GEOG 357

LECTURE 1

1

GEOG357 Introduction to Remote Sensing

Fall 2021

Lectures:
Tue/Thu
9.30 - 10.20

Labs:
Room 8-125
Thu
11.30 – 14.20

Outline and notes:
https://gis.unbc.ca

2

Remote Sensing

To define the term, the main concept is that it refers to the gathering of information from a distance.

Some Definitions:

- Remote sensing has been variously defined but basically it is the art or science of telling something about an object without touching it. (Fischer et al., 1976)
- Remote sensing is the acquisition of physical data of an object without touch or contact. (Lintz and Simonett, 1976)

3

Remote Sensing

Some Definitions:

- 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. This definition serves as a concise expression. (Campbell and Wynne, 2011; 5th Ed)

4

Remote Sensing

- Helpful as they are, those definitions are not universally applicable.
  - If a conversation is held at a distance (e.g. a phone call) and it involves gathering information about an object (e.g. a forest), does it count as remote sensing?

- In practice Remote Sensing is still concerned with the acquisition and manipulation of aerial and satellite images.

5

Milestones in the History of Remote Sensing

1800	Discovery of infrared by Sir William Herschel
1839	Beginning of practice of photography
1847	Infrared spectrum shown by A. H. L. Fizeau and J. B. L. Foucault to share properties with visible light
1850–1860	Photography from balloons
1873	Theory of electromagnetic energy developed by James Clerk Maxwell
1909	Photography from airplanes
1914–1918	World War I: aerial reconnaissance
1920–1930	Development and initial applications of aerial photography and photogrammetry
1929–1939	Economic depression generates environmental crises that lead to governmental applications of aerial photography
1930–1940	Development of radars in Germany, United States, and United Kingdom
1939–1945	World War II: applications of nonvisible portions of electromagnetic spectrum; training of persons in acquisition and interpretation of airphotos
1950–1960	Military research and development
1956	Colwell's research on plant disease detection with infrared photography
1960–1970	First use of term *remote sensing*
	TIROS weather satellite
	Skylab remote sensing observations from space
1972	Launch of Landsat 1
1970–1980	Rapid advances in digital image processing
1980–1990	Landsat 4: new generation of Landsat sensors
1986	SPOT French Earth observation satellite
1980s	Development of hyperspectral sensors
1990s	Global remote sensing systems, lidars

6

Remote Sensing and the 60s

- The term Remote Sensing was coined in 1960 by Evelyn Pruitt, a geographer, when she recognized that the term aerial photography was inadequate for imagery collected outside the visible region of the magnetic spectrum.
- She was employed by the U.S. Navy's Office of Naval Research,

7

Remote Sensing and the 60s

- The 1960s saw a series of important advancements
  - The meteorological satellite (TIROS-1) was launched in April 1960. It provided the basis for later development of land observation satellites.
  - Some of the remote sensing instruments developed for military reconnaissance were released for civilian use. These extended the reach of aerial observation outside the visible spectrum into the infrared and microwave regions.

8

Satellite Remote Sensing

- In 1972 marked the launch of Landsat 1, the first of many Earth-orbiting satellites designed for Earth observation.
  - Landsat provided systematic repetitive observation of the Earth's land areas.
    - Incentivised the rapid and broad expansion of uses of digital analysis for remote sensing.
    - Routine availability of multispectral data

9

Satellite Remote Sensing

- **11,139** satellites have been launched
- **7,389** individual satellites in Space, while the rest have either been burnt up in the atmosphere or have returned to Earth in the form of debris. (UN office of Outer Space Affairs, April 2021)

10

Satellite Remote Sensing

- According to Union of Concerned Scientists (UCS), which keeps a record of the operational satellites, there are **6,542 satellites**, out of which **3,372 satellites** are active and **3,170 satellites** are inactive, as recorded by 1st January, 2021.

