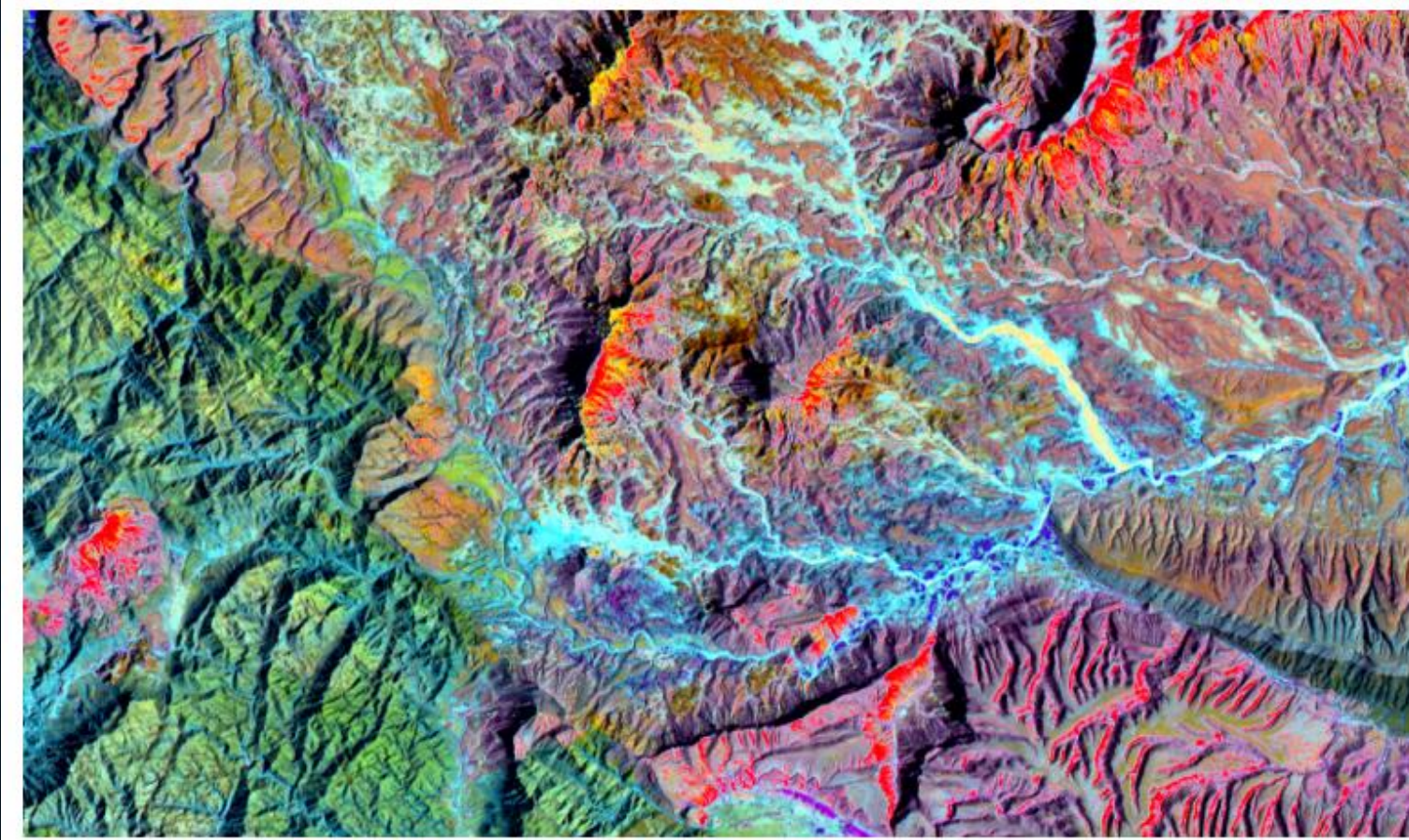


COURSE: SATELLITE IMAGE PROCESSING

LECTURE 2 – Concept of Satellite and Airborne Digital Imagery

Lecturer: Dr. Tingneyuc Sekac, Ph.D. PNG University of Technology

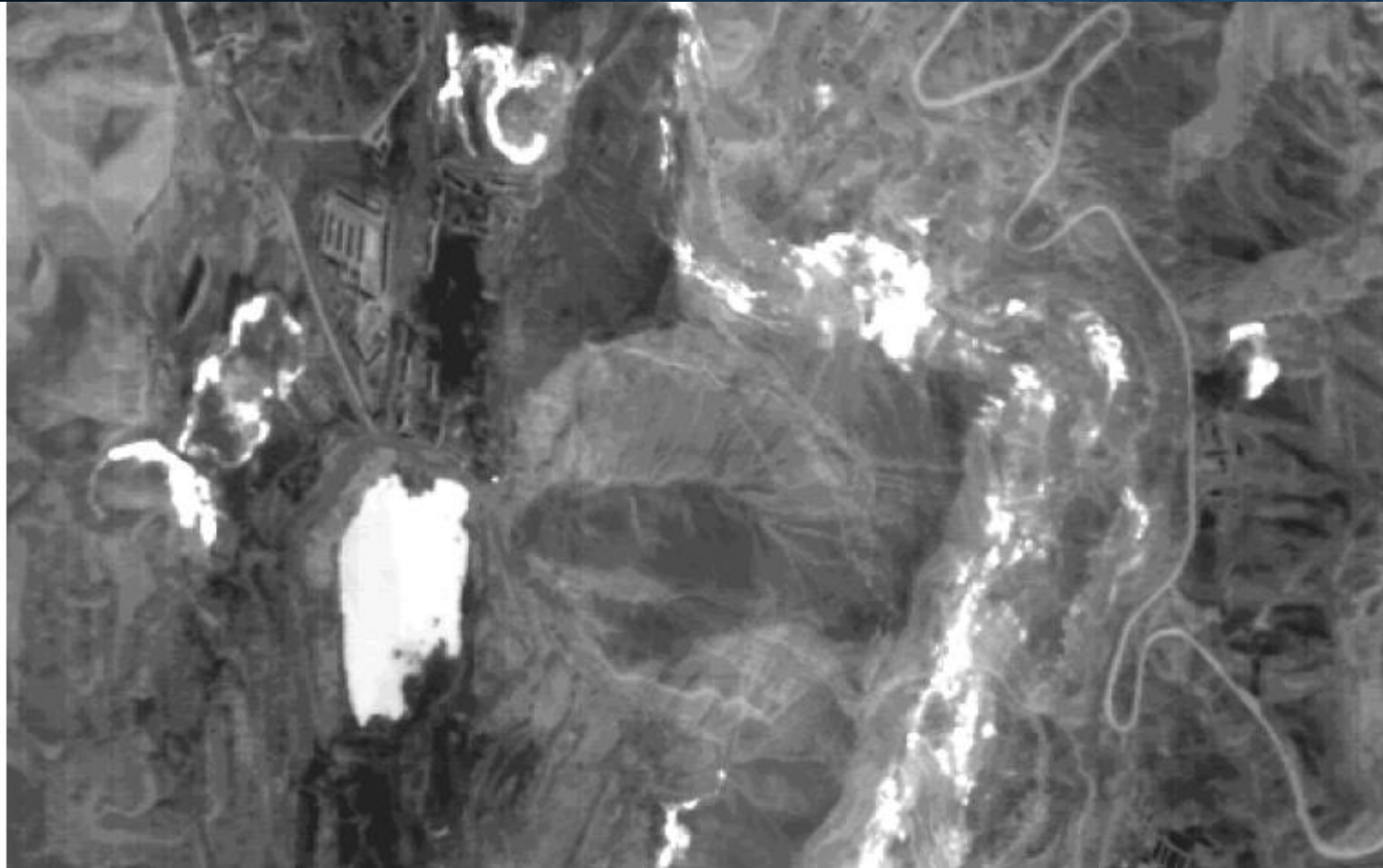
What is Remote Sensing Imagery



Landsat-5 TM false color
Composite of an area of 30km by
17 km

Source: Tempfli. K, et all, 2009

What is Remote Sensing Imagery



- ❑ Thermal image of a coal mining area
