

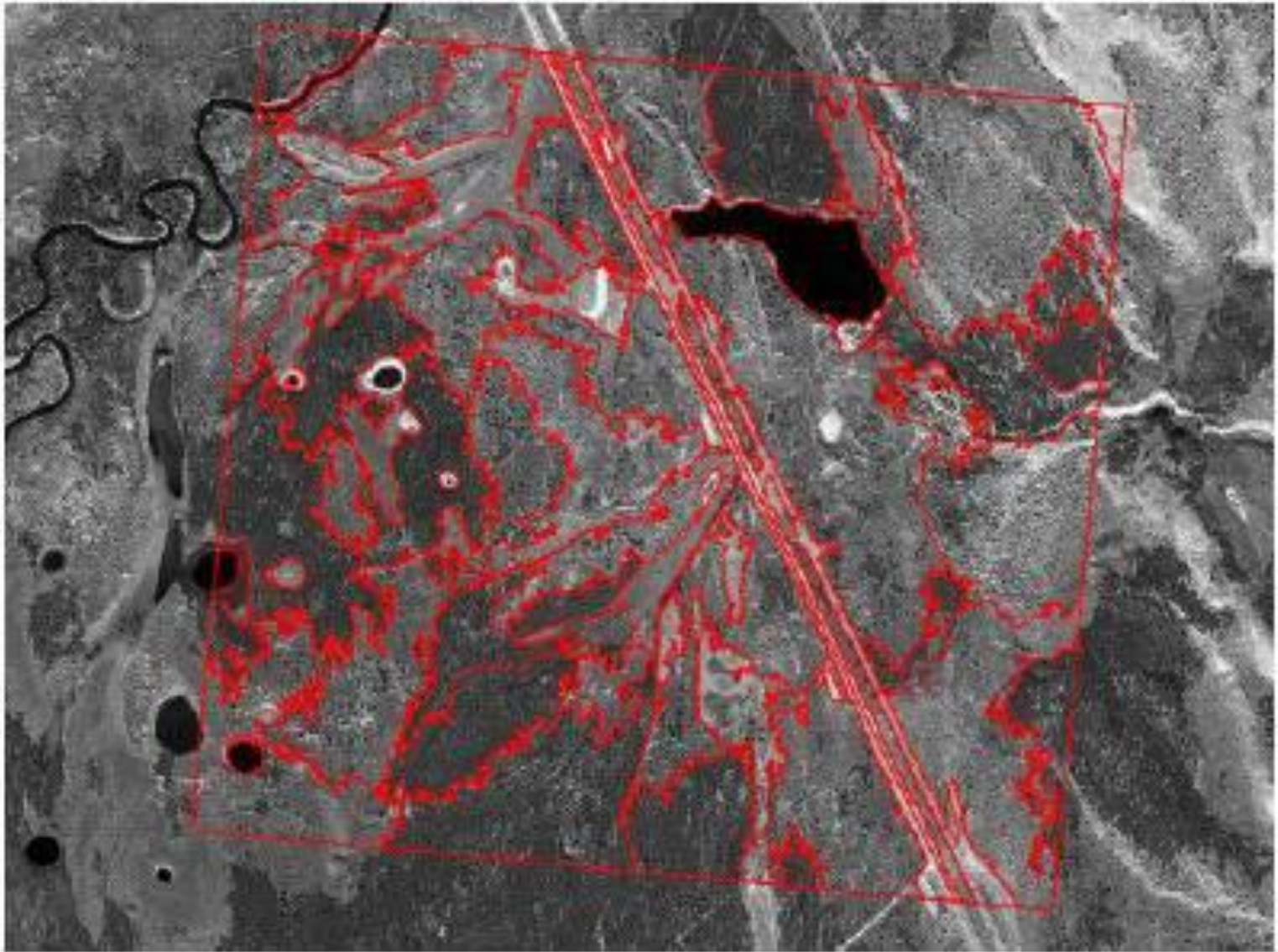
Feature Extraction

"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

Manual 'feature extraction' by photo interpretation e.g. BC TRIM
- all provincial / federal topographic data layers