11

Importance of Remote Sensing to Canada

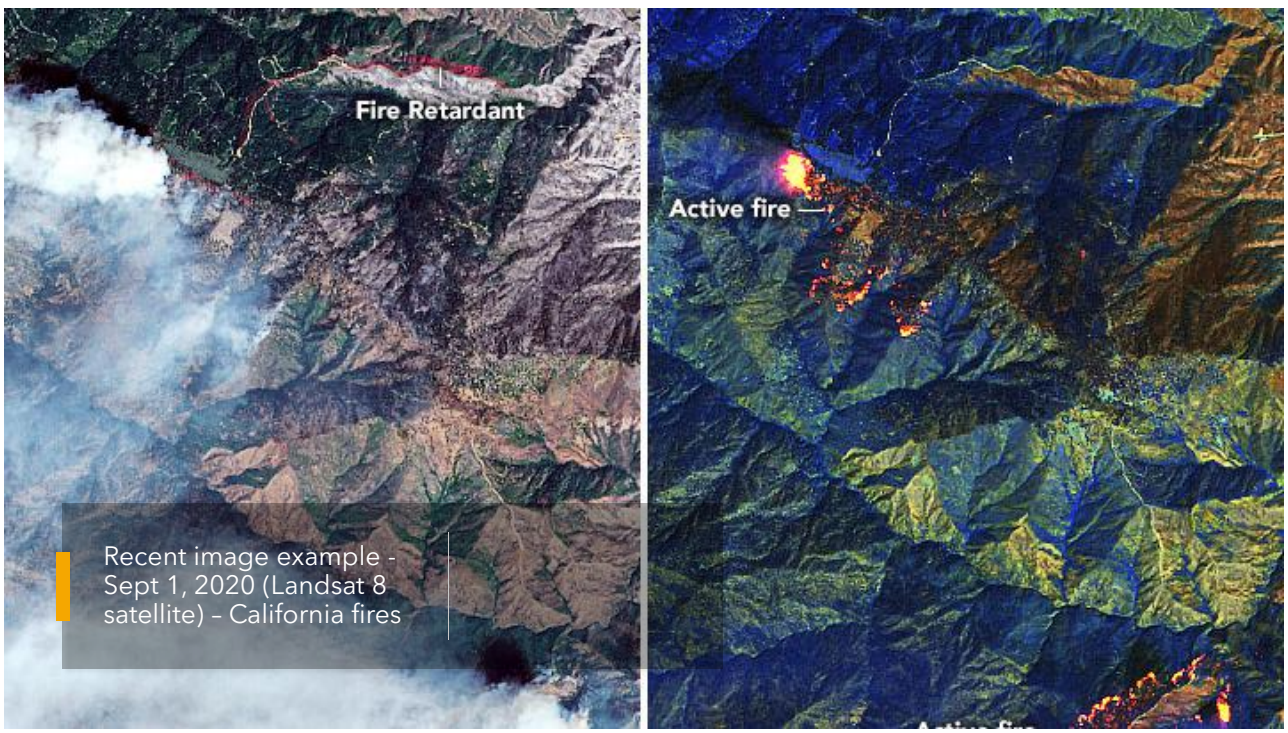
- The size and remoteness of much of Canada
  - Difficult to access, hence cannot be mapped easily
- Often spatial data is quickly outdated (e.g. land cover) yet it is costly to collect and process
  - Satellite images can be current
  - Satellite imagery is cost effective in the long term

12

Importance of Remote Sensing to Canada

- Images cross administrative boundaries (vector data may stop)
  - Federal and provincial administration, regulation and policies
- Images are not generalised (apart from scale)
  - Shows the spatial coverage as it is at a given moment in time
- Most GIS spatial data were created from remote sensing

13



Recent image example - Sept 1, 2020 (Landsat 8 satellite) – California fires

14

Myth #1 about remote sensing:
This is a satellite photograph, but most are NOT
e.g. the previous slide image (the fires) was produced from a scanner, not a camera

