BHARATHIDASAN UNIVERSITY

Tiruchirappalli- 620024, Tamil Nadu, India

Programme: M.Sc., Environmental Science

Course Title : Remote Sensing and GIS for Environmental Studies

Course Code : CO02

Unit-I

Fundamentals of Remote Sensing

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Basics of Remote Sensing

Definition of Remote Sensing

- "Remote sensing is the practice of deriving information about the earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the earth’s surface.” (Campbell, 1996)

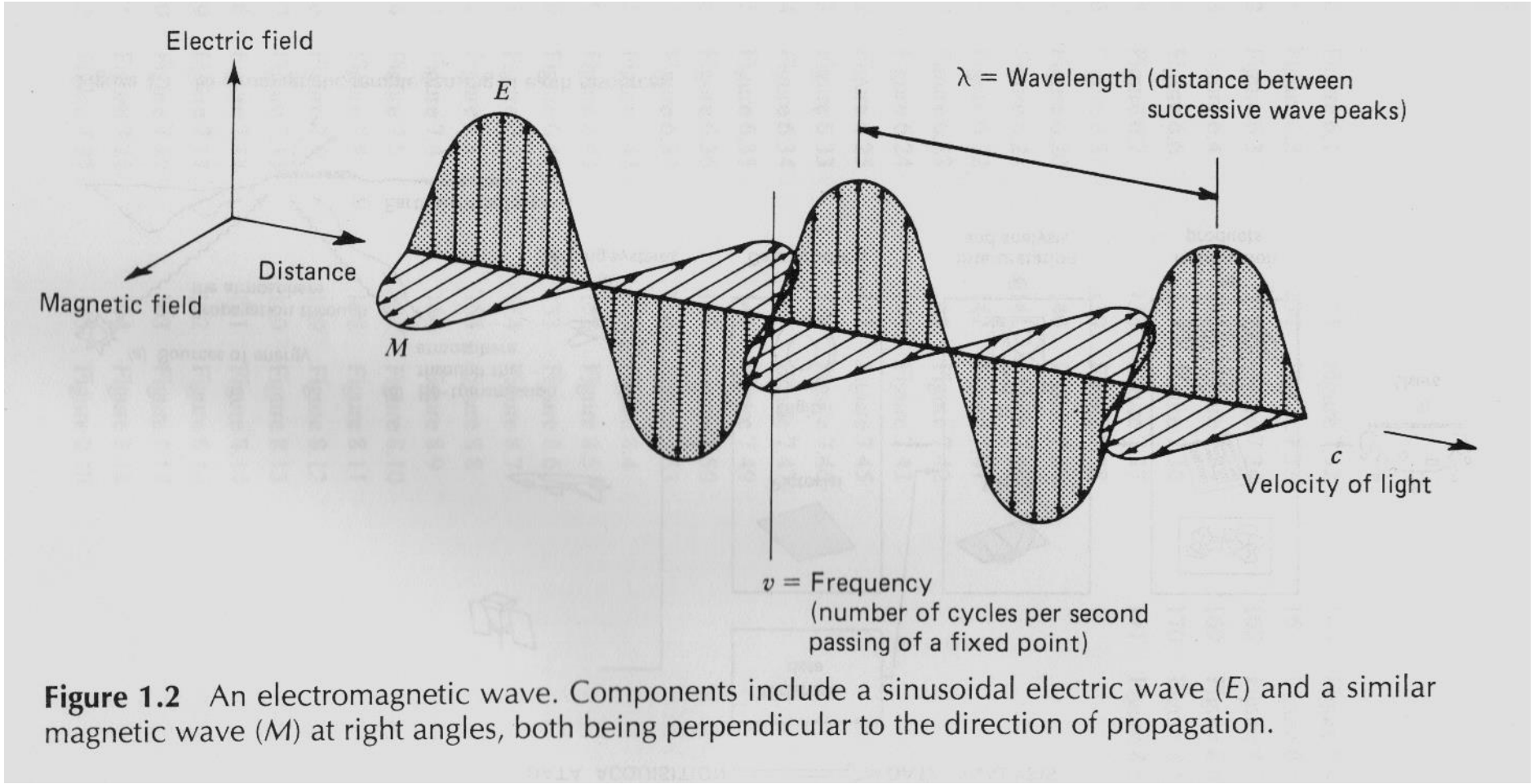
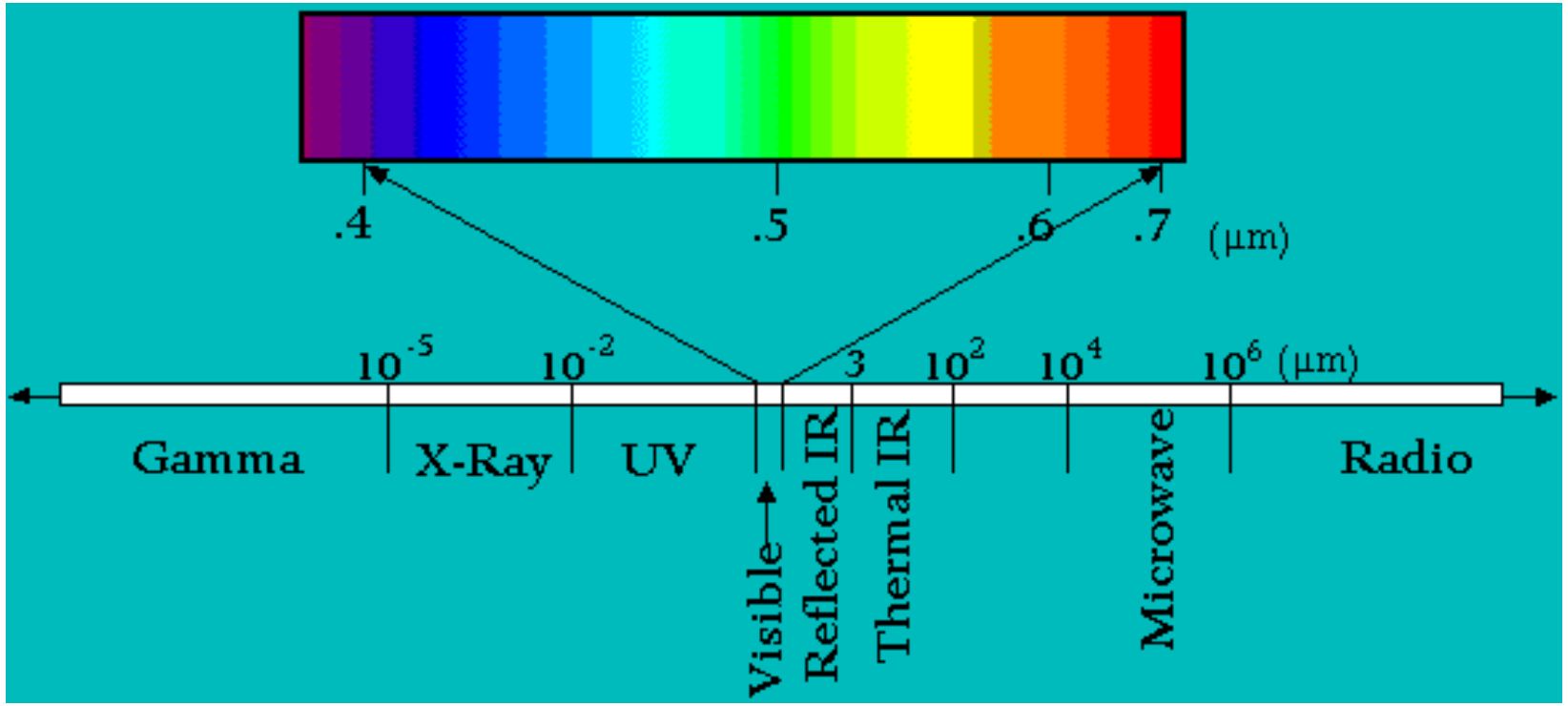


