM
Spheroid: WGS 84
Zone Number: 51
Datum: WGS 84
Map Units:
Meters
OK
Cancel
Help



In Geometric Tools select Display Resample Image dialogue. Then enter Output File name and choose Nearest Neighbor in Resample Method. Click OK to let resample process run.

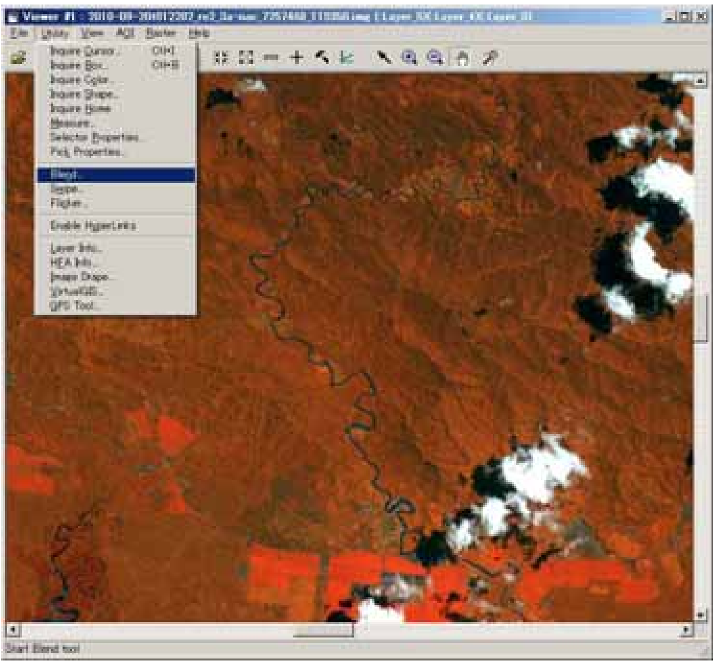


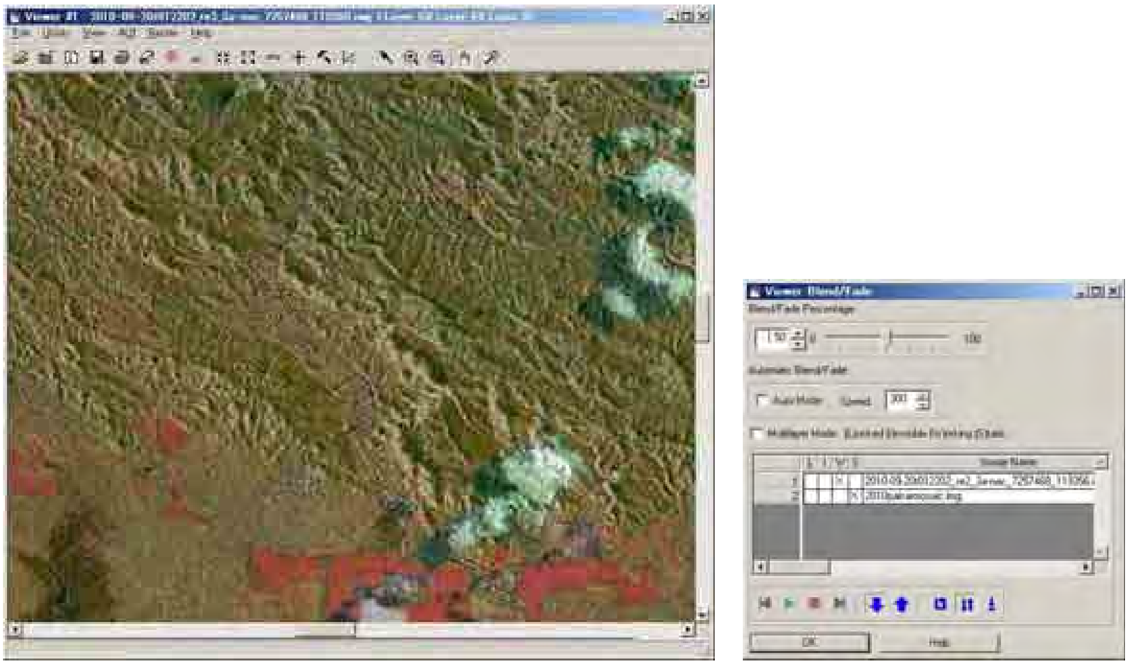
Create new Viwer to display geocoded (orthorectified) image. Open two images in same Viewer reference image and output resample image.



NB: When opening Output image untick Clear Display, tick Background Transparent and reset color combination to Red:3, Green:2 and Blue:1 depending on the Output image.

In Utility option select Blend or Flicker to view changes/difference in the two images.

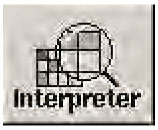


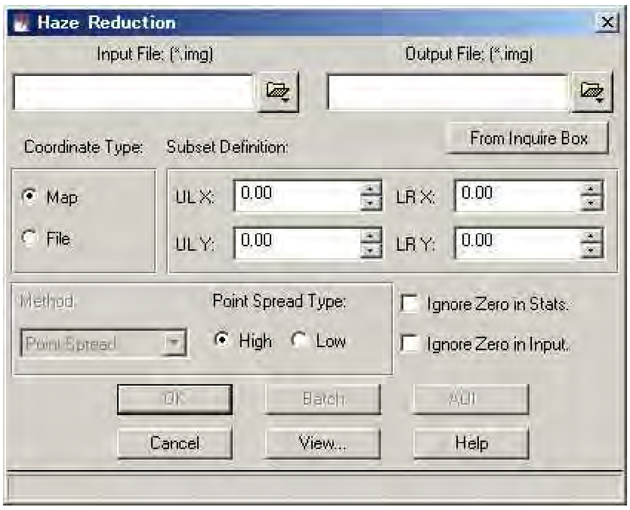


Comparing RapidEye image and PALSAR image using Blend/Fade.

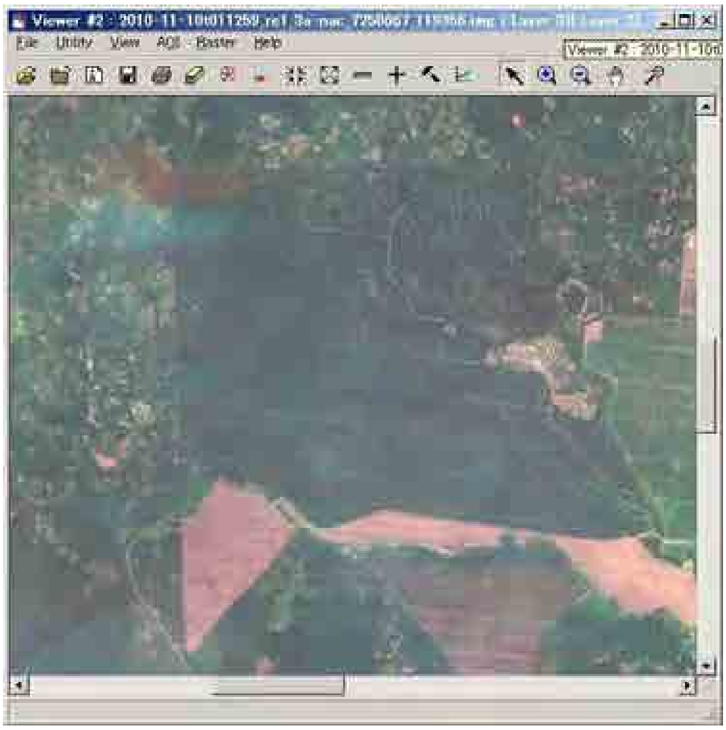
2-2. Atmospheric Correction (Pre-processing/Radiometric Correction)

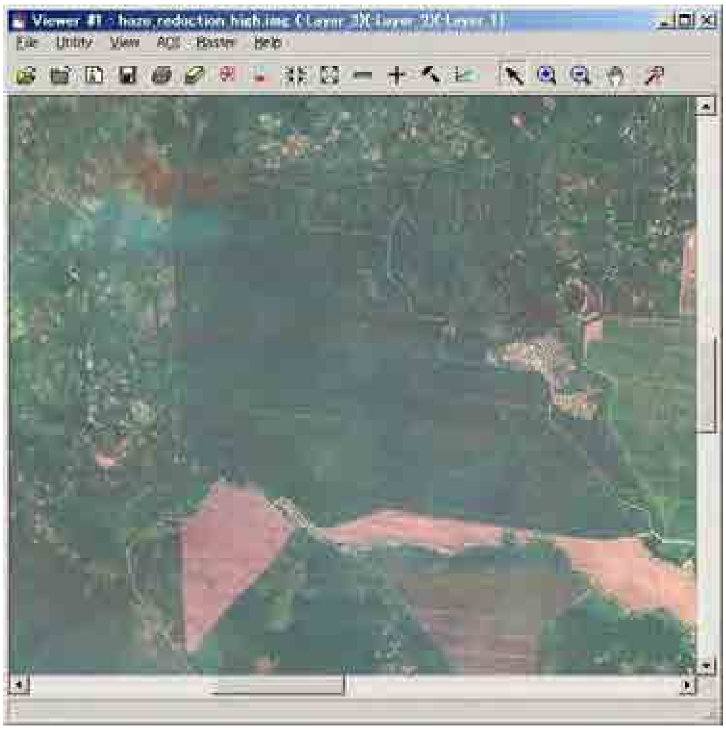
Select Interpreter menu and choose Radiometric Enhancement and select Haze Reduction or Noise Reduction. If Haze Reduction then open Input file (original) and create Output file (rename file). For Point Speed Type click High and rename Output file (eg, haze_reduction_high.img) and click OK to run.





To compare, repeat above process then click Low and rename Output file (eg, haze_reduction_low.img) and click OK to run.



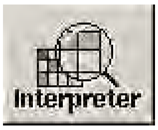


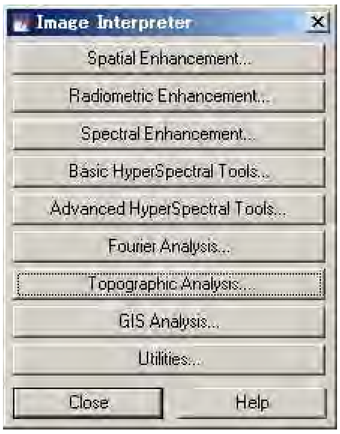
Top view is original RapidEye image.

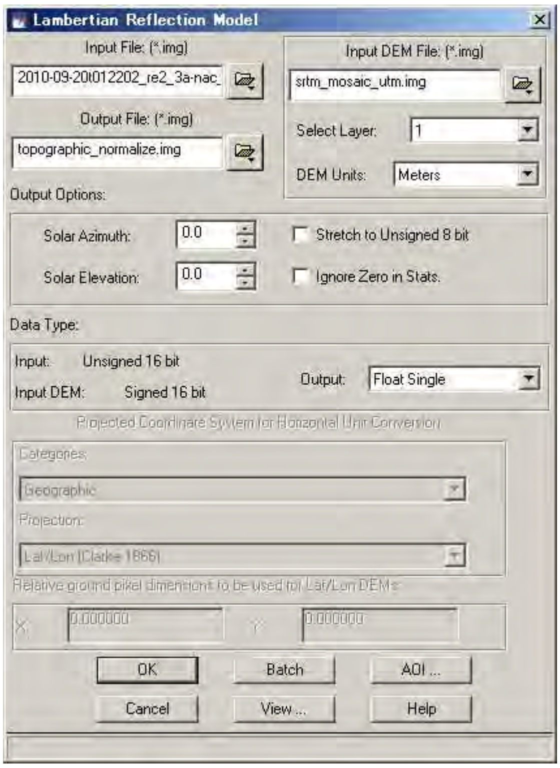
Bottom view is applied Haze Reduction.

2-3. Topographic Analysis (Pre-processing/Radiometric Correction)(Optional)

In Interpreter menu select Topographic Analysis and choose Topographic Normalize. In Lambertian Reflection Model specify target image (working image file) as below







Input DEM file (already created) and set layer number as 1 and DEM units in Meters. Then create Output file (eg, topographic_normalize.img). Set Solar Azimuth (eg, 34) and Solar Elevation (eg 76) and click OK to run. (NB: Solar azimuth and elevation values are obtained from respective metadata files or can be calculated from meteorological information from observation/acquired date)

2-6. Applications of Optical Image (RapidEye)

The Optical image has a range of applications in analysis of geographical features. For applications in forest cover analysis optical image has merits in observing status of vegetation areas/types in forest and monitoring its changes. Landuse changes such as plantations can also be monitored among the forest cover. The forest cover and landuse change can be analysed using NIR(Near Infrared) band (especially RapidEye has NIR band as band #5). Other features such as roads, rivers (inundated areas), settlements, natural and man-made disasters can also be effectively monitored using optical images.

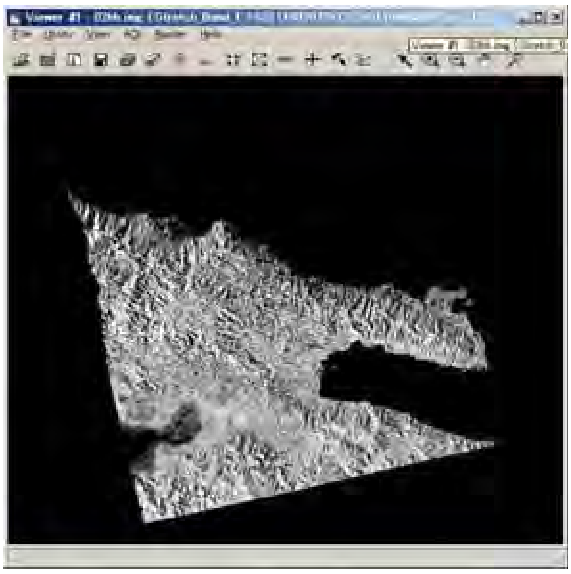
3. PALSAR data processing

3-1. Import PALSAR data

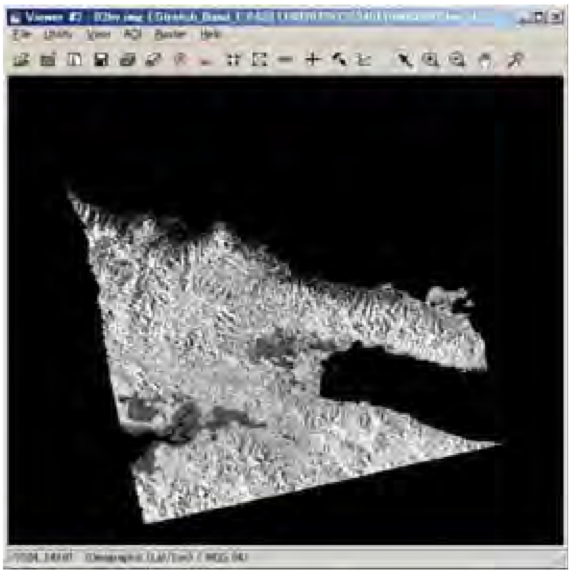
ERSDAC(A PALSAR provider) provides geocoded and orthorectified image as Geotiff file format, so it can be imported as geotiff image using Import tool. (See 2-1. How to import images.)

3-2. Combine HH-polarization image and HV-polarization image

In this programme, PALSAR FBD (Fine Beam Dual polarization) images are applied. FBD data are separated as HH data and HV data. Layer Stacking tool is used to combine the two images (HH data and HV data).



HH polarization image

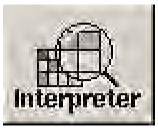

HV polarization image

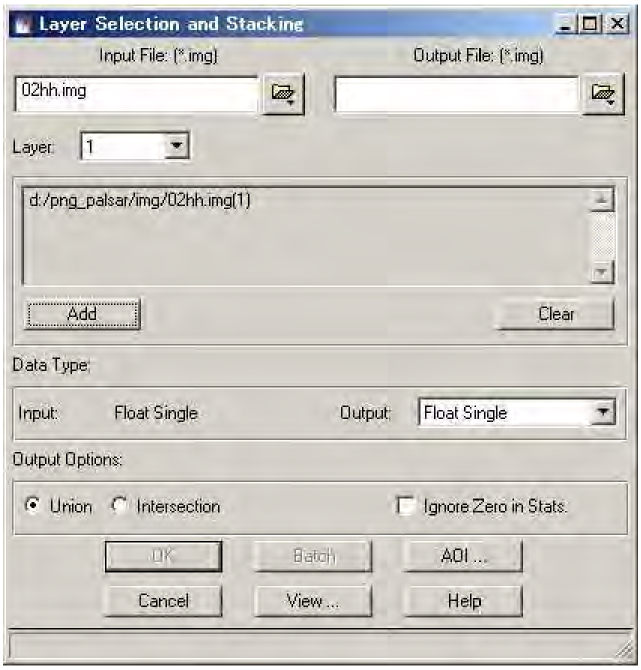
Note : What is HH polarization? and HV polarization?

The radar sensor is an active sensor apart from Optical sensor which is passive. Thus, the radar sensor (space-borne) transmits signals to the target (on ground) and receives backscatter signals from the target. The signal transmitted by radar sensor is referred to as H (horizontal signal). The signal received by radar sensor is backscatter signal and referred to as; (1) H (horizontal signal) and (2) V (Vertical signal).
If the target(surface) is smooth, the backscatter signal is H. If the target(surface) is rough or the target is forest crown, the backscatter signal is V because the signal polarization is rotated.

Insert a diagram showing HH and HV here.

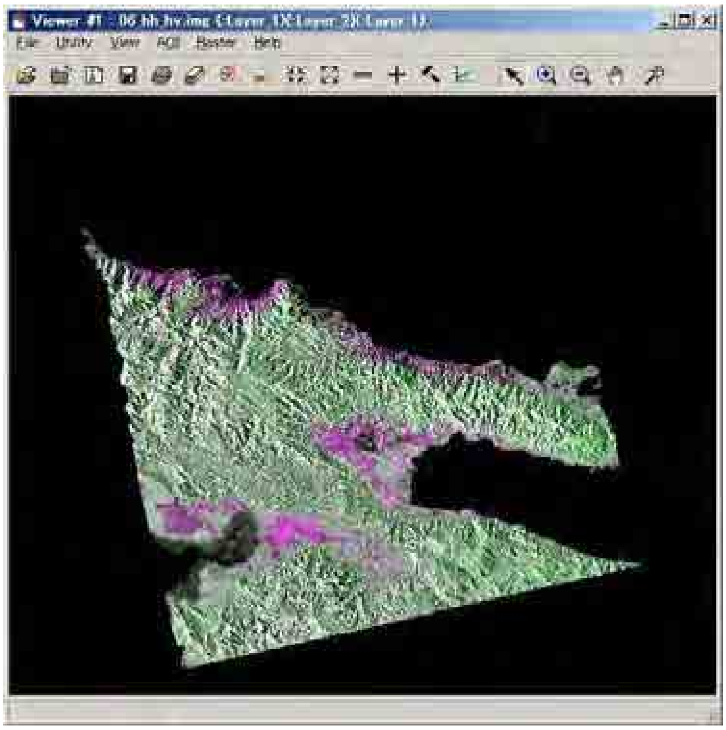
In ERDAS Imagine software select Interpreter menu and choose Utilities. Then select Layer Stack and choose Stacking. In Stacking open the Input file (*.hh.img) and click Add to add 'hh' file. Also open input file (*hv.img) and click Add to add 'hv' file.





Create an Output file as (*hh_hv.img) which combines the two images and click OK to run the stacking process.

To display the processed image select File/Open in Viewer menu and in Select Layer To Add choose Raster option to set color combination as; Red: Band 1 (HH), Green: Band 2 (HV) and Blue: Band 1 (HH).

