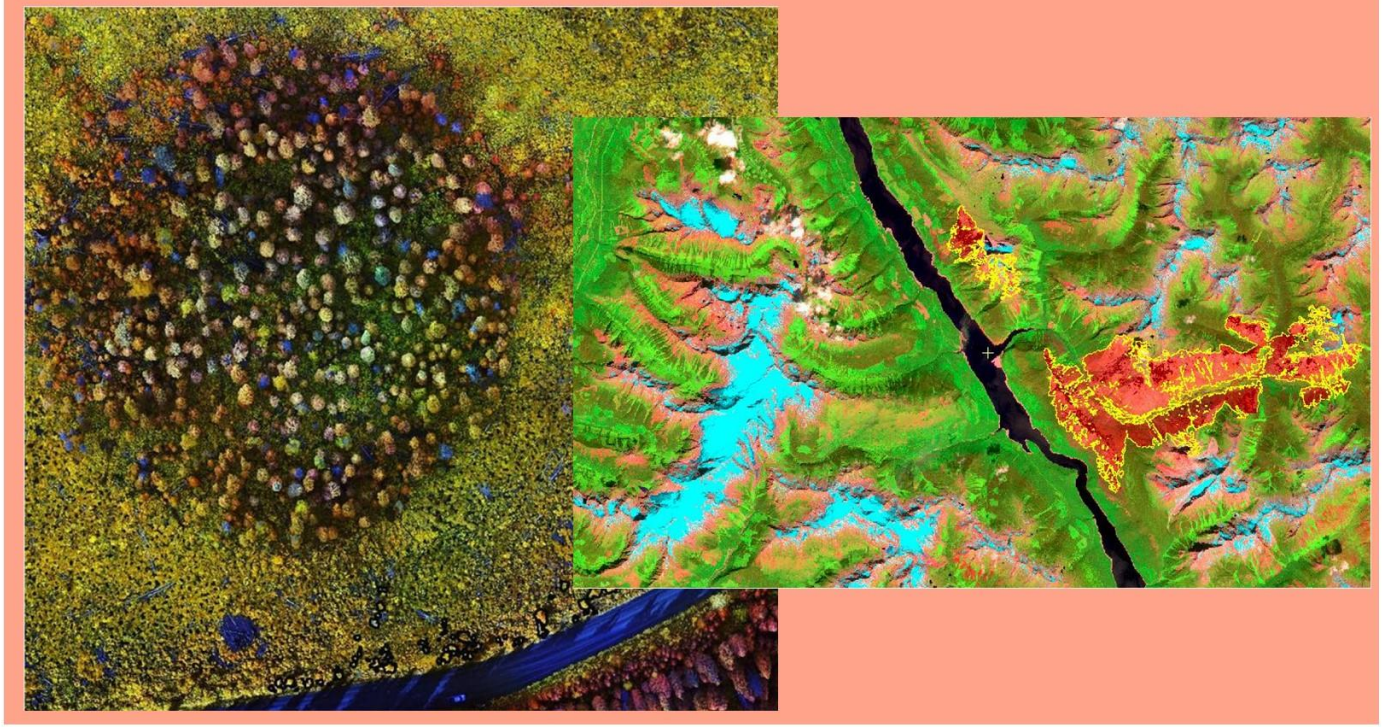
Fall 2024

GEOG 357-3

Introduction to Remote Sensing

Instructor: Dr. Roger Wheate



- **Lectures: Tuesday and Thursday, 10:30 - 11:20 am**
- **Lab: Wednesday, 3:00 - 5:50 pm**

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

GEOG357: Remote Sensing

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2024 class (13):

5 Geography

4 Computer Science

1 each: Forest Ecology/Mgmt, Psychology, Planning (northern/rural), Undeclared

Outline, lectures, labs: http://gis.unbc.ca

Lab assignments / grades: https://moodle.unbc.ca

References: online resources (websites) / library

RS: the acquisition/analysis of ground-aerial-satellite images

Textbook definition: "acquiring information from a distance" (no physical contact)

Why Remote sensing may be more 'important' than GIS, especially in Canada ?

