Feature Extraction

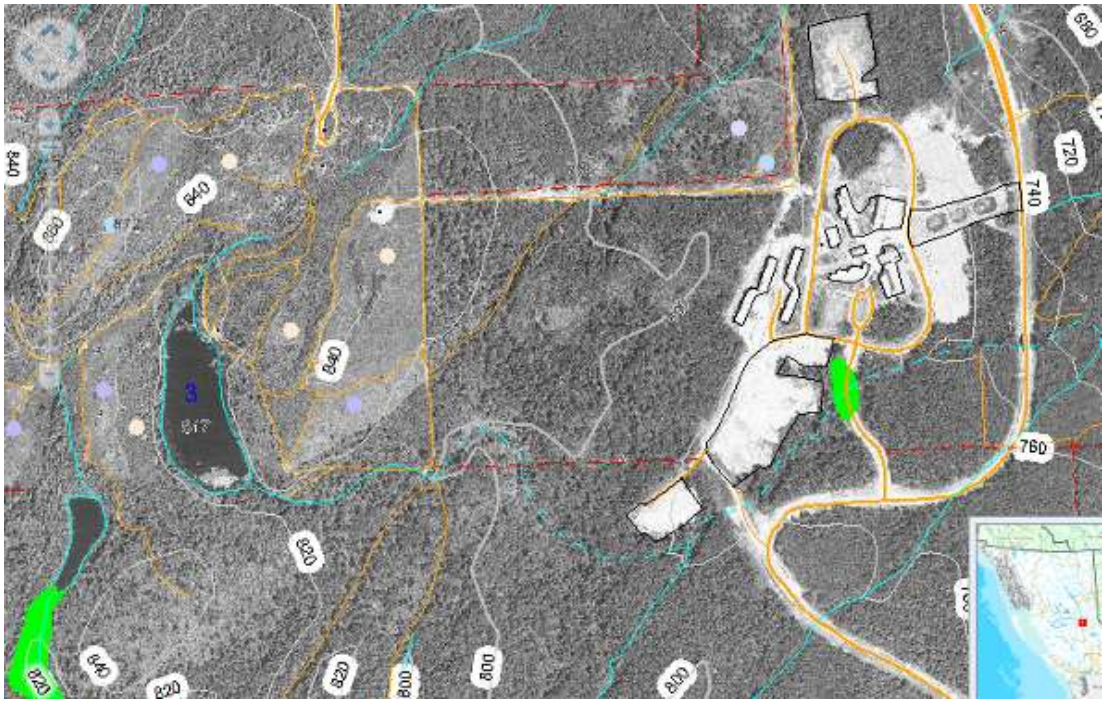
"The identification of geographic features and their outlines in remote-sensing imagery through post-processing technology that enhances feature definition, often by increasing feature-to-background contrast …. or using pattern recognition software."

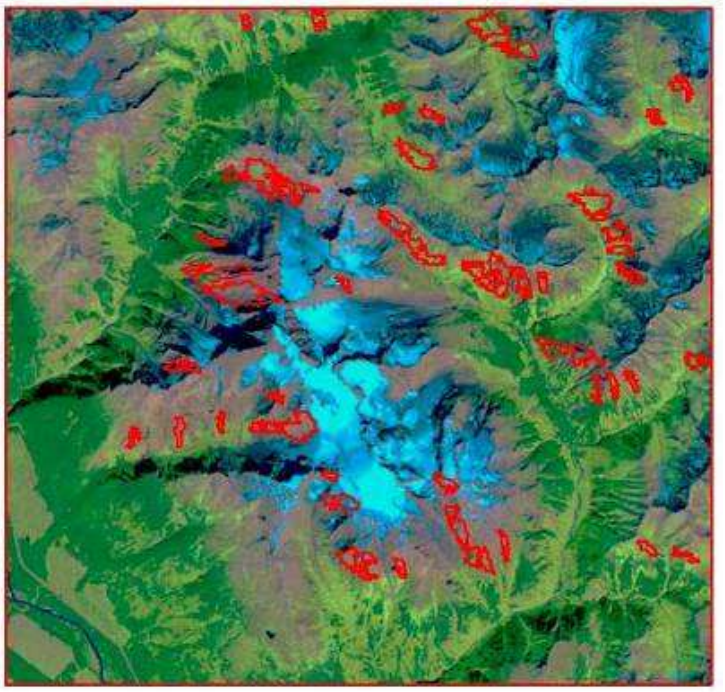
ESRI GIS

definitions

Image interpretation / feature extraction

- the **analogue** data unit is the photograph from a camera;
- the **digital** unit is the scene, composed of pixels, created using a scanner.
- analogue remote sensing involves interpretation, location & feature updating;
- digital applications include classification & feature extraction – based on DNs





Manual interpreting/digitization from photos | extraction of caribou habitats by Digital Numbers

Completion of the 1:50,000 National Topographic Database

with satellite Imagery 2000-2012

…used as background, not classifiable image data Why not ?

Figure 12 illustrates the evolution of the Northern mapping project that began in 2004 up (light green to dark green). Complete map coverage will be achieved with the 2011-2012 production plan utilizing SPOT5/HRS and Radarsat-2 data sources (Figure 13)

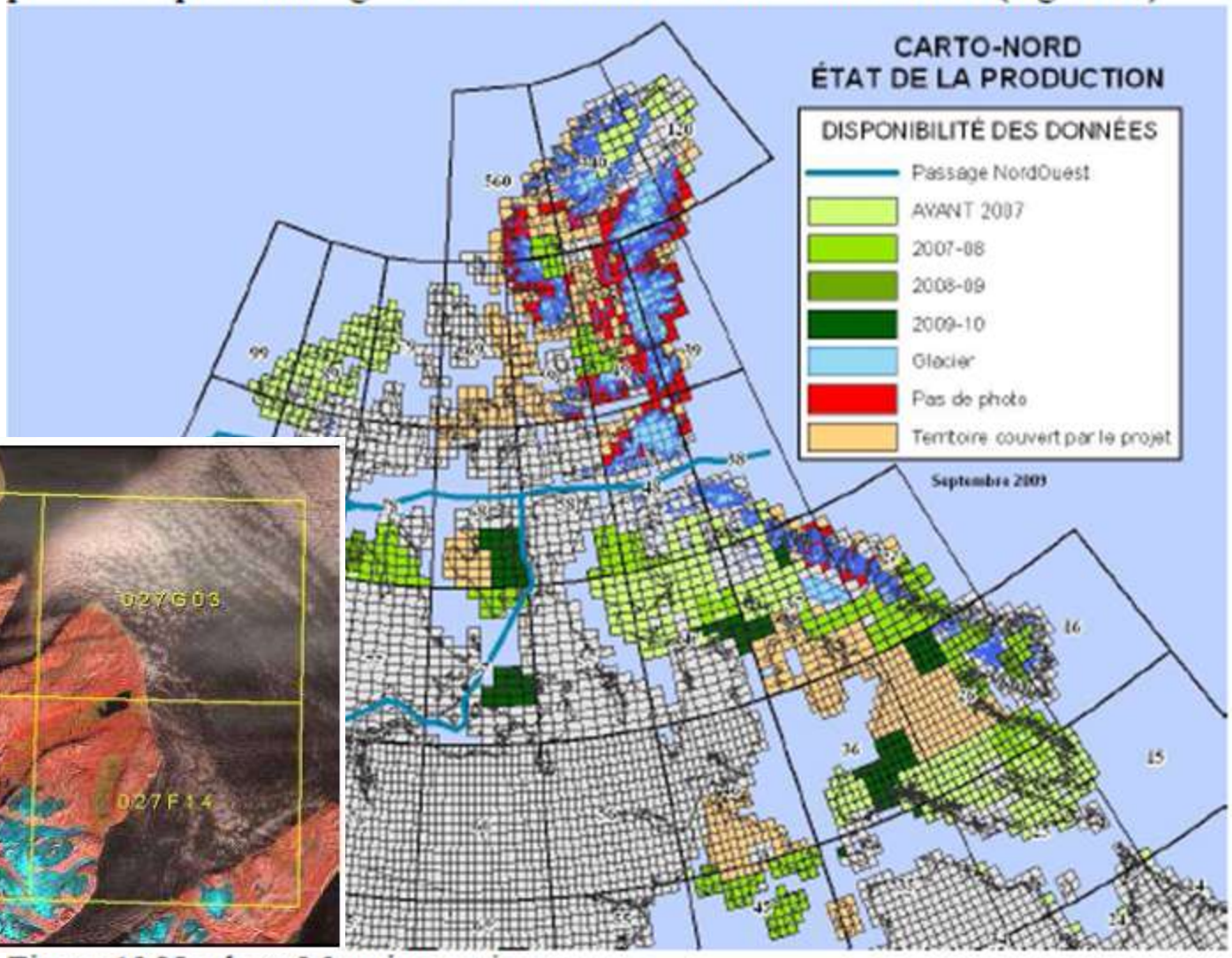
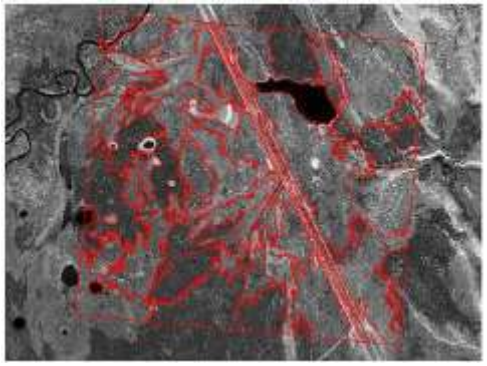


Figure 12 Northern Mapping project

Feature extraction (digitising) from aerial photography is the most tedious part of mapping ….. why hasn't remote sensing been used more to update GIS data layers ?



