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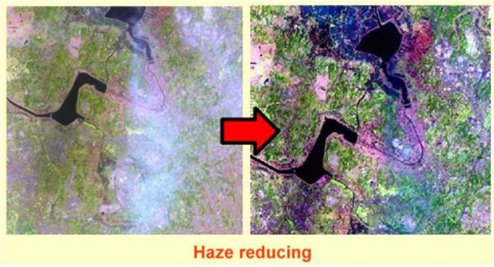
Remote Sensing Data Processing and Analysis

Remote Sensing Data Pre-processing

(a) Atmospheric correction
(b) Radiometric correction
(c) Geometric correction

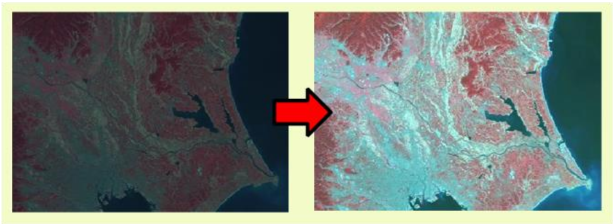
However, most remote sensing data can be acquired or purchased atmospheric, radio metric and geometric corrected data.
Here, we will introduce briefly.

(a) Atmospheric correction

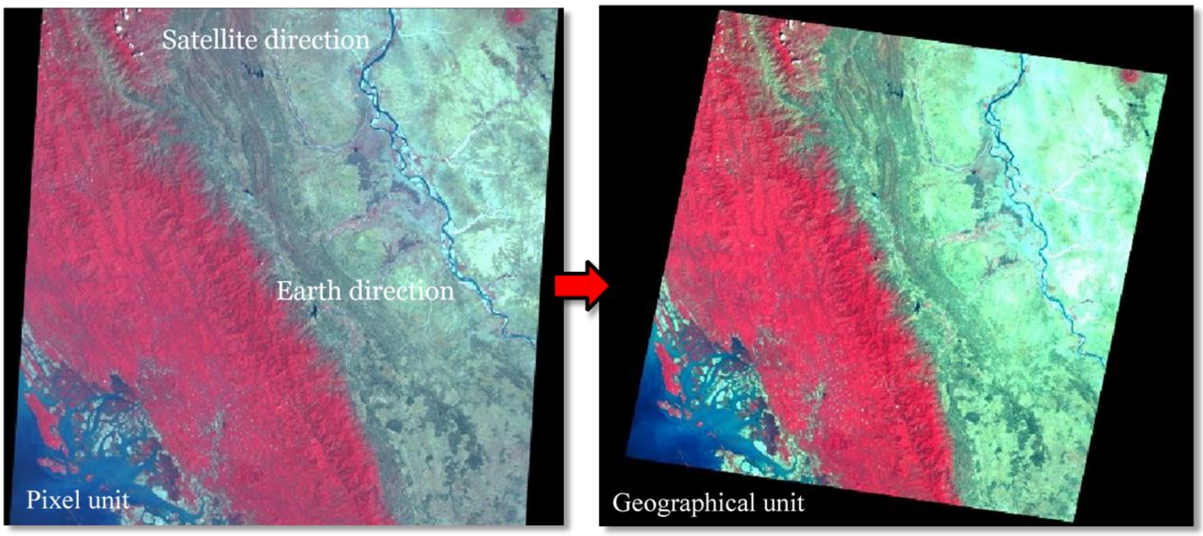


Small haze can be removed in Landsat TM/ETM.
But not clouds. Because B4 (IR) can penetrate the haze.

(b) Radiometric correction



(c) Geometric correction



Geometric distortion due to Earth rotation.

Methods of Geometric correction
1.Using satellite header file (satellite onboard GPS)
2.Image to image registration
3.Image to map registration
4.Manually entered GCPs (Ground Control Points)