- Size and remoteness of Canada – cannot be mapped easily

- vector data is often quickly outdated e.g. forest cover, urban areas
  …. while images can be current or more recent

- Images are not 'generalized' (pixel size apart) - shows it like it is

- Many image sources are freely downloadable

- Most GIS spatial data were created from remote sensing

- Images cross administrative boundaries (vector data may stop)
…. and (almost) no data blackouts

- Satellite image data are collected continuously
  https://earthnow.usgs.gov/observer

Types of remote sensing for Earth Observation (EO)

Satellite imagery

Low/medium resolution satellites for wide area / whole planet 500m-10km pixels

High res. for regional imagery e.g Landsat (NASA) / Sentinel (ESA) 10-30m pixels

Very high res. for local imagery e.g. 1 metre

Airborne

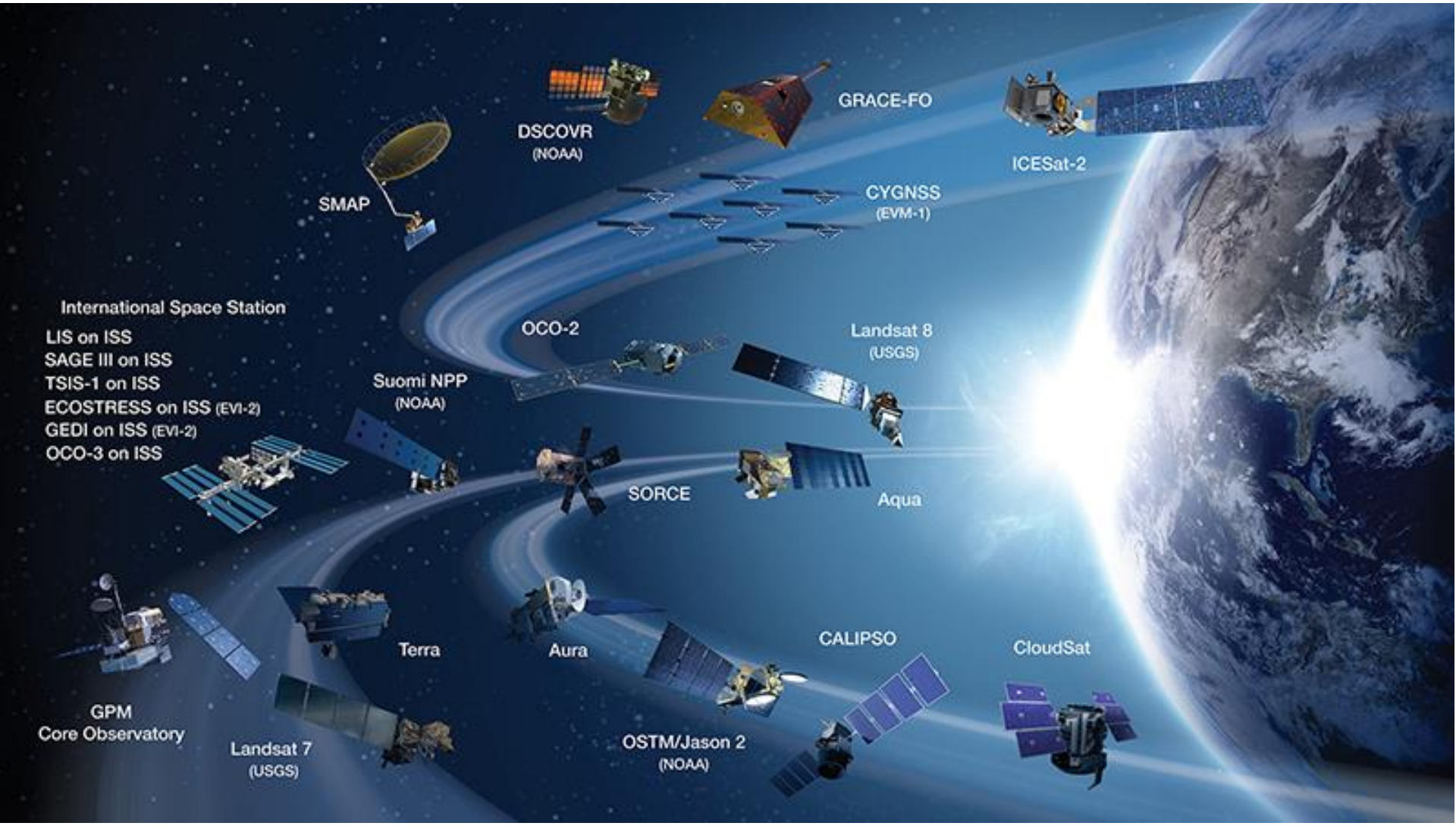
Digital photogrammetry

LiDAR

UAV (drones) – photography / LiDAR

GEOG357 focus: Landsat / Sentinel due to size of BC/Canada and archive (1984-2024)