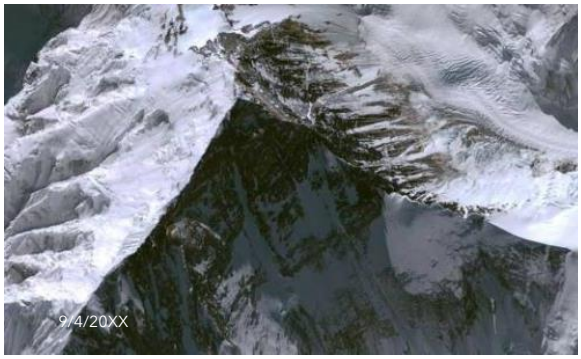
Alberta, BC and Rocky Mountain Trench, from International Space Station, Sept 06, 2014

15

SPOT satellite image: Manhattan
September 11, 2001

- http://earthnow.usgs.gov
  - Landsat (same day) data viewer

16



Myth #2: "Its so big you can see it from space":

- Since 2000, we have had very high resolution imagery = < 1 metres, so we can just about anything from space, similar detail to most aerial photography (& next slide)
- World's tallest building: Burj Khalifa, Dubai
- World's tallest mountain: Everest, Himalaya

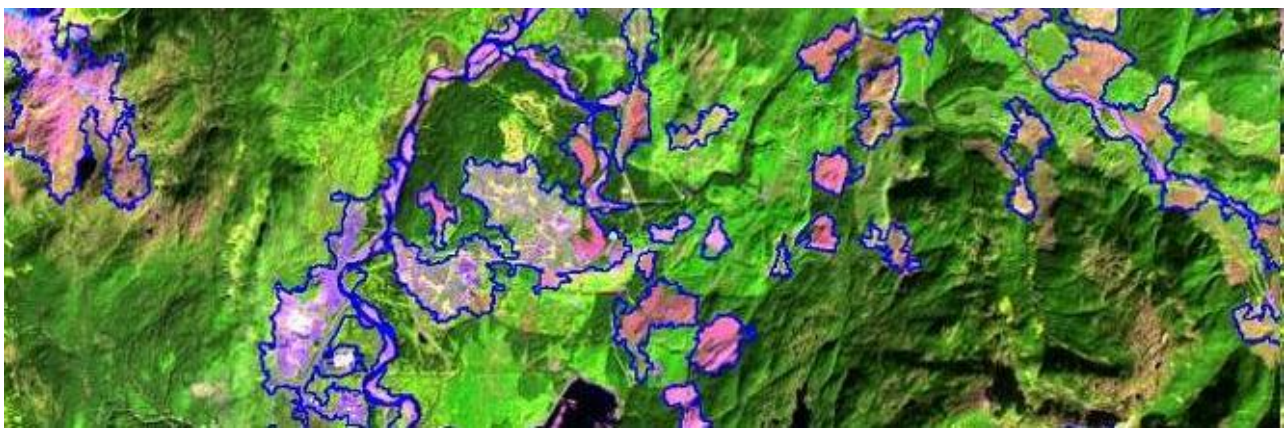
17

18

Traditional mapping from aerial photography and GIS layer creation – manual digitizing

All Canada was mapped this way 1945-1995 = > 13,000 map sheets at 1:50,000 scale including many thematic layers e.g. forestry, geology

19



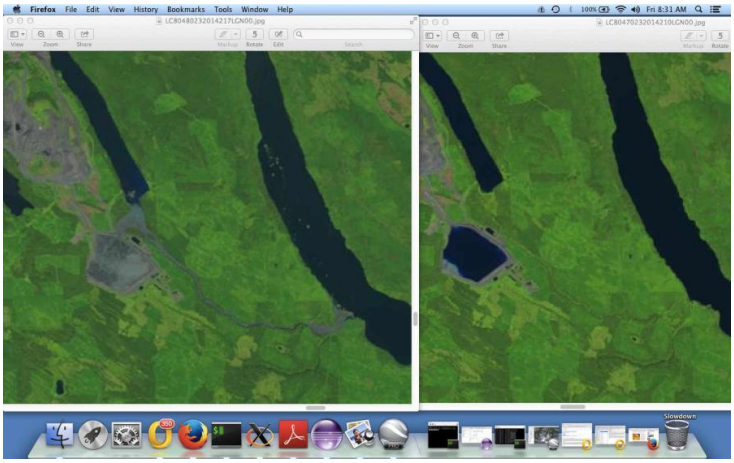
Digital remote sensing imagery -- auto-generation of vector layers (polygon data)

