Multi-Temporal Landsat Images Classification and Change Analysis of Land Cover in Urban Areas

Master's Thesis Defense
23 August 2012

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Outline

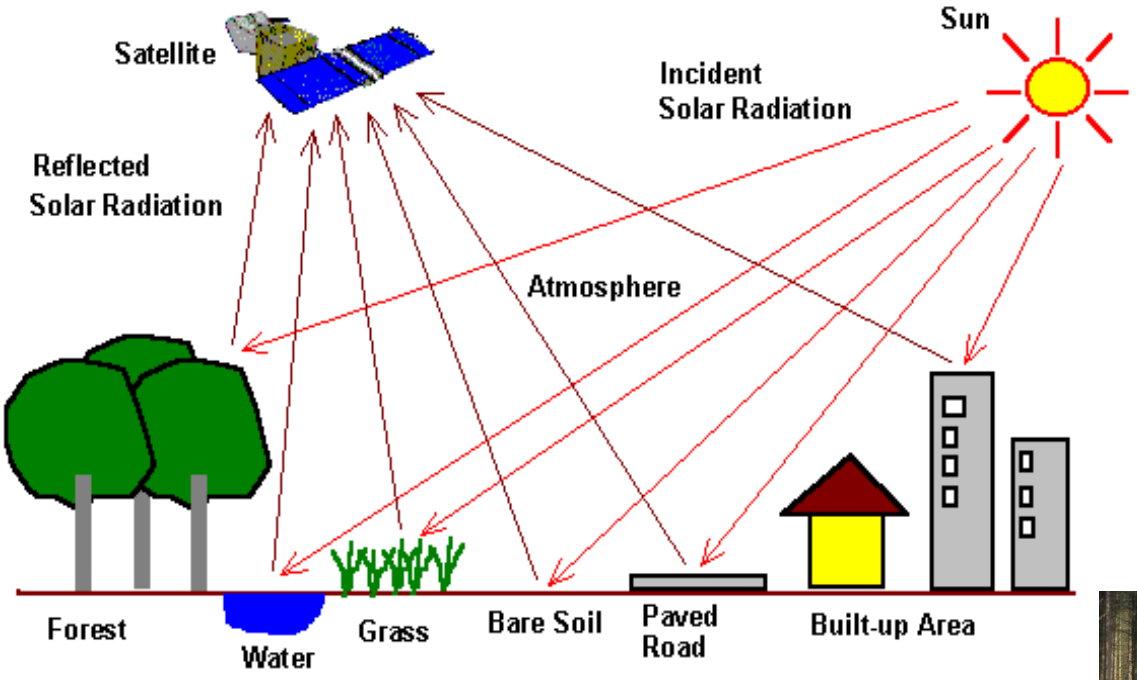
- Introduction
- Aim and Purpose

- Study Area- Hino City
  - Data Acquisition
  - Image Classification

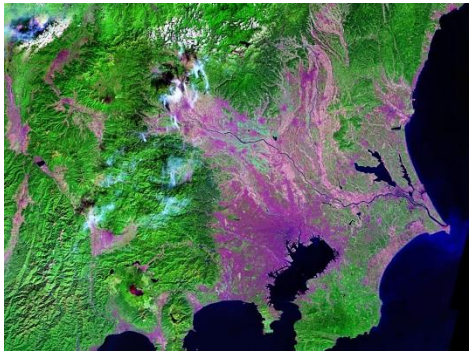
- Study Area-Mandalay city

- Evaluations & Conclusions

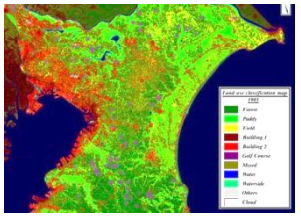
What is remote sensing?



Principle of RS



Satellite Images cover larger area



Applications

Introduction

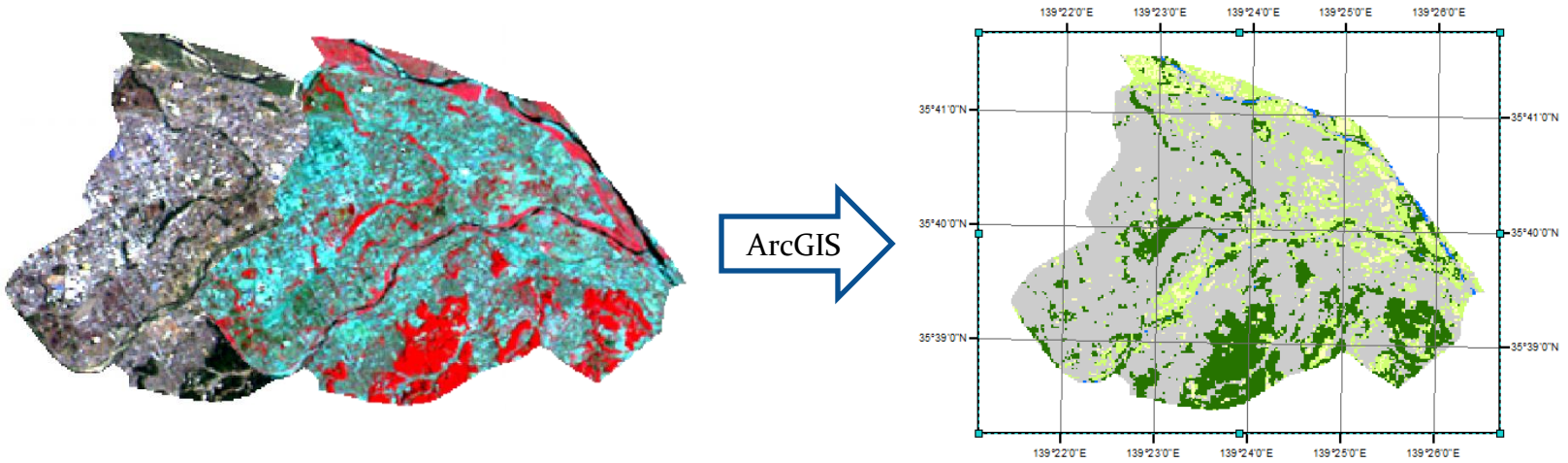
- Land cover dynamics alter the availability of different biophysical resources _ soil, vegetation, water and others.

- Satellite images -> accurate mapping & make landscape features and infrastructures .

- Geographic Information System (GIS) -> providing new tools for advanced ecosystem management.

ArcGIS

- A geographic information system (GIS) for working with maps and geographic information.
  - Satellite Imagery >> improve and faster analyzing geographically information.



Aim and Purpose

- to evaluate land cover & to analyze the change detection

  (RS Images analyzed by ArcGIS)

- *intended to provide the accurate evaluation for managing natural resources and monitoring environmental changes.*

Block Diagram of Study Analysis

Image Acquisition

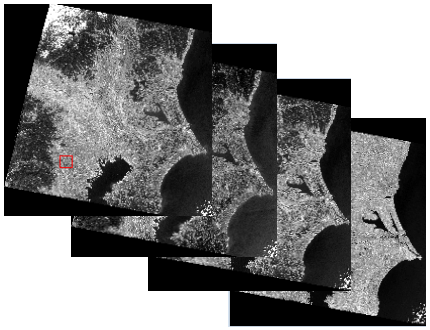
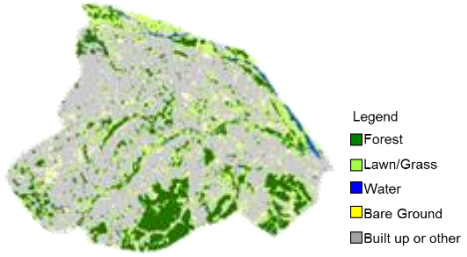
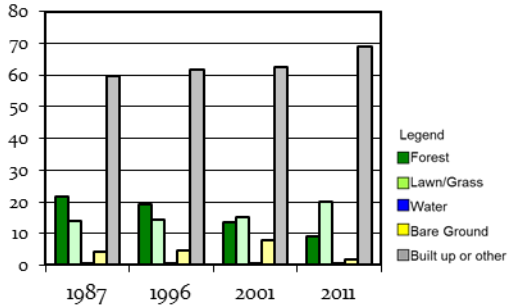