There are thousands of satellites in space, many of them for Earth Observation (EO)



15,000 satellites, 5000 for EO (some thousands no longer operational – satellite debris)
- Enable continuous monitoring of earth surface

https://earthobservatory.nasa.gov/

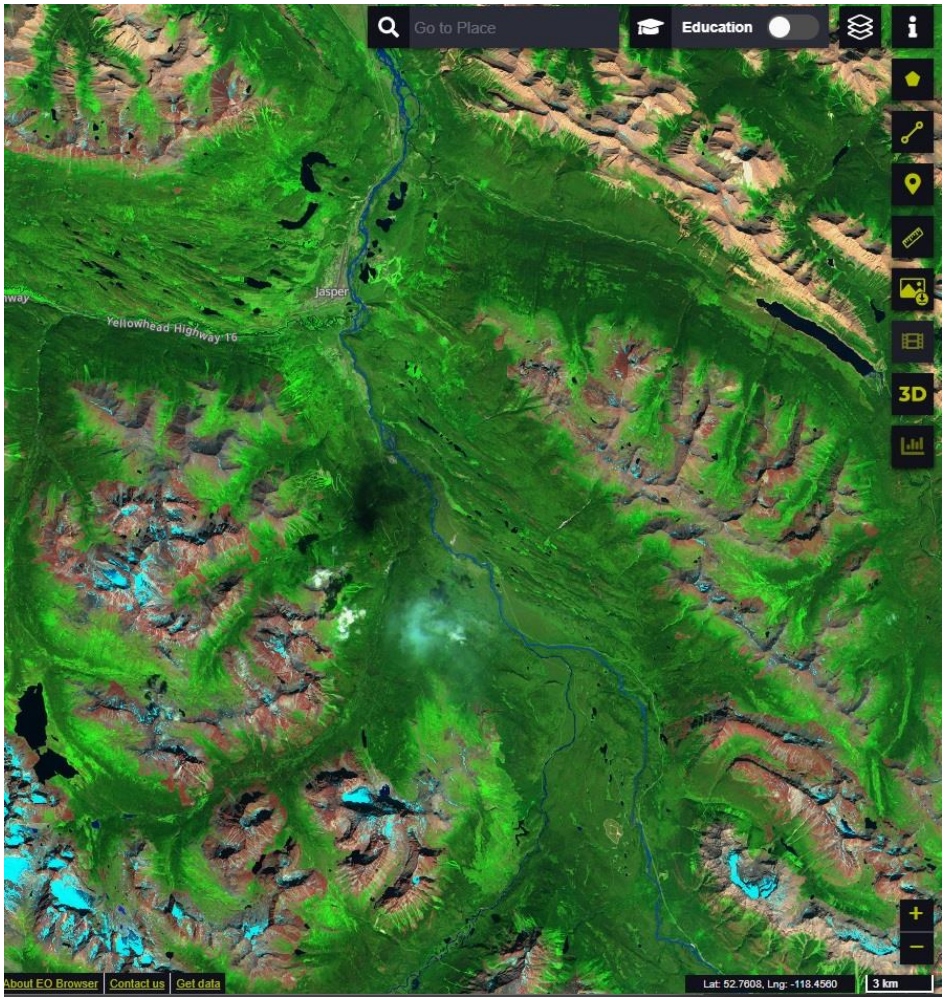
Fagradalsfjall, Iceland:
August 2022 eruption

2021-2022-2023

Jasper fire (July 22 2024): Sentinel2 July 20 - August 19
Image combines visible reflectance, Near and Shortwave Infrared
Fire, clouds (2%), one month season difference – snow, shadows

See also photos 1910-1920
https://explore.mountainlegacy.ca/stations/show/2732

https://apps.sentinel-hub.com/eo-browser



Early RS – (aerial) photography (>1840):

Balloons, US Civil war

World War 1:

Pigeon with german camera;
balloons and planes

Early to mid- 20th century RS milestones

1840: Invention of camera / photography

1910s First use of aerial photography from planes
(World War I: photo interpretation)