Figure 1.2 An electromagnetic wave. Components include a sinusoidal electric wave (*E*) and a similar magnetic wave (*M*) at right angles, both being perpendicular to the direction of propagation.

From Lillesand & Kiefer, 2001

Electromagnetic Spectrum

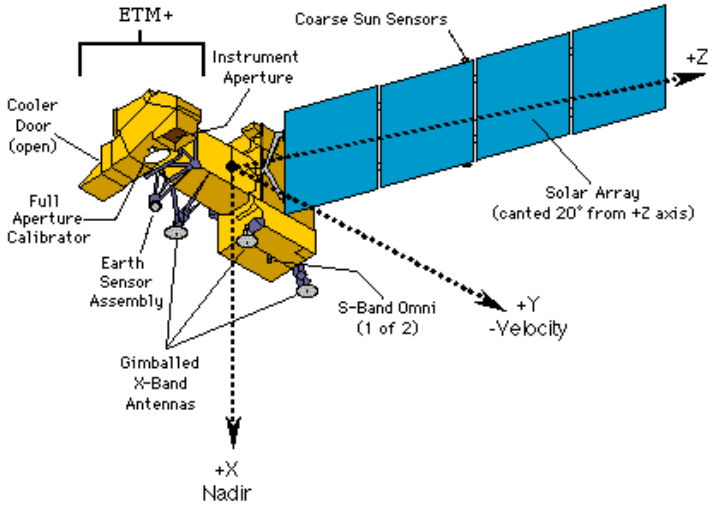
- Remote sensing images are taken within specific spectral regions



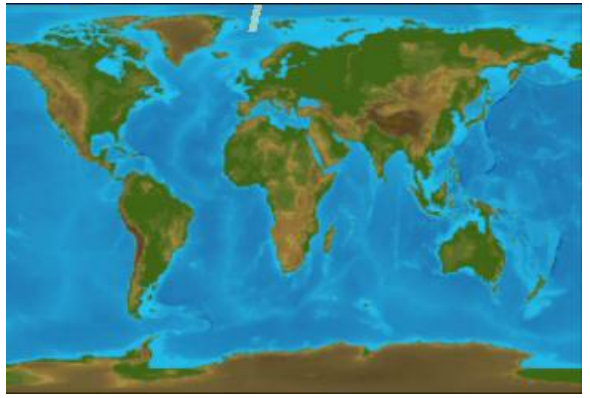
Platforms Used to Acquire Remote Sensing Data

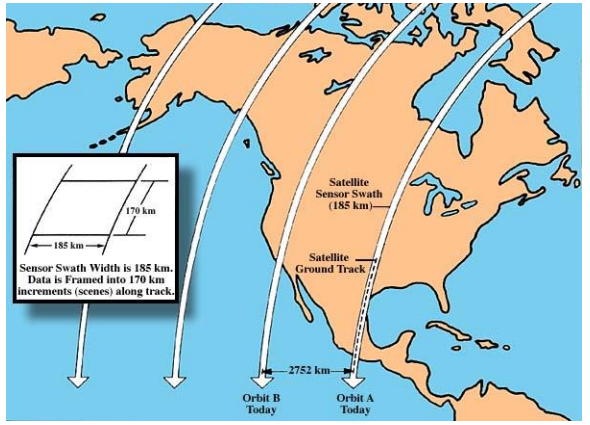
- Aircraft
  - Low, medium & high altitude
  - Higher level of spatial detail
- Satellite
  - Polar-orbiting, sun-synchronous
    - 800-900 km altitude, 90-100 minutes/orbit
  - Geo-synchronous
    - 35,900 km altitude, 24 hrs/orbit
    - stationary relative to Earth