A sample from GEOG357 project: non-forested layer

20

- Local environmental change example from satellite imagery
- http://earthobservatory.nasa.gov/IOTD/view.php?id=84202

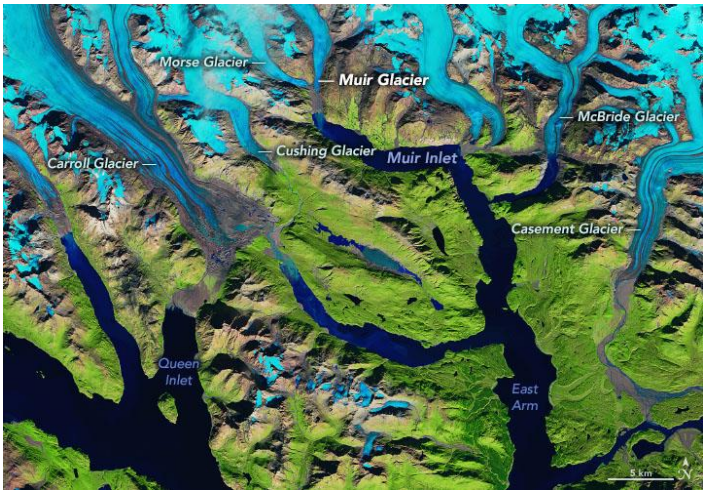
- Mount Polley Dam Breach, central BC, August 2014



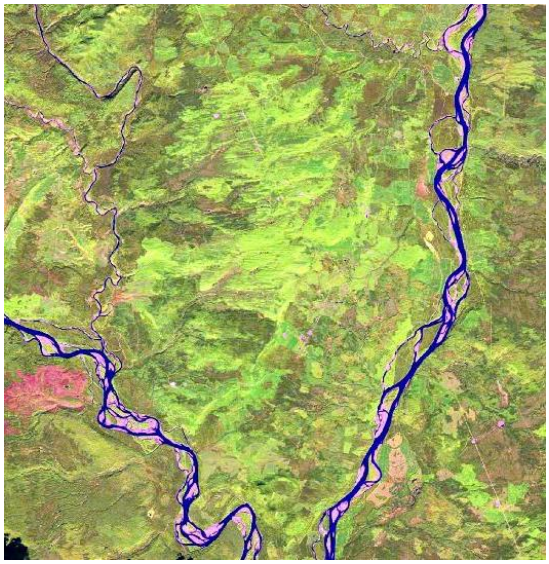
21

- Another example showing glacier change 1986-2019

- **https://earthobservatory.nasa.gov/images/147171/inlets-iceberg-maker-is-nearly-gone?src=eoa-iotd**

