

Remote Sensing Method in Implementing REDD+

FRIM-FFPRI Research on Development of Carbon Monitoring
Methodology for REDD+ in Malaysia

Remote Sensing Component

Mohd Azahari Faidi, Hamdan Omar, Khali Aziz Hamzah, Dr. Rahman Kassim,
Gen Takao, Yasumasa Hirata

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Project in Peninsular Malaysia**

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INSTITUT PENYELIDIKAN PERHUTANAN MALAYSIA
Forest Research Institute Malaysia

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Outline

- Introduction
- Objectives
- Study area and data
- Methodology
 - Remote sensing data processing
 - Ground truth data collection
 - Plotless sampling for biomass estimation
 - Field survey for remote sensing data classification
- Conclusion



Introduction

- REDD+ is a mechanism for providing financial rewards to countries that reduce carbon emissions caused by deforestation and forest degradation.
- Payments for avoided deforestation and forest degradation. Implementation requires comparison of actual forest change rates and the associated emissions, to a baseline.
- Remote sensing technology is expected to play a significant role as a transparent, replicable and long-term monitoring systems that needed for REDD+.
- This technology can be an essential data source, providing regular data that contribute to estimations of state and trends, including historical trends, of land use and carbon density in the landscape level.



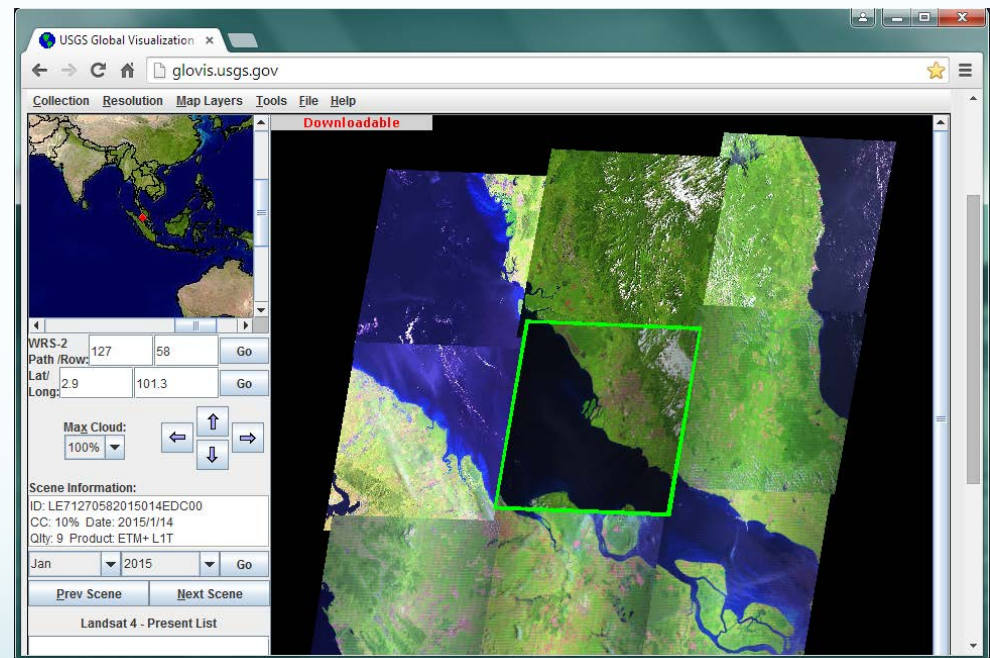
Objectives

- The aims of this component, through some technical image processing and sampling can be explained as follow:
 - Identify an appropriate method for landuse classification
 - Design an effective sampling scheme of the ground truth for classification
- These objectives is being supported by some remote sensing ground survey sampling, and images processing.

Study Area & Data

- Study area
 - 4 scenes of Landsat Images (Path 126–127, Row 057–058) over Peninsular Malaysia, covering Kelantan, Terengganu, Pahang, Johor, Melaka, Negeri Sembilan, Selangor and Perak.

- Data
 - USGS Landsat images
 - ~ 200 images taken in 1990 – 2010
 - Cloud $\leq 50\%$