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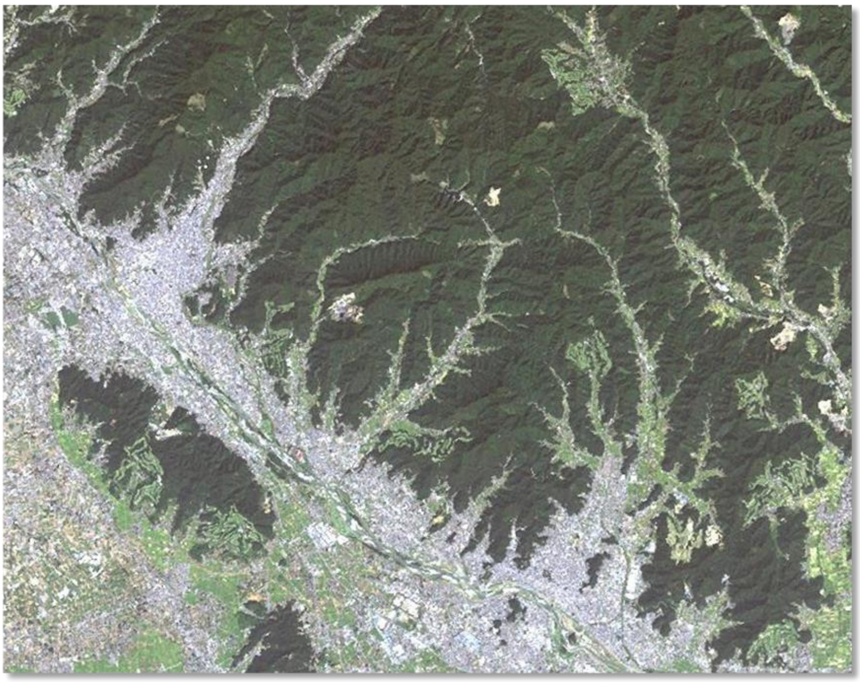
Visual Interpretation (Band combination)

First step interpretation and to distinguish various land covers into different colors



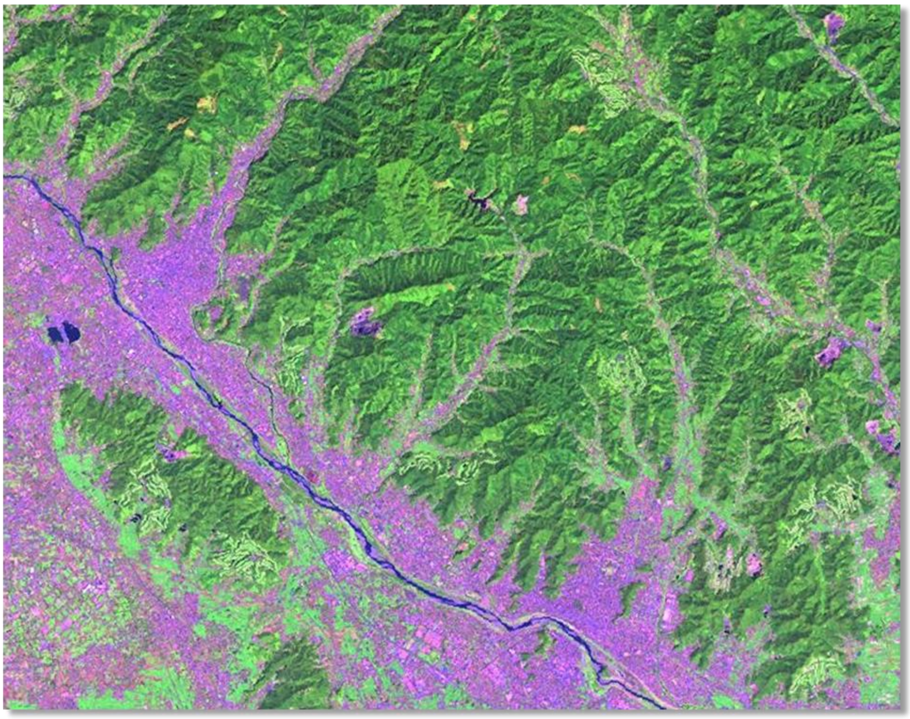
Landsat TM5 Tokyo (Ashikaga, Isezaki)

Example:

RGB 321 in Landsat TM/ETM gives natural color. Assign band 3 to red channel, band 2 to green channel and band 1 to blue channel in computer display.

To see landscape in realistic view.

Visual Interpretation (Band combination) *continued*



Landsat TM5 Tokyo (Ashikaga, Isezaki)

Example:

RGB 543 in Landsat TM/ETM gives false color. Assign band 5 to red channel, band 4 to green channel and band 3 to blue channel in computer display.

To discriminate between soil, vegetation and water.