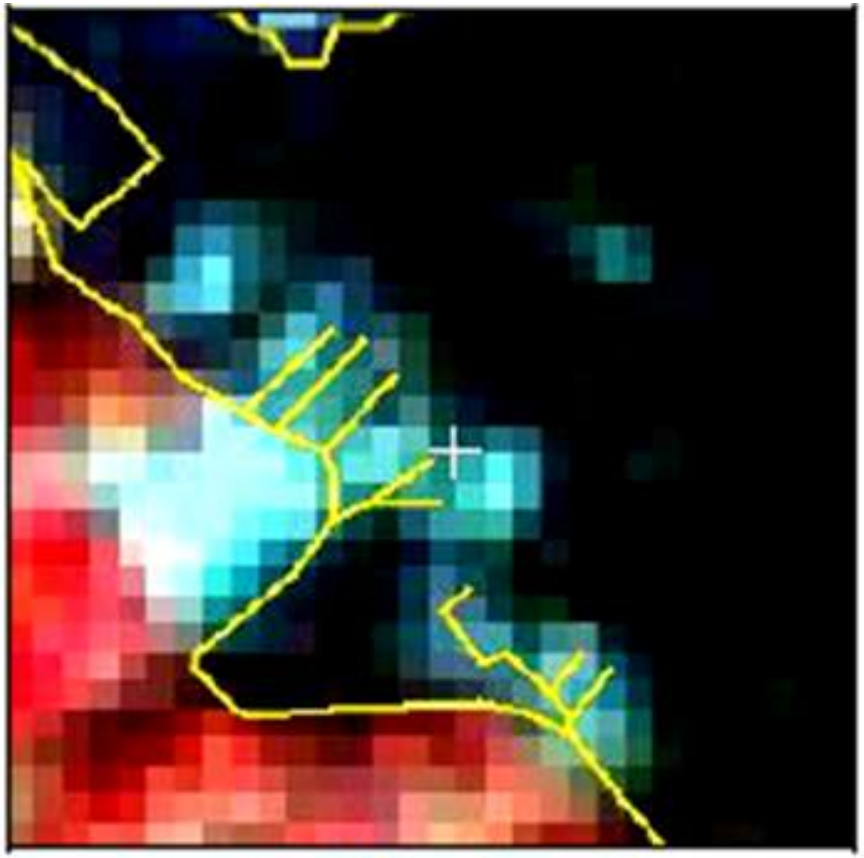
Principles of GIS: Aronoff (1989) – the first GIS textbook, Ottawa*

- **data are not well understood**
- **data are too expensive**
- **insufficient resolution**
- **classification accuracies**
- **complexities of reality = lack of homogeneity / contrast**

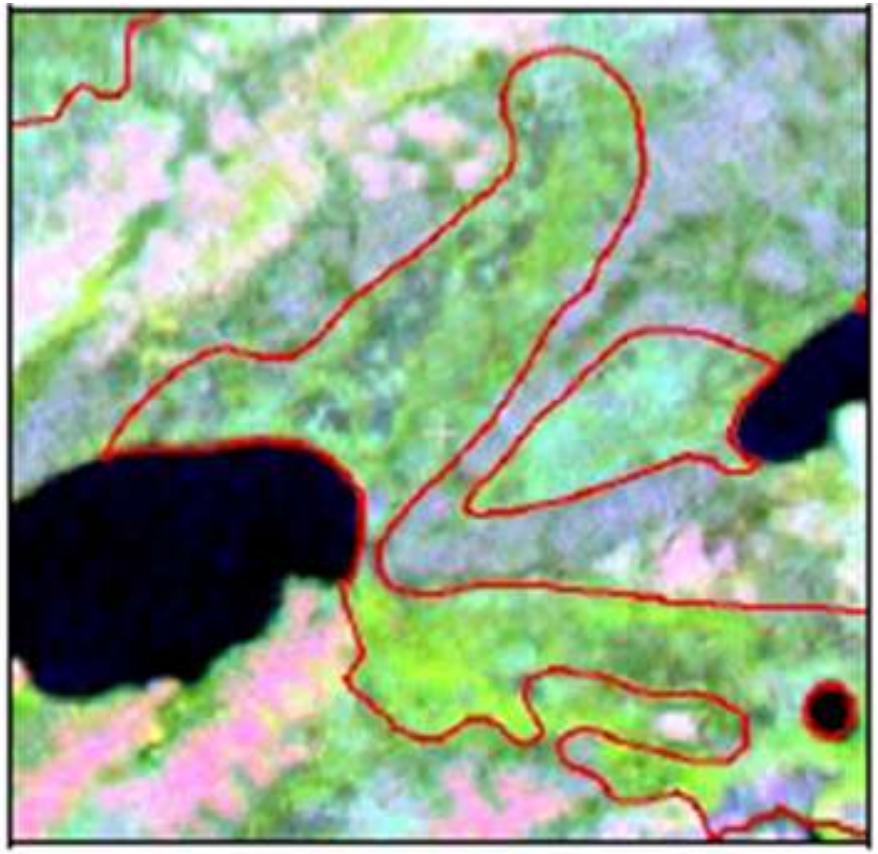
- *Stan Aronoff is a Canadian remote sensing author / expert*

1989 was within the first decade of Landsat 30m data; gray above = partly solved now

Examples of resolution and complexity of reality



Wharfs



Wetlands

Higher resolution might help a. (left), but not b. (right)

BC: updating of Vegetation Resource Inventory

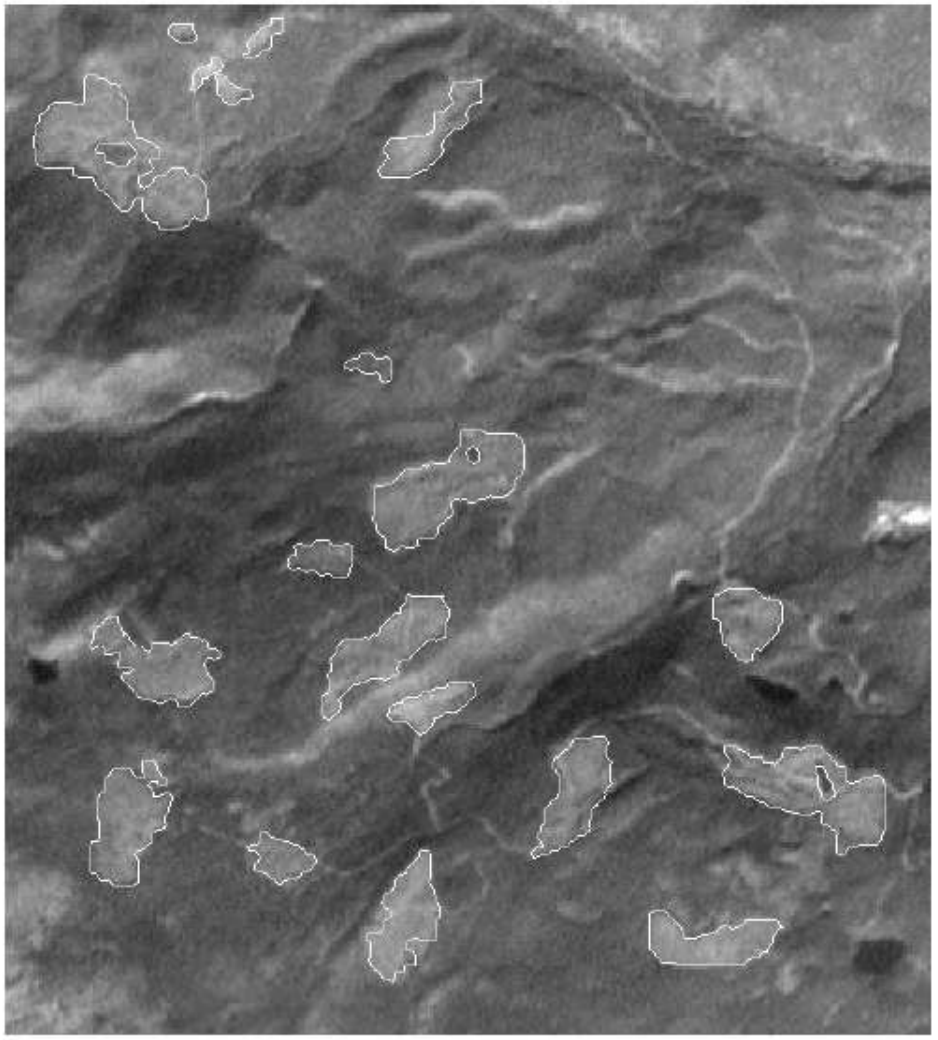
where does it work?

-Feature **simplicity**
Consistent shape, contiguity

- Feature **homogeneity**
Consistency inside feature

- Feature **certainty**
Contrast with other features

Below is an example of the spatial change coverage from the Lillooet TSA. The delineated cutblocks are shown in white overlaid on the 15m panchromatic band.



Bowron Lakes

- **Feature simplicity** e.g. cutblocks? alluvial fan deltas
- **Homogeneity** e.g. lakes, bare rock (sunlit)
- **Feature certainty** e.g. avalanche tracks, glaciers (?)

Process for creating feature vectors from image data:

- 1. Select bands / channels to maximise feature contrast
- 2. Classify (multispectral) or threshold (single channel)
- 3. Create feature raster channel or bitmap
- 4. Clean results -> sieve or filter (generalise)

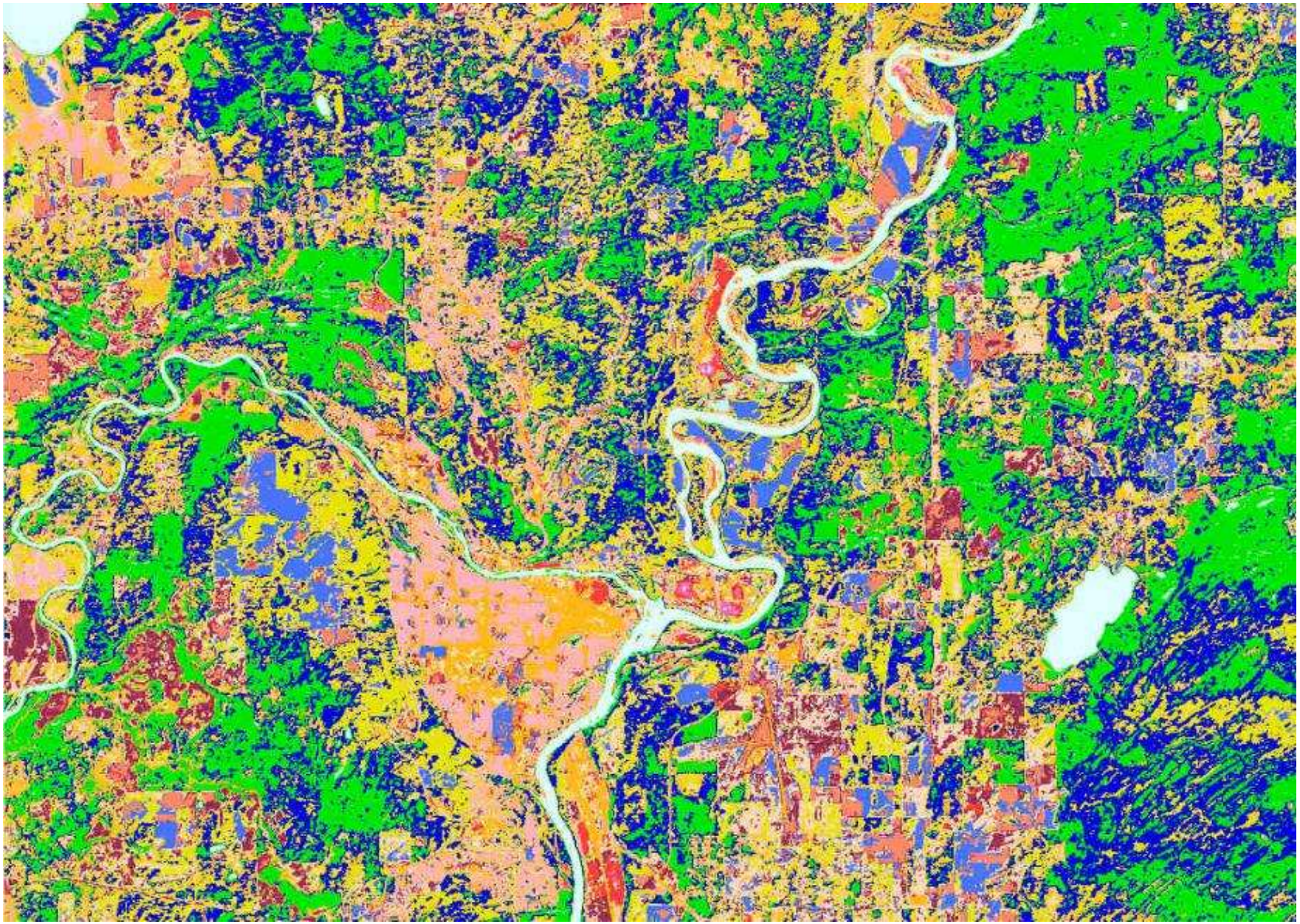
We are doing these below in the next lab