<http://glovis.usgs.gov/>



www.frim.gov.my

- Ground truths

- ~ 100 field surveys
- ~ 500 Google Earth interpretation

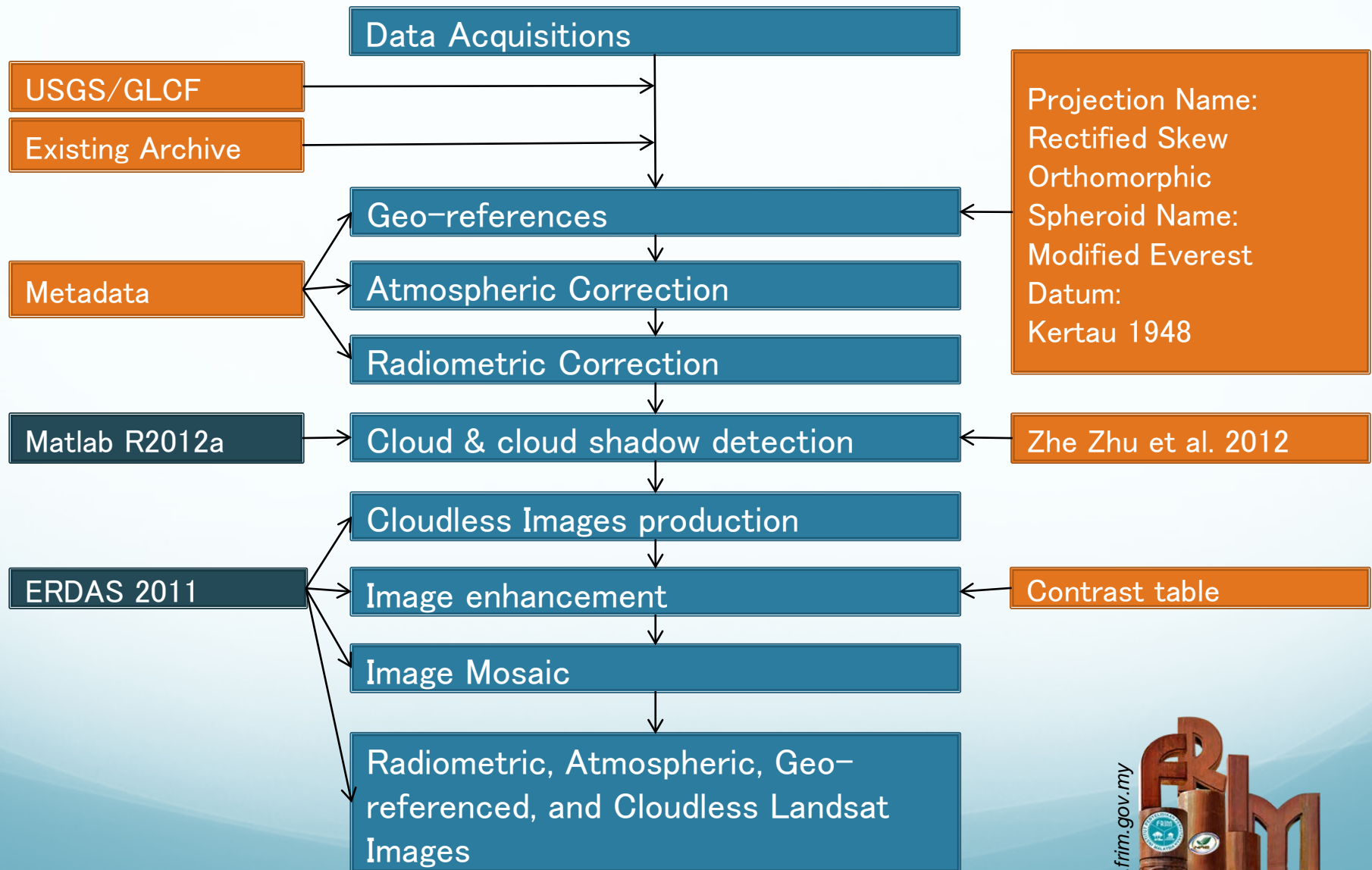
Methodology

Methodology : Remote Sensing data processing

- Raw data Landsat TM & ETM can be download freely from <http://glovis.usgs.gov/> – (.tiff format)
- Landsat data that provided 30m spatial resolution and 7 spectral bands is one of the most valuable datasets for studying landuse.
- Mostly covered by haze, cloud and cloud shadow especially in tropical area.
- Zhe Zhu et al. 2012 has successfully develop the Fmask algorithm to detect cloud and cloud shadow from Landsat Imagery.



- Data processing flow



Data Acquisitions

1990, 1992, 1996, 1998, 2000, 2002,
2004, 2006, 2008, 2010

Global Land Cover Facility
www.landcover.org
Landsat

About GLCF Research Data & Products Gallery Library Services Contact Site

Landsat Imagery

Data Access

- Download via Search and Preview Tool (ESDI)
- Download via FTP Server

Overview

Landsat (name indicating Land + Satellite) imagery is available since 1972 from six satellite Landsat series. These satellites have been a major component of NASA's Earth observation program, with three primary sensors evolving over thirty years: MSS (Multi-spectral Scanner) (Thematic Mapper), and ETM+ (Enhanced Thematic Mapper Plus). Landsat supplies high visible and infrared imagery, with thermal imagery and a panchromatic image also available from the ETM+ sensor. The collection of Landsat available through GLCF is designed to complement project goals of distributing a global, multi-temporal, multi-spectral and multi-resolution range of imagery appropriate for land cover analysis.

Sensor

Satellite	Sensor	Band#s	Spectral Range
L 1-4	MSS multi-spectral	1,2,3,4	0.5 - 1.1 μ m
L 4-5	TM multi-spectral	1,2,3,4,5,7	0.45 - 2.35 μ m
L 4-5	TM thermal	6	10.40 - 12.50 μ m
L 7	ETM+ multi-spectral	1,2,3,4,5,7	0.450 - 2.35 μ m