Image Classification



Analysis of Change Detection



Recent Studies on Land cover

- Per-field classifier has shown to be effective for improving classification accuracy (Lloyd *et al. 2007*)
  - impact of the mixed pixel problem
- Neural network approach (Atkinson et al., 2009)
  - Not satisfied to shadows caused by topography
- Object-oriented classification approaches (Tanmoy Das, 2010)
  - still noticeable some misinterpreted classes

Classification approach

- Multi-temporal images *
- Colour composite *
- Training Pixels by Knowledge based approach *

Study Area-1

Hino City Area= 27.53 km^2

Hino City in Western part of Tokyo Region

Multi-temporal Images

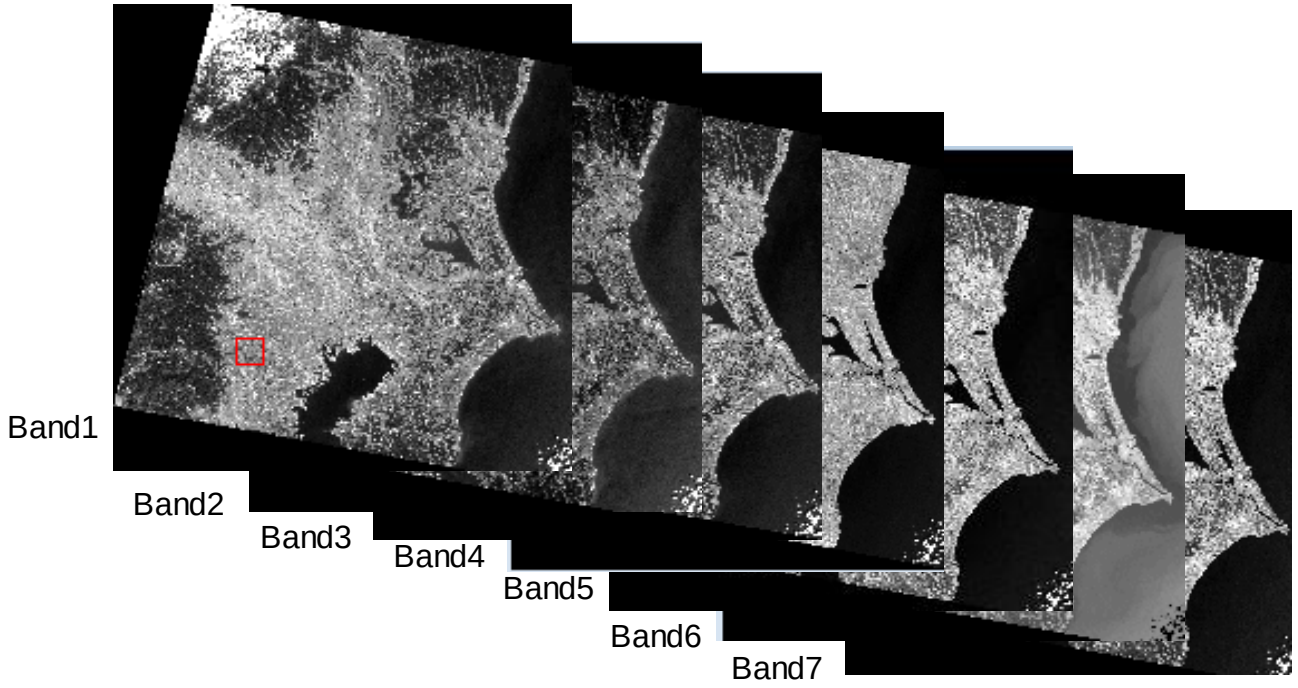
Data Source

No.	Data Type	Date of Production	Resolution	Source
1.	Landsat image (Hino city)	1987/5/21	30m™	USGS*
2.	Landsat image (Hino city)	1996/4/27	30m^{TM}	
3.	Landsat image (Hino city)	2001/4/1	30m^{ETM+}	
4.	Landsat image (Hino city)	2011/4/5	30m^{TM}	
5.	GIS Map of Hino City (IKONOS data-1m)	2008/9/9	1:56,424 (view scale)	Hino City

Knowledge for training pixel

*United State Geological Survey
TM- Thematic Mapper
ETM-Enhanced Thematic Mapper

Landsat Image

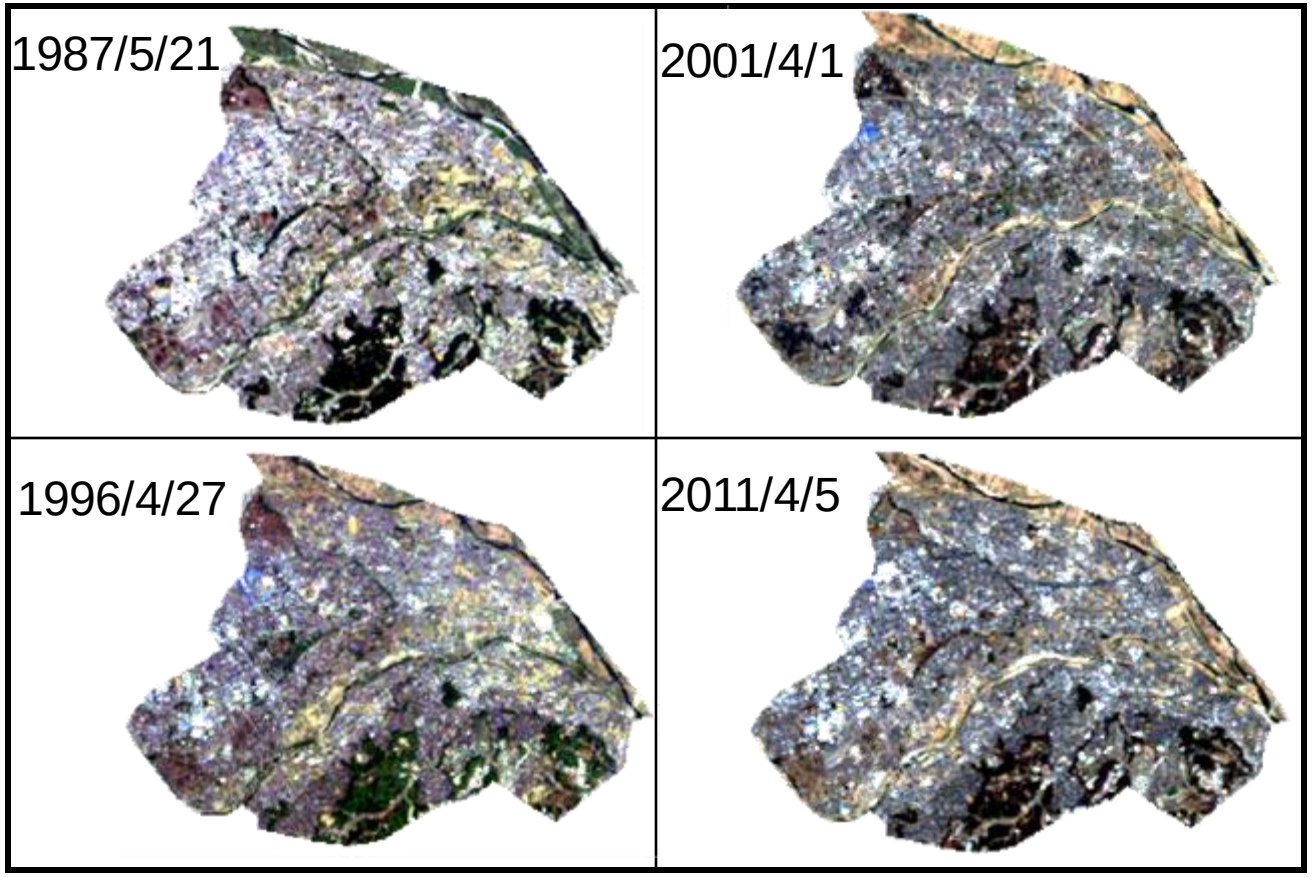


Pixel values –
0(Black)~255(White)