Affected by underground coal fires.
- ❑ Darker tones represent colder surfaces, While lighter tones represents warmer areas.
- ❑ Large white patch is a lake – high temperature.

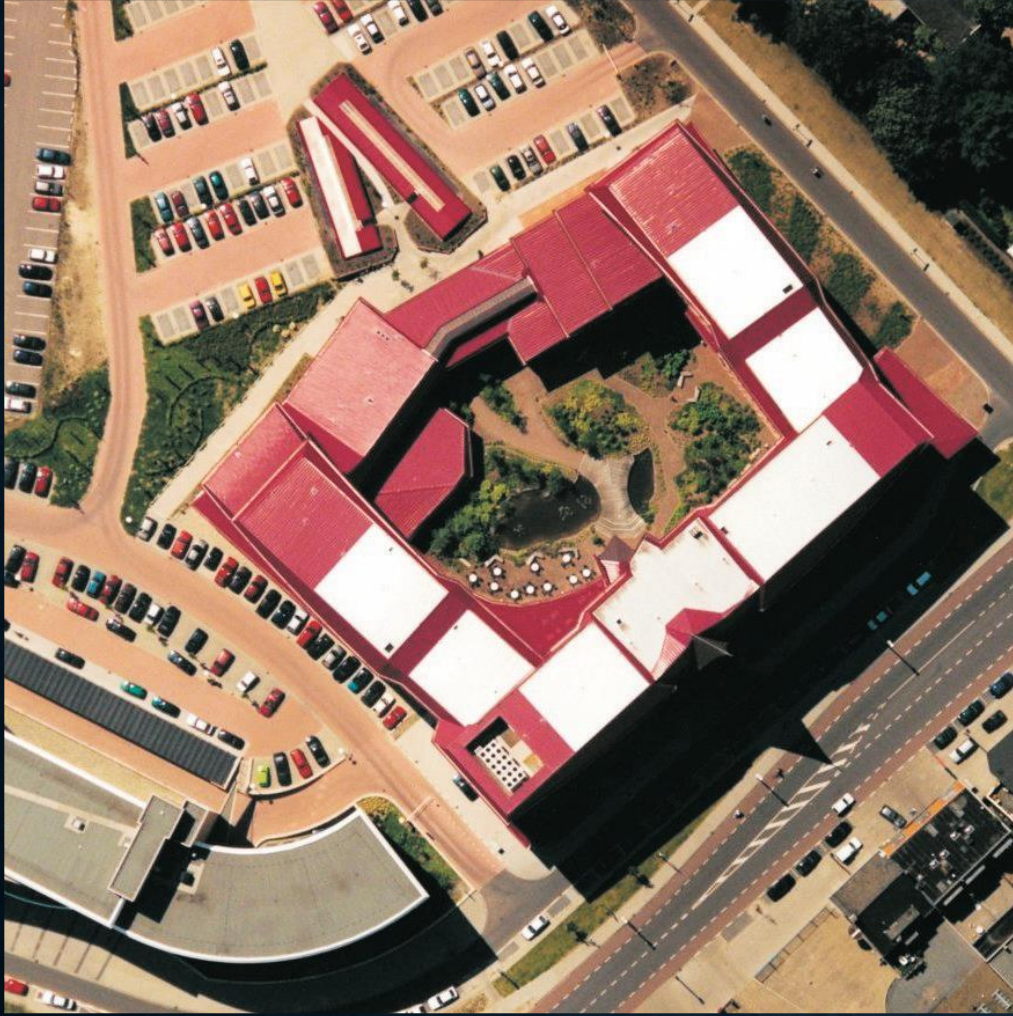
What is Remote Sensing Imagery



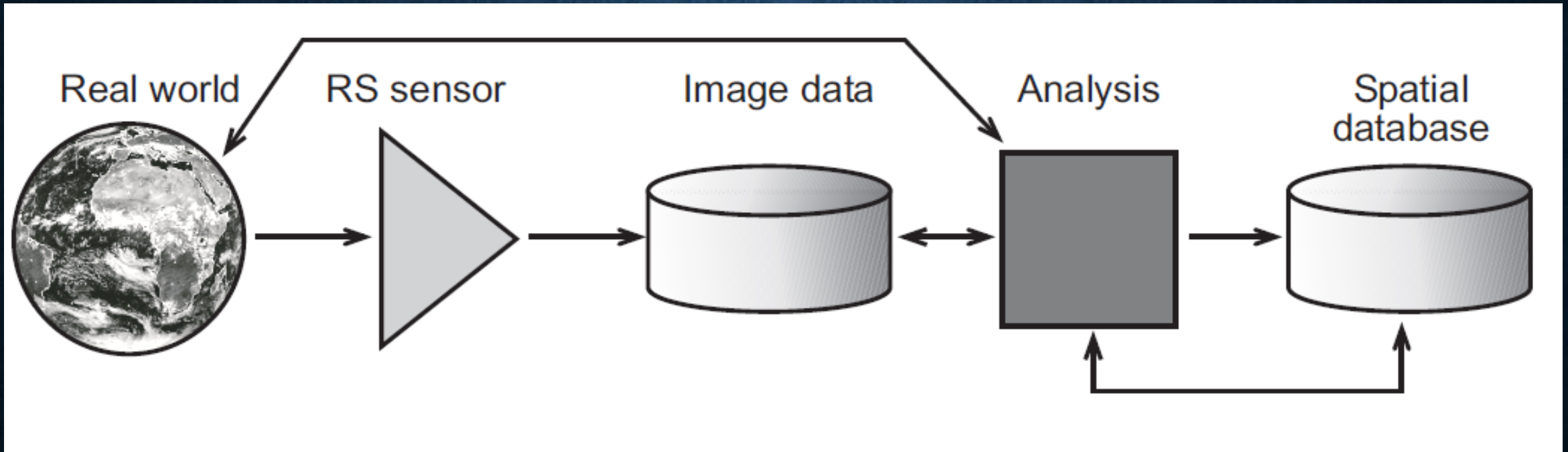
Digital Terrain
Model (5 m grid) of
the marl-pit on the Sint
Pietersberg, the Netherlands.
The size of the pit
is roughly 2 km by 1 km.