Completion of the 1:50,000 National Topographic Database with satellite Imagery 2000-2012

But 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)

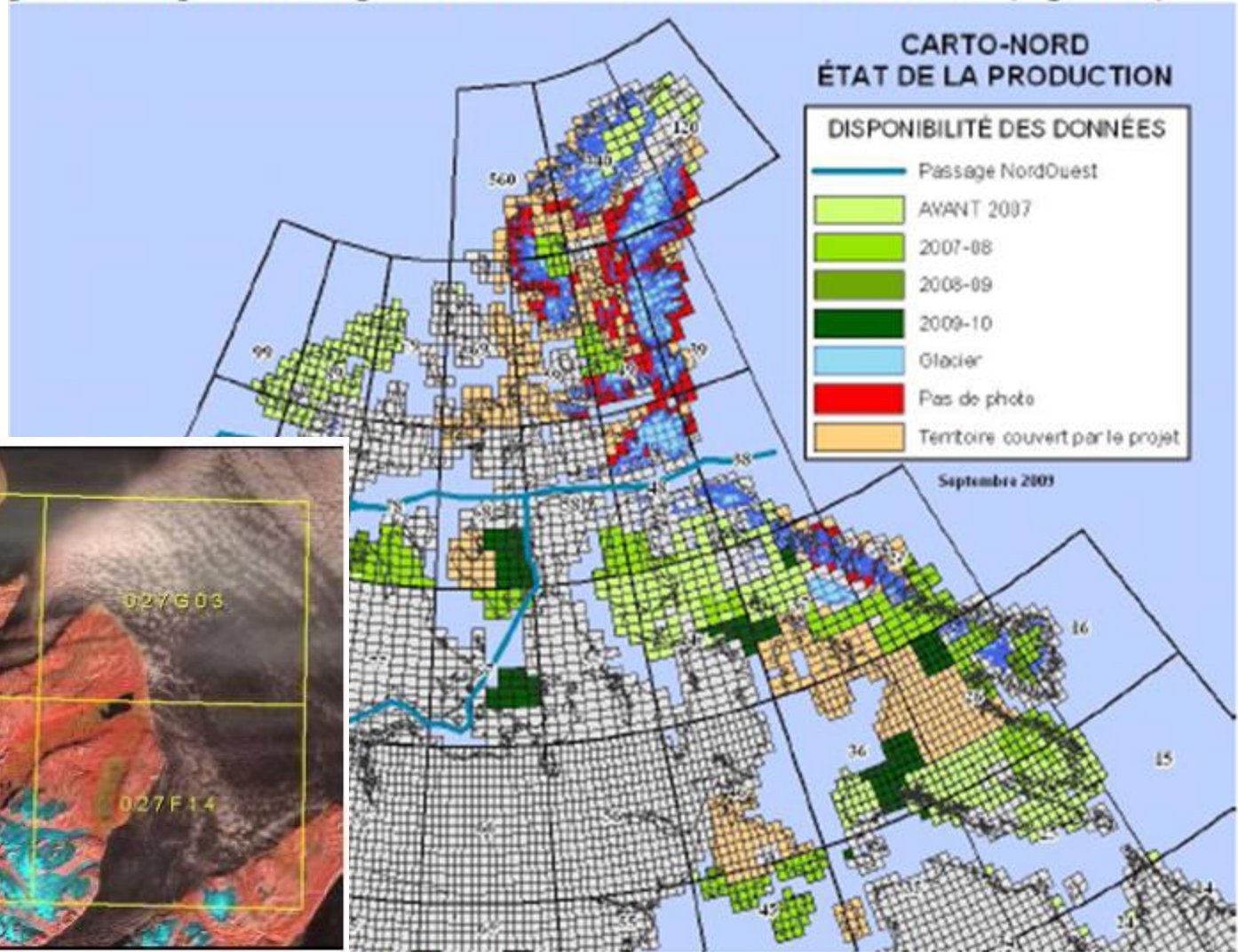


Figure 12 Northern Mapping project

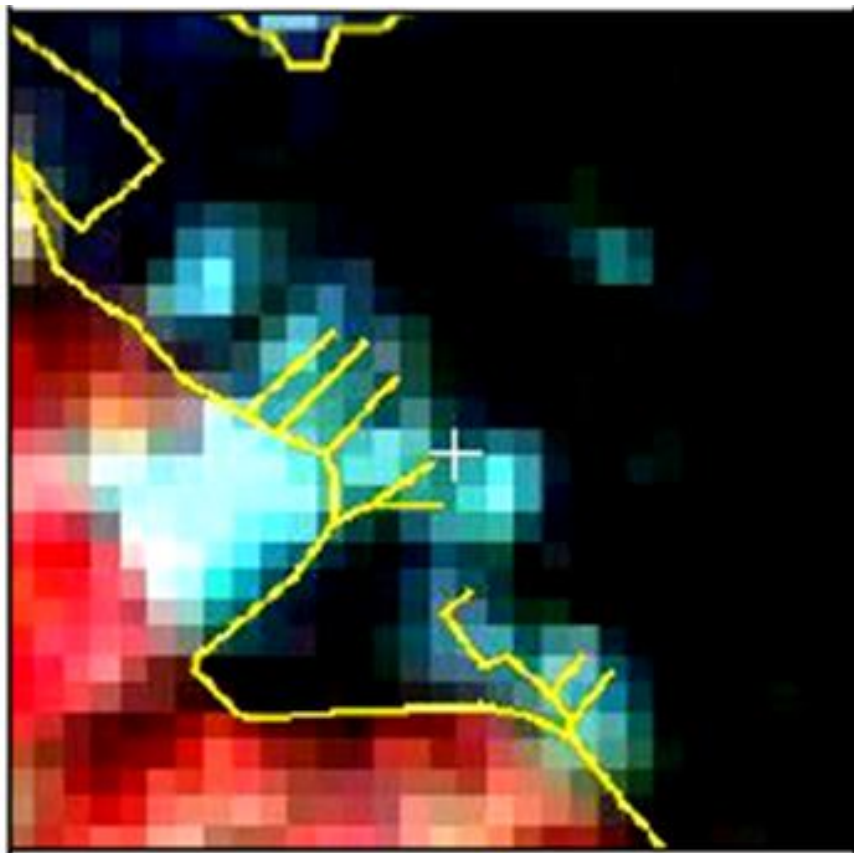
Feature extraction (digitising) from aerial photography is the most tedious part of mapping why hasn't remote sensing been used more to update GIS data layers ?

