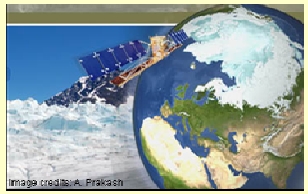
Remote Sensing for Studying Earth Surface and Changes



Anupma Prakash

Day : Tuesday
Date : September 26, 2008
Audience : AMIDST Participants

Geophysical Institute, University of Alaska Fairbanks

Contents

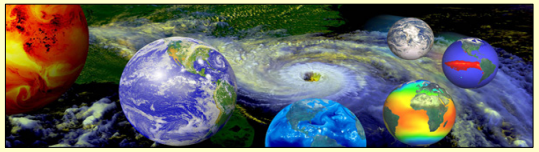


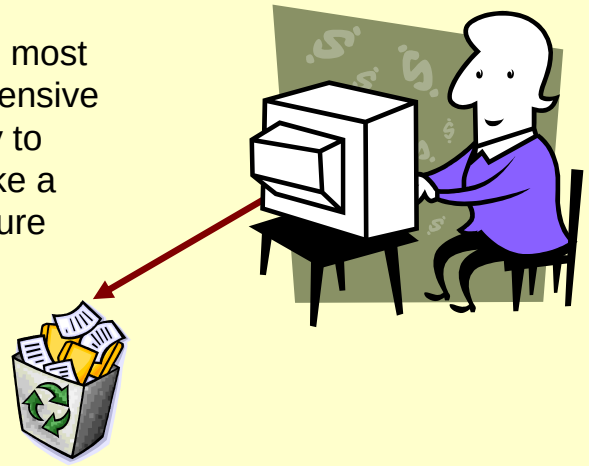
Image credits: NASA

What is remote sensing?

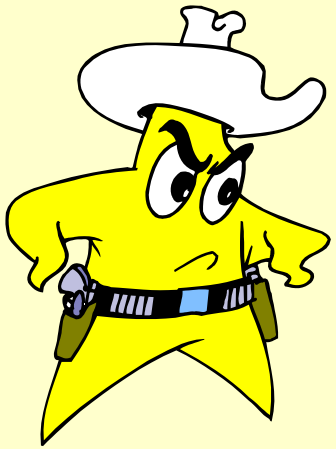
Some Unconventional Definitions

What is remote sensing?

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

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)

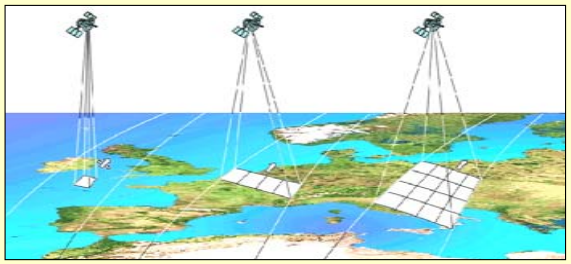


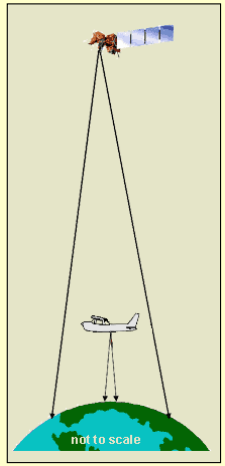
Image credits: CCRS

Remote sensing: by Anupma Prakash

9

Flying height

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

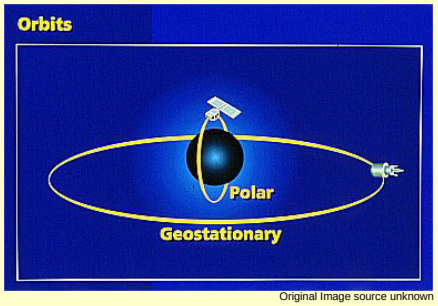


Source : Alaska – A Bird's Eye View
www.birds-eye-view.alaska.edu

Remote sensing: by Anupma Prakash

10

So – how remote is remote?



Original Image source unknown

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

Remote sensing: by Anupma Prakash

11

From where to where?

Original Image source unknown

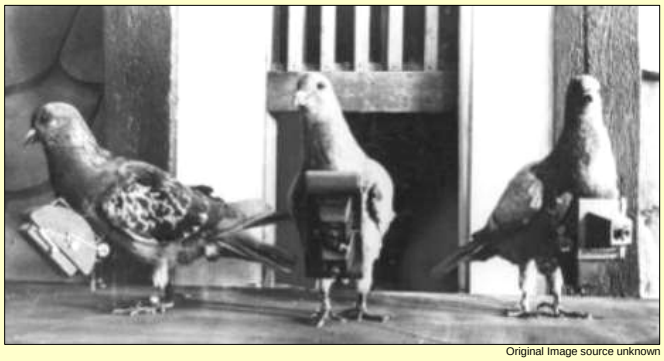
1827

- World's oldest photograph

Remote sensing: by Anupma Prakash

12

From where to where?



Original Image source unknown

1903

- Pigeon mounted cameras

Remote sensing: by Anupma Prakash

13

From where to where?

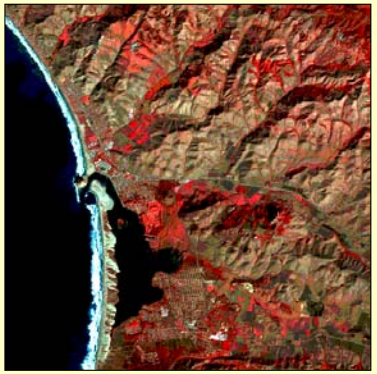


Image credits: USGS

1972

- NASAs first Landsat Satellite was launched – big BOOM !!

Remote sensing: by Anupma Prakash

14

From where to where?

