This week**:**

Today: feature extraction
Wednesday Lab: feature extraction (water and avalanche slopes)
Thursday lecture: thermal remote sensing

Next week:

Tuesday lecture: environmental change + demo of method

Wednesday lab: planning, finding, extracting a before/after image pair

e.g. fire, glacier, volcano, urban expansion, deforestation

- must be visible / substantial area impacted
- - **self-directed – I won't be there (the most time is you deciding area of location**

- I will demonstrate how to find/extract/process an example on Tuesday

Thursday lecture timeslot: **midterm on Moodle** (not in class)

GEOG357, Fall 2024 – sample questions

Will cover content up to October 11 (thermal RS)

Multiple Choice (15%) - 30 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 Thematic Mapper (TM) reflective data (in metres)?

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

Feature Extraction

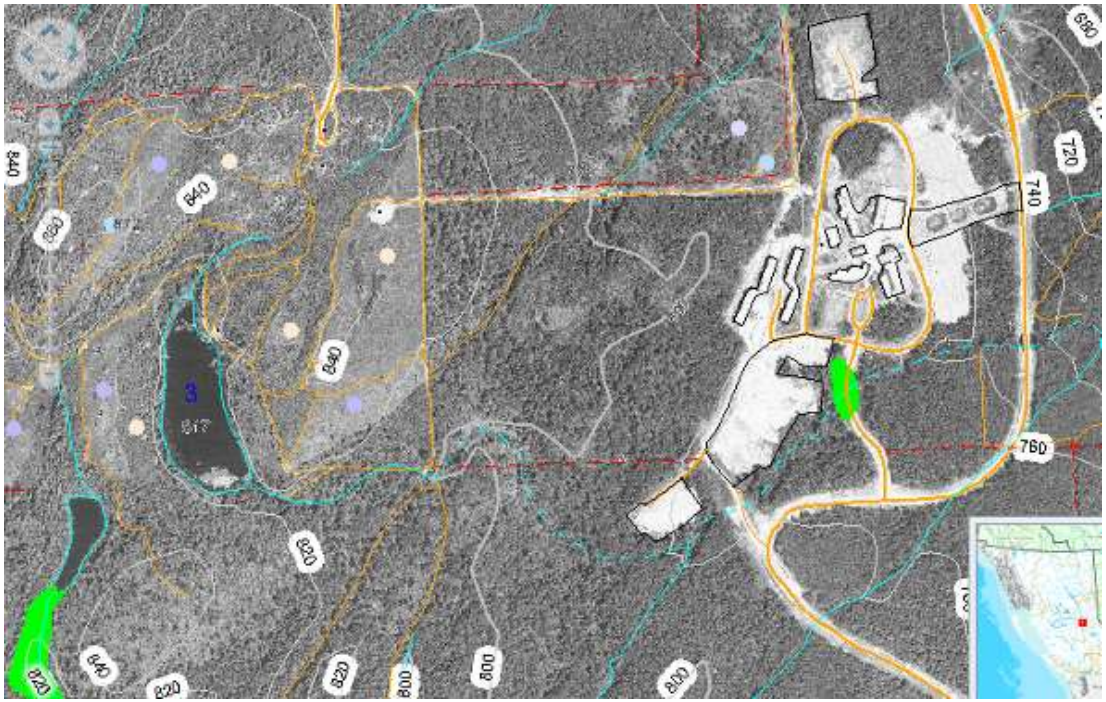
"The identification of geographic features and their outlines in remote-sensing imagery through post-processing technology that enhances feature definition, often by increasing feature-to-background contrast …. or using pattern recognition software."

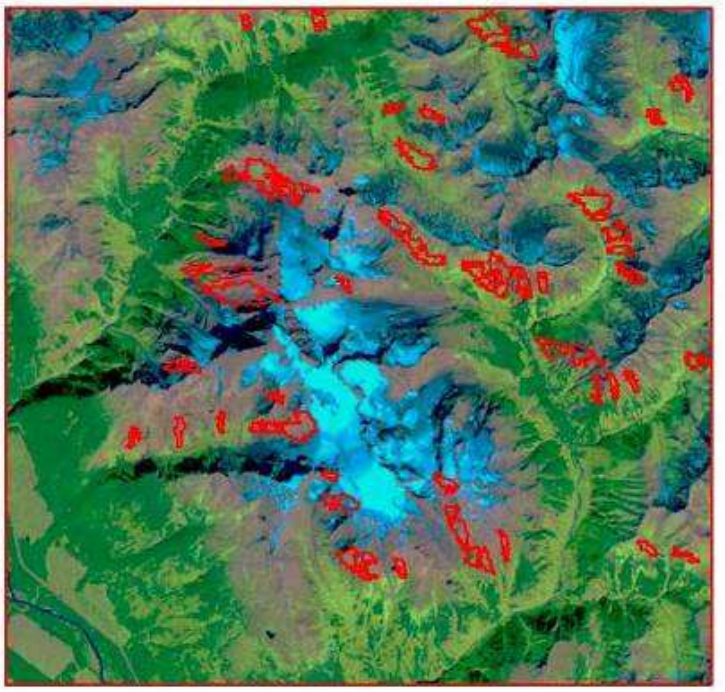
ESRI GIS

definitions

Image interpretation/ extraction

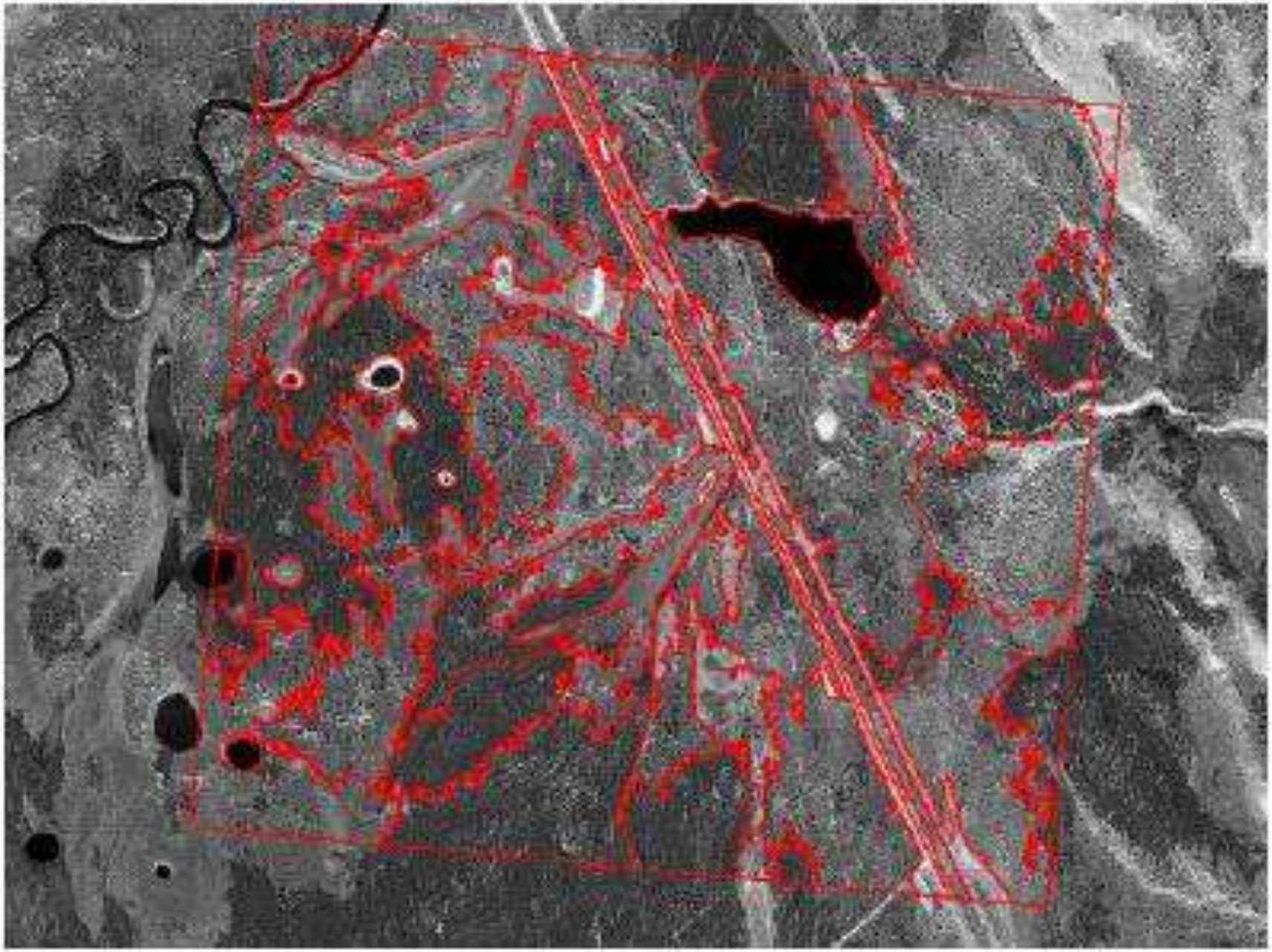
- The **analogue** data unit is the photograph from a camera;
- the **digital** unit is the scene, composed of pixels, created using a scanner.
- Analogue remote sensing involves interpretation, location & feature updating;
- digital applications include classification & feature extraction – based on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