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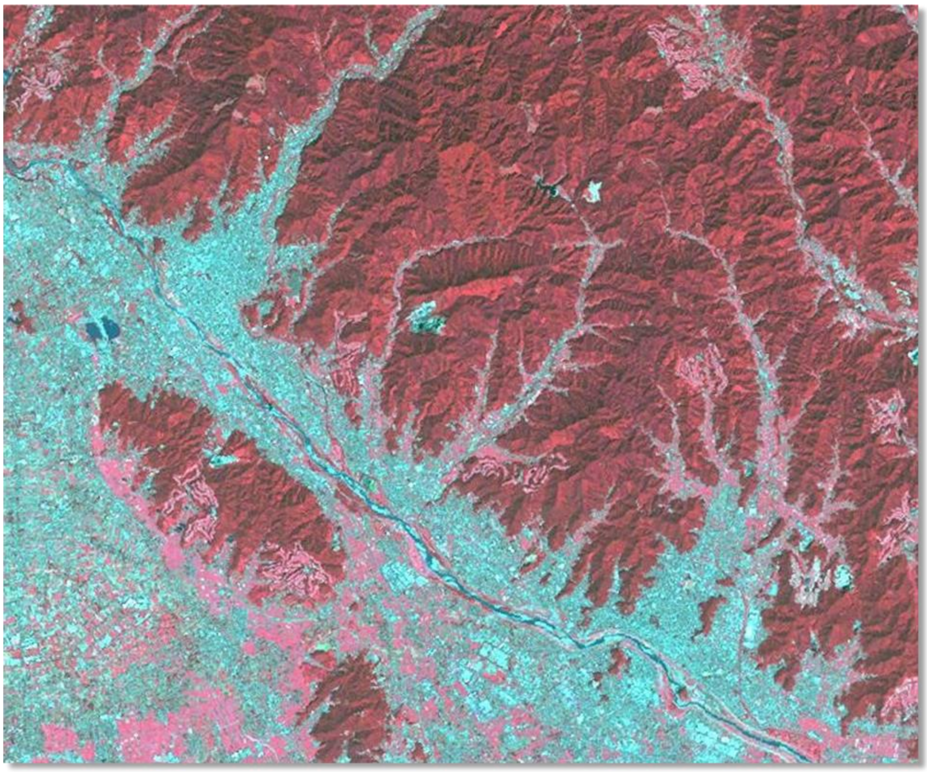
Visual Interpretation (Band combination) *continued*



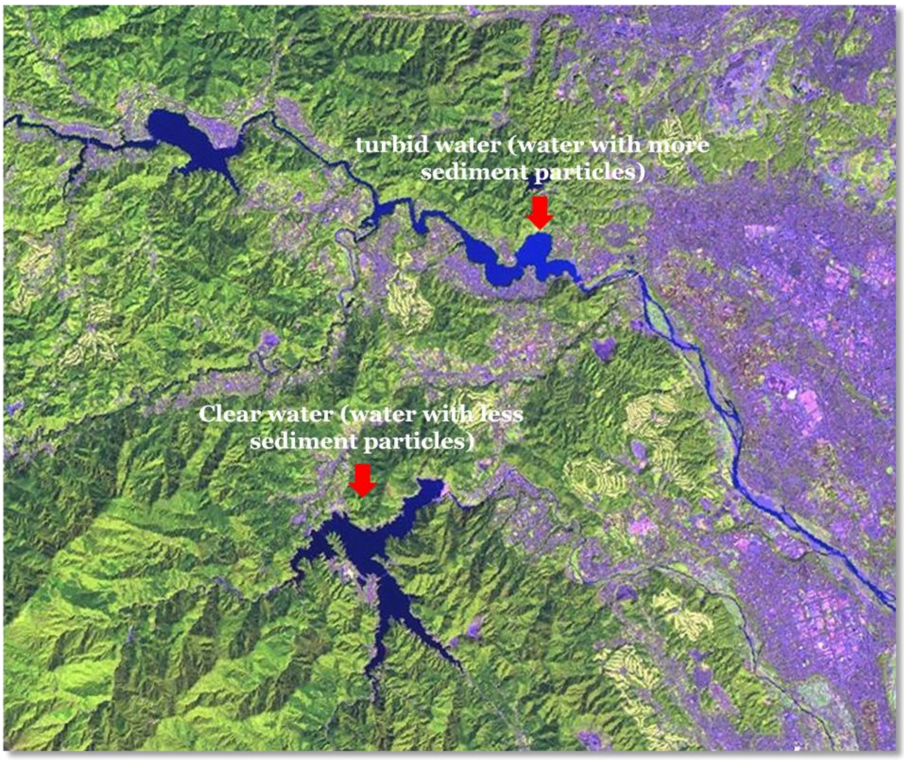
Landsat TM5 Tokyo (Ashikaga, Isezaki)

Example:

RGB 432 in Landsat TM/ETM gives false color. Assign band 4 to red channel, band 3 to green channel and band 2 to blue channel in computer display.