- 5. RTV -> Raster to Vector conversion -> polygons …

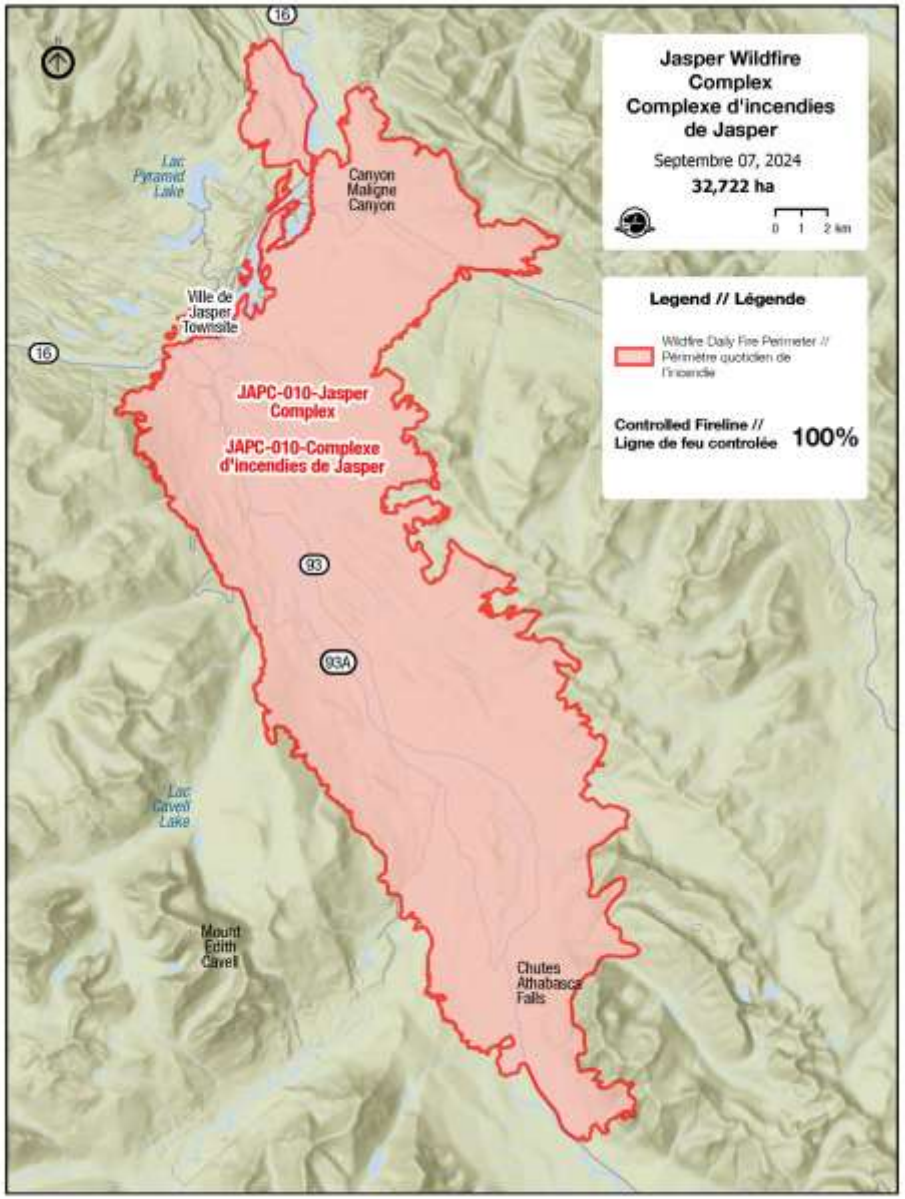
- 6. Smooth lines / generalise (-> export to GIS)

- 7. Massage attribute table / calculate areas etc.. (RS or GIS)

Land cover **classifications** or thresholds can be vectorized into polygons (tool: RAS2POLY)
- But they need major Sieving – this image could take till the end of semester, but would crash



Example: Jasper 2024: ESA Sentinel image 5 September; and map 7 September

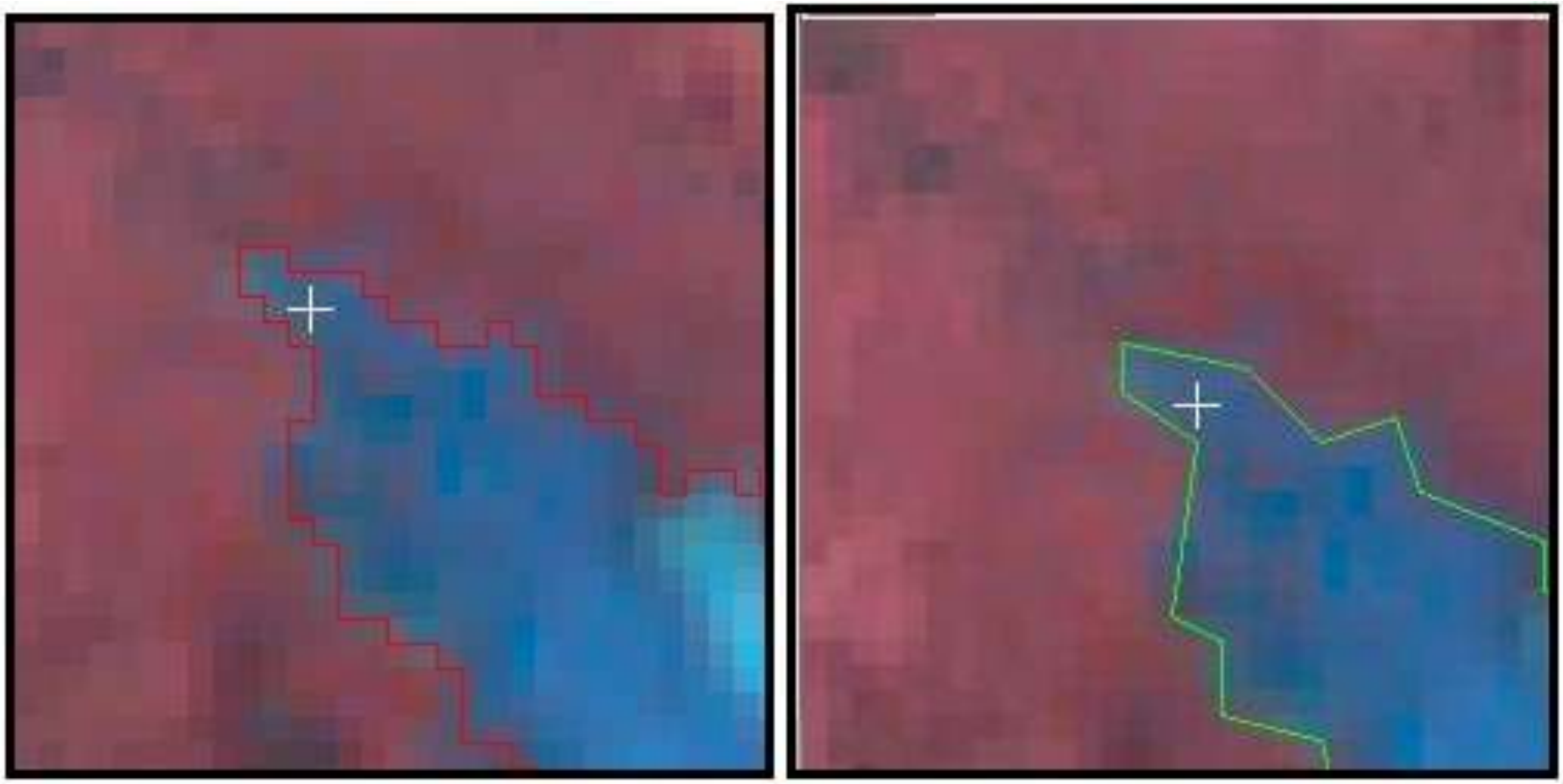


Burn Index could be used with a threshold DN

but can be problematic to separate fire from mountains / shadow (needs before/after image)