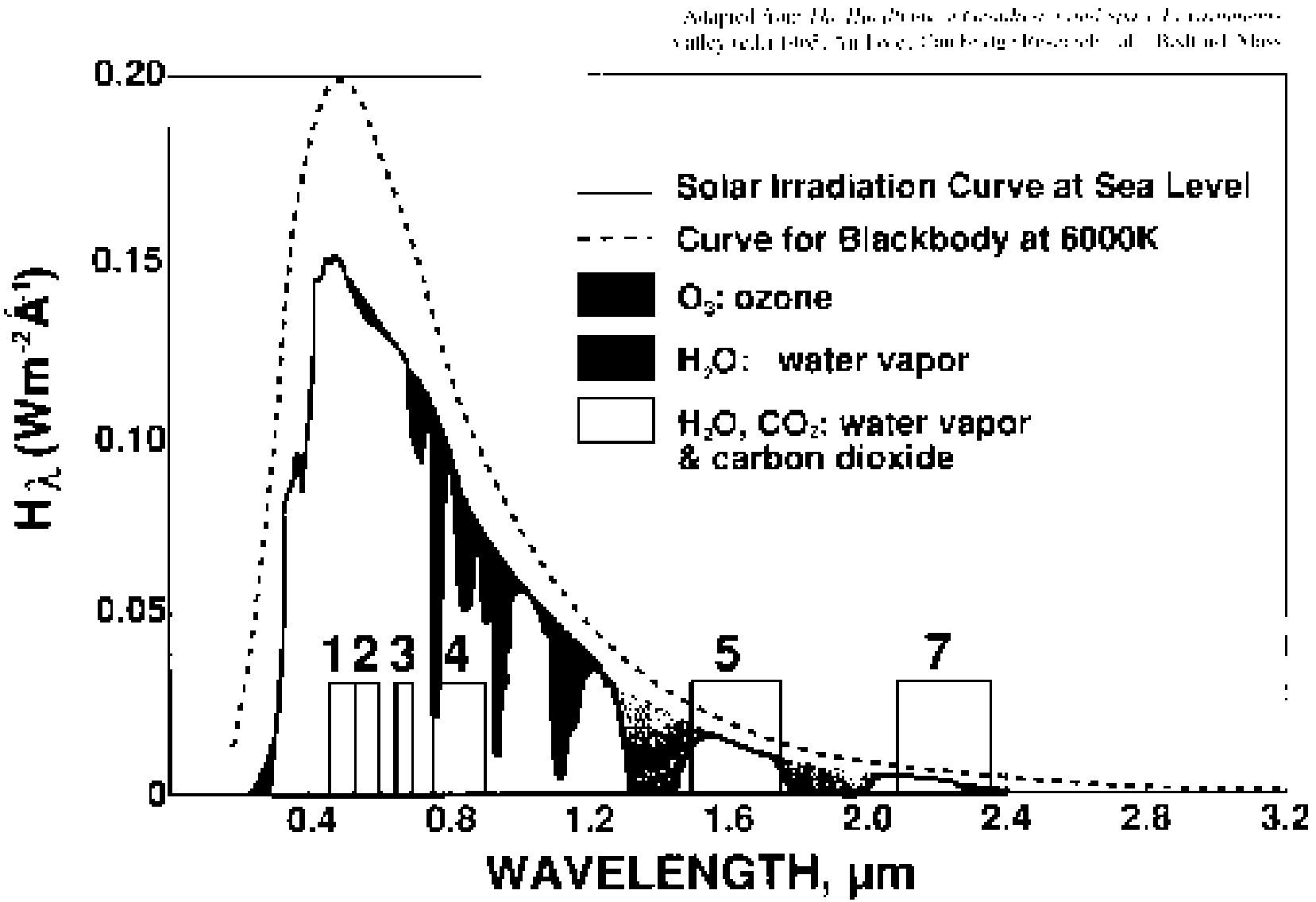
- 705-km altitude
- 16-day repeat cycle
- 185 km swath width
- Descending node at 10:00 - ±15 min
- *Whisk-broom* scanner
- Radiometric resolution: 2^8 (256 levels)



- ETM+ sensor
  - 30-m XS (for 6 bands) & 60-m thermal
  - 15-m pan band
- Image data (185 km by 185 km)
  - $475 – raw data; $600 – corrected data
  - NASA developing a global archive of ETM+