Courtesy Survey
Department, Rijkswaterstaat.

Aerial Photograph



What is Remote Sensing Imagery



What is Remote Sensing Imagery

- Remote sensing imagery refers to images of the Earth's surface or atmosphere captured from a distance using specialized sensors mounted on;
 - satellites,
 - aircraft,
 - drones, or
 - ground-based platforms.

Importance of Remote Sensing Imagery

- The images provide valuable information about;
 - land cover,
 - vegetation,
 - urban areas,
 - water bodies,
 - Infrastructures
 - Environmental changes over time
 - Other.

Field of Application for Remote Sensing Imagery

- ❑ Remote sensing imagery plays a crucial role in various fields, including:
 - Agriculture,
 - environmental monitoring,
 - urban planning,
 - disaster management, and
 - natural resource management.

Analog and Digital Images

- ❑ An image is a two-dimensional representation of objects in a real scene.
- ❑ Image can be Analog or Digital



ANALOG FORMAT – Photogrammetry



DIGITAL FORMAT

Difference between Photograph and Satellite image

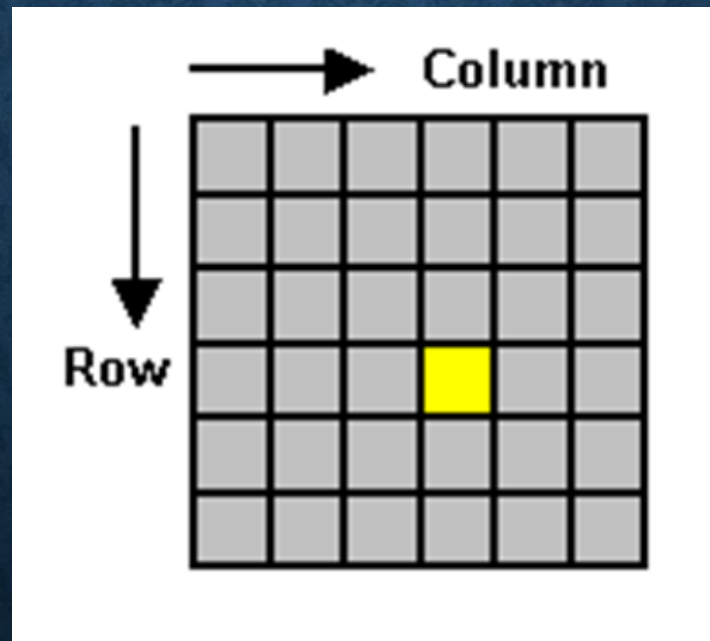
- ❑ The main difference between a photograph and a satellite image is that the photograph has an analogue format and is usually printed on paper before being interpreted.
- ❑ The satellite image has a digital format and a computer is generally used to analyse and interpret it.

Analog Images/ Photograph

- ❑ Much interpretation and identification of targets in remote sensing imagery is performed manually or visually, i.e. by a human interpreter.
- ❑ In many cases this is done using imagery displayed in a pictorial or photograph-type format.
- ❑ In this case we refer to the data as being in analog format.

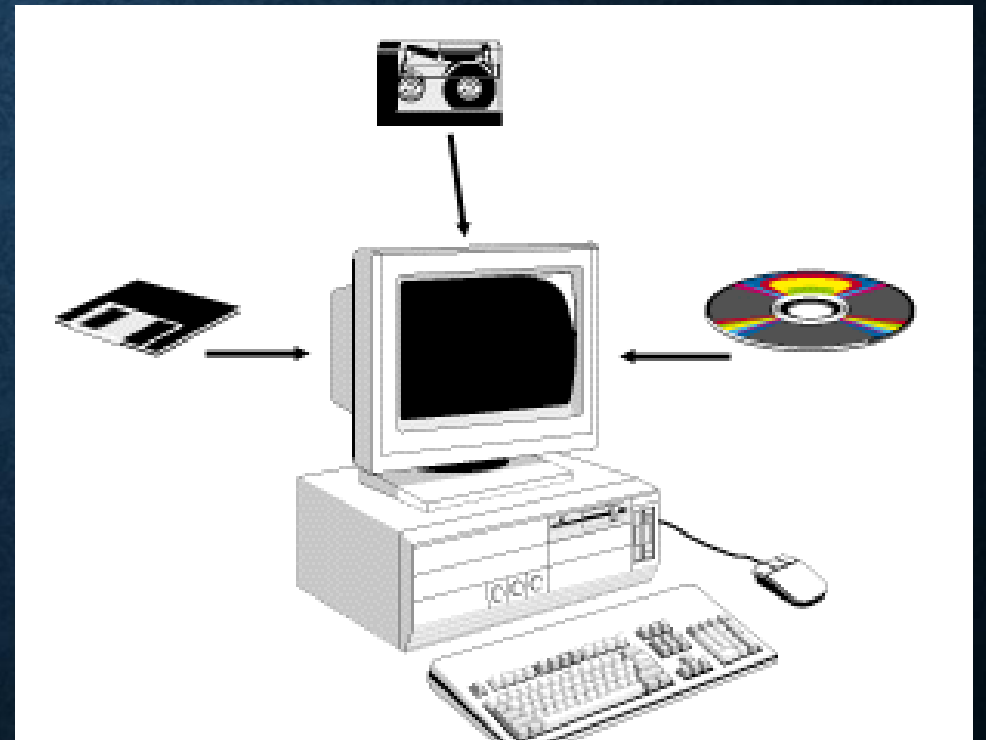
Digital Imagery

- A digital image is a two-dimensional array of pixels. Each pixel has an intensity value (represented by a digital number) and a location address (referenced by its row and column numbers).