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

Manual ‘feature extraction’ by photo interpretation e.g. BC TRIM



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)

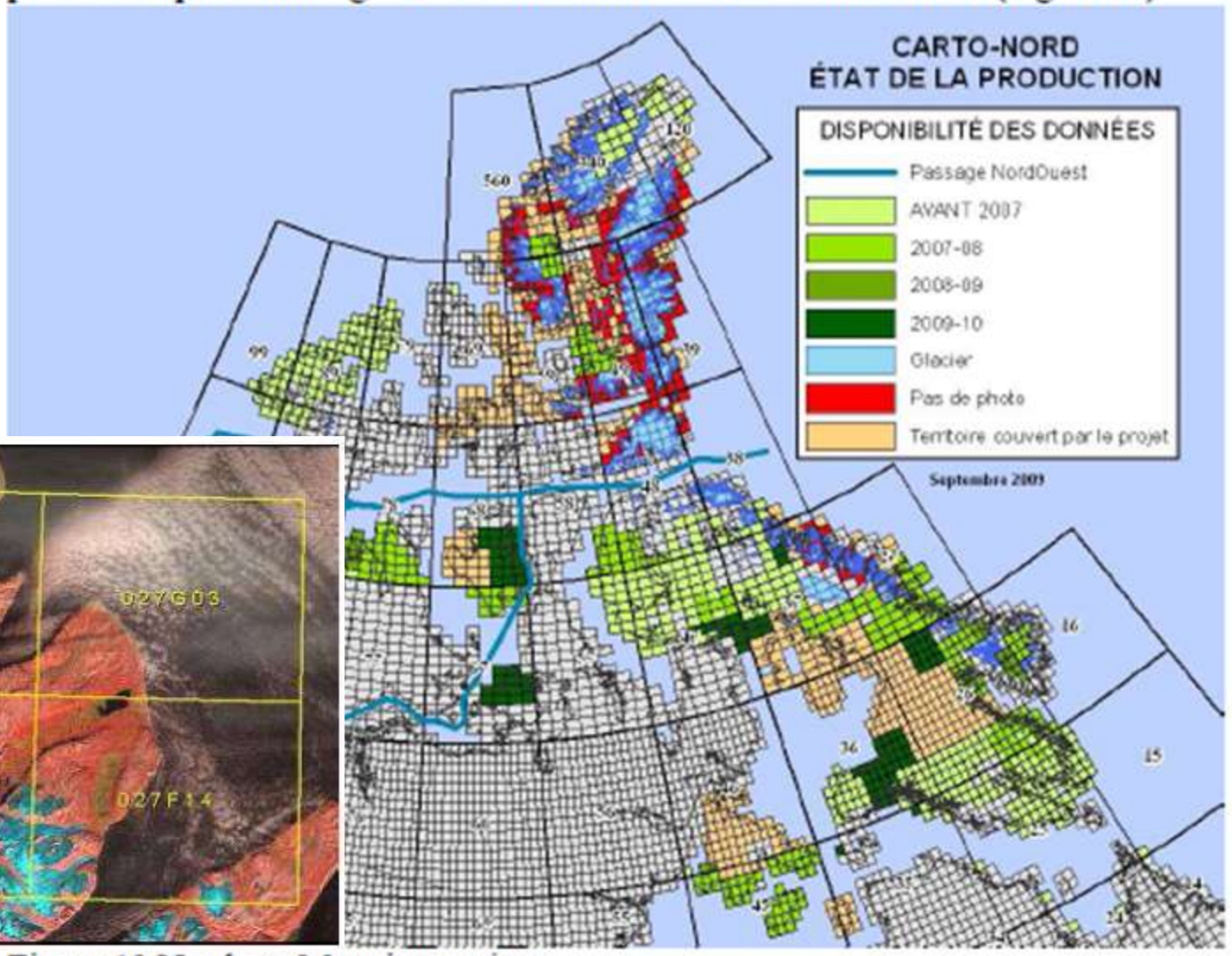


Figure 12 Northern Mapping project

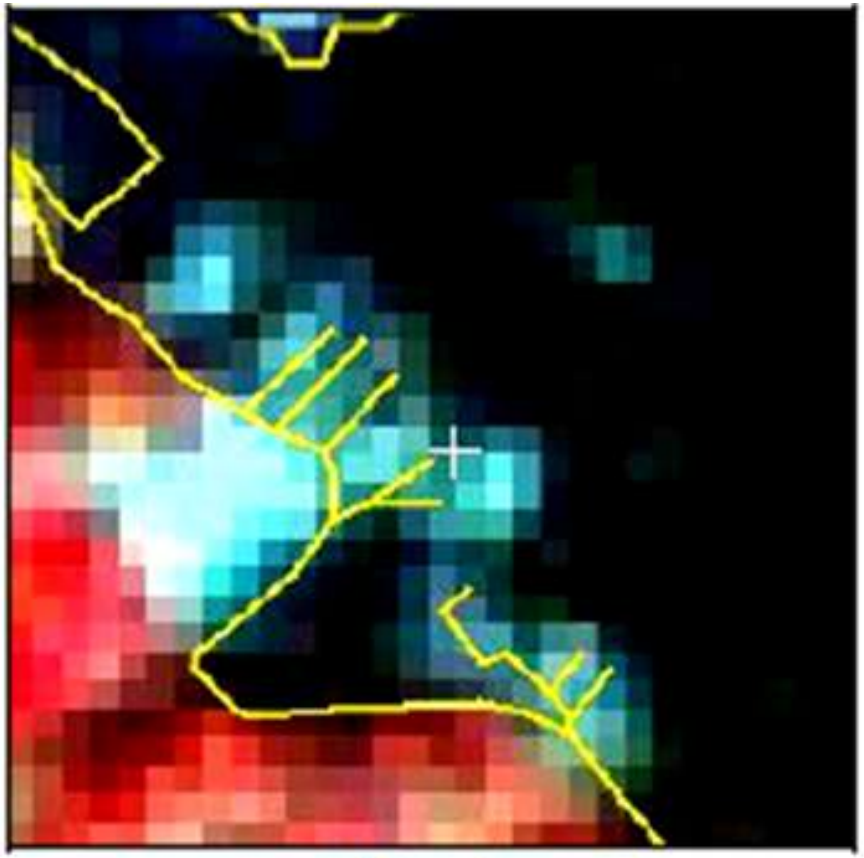
Feature extraction (digitising) from aerial photography is the most tedious part of mapping ….. why hasn't remote sensing been used more to update GIS data layers ?