7 bands of Landsat Image (Tokyo Region)

1)Blue (0.45-0.52µm)
2)Green (0.52-0.60µm)
3)Red (0.63-0.69µm)
4)Near Infrared (NIR) (0.76-0.90µm)
5)Intermediate Infrared (1.55-1.75µm)
6)Thermal (10.4-12.5µm)
7)Intermediate infrared (2.08-2.35µm)

Visual RGB Composite

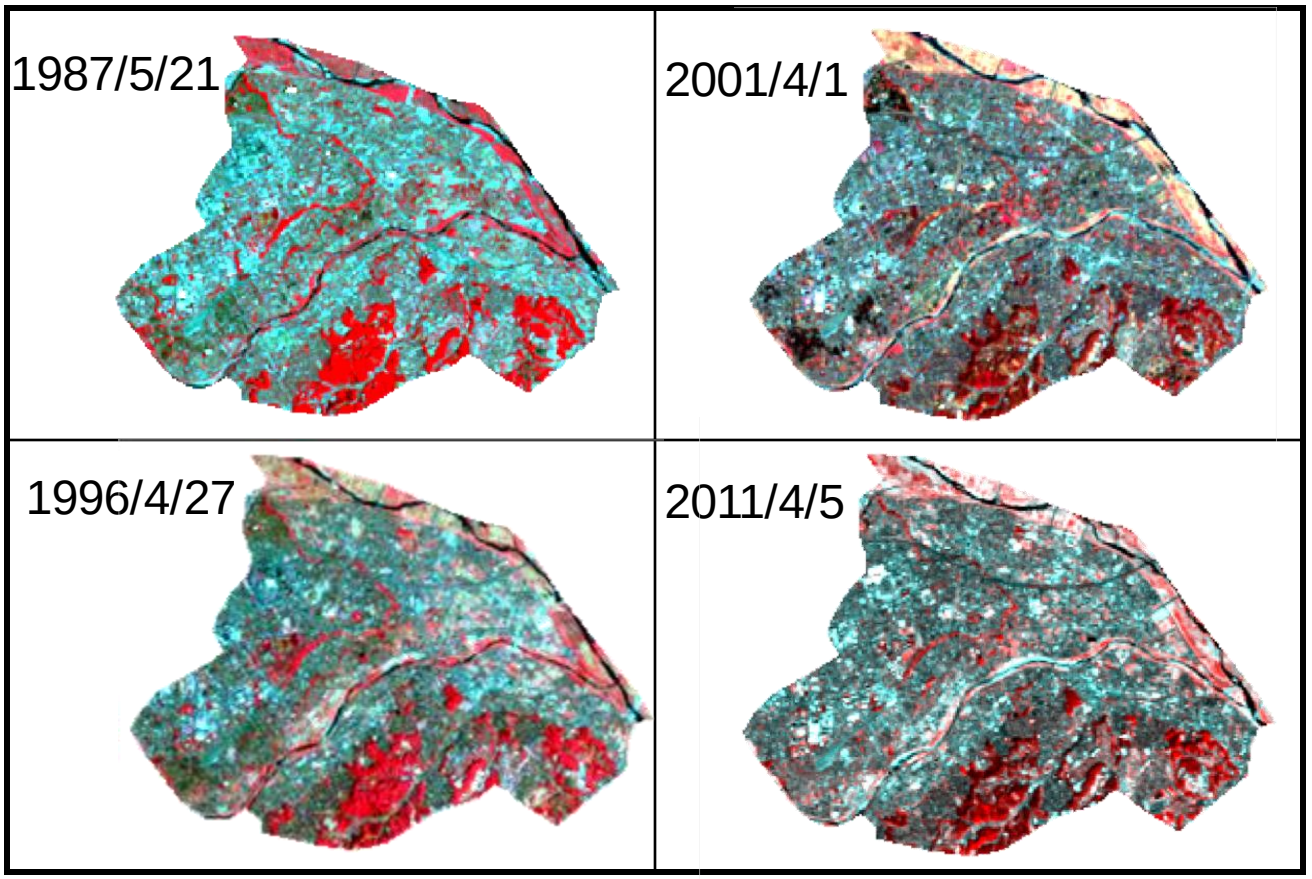


-Red band -> Red
-Green band -> Green
-Blue band - > Blue

- Used to classify type of ground

Landsat Images of Hino City

Near Infrared Composite



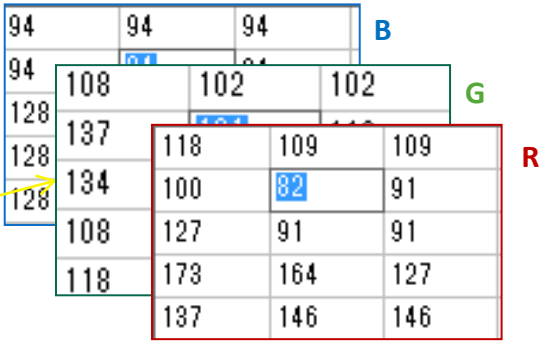
-near Infrared Band -> Red
-Red band -> Green
-Green band -> Blue

- Used to classify vegetation and water.

Images of Hino City

Pixels in Composite Image

1987/5/21 RGB Visual Composite



Pixel values in RGB visual Composite

Pixel values in a band – 0(Black)~255(White)

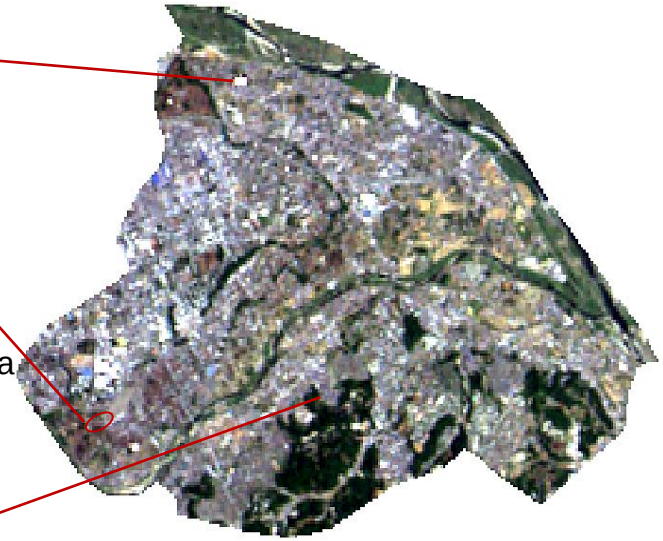
Total no. of Pixels in each band for Hino City – 30466 pixels