Image credits: Space Imaging

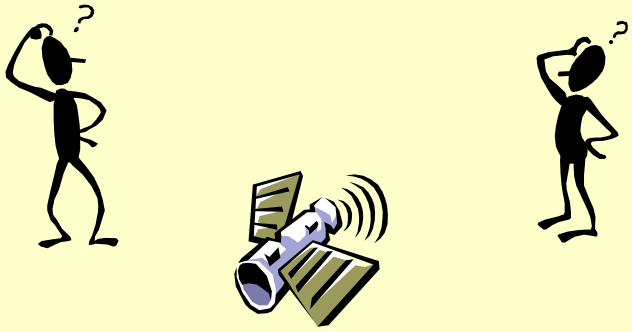
1999

- High resolution space imaging IKONOS 1m spatial resolution

Remote sensing: by Anupma Prakash

15

How remote sensing works

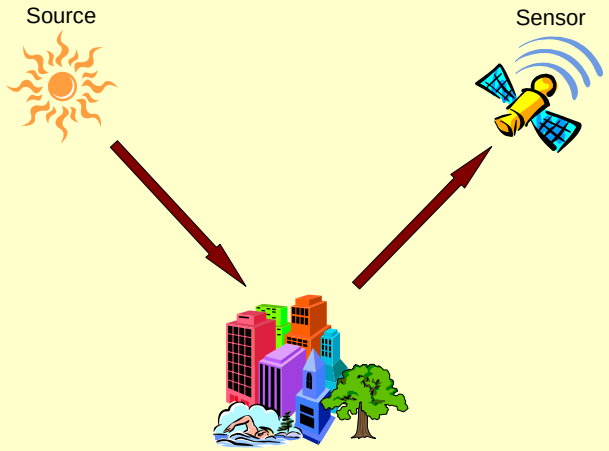


Today I'll tell you only half the truth

Remote sensing: by Anupma Prakash

16

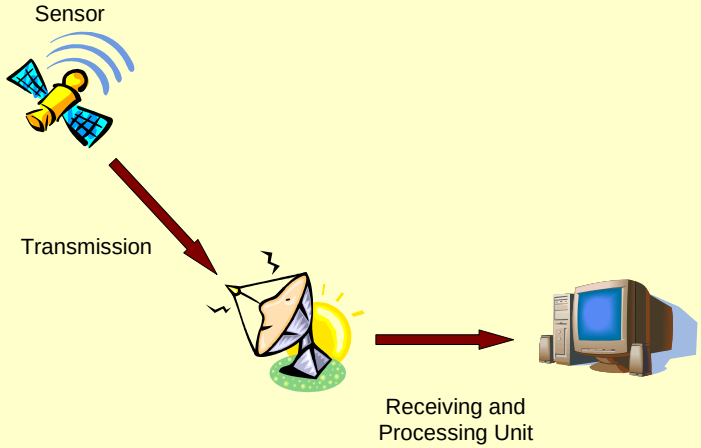
First stage in remote sensing



Remote sensing: by Anupma Prakash

17

Second stage in remote sensing



Remote sensing: by Anupma Prakash

18

Third stage in remote sensing

Remote sensing: by Anupma Prakash

19

Source

- The sun gives out EM energy
- This energy travels though space (vacuum) in the form of EM radiations

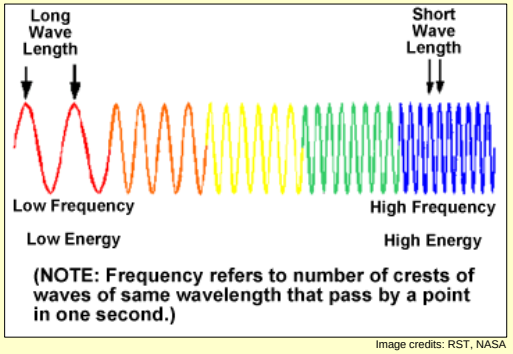


Image credits: RST, NASA

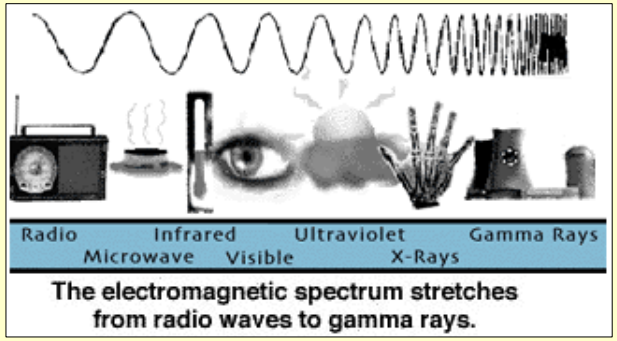
Remote sensing: by Anupma Prakash

20

Let's stop and think about these electromagnetic radiations (waves)

Electromagnetic Spectrum

- The entire range of EM energy constitutes the EM Spectrum

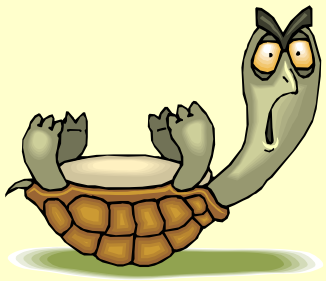


The electromagnetic spectrum stretches from radio waves to gamma rays.

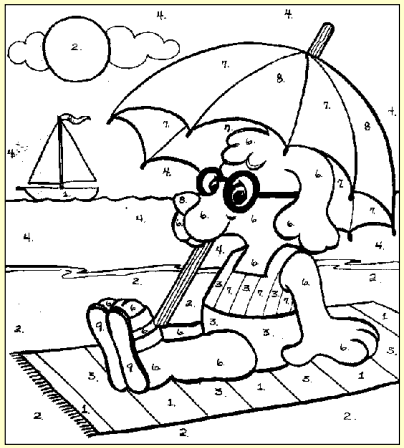
Image credits: RST, NASA

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

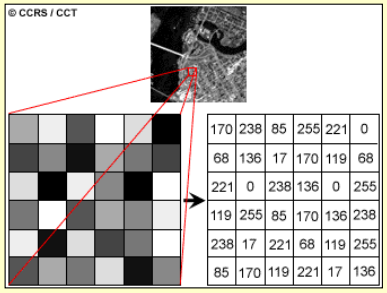


What is an image?



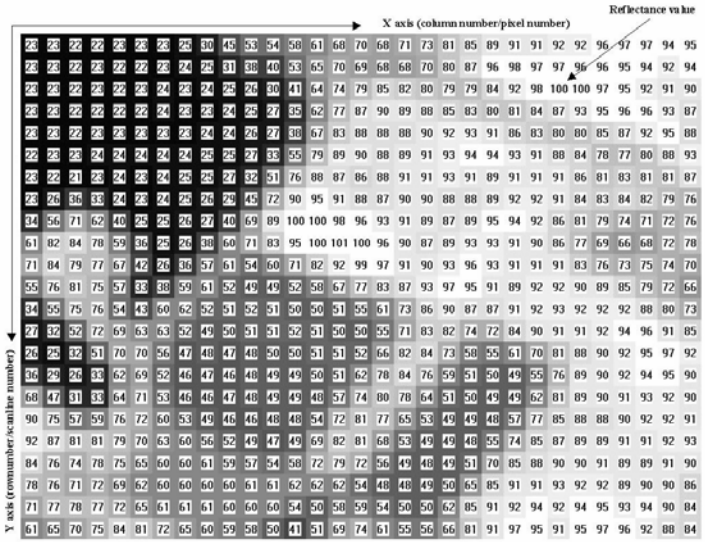
- Color by numbers
- The concept is very similar

What is an image?



