United Nations Institute for Training and Research

UNOSAT

# Digital Image Classification for Monitoring Landcover

**Trainer**
Khaled Mashfiq

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Training Module A1 Session 2

*Advanced Application of Geospatial Information technology for Decision Support related to Disaster Risk Reduction*

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*In partnership with*

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

- What is Landcover and role of Landcover Assessment in Drought Risk Management
- Introduction to digital image classification
- Basics of spectral feature space
- Unsupervised image classification
- Supervised image classification
- Post-Classification cleanup
- Assessing accuracy of image classification

Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc.

- Observing Monitoring Landcover can give us better insights on earths biophysical characteristics and also the changes in time
- Crops and their condition can also the identified and monitored


| SDGs | Land Use data | Land Cover data | Land Cover Change data | Biomass data (AGB) | Fire data (Active fires, burnt areas) |
|---|---|---|---|---|---|
| Zero hunger | some essential / some complementary | Complementary | Not relevant | Not relevant | Not relevant |
| Clean water | some essential / some complementary | some essential / some complementary | Essential | Not relevant | Not relevant |
| Industry | Complementary | Not relevant | Not relevant | Not relevant | Not relevant |
| Cities | Complementary | Complementary | Not relevant | Not relevant | Not relevant |
| Consumption & production | Complementary | Complementary | Not relevant | Not relevant | Not relevant |
| Climate action | Not relevant | Not relevant | Not relevant | Not relevant | Not relevant |
| Life below water | some essential / some complementary | some essential / some complementary | Essential | Not relevant | Not relevant |
| Life on land | Essential | Essential | Essential | Essential | Essential |

**Importance of data for indicators in place to monitor targets/goals:**

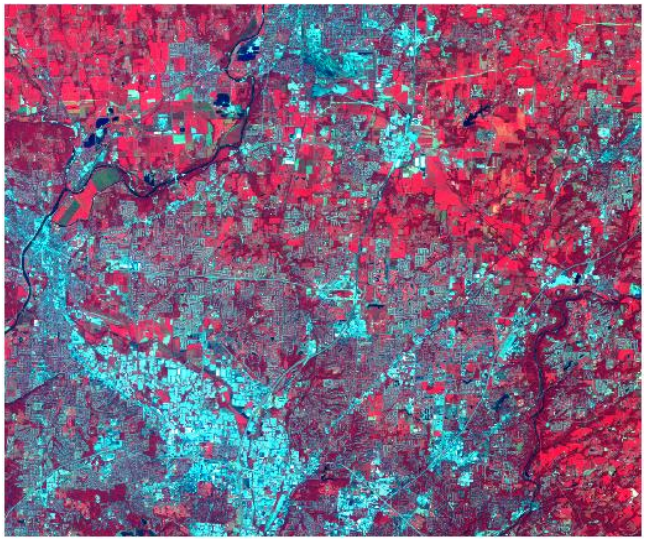
| Essential | some essential / some complementary | Complementary | Not relevant |
|---|---|---|---|

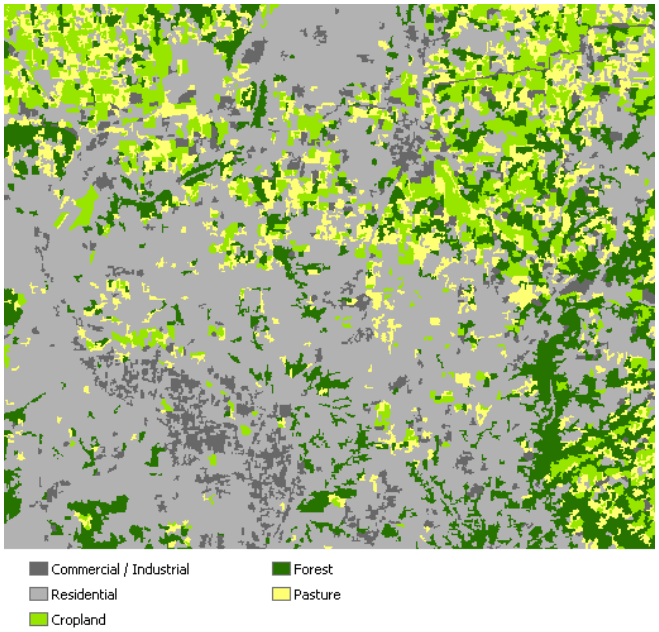
*Importance of Landuse, Landcover data for Monitoring SDG targets (Erika Romijn et al. 2016)**

The process of automatic or semi-automatic interpretation of imagery with the help of certain given conditions.