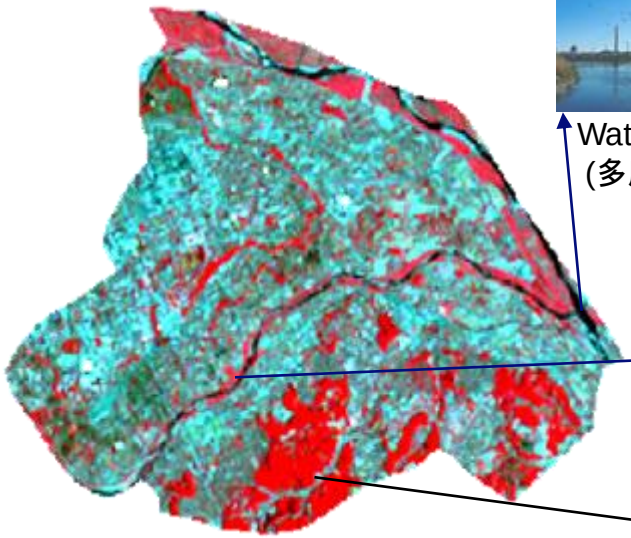
Training Pixels by Knowledge based

Bare Ground

Concrete based area
(豊田車両センター)

Built-up (南平)





Water
(多摩川　四谷橋付近)

Lawn/grass
(浅川)

Forest (高幡教会付近)

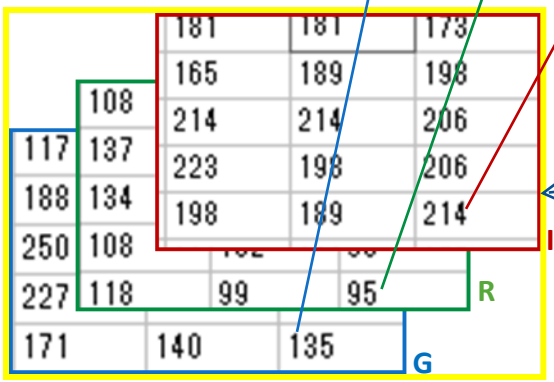
Land Cover Categories	No. of training pixels
Forest	121 pixels
Lawn/Grass	9 pixels
Water	23 pixels
Bare Ground	4 pixels
Built-up/other Land	44 pixels

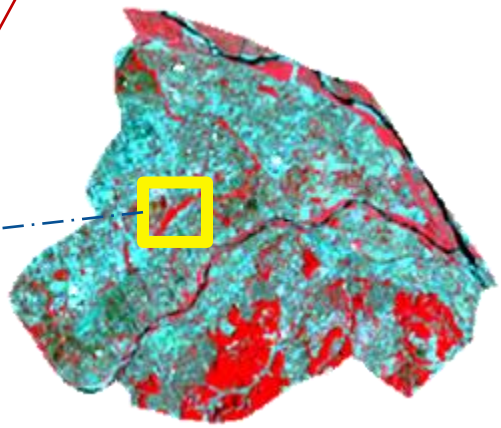
Select **Pixels** Known Locations from Knowledge based on Hino City GIS data.

Classify the Image

Deciding the range of Training Pixels value

Land Cover	Mini ~ Maxi pixel value			Mean		
	Green	**Red**	**NIR**	**Green**	**Red**	**NIR**
Forest	**85~135**	**63~95**	**208~255**	104.92	71.97	243.22
Lawn/Grass	**127~170**	**109~137**	**150~222**	155.88	127	197.25
Water	**85~120**	**68~105**	**10~59**	99.95	81.09	29.45
	Blue	**Green**	**Red**	**Blue**	**Green**	**Red**
Bare Ground	**29~32**	**30~35**	**32~44**	30.56	32.88	38.31
Built-up/other	**36~44**	**39~52**	**36~56**	40.15	46.08	49.10





Classified Data of 1987Image

Land cover categories	No. of Pixels
Forest	6584
Lawn/Grass	4246
Water	224
Bare ground	1254
Built up or other	18158

- Classify total no of Pixels–30466

Classified Images

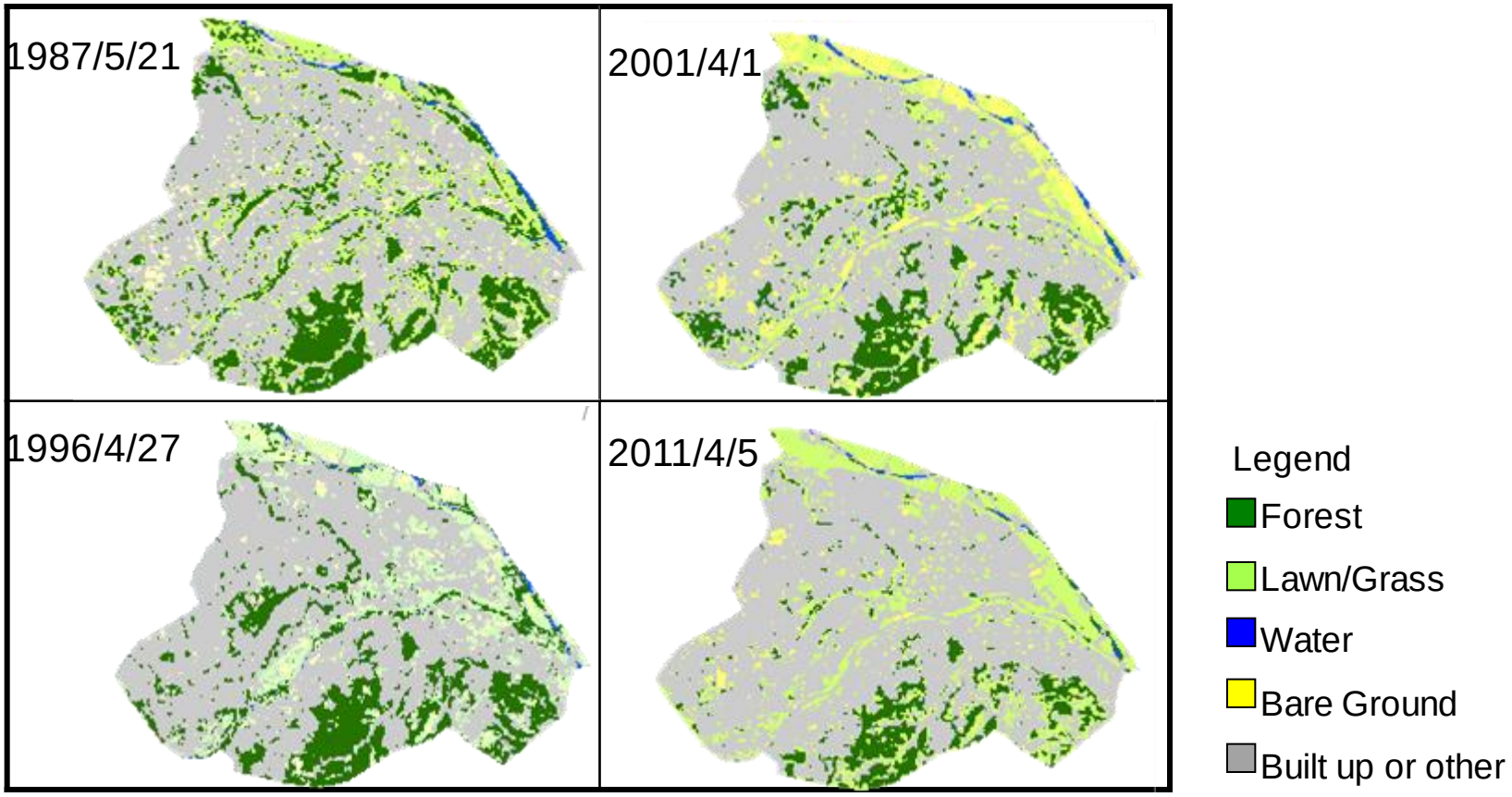
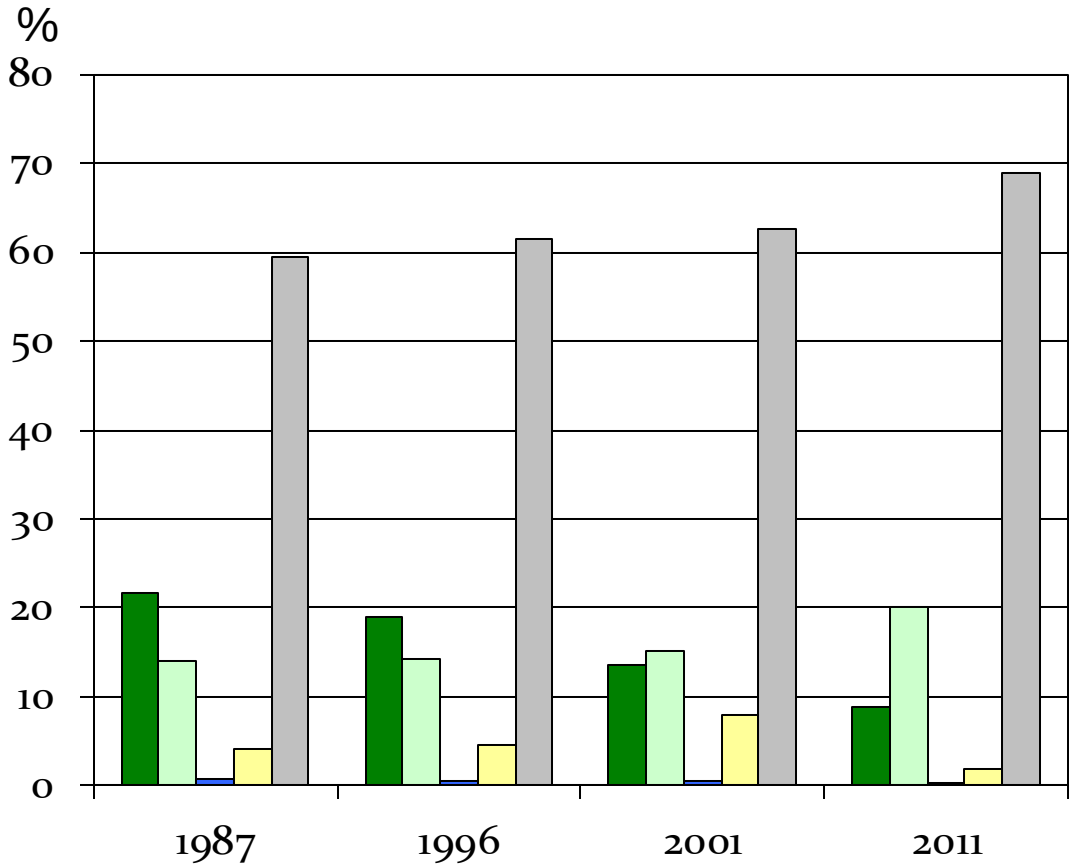