L 7	ETM+ thermal	6,1, 6,2	10.40 - 12.50 μ m
Panchromatic	ETM+ thermal	8	0.52 - 0.90 μ m

How to Cite This Data Set

Citation Format: Author (Publication Date), Collection Name, Image Name, Processing Level, Product Coverage Date.

コンピュータ -> HDV-UT (L) -> LandsatETM

ライブラリに追加 共有 書き込み 新しいフォルダー

名前	更新日時	種類	サイズ
LE71260571999251EDC00.targz	2012/06/06 14:00	WinRAR archive	285,959 KB
LE71260572000094EDC00.targz	2012/06/07 9:19	WinRAR archive	262,061 KB
LE71260572001160DK10.targz	2012/07/03 14:28	WinRAR archive	275,001 KB
LE71260572003054SCS01.targz	2012/06/07 11:41	WinRAR archive	275,995 KB
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LE71260572005057SED00.targz	2012/06/06 16:37	WinRAR archive	245,855 KB
LE71260572005091DK100.targz	2012/06/06 16:46	WinRAR archive	234,048 KB
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LE71260572009182SCS00.targz	2012/01/21 10:38	WinRAR archive	232,375 KB
LE71260572009230EDC00.targz	2012/01/21 10:39	WinRAR archive	233,665 KB

115 個の項目

USGS
science for a changing world

Earth Resources Observation and Science Center (EROS)

USGS Global Visualization Viewer

Collection Resolution Map Layers Tools File Help

Downloadable

WRS-2 Path/Row: 126 57 Go
Lat/Long: 4.3 103.2 Go

Max Cloud: 100% [up/down/left/right arrows]

Scene Information:
ID: LE71260572000190SGS00
CC: 4% Date: 2000/7/8
Qty: 9 Product: ETM+ L1T

Jul 2000 Go

Prev Scene Next Scene

L4-7 Combined Scene List

Add Delete Send to Cart

1000m No Limits Set

USGS

Quick Start Guide	User Guide	What's New!
Browser Requirements	Download Source Code	About Browse Images

Cover, Orthorectified, Terrain
(convention)
58_05820031026, SLC-Off, USGS,

Total Landsat image (200):

- 126_057: 47
- 126_058: 48
- 127_057: 52
- 127_058: 53

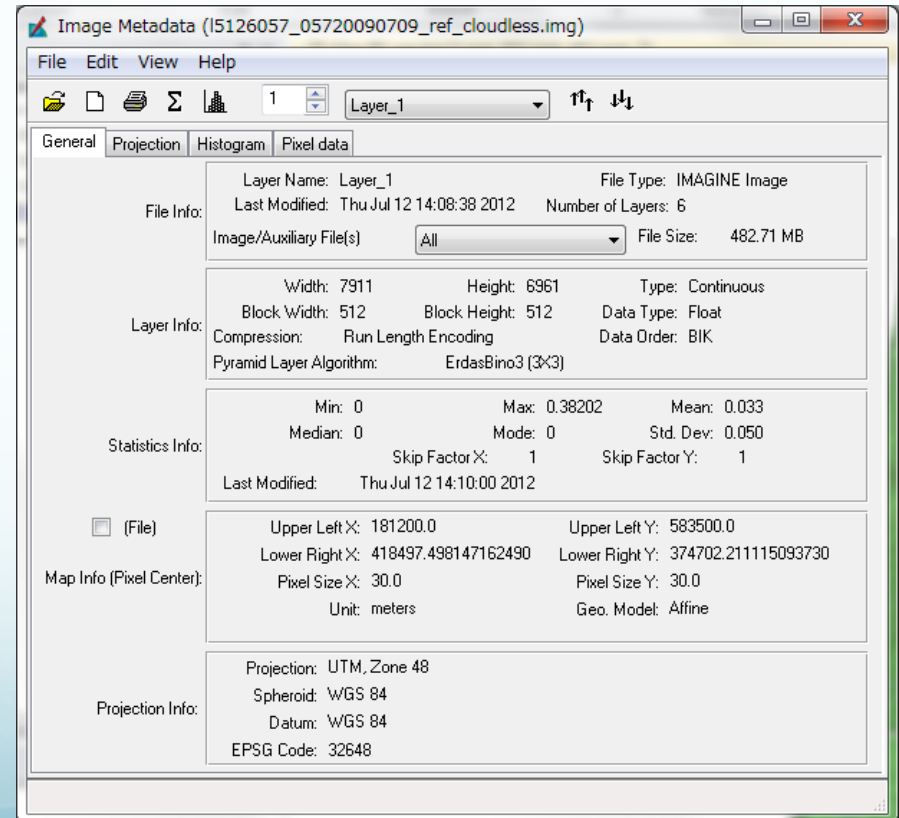
Geo-references image

Basically all the data from USGS & GLCF is already geo-referenced to standard world projection:

- Projection name: Universal Transverse Mercator (UTM)
- Spheroid name: WGS 84
- Datum name: WGS 84

Standard Peninsular Malaysia projection:

- Projection name: Rectified Skew Orthomorphic (RSO)
- Spheroid name: Modified Everest
- Datum name: Kertau 1948

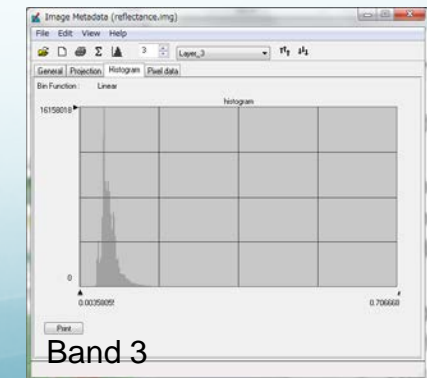
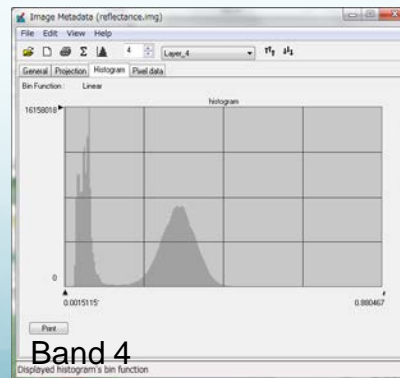
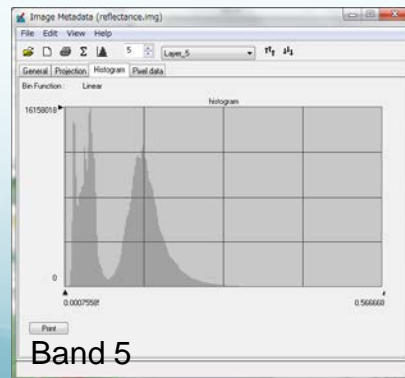
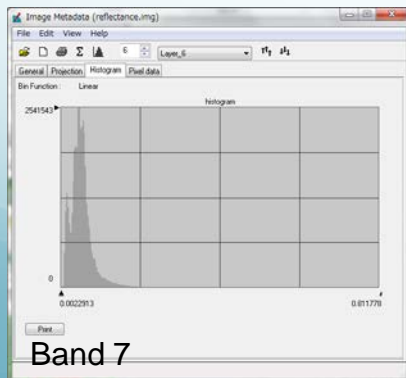
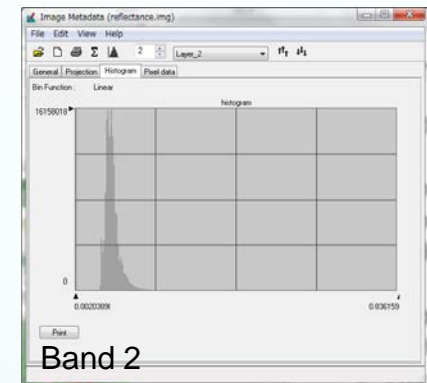
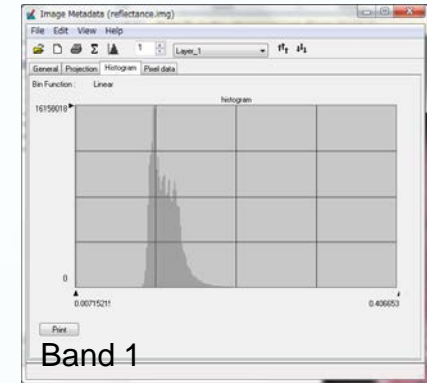


Raw Metadata

Radiometric & Atmospheric correction

Using method that has been established by Sergio M.V. et al 2008

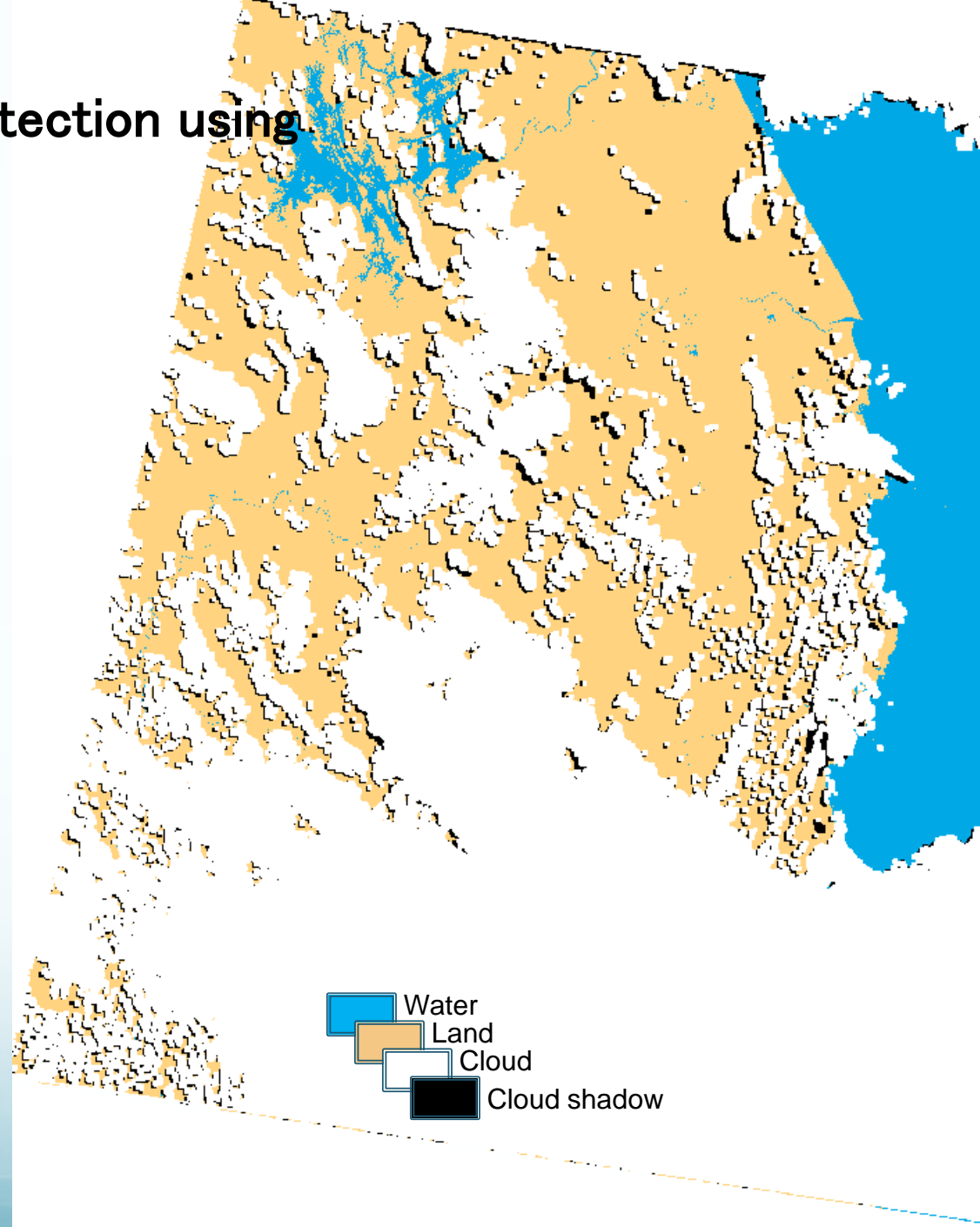
- Radiometric correction
 - Conversion DN to satellite radiances
 - Radiances to TOA reflectance
- Atmospheric correction
 - Dark Target Approach (DTA)
 - Lhaze from minimum radiances value