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

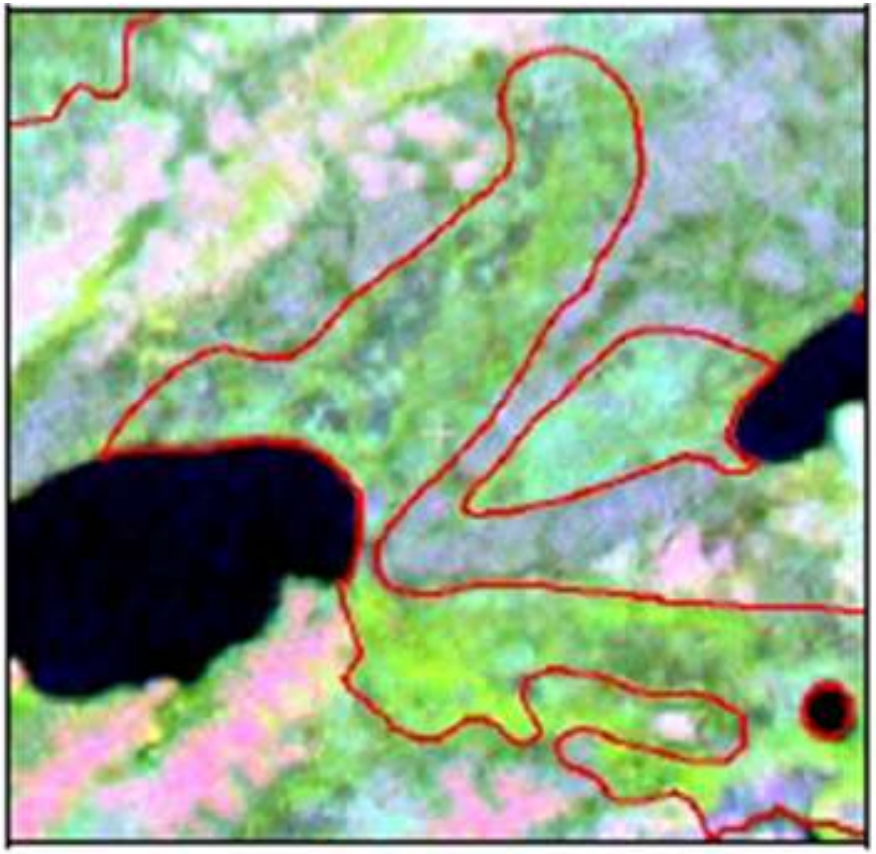
- **data are not well understood**
- **data are too expensive**
- **insufficient resolution**
- **classification accuracies**
- **complexities of reality = lack of homogeneity / contrast**

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

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.

the Bowron again …

- **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:
(one could also manually digitise from digital imagery… boring / subjective)

- 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've done all these …*

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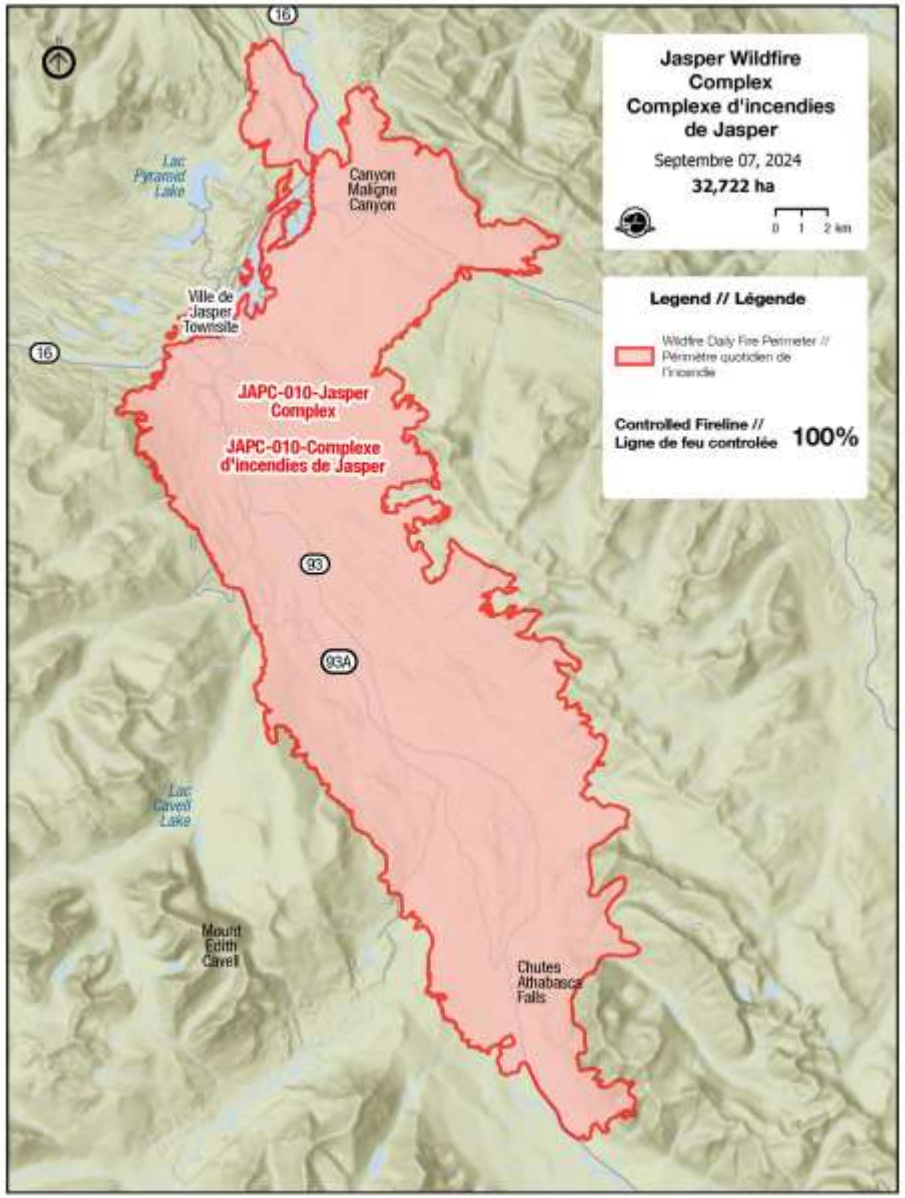
We are doing these below in the next lab

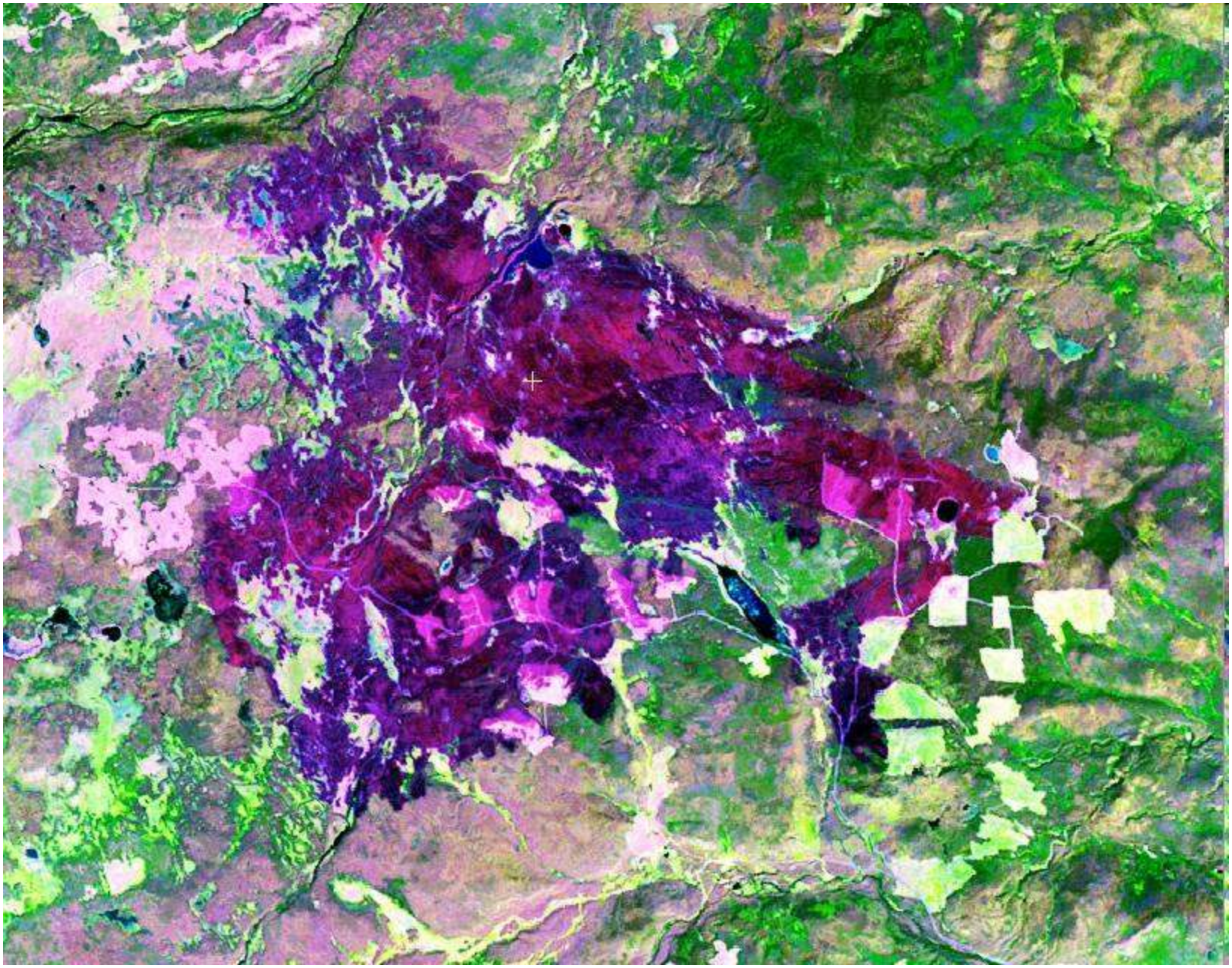
- 5. RTV -> Raster to Vector conversion -> polygons …
- 6. Smooth lines / generalise -> export to GIS
- 7. Massage attribute table / calculate areas etc.. (GIS)