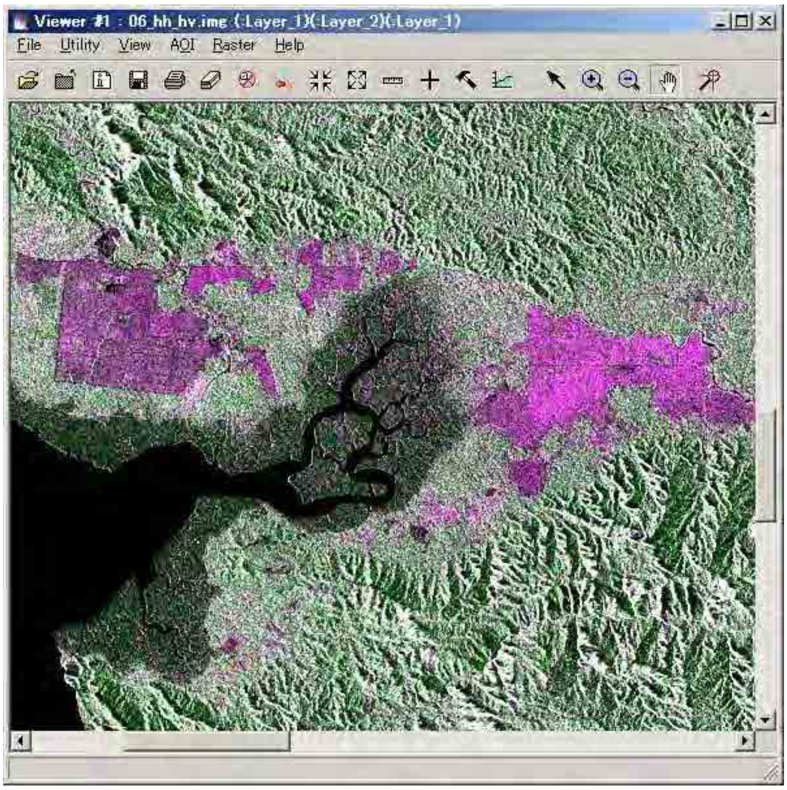


Viewer #1
File Utility View AOI Raster Help

3-3. Comparing HH image and HV image

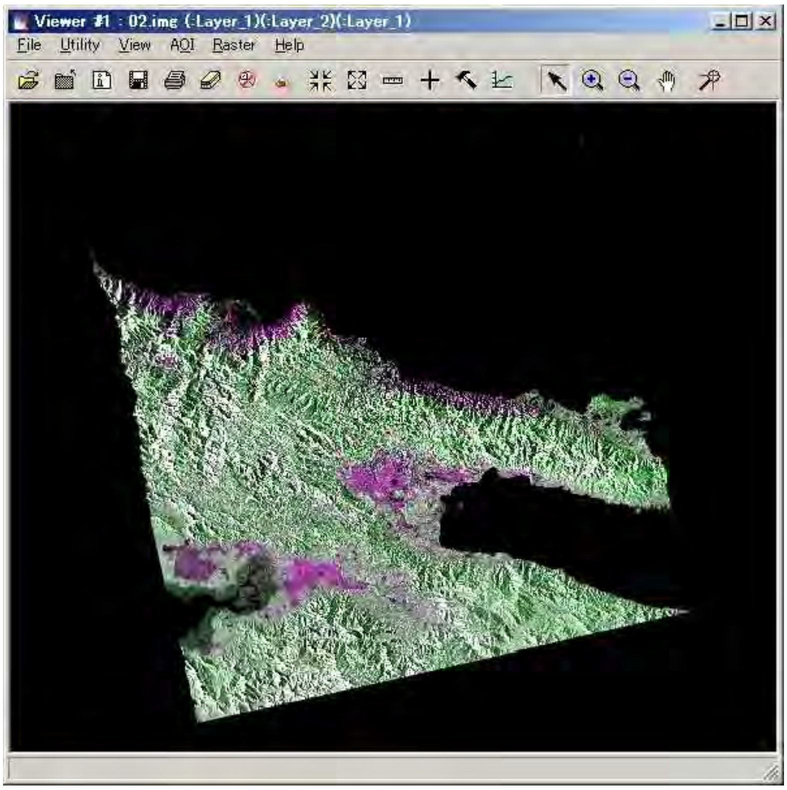
In figure ……. the processed image display false color of the image and so it depicts a profile of vegetation cover in area of interest (AOI). The HH signal received with bright/strong backscatter shows features such as buildings, settlements due to its double-bounce effect. The HV signal received with bright/strong backscatter shows vegetation areas or relief areas (rough areas) due to volume scattering.

In figure below, mangrove area is shown as dark green but due to water cover it also indicates grey color among mangrove areas. (HV signal received with dark/weak backscatter)

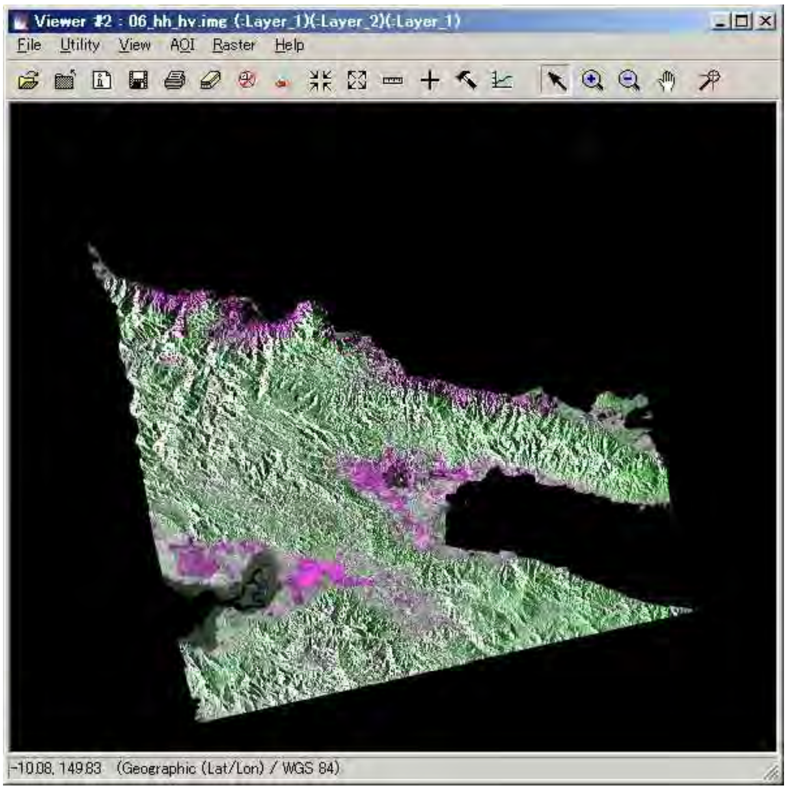


3-4. Comparing PALSAR image in 2007 and 2010

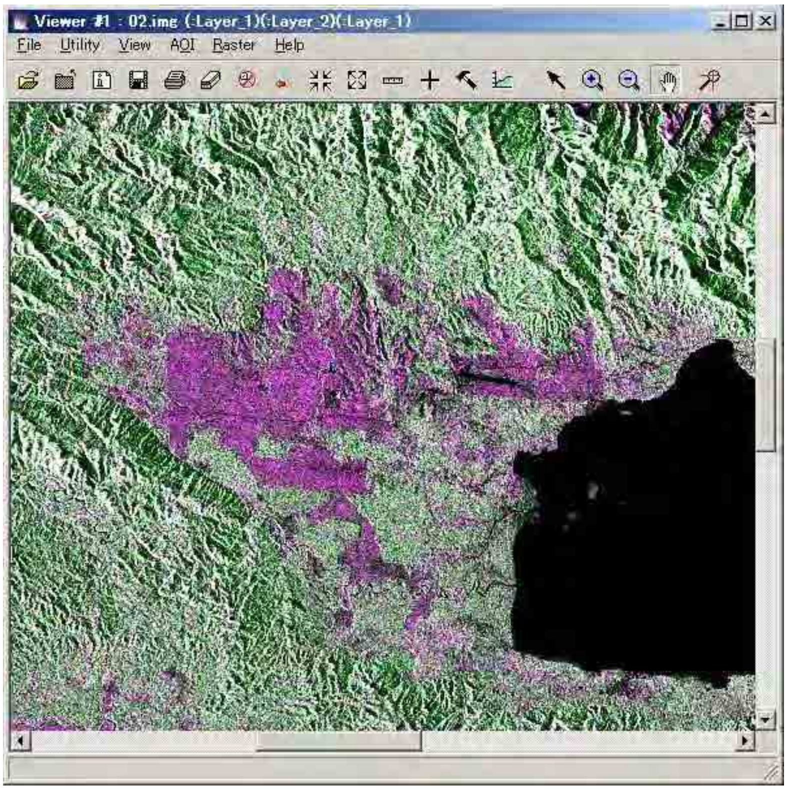
Physical/Geographical changes can be observed over certain period of interest and thus the PALSAR image can be used as such in comparing images of 2007 and 2010. The two images can be compared to monitor or detect changes in vegetation/forest cover over time period. If the image (HV signal as backscatter effect with color Green: band 2) shows bright/strong effect in year 2010 than in 2007, it indicates afforestation, or re-growth/regeneration. If the image (HV signal as backscatter effect with color Green: band 2) shows dark/weak effect in year 2010 than in 2007, it indicates deforestation/logged area or burning/clearing area of forest/vegetation cover. If the image (HH signal as backscatter effect with color Magenta: band 1) shows bright/strong effect in year 2010 than in 2007, it indicates building constructions or new planting areas (agriculture). If the image (HH signal as backscatter effect with color Magenta: band 1) shows dark/weak effect in year 2010 than in 2007, it indicates clearing/removal of .buildings, roads, surface areas with water cover or flooding areas.



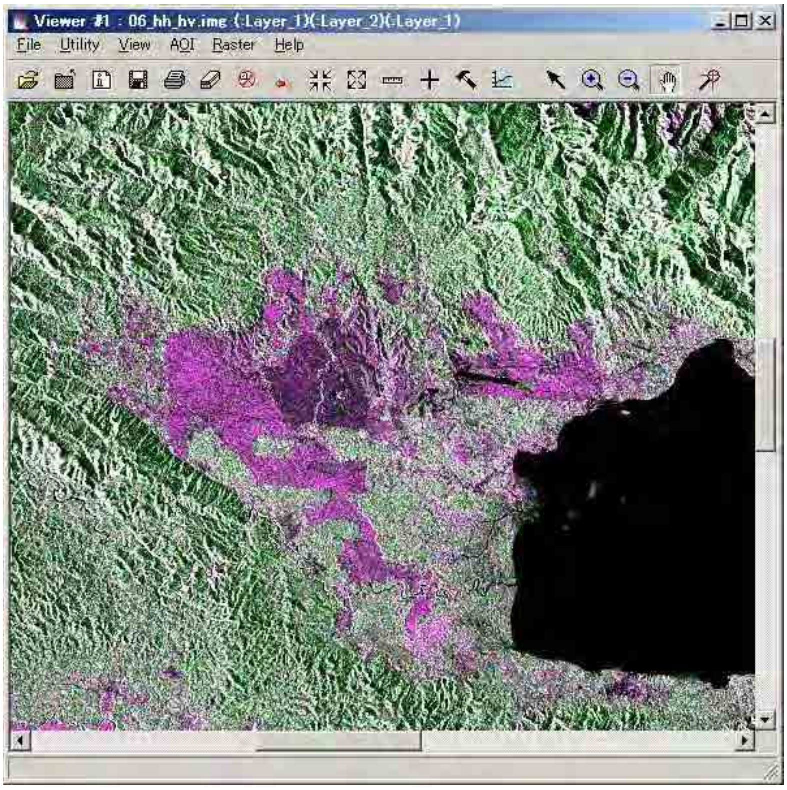
PALSAR image in 2007



PALSAR image in 2010



PALSAR image in 2007



PALSAR image in 2010

4. Applications of RapidEye, PALSAR and GeoSAR

The table below summarizes the applications and its merits and demerits.

RapidEye	PALSAR	GeoSAR
Applications Forest/Vegetation Types Plantation Land-use Roads Rivers Settlements Natural/Man-made disaster	**Applications** Forest/Vegetation Change detection Geological structure Natural/man-made disaster Plantations	**Applications** Forest cover detection Tree height
Demerits Cloud cover Expensive	**Demerits** Difficult to interpret/understand	**Demerits** More expensive One time observation Limited area of observation (Cannot cover whole of PNG)

Presentation on JICA Training Program

JICA PROGRAM

CAPACITY DEVELOPMENT ON FOREST RESOURCE MONITORING FOR ADDRESSING CLIMATE CHANGE IN PAPUA NEW GUINEA (PNG)

PROGRAM OBJECTIVE:

1. TO UNDERSTAND THE WHOLE PICTURE OF FUTURE ACTIVITIES THROUGH THE INTRODUCTION OF CASE EXAMPLE OF JAPANESE REDD & RELATED SUPPORT
2. 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.

PO 1. (A) CASE EXAMPLE OF JAPANESE REDD & RELATED SUPPORT:

(ERSDAC) EARTH REMOTE SENSING DATA ANALYSIS CENTRE

PALSAR Project

PHASE ARRAY TYPE L – BAND SYNTHETIC APERTURE RADAR IS ONE OF THE IMAGING SENSORS ON BOARD THE ALOS (ADVANCED LAND OBSERVING SATELLITE) LAUNCHED IN JANUARY 24,2006.

CHARACTERISTICS OF PALSAR

- ALL WEATHER SENSOR (RAIN/NIGHT/CLOUD)
- L BAND (1.27 GHZ/23.6CM)
- HIGH RESOLUTION (GROUND RES.10M)/ SWATH 70KM
- MULTI-POLARIZATION: HH, VV, HH + HV, VV + VH, HH + HV + VH + VV. FOR VEGETATION, SOIL AND GEOLOGIC CLASSISFICATION

Japan Aerospace Exploration Agency (JAXA)

REDD AND FOREST MONITORING USING ALOS/PALSAR

- GLOBAL TIME SERIES HIGH RESOLUTION (10M AND 25M) L – BAND SAR DATASET USING JERS-1(1992 – 1998) AND PALSAR (2007 – 2010) ARE BEING GENERATED AND USED FOR REDD+, i.e, MONITORING THE FOREST CHANGE, FOREST CLASSIFICATION AND IN FUTURE CONVERTING TO BIOMASS

- SEVERAL CLASSIFICATION METHODS ARE EVALUATED FROM THE MAIN (AUTHOMATIC OPERATION) DRIVER FOR REDD. JAXA IS KEEN TO SHARE THE REDD+ACTIVITY JOINTLY USING THE SATELLITE DATA, GROUND TRUTH DATA, EXPERIMENT, EVALUATION WITH INTERESTED PARTIES.

Forestry & Forest Products Research Institute

ONE OF THE ROLES OF REDD R & D CENTRE OF FFPRI IN FFPRI– REDD PROGRAM IS TO;

- DEVELOP REMOTE SENSING METHODOLOGIES AND ANALYTICAL TECHNIQUES IN ORDER TO MONITOR DEFORESTATION AND FOREST DEGRADATION IN DEVELOPING COUNTRIES.

- FFPRI DEVELOPS METHODS TO INTEGRATE REMOTE SENSING TECHNIQUIES WITH GROUND MEASUREMENTS FOR FOREST MONITORING. REMOTE SENSING BY SATELITE IS A PARTICULARLY USEFUL TECHNIQUE FOR MONITORING FORESTS OVER LARGE AREAS. IT IS ESPECIALY EFFECTIVE WHEN MONITORING DEFORESTATION. AND FOREST DEGRADATION IN DEVELOPING COUNTRIES.

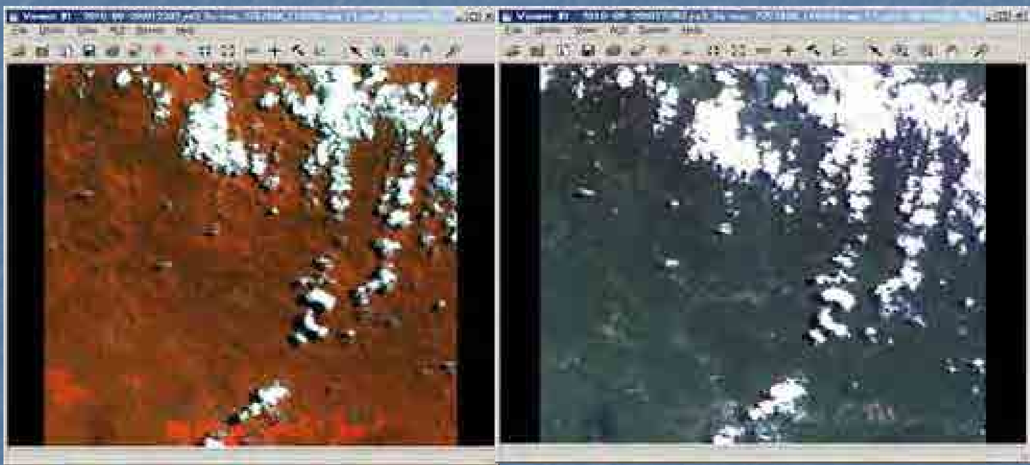
- METHODS ARE CURRENTLY DEVELOPED TO ESTIMATE CHANGES IN CARBON STOCK LEVELS AND TO IDENTIFY THE VARIOUS CAUSES OF FOREST DEGRADATION BY USING MULTI TEMPORAL OR HIGH RESOLUTION SATELLITE DATA IN COMBINATION WITH GROUND MEASUREMENTS.

- ALSO RESEARCHING WAYS OF USING THE SAR CARRIED ON THE JAPAN ALOS SATELLITE AND EXHIBITING ITS ABILITY TO PENETRATE CLOUD COVER IN ORDER TO IDENTIFY DEFORESTATION AND FOREST DEGRADRADATION IN CLOUD COVERED TROPICAL RAIN FORESTS.