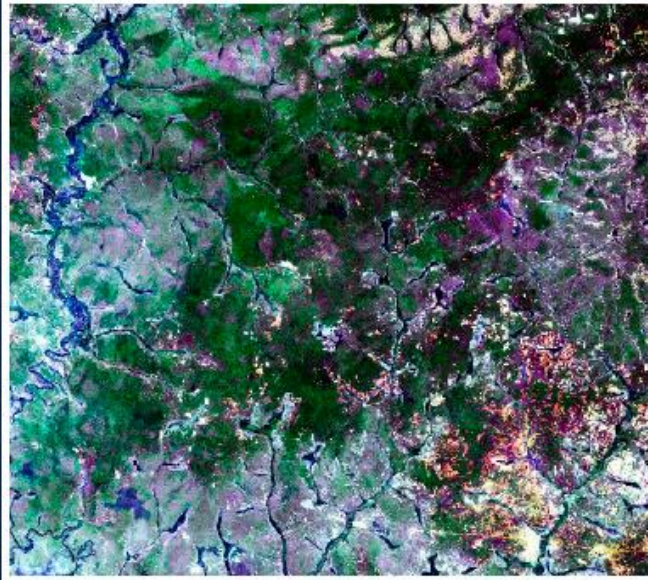


Digital Imagery

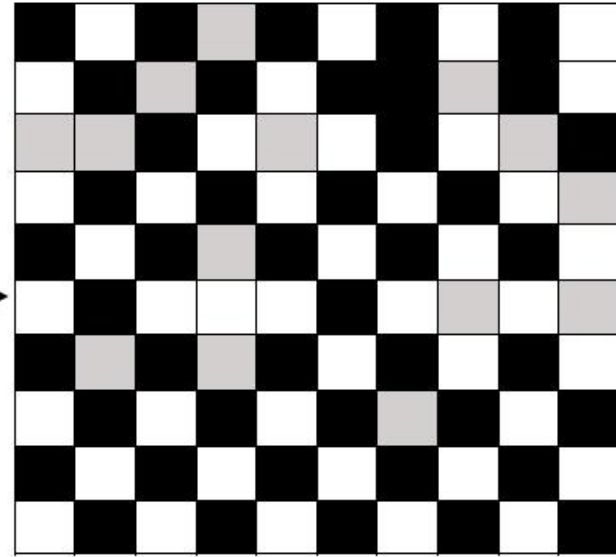
- ❑ Digital remote sensing images are represented in a computer as arrays of pixels, with each pixel corresponding to a digital number. Hence becoming digital



Digital Imagery



Landsat Image



Pixels

23	11	12	200	34	35	45	46	50	25
1	89	1	33	78	60	55	1	76	99
89	0	56	45	90	91	88	3	80	87
67	56	77	90	23	1	99	34	90	68
44	99	80	65	40	100	8	7	8	49
55	32	23	55	71	0	19	200	33	45
45	34	21	44	207	65	18	33	12	77
88	45	22	33	45	66	78	89	0	77
9	10	13	57	89	88	90	200	208	100
11	23	12	7	209	56	78	45	88	78

Digital Numbers

Digital Vs Analog Imagery

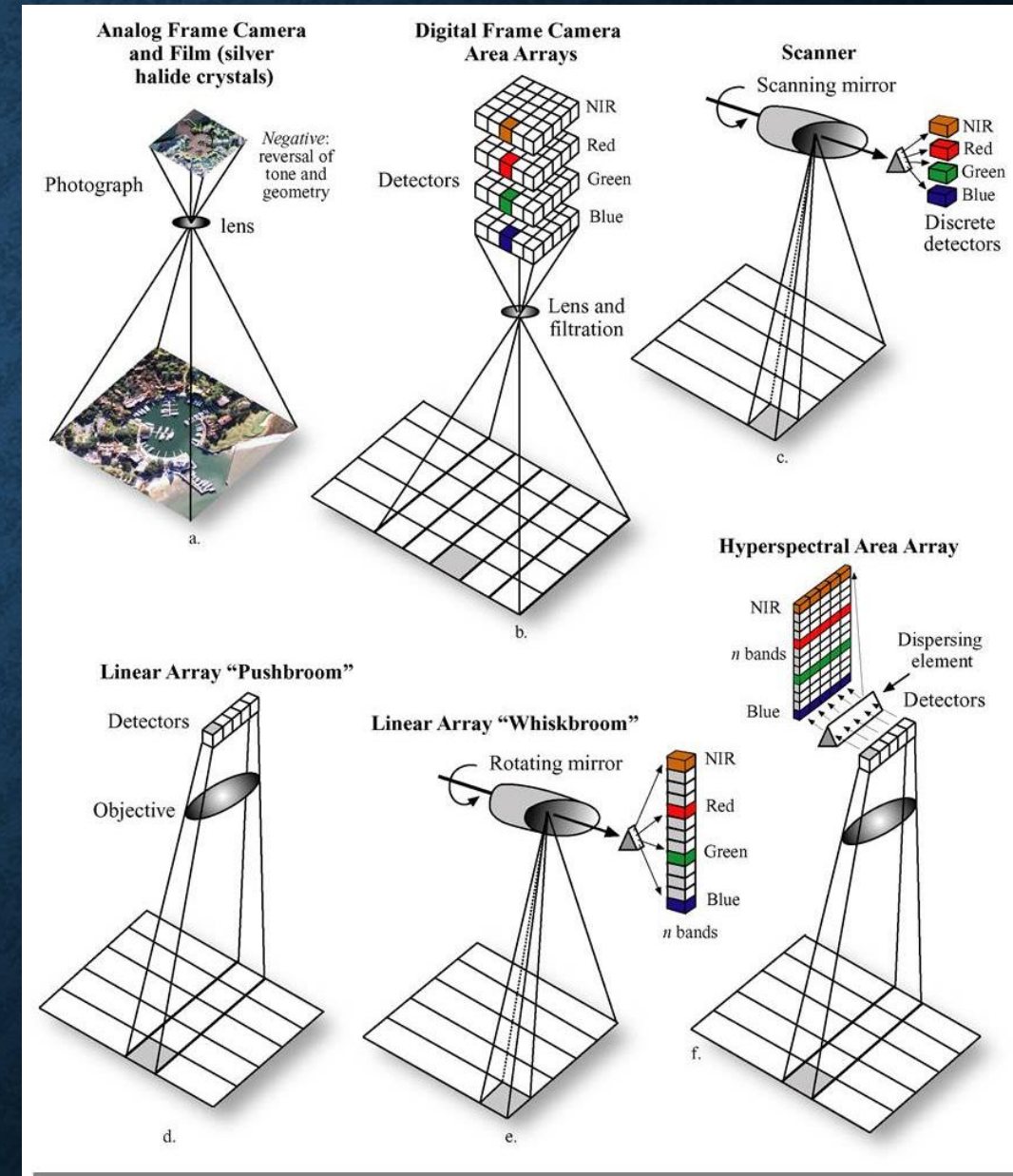
- ❑ Manual interpretation and analysis dates back to the early beginnings of remote sensing for air photo interpretation.
- ❑ Digital processing and analysis is more recent with the advent of digital recording of remote sensing data and the development of computers.