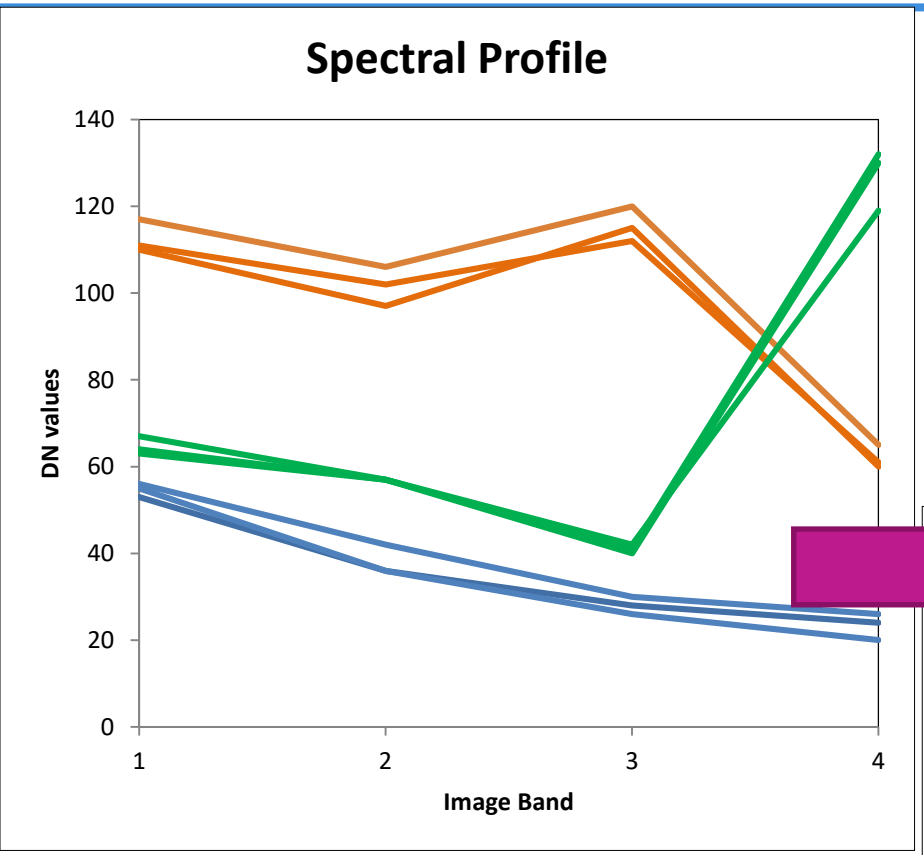
With the help of digital image classification different spectral characteristics of different earth cover can be extracted such as –