6. Generalise 'Smoothing the jaggies' – remove staircase pixellation

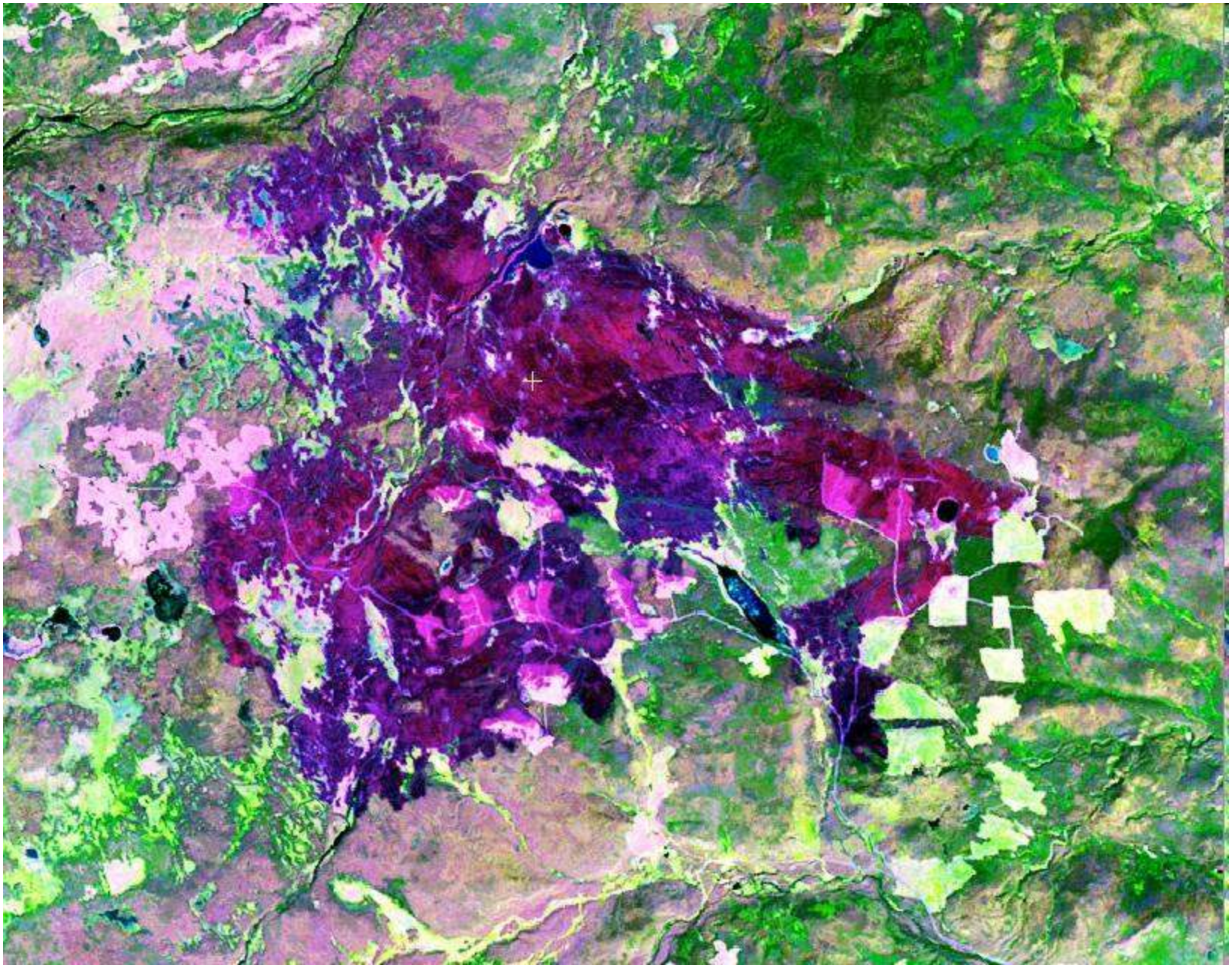
e.g. algorithm: smmcmaster, smboyle – both derived from Douglas-Poiker algorithm (GIS)



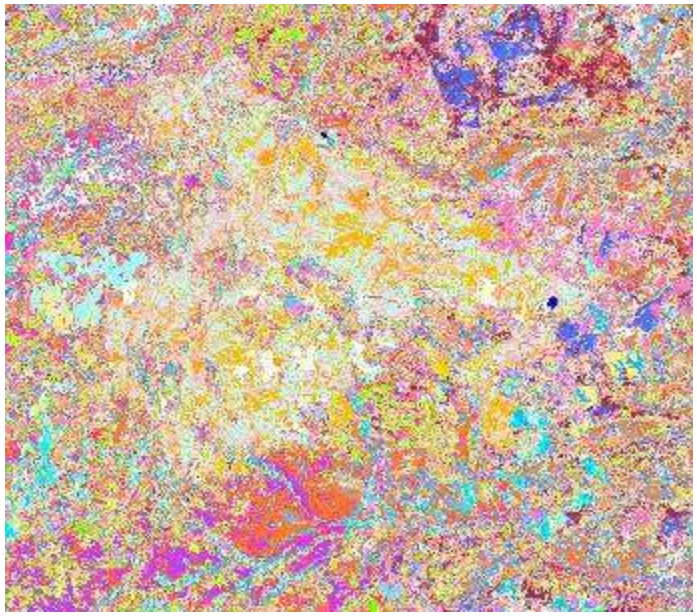
Several different algorithms for line generalisation (from GIS history)

Smoothing – more faithful to geography, but is it as accurate ?
- Compare with higher resolution PAN band if available or Google maps

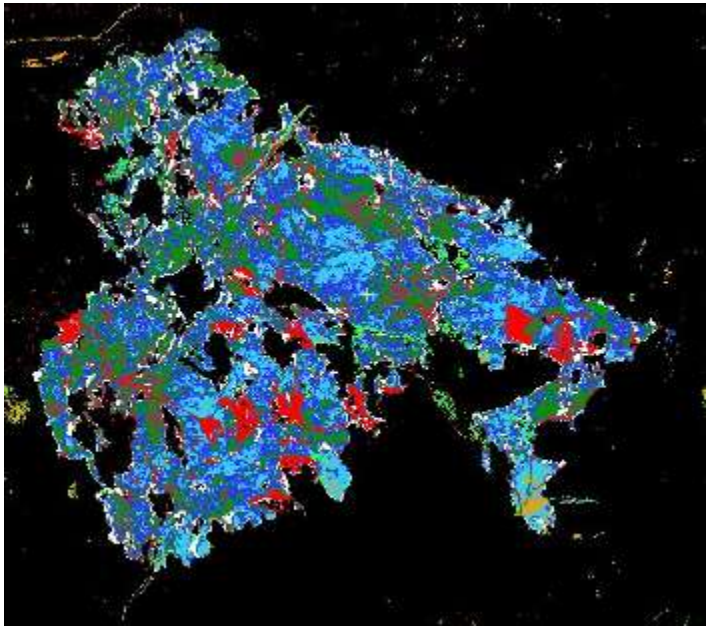
Project example to ‘digitally’ map a complex fire polygon



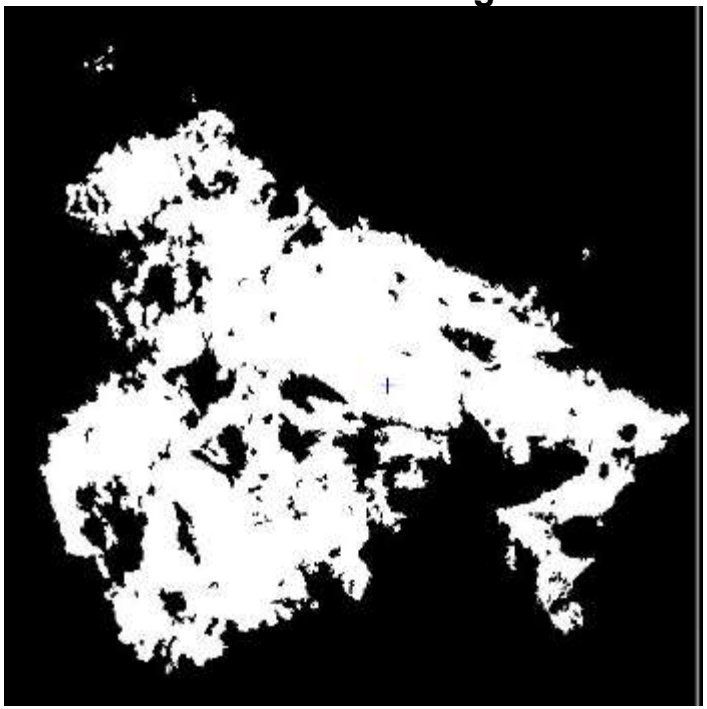
One approach: Normalised Difference Burn Ratio (NIR-SWIR) / (NIR+SWIR); alternative = classification



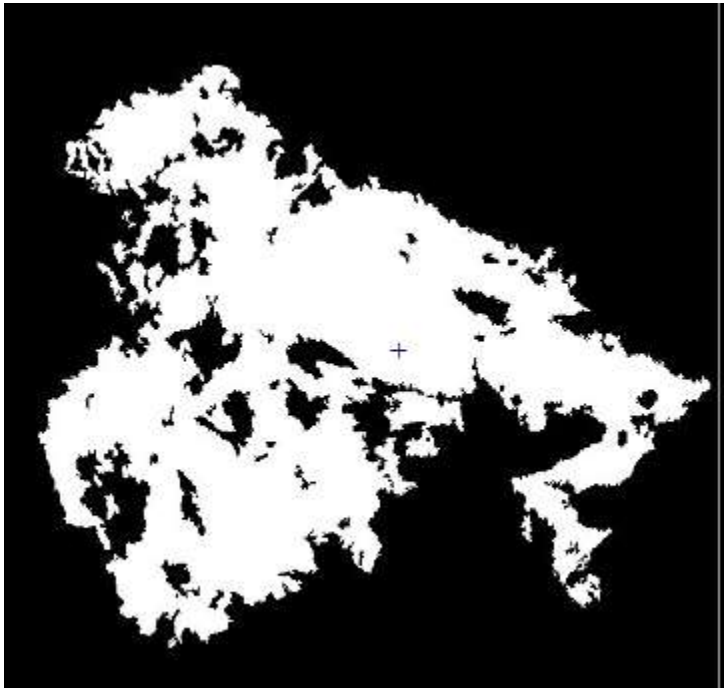
ISODATA classification showing 50 classes