Digital Vs Analog Imagery

- Both manual and digital techniques for interpretation of remote sensing data have their respective advantages and disadvantages
 - Manual - not that expensive with limited resources, capability for information extraction is minimum.
 - Digital - Much expensive and requires more software, hardware processing system and information extraction is more.

Digital and Analog Imagery capturing

Remote Sensing systems used to collect Aerial photography, Multispectral and Hyperspectral Imagery



Digital Image

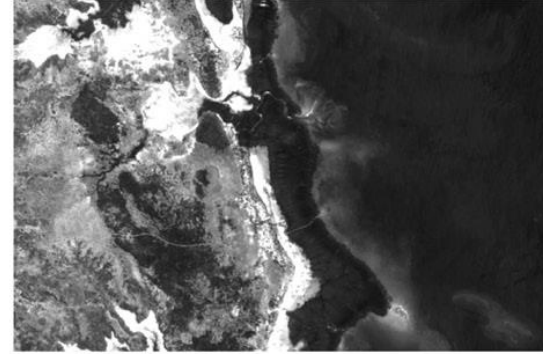
Blue band



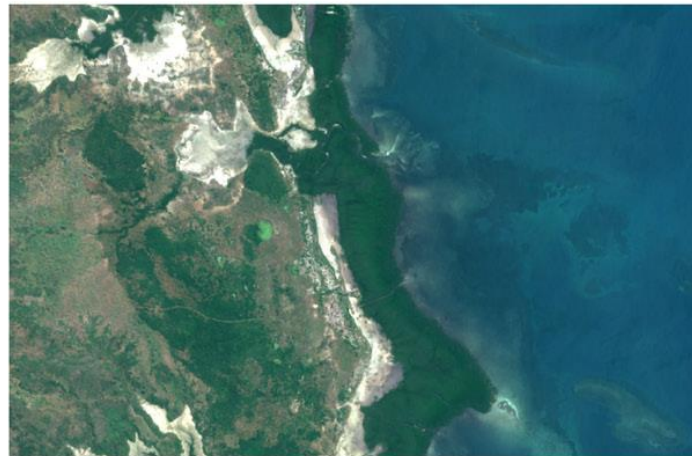
Green band



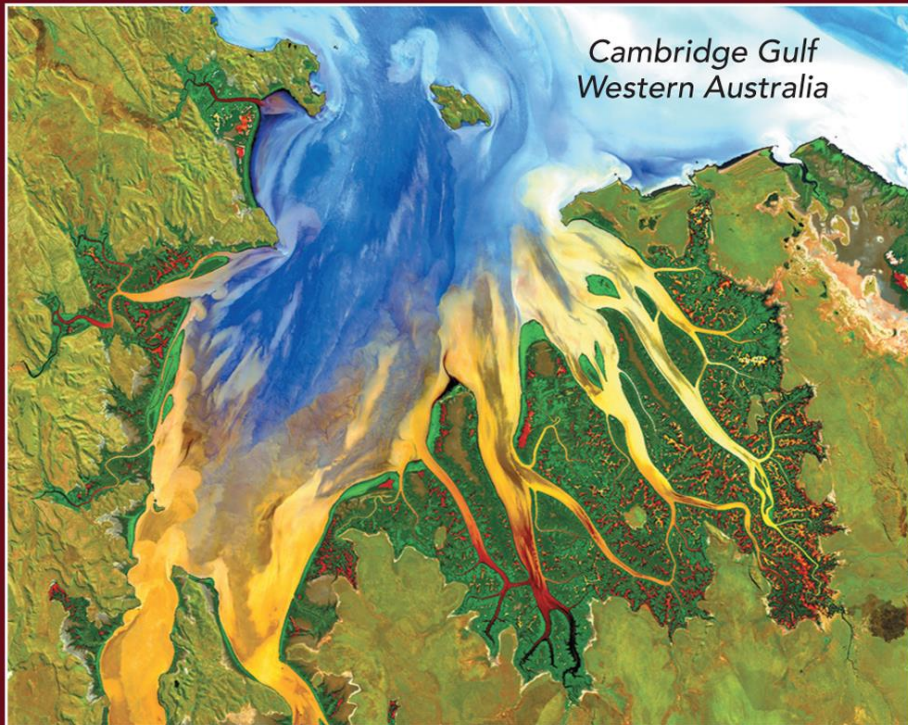
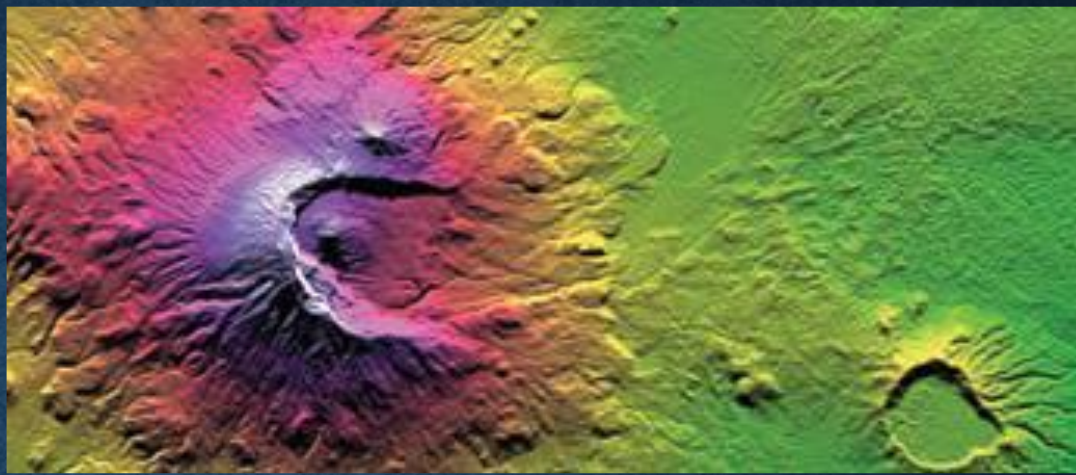
Red band



RGB composite



Remote Sensing Digital Imagery



Introduction to Image Processing

Most of the common image processing functions available in image analysis systems can be categorized into the following four categories:

- Preprocessing
- Image Enhancement
- Image Transformation
- Image Classification and Analysis
- Feature extraction

Introduction to Image Processing

Image Preprocessing:

- Before analysis, remote sensing images often undergo preprocessing steps to correct for sensor and atmospheric effects.
- This may include radiometric calibration, geometric correction (orthorectification), atmospheric correction, and noise reduction.