- Vegetation
- Water
- Soil
- Urban Area

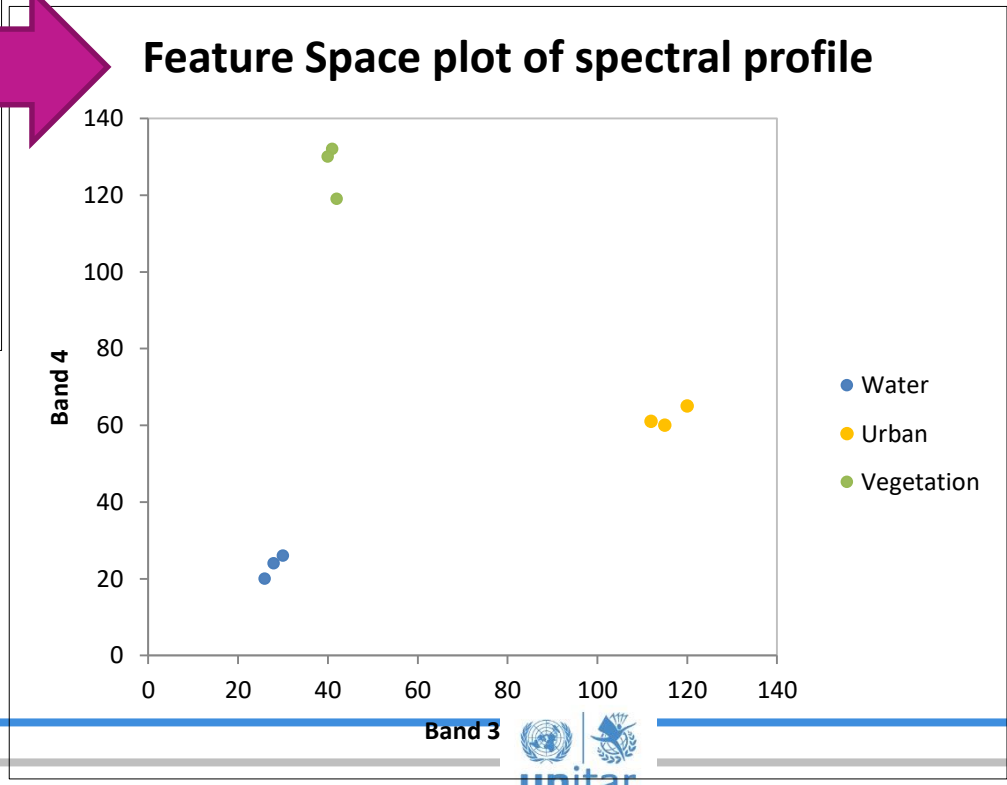




# Basics of Image Classification => Feature Space




- A graphical representation of the pixels by plotting 2 bands vs. each other
- For a 6-band Landsat image, there are 15 feature space images