Clusters 5, 7, 12, 15, 20, 25, 37 -> burn extent

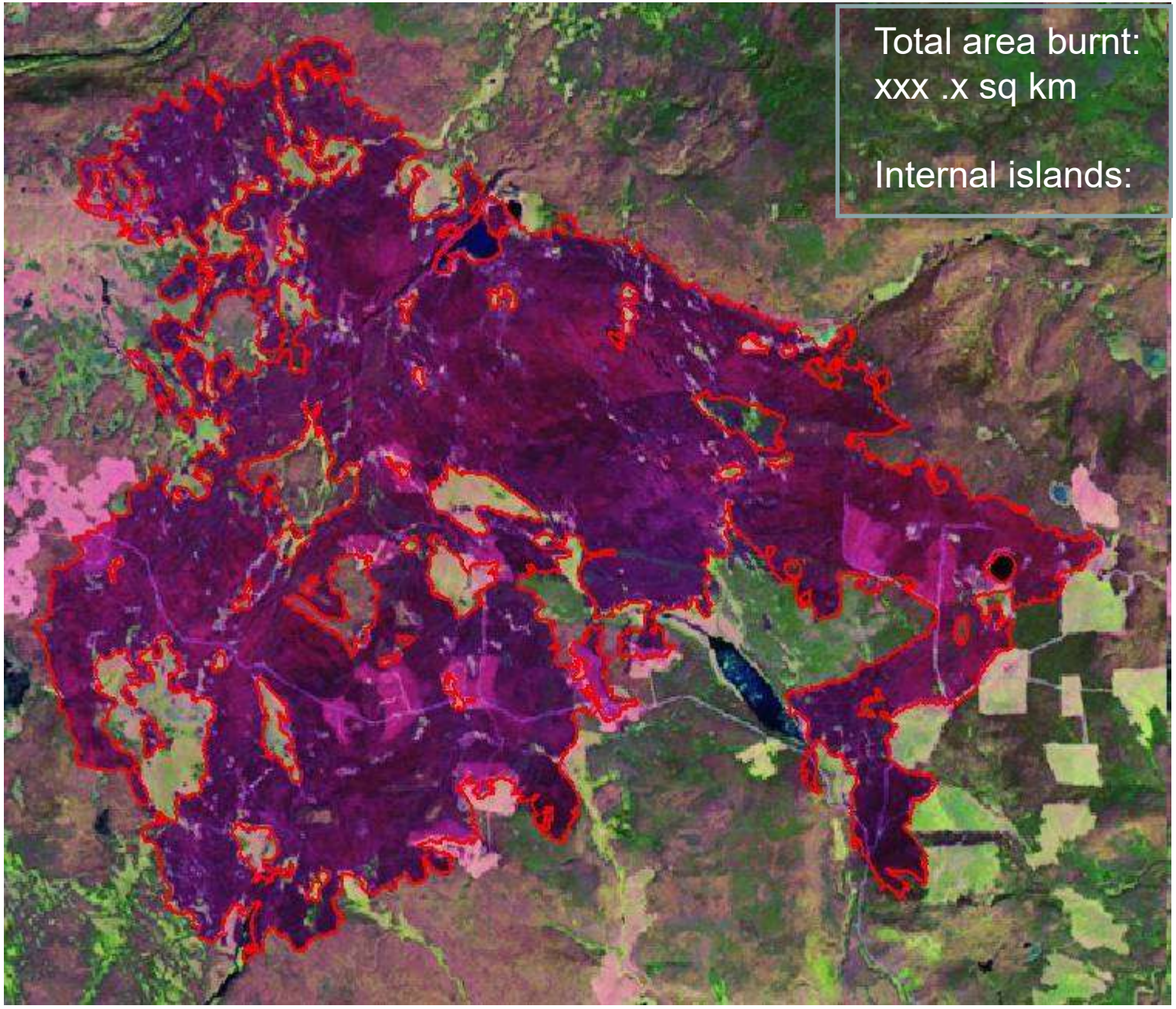


Aggregation -> feature extraction



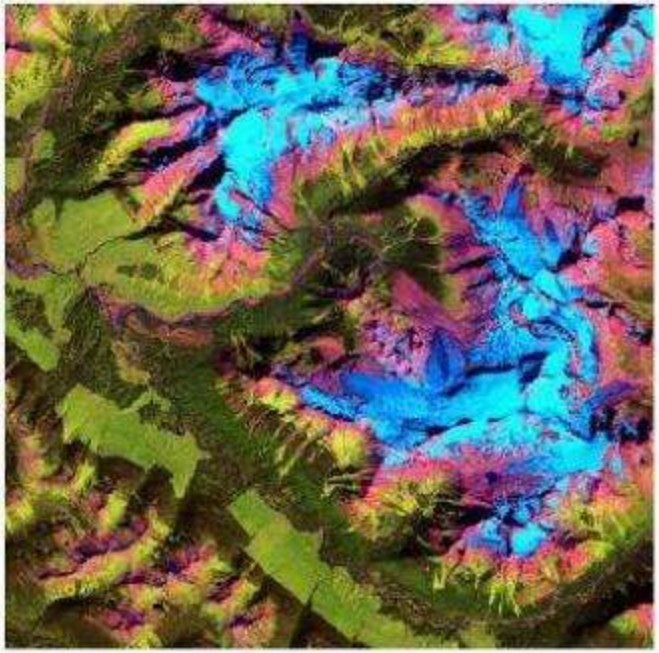
Sieve

5,6,7: RTV: Raster to vector conversion, smoothing, and tabulation

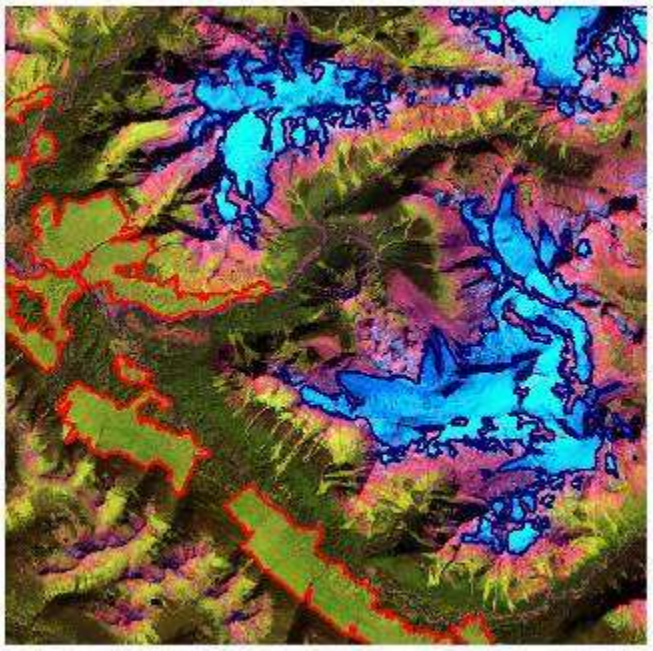


Tends to be even more complex in mountains due to shadow and bare rock e.g. Jasper

Geog357 project: Extracting glaciers and cutblocks in Kakwa

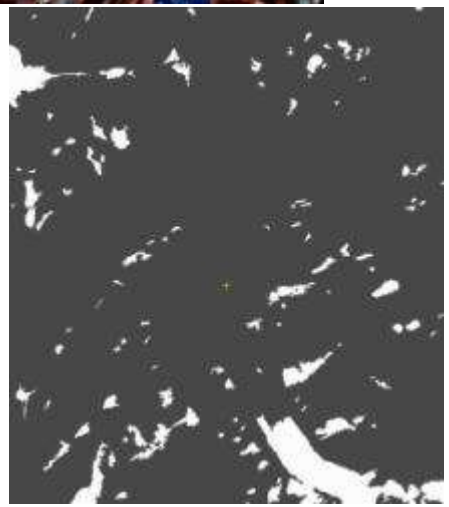


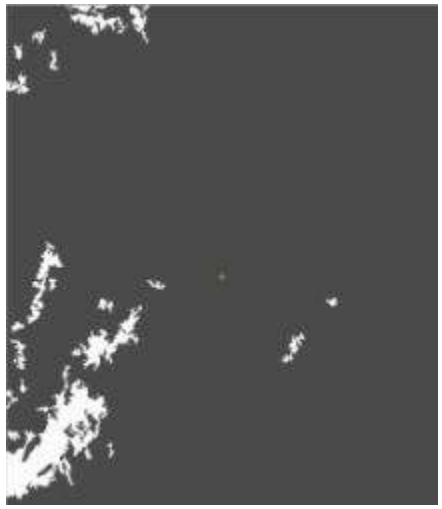
Glaciers/snow
TM 3/5
threshold
ratio -> 2.0