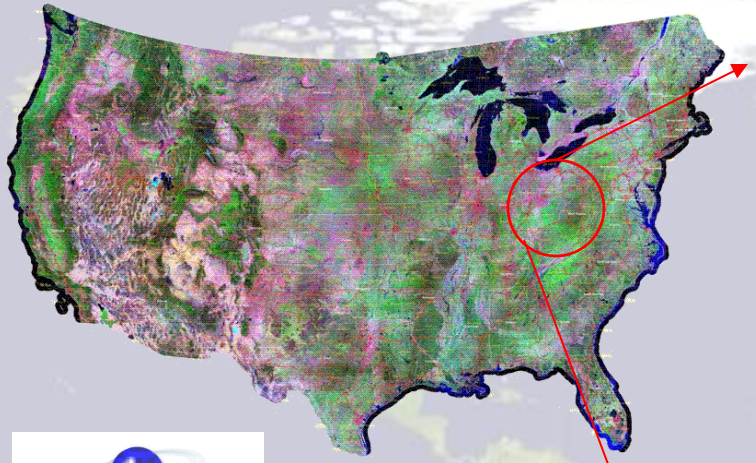


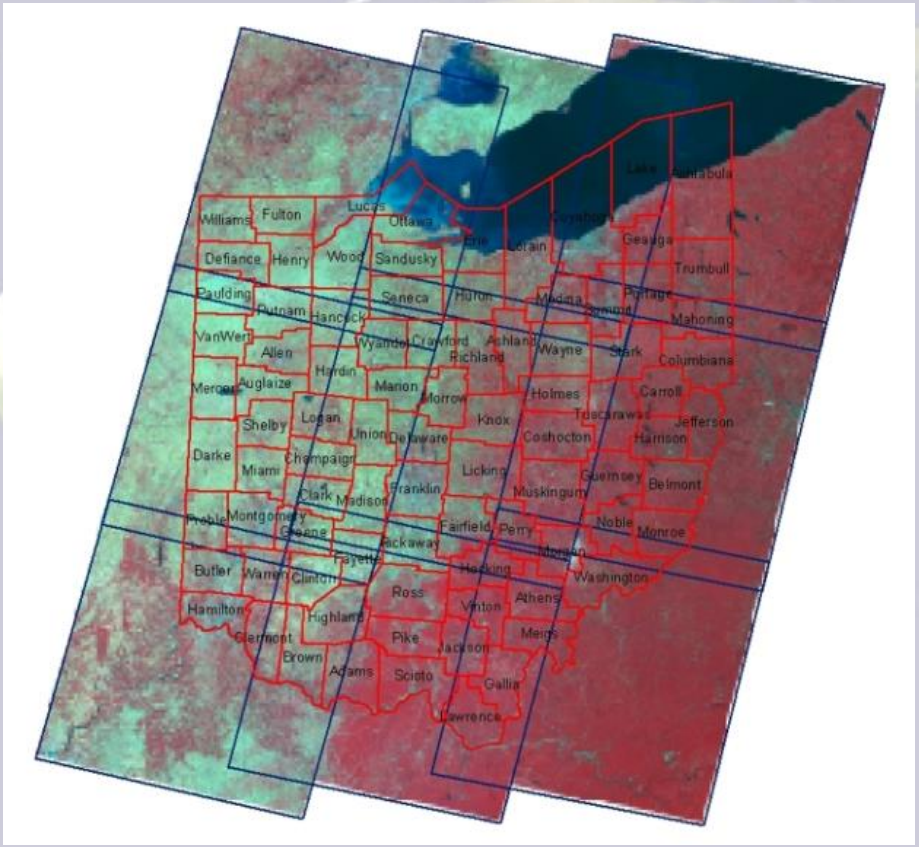


Atmospheric Absorption

Band	*Wavelength (μm)*	*Spectral Location*	*Resolution (m)*
Pan	**0.52-0.90**	**Pan**	**15**
1	**0.45-0.52**	**Blue**	**30**
2	**0.53-0.60**	**Green**	**30**
3	**0.63-0.69**	**Red**	**30**
4	**0.76-0.90**	**Near IR**	**30**
5	**1.55-1.75**	**Mid IR**	**30**
6	**10.4-12.5**	**Thermal IR**	**60**
7	**2.07-2.35**	**Mid IR**	**30**

Band	*Principal Applications*
1	Coastal water mapping, soil/vegetation discrimination, forest type mapping, cultural feature identification
2	Measures green reflectance peak of vegetation for vegetation discrimination & vigor assessment, cultural feature identification
3	Senses a chlorophyll absorption region aiding in plant species differentiation, cultural feature identification
4	Determine vegetation types, vigor & biomass content, delineate water bodies, soil moisture discrimination
5	Indicative of vegetation moisture content & soil moisture, differentiate snow from clouds
6	Useful for vegetation stress analysis, soil moisture discrimination, thermal mapping applications
7	Discrimination of mineral & rock types, sensitive to vegetation moisture content
Pan	Detailed mapping, useful in sharpening multispectral images



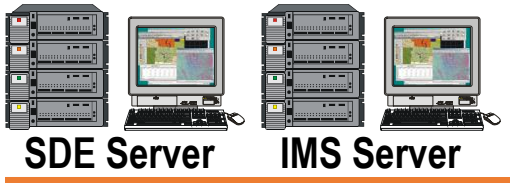


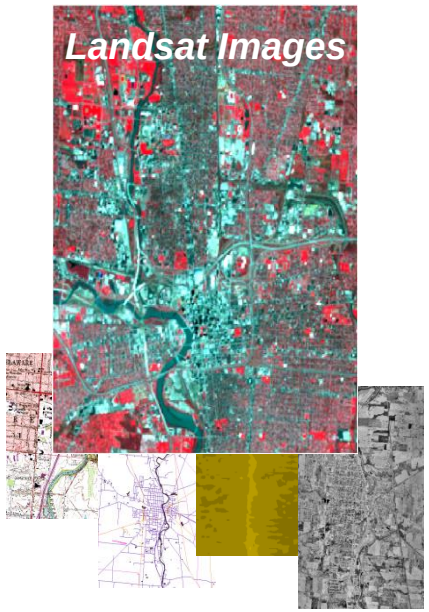
OhioView is represented by ten Ohio universities and partners, including NASA GRC, the USGS EROS Data Center, OAI, and the Ohio Library and Information Network (OhioLINK)

The primary mission for OhioView is to make remote sensing imagery accessible to Ohioans and to fill the knowledge gap in education about the use of these valuable data sets.