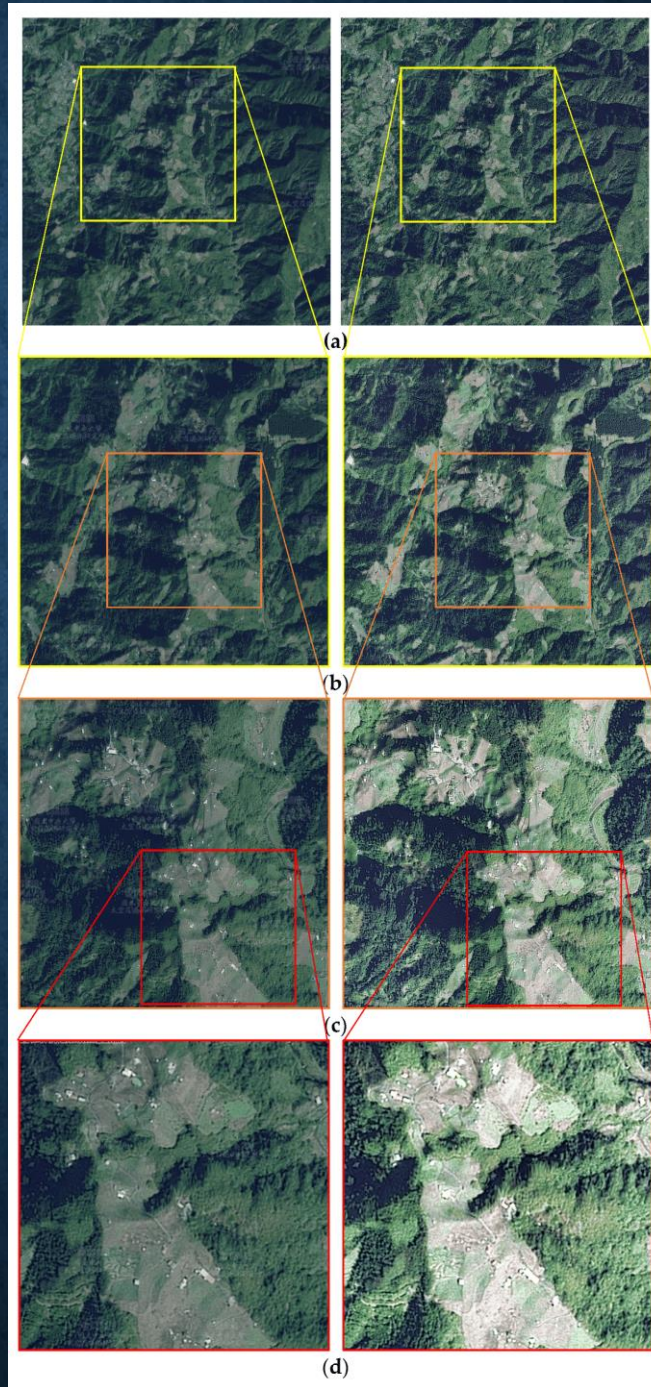
Introduction to Image Processing

Image Enhancement:

- Techniques such as contrast stretching, histogram equalization, and image sharpening are used to improve the visual quality and interpretability of remote sensing images.
- These enhancements can help highlight features of interest and improve image clarity.

Introduction to Image Processing

Image Enhancement:



Introduction to Image Processing

Image Classification:

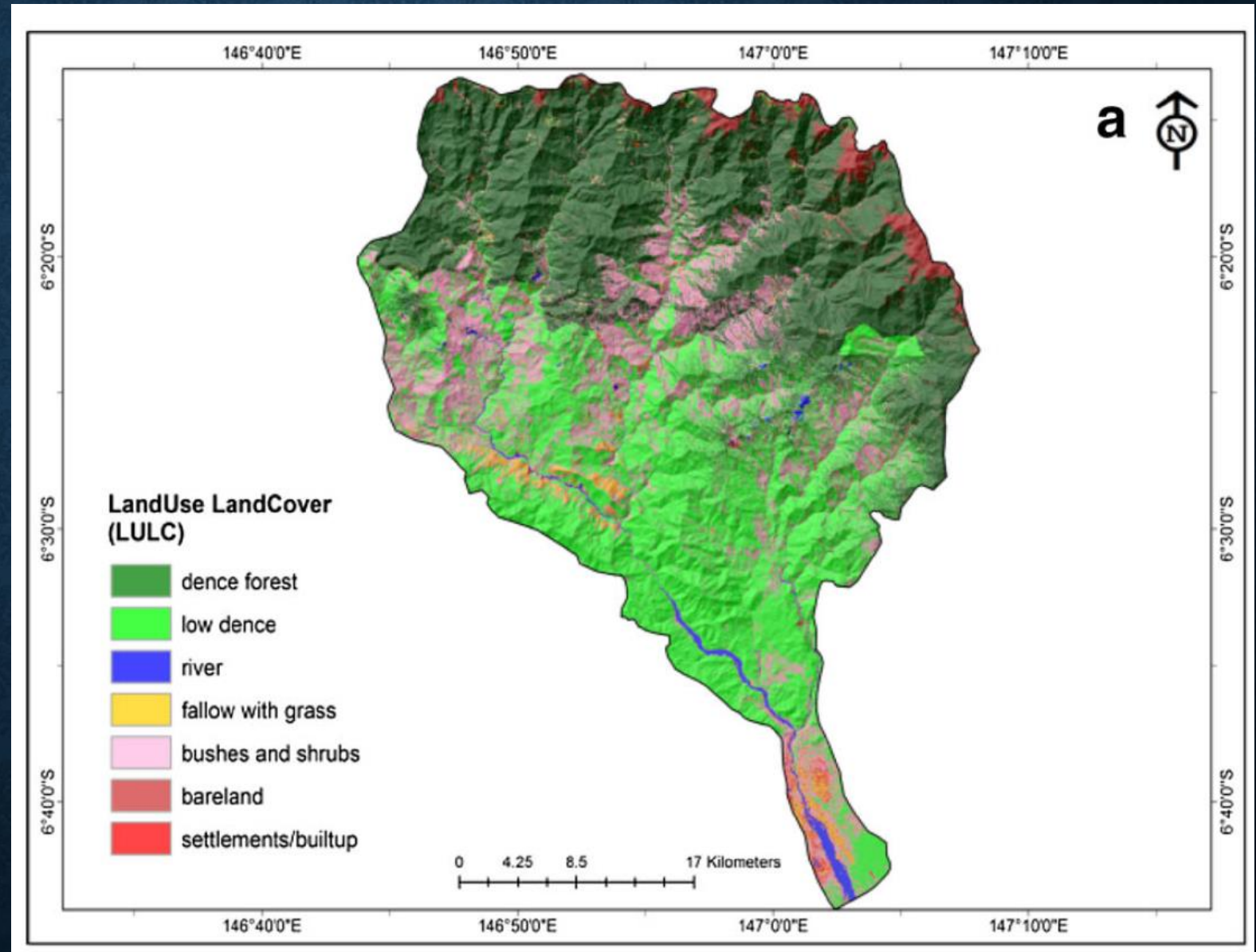
Image classification involves categorizing pixels within an image into different thematic classes or land cover types based on their spectral characteristics.