Cut blocks
-Deciduous
<-TM 4/3
ratio > 2.0

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





Threshold images for ice, water and vegetation derived from ratios

Mt. Edziza, BC

Land cover boundaries
-simpler than PG 2023

From: Classification or Greenness
a. NIR/Red
b. NDVI
c. Tassel greenness

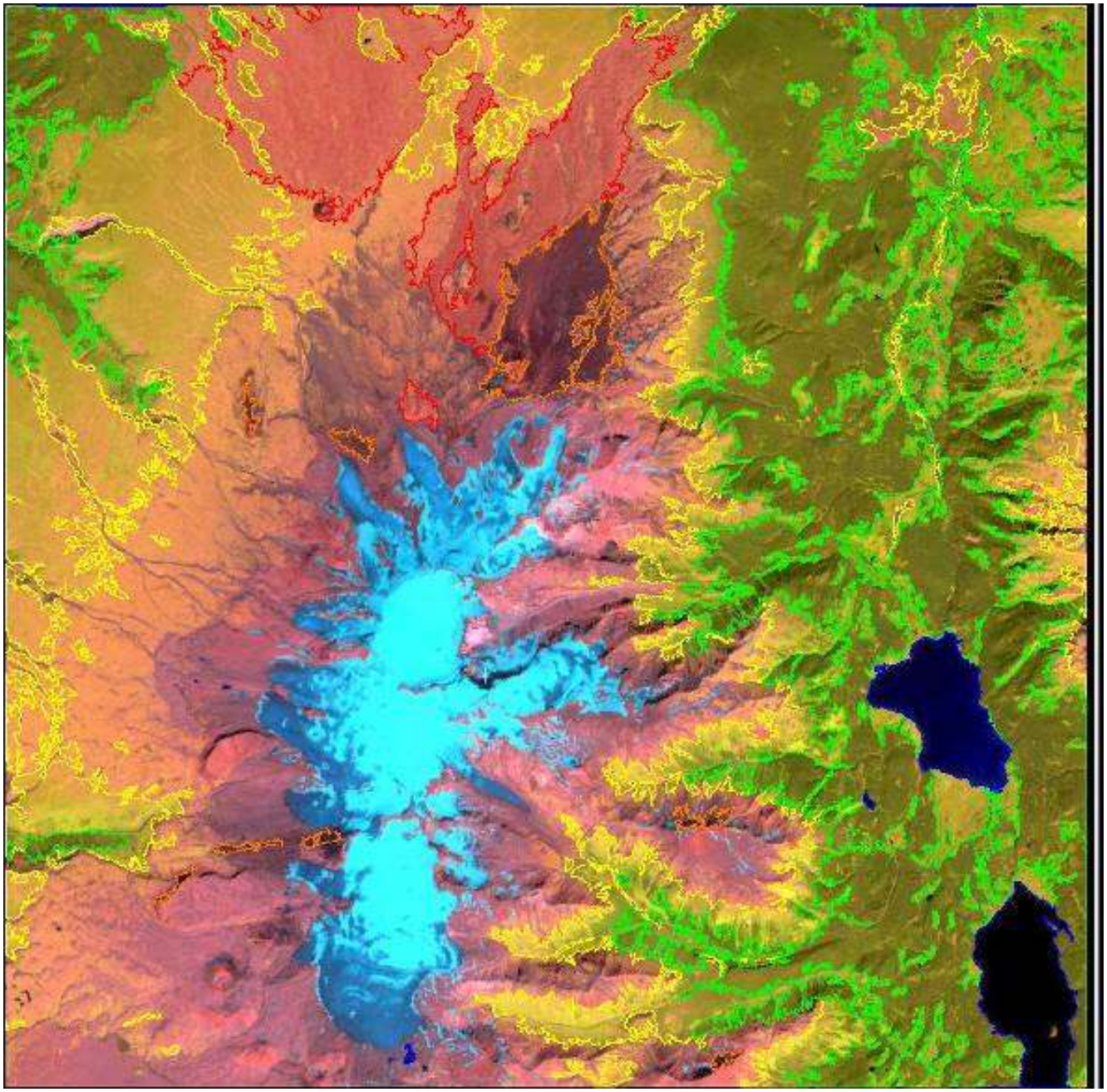
- Lava flows

- Bare ground

- Deciduous

- Coniferous

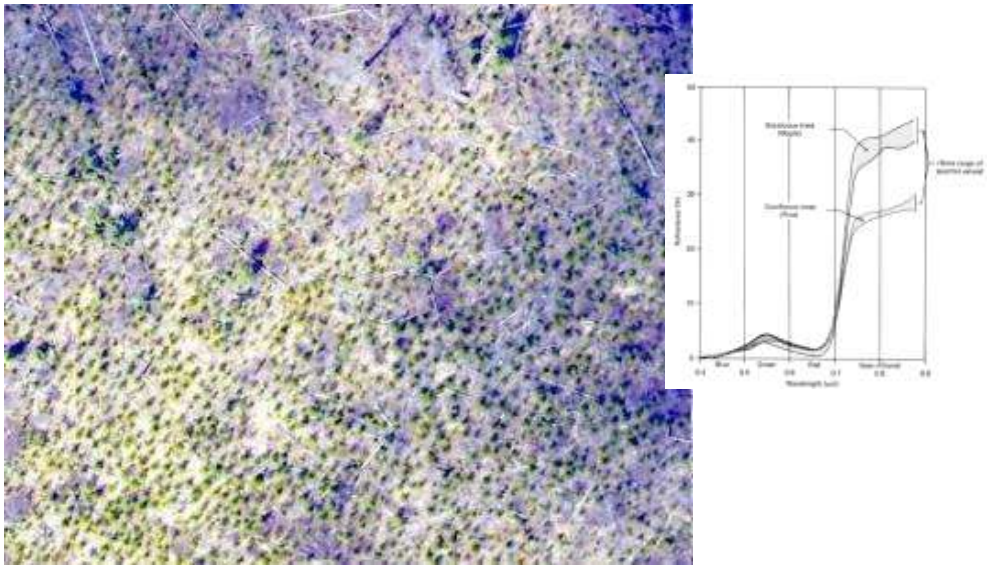
+ Lakes, Glaciers



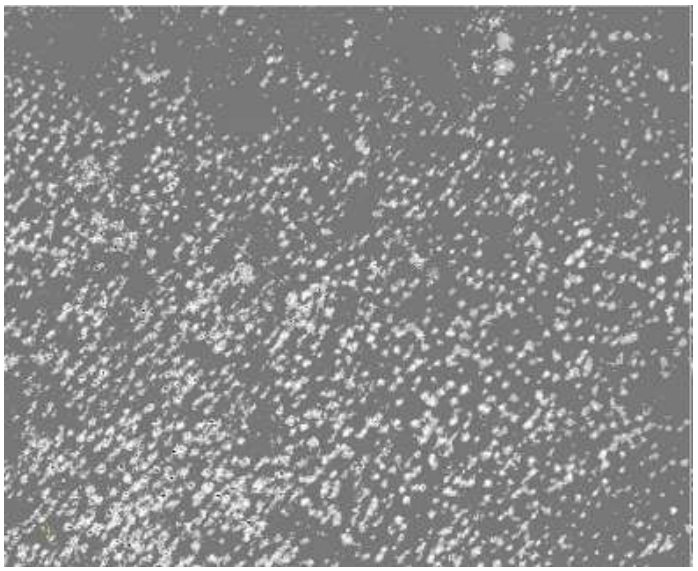
Extraction of road networks – lines – not easy (RAS2LINE)

Experiment to extract trees as points to avoid many trees digitizing: RAS2POINT
Masters thesis with 20 colour photos; image is ~5% of one photo

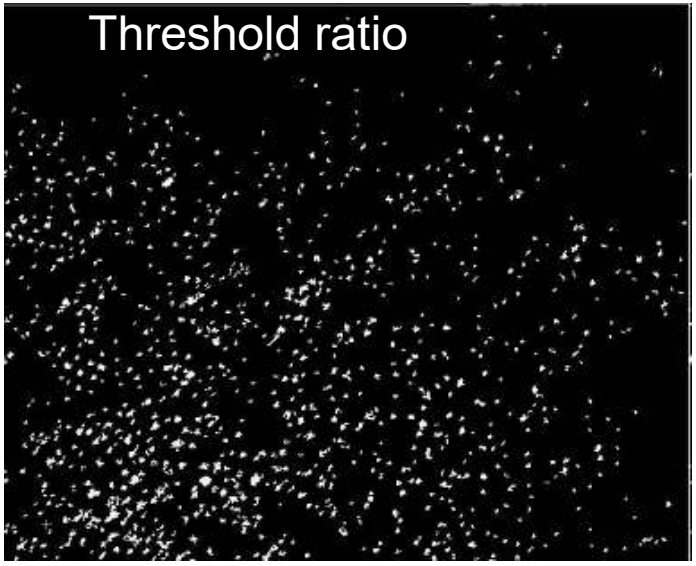
RGB Colour photo



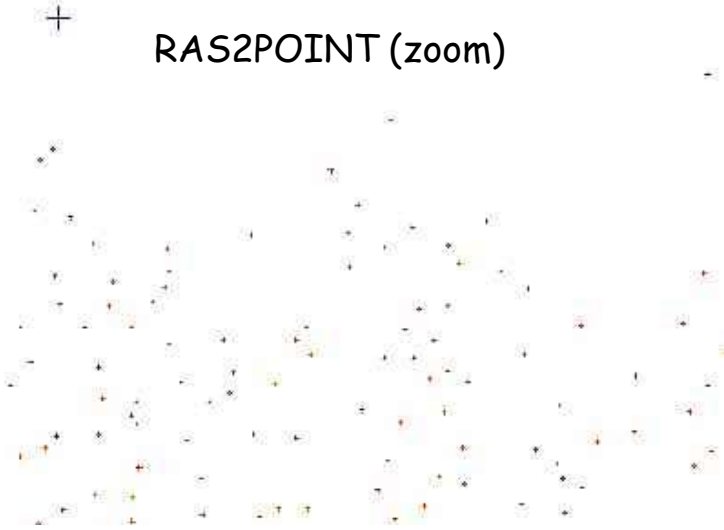
Green / red ratio



Threshold ratio



RAS2POINT (zoom)



GEOG357, Fall midterm exam 15 October 2025 - sample questions

Thees will cover content up to today's class (+ next week's lab)

Multiple Choice (10%) - 20 questions

1. Which one of these below are the shortest wavelengths ?

a. Near Infra-red
b. Mid-infrared
c. Red
d. Thermal infra-red
e. Green

2. What is the pixel size in Landsat (4-9) band reflective data (in metres)?

a. 5
b. 10
c. 30
d. 50
e. 80

Short answers (5%) – 5 questions

1. Explain the difference between Colour composite display versus grayscale display

Oct 14: Lab 5 next week: Feature Extraction

Oct 15: Wednesday 8.30am: midterm exam (15%) in class time

Oct 20: Lecture: remote sensing of glaciers

Oct 21: Lab 6: Glaciers – extraction of glacier extents

Oct 22: Lecture: Change detection

Environmental change exercise 2025 (10%)

… the world is your oyster. Pick a good example

Goal: identify an event or change somewhere in (1972) 1984 - 2025,
find/download/clip before/after image …

Further details in Oct 22 lecture

Download / prepare images Oct 20- Nov 7 (Nov 10-14 = reading break)

Send me your slides via moodle or email by Nov 15, 17:00

Before/after images and text slide(s) explaining the changes

Give a 3 minute summary in class on Nov 17

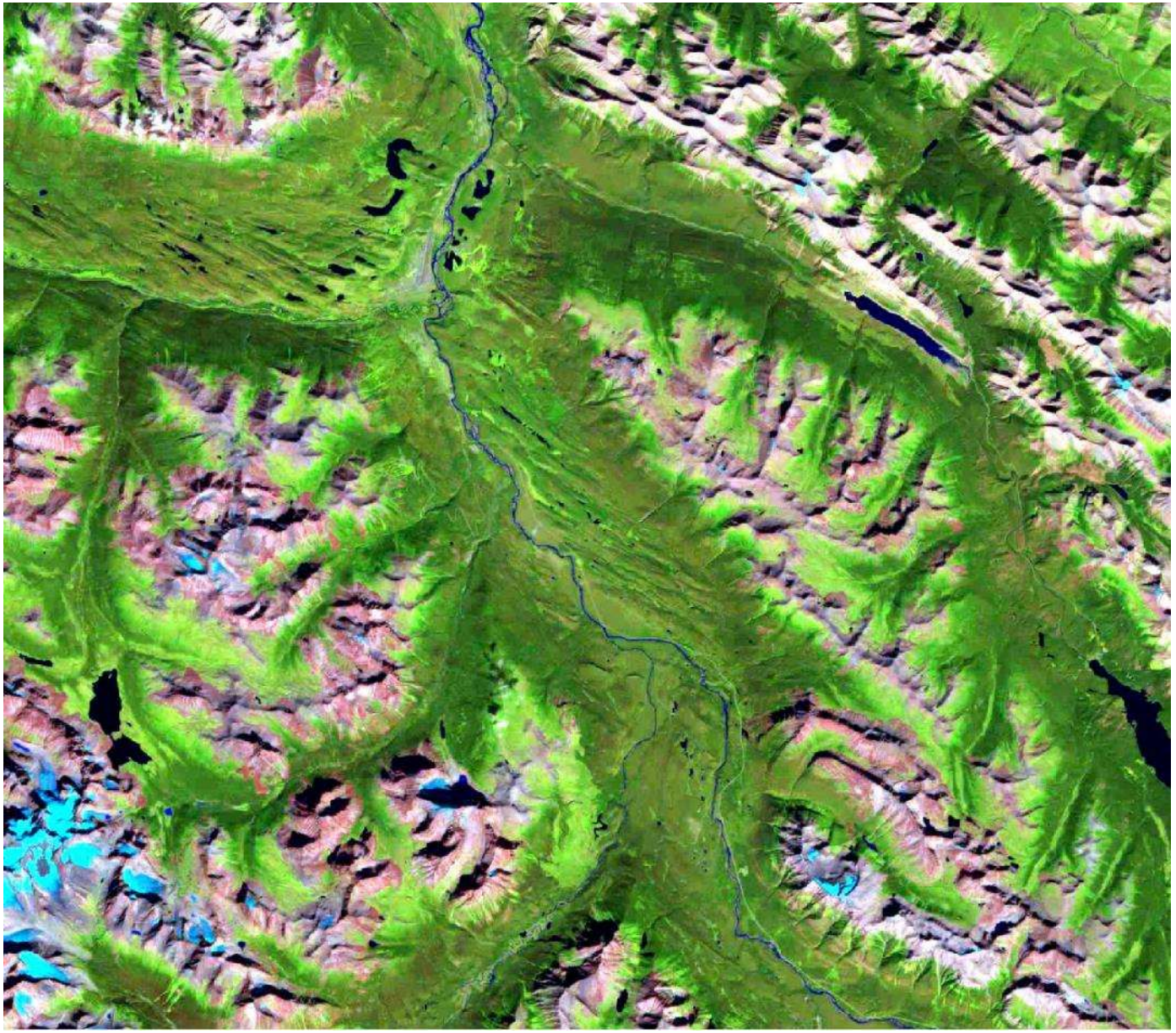
Landslide Dams the Chilcotin River

https://earthobservatory.nasa.gov/images/153158/landslide-dams-the-chilcotin-river