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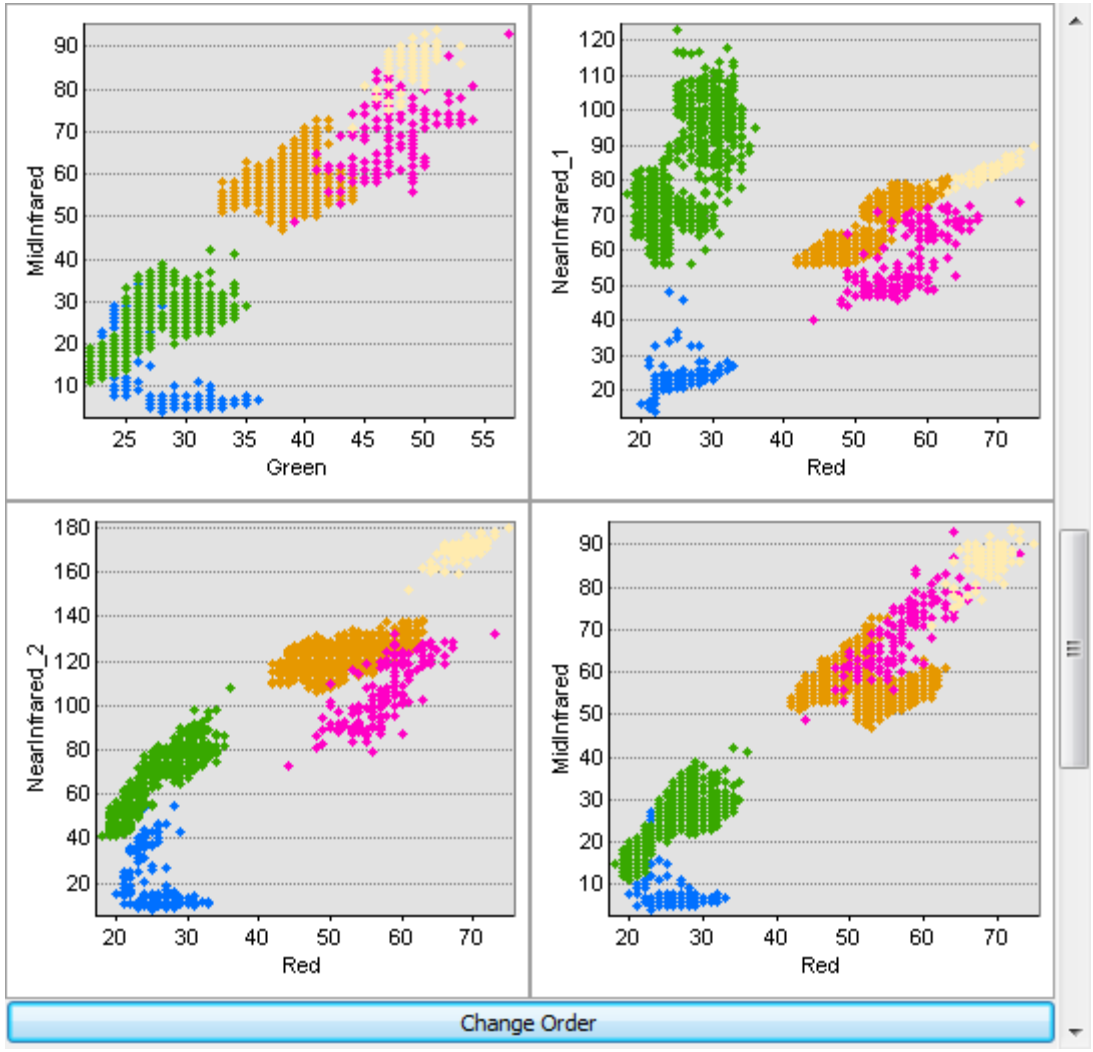
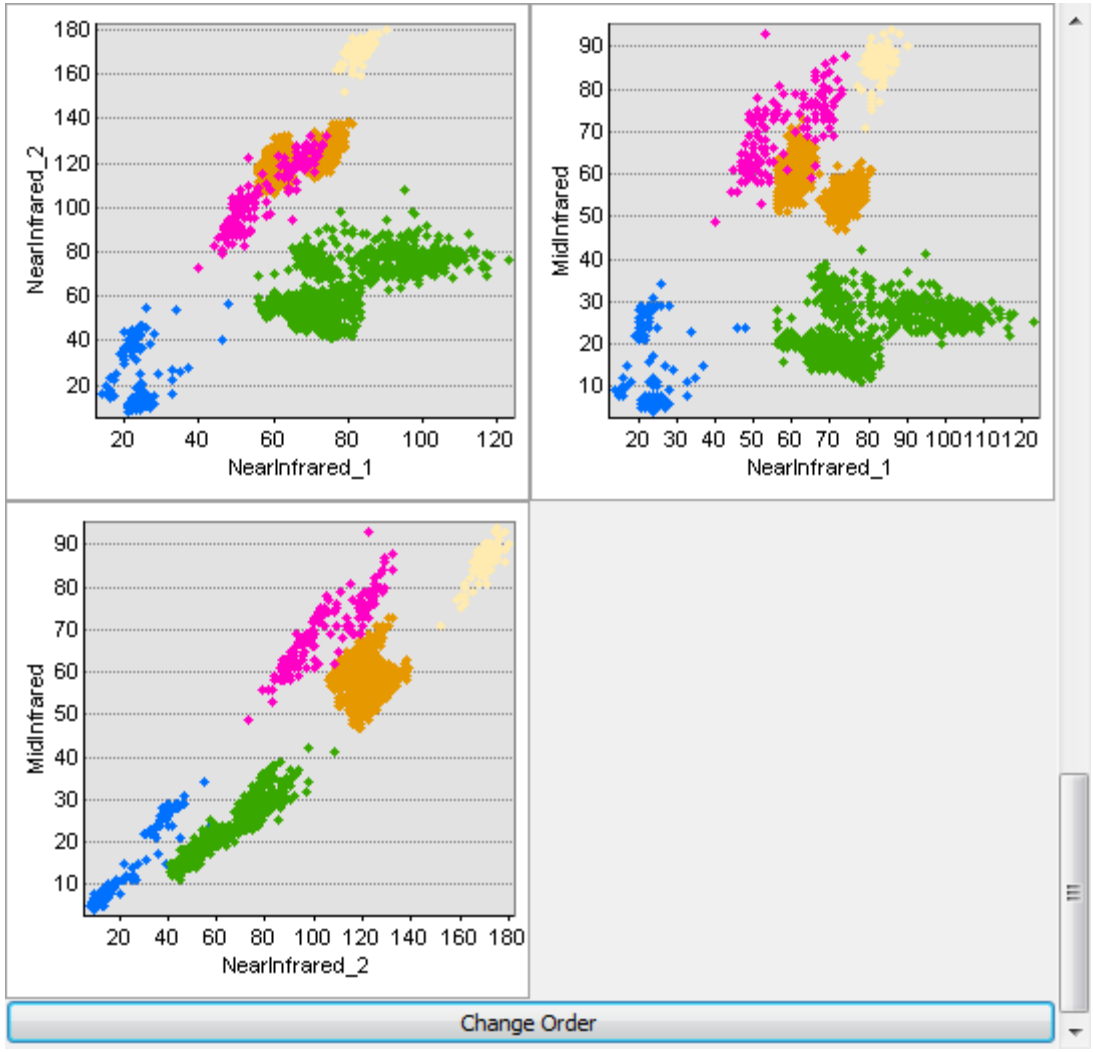
# Example Feature Space Plot from Samples picked from the multi-band raster