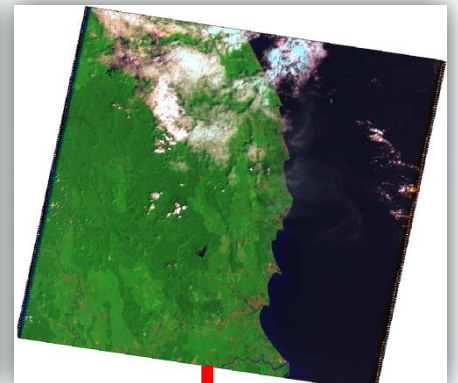
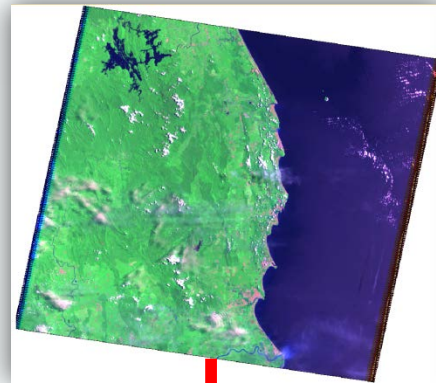
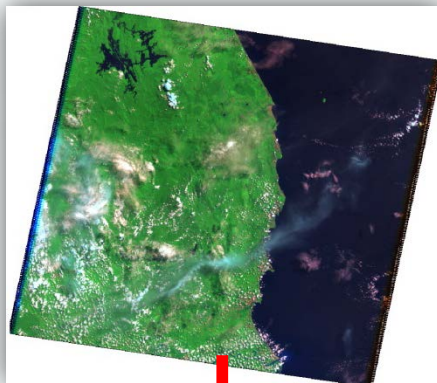
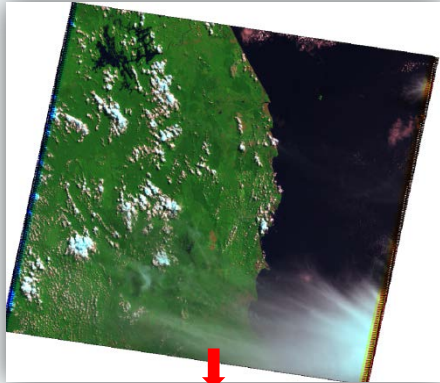
Cloud and cloud shadow detection using Matlab

Using Object-based cloud and cloud shadow detection by Zhe Zhu et al. 2012:

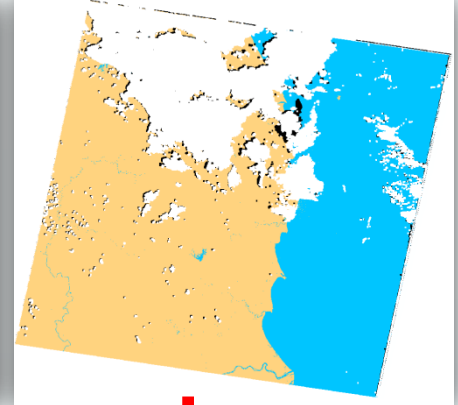
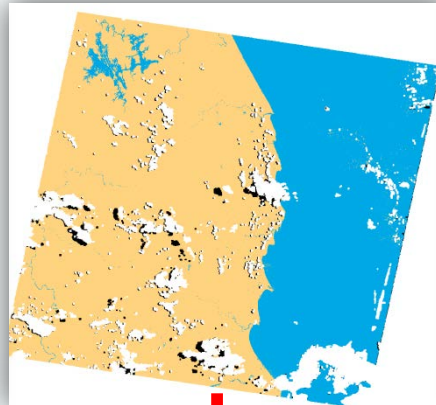
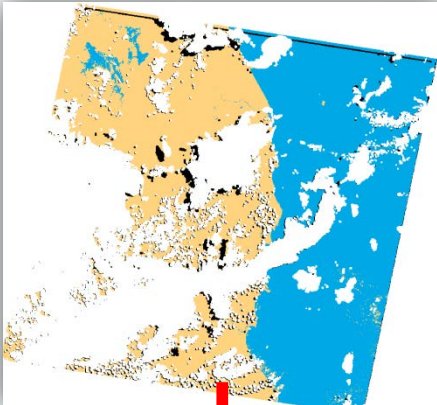
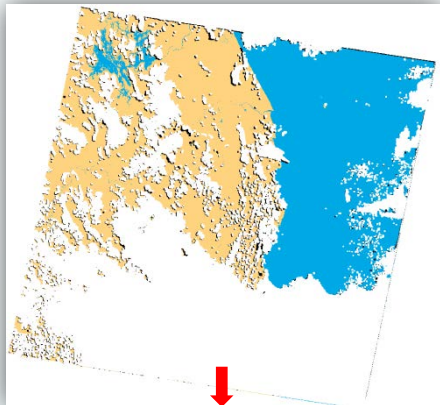
- Fmask algorithm
 - Potential cloud layer
 - Potential cloud shadow layer
- Buffer surrounding cloud and cloud shadow, 3 pixel (90m)