PO (2): PRACTICAL WORK OF FOREST COVER CLASSIFICATION USING REMOTE SENSING TECHNOLOGY AND ACTUAL DATA OF PNG

(2.1) Image processing of RapidEye by ERDAS Imagine for Milne Bay Province (PNG)

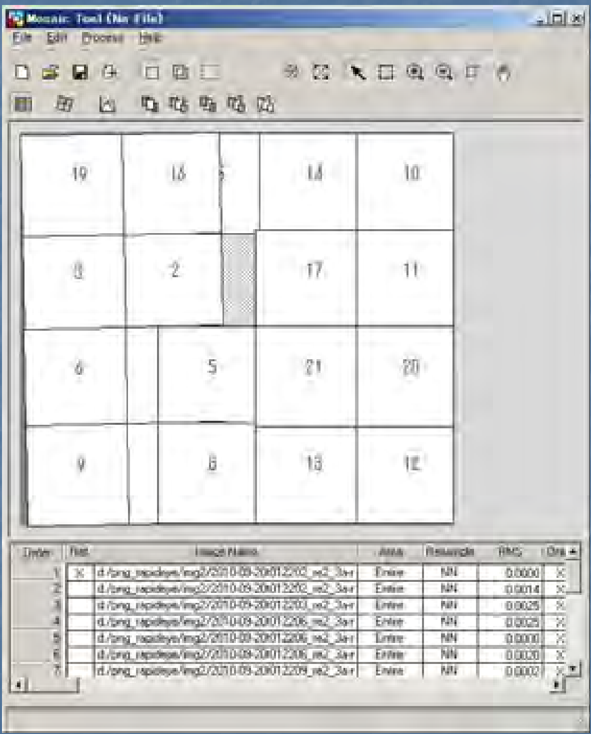
Comparing visible (natural color) image and infrared image

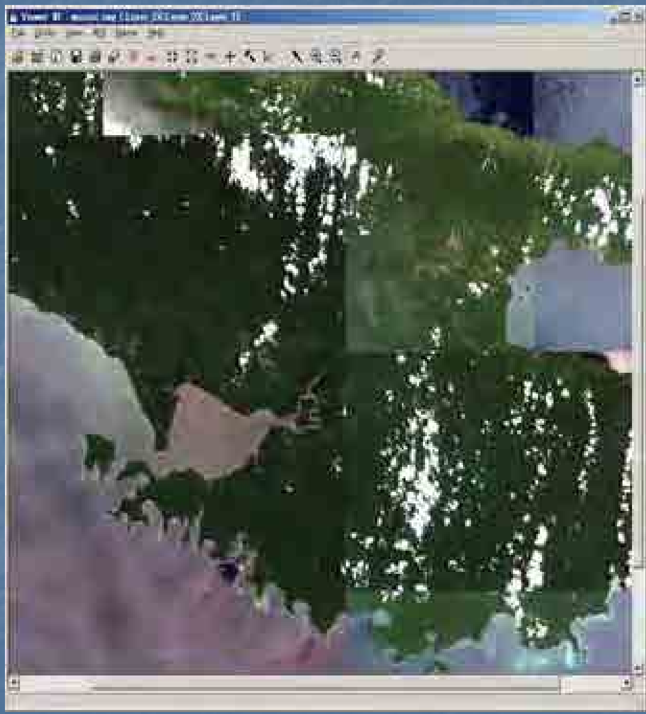


The left image in Infrared color (false) shows difference of forest and land-use area.
The right images shows natural color (useful in mapping)

Mosaic Of RapidEye Images by ERDAS

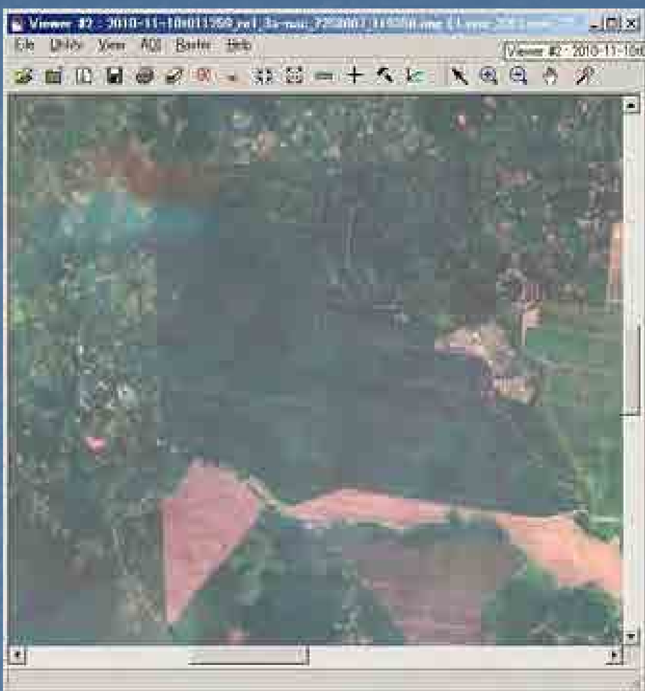
Mosaic index information



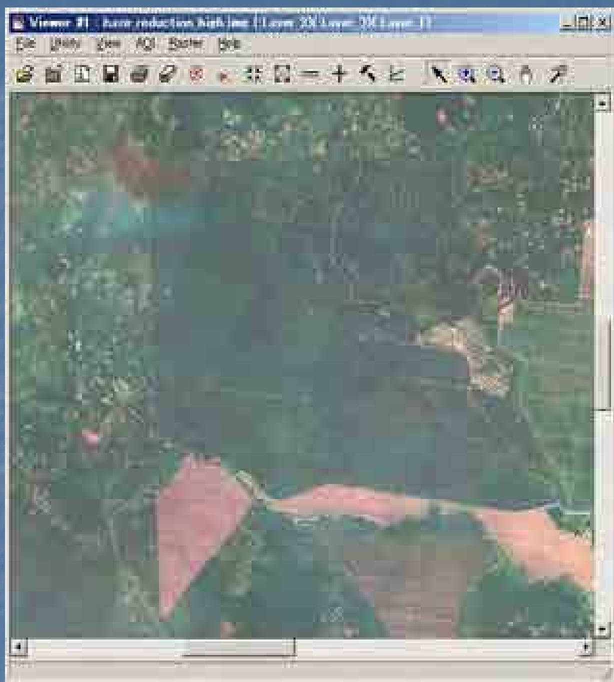


View of final/complete mosaic image.

Atmospheric Correction (Pre-processing/Radiometric Correction)

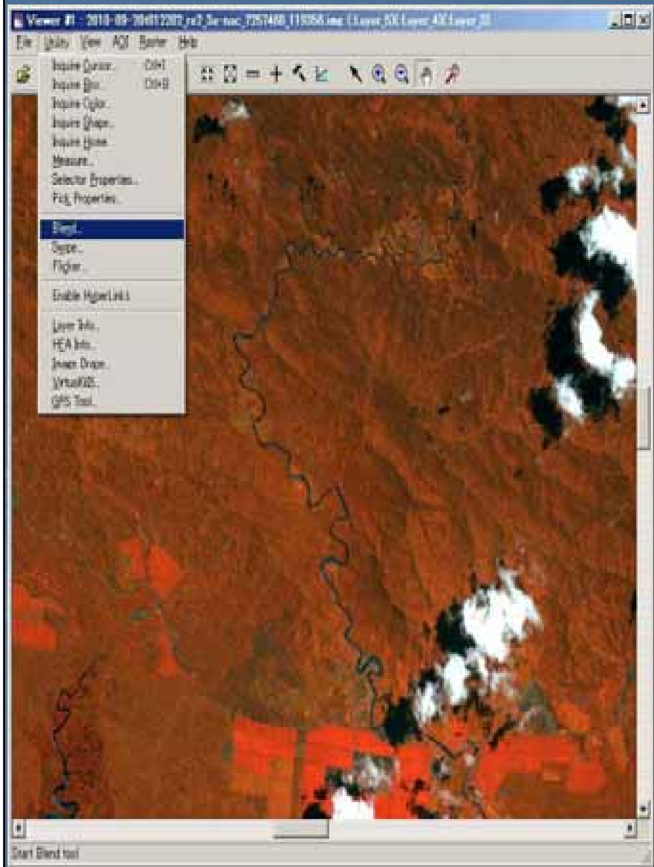


Left view is original RapidEye image.



Right view is applied Haze Reduction.

Comparing/merging RapidEye image and PALSAR image using Blend/Fade



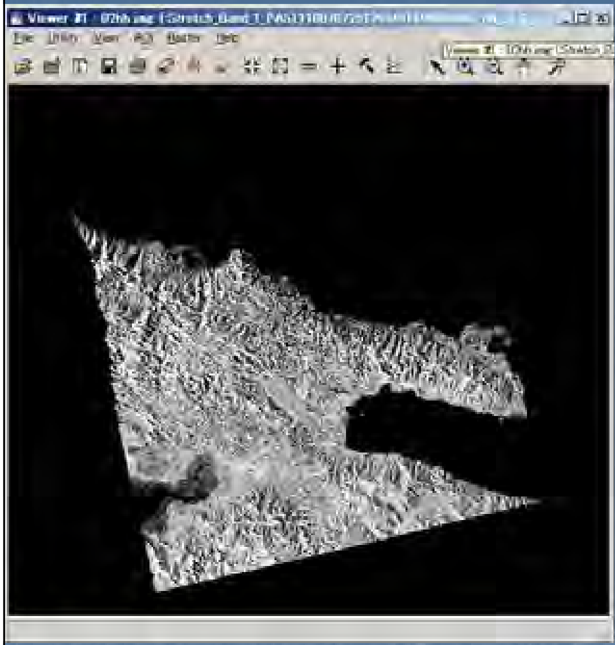
RapidEye/PALSAR Image

PALSAR/RapidEye Image

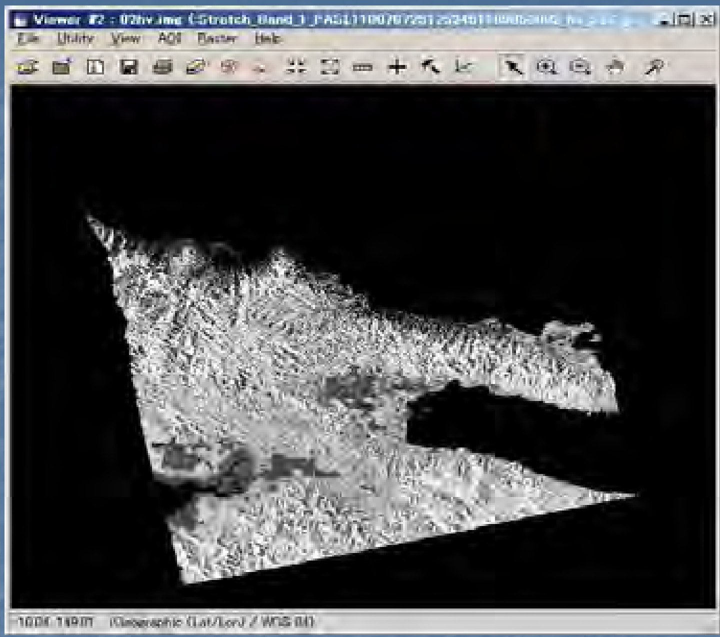
Applications of Optical Image (RapidEye)

The Optical image has a range of applications in analysis of geographical features. For applications in forest cover analysis optical image has merits in observing status of vegetation areas/types in forest and monitoring its changes. Landuse changes such as Logged and Landuse features can also be monitored among the forest cover. The forest cover and its changes can be analysed using NIR(Near Infrared) band (especially RapidEye has NIR band as band #5). Other features such as roads, rivers (inundated areas), settlements, natural and man-made disasters can also be effectively monitored using optical images.

2.2 PALSAR Data Processing



HH polarization image



HV polarization image

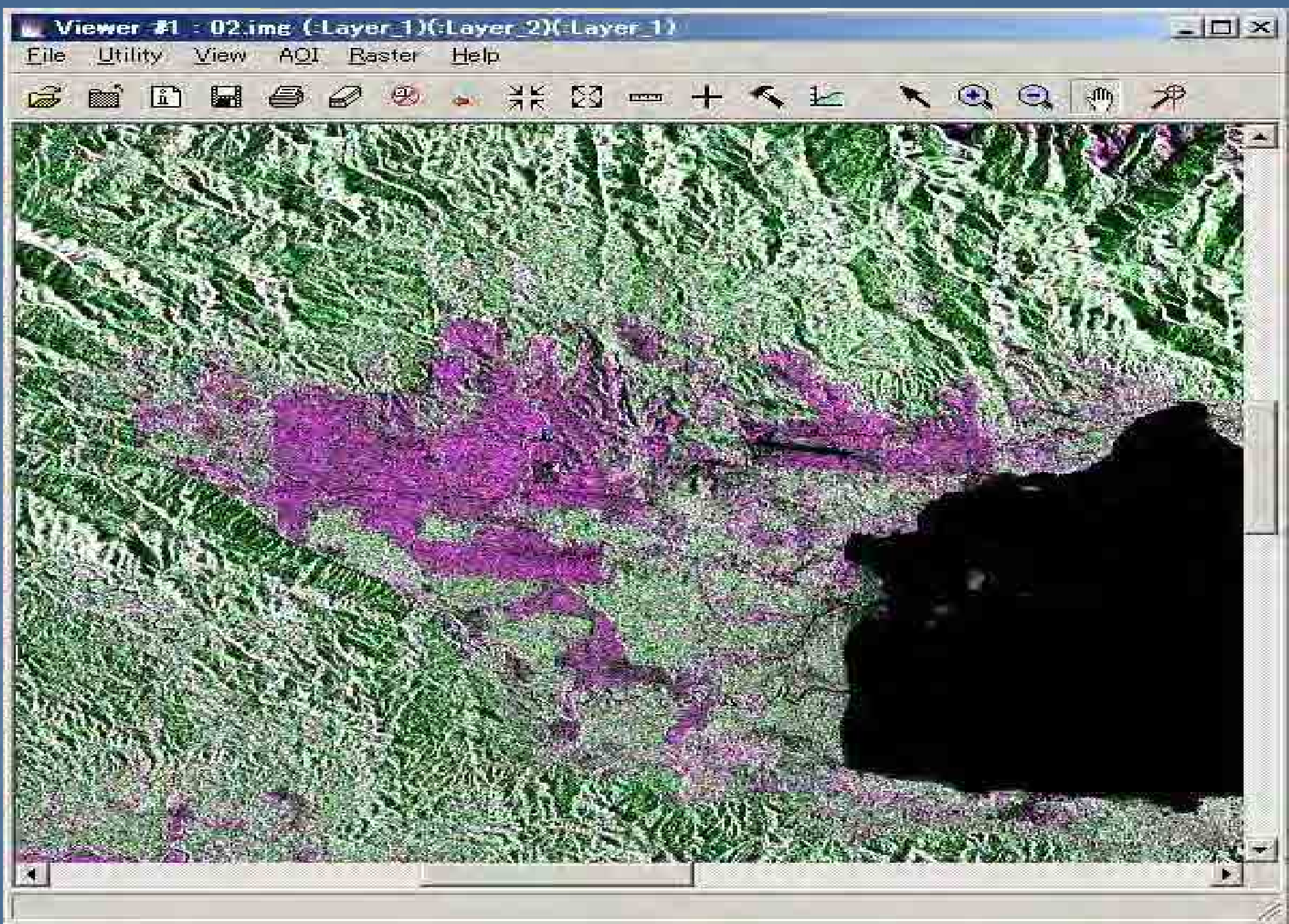
What is HH polarization? and HV polarization?

- The radar sensor is an active sensor apart from Optical sensor which is passive. Thus, the radar sensor (space-borne) transmits signals to the target (on ground) and receives backscatter signals from the target. The signal transmitted by radar sensor is referred to as H (horizontal signal). The signal received by radar sensor is backscatter signal and referred to as; (1) H (horizontal signal) and (2) V (Vertical signal).
- If the target (surface) is smooth, the backscatter signal is H. If the target (surface) is rough, eg; forest crown , the backscatter signal is V because the signal polarization is rotated. (Illustrate)

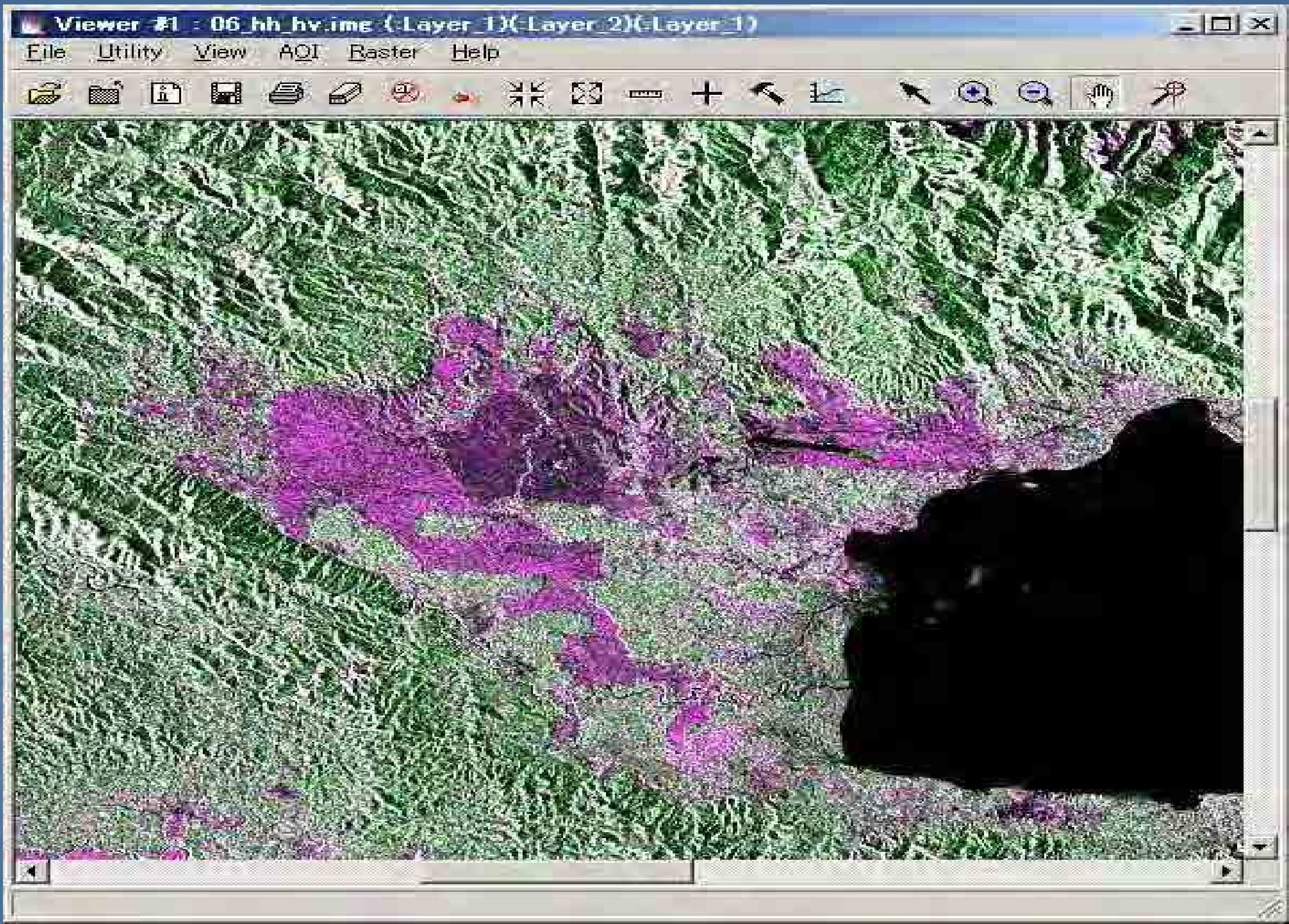
Comparing PALSAR image of 2007 and 2010

- Physical/Geographical changes can be observed over certain period of interest and thus the PALSAR image can be used as such in comparing images of 2007 and 2010. The two images can be compared to monitor or detect changes in vegetation/forest cover over time period.

- If the image (HV signal as backscatter effect with color Green: band 2) shows bright/strong effect in year 2010 than in 2007, it indicates afforestation, or re-growth/regeneration.
- If the image (HV signal as backscatter effect with color Green: band 2) shows dark/weak effect in year 2010 than in 2007, it indicates deforestation/logged area or burning/clearing area of forest/vegetation cover.
- If the image (HH signal as backscatter effect with color Magenta: band 1) shows bright/strong effect in year 2010 than in 2007, it indicates building constructions or new planting areas (agriculture).
- If the image (HH signal as backscatter effect with color Magenta: band 1) shows dark/weak effect in year 2010 than in 2007, it indicates clearing/removal of .buildings, roads, surface areas with water cover or flooding areas.