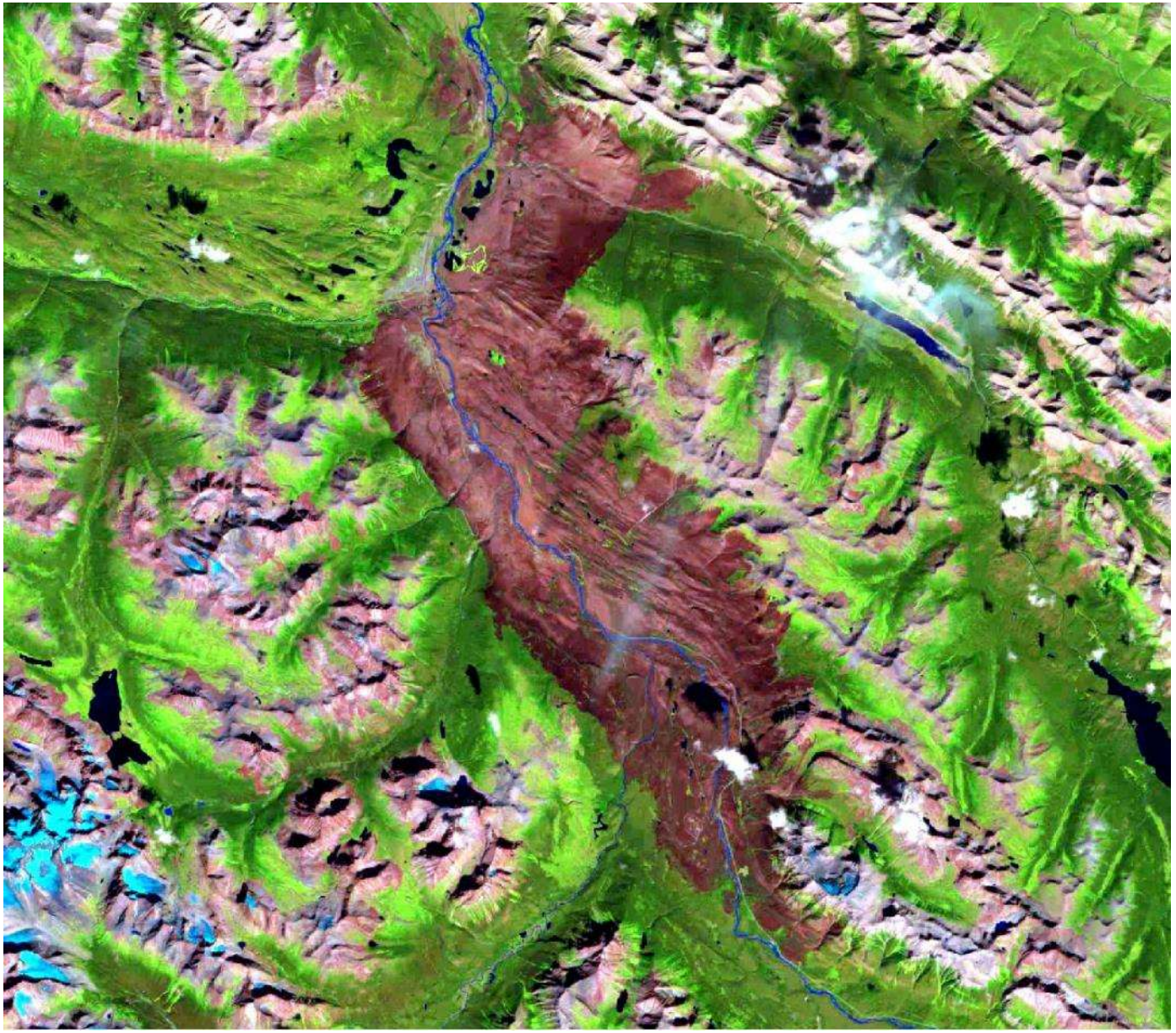
Jasper example
Sept 2, 2023
Path/row 45-23