1920s Development of photogrammetry for mapping

1940 Military use of RADAR (World War II)

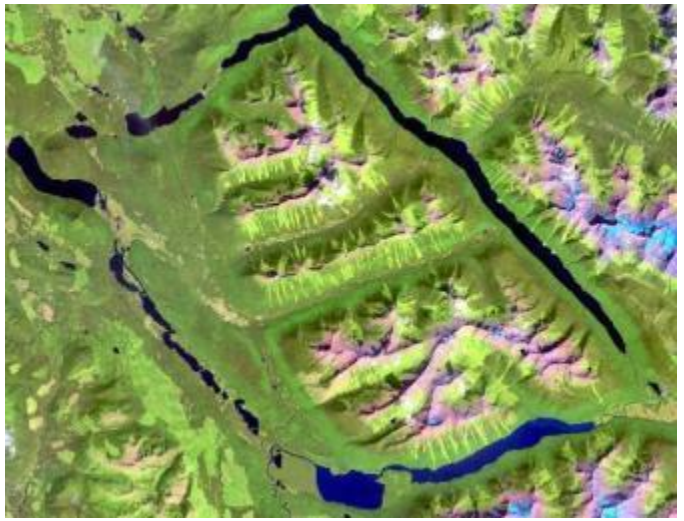
1945-> Main aerial photo mapping programs in Canada

1950s Use of colour photography and infra-red

1960 First reconnaissance satellites: Corona

1960s First weather satellites: Tiros (1960); Nimbus (1964)
(and first digital data transmission from space)

Why did 'RS' appear in 1960s ?



Advent of :

a. Satellites (Space Race)

b. Use of non-visible energy
e.g. infra-red, RADAR

- extended beyond aerial photography

Remote Sensing coined by Evelyn Pruit
American geographer, 1918-2000

1970-> RS milestones

1970s: Landsat 1-3 (NASA) – first Earth Observation (EO) satellites

1980s: Landsat 4-5 – the 'next generation' imagery (1984-2011)
and first commercial software e.g. PCI (Canada)

1986: SPOT 1 (France)

1990s: more satellites from various countries / India, Europe (ESA)

2000s: corporate high resolution (<1metre) satellites
2005: Google Maps / Earth – global Landsat mosaic
2008: Landsat data freely downloadable (others follow)

2010s: LiDAR and UAVs (drones)

2020s: Online data processing 'in the cloud' e.g Google Earth Engine
Free online software options e.g. ESA SNAP


Very high-res example
Worldview3 2014
Rainbow Range
Chilcotin, BC 31cm
Google

RS in the media myth 1:

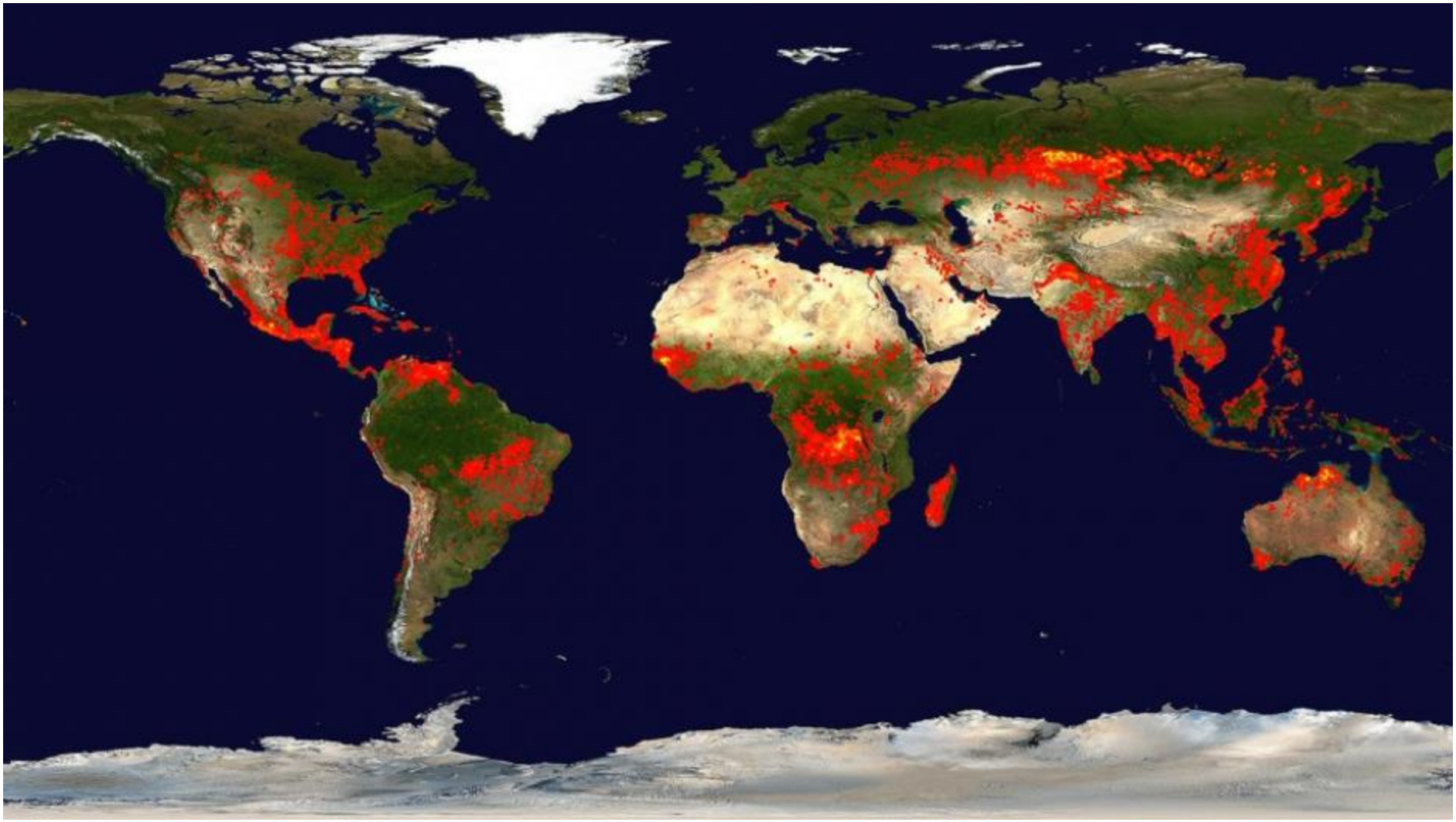
“it’s so big, you can see it from space”