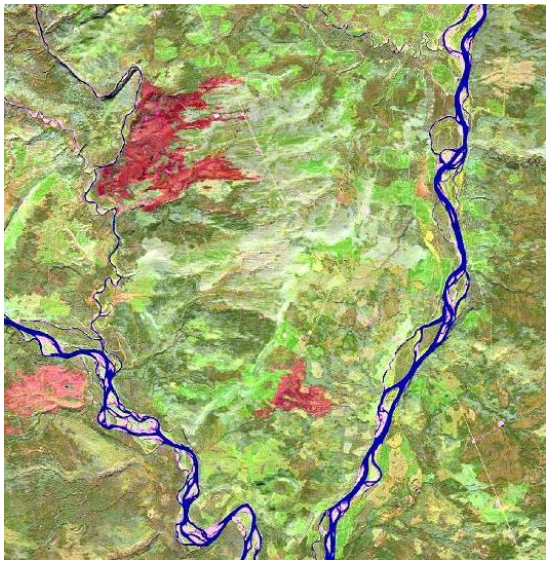


22



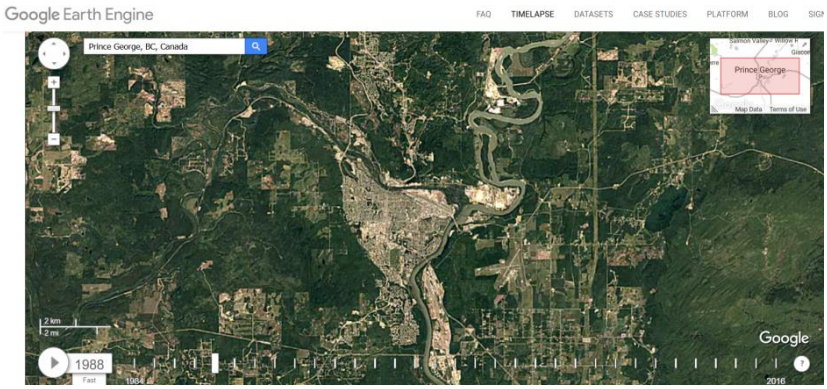
- GEOG357 assignment example- before / after
- Nelson Forks, September 3rd 2017
- This is the first graded assignment
  - you select/download two images showing change

23



- GEOG357 assignment example- before / after
- Nelson Forks, September 29th 2019
- This is by one of the students in 2019. It is showing an area close to his home.
- Your project should cover an area and topic of interest to you and your studies.

24

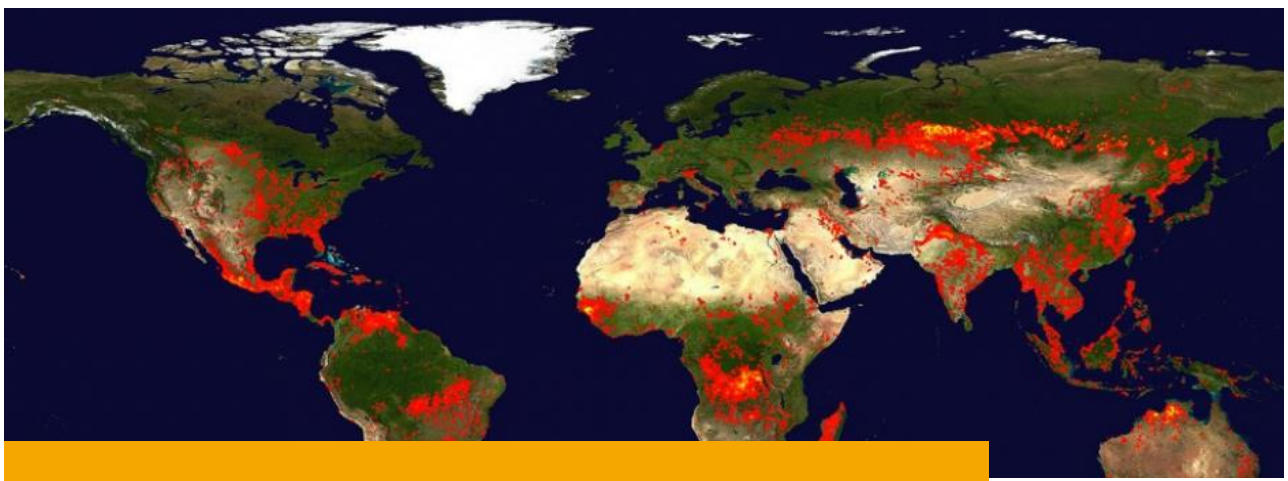


Mapping and showing change
Landsat images 1984 - 2019 (30m res.)

https://earthengine.google.com/timelapse/

- The google earth engine now shows 35 years of change around the world, though the images chosen are not always the best – they will be in your work !.. You can use the link above to review where they might be interesting changes (quite subtle in Prince George)

25



- Fires around the world, May 2019
  - Example of Global Remote Sensing from free satellite imagery

26

GEOG 357, Fall 2021

- **Course goals, you should develop / gain:**
- Understanding of imagery and wavelengths
- Potential of digital imaging to extract selected features
- The potential power of multispectral sensing
- Contribution of remote sensing to Geomatics / GIS
- Public education and media e.g. Google Earth
- Data availability for a range of applications
- Ongoing developments in current technology

27