PALSAR image in 2007

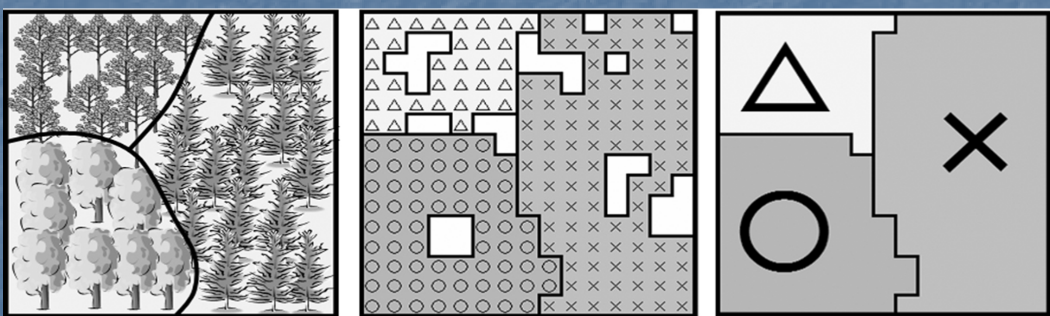


PALSAR image in 2010

2.3 Forest Cover Classification

- **Object based classification (eCognition Software)**

  Object-Based Classification is a method of image analysis to conduct classification based on image objects. This method to partition a comparatively homogeneous domain on an image is similar to image interpretation by human eyes (Figure 1 (a)). It is difficult to partition homogeneous domain on the existing pixel-based classification without the difference of the minute domain, because it does not consider relations with neighboring pixels (Figure 1 (b)). Therefore, in many applications, the object-based classification can be more effective for high resolution image analysis than pixel-based classification (Figure 1 (c)).



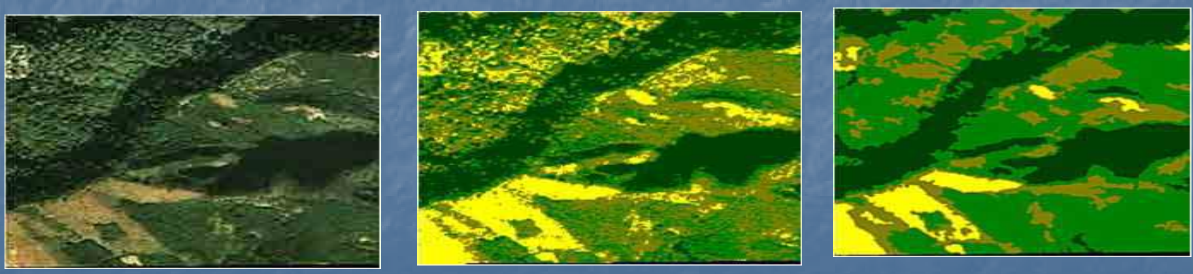
(a) (b) (c)

Figure 1: Differences between Object-based Classification and Pixel-based Classification

Classification

- (a) Human eyes' interpretation (Boundaries of different vegetation types can be extracted.)
- (b) Pixel-based classification (The difference of the minute domain is extracted unnecessarily)
- (c) Object-based classification (Results can be close to those of human interpretation.)
- Regarding pixel-based classification, because one class of domain may contain many minute domains of other classes, it is often hard to interpret a resulting classification map. Regarding object-based classification, on the other hand, because this method segments a whole image into small domains (image objects), a resulting classification map can be similar to a map that can be created based on human eyes' interpretation (Figure 2).

Figure 2: Comparison of Pixel-based Classification and Object-based Classification



Original Image　　Pixel-Based Classification　　Object-Based Classification

2.4 Applications of RapidEye, PALSAR and GeoSAR
The table below summarizes the applications and its merits and demerits.

RapidEye	PALSAR	GeoSAR
Applications Forest/Vegetation types Plantation Land-use Roads Rivers Settlements Natural/Man-made disaster	**Applications** Forest/Vegetation Change detection Geological structure Natural/man-made disaster Land-use	**Applications** Forest cover detection Tree height
Demerits Cloud cover Expensive	**Demerits** Difficult to interpret/understand	**Demerits** More expensive One time observation Limited area of observation (Cannot cover whole of PNG)


Arigato Gozaimasu
JAXA
JAXA
(Acknowledgements)

Progress Report on

JICA Technical Cooperation Project & Grant Aid "Forest Preservation Programme

November 3rd, 2011

Table of Contents

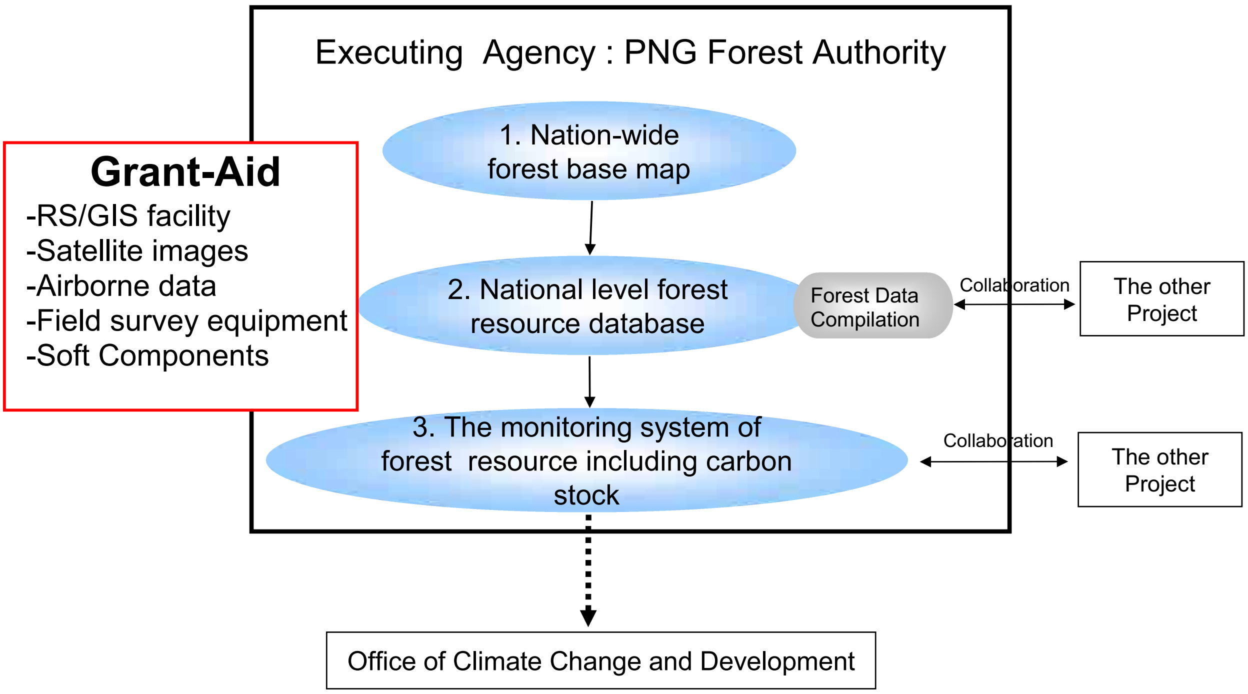
1. Basic Information
2. Project/Programme Scope
3. Institutional Arrangement
4. Grant Aid Procurement
5. Demonstration of Procured Items
6. Benchmark Map Development
7. Database Design/Development
8. Carbon Stock Estimation
9. Capacity Buidling (Japan/PNG)

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

JICA Technical Cooperation Project



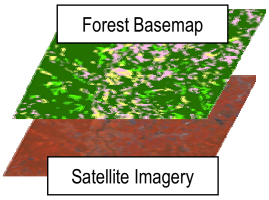
Target Analysis for Forest Monitoring in PNG

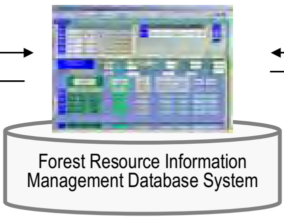
【To-Be】	【To-Be】	【To-Be】
1. National forest resource basemap is developed & utilized	2. National level forest resource GIS/Database is developed & utilized	3. Carbon/Biomass stock is estimated.
【Problem】 ・PNGFA does not have data and facility to develop ・Need time to develop national level map	【Problem】 ・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

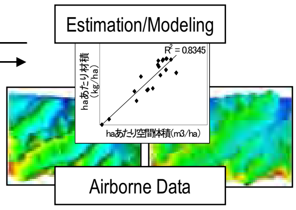
To-Be (Goals)

Problem

As-Is (Current)







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

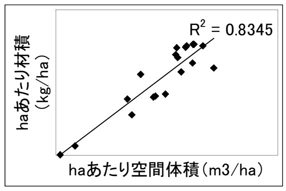
ALOS/PALSAR K&C Mosaic

Nation-wide Expansion

Multi Platform Sensing

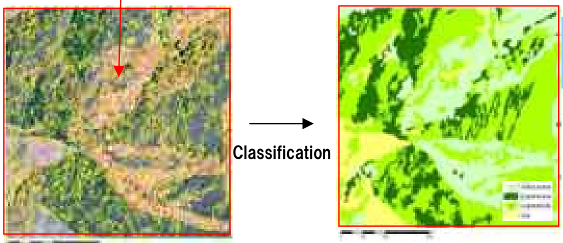
Biomass/Carbon Modeling based on Spatial Volume

Tree Stand Volume

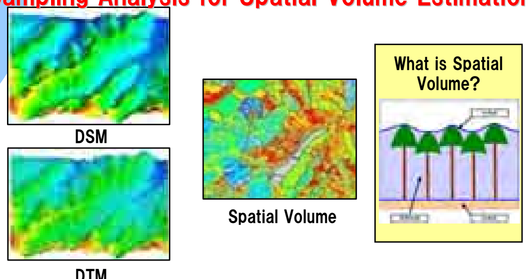


Relational Expression of Spatial Volume & Tree Stand Volume

Forest Basemap Development with Optical Satellite



Sampling Analysis for Spatial Volume Estimation



2D: Area of Forest/Vegetation Type

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

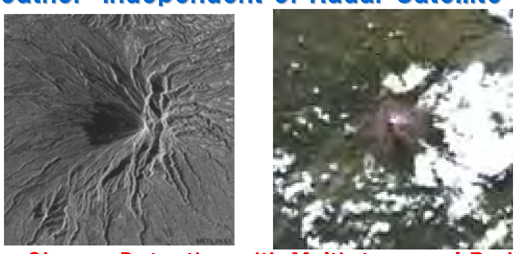
Developing Forest Base-map with Constellation of Optical Satellites

Change Detection with Multi-temporal Radar Image (ALOS/PALSAR)

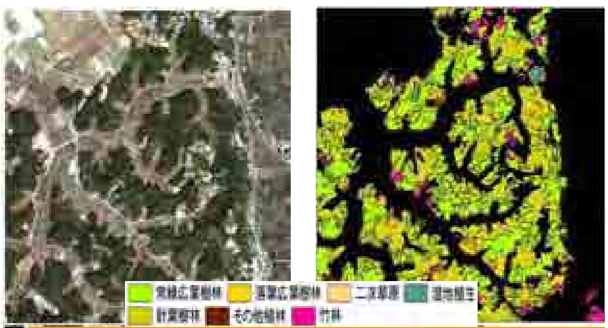
Constellation of Optical Satellites

RapidEye A.G.

Weather-independent of Radar Satellite

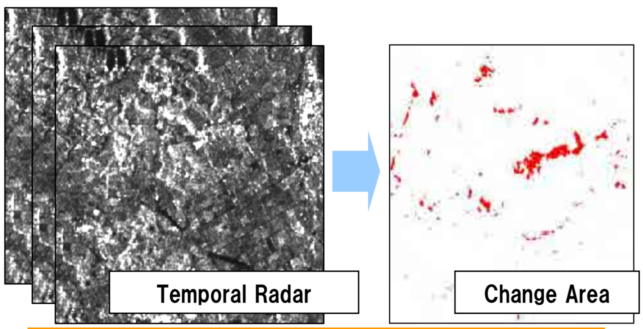


Vegetation Type Classification for Forest Benchmark map



Benchmark Map by Optical Satellite

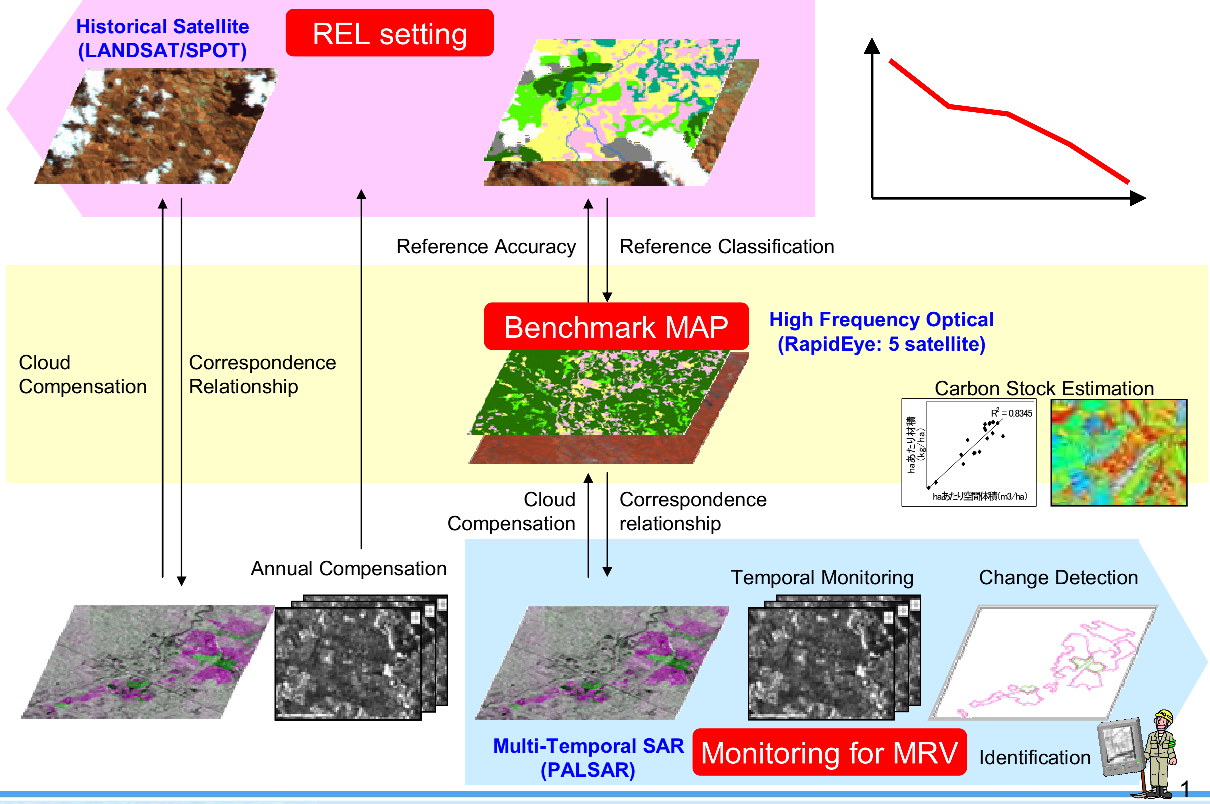
Change Detection with Multi-temporal Radar



Change Detection by Radar Satellite

2. Project/Programme Scope

Forest Monitoring Practice for REDD+



2. Project/Programme Scope

PNGFA/JICA Approach to Activity Data

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

FOR DISCUSSION

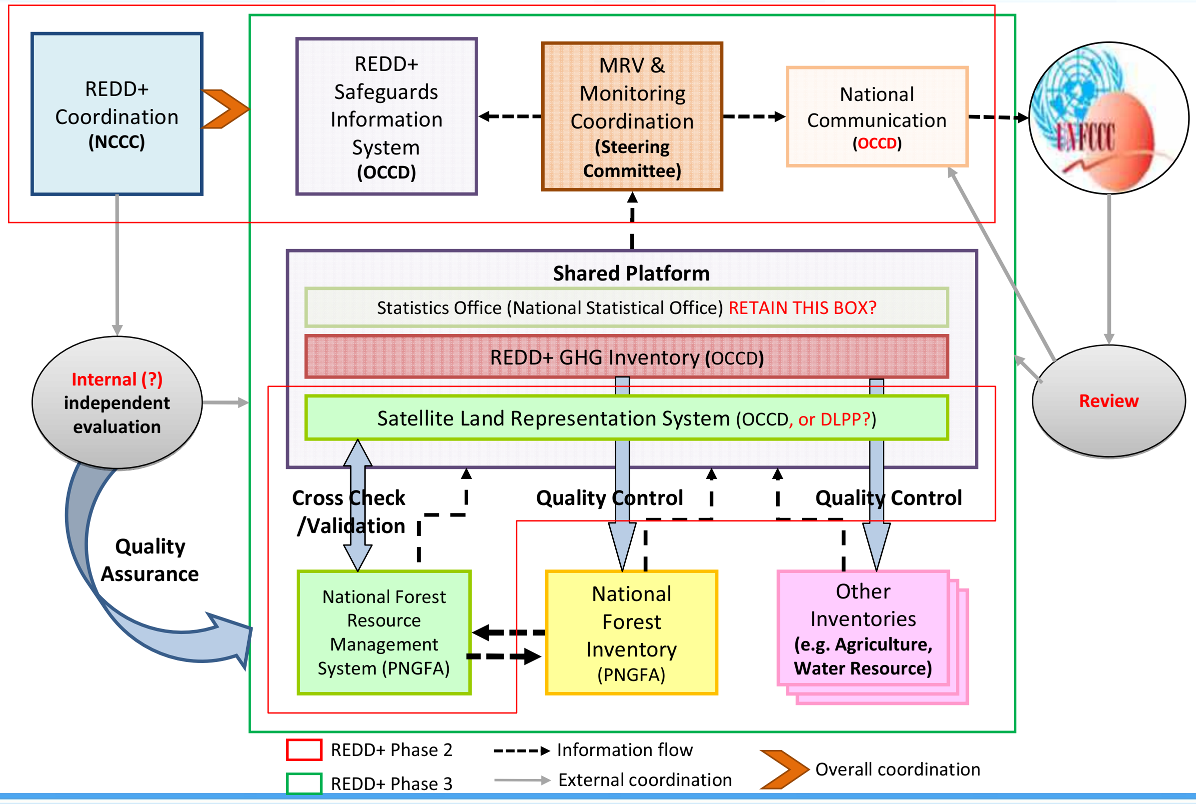
GOFC-GOLD Framework		Issues for consideration	PNGFA approach to National Level MRV
Step 1	Selection of the forest definition	• Is FAO definition sufficient • How to stratify	• Definitional issue: Forest definition and classification including Mangrove consistently applied in PINGRIS, FIM-5, and FAO-FRA 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)