Principles of GIS: Aronoff (1986) – the first GIS textbook*

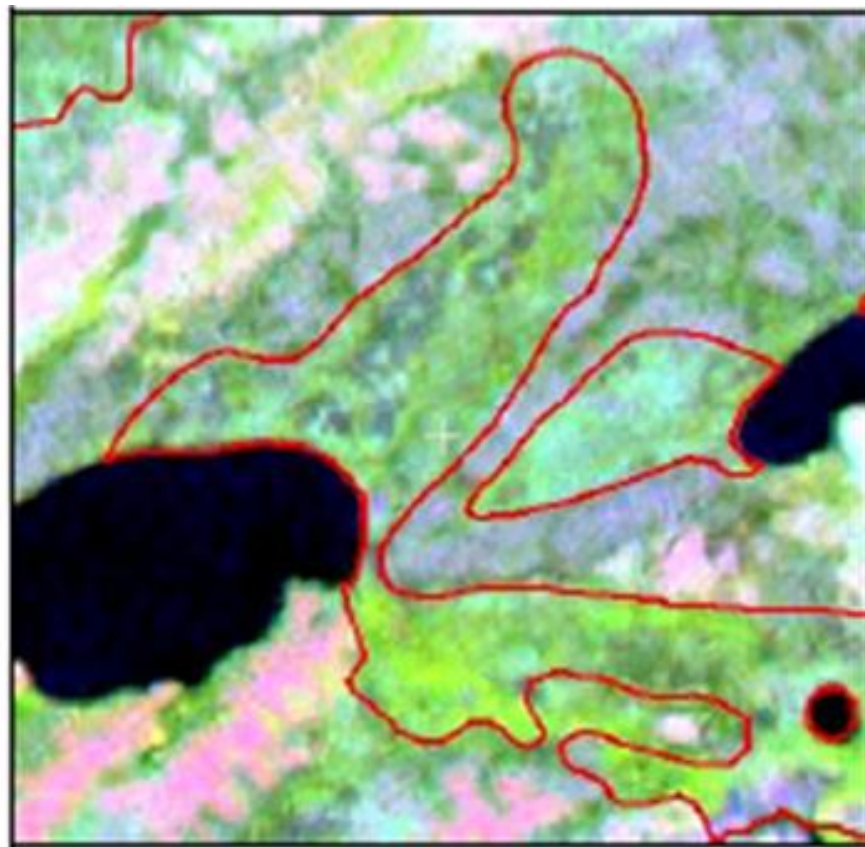
- **data are not well understood**
- **data are too expensive**
- **insufficient resolution**
- **classification accuracies**
- **complexities of reality = lack of homogeneity / contrast**

** 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

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.

where does it work?