Common classification methods include:

- supervised classification
- unsupervised classification

Introduction to Image Processing

Supervised Image Classification



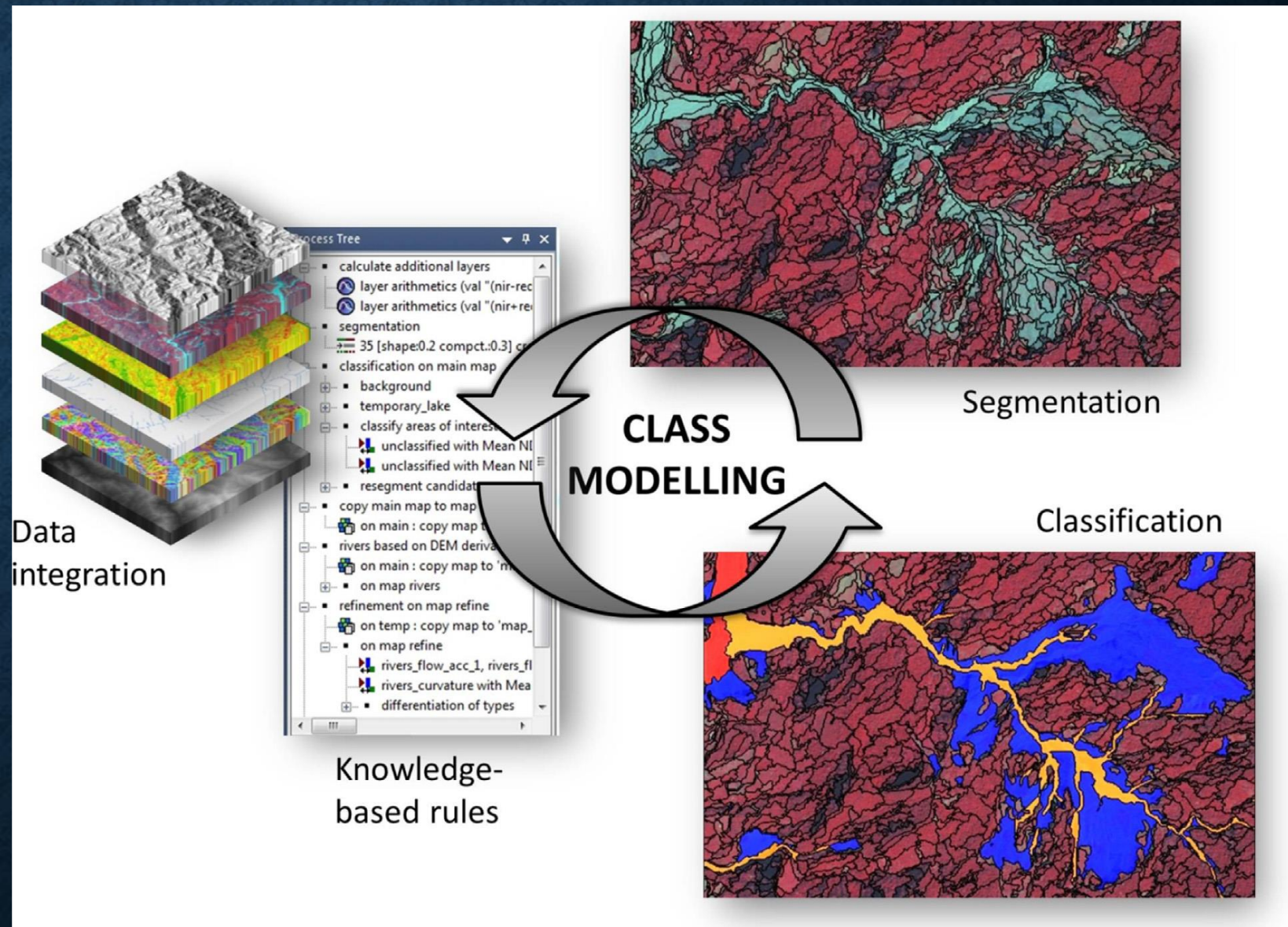
Introduction to Image Processing

Feature Extraction:

- Feature extraction techniques aim to identify and delineate specific features or objects within remote sensing images.
- This may involve edge detection, object-based image analysis (OBIA), and texture analysis to extract information about land cover, vegetation, buildings, and other features.