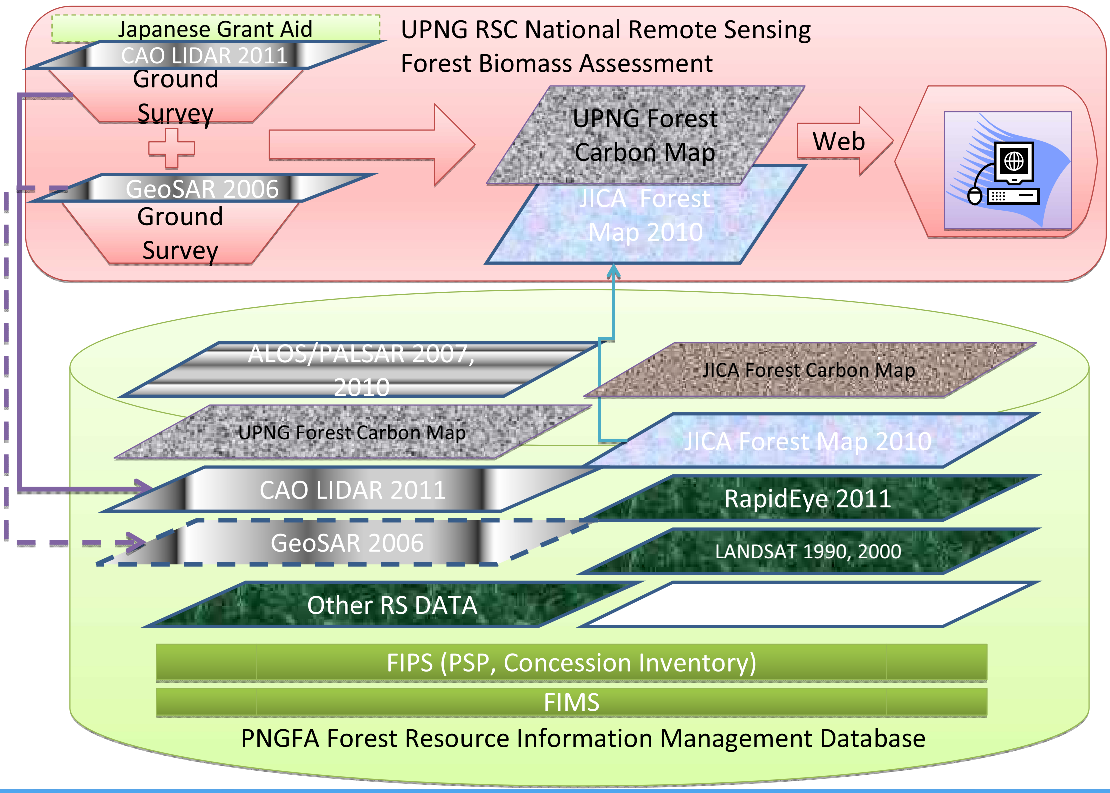
Step 4	Decisions for sampling versus wall to wall coverage	• Systematic vs. stratified sampling • How to identify 'hot-spots' for stratified sampling	• Wall-to-wall coverage since PINGRIS and FIM-5 • Database ability and design to be considered using ISO-19000 Unified Modeling Language • Reports on resource monitoring, reports from FRI-PSPs, concession 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



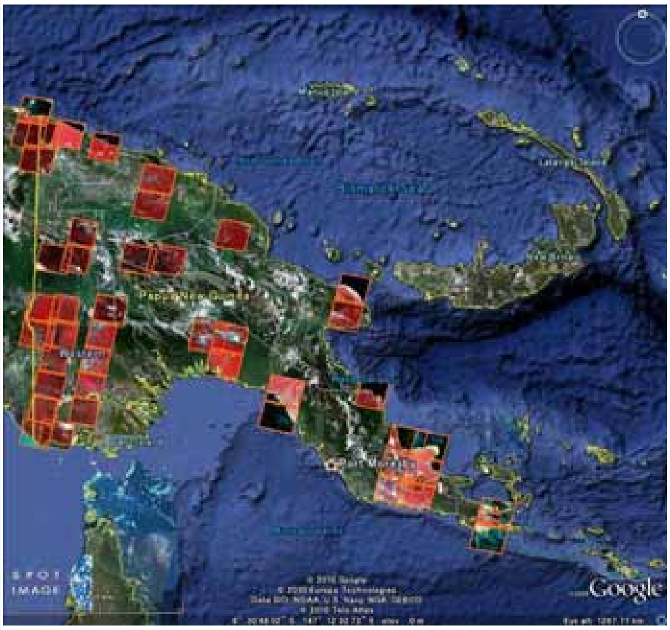
Procurement Items

	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

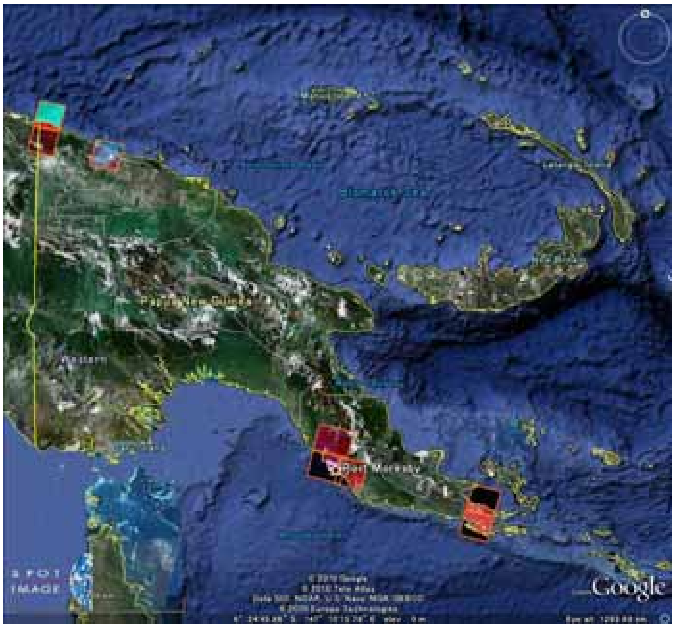
Due to the problem of ALOS, changed from 2012 to 2007 (Training items are not changed)

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

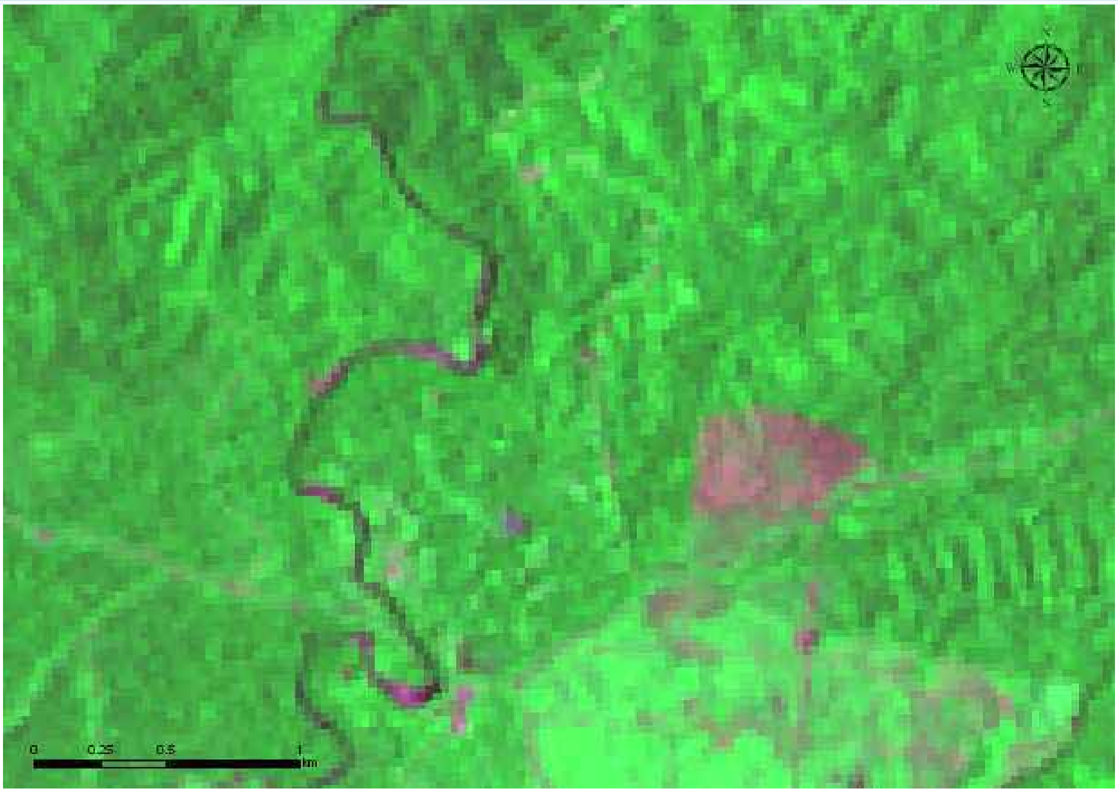
Solution of RS in PNG: RapidEye Basic Information

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

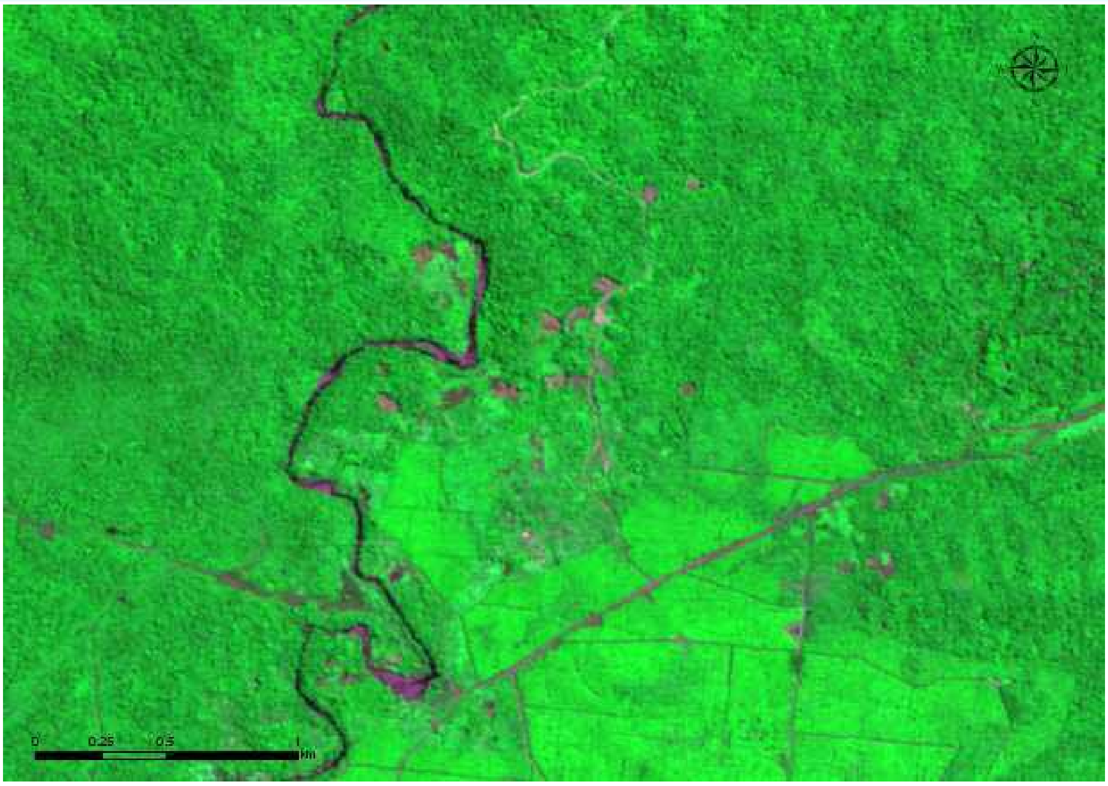
Ref. RapidEye Web

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

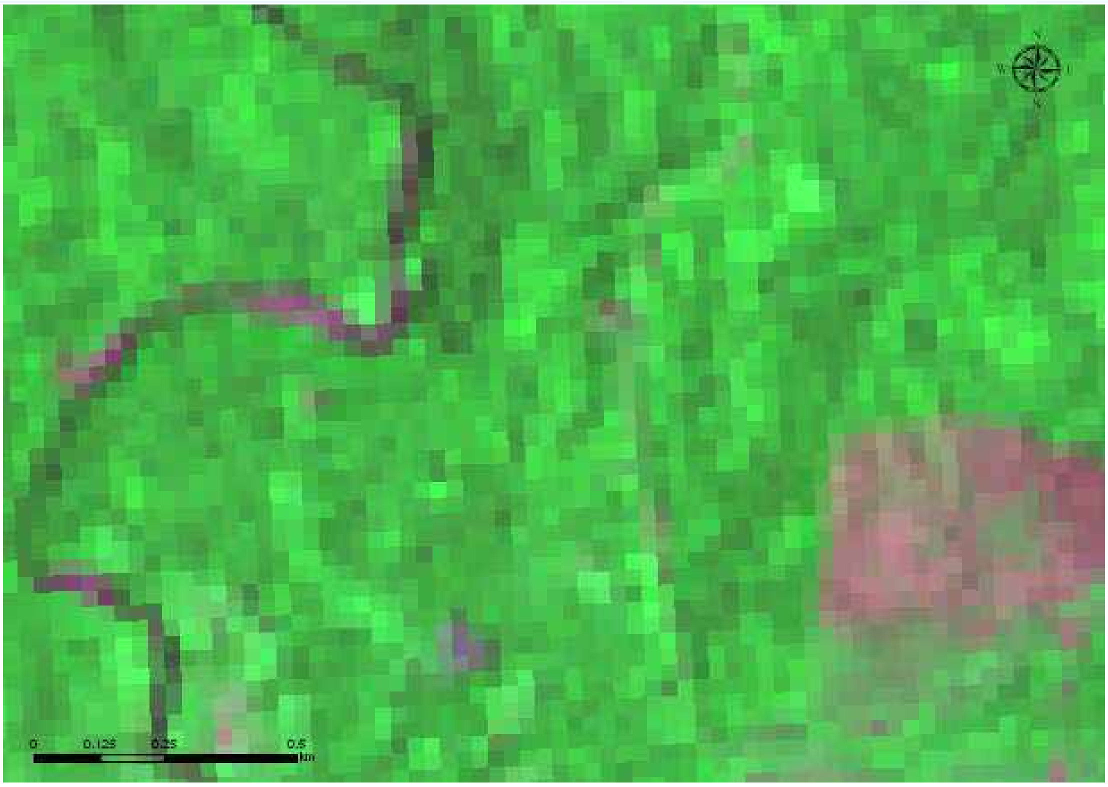
LANDSAT ETM+ 2000 (MS 30m Resolution) 1:10,000 Level



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

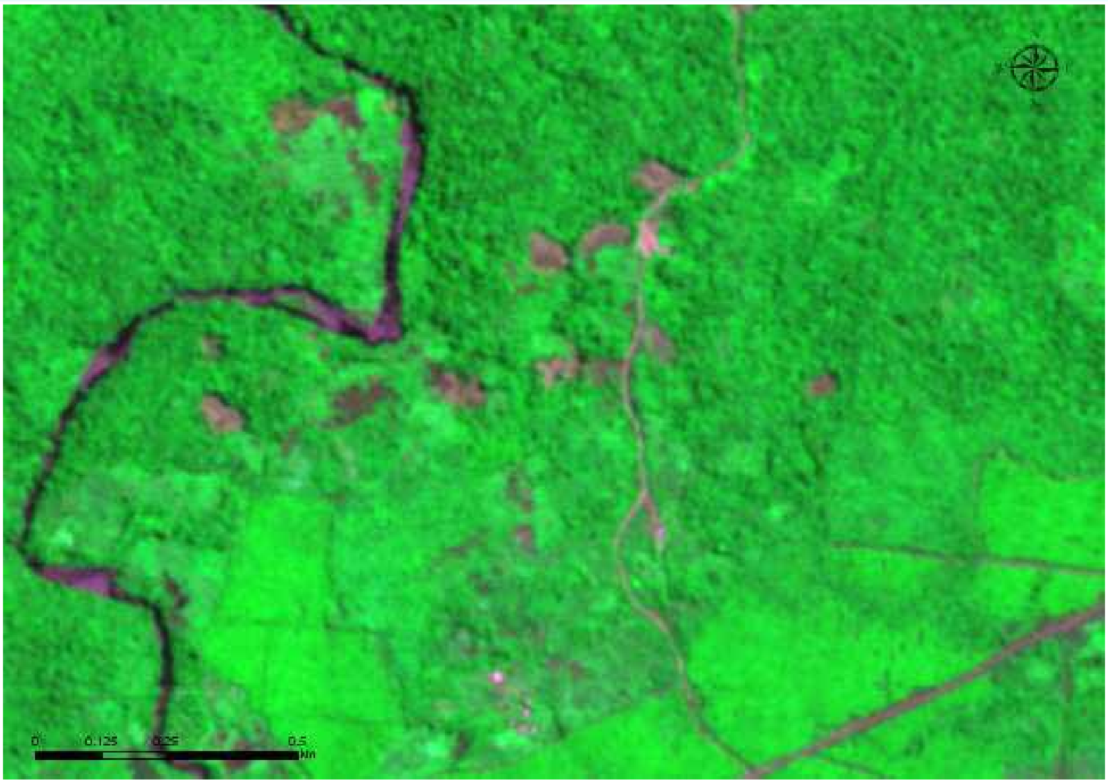


LANDSAT ETM+ 2000 (MS 30m Resolution) 1:5,000 Level

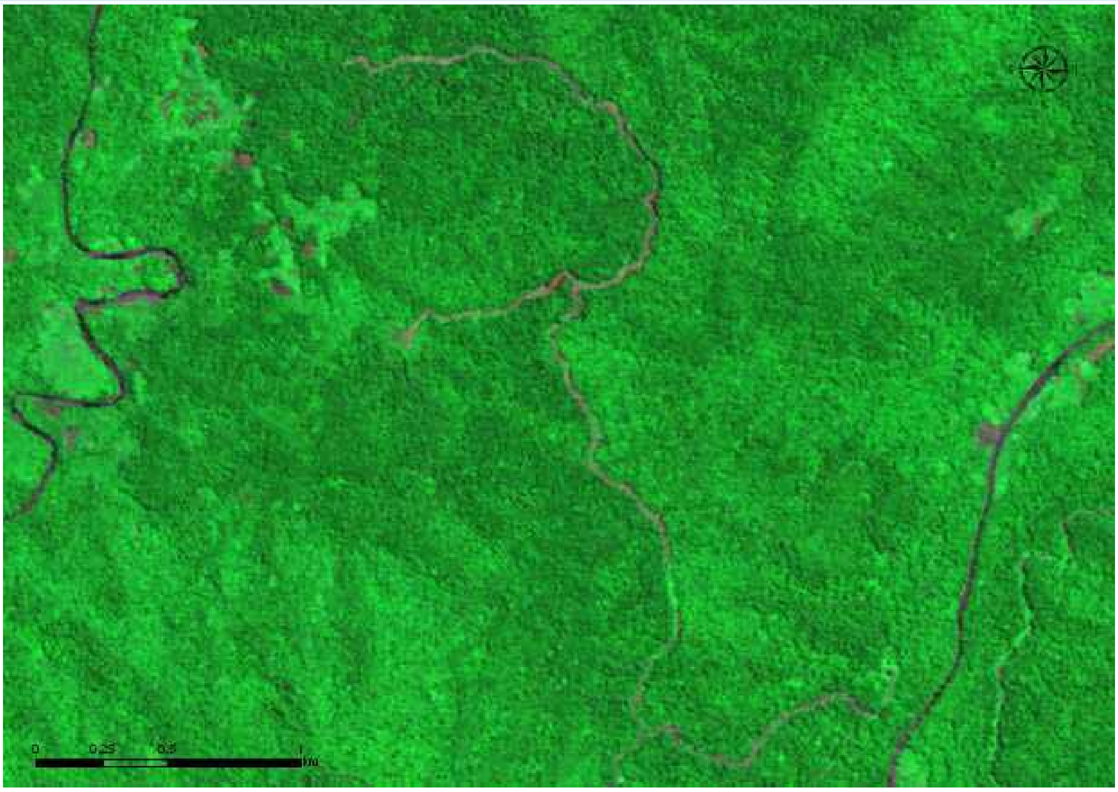


5. Demonstration of Optical Satellite

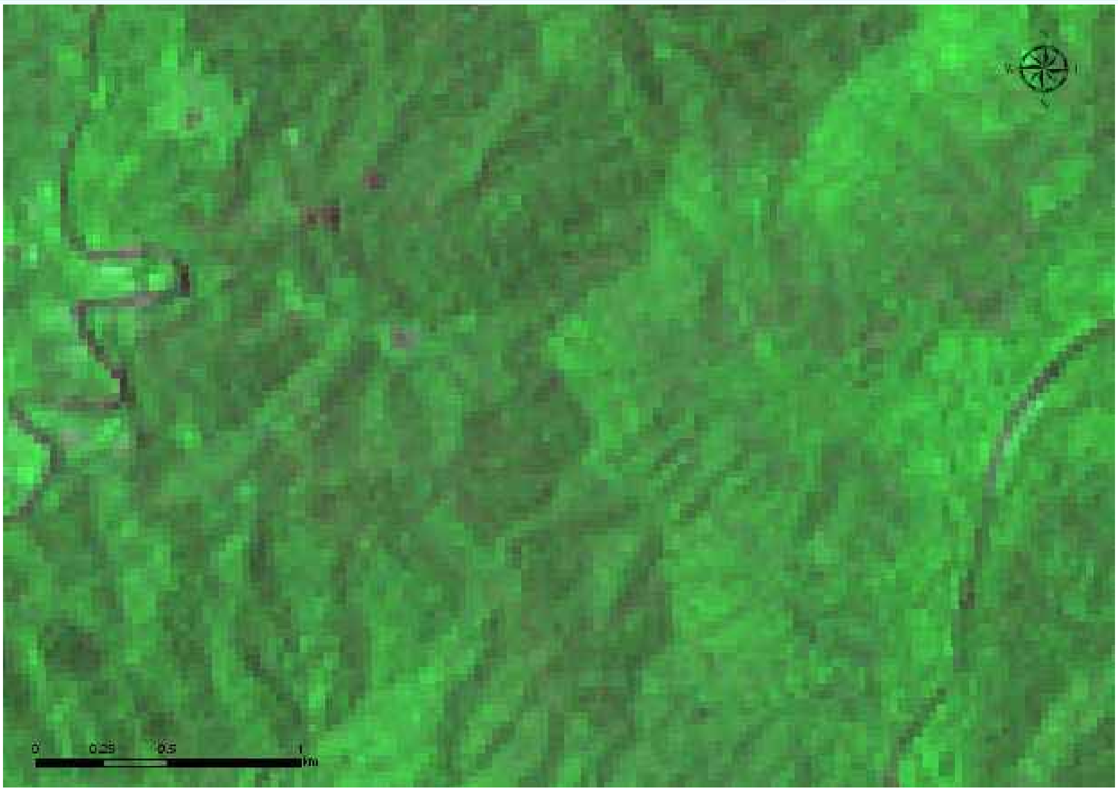
RapidEye MS 2010 (6.5m -> 5.0m Resolution) 1:5,000 Level