Figure 6. Classified Data of Hino City

Graph of Classified Data



Graph of Classified Data from Landsat Images

Hino City GIS data
(IKONOS data -1m resolution)

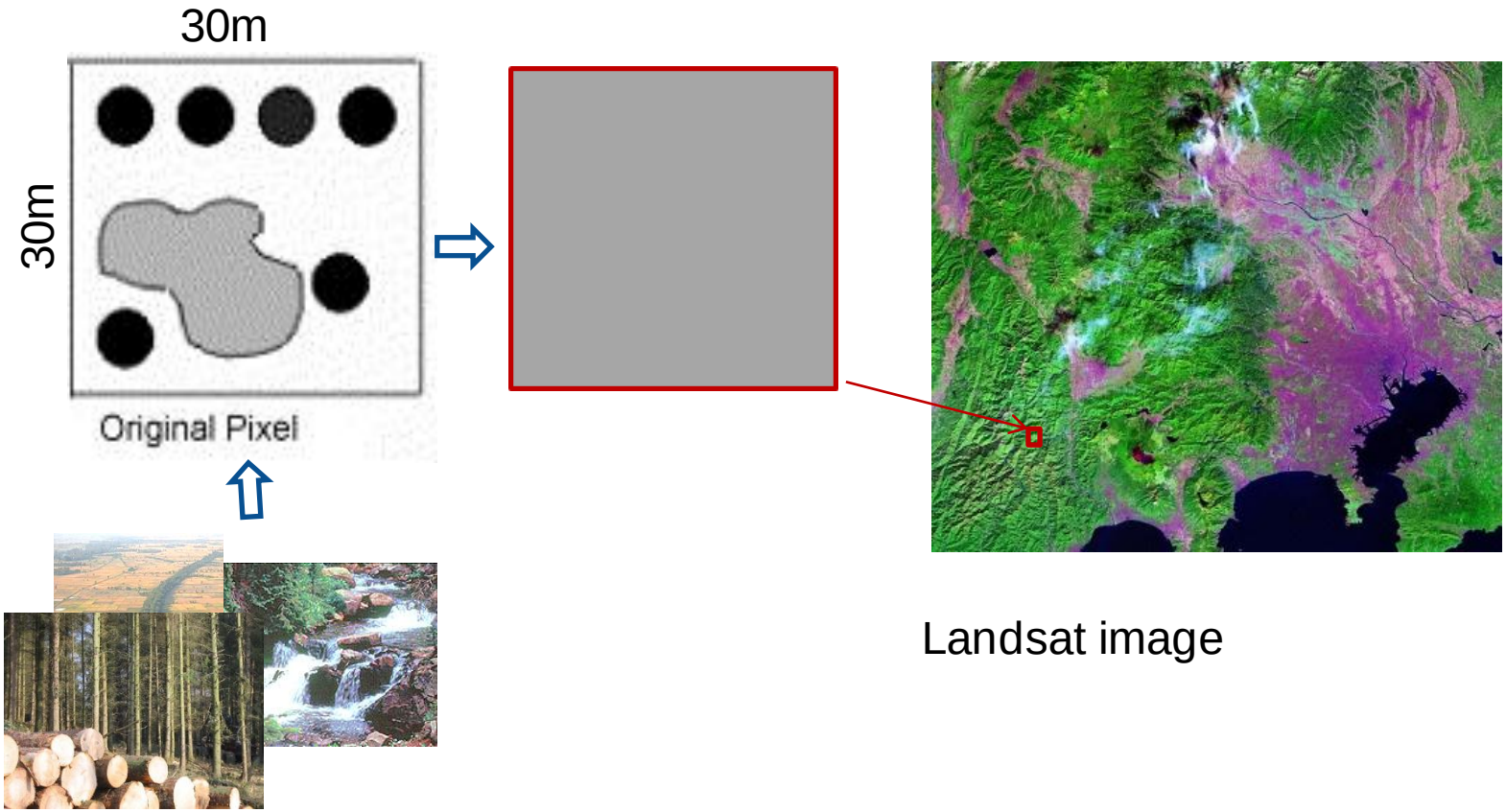
2008/9/9	Percentage
Green Cover	29.57%
Rice Field	6.86%
Water	2.97%
Bare Ground	2.57%
Other	58.08%