To determine vegetation stress and vigor.

Visual Interpretation (Band combination) *continued*



Landsat TM5 Tokyo (Hachioji)

Example:

RGB 541 in Landsat TM/ETM gives false color. Assign band 5 to red channel, band 4 to green channel and band 1 to blue channel in computer display.

To assess water quality. Turbid water gives bright blue and clear water gives dark blue.

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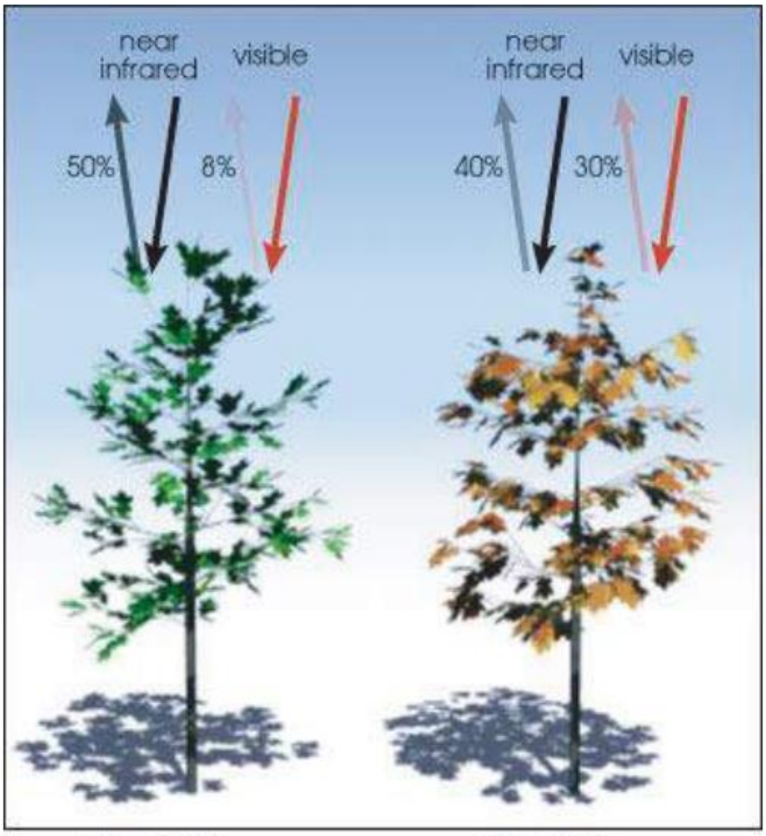
Normalized Difference Vegetation Index (NDVI)

The Normalized Difference Vegetation Index (NDVI) was introduced by Rouse et al. (1974) in order to produce a spectral VI that separates green vegetation from its background soil brightness using Landsat MSS digital data.

It is expressed as the difference between the near infrared and red bands normalized by the sum of those bands. Healthy vegetation (left, in above figure) absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation (right, in above figure) reflects more visible light. It is the most commonly used VI as it retains the ability to minimize topographic effects while producing a linear measurement scale.

In addition, division by zero error is significantly reduced. Calculations of NDVI for a given pixel always result in a number that ranges from minus one (-1) to plus one (+1); however, no green leaves gives a value close to zero. A zero means no vegetation and close to +1 (0.8 - 0.9) indicates the highest possible density of green leaves.



$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72 \qquad \frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$

Apply Algorithms

We can manipulate between bands (playing with DN Digital Numbers) and extract meaningful information.

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NDVI (Normalized Difference Vegetation Index)

Perhaps, well known and useful algorithm is NDVI (Normalized Difference Vegetation Index). Vegetation is low reflectance in Red band and high reflectance in Infrared band. By normalizing this two bands, we can measure vegetation stress and vigor.