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

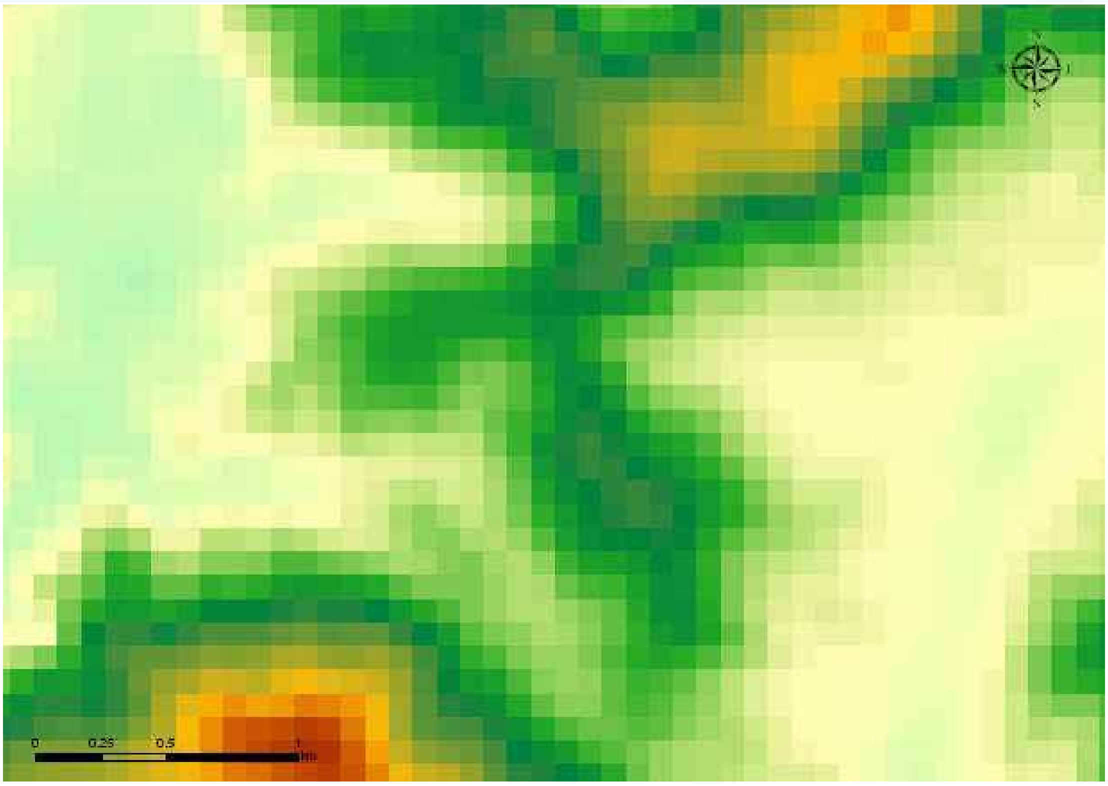


LANDSAT ETM+ 2000 (MS 30m Resolution) 1:10,000 Level



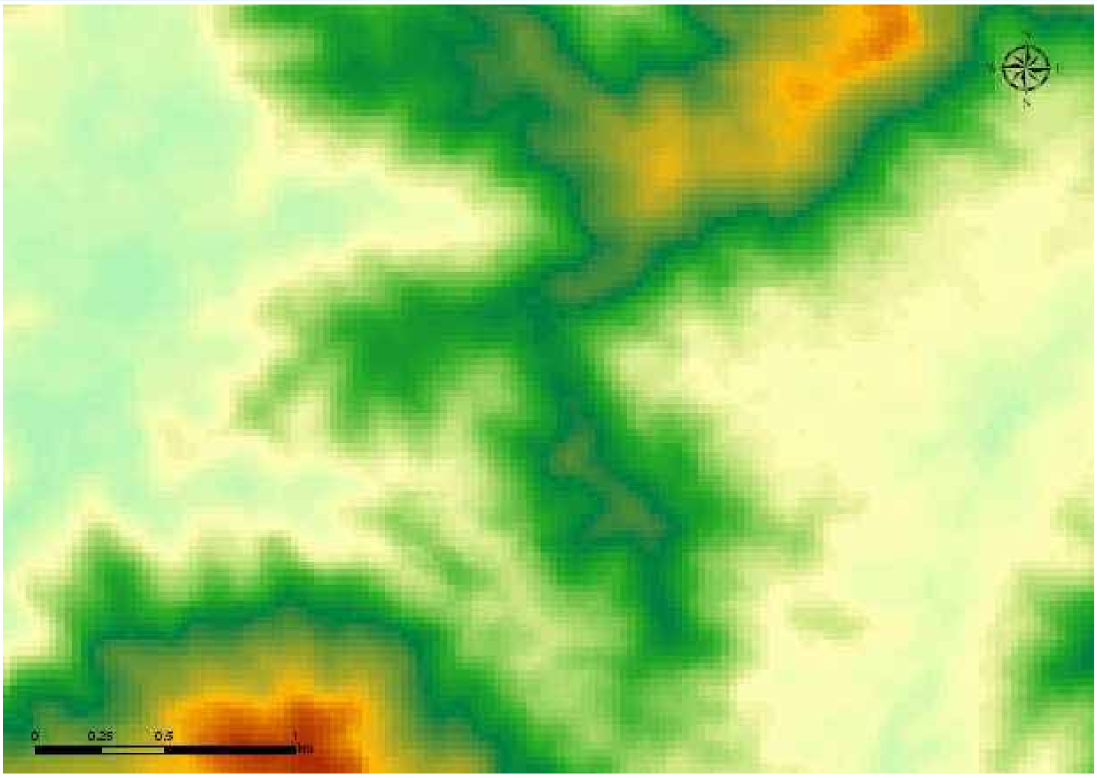
5. Demonstration of Spatial Analysis

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

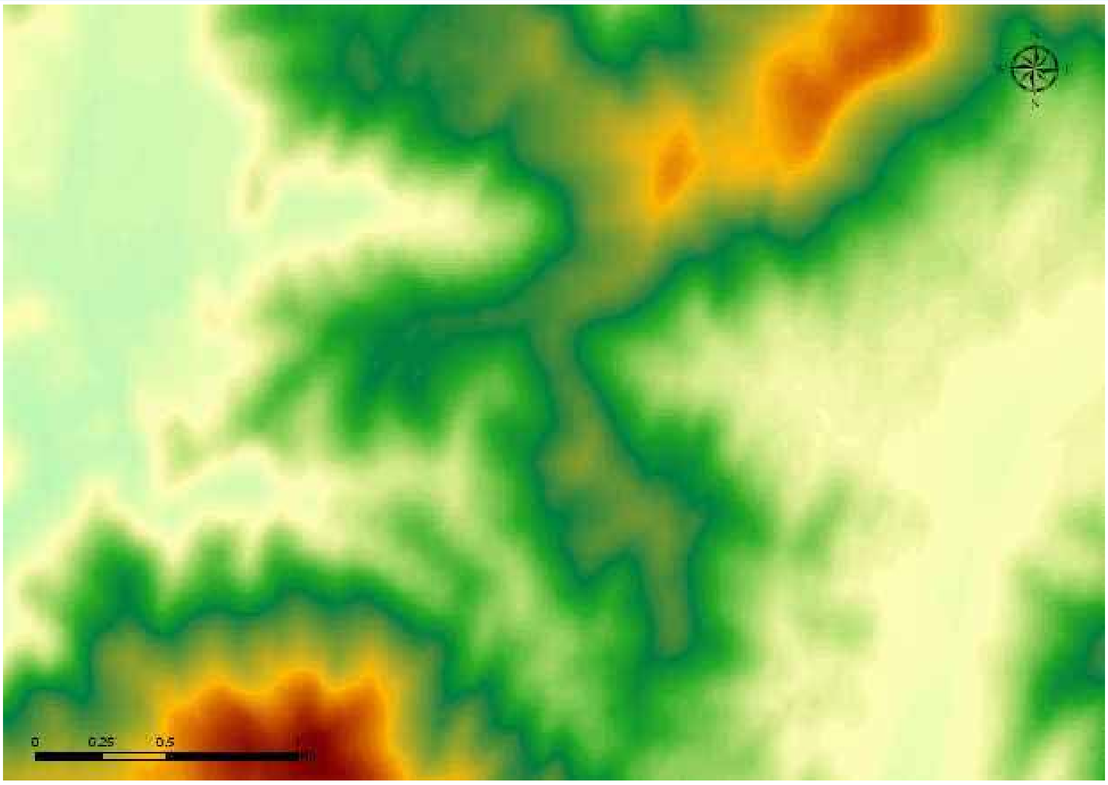


5. Demonstration of Spatial Analysis

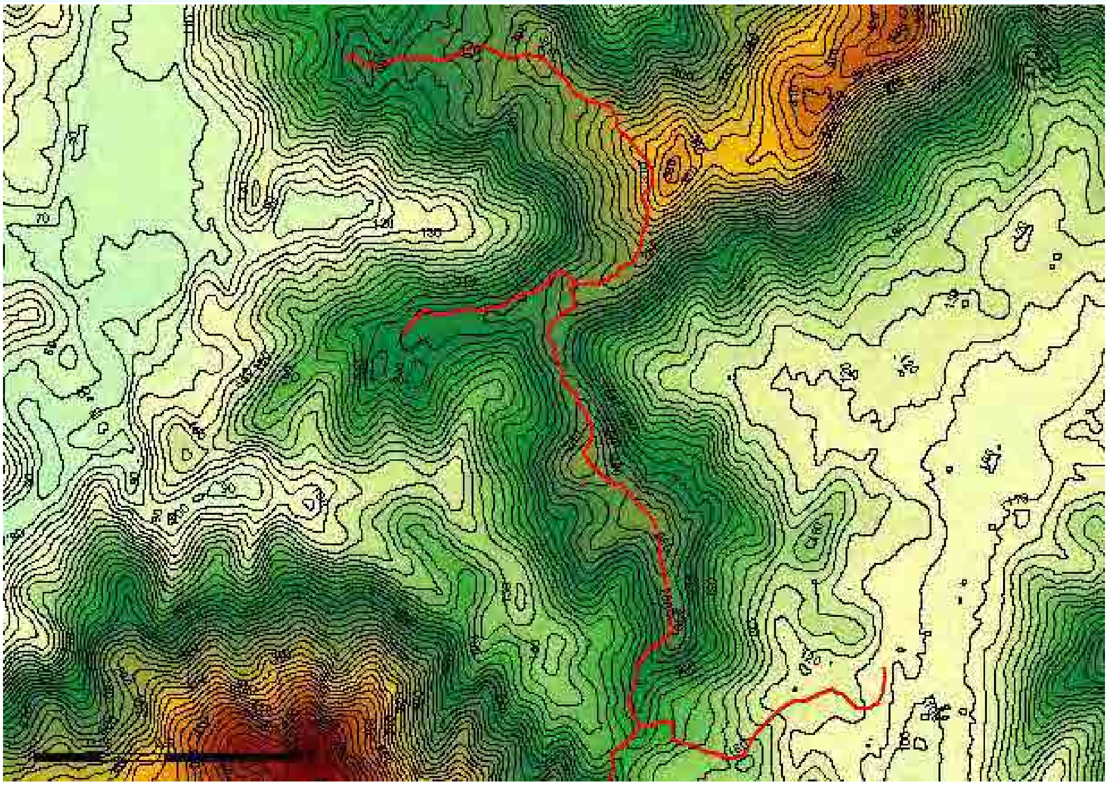
DEM(30m mesh): Terra/ASTER GDEM (ver.2)



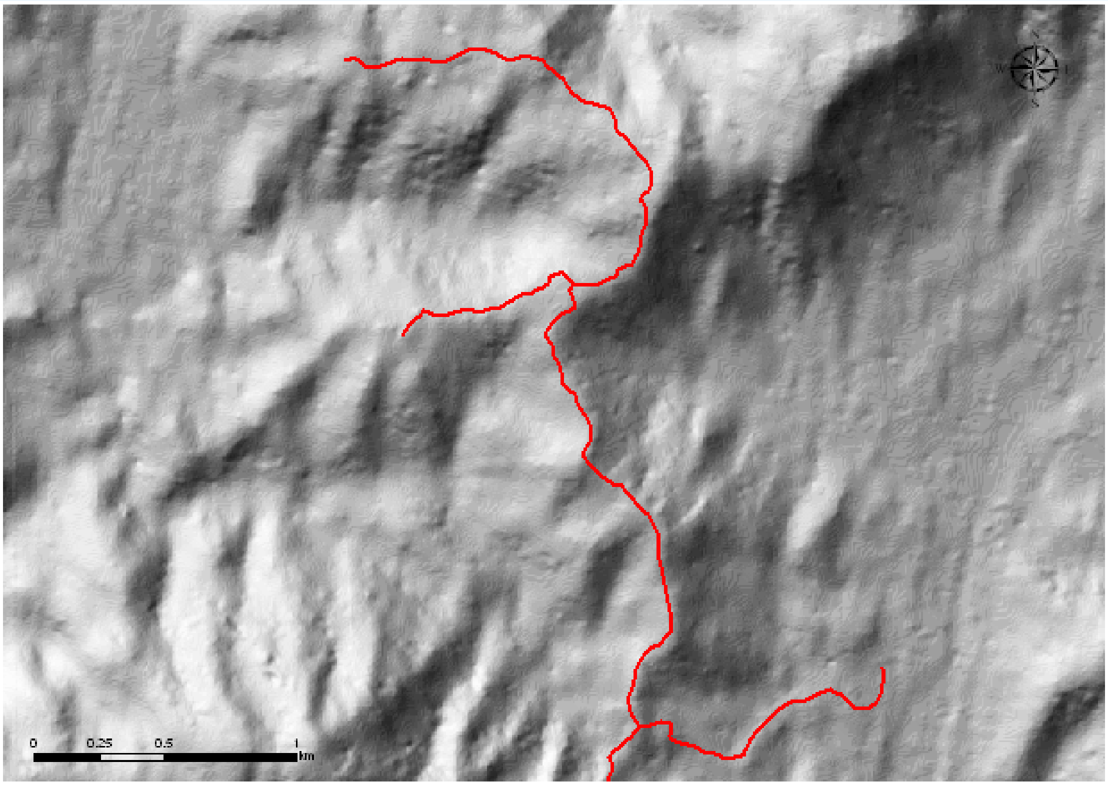
DEM(5m mesh): Airborne Radar



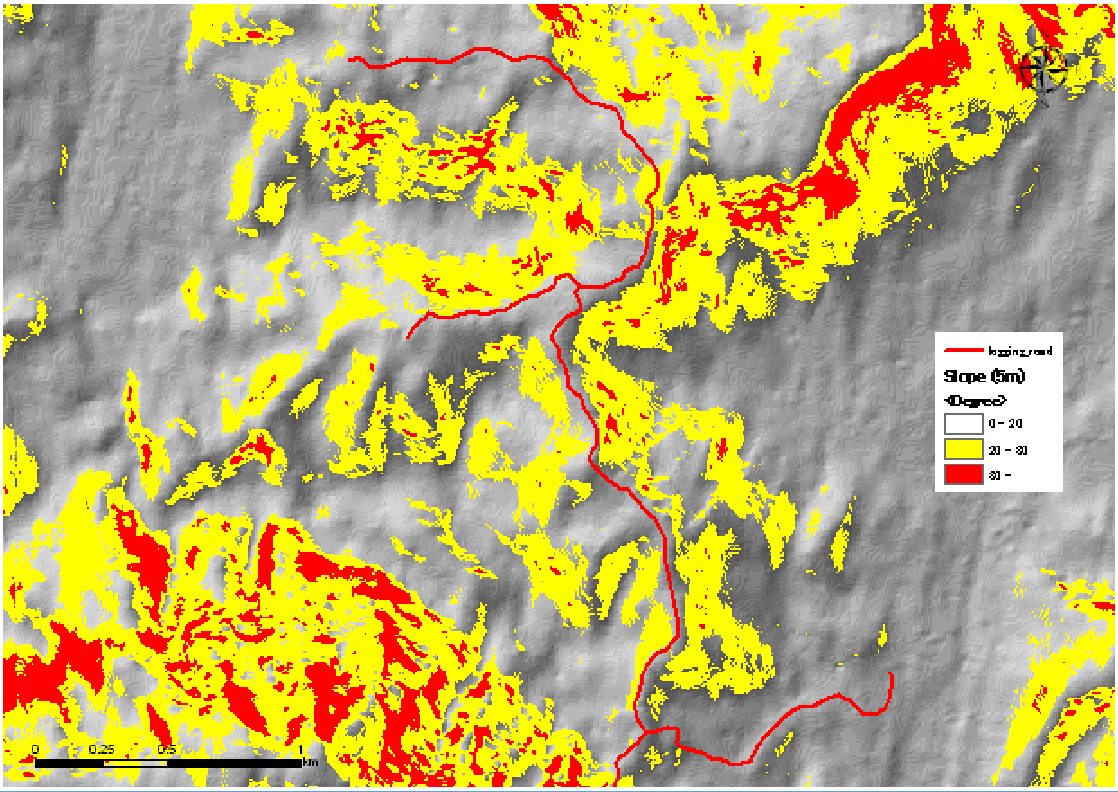
DEM derived contours (10m interval) & logging road