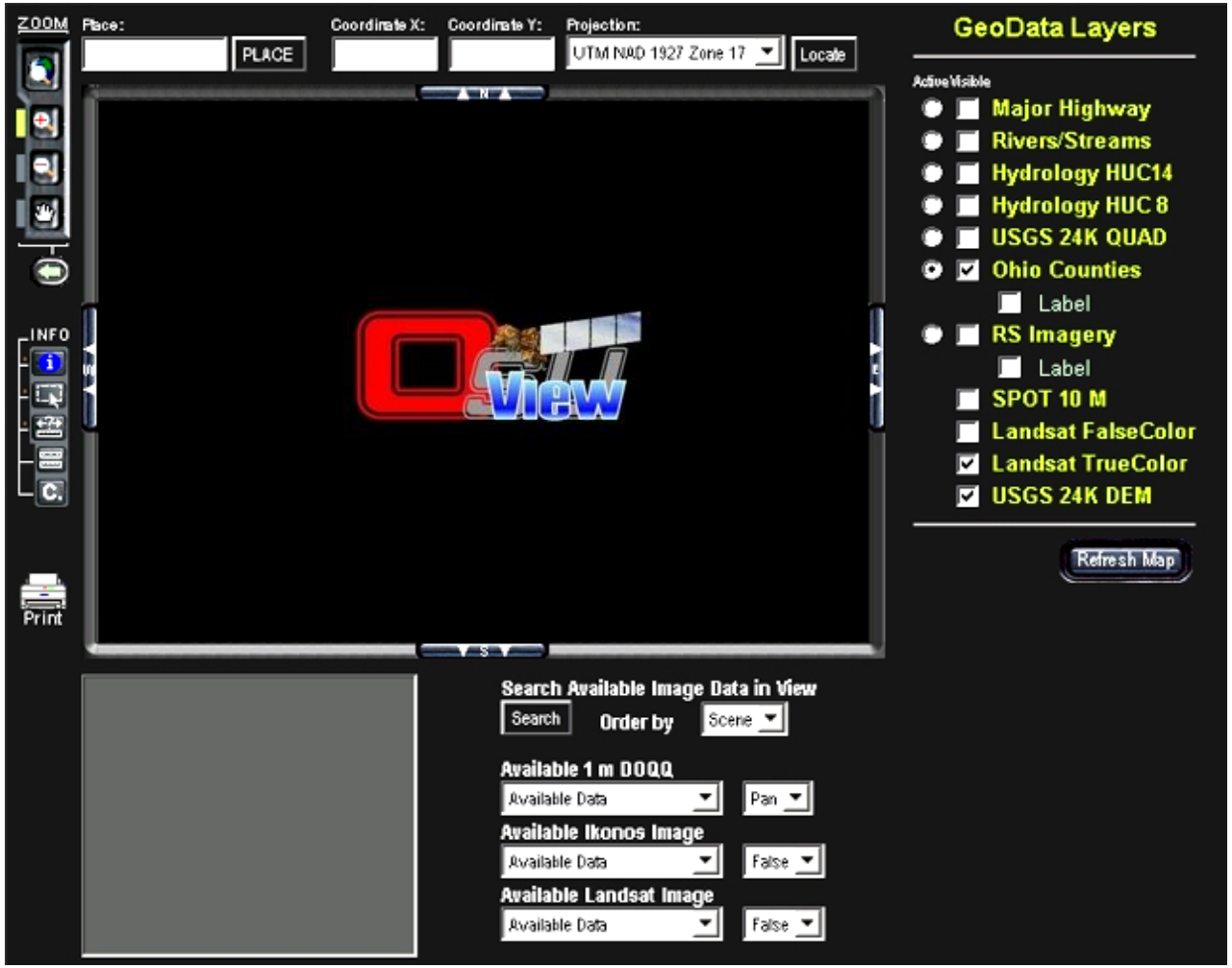
http://OSUView.ceegs.ohio-state.edu

OhioView Mirror Set @ OSUView

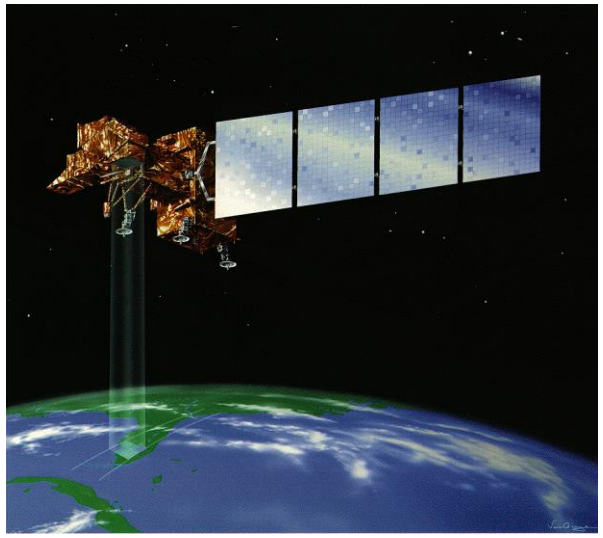




DRG *DLG* *DEM* *DOQQ*



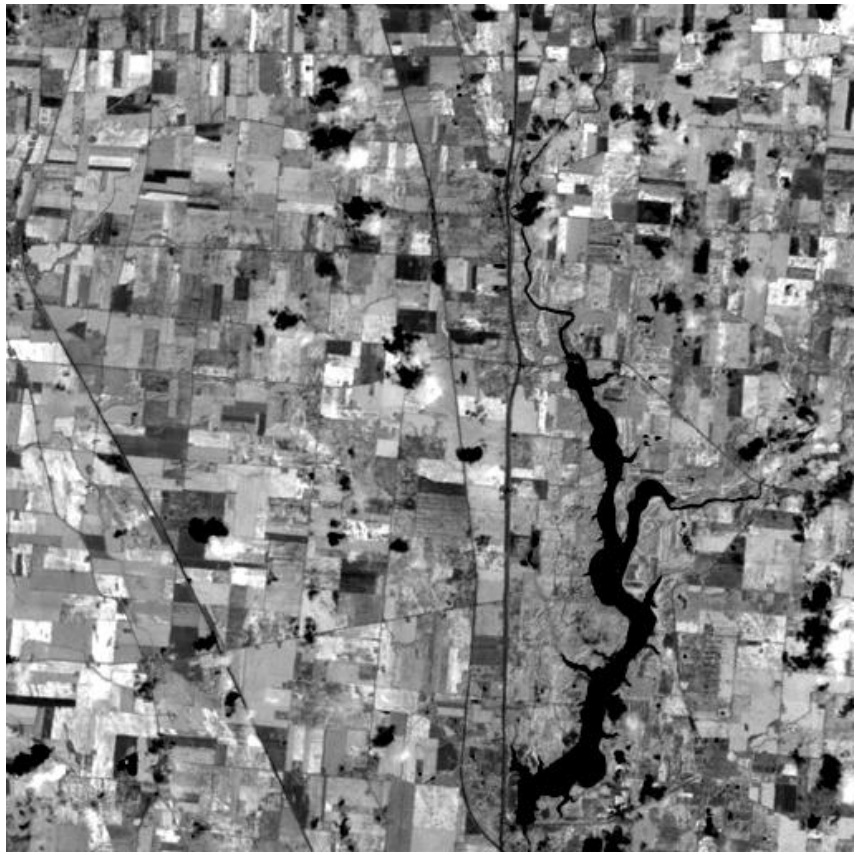
Landsat Web Sites



- http://geo.arc.nasa.gov/sge/landsat/landsat.html
- http://landsat.gsfc.nasa.gov/
- http://landsat.usgs.gov/
- http://earthexplorer.usgs.gov
- http://glovis.usgs.gov
- http://www.ohioview.org/