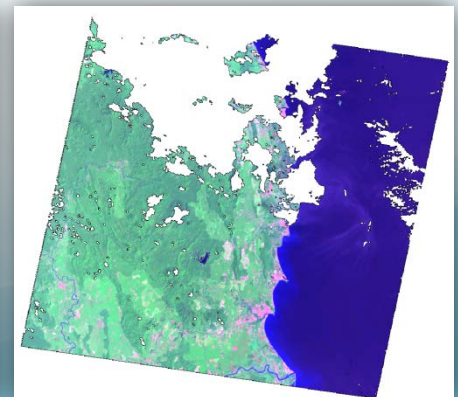
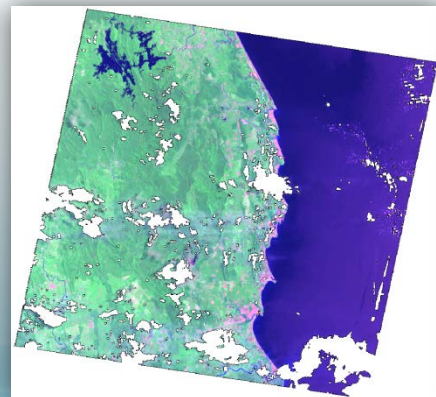
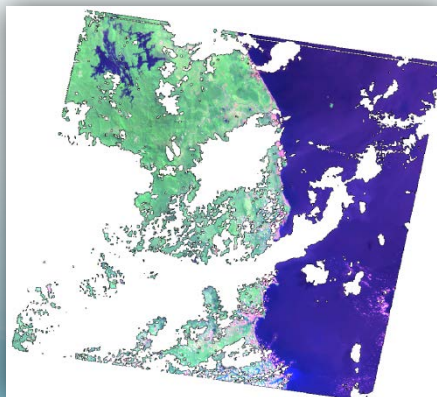
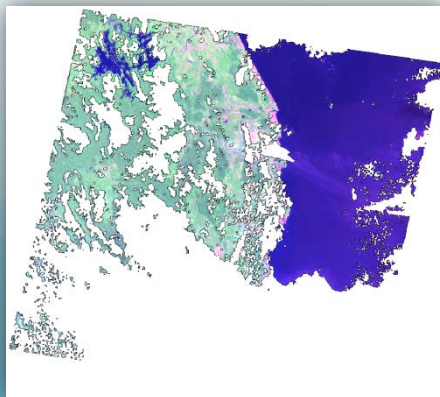
Landsat TM image (126_057)



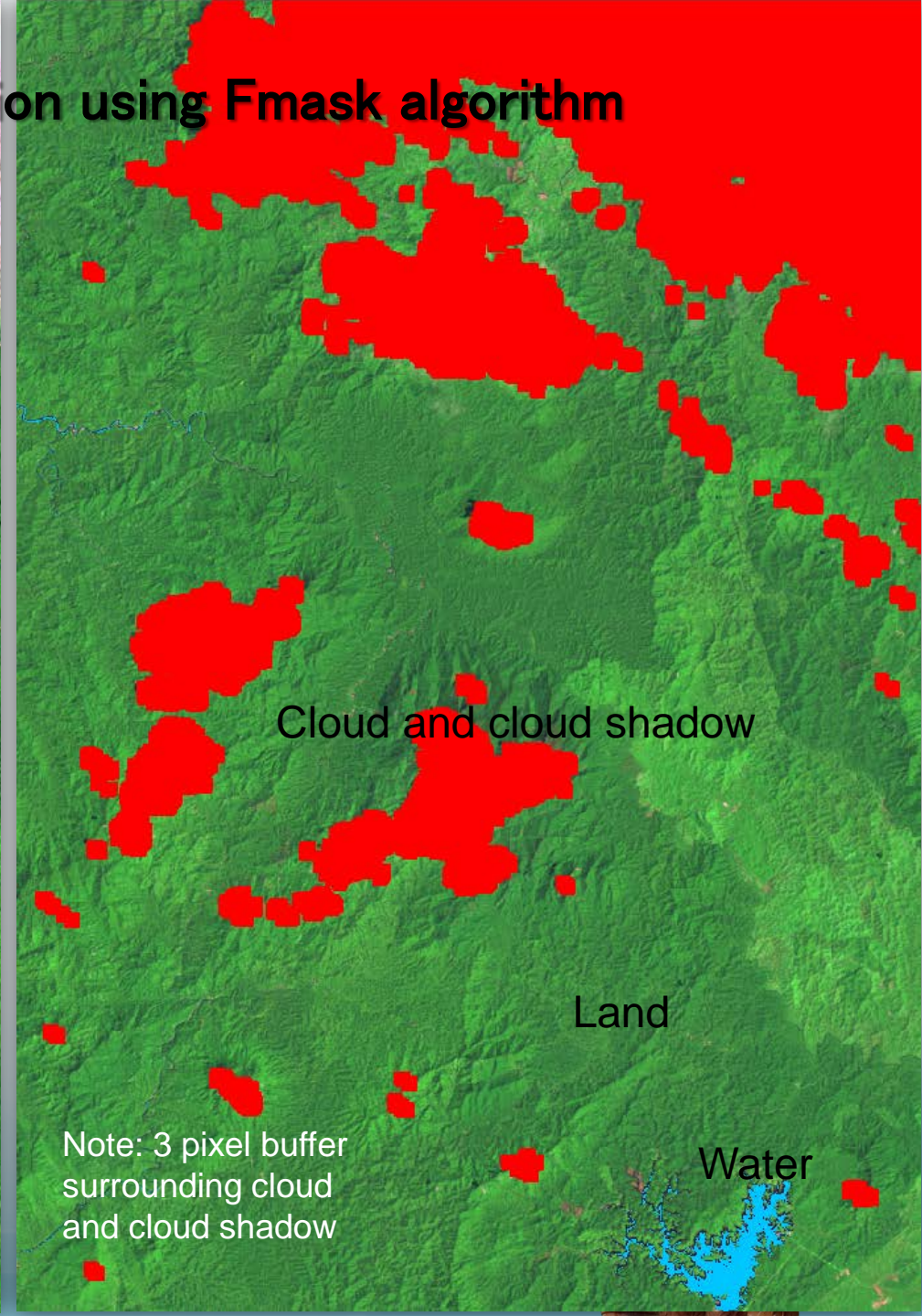
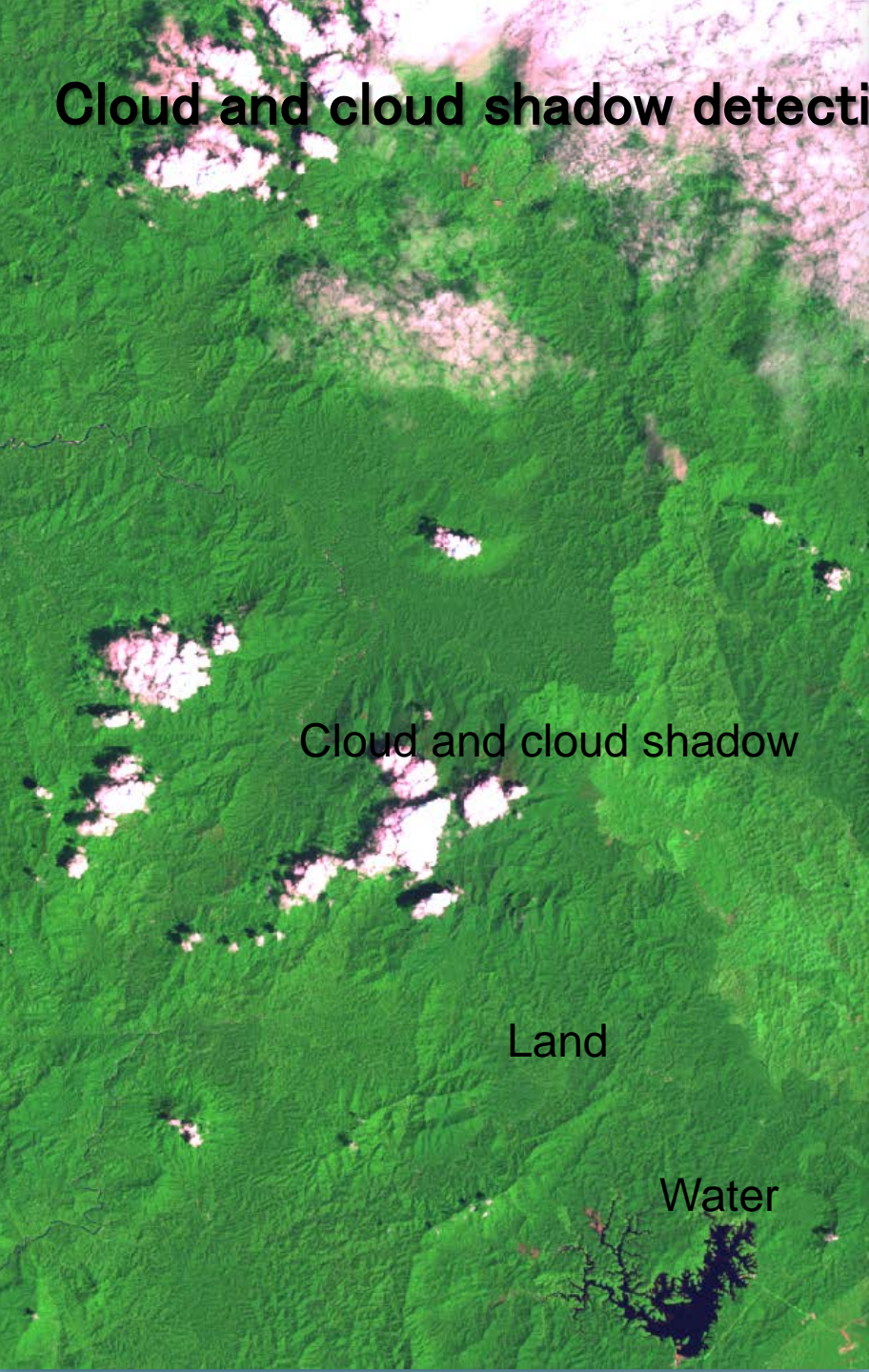
Shadow and cloud shadow layer