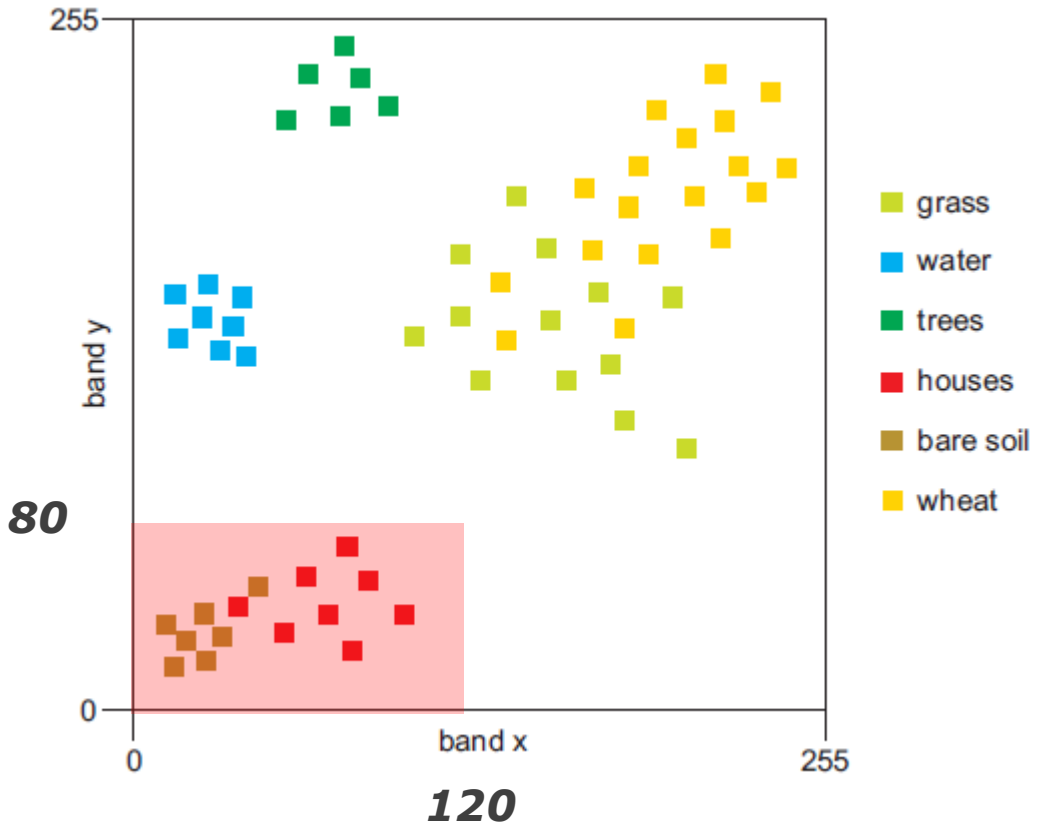

| Class Name | Color |
|---|---|
| Dry Soil | |
| Medium Dry Soil | |
| Urban | |
| Water | |
| Vegetation | |

# Example Feature Space Plot from Samples picked from the multi-band raster



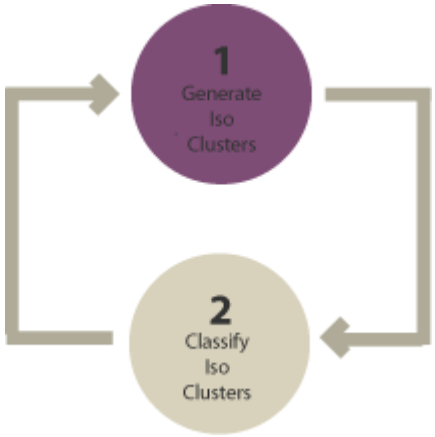

| Class Name | Color |
|---|---|
| Dry Soil | |
| Medium Dry Soil | |
| Urban | |
| Water | |
| Vegetation | |