- Feature **simplicity**

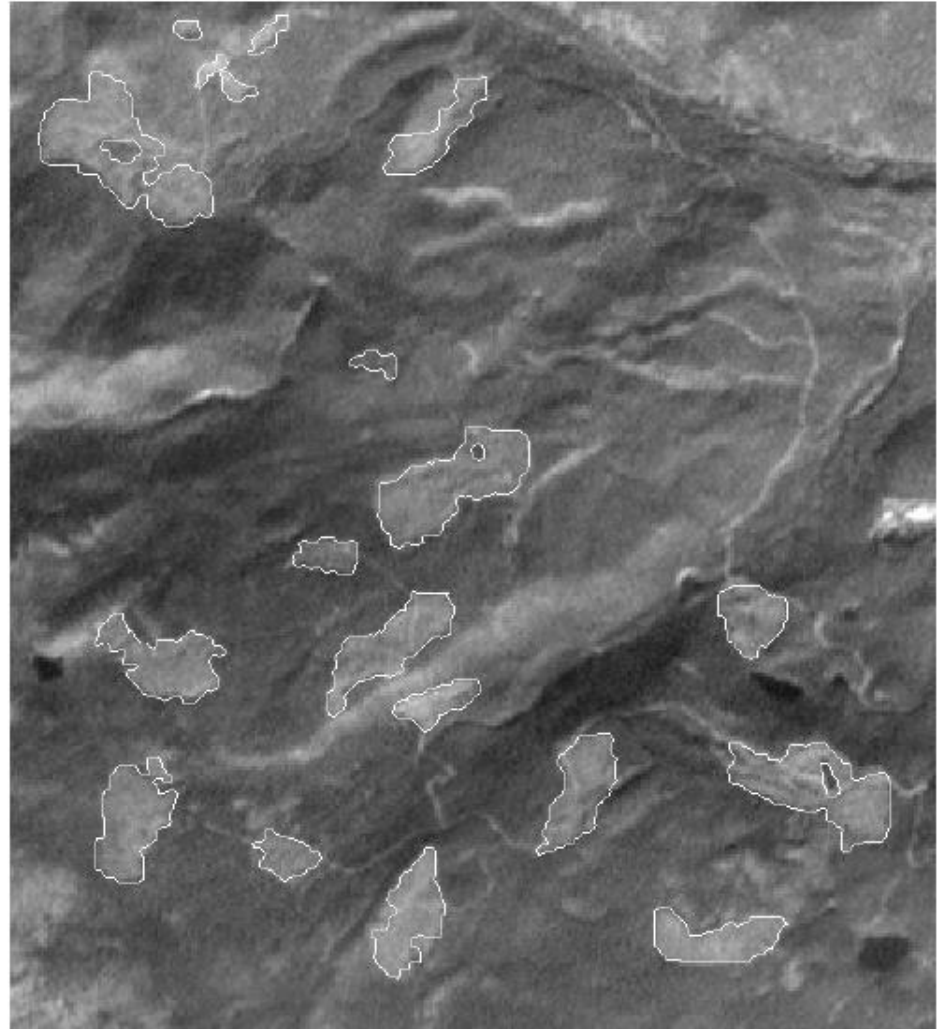
Consistent shape, contiguity

- Feature **homogeneity**

Consistency inside feature

- Feature **certainty**

Contrast with other features