High resolution satellite imagery (Maxar), 15-30cm Feb 28, 2022; Russian tanks

Ukraine: the new satellite war
https://www3.nhk.or.jp/nhkworld/en/shows/digitaleye

Fires around the world, May 2019

Example of Global Remote Sensing from free satellite imagery



Alabama teenager is using this site to map fires started in Ukraine

.. ‘OSINT’ – Open Source Intelligence – helps show current Russian activity

Myth #2 about remote sensing: This is a satellite photograph, but most are NOT
e.g. the previous slide images were captured from scanners, not a camera (not 'taken')

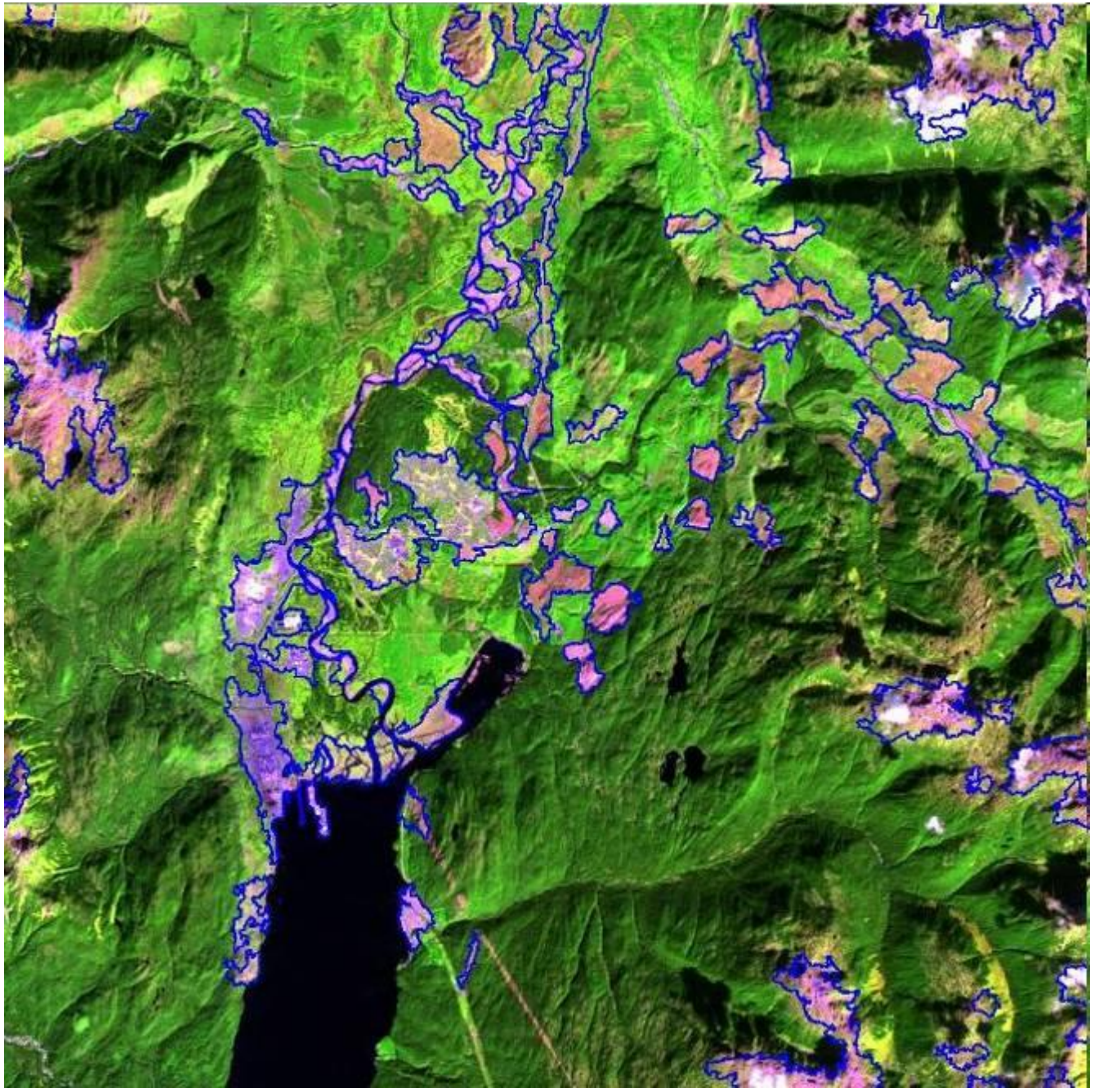
Exceptions e.g. ISS: Alberta, BC / Rocky Mountain Trench, from International Space Station, 2014
Aerial and drone digital photography – cameras, not scanners (but some planes do use scanners)