Introduction to Image Processing

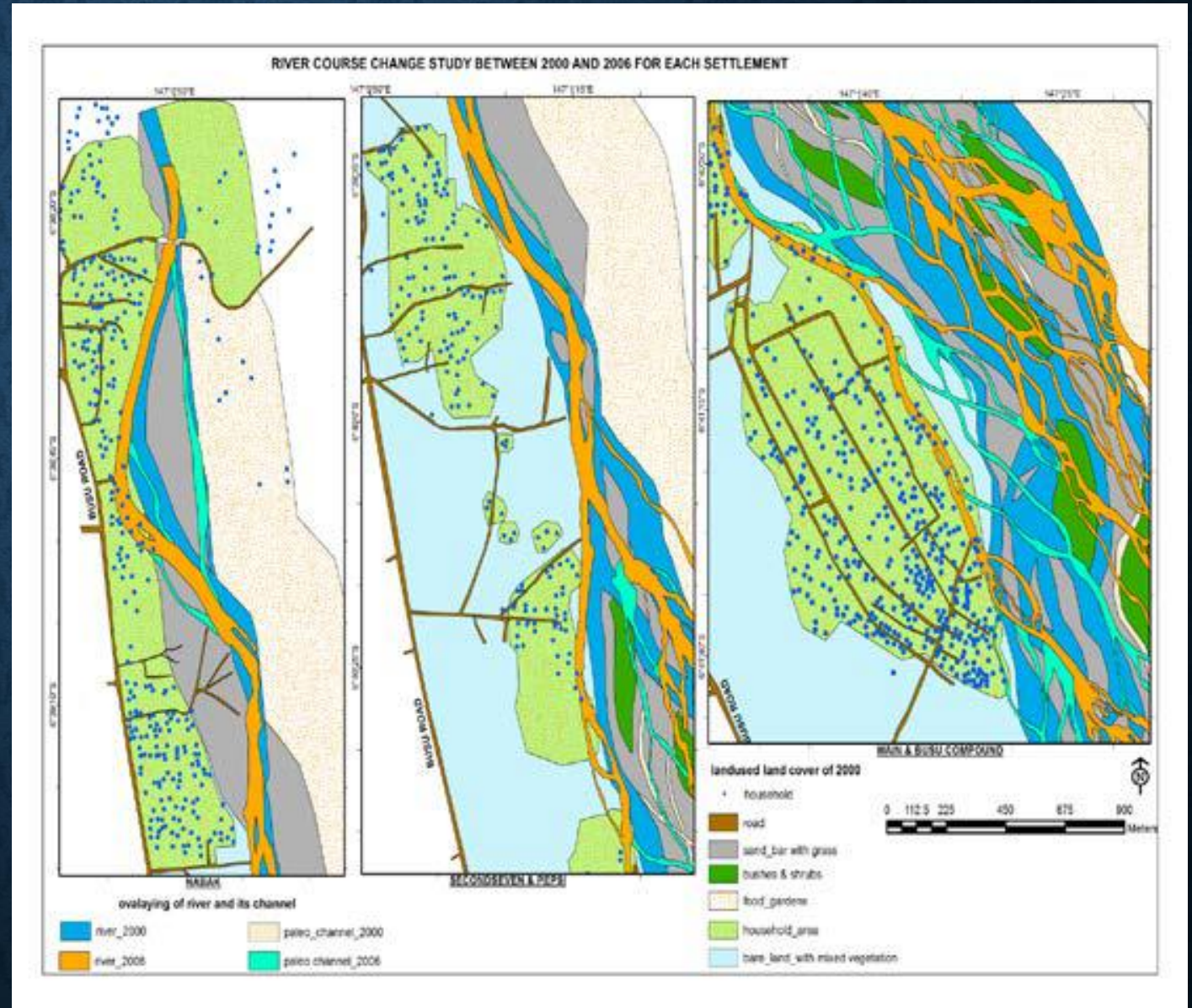
Object Based Image Classification



Introduction to Image Processing

Feature extraction by Manual digitizing from High Resolution Remote Sensing Imagery

Busu River, Lae, Morobe Province, Change Detection



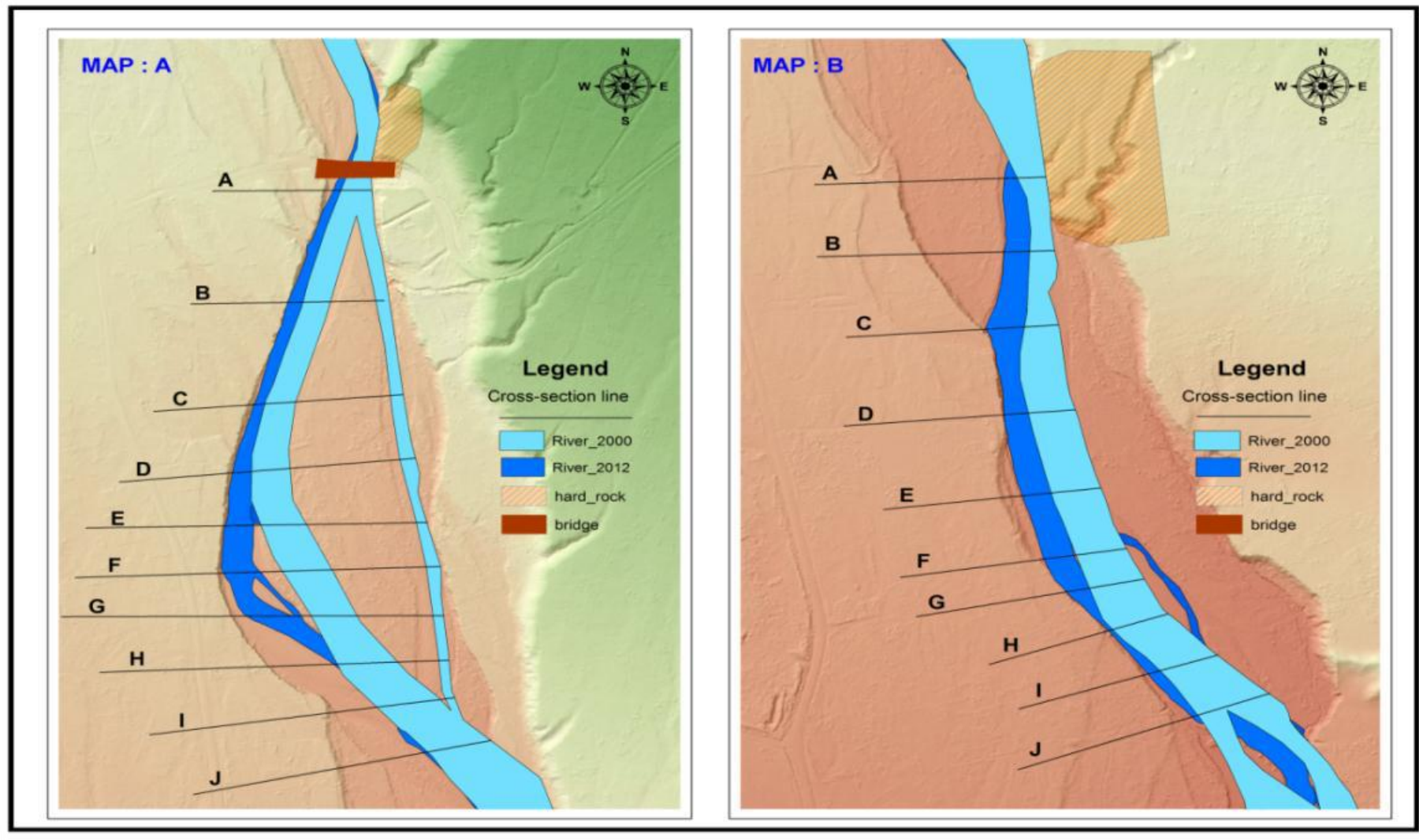
Introduction to Image Processing

Change Detection:

- Change detection techniques compare multiple images acquired at different times to identify and quantify changes in land cover, land use, and environmental conditions over time.
- Change detection methods include image differencing, principal component analysis (PCA), and post-classification comparison.

Introduction to Image Processing

Change Detection of busu River:



Source: T. Sekac et, al 2016

References:

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Sekac, T., Jana, S.K. & Pal, D.K. Identifying potential sites for hydropower plant development in Busu catchment: Papua New Guinea. *Spat. Inf. Res.* **25**, 791–800 (2017).
<https://doi.org/10.1007/s41324-017-0145-z>

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<https://doi.org/10.3390/rs9090967>