General formula NDVI = (Infrared – Red) / (Infrared + Red)

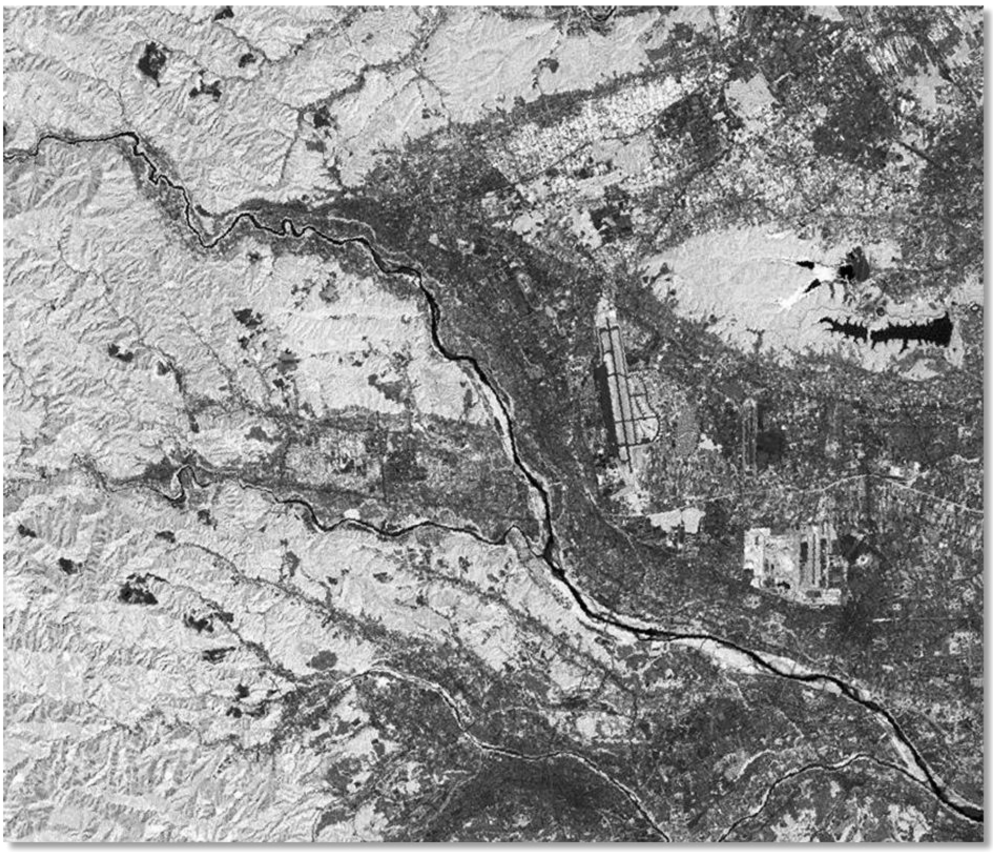
The value is between +1 (vigor) ~ -1 (stress)

NOAA AVHRR NDVI = (B2 – B1) / (B2 + B1)

Landsat TM/ETM NDVI = (B4 – B3) / (B4 + B3)

IKONOS/QuickBird NDVI = (B4 – B3) / (B4 + B3)

Apply Algorithms *(continued)*



Landsat TM5 Tokyo (Hanno)

Example:

Vegetation index (NDVI) stretched to 8-bit.