- Classification:
  - Delineate boundaries of classes in n-dimensional space
  - Assign class names to pixels using those boundaries



# Types of digital image classification

## Based on user interference

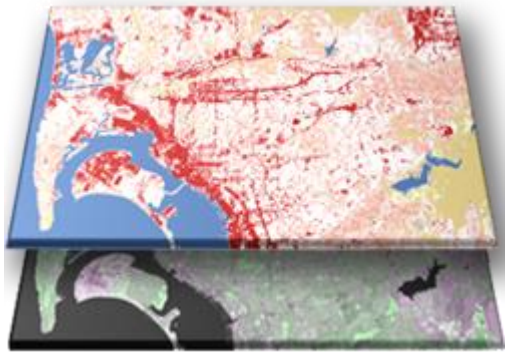


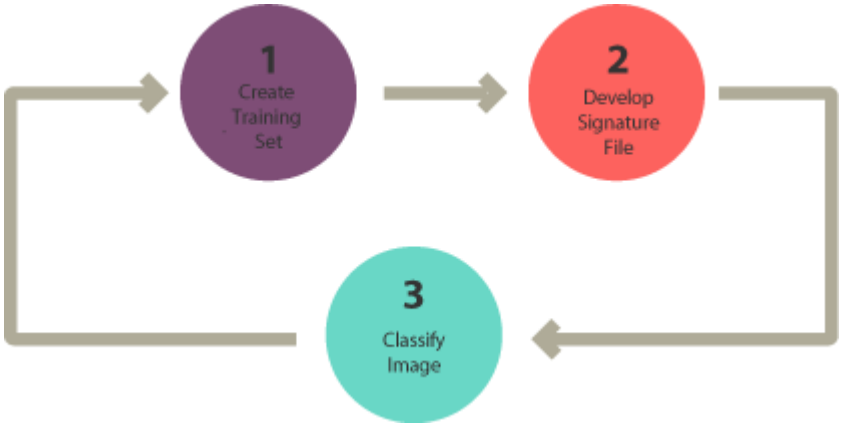

### Unsupervised

Feature space is automatically divided into clusters.

From the automatically divided clusters, unnamed classes are generated

User input is required to group them into meaningful classes

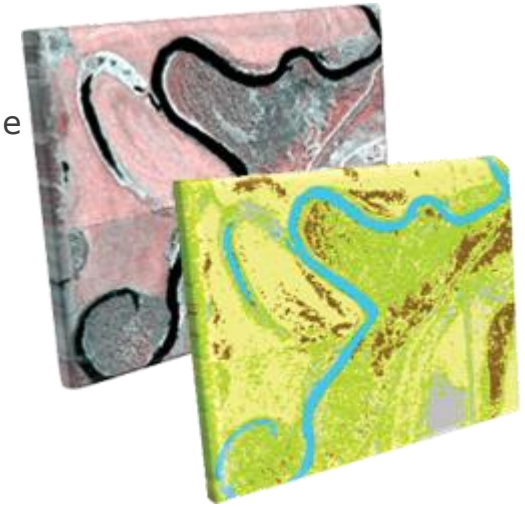





### Supervised

Feature space is divided into clusters based on the training samples.

From the automatically divided clusters, named classes are generated



*Courtesy: gisgeography.com*

## Supervised Classification

**Advantages**

- Analyst has control over the selected classes tailored to the purpose
- Has specific classes of known identity
- Does not have to match spectral categories on the final map with informational categories of interest
- Can detect serious errors in classification if training areas are misclassified

**Disadvantages**

- Analyst imposes a classification (may not be natural)
- Training data are usually tied to informational categories and not spectral properties
- Training data selected may not be representative
- Selection of training data may be time consuming and expensive
- Number of training classes are inadequate to represent the whole region

## Un-supervised Classification

**Advantages**

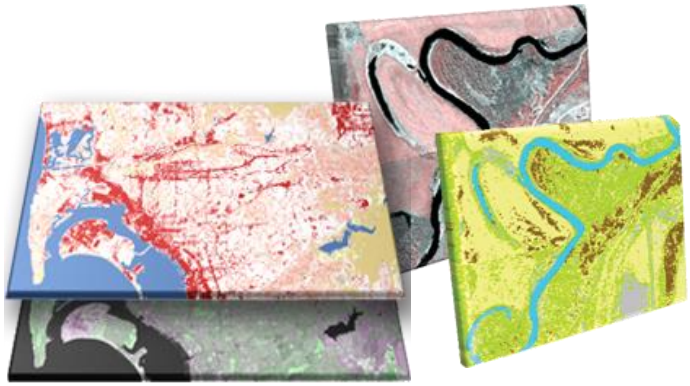
Takes maximum advantage of spectral variability in an image