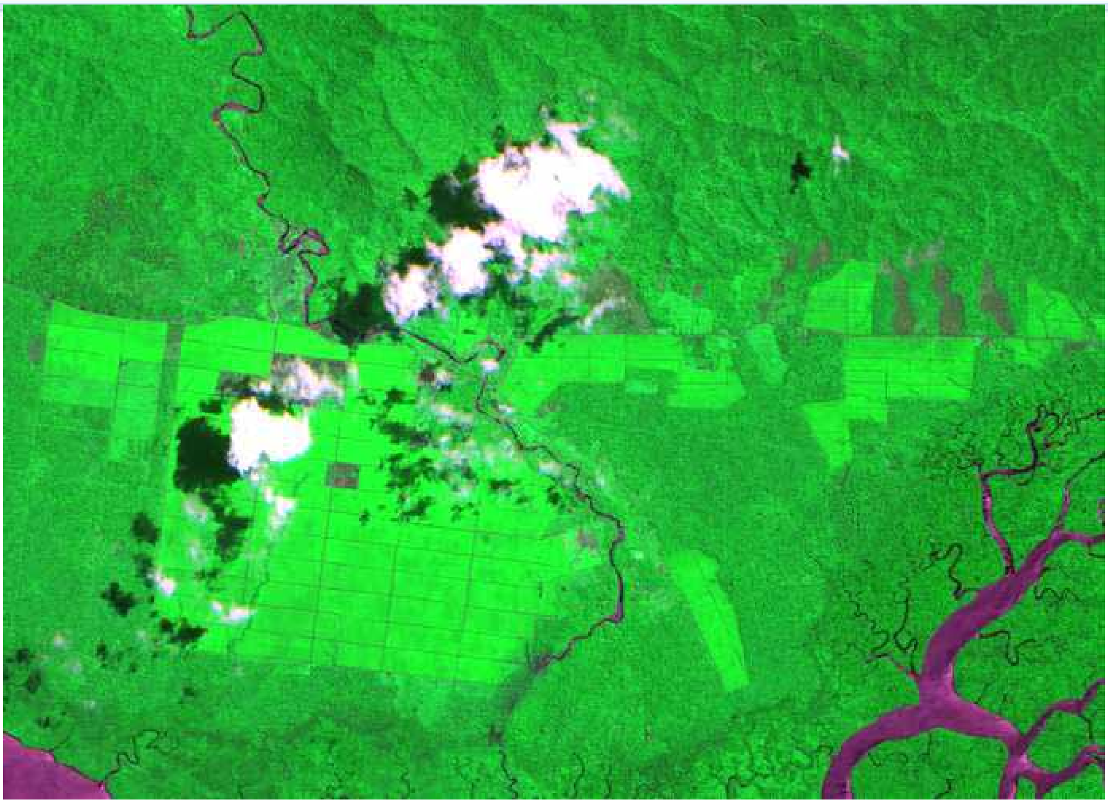
Hillshade(10m mesh) derived from DEM & logging road



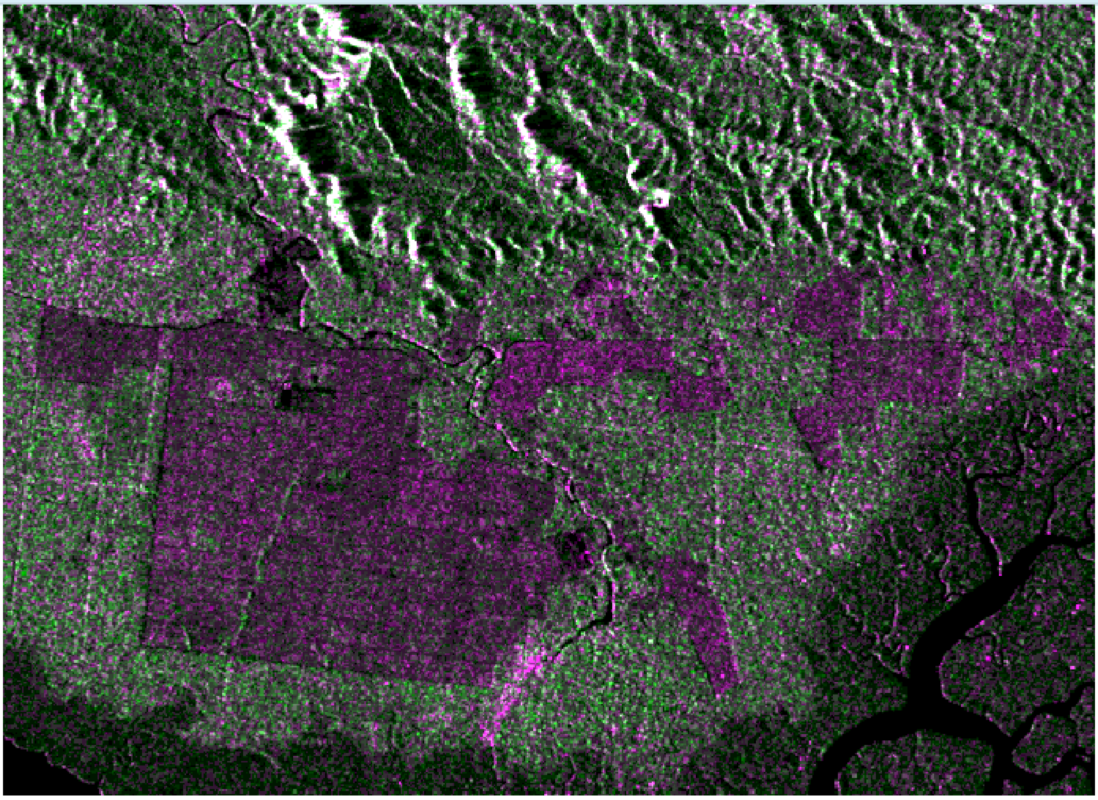
Slope (10m mesh) Analysis derived from DEM & logging road



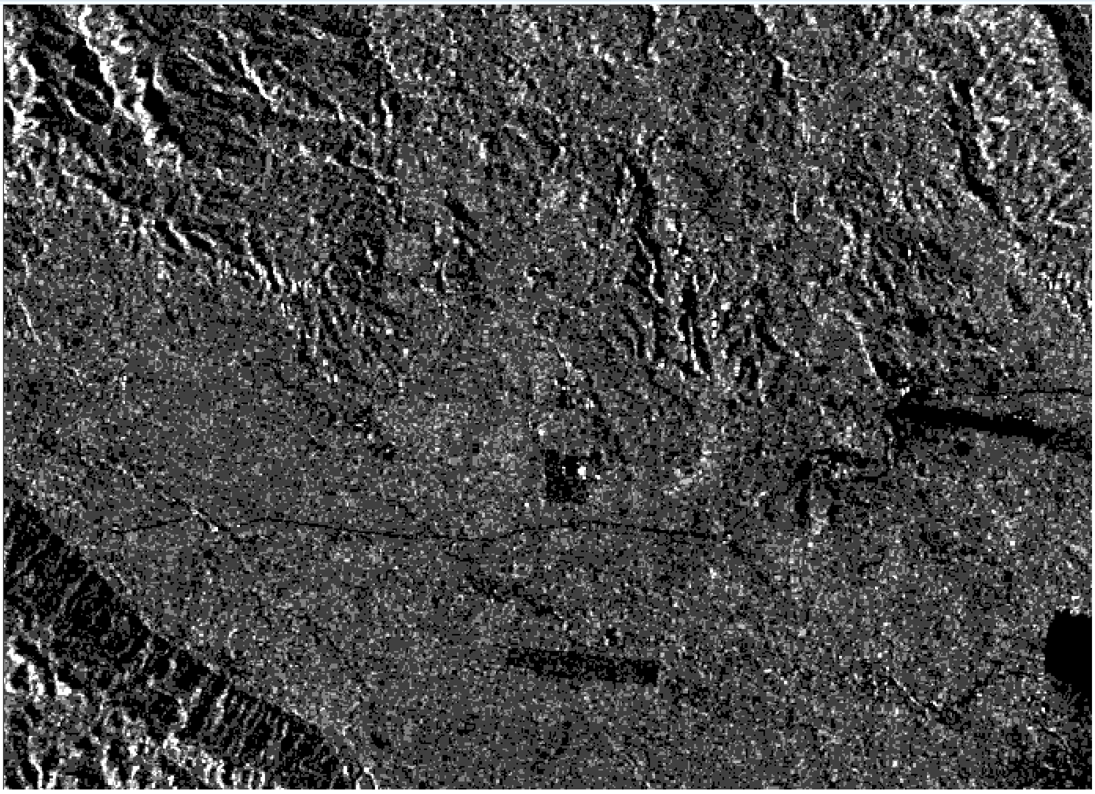
RapidEye 2010 (with Cloud)



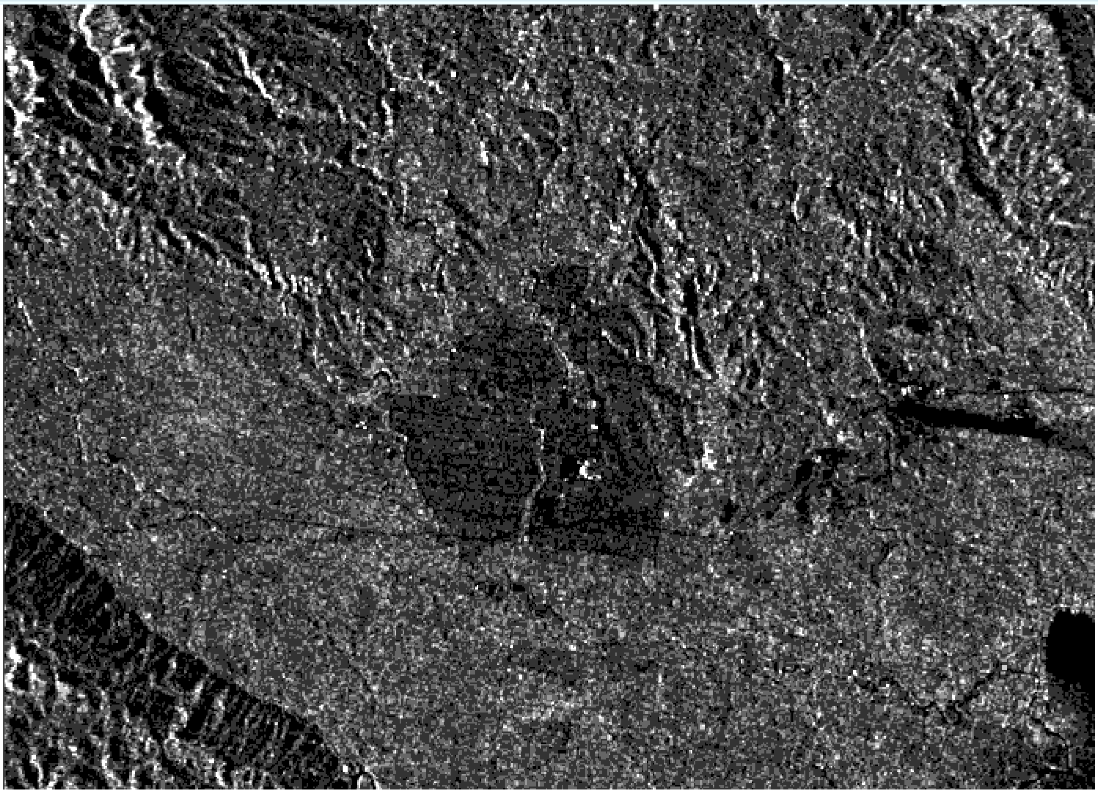
ALOS/PALSAR 2010 (No Cloud)