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

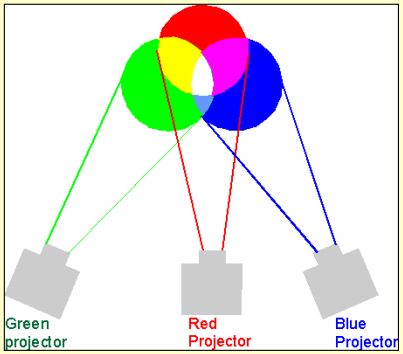
Remote sensing: by Anupma Prakash



Original Image source unknown

Color image

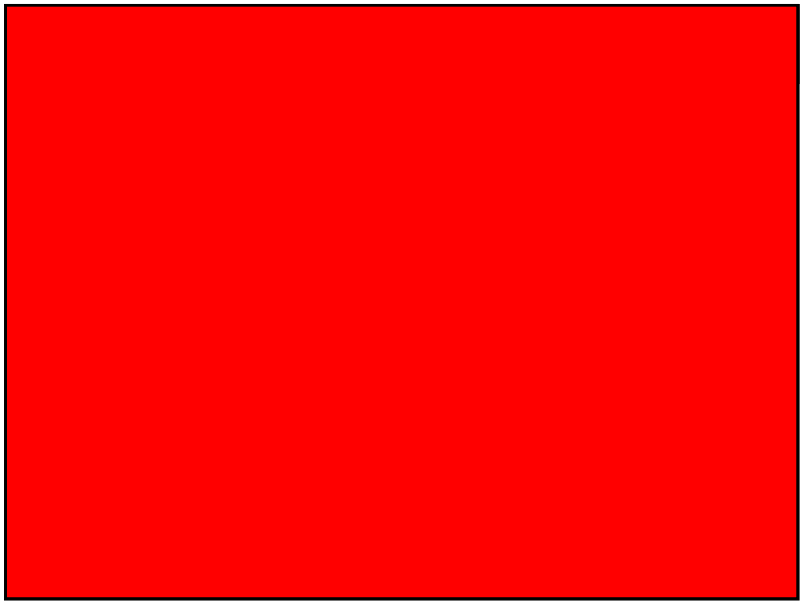
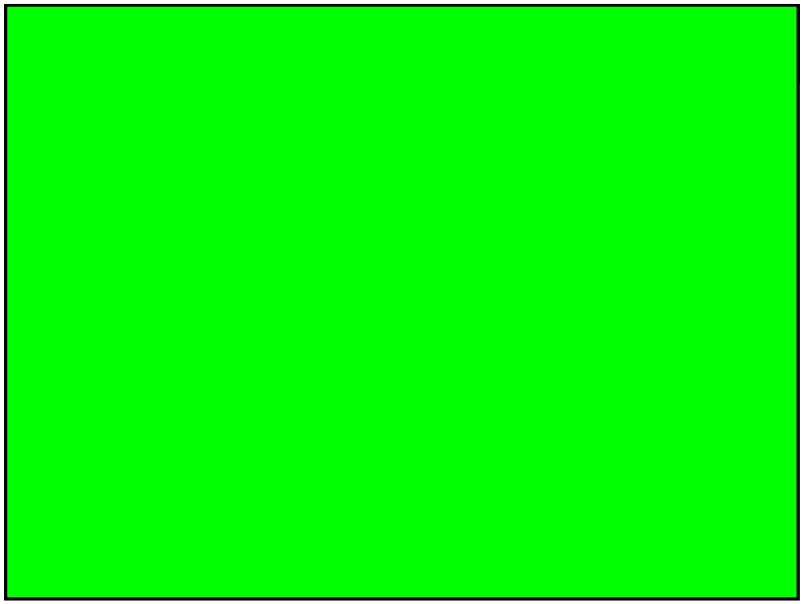
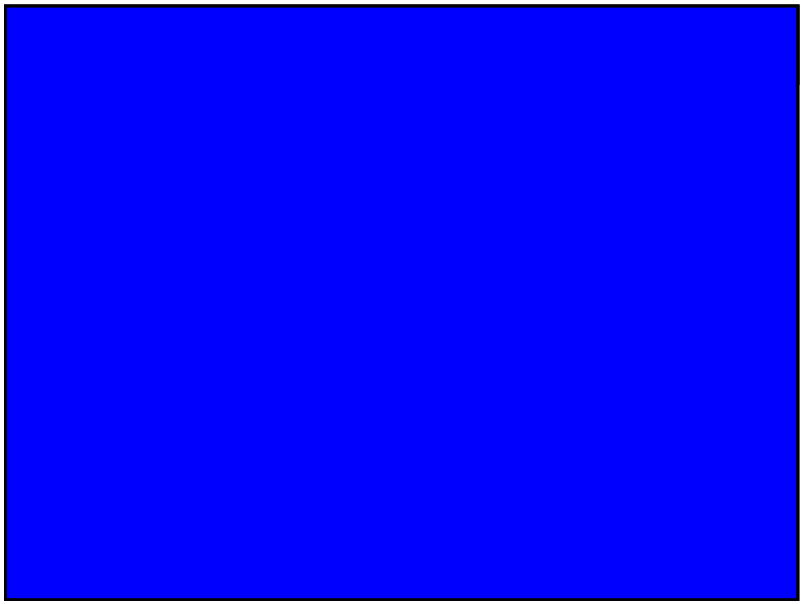
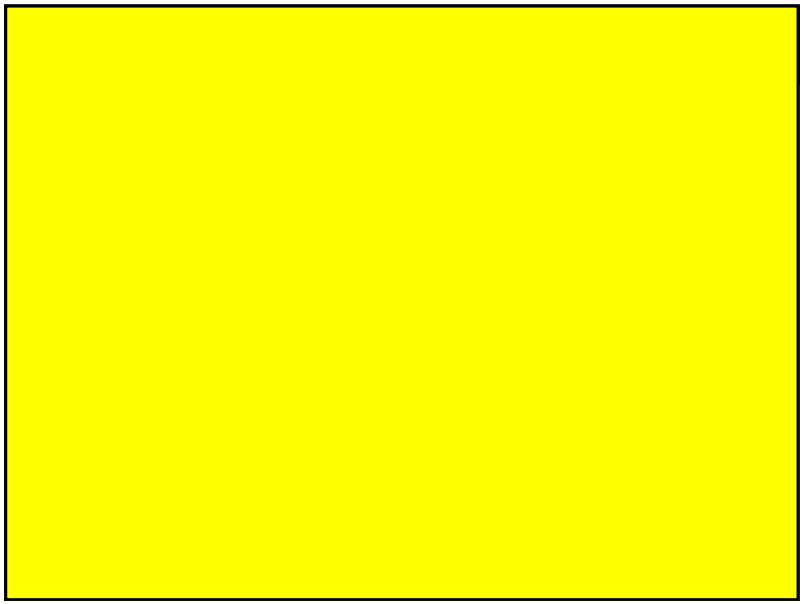
- How do we get color from a black-and-white image?