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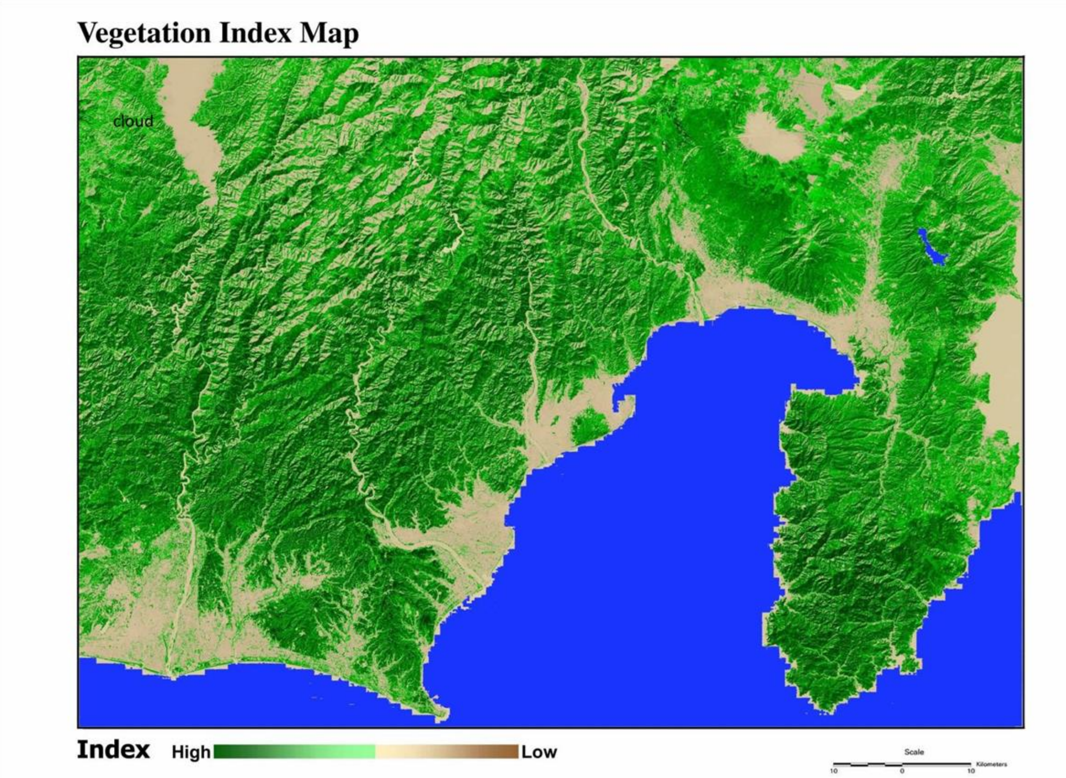
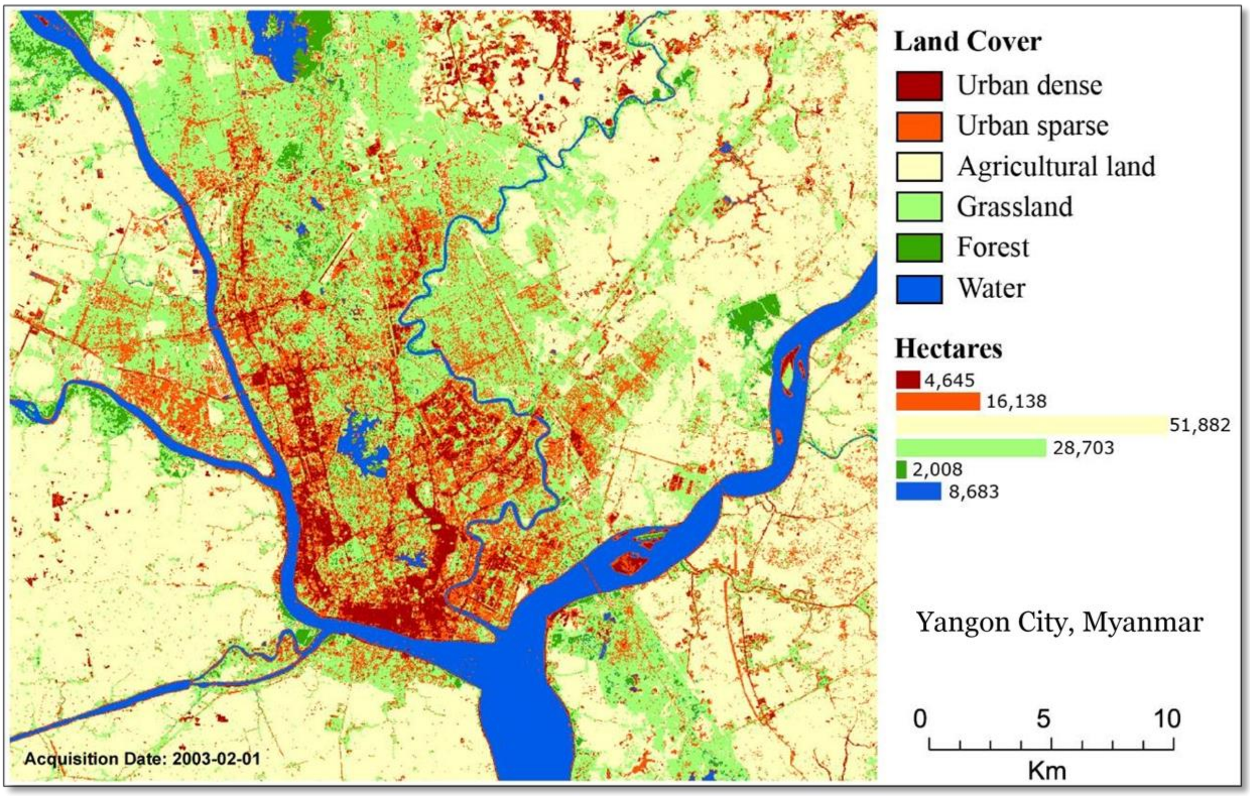
Apply Algorithms *(continued)*



Land Cover Classification from Landsat ETM+



Land cover classification form Landsat ETM++

Source: Lwin, K. K. and Murayama, Y. (2013), Evaluation of land cover classification based on multispectral versus pansharpened Landsat ETM+ imagery, ***GIScience and Remote Sensing***, 50, 458-472.