Delaware, Ohio – 26 July 2000

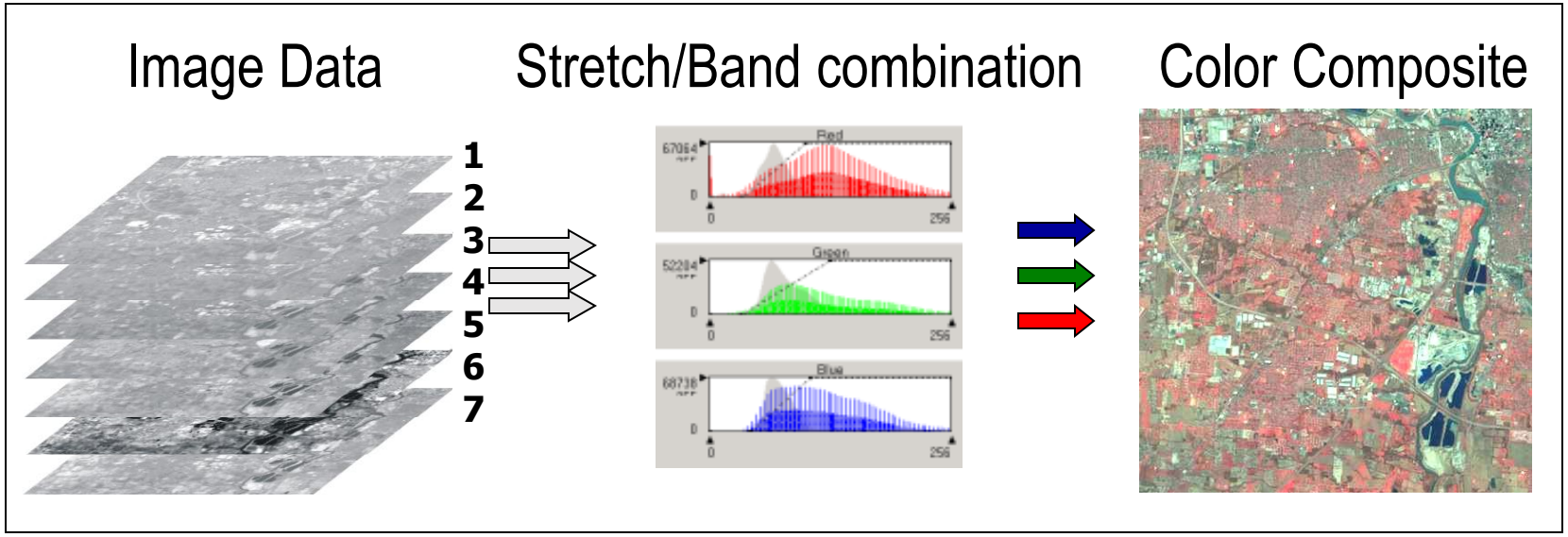
TM band 1
Blue – 0.45-0.52 μm



TM band 4
Near IR – 0.75-0.90 μm

Image display

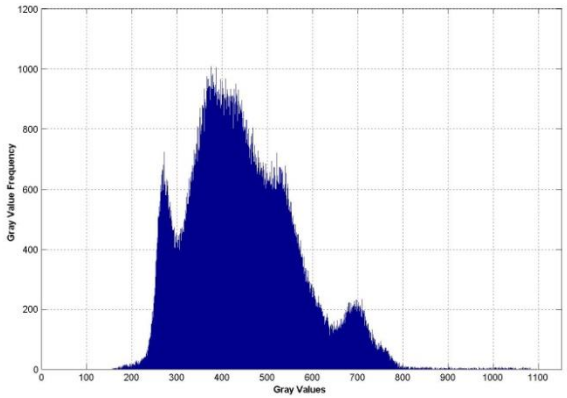
Selected bands are remapped (stretched) to fit the display device. The output image color space is called a look-up table.