Cloudless, geocode, radiometric and atmospheric corrected image




Cloud and cloud shadow detection using Fmask algorithm

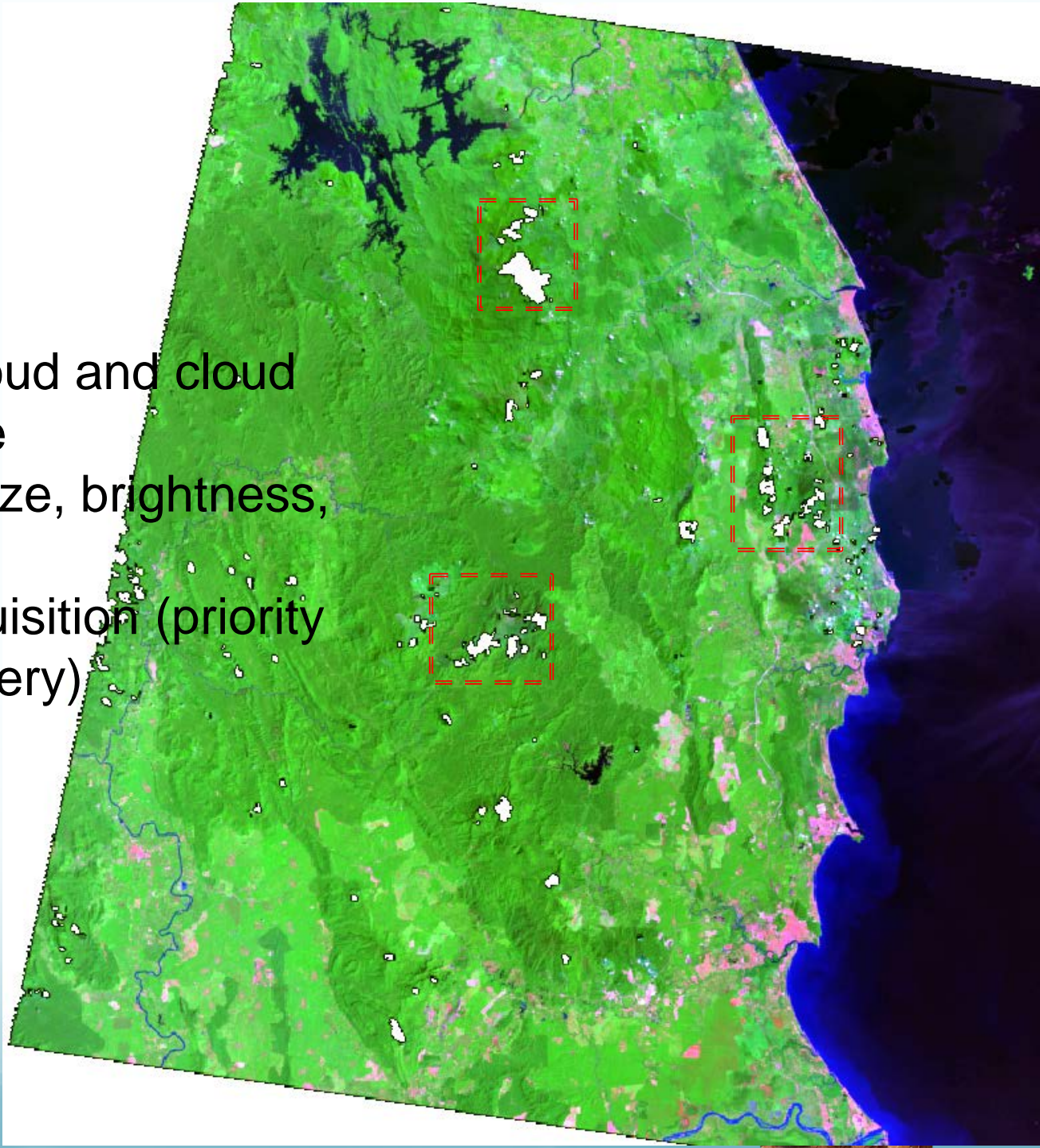


Mosaic Image

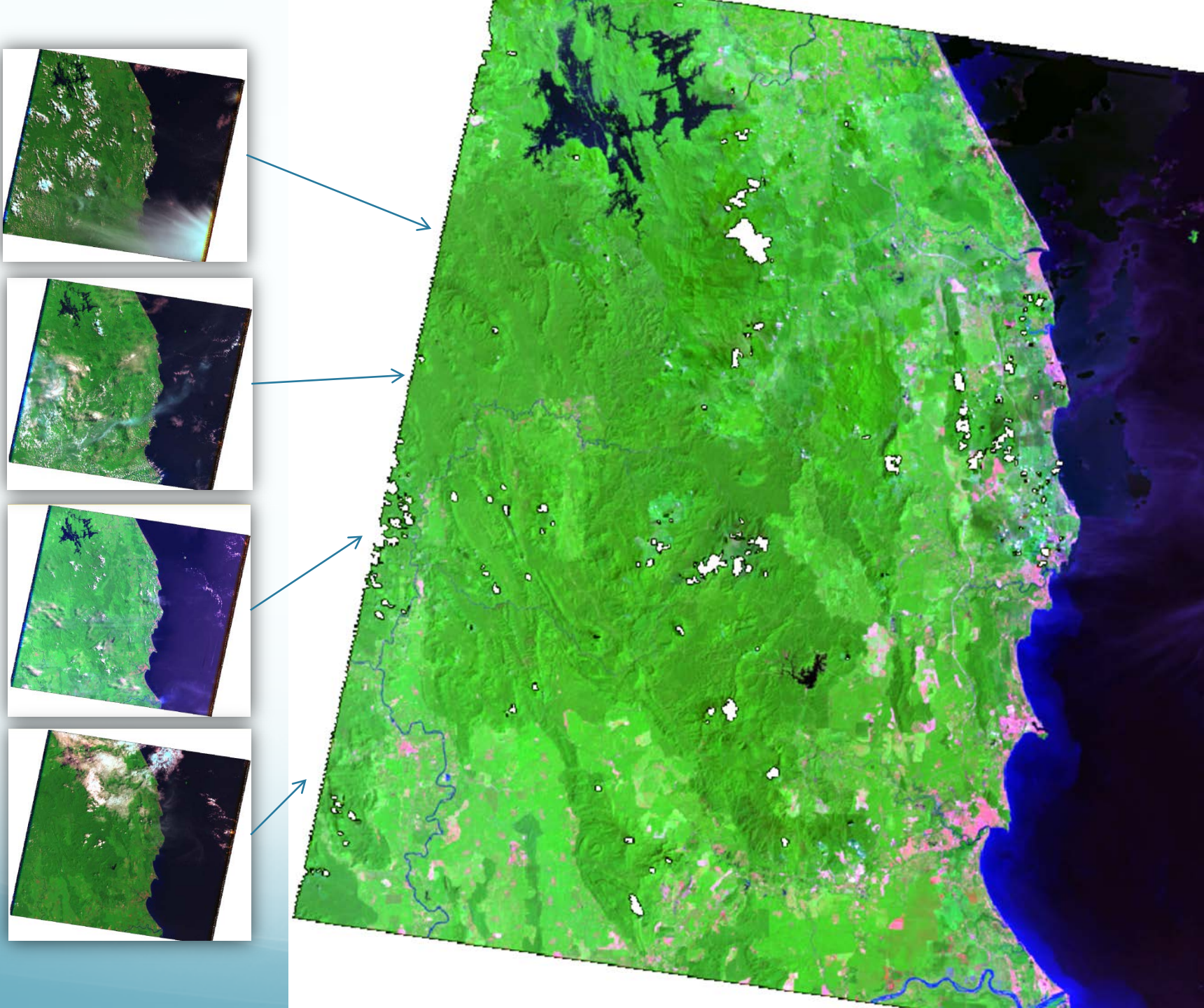
Selection Criteria:

1. Percentage of cloud and cloud shadow coverage
2. Image quality (haze, brightness, etc.,)
3. Date of data acquisition (priority to the latest imagery)