Oy vei, not 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 ...*

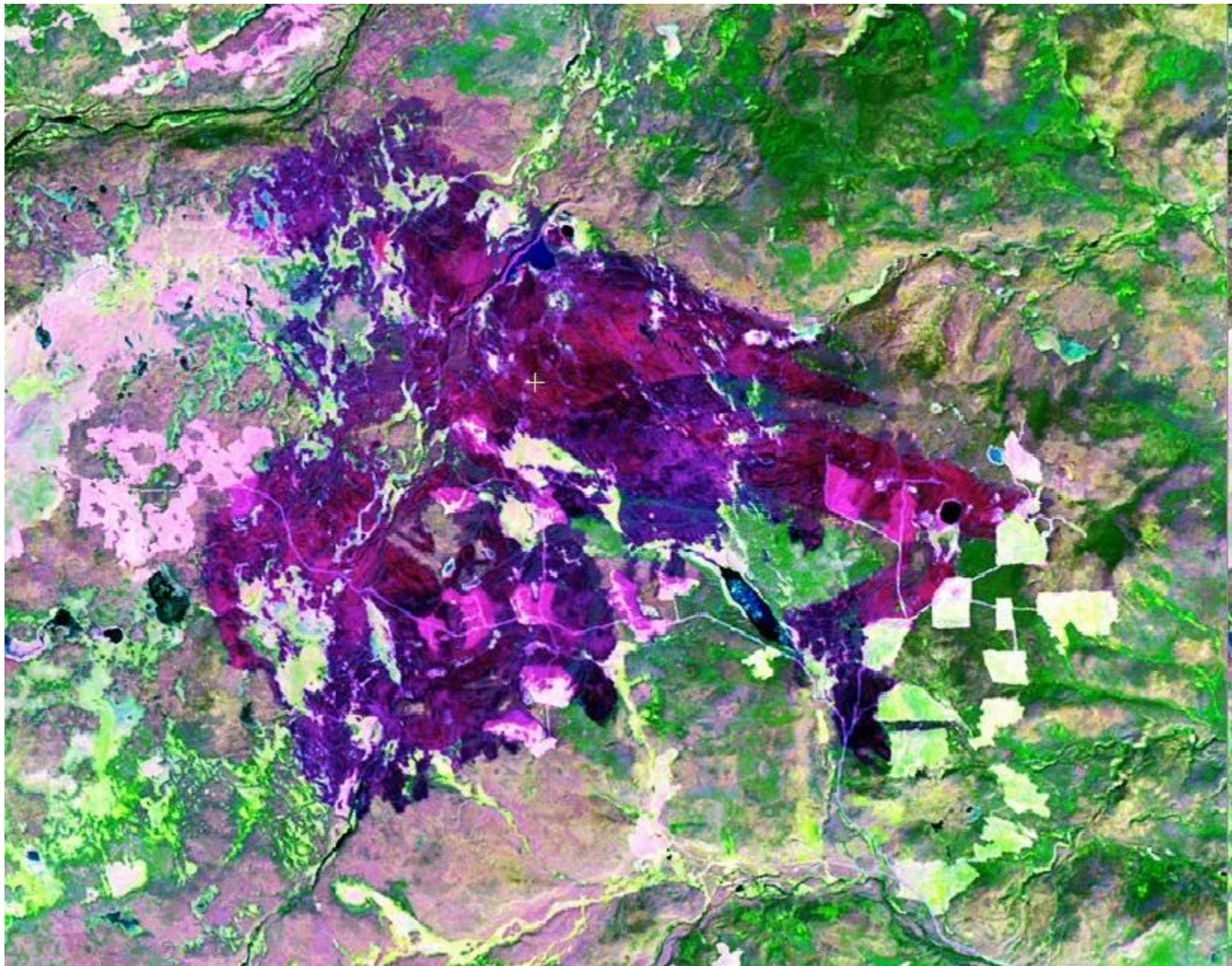
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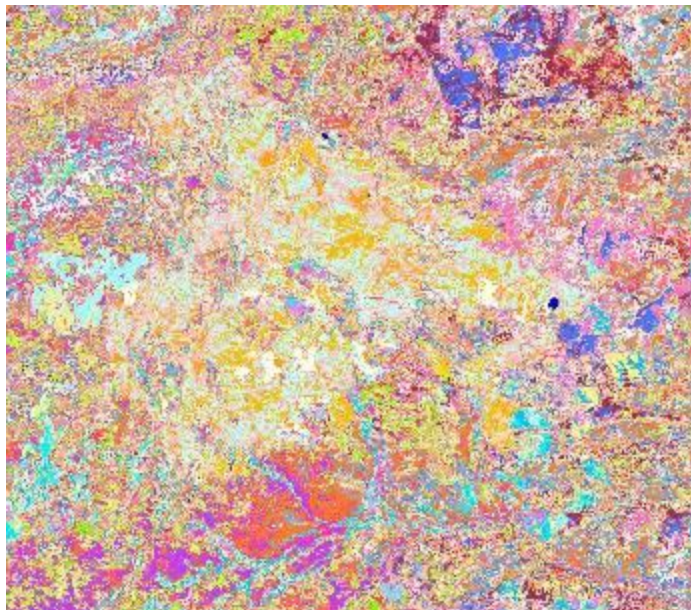
We are doing these 5-7 below in the next lab