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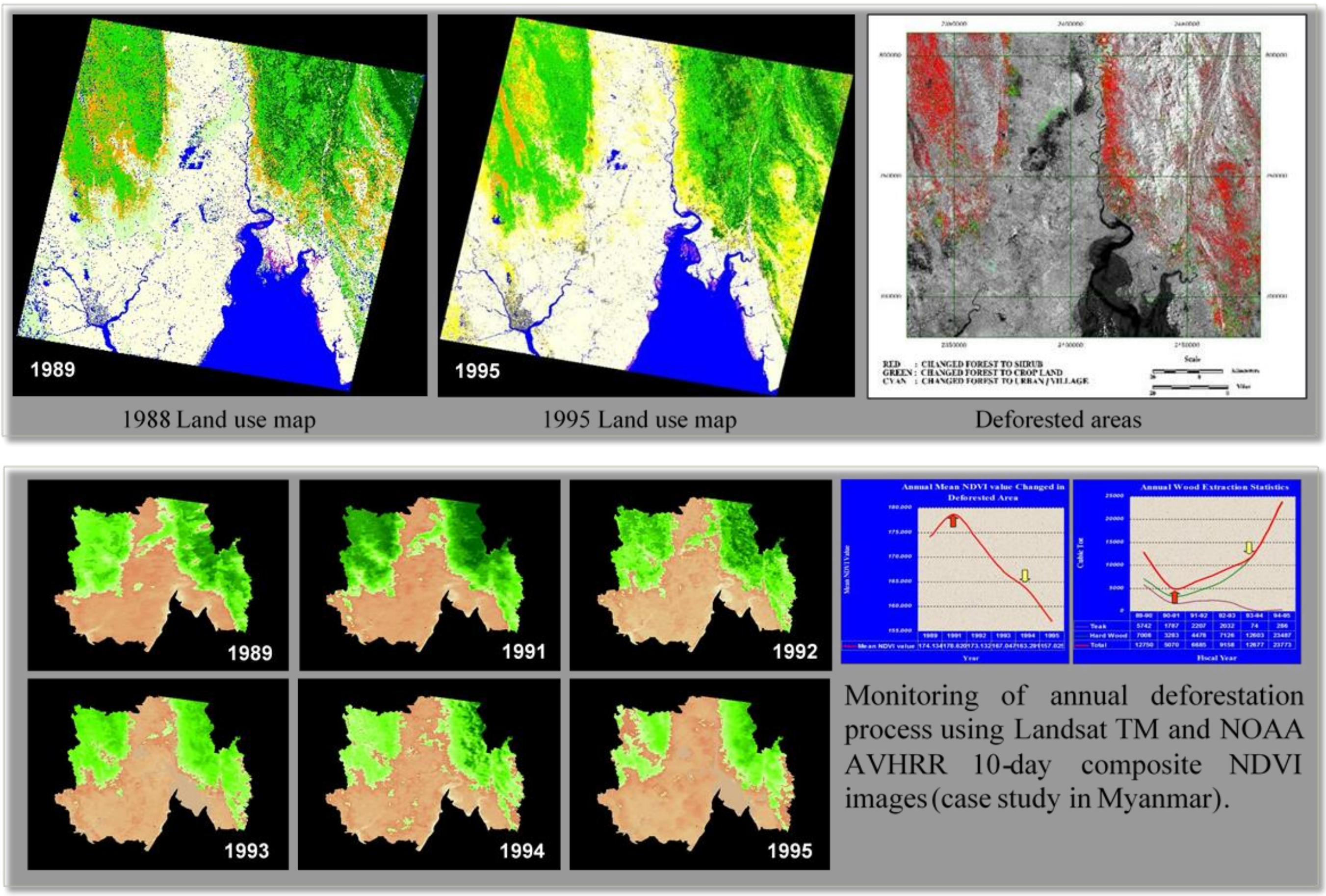
Land Use / Land Cover (LULC) Classification

Land Use / Land Cover Classifications are among the most iconic tasks for remote sensing scientists. They enable us to explore, map and monitor landscapes as well as better understand the impacts of for exampel natural hazards or anthropogenic influences.

Land cover refers to the actual (bio-)physical cover present on the observed surface, and thus can be determined directly by analyzing satellite imagery. This could for example be shrublands, forests, bare soil or water.

