# Satellite Remote Sensing (UG Hone Vear)

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### Outline

- Remote Sensing Defined
- Resolution
- Electromagnetic Energy (EMR)
- □ Types
- Interpretation
- Applications



### Remote Sensing Defined

#### Remote Sensing is:

"The art and science of obtaining information about an object without being in direct contact with the object" (Jensen 2000).

There is a medium of transmission involved.













### Remote Sensing Defined

#### Environmental Remote Sensing:

- In the collection of information about Earth surfaces and phenomena using sensors not in physical contact with the surfaces and phenomena of interest.
- We will focus on data collected from an overhead perspective via transmission of electromagnetic radiation.





Source: Jensen (2000)



### Remote Sensing Defined

#### □ Remote Sensing Includes:

- A) The mission plan and choice of sensors;
- B) The reception, recording, and processing of the signal data; and

#### C) The analysis of the resultant data.



#### **Remote Sensing Process Components**



Source: Canadian Centre for Remote Sensing

**Energy Source or Illumination** (A)

**Radiation and the Atmosphere (B)** 

Interaction with the Target (C)

Recording of Energy by the Sensor (D)

Transmission, Reception, and Processing (E)

**Interpretation and Analysis (F)** 

Application (G)



### Resolution

# All remote sensing systems have <u>four types</u> of resolution:

Spatial

Spectral

Temporal







#### **Spatial Resolution**

High vs. Low?

Source: Jensen (2000)





# Spectral Resolution

Source: Jensen (2000)



#### **Temporal Resolution**





#### **Radiometric Resolution**

 $\begin{array}{c} 6\text{-bit range} \\ 0 \longrightarrow 63 \end{array}$ 

8-bit range

0 → 255

10-bit range

0-



► 1023

### **Electromagnetic Radiation**





#### Spatial Resolution Example





#### **Radiometric Resolution**

The number of gray levels that can be differentiated by a sensor



### Electromagnetic Spectrum





### Signature Spectra





### Types of Remote Sensing

Aerial Photography

Multispectral

Active and Passive Microwave and LIDAR



### Aerial Photos

- Balloon photography (1858)
- Pigeon cameras (1903)
- Kite photography (1890)
- Aircraft (WWI and WWII)
- □ Space (1947)





Images: Jensen (2000)





### Multispectral

□ NOAA-AVHRR (1100 m) □ GOES (700 m) MODIS (250, 500, 1000 m)  $\Box$  Landsat TM and ETM (30 – 60 m) □ SPOT (10 – 20 m) IKONOS (4, 1 m)  $\Box$  Quickbird (0.6 m)



#### AVHRR (Advanced Very High Resolution Radiometer) NASA



# GOES (Geostationary Operational Environmental Satellites) IR 4





#### Landsat TM (False Color Composite)





## SPOT (2.5 m)





### QUICKBIRD (0.6 m)





### IKONOS (4 m Multispectral)





### IKONOS (1 m Panchromatic)



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#### RADAR (Radio Detection and Ranging)





#### LIDAR (Light Detection and Ranging)



*Image: Bainbridge Island, WA courtesy Pudget Sound LIDAR Consortium, 2005* 



#### □ Shape:

- Many natural and human-made features have unique shapes.
- Often used are adjectives like linear, curvilinear, circular, elliptical, radial, square, rectangular, triangular, hexagonal, star, elongated, and amorphous.







#### □ Shadow:

- Shadow reduction is of concern in remote sensing because shadows tend to obscure objects that might otherwise be detected.
- However, the shadow cast by an object may be the only real clue to its identity.
- Shadows can also provide information on the height of an object either qualitatively or quantitatively.











#### Tone and Color:

- A <u>band</u> of EMR recorded by a remote sensing instrument can be displayed on an image in shades of gray ranging from black to white.
- These shades are called "tones", and can be qualitatively referred to as dark, light, or intermediate (humans can see 40-50 tones).
- Tone is related to the amount of light reflected from the scene in a specific wavelength interval (band).



### Tone and Color





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#### Texture:

- Texture refers to the arrangement of tone or color in an image.
- Useful because Earth features that exhibit similar tones often exhibit different textures.
- Adjectives include smooth (uniform, homogeneous), intermediate, and rough (coarse, heterogeneous).



#### Texture





#### Pattern:

- Pattern is the spatial arrangement of objects on the landscape.
- General descriptions include random and systematic; natural and human-made.
- More specific descriptions include circular, oval, curvilinear, linear, radiating, rectangular, etc.



#### Pattern







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#### Height and Depth:

- As discussed, shadows can often offer clues to the height of objects.
- In turn, relative heights can be used to interpret objects.
- In a similar fashion, relative depths can often be interpreted.
- Descriptions include tall, intermediate, and short; deep, intermediate, and shallow.







#### Association:

This is <u>very</u> important when trying to interpret an object or activity.

<u>Association</u> refers to the fact that certain features and activities are almost always related to the presence of certain other features and activities.



### Association





### Imaging Tools and Data

#### □ Google Earth

#### ERDAS Imagine

#### Digital Northern Great Plains







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### **THANK YOU**