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

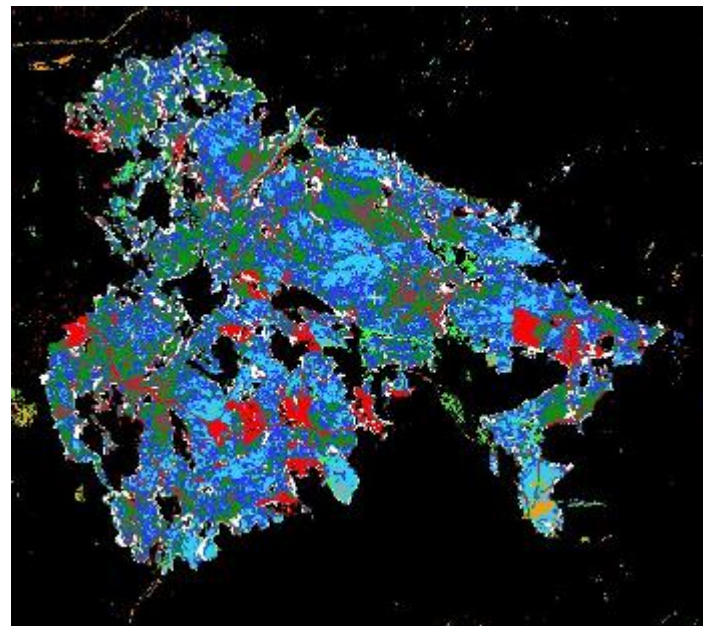
Project example to automatically map a complex fire polygon