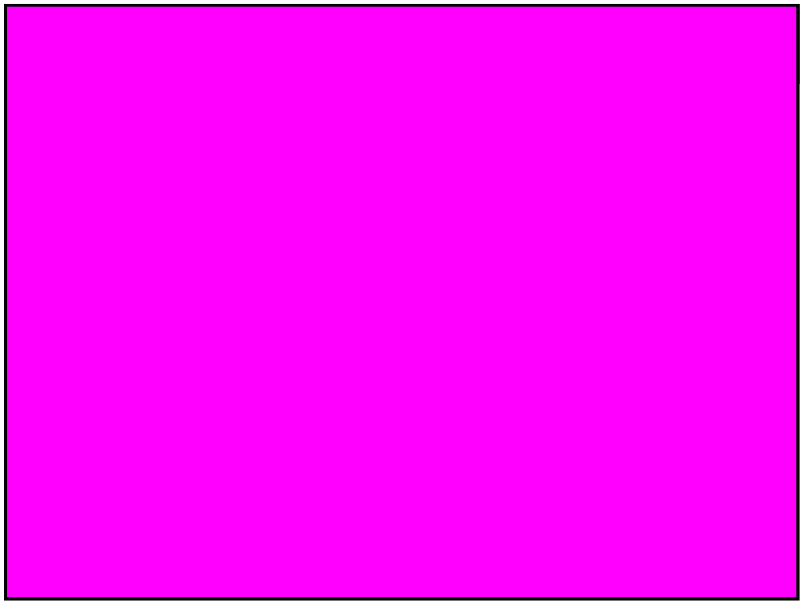


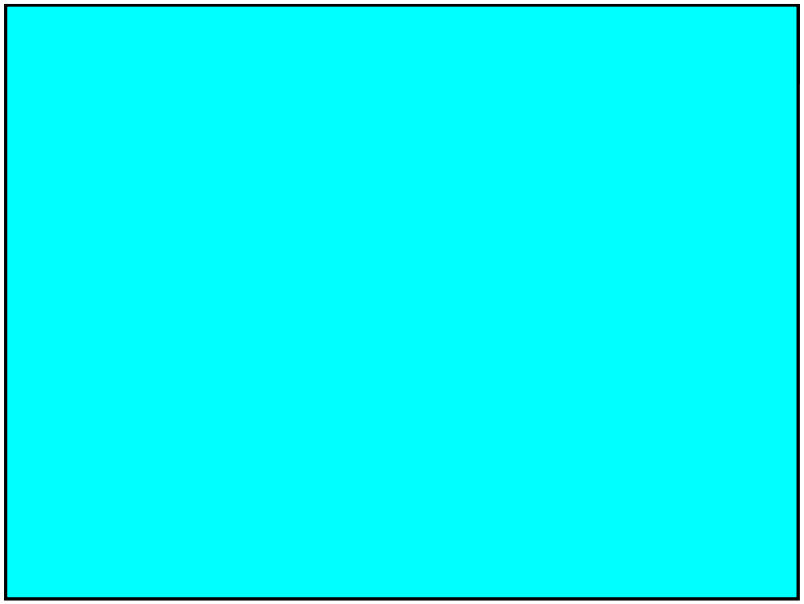
Remote sensing: by Anupma Prakash

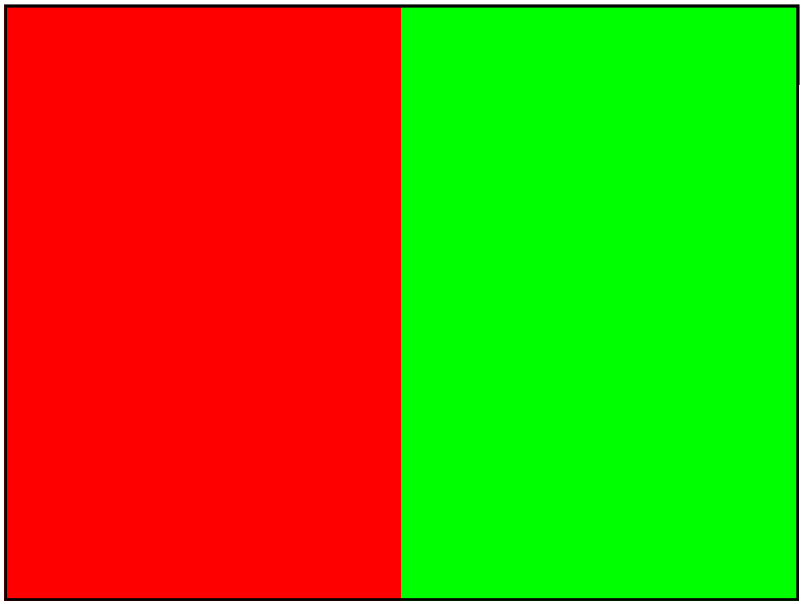
Let us play with light waves and make some color

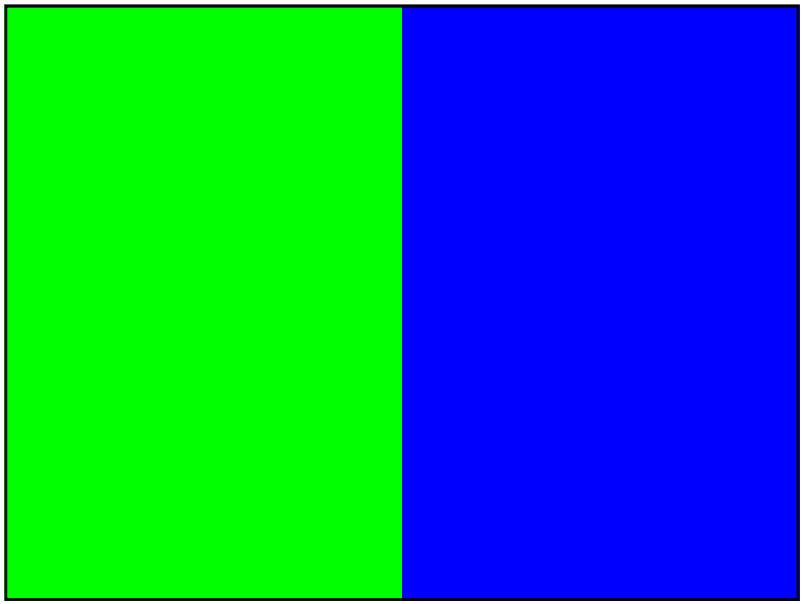
Remote sensing: by Anupma Prakash



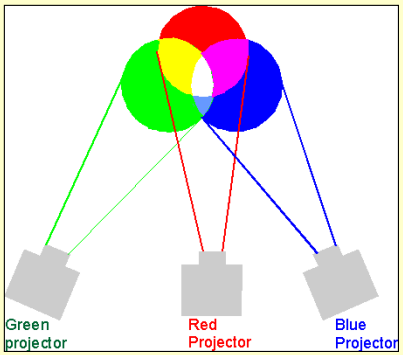




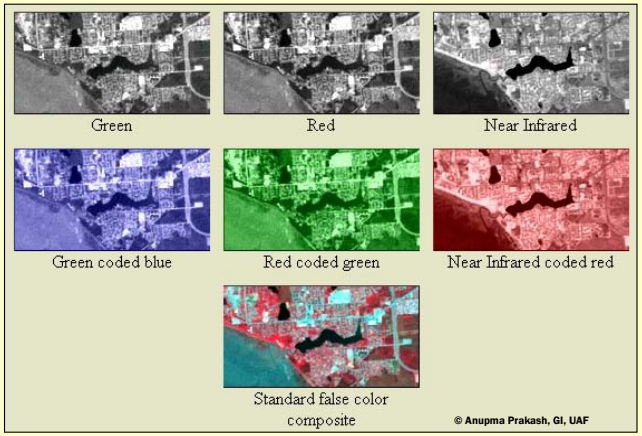


Color image

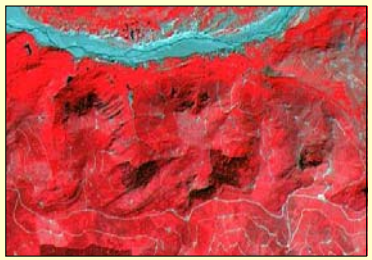
- How do we get color from a black-and-white image?

