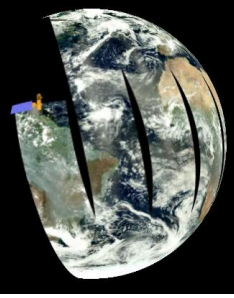
Geog 1000 - Lecture 31

Remote Sensing Systems

http://scholar.ulethbridge.ca/chasmer/classes/



Today's Lecture

1. Hand in Assignment 4
2. Discuss Assignment 5
3. Review Questions for Final Exam

4. Active vs. Passive remote sensing
5. Interpreting remote sensing imagery
6. Satellite orbits and swaths
7. Spatial resolution and pixel size.
8. Spectral resolution
9. Radiometric resolution
10. Temporal resolution

Assignment 5

Reading Assignment: *Global Consequences of Land Use*
Author: Foley et al. 2009

Article: Examines changes in land use (using remote sensing data) over the past several decades; describes challenges, and trade-offs.

1. A) What is the underlying dilemma currently faced by humanity with regards to the use of land for natural resources? (Total = 4 marks)

2. Throughout the article, many comparisons have been made between human use of natural resources and subsequent degradation of the local environment. A) Describe 3 ways in which humans have been able to improve the extraction and use of natural resources through technological advancement (3 marks: 1 mark each), whilst at the same time degrading another natural resource they require, in the process (6 marks: 2 marks each). B) Describe the effect of the resulting degradation on the local population (even if it isn't discussed) (3 marks: 1 mark each). For example, increased urbanization … lowered fish stocks that are depended on for food. (Total = 12 marks)

Assignment 5

Reading Assignment: *Global Consequences of Land Use*
Author: Foley et al. 2009

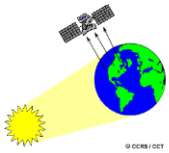
Article: Examines changes in land use (using remote sensing data) over the past several decades; describes challenges, and trade-offs.

3. Using the "Local-scale" case studies as an example (on the last page), provide your own example of a case study (can be real or hypothetical) where we might see a "win-win-win" scenario that would address environmental, social and economic benefits (1 mark for the example). Describe each of the environmental, social, and economic benefits that might come about from your hypothetical or real example (3 marks each). Some examples to get you started might include: initiating a community garden; creating an urban forest; urban gardening on flat rooftops; marshland reclamation along the Oldman River, renewable energy use (e.g. individual home owners feeding back into the grid for increased revenue), etc. Doesn't need to be focused on Lethbridge (Total = 10 marks).

Passive vs. Active Remote Sensing

Passive remote sensing

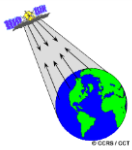
→ Sun provides the source of energy
→ Sensors detect reflected, absorbed/re-emitted energy
→ Reflected energy: sensed during day
→ Re-emitted energy: sensed day or night



What is an example of re-emitted energy?

Active remote sensing

→ Sensors provide their own energy
→ Radiation is emitted
→ That which is reflected is measured
→ Can sense day or night

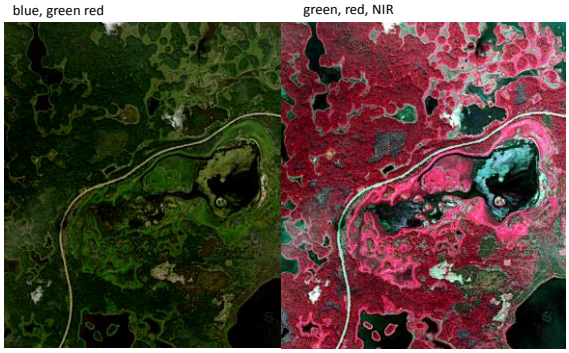


Images: Any pictorial representation
Photographs: Any image detected using photographic film.

Example of Passive Remote Sensing

Wetlands, forests and lakes in blue, green red

Wetlands, forests and lakes in green, red, NIR

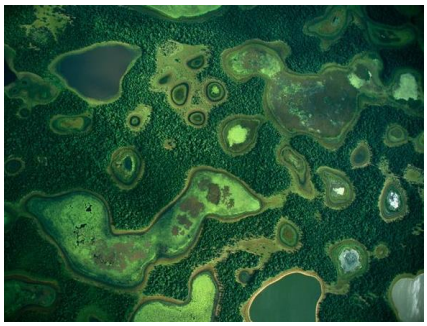


Other examples of passive remote sensing

What do we see in these images? How can you tell?

Other examples of passive remote sensing

What do we see in these images? How can you tell?



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Other examples of passive remote sensing

What do we see in these images? How can you tell?

Visual interpretation of remote sensing data

Visual inspection of images → Interpret what is going on.

Key Areas of Recognition:

Pattern – object arrangement.

Visual interpretation of remote sensing data

Key Areas of Recognition:

Site and Association – Location of object characteristics, proximity

Visual interpretation of remote sensing data

Key Areas of Recognition:

Size – Size of known and unknown objects.