See also August 25, 2023

This is a geotiff bands 654 compressed to 8-bit data Channels123



Jasper
Aug 19, 2024
Path/row 45-23

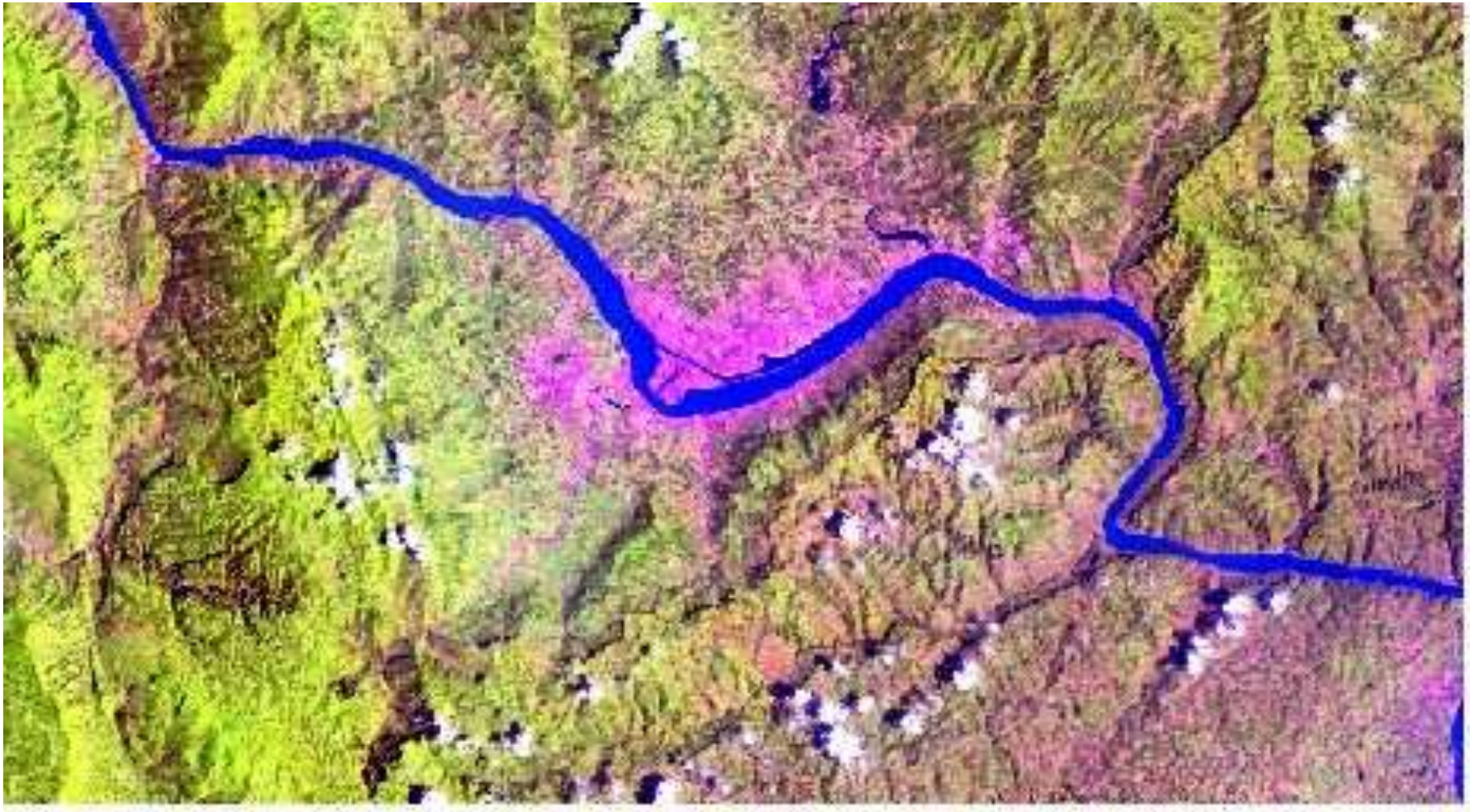


Three Gorges Dam, China

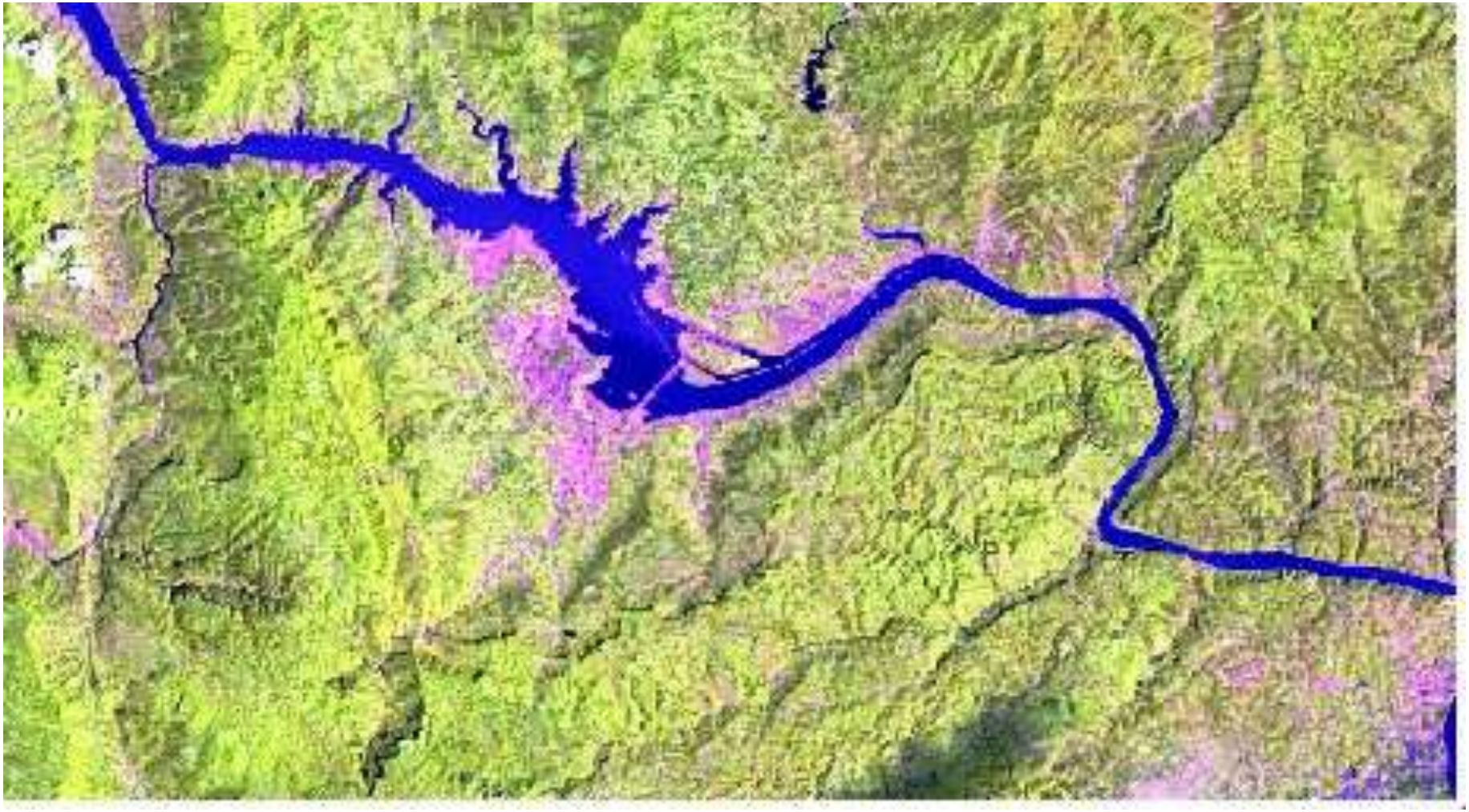
Dam location: $30^{o}49'$ North $111^{o}00'$ East

http://www.businessinsider.com/chinas-enormous-three-gorges-dam-is-turning-out-to-be-a-huge-mistake-2012-4

Sandouping, August 1999

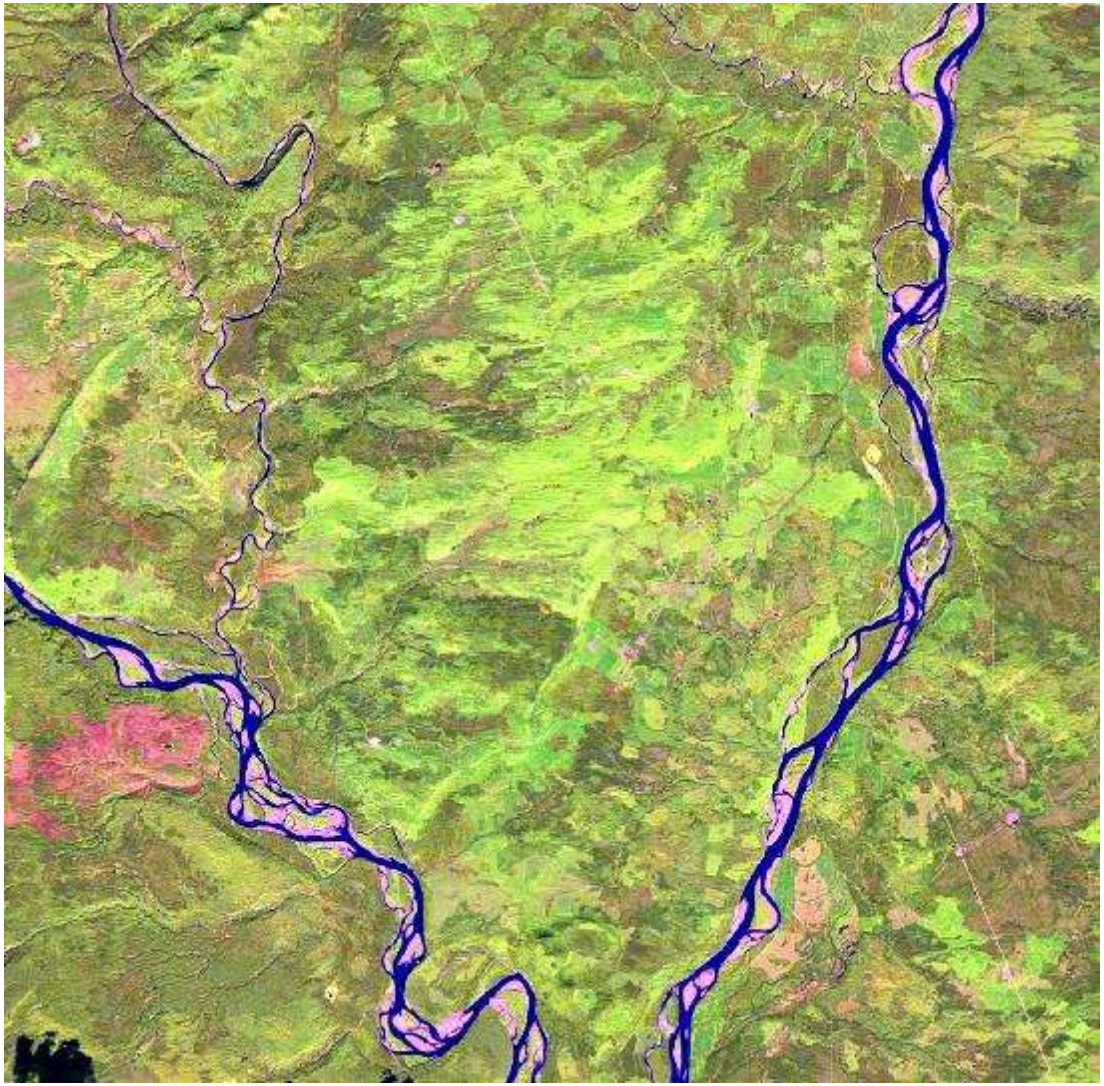


Sandouping, August 2017



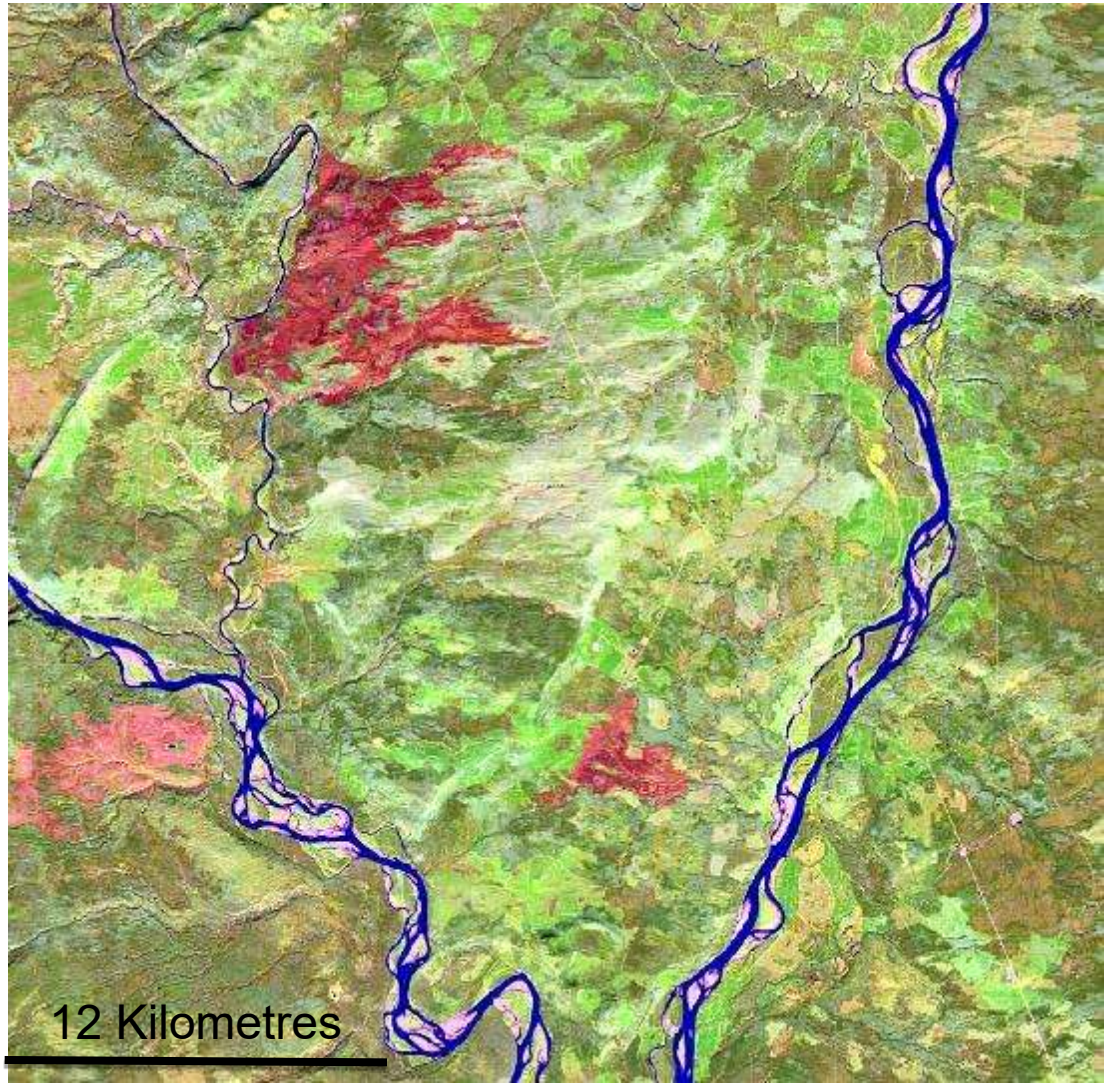
GEOG357 environmental change before / after

Nelson Forks
September 3rd
2017



10% assignment – you select/download two images showing change

Nelson Forks
September 9th
2019



Pick an area and topic of interest to you and your studies
Could also be a basis for your term project …