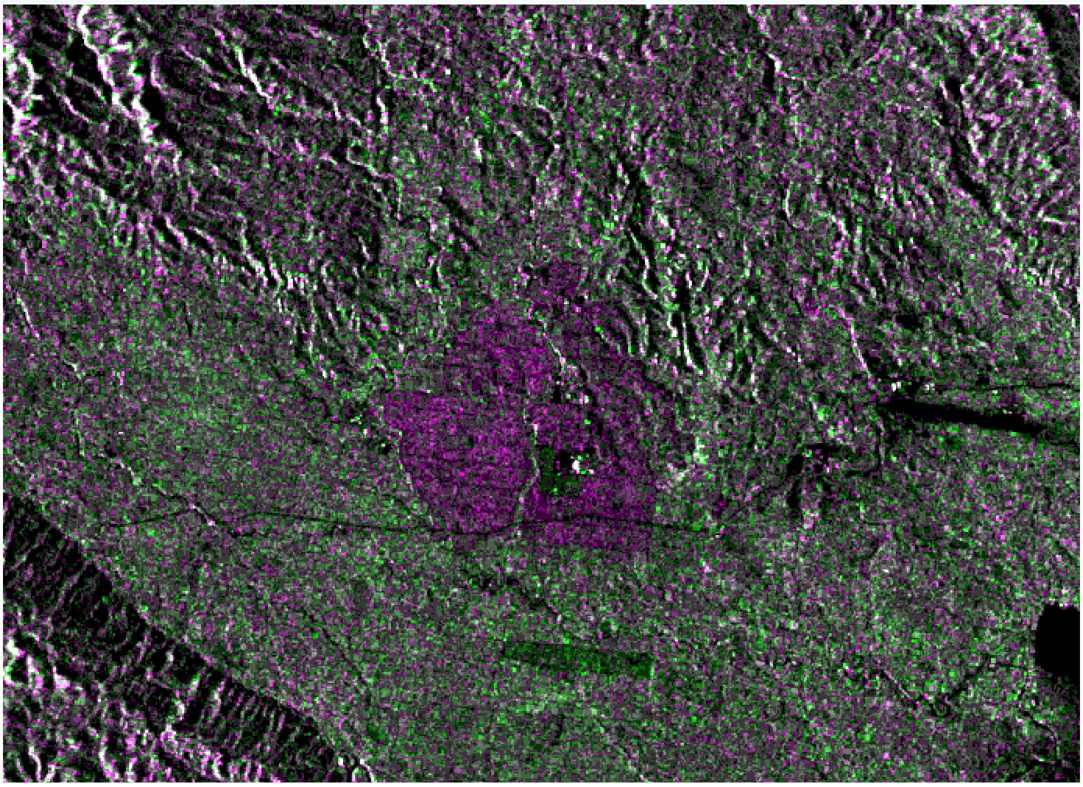
ALOS/PALSAR 2007



ALOS/PALSAR 2010

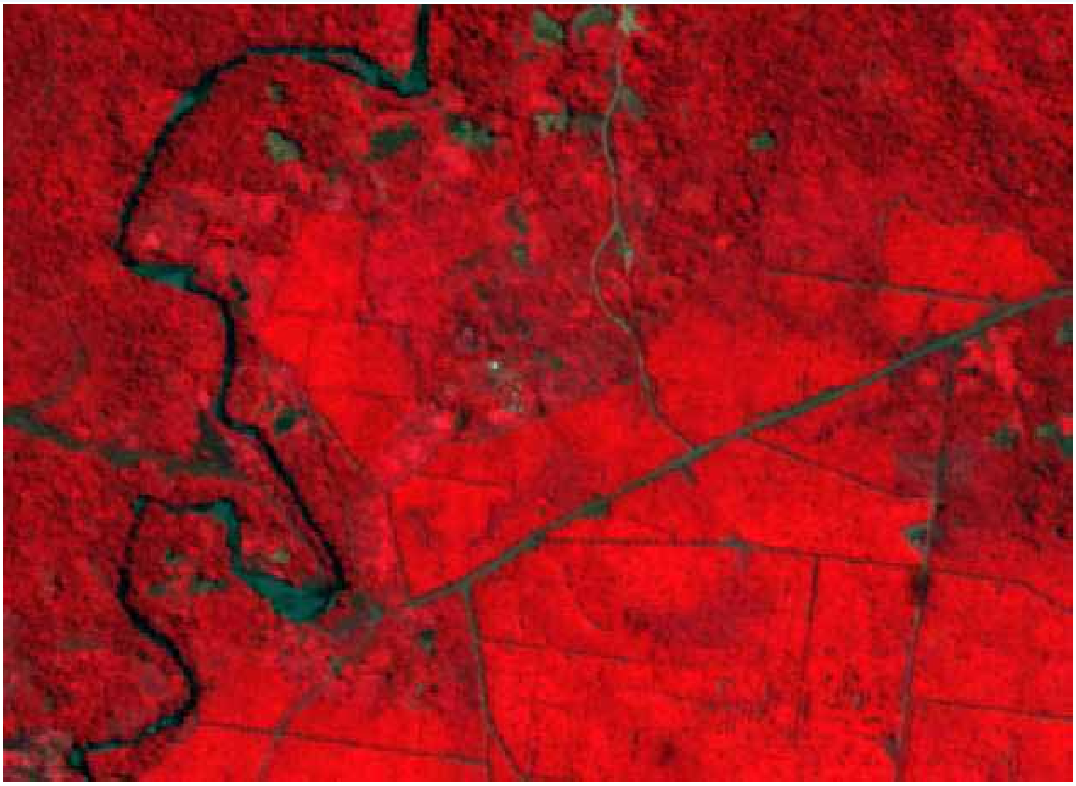


Change Detection by ALOS/PALSAR

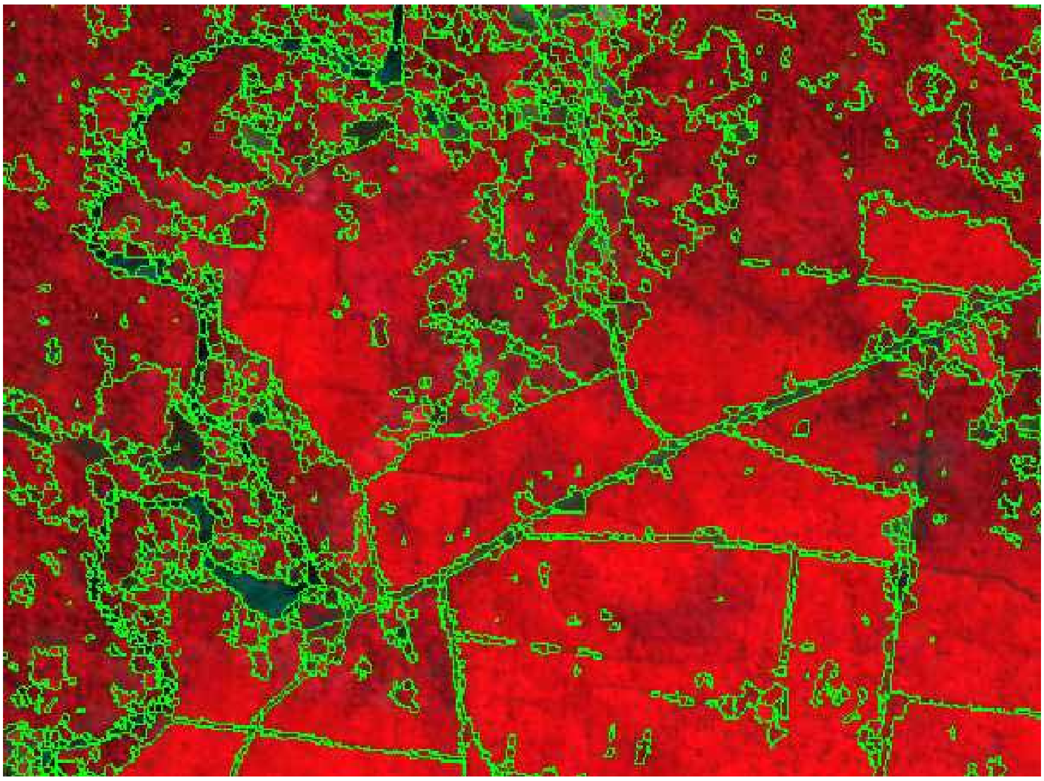


Feature Identification by RapidEye 2010

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

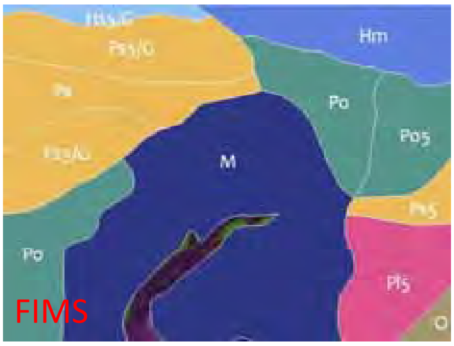
6. Benchmark Map Development

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

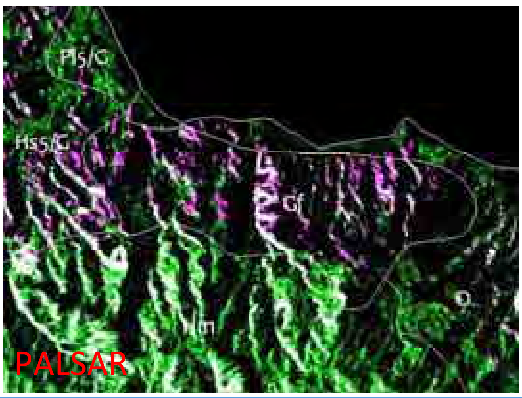
Interpretation Practice

Sample 1 : M - Mangrove



Interpretation Practice

Sample 2 : Gf - Glassland with some forest



Interpretation Practice for Classification

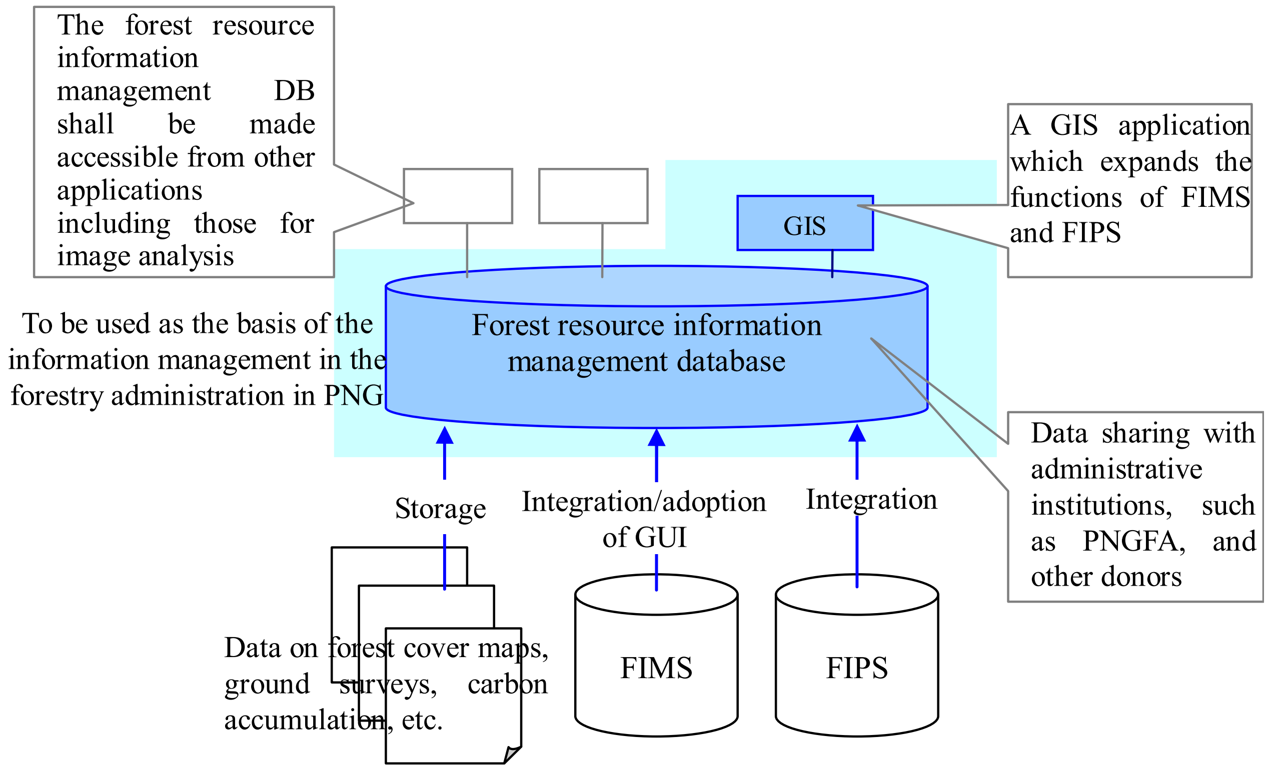
Structural formation	Vegetation type	Shape (Crown)	Color	Shape	Size	Pattern	Texture	Shade	Circum-stance
Forest	Low Altitude Forest on Plains and Fans "P" (<1,000m)		Mixed			Relatively regular Scattered crown	Relatively regular, fine in Natural (RGB 4:5:2) Image of RapidEye		Along coast, flat topography, 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)

6. Benchmark Map Development

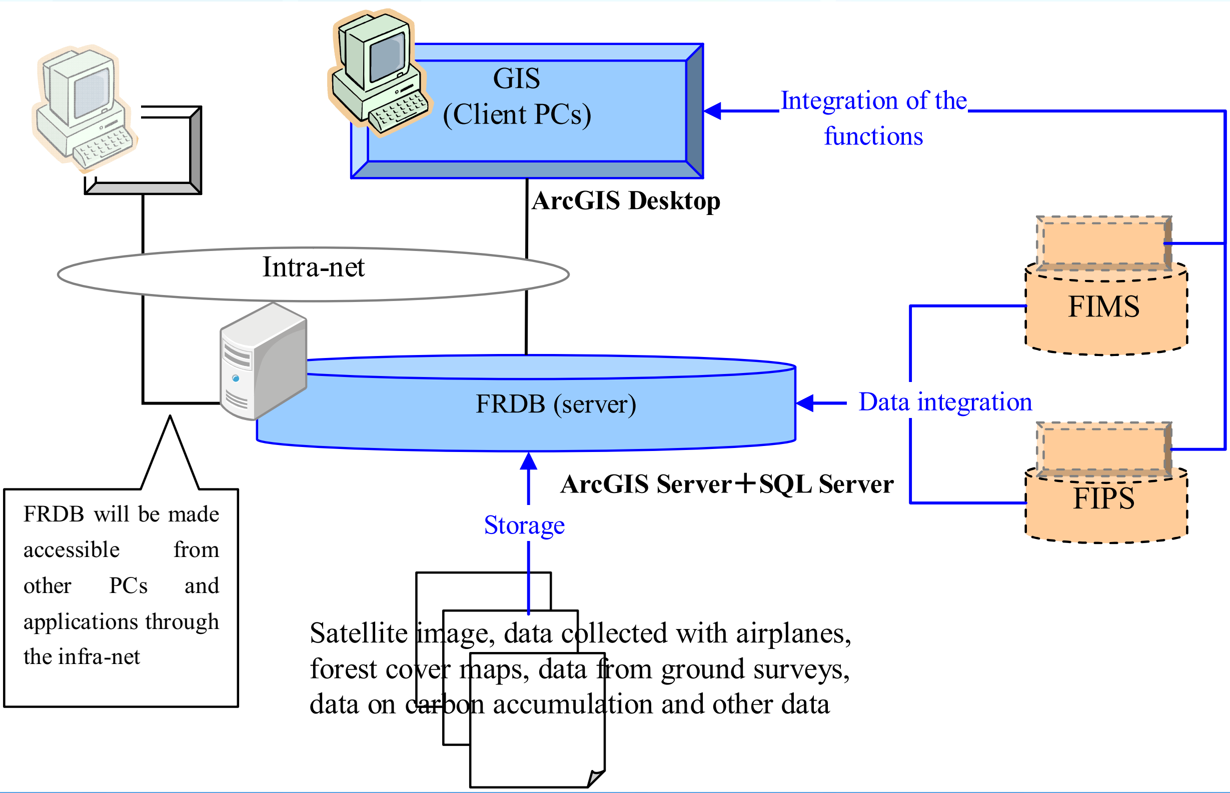
Interpretation Practice for Classification

	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"									

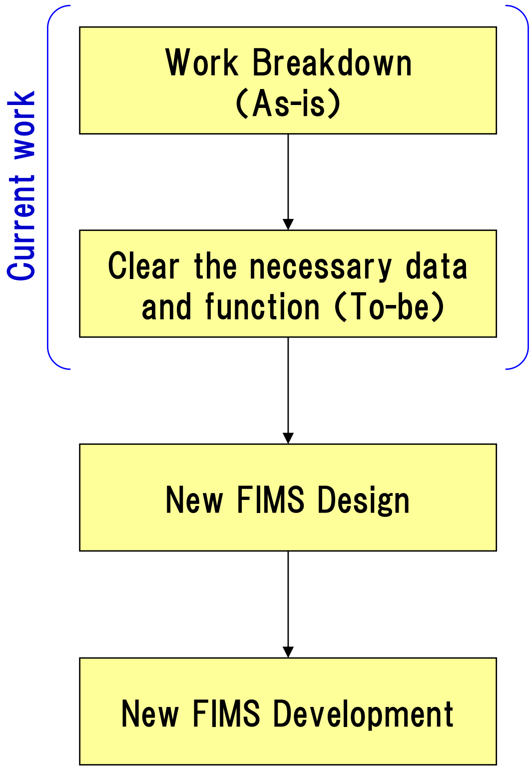
Scope of Forest Resource Information Management Database



Composition of Database System

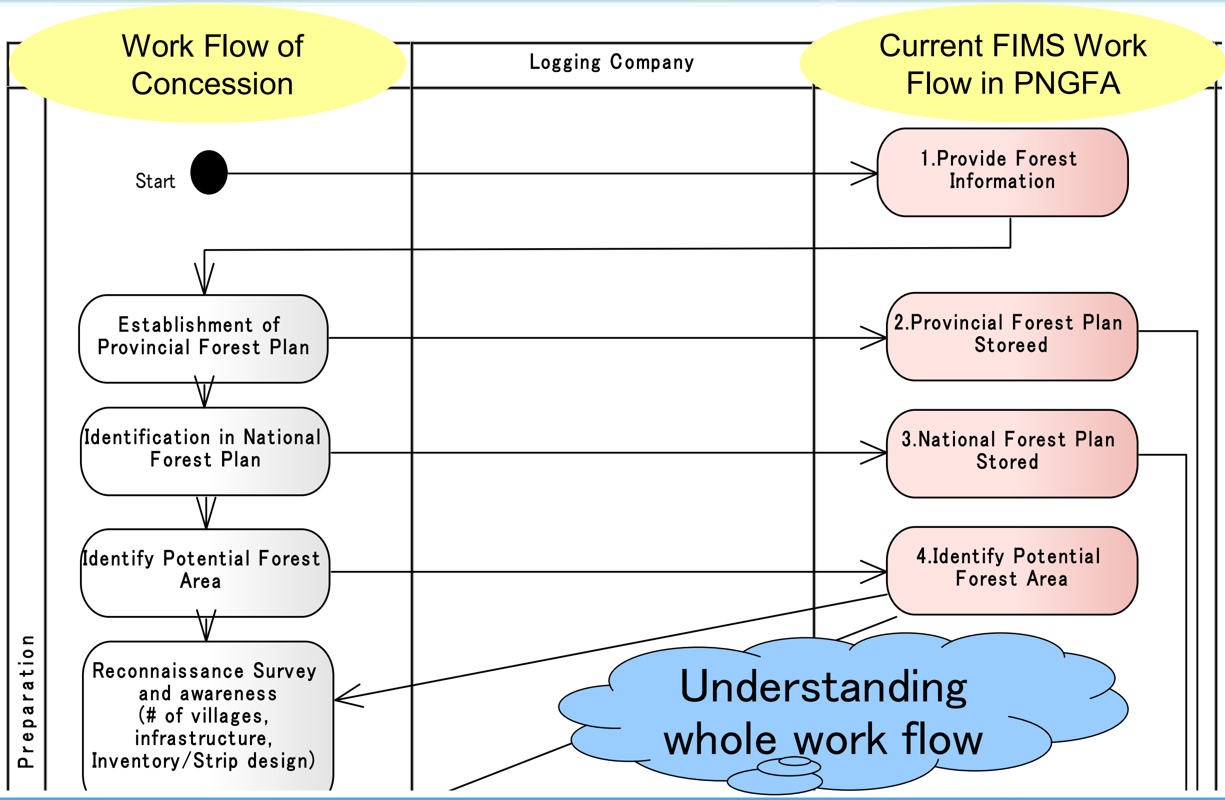


Development of Forest Inventory and Mapping System (FIMS)



- 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.

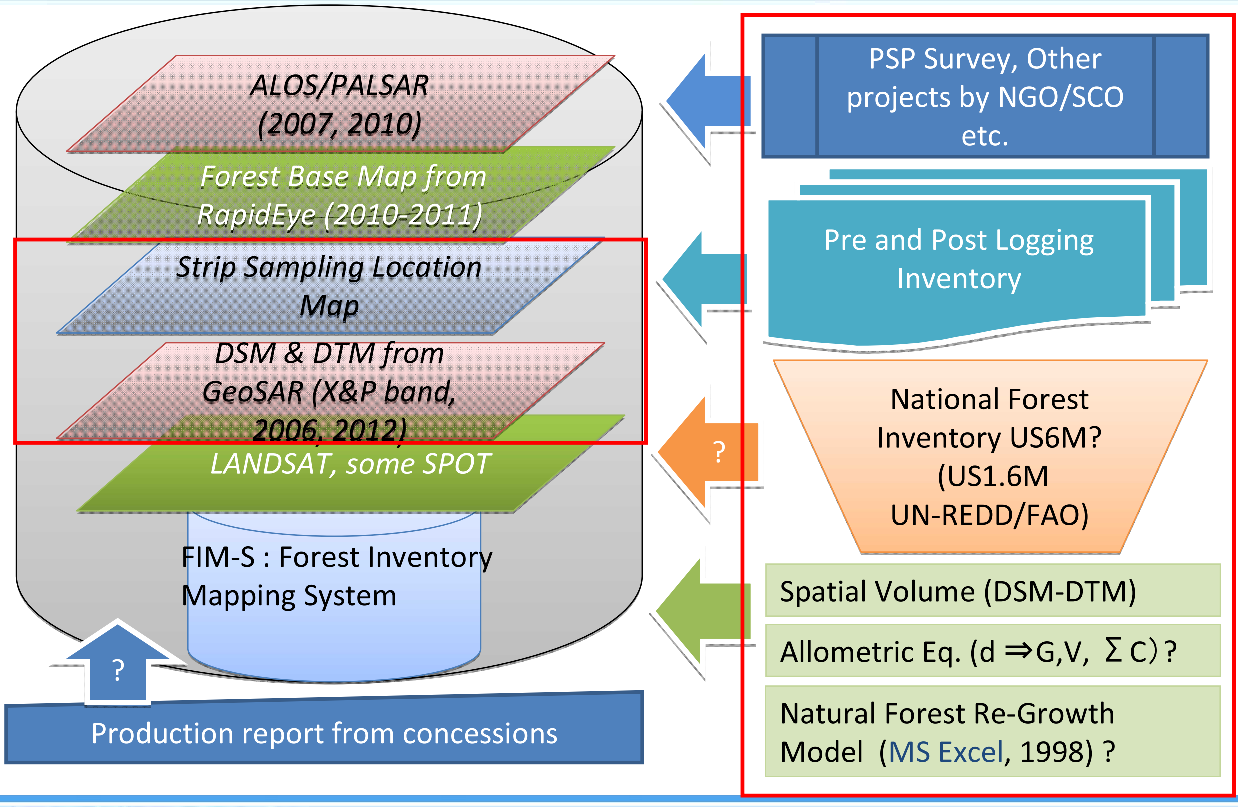
Sample of Work Breakdown 1



Sample of Work Breakdown 2

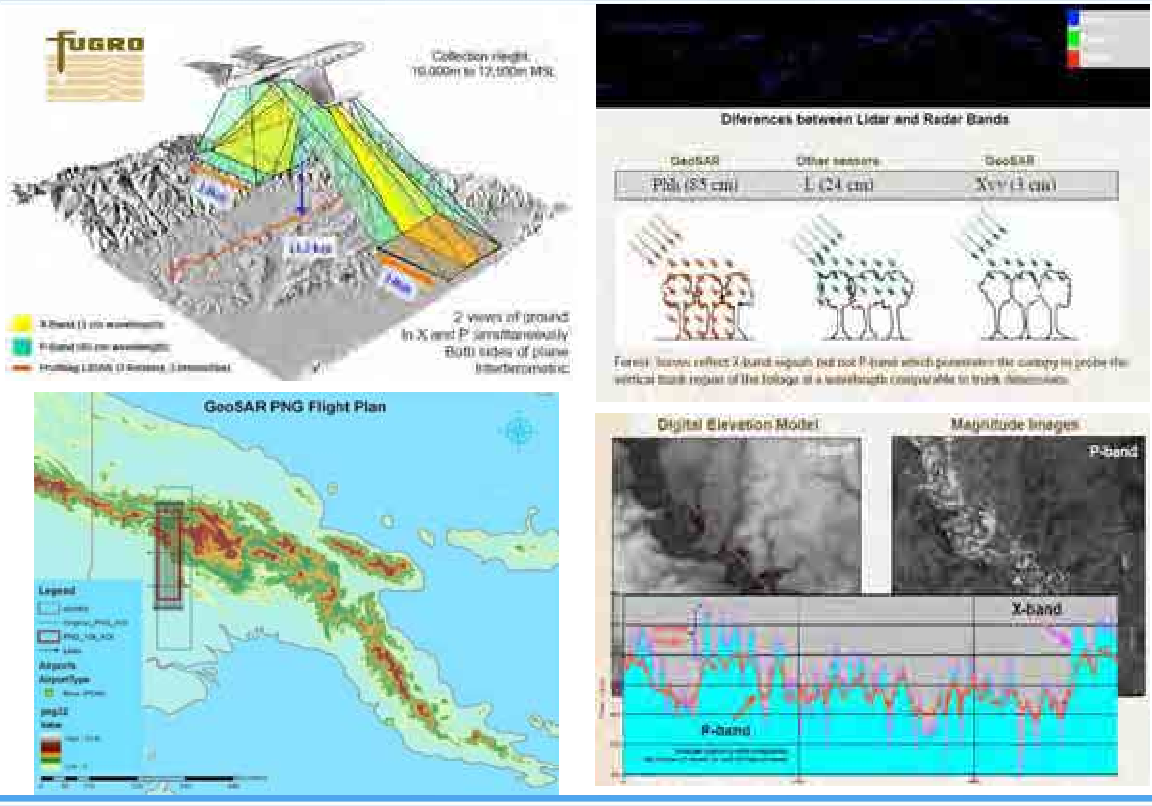
	No.	1	2	…
Use case (As Is)	Work	Sequence for Provide Forest Information (FIMS)	Sequence for Provincial Forest Plan	…
	Who	FIMS administrator to Senior Plan Supervisor	Senior Plan Supervisor	…
	When	Every five years (It takes a couple of hours each provinces)	Every five years based on Section 49 of Forestry 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



8. Carbon Stock Estimation

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



9. Capacity Building

Progress of Capacity Building Activity

Jul. — 1st JICA Consultants Assignment

Aug. — Basic RS/GIS Training (JICA-NET) ↔ Group RS/GIS Training in Japan

Sep. — Customized RS/GIS Training in Japan

Oct. — 2nd JICA Consultants Assignment

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)