Legend

- Forest
- Lawn/Grass
- Water
- Bare ground
- Built up/Other

Evaluations

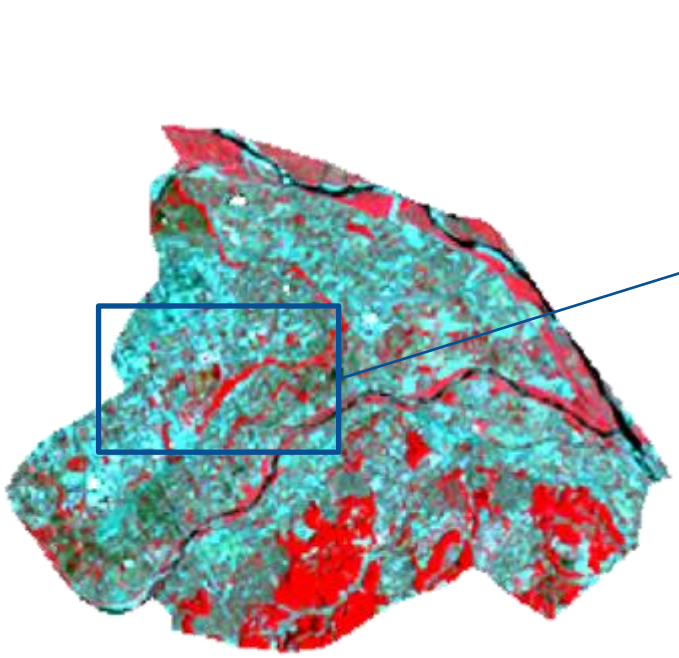
Mixed pixel problem can be ignored in Landsat image.



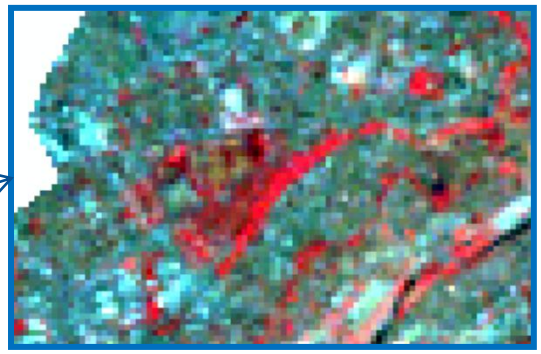
Landsat image

Evaluations

Every pixel was classified with no misinterpreted class.



Infrared Composite



Knowledge based method

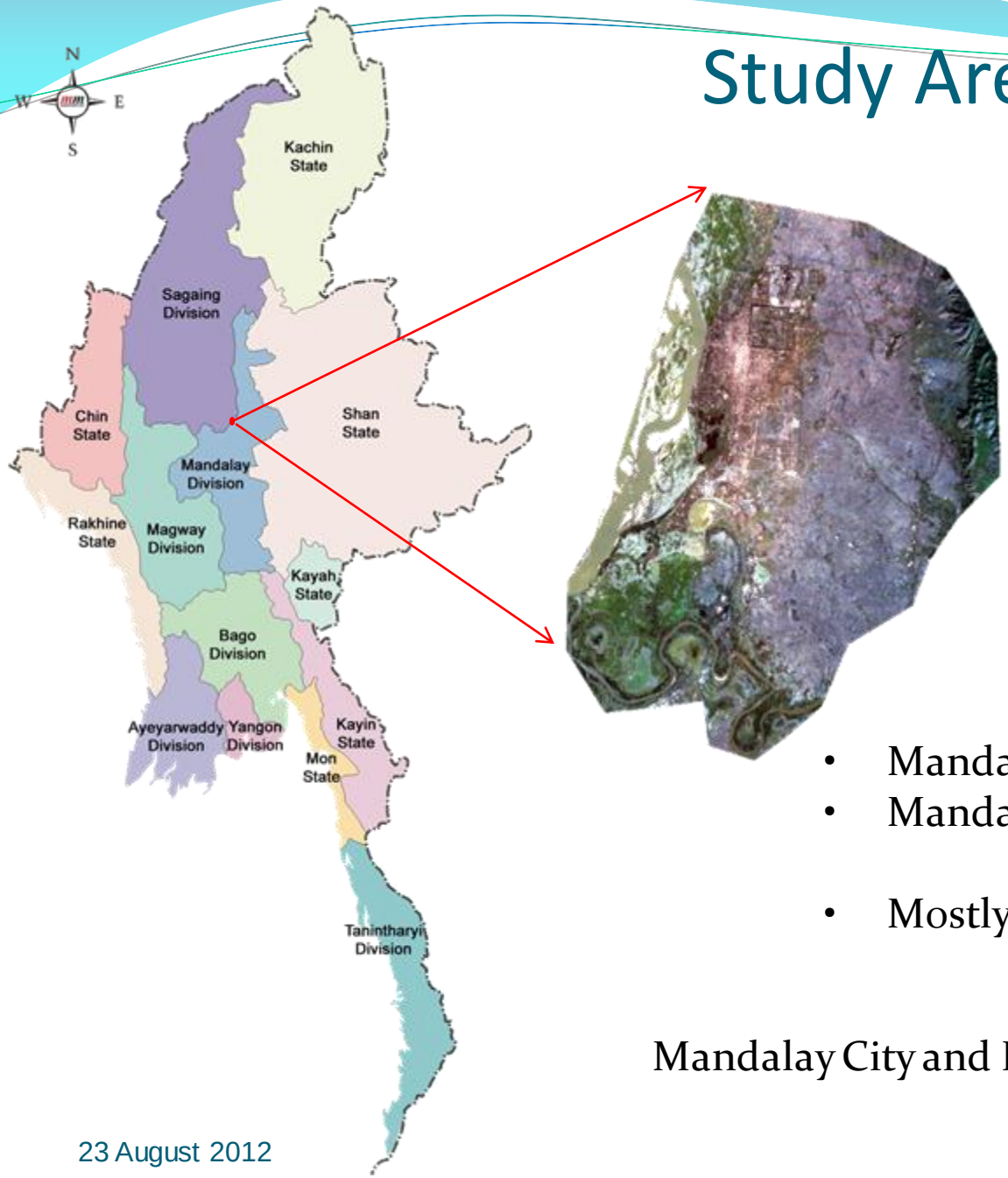
Object Oriented method

Legend

Forest

Lawn

Study Area



- Mandalay city was chosen as study area.
- Mandalay City Area= 506.36 km²
- Mostly Equivalent to Chichibu ward.