Visual interpretation of remote sensing data

Key Areas of Recognition:

Shadow → provide information on height and depth of objects

Satellite Orbits

Satellite Orbits:

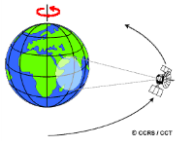
→ Path followed by the satellite
→ Designed to match purpose of satellite
→ Varies → altitude, orientation relative to Earth

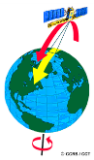
Geostationary Satellites:

→ Very high altitudes (36,000 kms)
→ Revolve at same speed as Earth
→ View same part of Earth at all times

Sun-synchronous Satellites:

→ Follow north-south orbit + west to east rotation = sensing of portions of Earth.
→ Location always at same time each day.

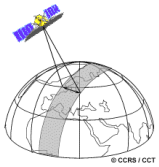


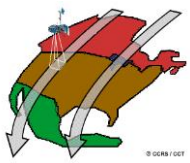


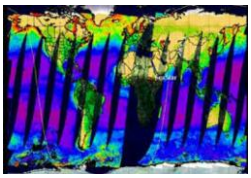
Satellite Swath Width

Satellite Swath:

→ Area imaged on Earth's surface
→ Vary between tens to hundreds of kms wide
→ West to east movement of Earth (rotation) = westward movement of satellite
→ New area imaged.







Spatial Resolution

Spatial Resolution

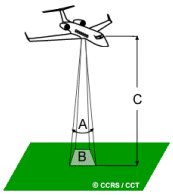
→ Detail found within an image
→ The smallest possible feature detected.

Instantaneous Field Of View (IFOV)

→ Angular cone of visibility (A)
→ Determines area that can be seen on ground (B).
→ Area on ground = *resolution cell* (max spatial resolution).

** For an object to be 'seen', it must be = to or larger than the resolution cell.

Smaller features will be averaged with other object brightness in the cell (pixel)

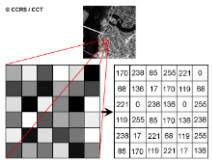


Pixels or 'Picture Elements'

Pixels: The smallest units of an image.

→ Digital representation of equal sized, shaped areas.
= Brightness of each area using a digital number

→ Every pixel has geographic location on Earth

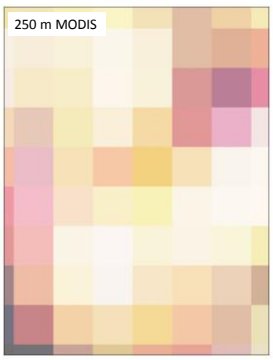


For example: 20 m pixel resolution → 20 m x 20 m on the ground.

The higher the resolution, the less ground area that can be seen.

Pixels or 'Picture Elements'

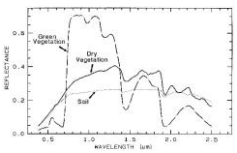
Fine (high) pixel resolution to Course (low) pixel resolution of permafrost and wetland areas, NWT.



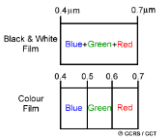
Spectral Resolution

Spectral Response:

Know that Earth objects have a spectral response:



The reflectance of feature over different wavelengths.



Objects → identified by distinct wavelengths

E.g. Water = broad absorption of visible and NIR
Different rock types = much finer wavelengths

Spectral resolution → wider or narrower ranges of wavelengths

Radiometric Resolution

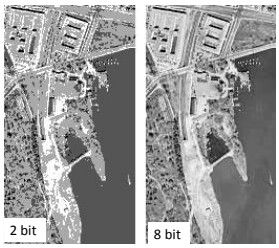
Radiometric Response:

→ Sensitivity to magnitude of electromagnetic energy backscatter
→ Ability to see slight differences in energy

Finer radiometric resolution = greater sensitivity to reflectance

Digital numbers → vary from 0 to 1 less than a selected power of 2:

e.g. 1 bit = 2; 8 bit = 256 DNs (0-255)

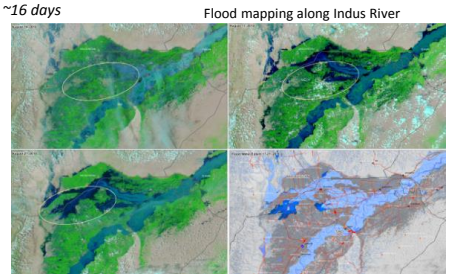


Temporal Resolution

The 'revisit time' of satellites → the length of time it takes a satellite to complete a full orbit and come back to that same location.

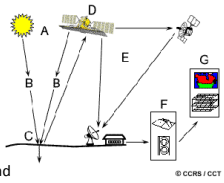
Multitemporal Imagery
→ *E.g. MODIS ~ every other day*
→ *Landsat ~16 days*

Flood mapping along Indus River



Remote Sensing Workflow:

A) Illumination
B) Radiation interaction with atmosphere
C) Radiation interaction with target
D) Energy recorded by sensor
E) Transmission of data to user, reception and image processing
F) Interpretation/analysis
G) Application



No Reading for the weekend.
Final Assignment introduced on Monday