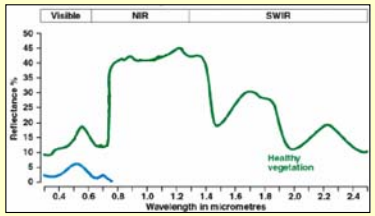


False color image



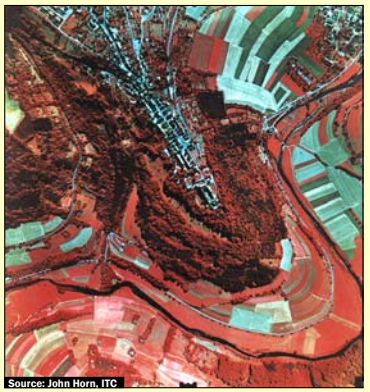
Why all that red color?





- 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?



- What can you tell me about these two images?

Remote sensing: by Anupma Prakash

41

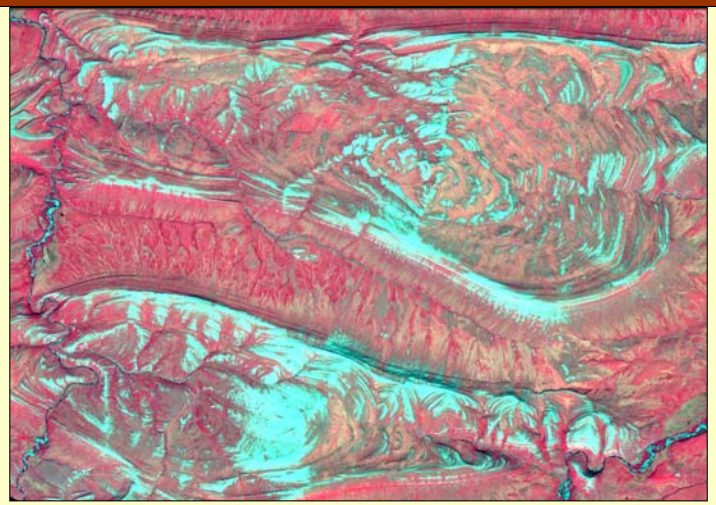
Geological Mapping

Landsat Data from USGS

Remote sensing: by Anupma Prakash

42

Geological Mapping



Landsat data from USGS: Processed by A. Prakash

Remote sensing: by Anupma Prakash

43

Glaciers

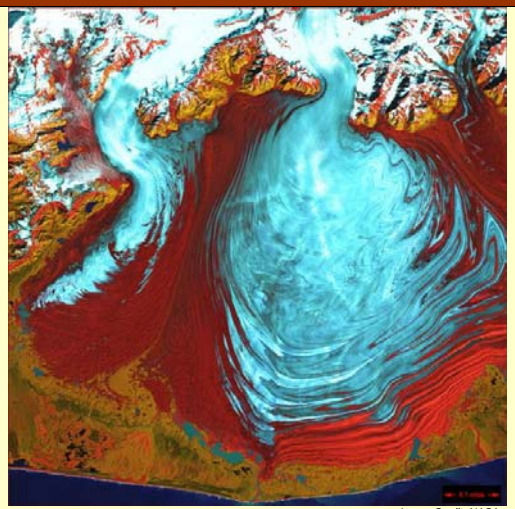


Image Credit: NASA

Remote sensing: by Anupma Prakash

44

Glaciers

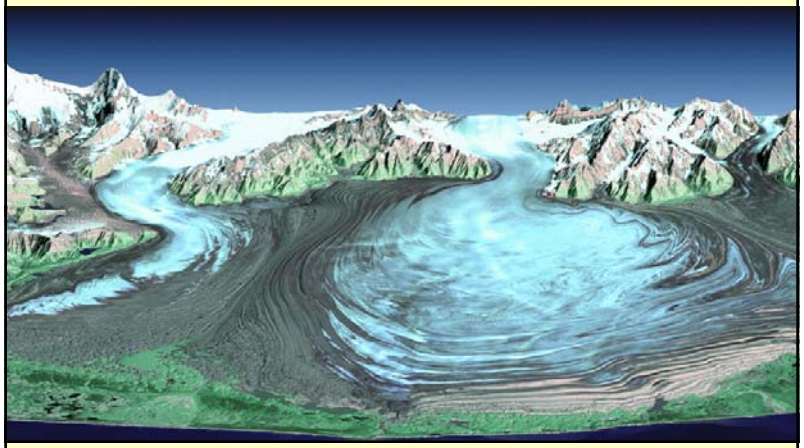
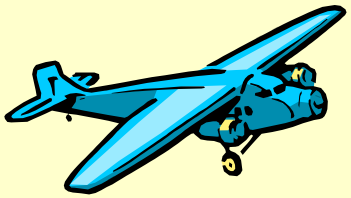


Image Credit: NASA

45

Aerial Photography



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

Aerial Photo UAF campus (Sept 2001)