 **Note: No data (cloud and shadow detected on all scenes)**

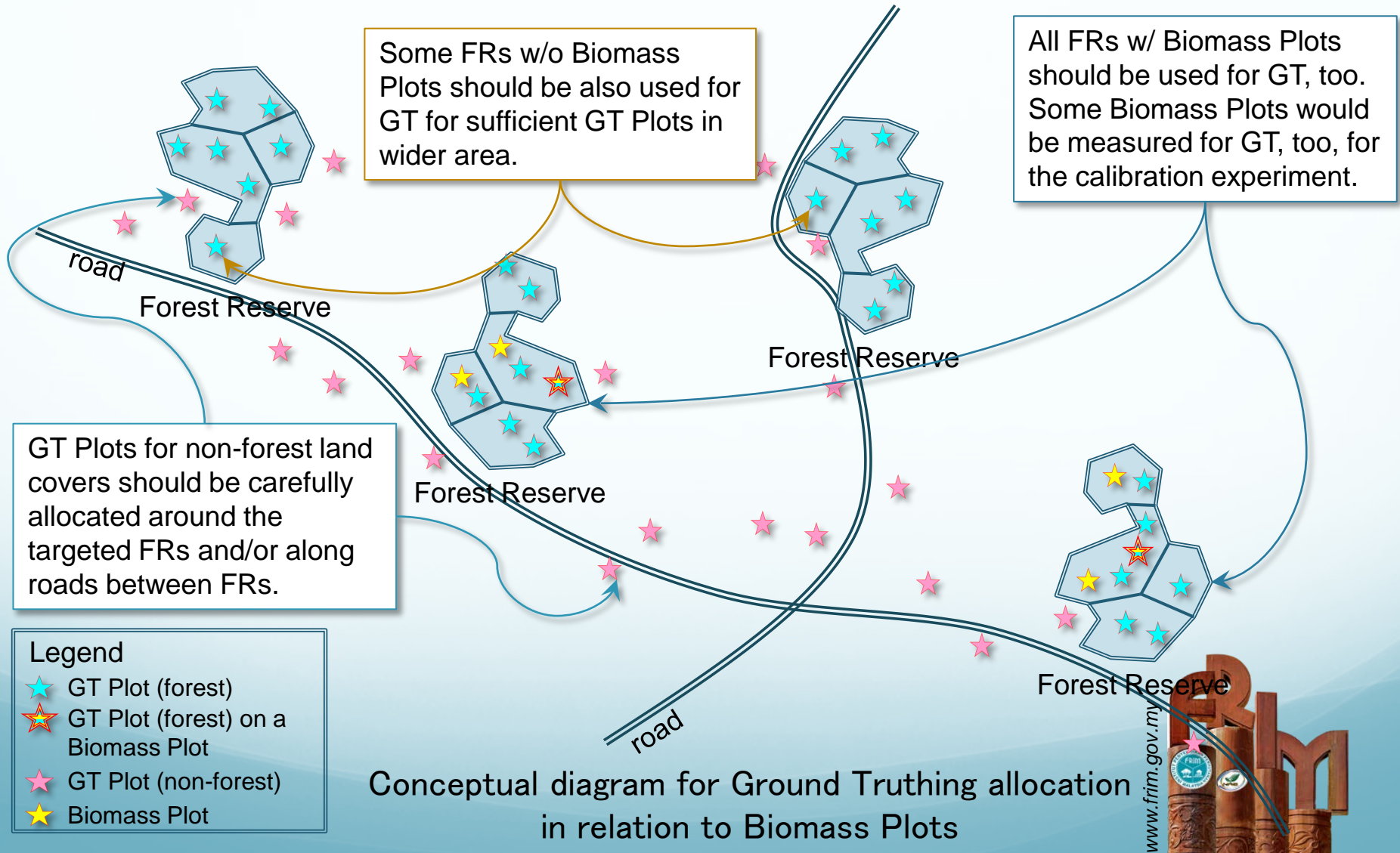


Radiometric, Atmospheric, Geo-referenced, and Cloudless Landsat Images



Methodology : Ground truth data for biomass estimation

- Using Prism method for forest inventory activity



Main activities during forest survey

1. Measurement of the positioning data of the plots by using GPS
2. Observation of the forest type
3. Identification of the dominant species
4. Measurement of the total basal area by applying Prism method
5. Measurement of DBH and total height
6. Taking photographs of the forest condition



Field Note for Plotting Sampling (2011-2012)			
Plot ID		Date	
P-01-01-01-01		2012-01-01	
Location	Non-forested	Disturbed area: 10 m	
Forest Type	Disturbed Logged area	Disturbed more than 10 y	
Forest Reserve		Province	
Surveyors		Observer	
Coordinates of Plotting		Coordinates of Plotting	
Lat	1° 52' 0.0"	Long	103° 50' 0.0"
Departure Time	12:00	Arrival Time	
Coordinates of Plot		Coordinates of Plot	
Lat	1° 52' 0.0"	Long	103° 50' 0.0"
Start Time		End Time	



Procedure of the survey

1. Measurement of the positioning data of the plots by using GPS:
 - Position at the center of the plot (using GPS)
 - Slope direction and inclination (using Clinometers)

2. Observation of the forest type
 - ①. Mangrove forest
 - ②. Peat swamp forest
 - ③. Low land forest
 - ④. Hill forest

3. Identification of the tree species
 - Dominant tree species (local name if possible)
 - “Dipterocarp” or “Non Dipterocarp” (at least)



4. Measurement of the tree:

- Counts trees by Bitterlich/Prism method

5. Measurement of DBH

- Measure DBH (at the height of 1.3m)
- ✂ All trees that have been counted in Bitterlich/Prism method.

6. Taking photographs of the forest condition

- Photos toward 4 directions (N-E-S-W) and Vertically above
- Photos from a proper position where the plot can be overlooked



Advantages of plotless sampling

- The cost is lower
- Data collection is faster
- Easily planned
- It gives better estimates of the mean than unrestricted random



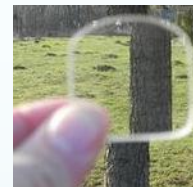
GPS



Vertex transponder



Dbh Tape



Prism

Equipments for field survey

Ground truths data for remote sensing classification

- Ground truth is a term used in remote sensing; it refers to information collected on location.
- Ground truth allows image data to be related to real features and materials on the ground.
- The collection of ground-truth data enables calibration of remote-sensing data, and aids in the interpretation and analysis of what is being sensed.



Ground truths data for remote sensing classification

There are many methods to get the ground truth data for remote sensing classification. For example,

- Field work activity
 - Interpretation from higher resolution images (aerial photo, Google earth images)
 - From current reference data(forest map, vegetation map, etc.)
-
- The field work for ground truth data collection requires representative samples, and photos should tell the story of the selected landuse



Collecting ground truth data from Google Earth

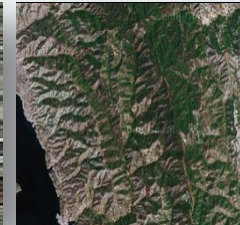
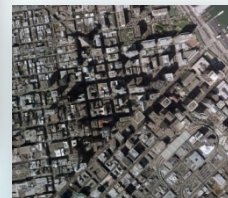
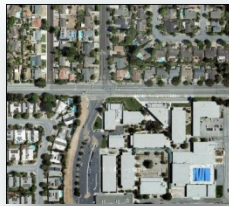
- Since field survey is time consuming and needs much budget, GE can be considered another complementary product for remote sensing analysis,
- The high spatial resolution images released from GE, as a free and open data source, have provided great supports for the traditional land use mapping.
- Can be treated as ancillary data to collect the training or testing samples for land use classification and validation or used as a visualization tool for land use maps.

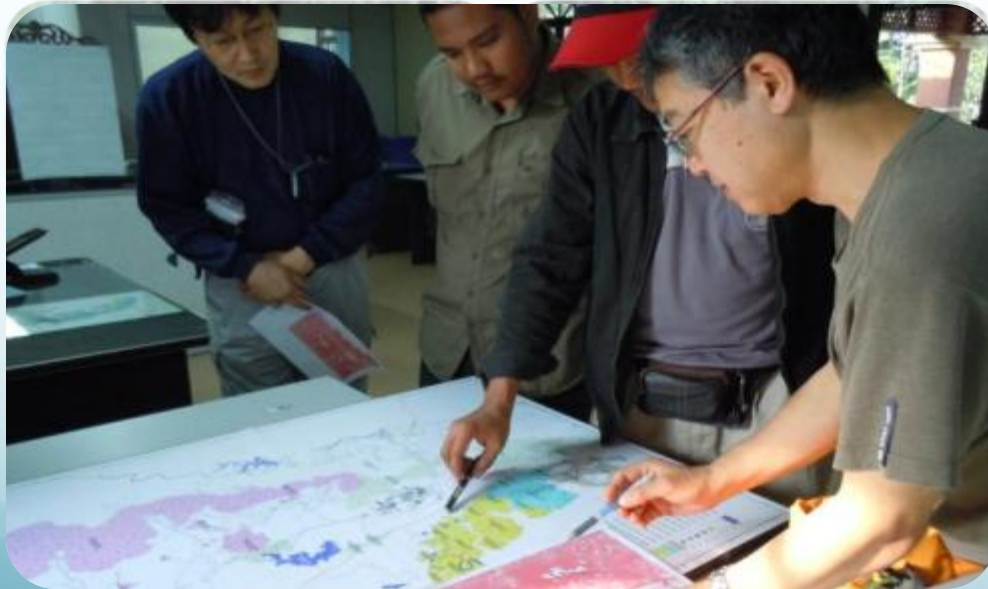


Collecting ground truth data from Google Earth

There are several clues can be use to help for interpret images in GE:

- Shape
- Size
- Pattern
- Tone and Color
- Shadow





CONCLUSION

This project component explore some technical image processing and sampling that can help in interpretation and analysis of remote sensing data that can help for implementing REDD+.

THANK YOU