Land use refers to the way specific land is used, as the name implies. This could be for example agricultural land, transport infrastructure, industrial or recreational land like parks.

Monitoring of Deforestation Process



Source: Lwin, K. K. and Shibasaki, R., (1998), Monitoring and Analysis of Deforestation Process Using Remote Sensing and GIS: A Case Study of Myanmar, in: ***19th Asian Conference on Remote Sensing (ACRS)***, Manila, Philippines.

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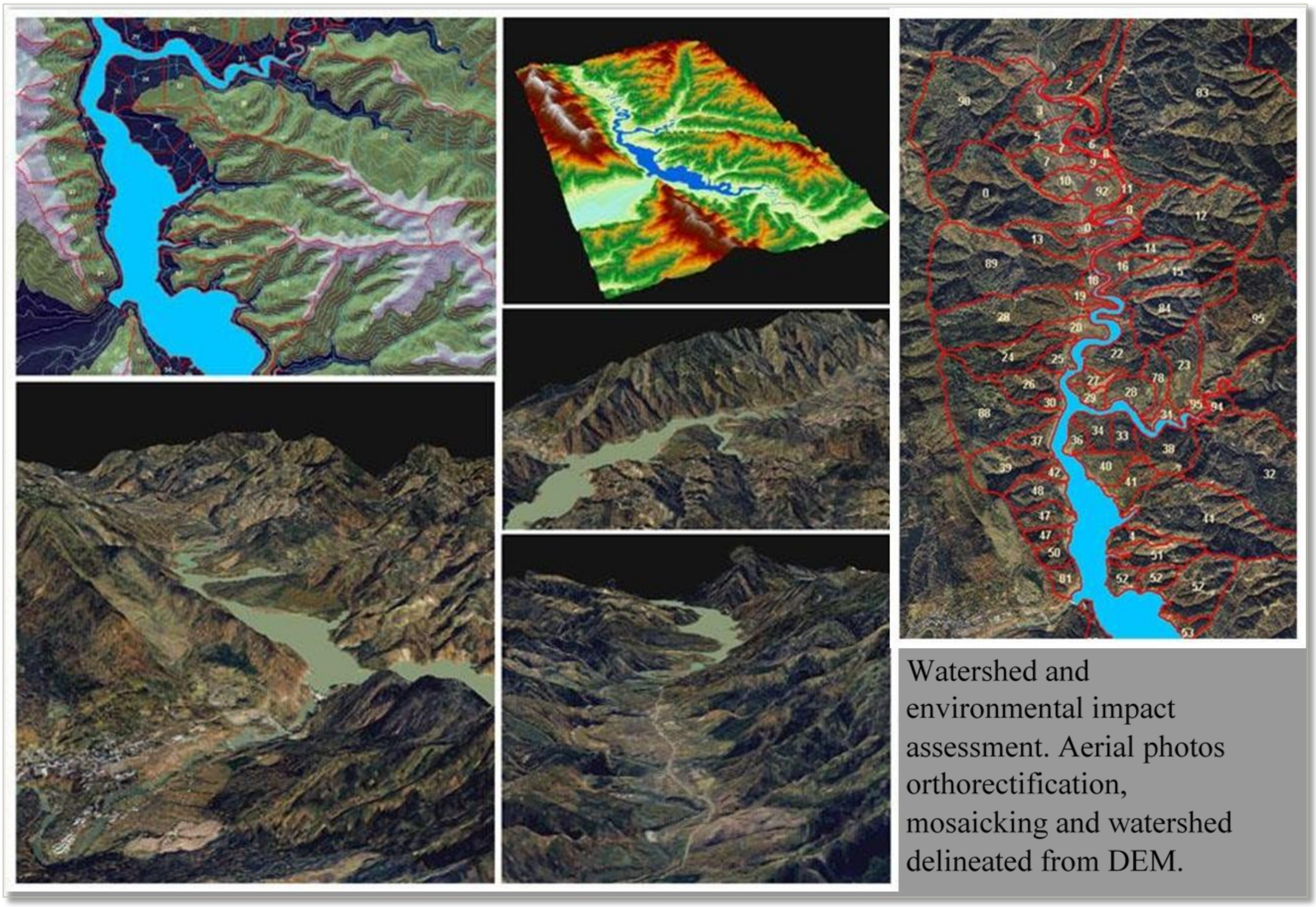
Watershed and Environmental Impact Assessment



Watershed and environmental impact assessment. Aerial photos orthorectification, mosaicking and watershed delineated from DEM.