Remote sensing: by Anupma Prakash

46

The difference

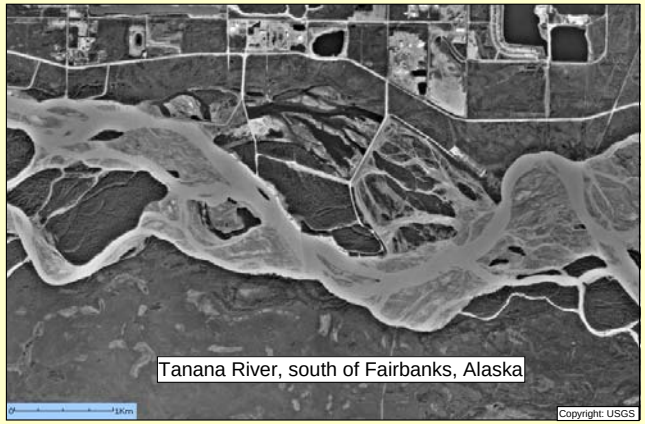
New York:
A good satellite image

Remote sensing: by Anupma Prakash

47

Tone

- Relative brightness on a gray scale image



Remote sensing: by Anupma Prakash

48

Shape

- geometric aspects of the object

Chena River, flowing through Fairbanks, Alaska

Remote sensing: by Anupma Prakash

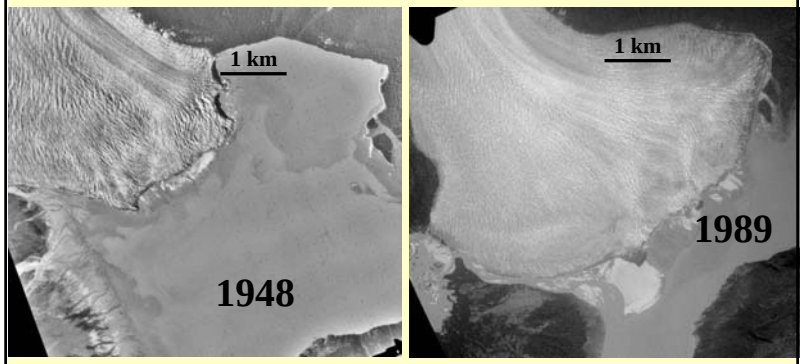
49

Size

Remote sensing: by Anupma Prakash

50

Terminus advancement



Source: Final class project of Elsbeth Kuriger: Student GEOS 422, Fall 2003, UAF

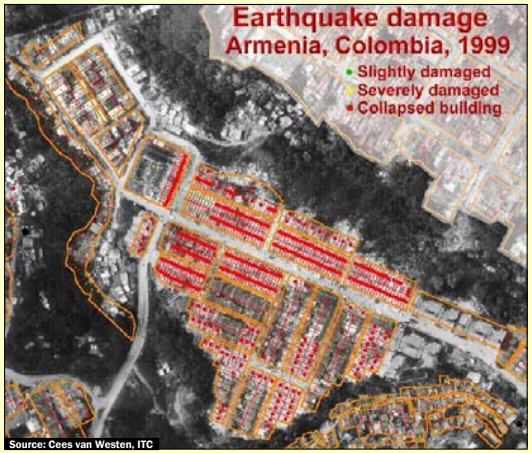
51

Armenia before earthquake

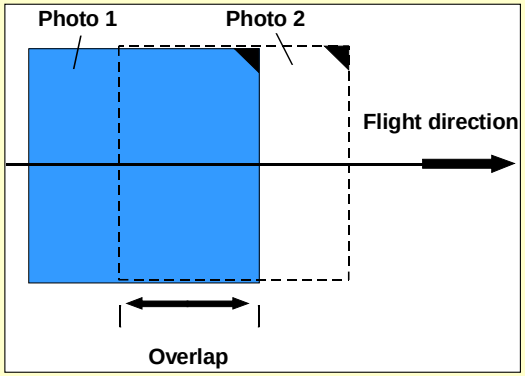
52

Armenia after earthquake

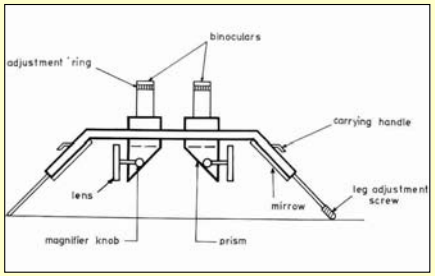
Information extraction and visualization



