Remote Sensing for Studying Earth Surface and Changes

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Audience : AMIDST Participants

Contents

• What is remote sensing?
• How does remote sensing work?
  – Introduction to waves
• How do we interpret remote sensing data?
• Some application examples

Image credits: NASA

What is remote sensing?

Some Unconventional Definitions

The most expensive way to make a picture
What is remote sensing?

Seeing what can't be seen, then convincing someone that you're right

What is remote sensing?

Staying as far away from the problem as possible

What is remote sensing?

I don't know what it is but I am doing it

STEP 2008

What is remote sensing?

• Acquire information about an object or phenomenon without being in direct contact with it (remotely)

Image credits: NASA
What is remote sensing?

- Viewing vertical rather than horizontal
- Viewing from a distance
- Recording digitally
- Making sense from digital numbers (image)

Flying height

- Aircrafts ~ 1-3 km or more
- Satellites ~ 700-800 km (polar – earth observing)
- Weather satellites (~36,000 km)

So – how remote is remote?

- Earth observing polar satellites: 700-850km
- Geostationary (meteorological): 35,800km i.e. about one-tenth the distance to moon

From where to where?

- World's oldest photograph

Original Image source unknown
Remote sensing: by Anupma Prakash

From where to where?

1903 • Pigeon mounted cameras

1972 • NASAs first Landsat Satellite was launched – big BOOM !!

1999 • High resolution space imaging IKONOS 1m spatial resolution

How remote sensing works

Today I’ll tell you only half the truth
First stage in remote sensing

Source

Sensor

Target

Second stage in remote sensing

Sensor

Transmission

Receiving and Processing Unit

Third stage in remote sensing

Processor

Interpreter

Application

Source

- The sun gives out EM energy
- This energy travels though space (vacuum) in the form of EM radiations
Let’s stop and think about these electromagnetic radiations (waves)

Electromagnetic Spectrum

- The entire range of EM energy constitutes the EM Spectrum

Why do we discuss this?

- We carry out remote sensing not only in the visible part of the spectrum but also beyond it – for example in the infrared region

What is an image?

- Color by numbers
- The concept is very similar
What is an image?

- An image is simply numbers.
- Higher the number, brighter (whiter) the image.
- Lower the number, darker the image.

Color image

- How do we get color from a black-and-white image?

Let us play with light waves and make some color.
How do we get color from a black-and-white image?

Why all that red color?

That is because these are not natural color images.

These are color infrared images (infrared band shown in red).

Healthy vegetation reflects very strongly in infrared.

What can you tell me about these two images?
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• What can you tell me about these two images?
**Remote Sensing**

**Glaciers**

Image Credit: NASA

**Aerial Photography**

Compared to a satellite image you see a lot more detail on an aerial photo.

Aerial Photo UAF campus (Sept 2001)

**The difference**

New York: A good satellite image

**Tone**

- Relative brightness on a gray scale image

Tanana River, south of Fairbanks, Alaska
Shape

- geometric aspects of the object

Chena River, flowing through Fairbanks, Alaska

Size

Cincinnati, USA

Terminus advancement

1948 - 1989

1 km

Armenia before earthquake

Source: Final class project of Elsbeth Kuriger; Student GEOS 422, Fall 2003, UAF
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Armenia after earthquake

Remote sensing by Anupma Prakash

Information extraction and visualization

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Overlap

Photo 1

Photo 2

Flight direction

Overlap

Stereo viewing – 3D

• Needed in order to measure 3-dimensionally
• Achieved by overlap in aerial photography
• Typically 60% overlap between images
Examples

Seasonal variation in sea ice

• During summer months, the sea ice covers an average of 7,000,000 sq km,
• It grows to around 14,000,000 sq km during the winter.
• By comparison, the entire United States is just over 9,000,000 sq km

Coastal regions

• Fish Creek coast shows anomalous amounts of suspended sediments
Coastal regions

- Cape Simpson provides a potential oil prospect area

Volcano monitoring (AVO)

- Hot areas emit more energy and therefore look brighter on a thermal infrared image
Volcano monitoring (AVO)

- Landsat color composite of Cleveland eruption. Hot area and ash clouds visible

Source: Alaska Volcano Observatory

Forest fires

- Forest fire in Montana (2000)
- By John McColgan, Fairbanks, Alaska

Forest fires

- Actively burning fires

Source: Prakash et al. 2003

Cold climate river system

- Colville river
- Drainage area 35820 km²
- Only one gauging station
- Braided and meandering pattern
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Cold climate river system

Measured rate of movement is roughly 46 meters per year

Source: Final class project of Sean O'Guinn, Undergraduate student GEOS 422, Fall 2002, UAF

Cold climate river system

Questions?

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