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

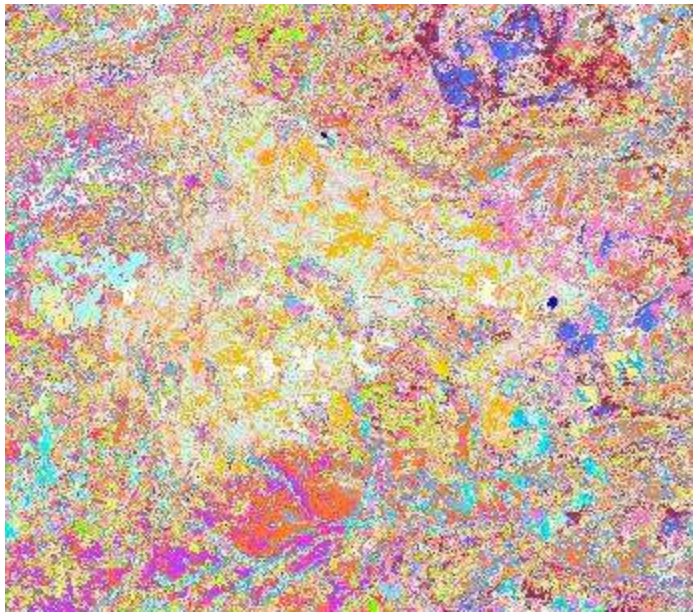


Using Burn Index can be problematic to separate fire from mountains / shadow (needs before/after image)

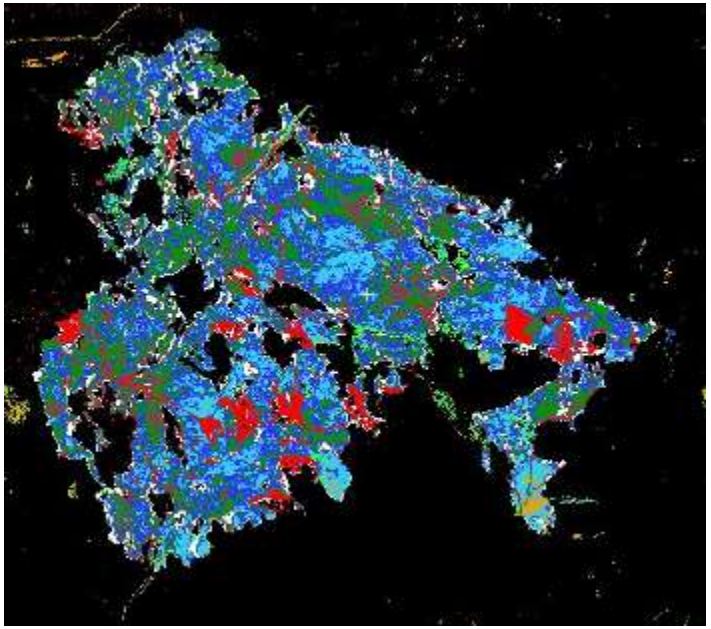
Project example to 'digitally' map a complex fire polygon



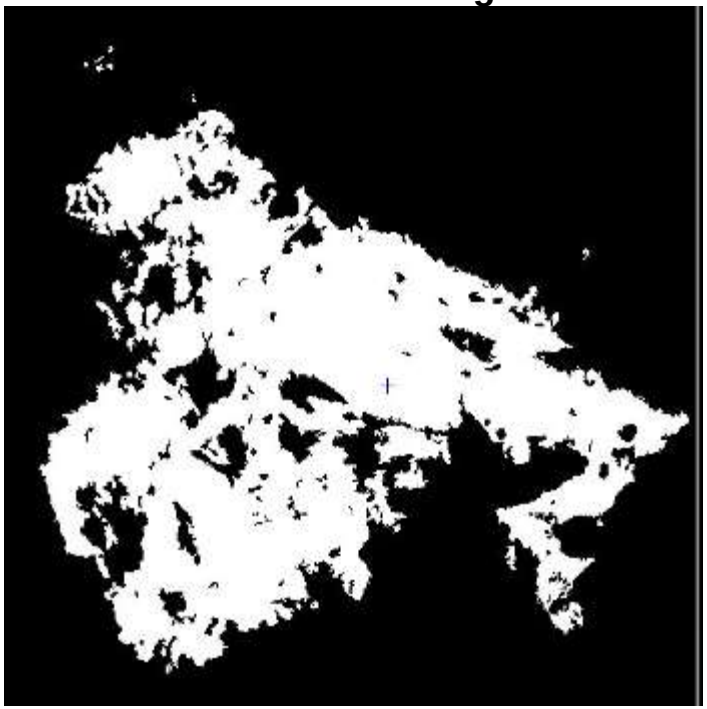
One approach: Normalised Difference Burn Ratio (NIR-SWIR) / (NIR+SWIR); alternative = classification



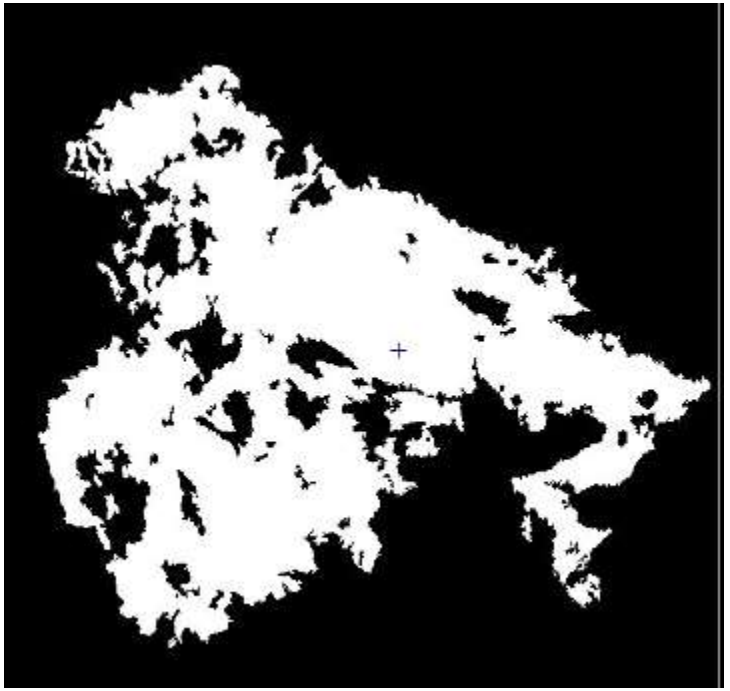
ISODATA classification showing 50 classes