Overlap



Stereo viewing – 3D



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

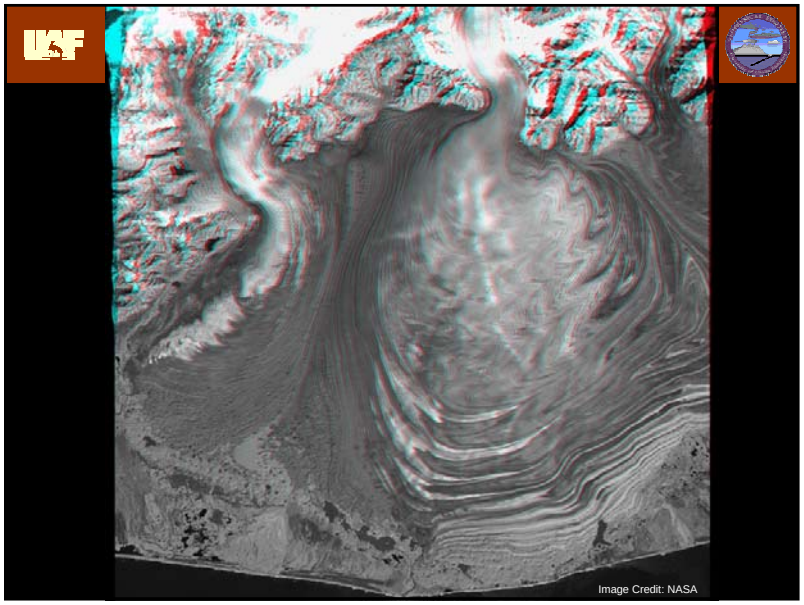


Image Credit: NASA

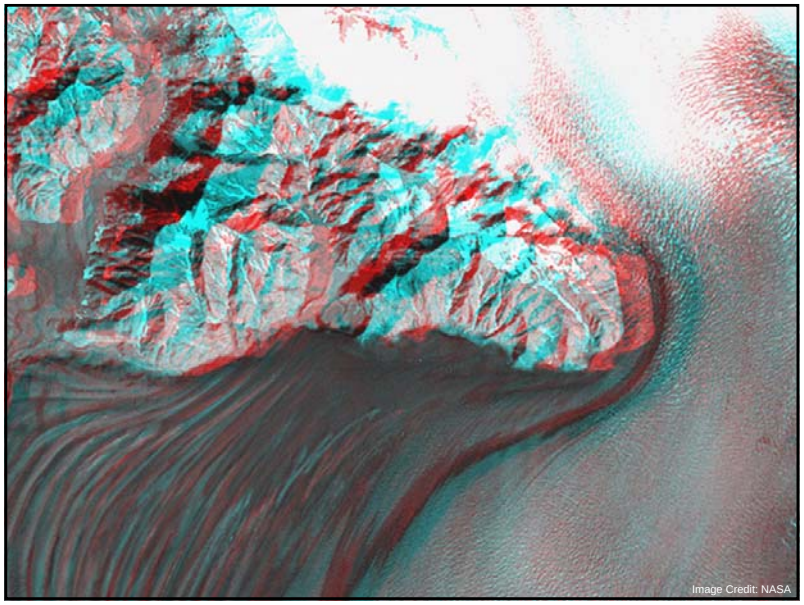


Image Credit: NASA

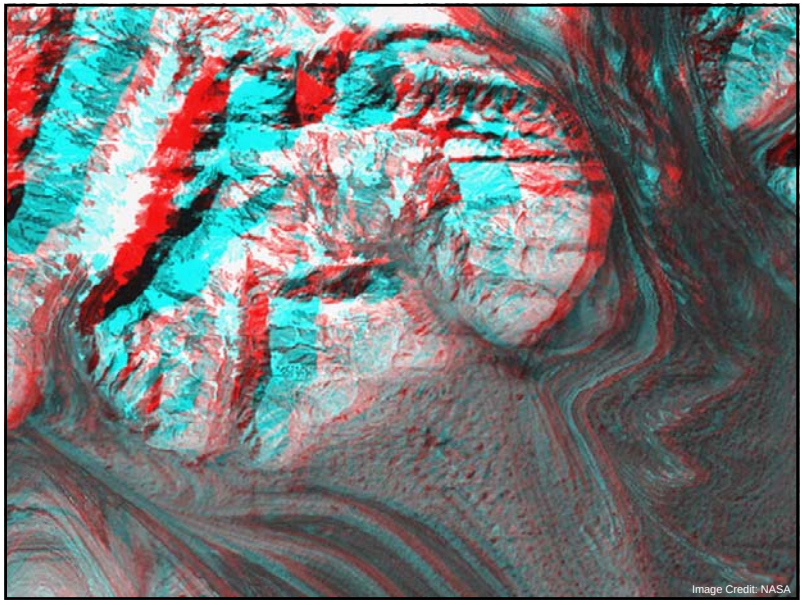


Image Credit: NASA

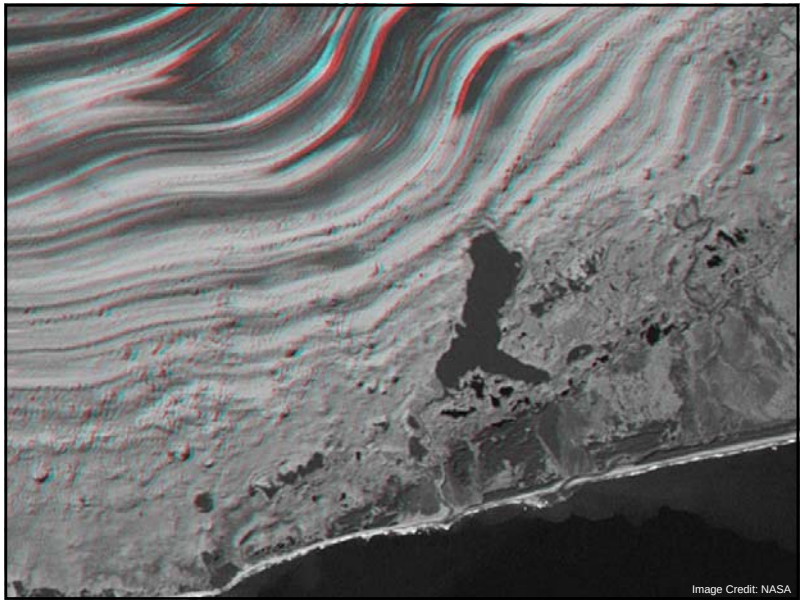
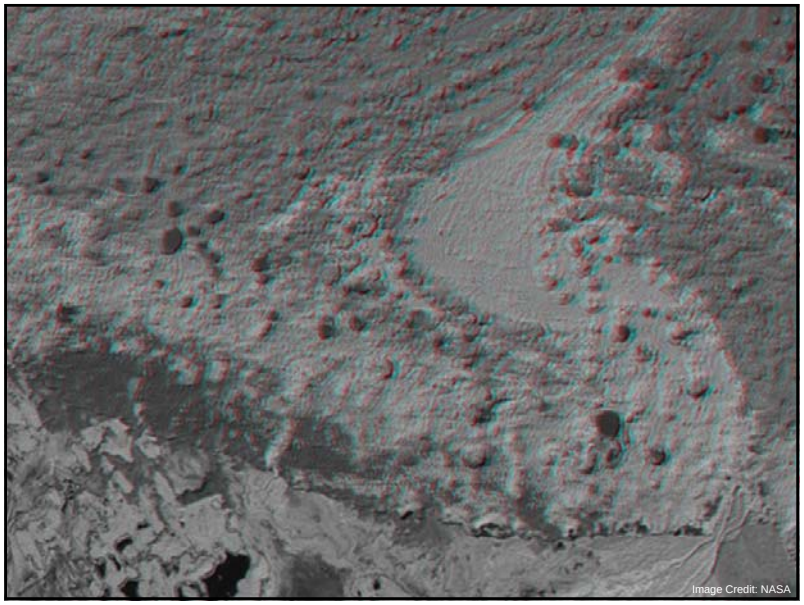


Image Credit: NASA

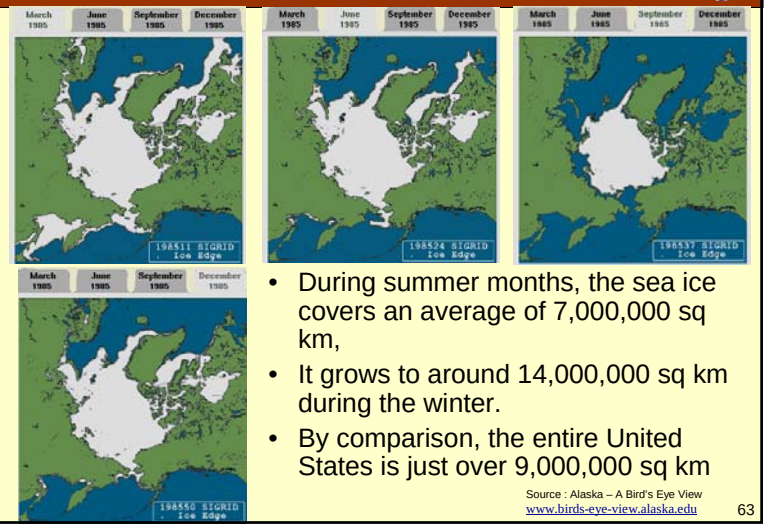


Remote sensing: by Anupma Prakash

Examples

Remote sensing: by Anupma Prakash

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

Source : Alaska – A Bird's Eye View
www.birds-eye-view.alaska.edu

Remote sensing: by Anupma Prakash

Coastal regions

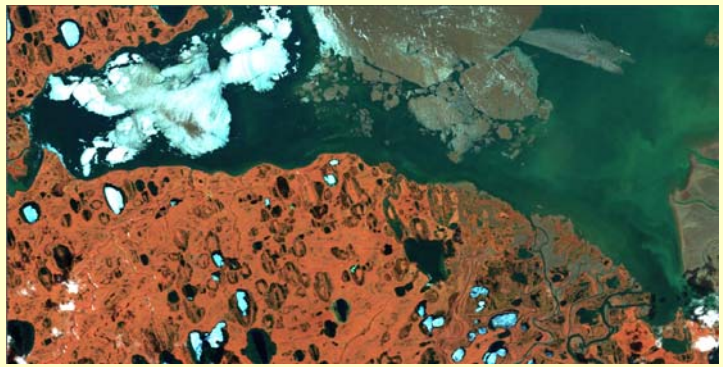


Image processed by Anupma Prakash, GI, UAF: North is up and approximate width of image is 32 km