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

Canada was mapped this way 1945-2012 = > 13,300 map sheets at 1:50,000 scale also including thematic layers e.g. forestry, geology

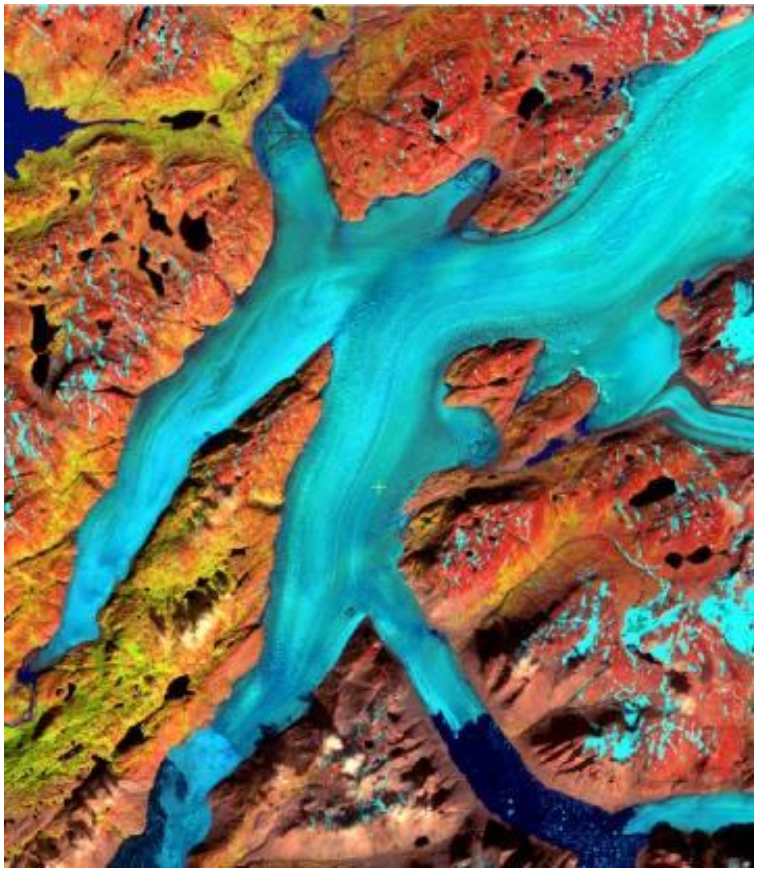
Digital remote sensing imagery – auto-generation of GIS layers – e.g. polygon data

Sample from GEOG357 project: non-forested layer



GEOG357 project to extract polygon layers

Extraction of Glaciers, Water, and Vegetation - the Southeast Coast of Greenland



Threshold images for ice, water and vegetation derived from ratios