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

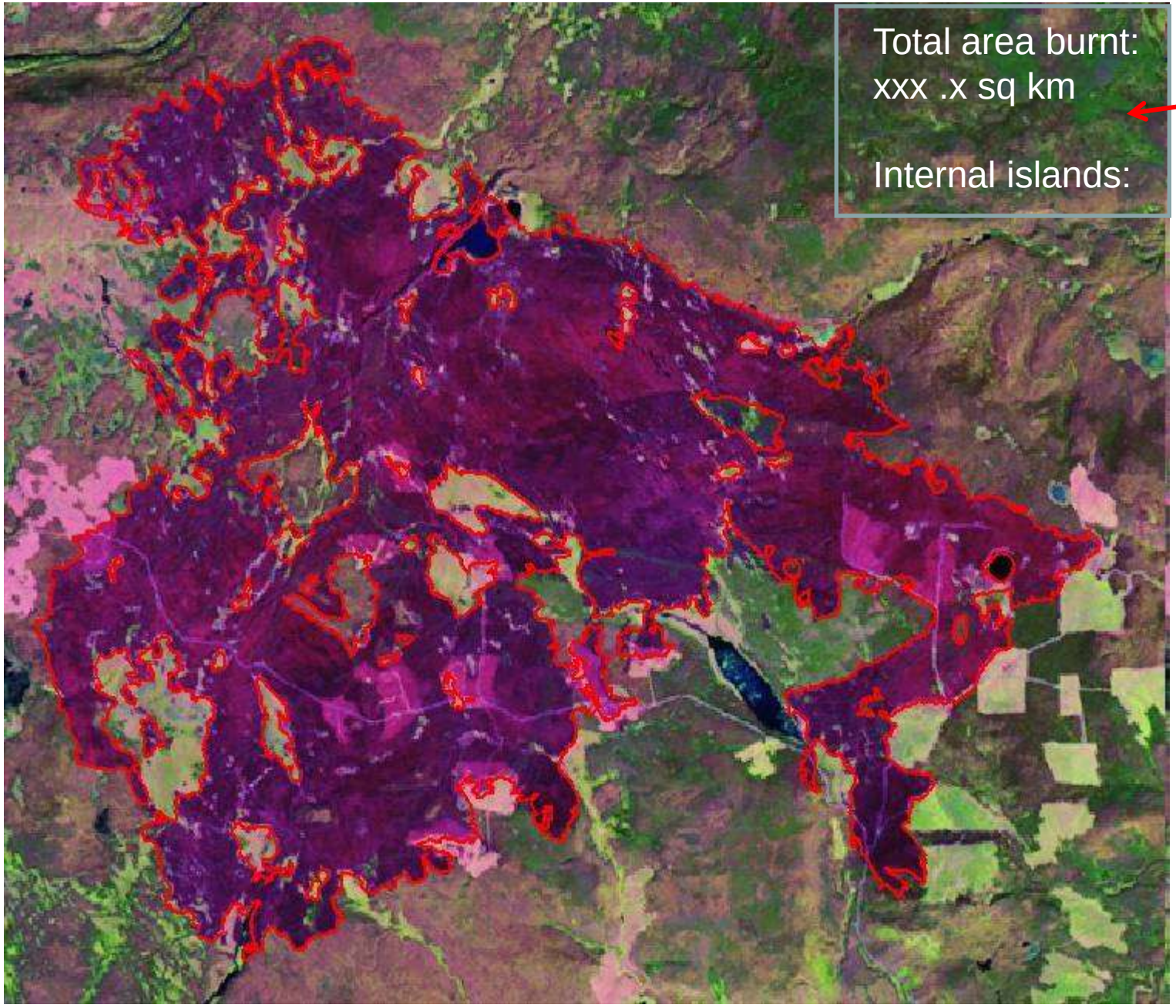


Aggregation -> feature extraction



Sieve

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

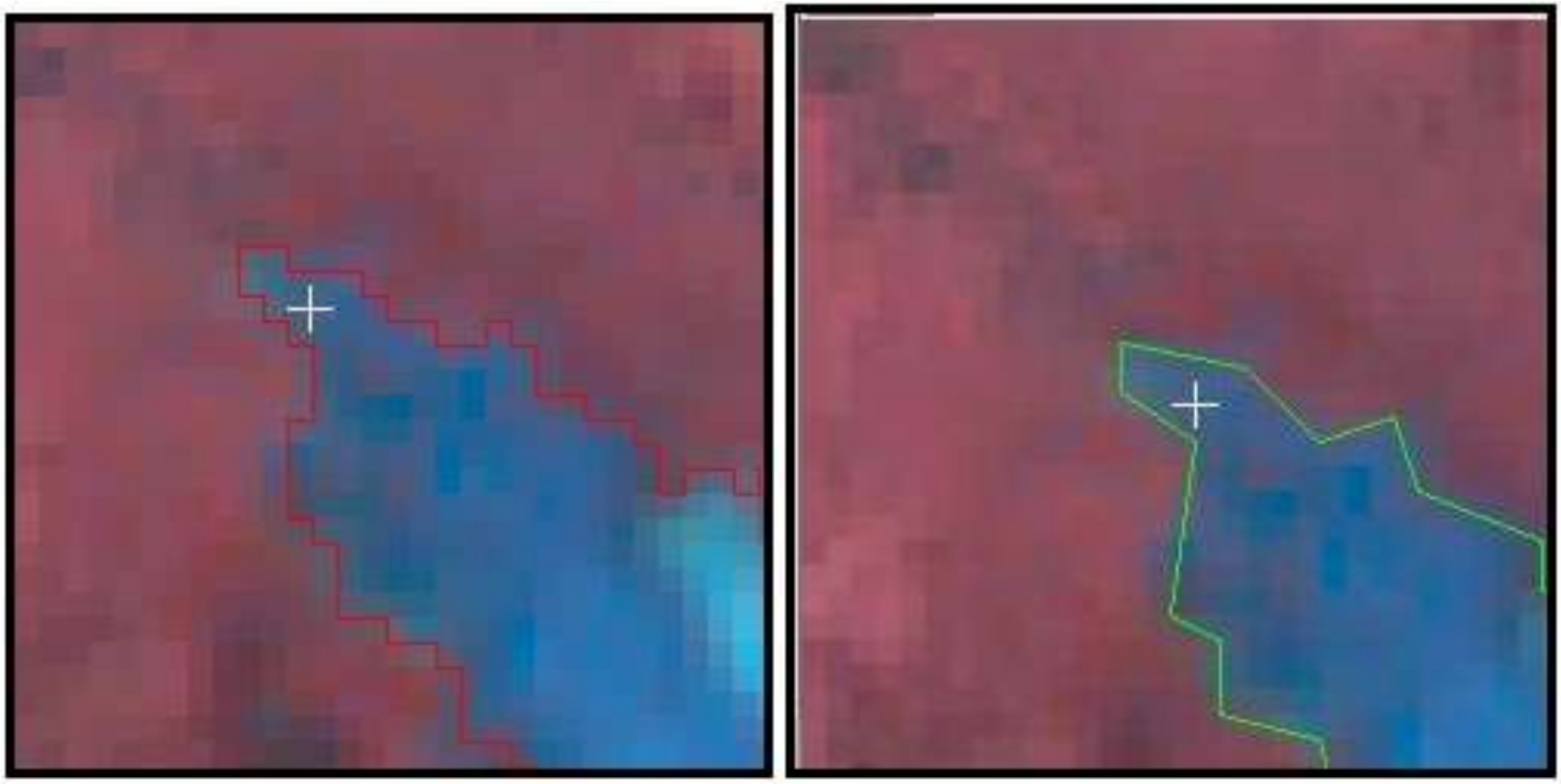


GIS tends to do this easier !

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

6. Generalise 'Smoothing the jaggies' ... e.g. algorithm: smmcmaster, smboyle

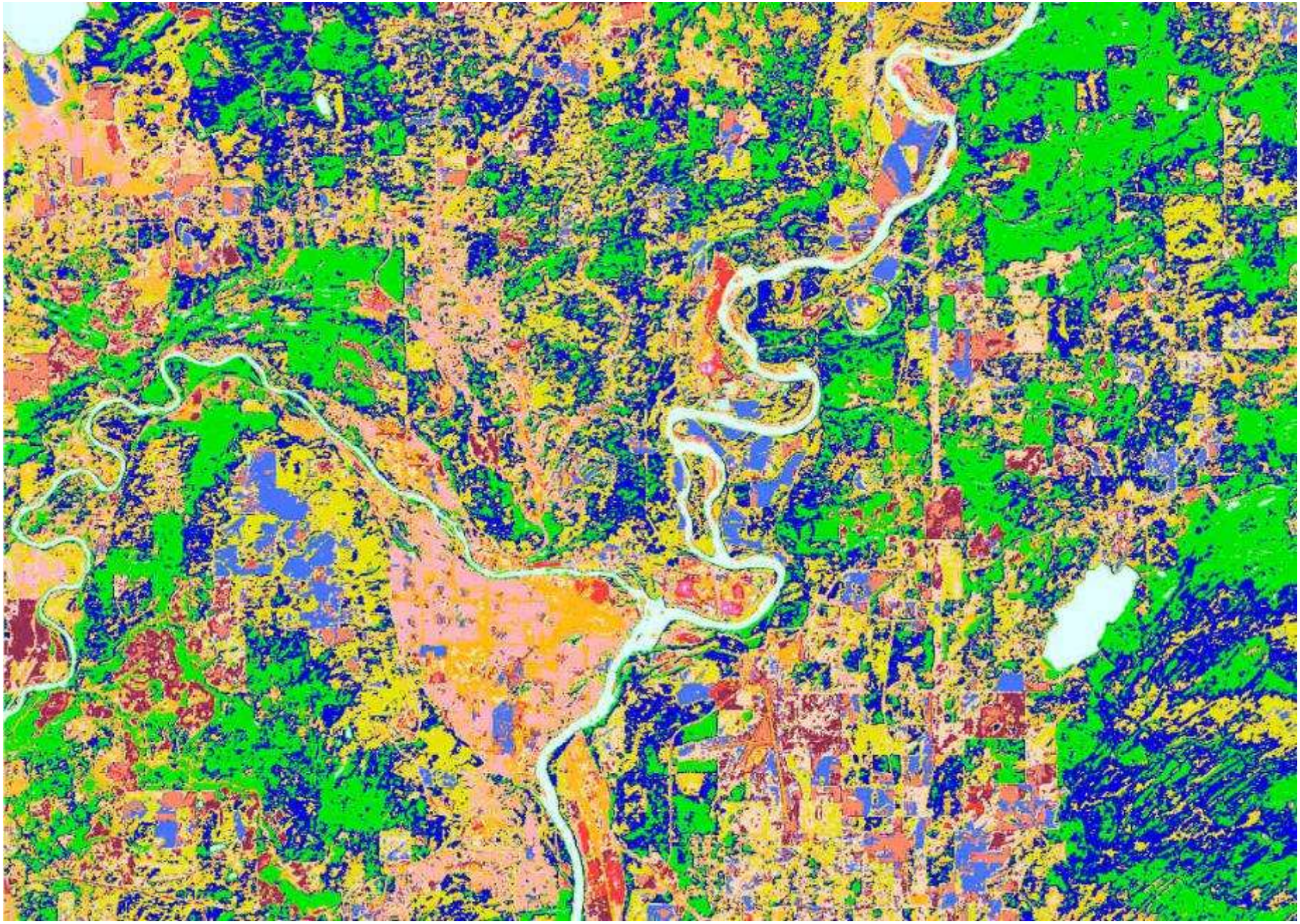
Robert McMaster, Ray Boyle – both derived from Douglas-Poiker algorithm