Mandalay City and Region

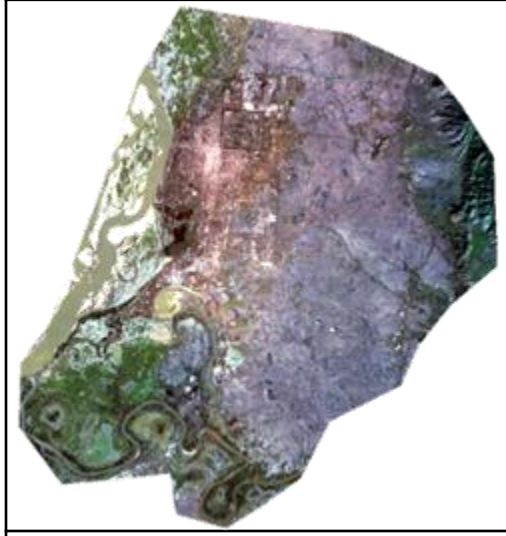
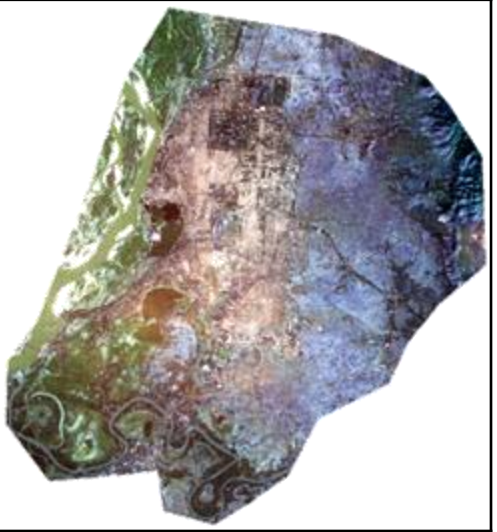
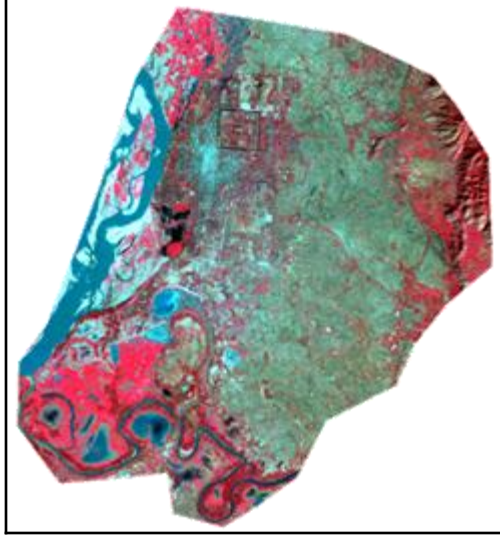
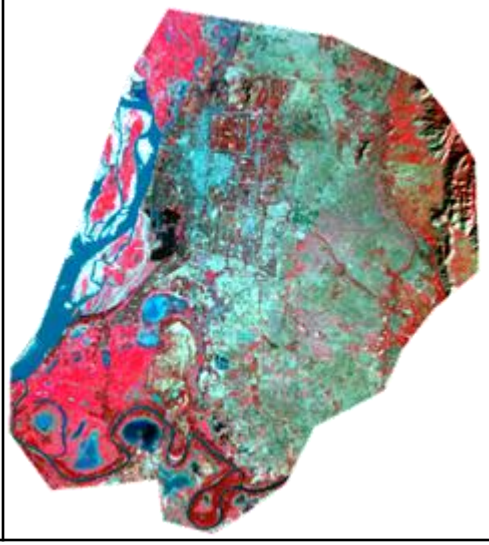
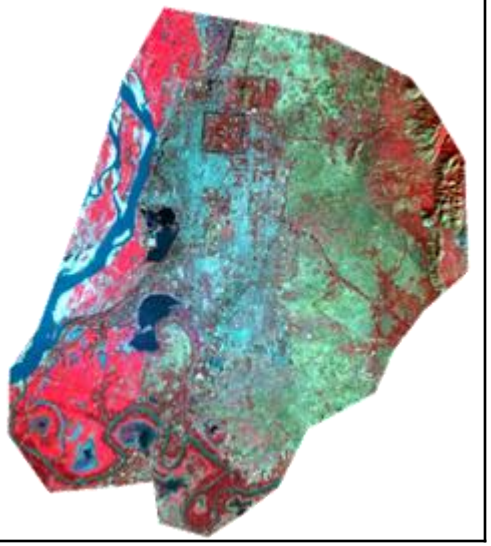
Multi-temporal Images

Data Source

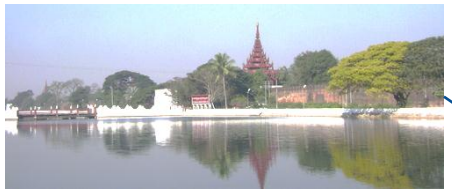
No.	Data Type	Date of Production	Resolution	Source
1. 2. 3.	Landsat image Landsat image Landsat image	1988/12/31 1996/1/12 2009/1/15	30m™ 30m™ 30m™	USGS*
4.	Map of Mandalay City	2005	1:9,196,429 (view scale)	Local City Hall

*United State Geological Survey
TM- Thematic Mapper

Visual RGB & Near Infrared Composite Images of Mandalay City

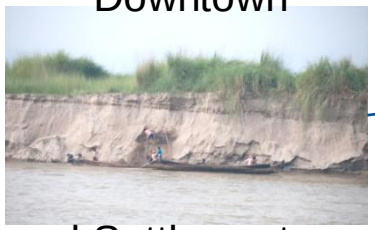
	1988/12/31	1996/1/12	2009/1/15
Visual RGB Composite			
NIR Composite			