- Fish Creek coast shows anomalous amounts of suspended sediments

Coastal regions

Remote sensing: by Anupma Prakash

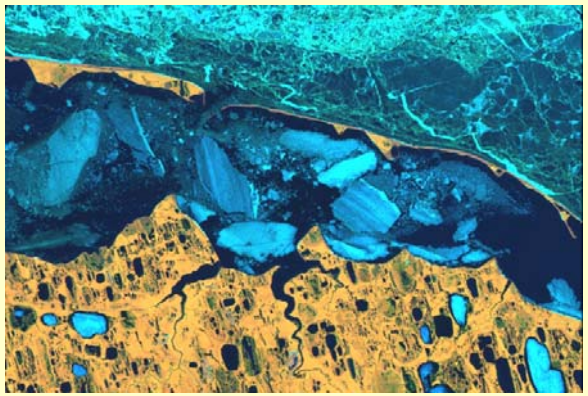


Image processed by Anupma Prakash, GI, UAF: North is up and approximate width of image is 20 km

- Cape Simpson provides a potential oil prospect area

65

Volcano monitoring (AVO)

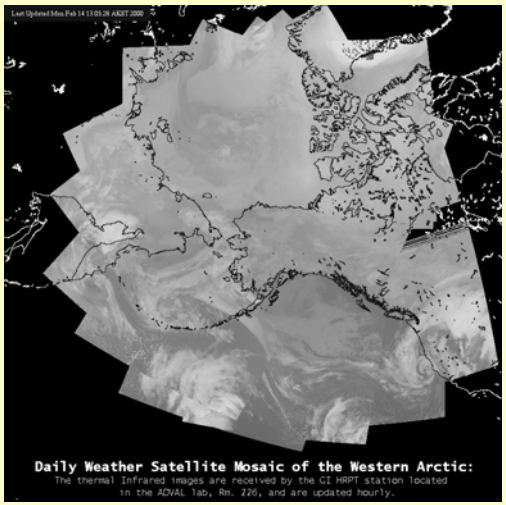
Remote sensing: by Anupma Prakash

Source: Alaska Volcano Observatory

66

Volcano monitoring (AVO)

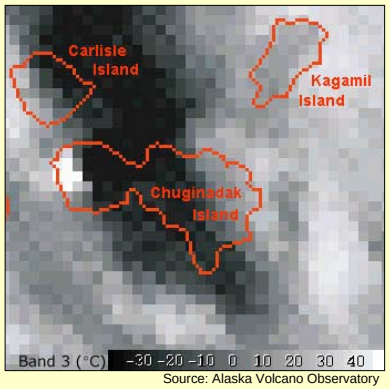
Remote sensing: by Anupma Prakash



67

Volcano monitoring (AVO)

Remote sensing: by Anupma Prakash



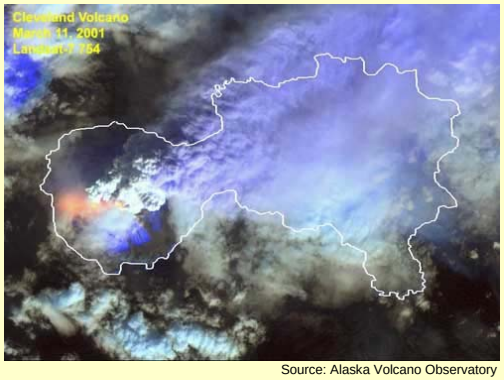
Source: Alaska Volcano Observatory

- Hot areas emit more energy and therefore look brighter on a thermal infrared image

68

Volcano monitoring (AVO)

Remote sensing: by Anupma Prakash



Source: Alaska Volcano Observatory

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

69

Forest fires

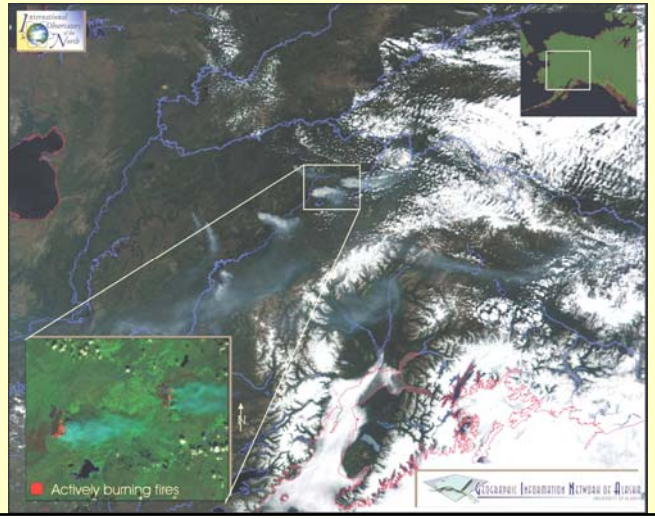
Remote sensing: by Anupma Prakash

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

70

Forest fires

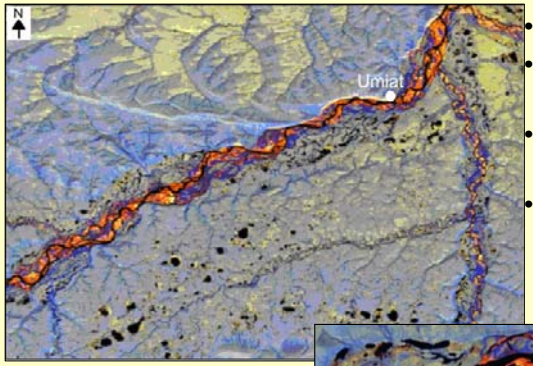
Remote sensing: by Anupma Prakash



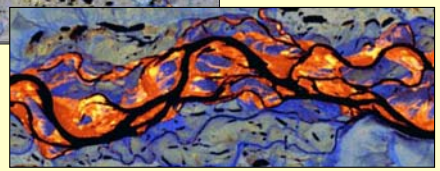
71

Cold climate river system

Remote sensing: by Anupma Prakash



Source: Prakash et al. 2003



- Colville river
- Drainage area 35820 km^2
- Only one gauging station
- Braided and meandering pattern

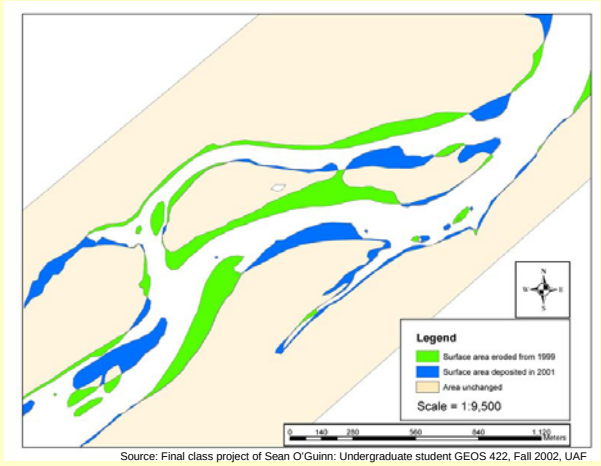
72

Cold climate river system

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

Measured rate of movement is roughly 46 meters per year

Cold climate river system



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

Questions?