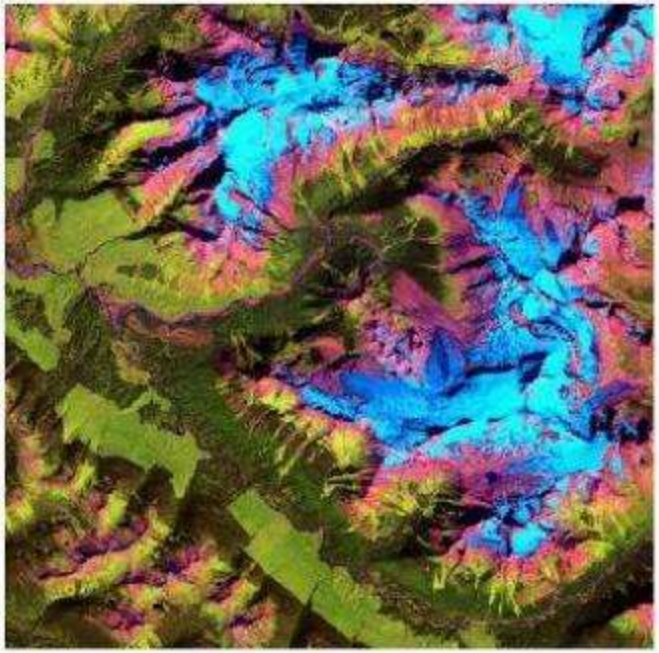
Several different algorithms for line generalisation (from GIS history)

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

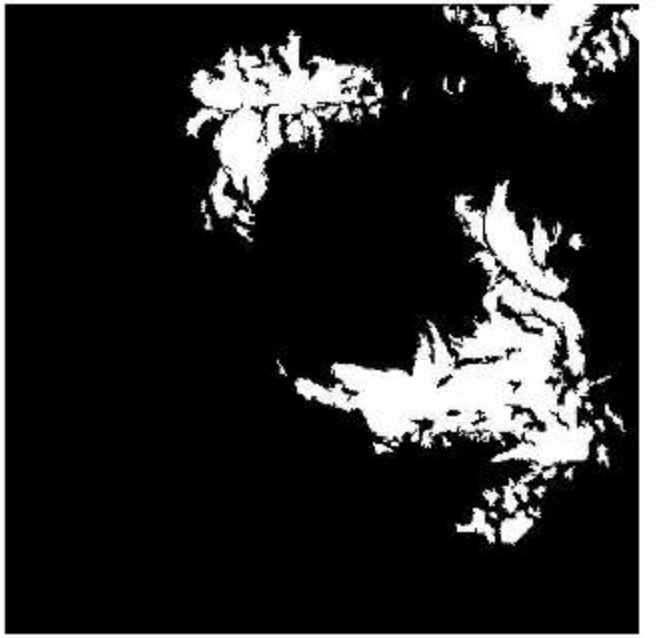
Land cover classifications or thresholds can be vectorized into polygons (‘RAS2POLY’)



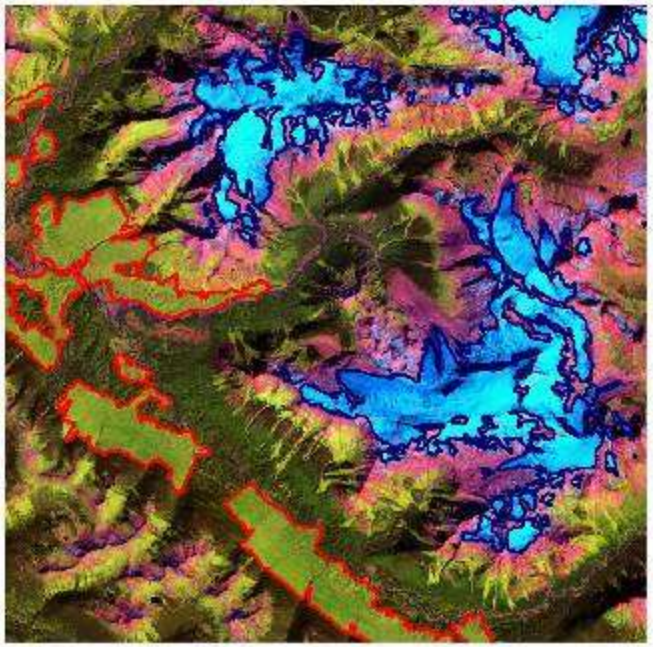
Geog357 project: Extracting glaciers and cutblocks in Kakwa