**Disadvantages**

The maximally-separable clusters in spectral space may not match our perception of the important classes on the landscape

# Types of digital image classification

Based on Interpretation level



## Pixel Based

Traditional Method

Feature space is divided into clusters automatically or based on training sample to produce pixel by pixel classified raster


## Object Based Image Analysis (OBIA)

Perform multiresolution segmentation

Select training areas

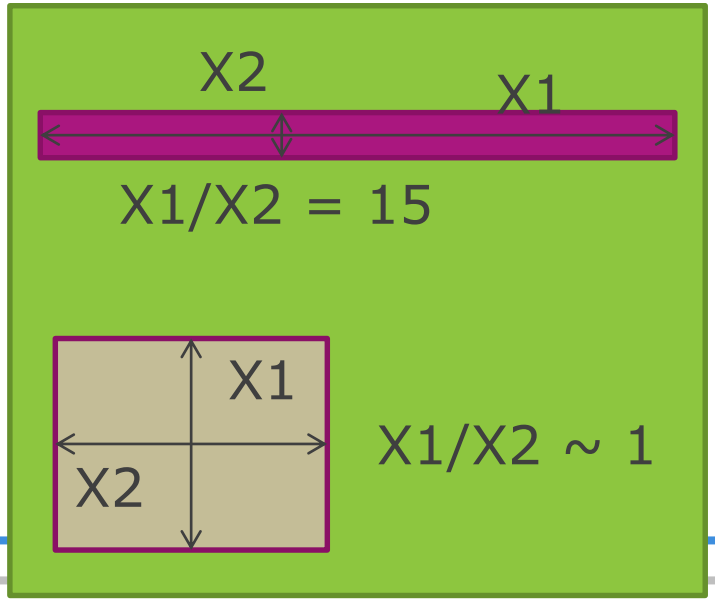
Define statistics

Classify

*Courtesy: gisgrography.com*

# OBIA Example

- *Image Segmentation*
- *Extraction of Grass using NDVI*
- *Extraction of tress using NDVI*
- *Extraction of Bare Soil from Band Ratio*
- *Differentiate road and building by shape properties*




# OBIA

**Advantages**

- Detect objects instead of pixels
- Cleaner output

**Disadvantages**

- Higher resolution image required
- Considerable time required for fine tuning OBIA model for a small area
- Best software for OBIA are super expensive

It is the process of checking the accuracy of the image classification against data from the ground.

Comparison of classification result with enough real world (field) samples:

- Random sampling
- Stratified random sampling

Finally these sample data are used to calculate confusion matrix or error matrix (Next Page)

Overall accuracy: Proportion Correctly Classified (PCC)
Error of Commission: Incorrectly classified samples
Error of Omission: Sample points omitted in interpretation

| | A | B | C | D | Total | Error of Commission (%) | User Accuracy (%) |
|---|---|---|---|---|---|---|---|
| | Reference classes | | | | | | |
| a | 35 | 14 | 11 | 1 | 61 | 43 | 57 |
| b Classes in | 4 | 11 | 3 | 0 | 18 | 39 | 61 |
| c classification result | 12 | 9 | 38 | 4 | 63 | 40 | 60 |
| d | 2 | 5 | 12 | 2 | 21 | 90 | 10 |
| Total | 53 | 39 | 64 | 7 | 163 | | |
| Error of Omission | 34 | 72 | 41 | 71 | | | |
| Producer Accuracy | 66 | 28 | 59 | 29 | | | |

**Omitted 18 classes of total 53**

53 samples in "real world" but 61 cases in classification
in 35 classes agreement between classification and "real world"
Error or Omission: 53 – 35 = 18 / 53 * 100 = 34 %
Producer accuracy: 35 / 53 * 100 = 66%

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联合国训练研究所

UNITAR
International Environment House
Chemin des Anémones 11-13,
CH-1219 Châtelaine,
Geneva - Switzerland
T +41 22 917 8400
F +41 22 917 8047
www.unitar.org