Training Pixels by Knowledge based



Moat

Downtown



Land Settlement

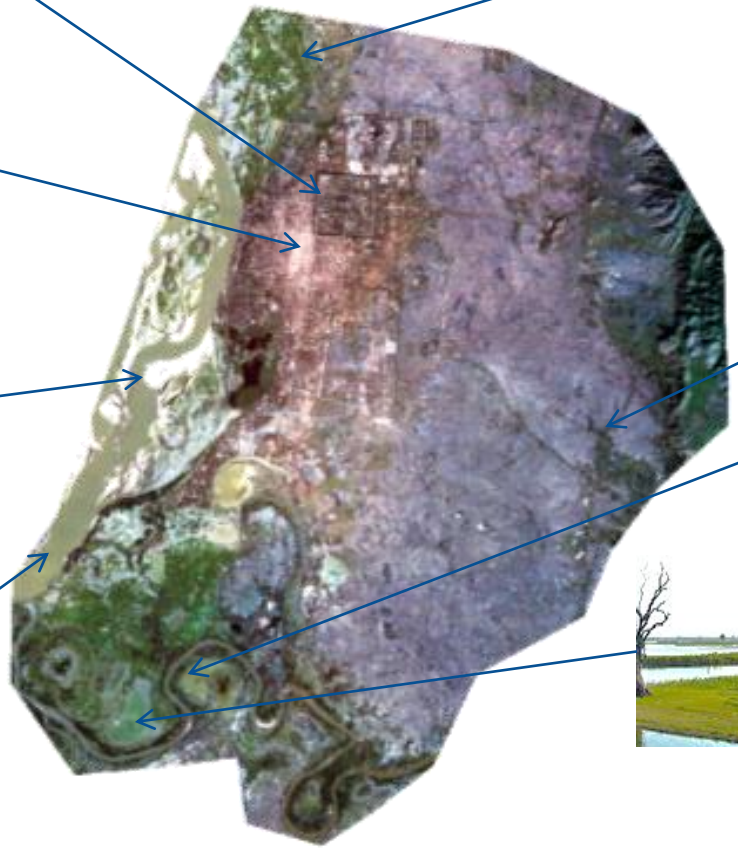
River

Forest

Agriculture

Pond

Lawn



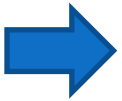
Known Locations from Map of Mandalay

Classify the Image

Deciding the range Training Pixels

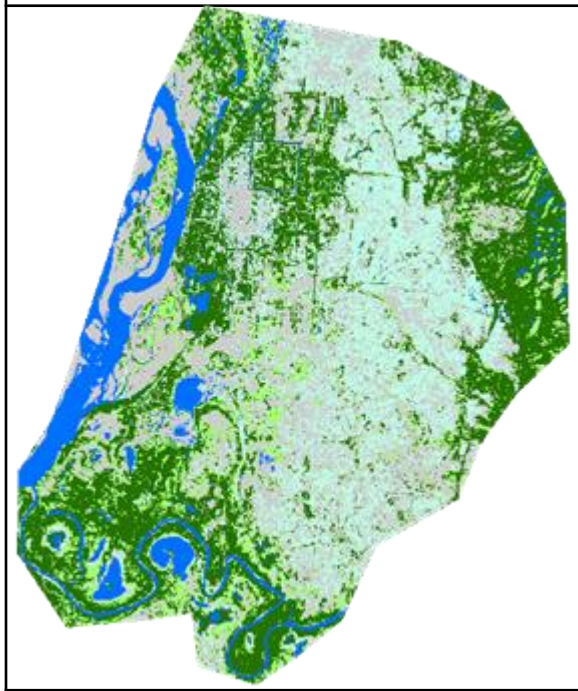
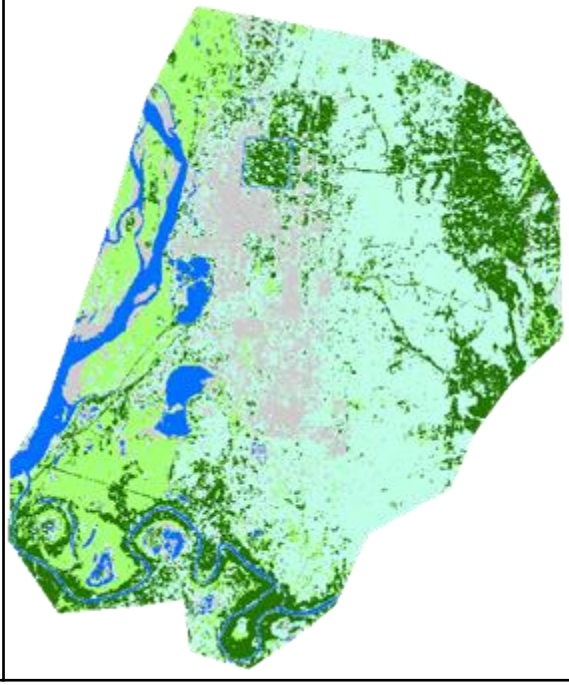
Land Cover	No. of training pixel	Mini~Maxi pixel value			Mean		
		Green	**Red**	**NIR**	**Green**	**Red**	**NIR**
Forest	199	23~28	19~26	46~113	26.34	21.52	64.47
Lawn/Grass	31	31~32	26~28	67~77	31.13	27.29	72.35
Water	1161	23~39	17~40	11~28	33.20	29.89	16.55
		Blue	**Green**	**Red**	**Blue**	**Green**	**Red**
Agriculture Mixed	16	29~32	30~35	32~44	30.56	32.88	38.31
Built-up/ other	84	36~44	39~52	36~56	40.15	46.08	49.10

- Classify total no of Pixels–563929 (Image (1988) using ArcGIS)



Land cover categories	No. of Pixels
Forest	231211
Lawn/Grass	51754
Water	50753
Agriculture Mixed	107147
Built up or other	123064

Classified Images

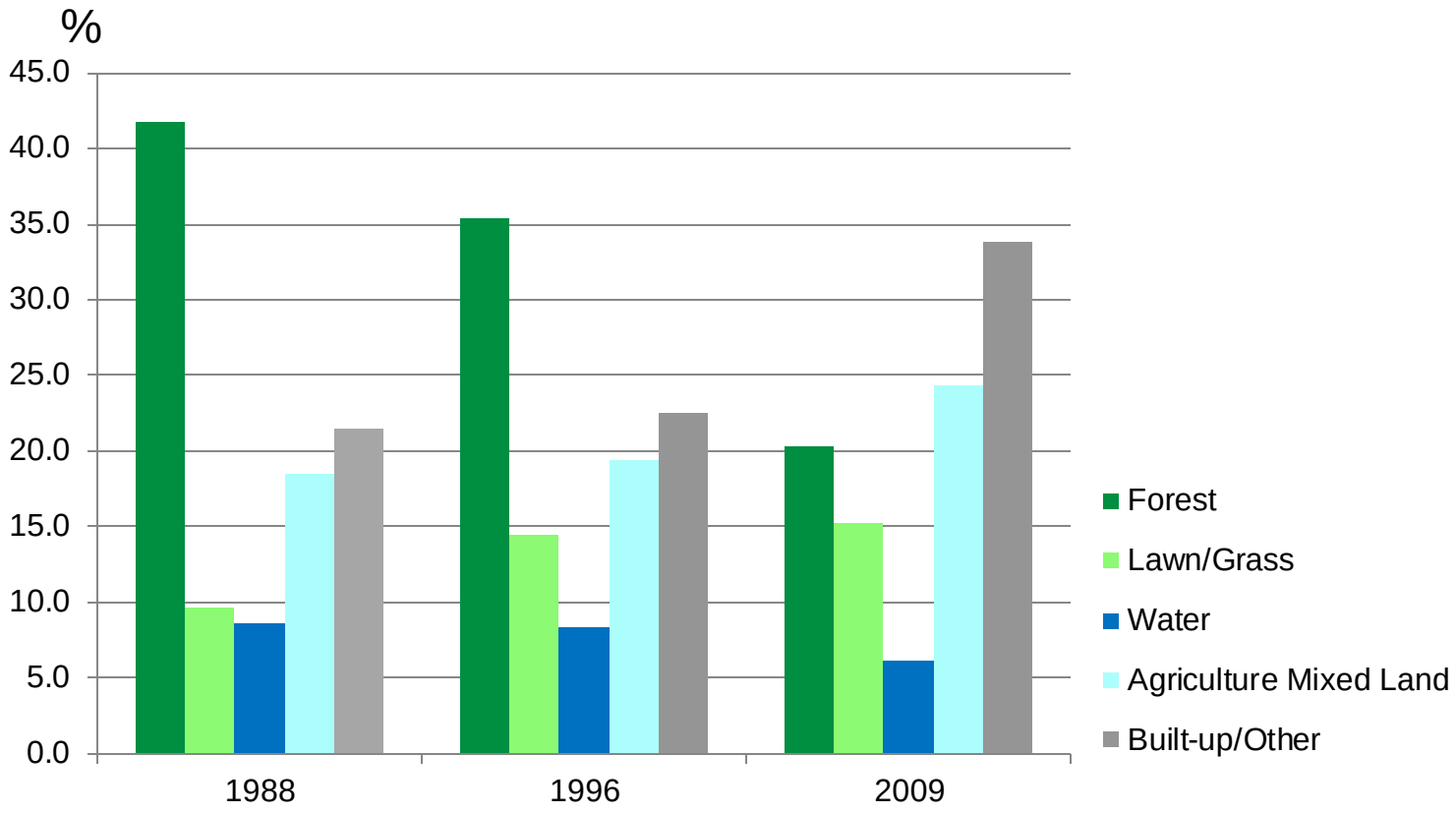
1988/12/31	1996/1/12	2009/1/15
		

Classified Satellite Images of Mandalay City

Legend

- Forest
- Lawn
- Water
- Agriculture Mixed
- Other

Graph of Classified Data



Graph of Classified Data of Mandalay City

Evaluations

- Works well on different landscape study areas

- Classified Five classes of land cover as through years.
  - Water Area changed due to land forming in Mandalay city.
  - Forest decreased greatly in both study areas.
  - Agriculture mixed land and other build up area increased in both study areas.

Conclusions

- Demonstrates the ability of ArcGIS and RS
- Classification method is very suitable for both study areas using Landsat image. (Every pixel was classified to each corresponded class)
- The more training pixels, the higher accuracy.

- Depends on training pixels (not always a safe assumption from Map*)
- Due to resolution of the images (30×30m)
  - not easy discriminating between light colored
  - Transitions between classes are always difficult

- To collect ground truth data by eco-social survey
- by utilizing very high resolution (VHR) satellite imagery

Publications

- *"Correlation of Land Surface Temperature and Vegetation Density Classified from Satellite Images"*, The proceeding of International Global Navigation Systems Satellite (IGNSS), Sydney, November (2011).

- *"Extracting the Assessment of Environmental Changes from Satellite Image"*, The proceeding of International Symposium on GPS/GNSS, Tokyo, November (2008).

- *"Detecting the Environmental Changes from Satellite Image"*, The proceeding of 28th ASEAN Conference on Remote Sensing (ACRS 2007), Kuala Lumpur, November (2007), 202-203.

Thank you very much for your attention!