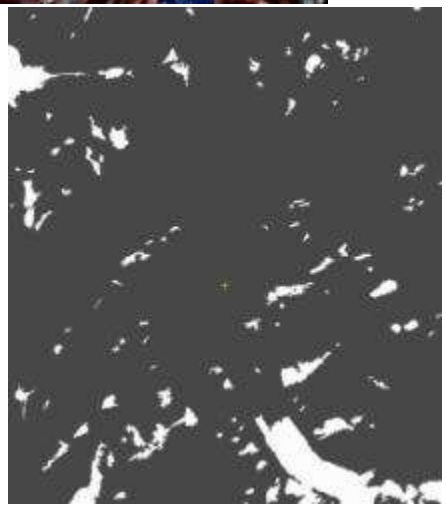
Glaciers/snow
TM 3/5
ratio -> 2.0

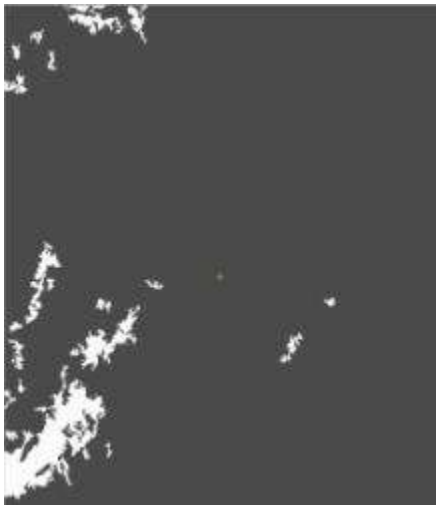


Cut blocks
-Deciduous
<-TM 4/3
ratio > 2.0



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

Based on: Classification or Greenness

a. NIR/Red

b. NDVI

c. Tassel greenness

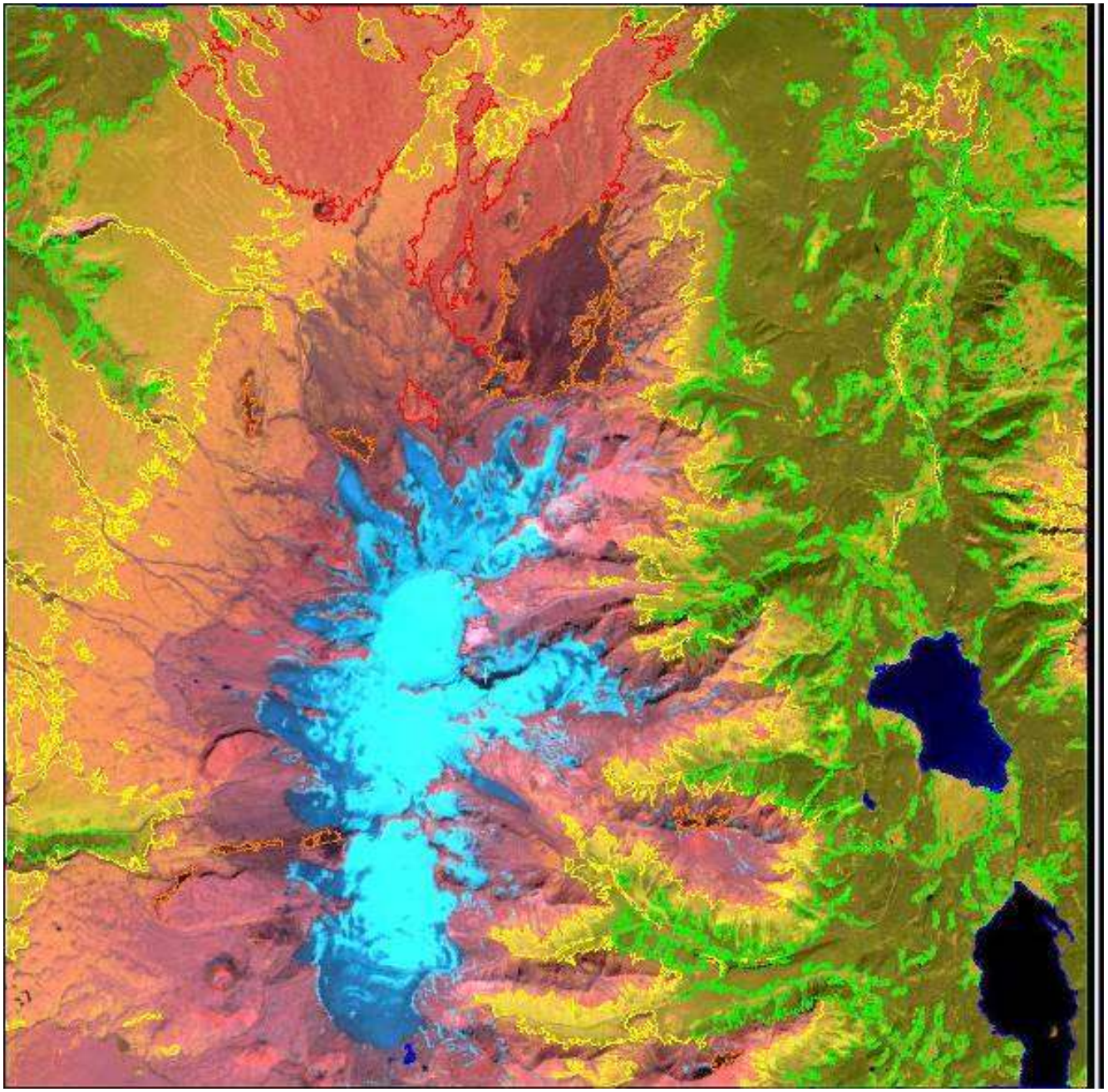
- Lava flows

- Bare ground

- Deciduous

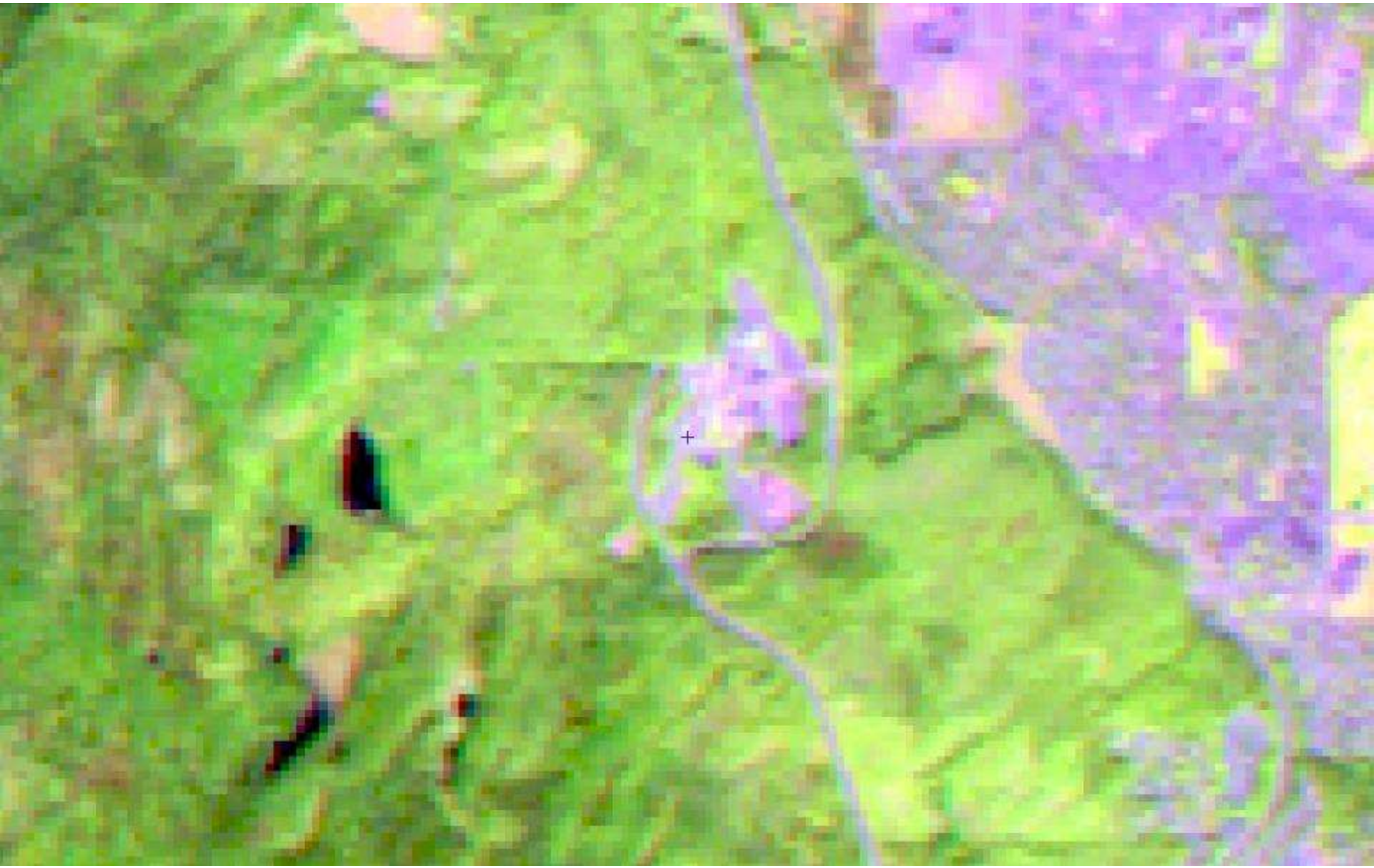
- **Coniferous**

- **(Water, Glaciers)**



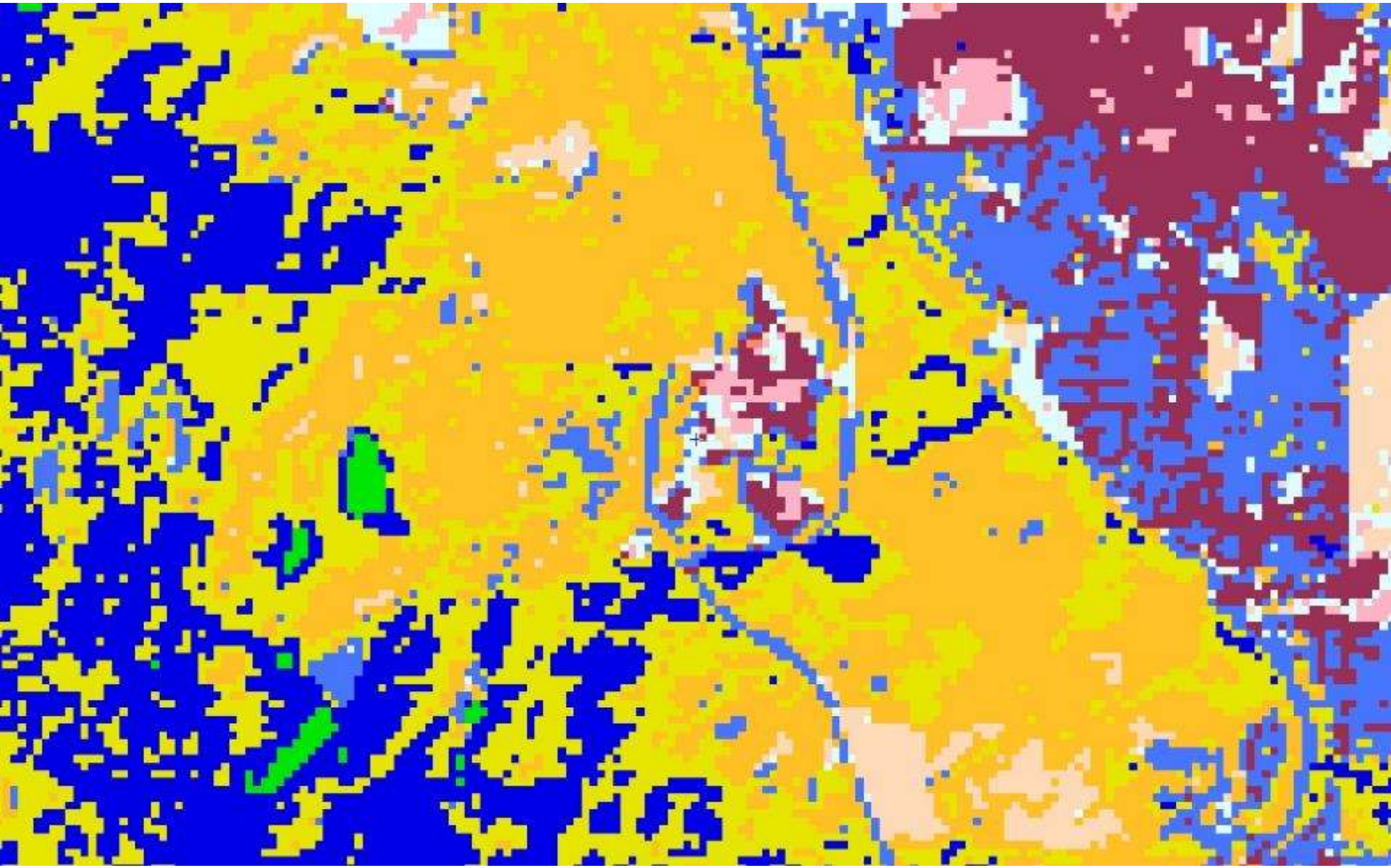
Extraction of road networks – lines – not easy (RAS2LINE)