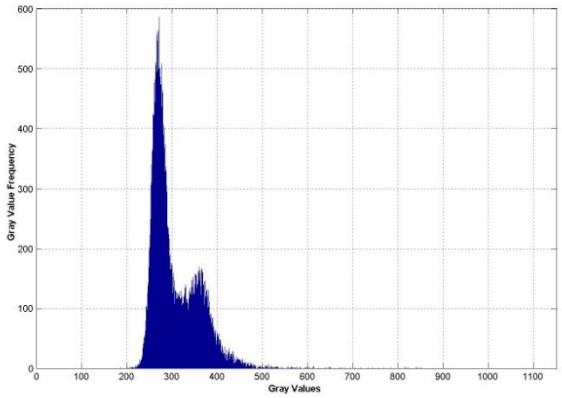
Natural color composite
3,2,1

False color composite
4,3,2

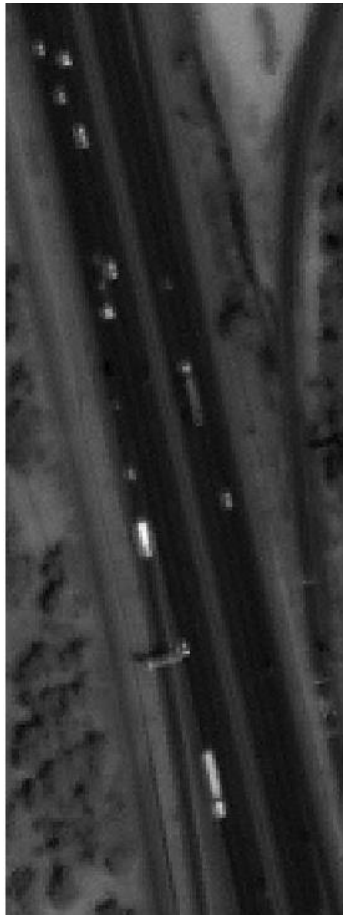
Image histogram



Entire image histogram

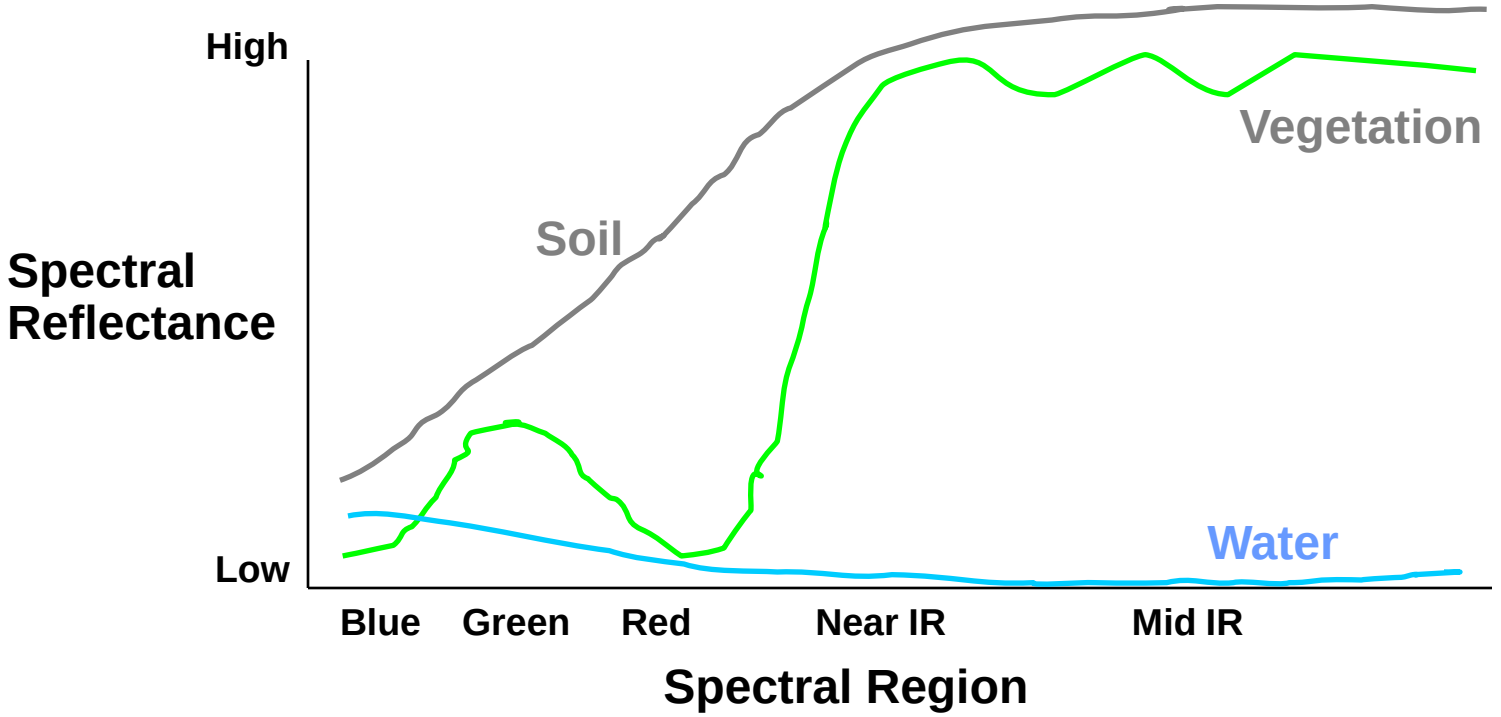


Pavement pixels only

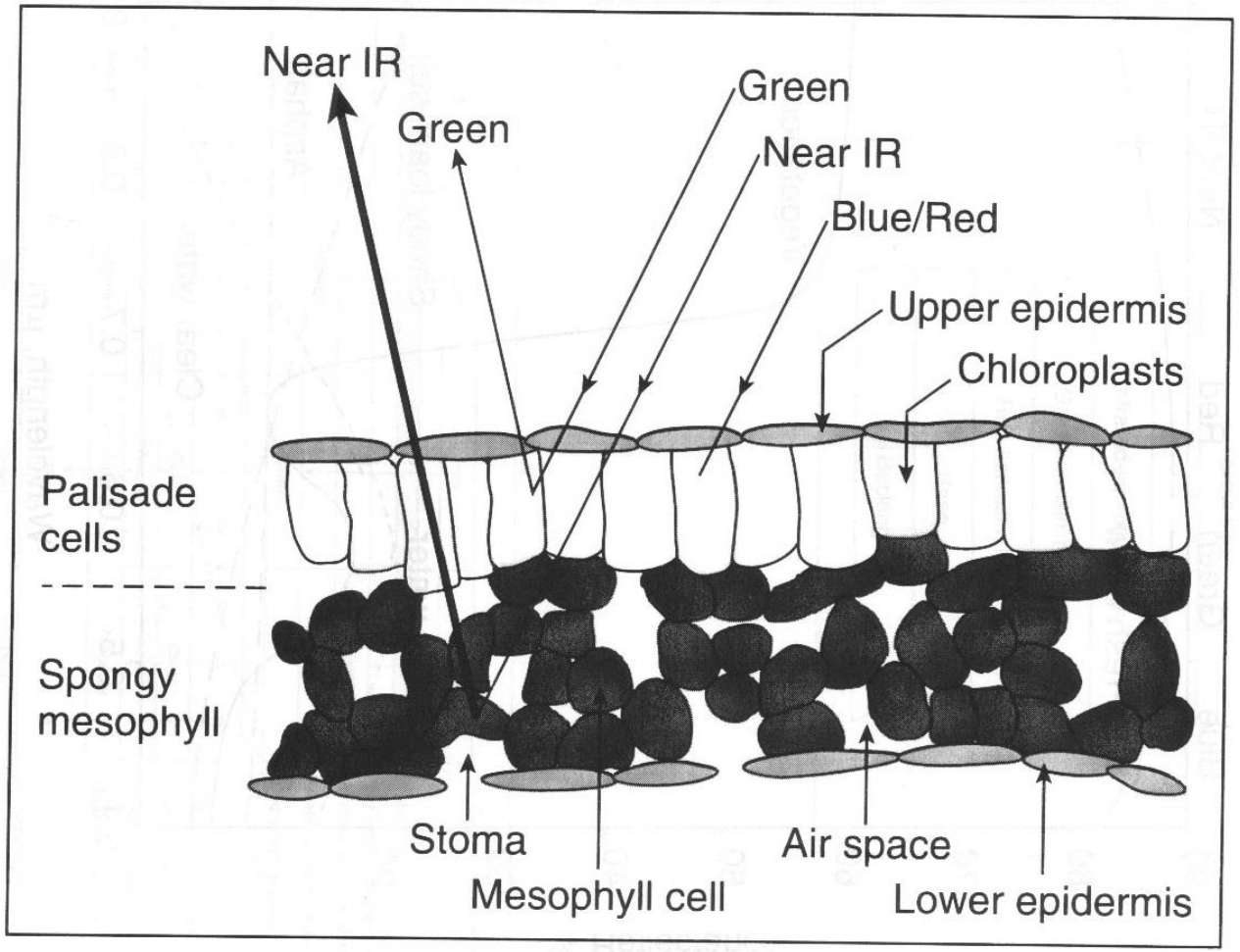


Original image

Spectral Reflectance Curve



Reflectance from a leaf

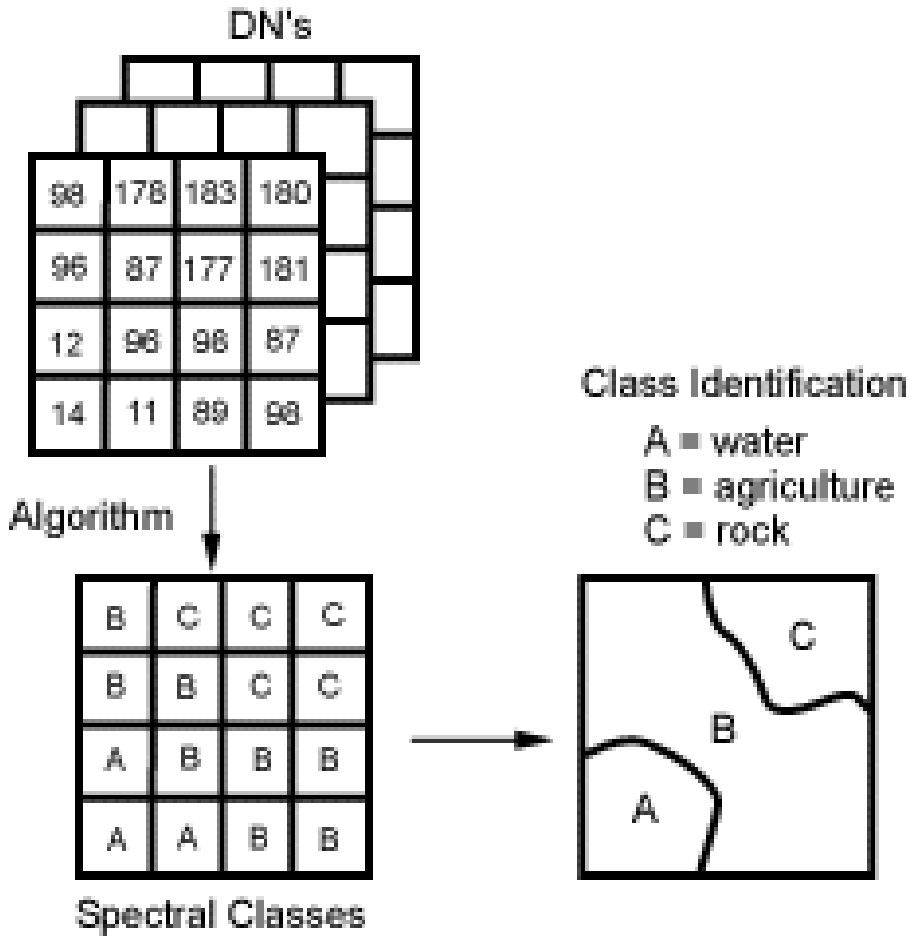


From Avery & Berlin, 1977

Unsupervised classification

- Analyst has minimal interaction
- Computer algorithm searches for natural, inherent groupings in remote sensing images
- Clustering algorithm – ISODATA
- Analyst determines categories for these spectral groups by comparing classified image to ground reference data

Unsupervised classification



Source: Canadian Center for Remote Sensing

Multispec

- Developed at Purdue University – free!
- Works on 512 by 512 images
- Simple image processing techniques
- Techniques today – Delaware, OH area
  - Image display
  - Image classification
- Take home images of your school area
- http://www.ece.purdue.edu/~biehl/MultiSpec/

On-line tutorials in remote sensing

- Fundamentals of Remote Sensing - CCRS
  - http://www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php
- NASA Remote Sensing Tutorial
  - http://rst.gsfc.nasa.gov/
- Remote Sensing Core Curriculum – J. Jensen, Introductory Digital Image Processing
  - http://www.cla.sc.edu/geog/rslab/Rscc/index.html
- Other Landsat-7 data sets:
  - http://l7downloads.gsfc.nasa.gov/index.htm