PG 2013 - campus, Univ.Way / Tyner Blvd and Forests for the World / Shane Lake



30 metre multispectral pixels

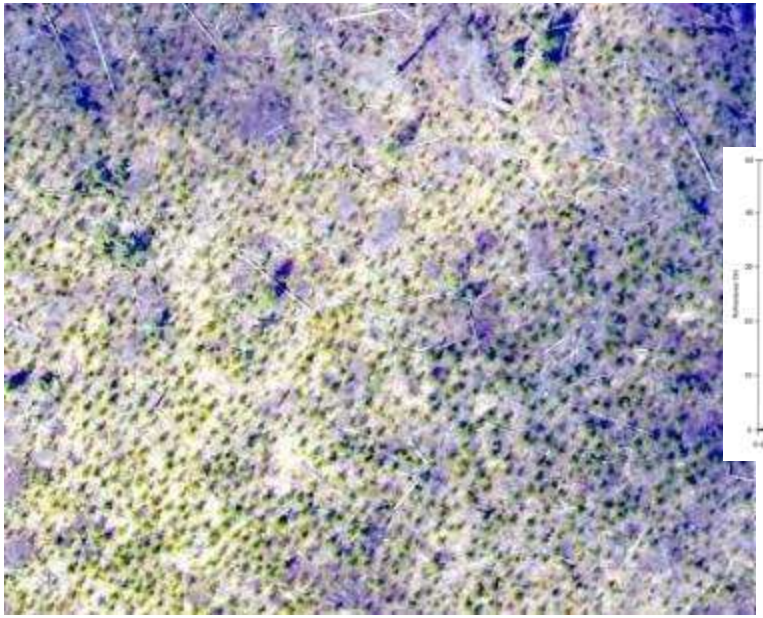
Limitations of per-pixel classifiers e.g. road ‘staircase’

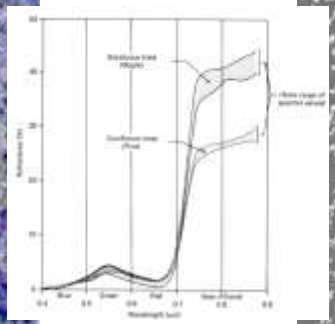


Note ring of coniferous forest around Shane Lake .. could maybe use machine learning algorithms ….

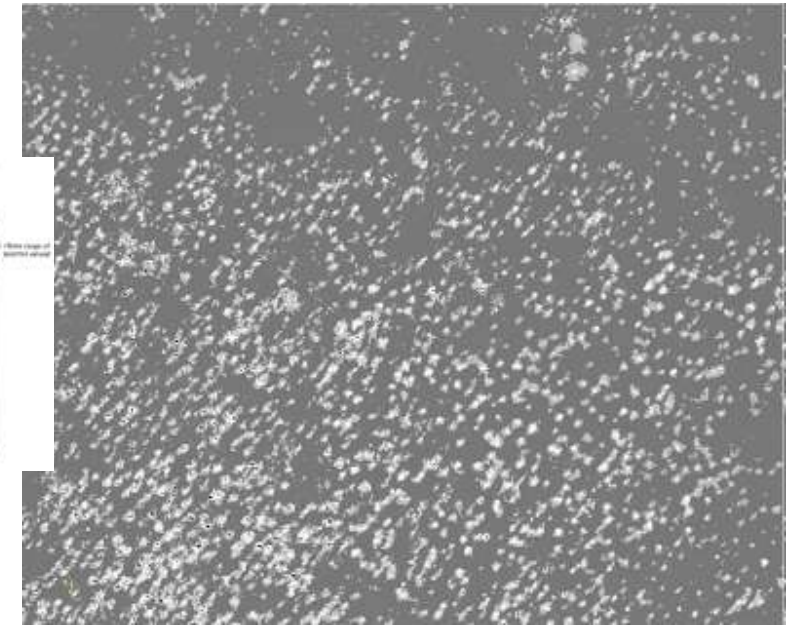
Experiment to extract trees as points to avoid many trees digitizing: RAS2POINT

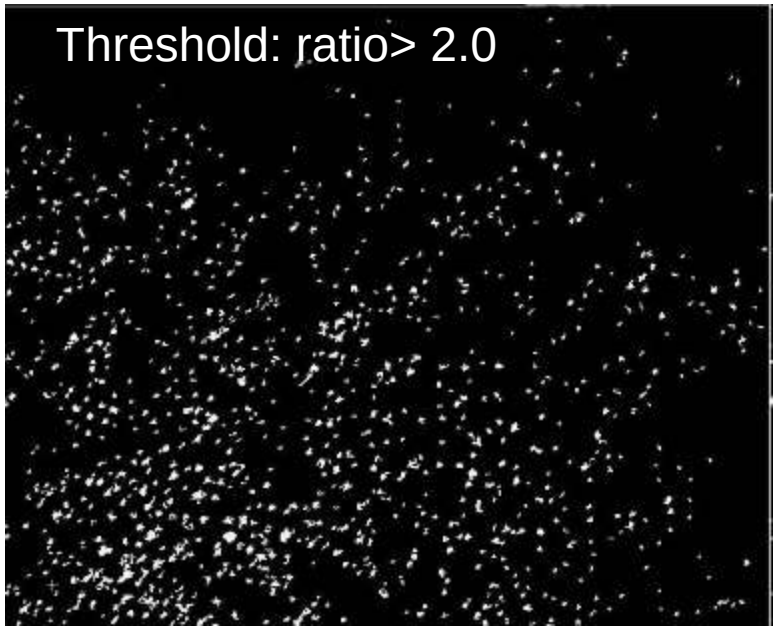
RGB Colour photo





Green / red ratio





RAS2POINT
(zoom)