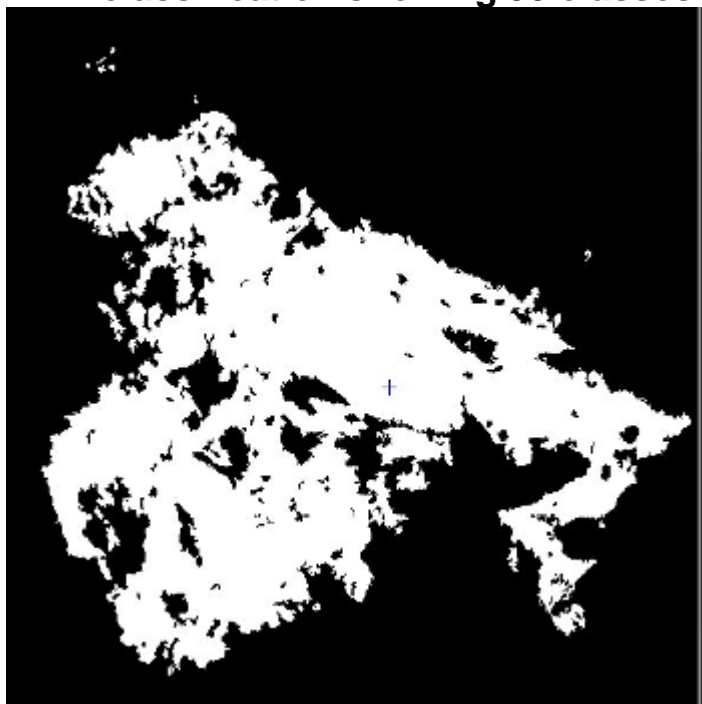
One approach: $\text{Normalised Difference Burn Ratio} = \frac{\text{NIR} - \text{MIR}}{\text{NIR} + \text{MIR}}$



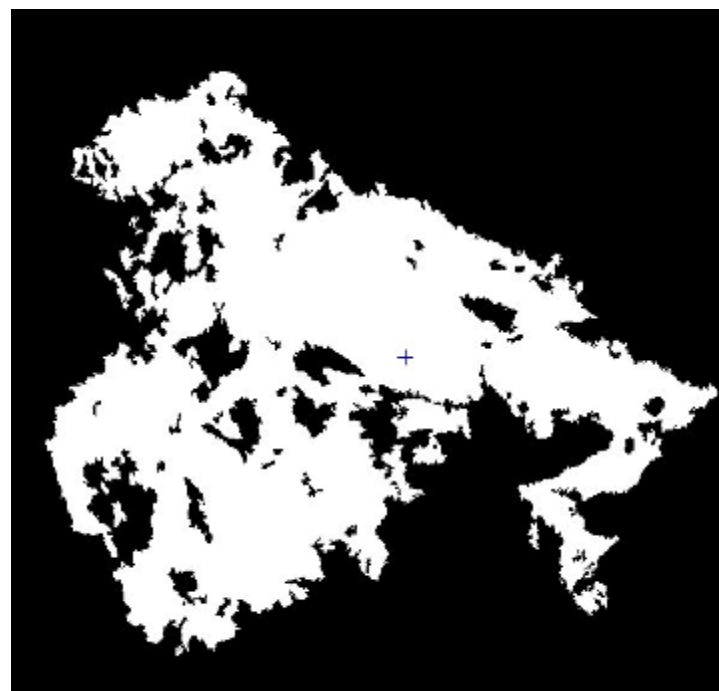
ISODATA classification showing 50 classes



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

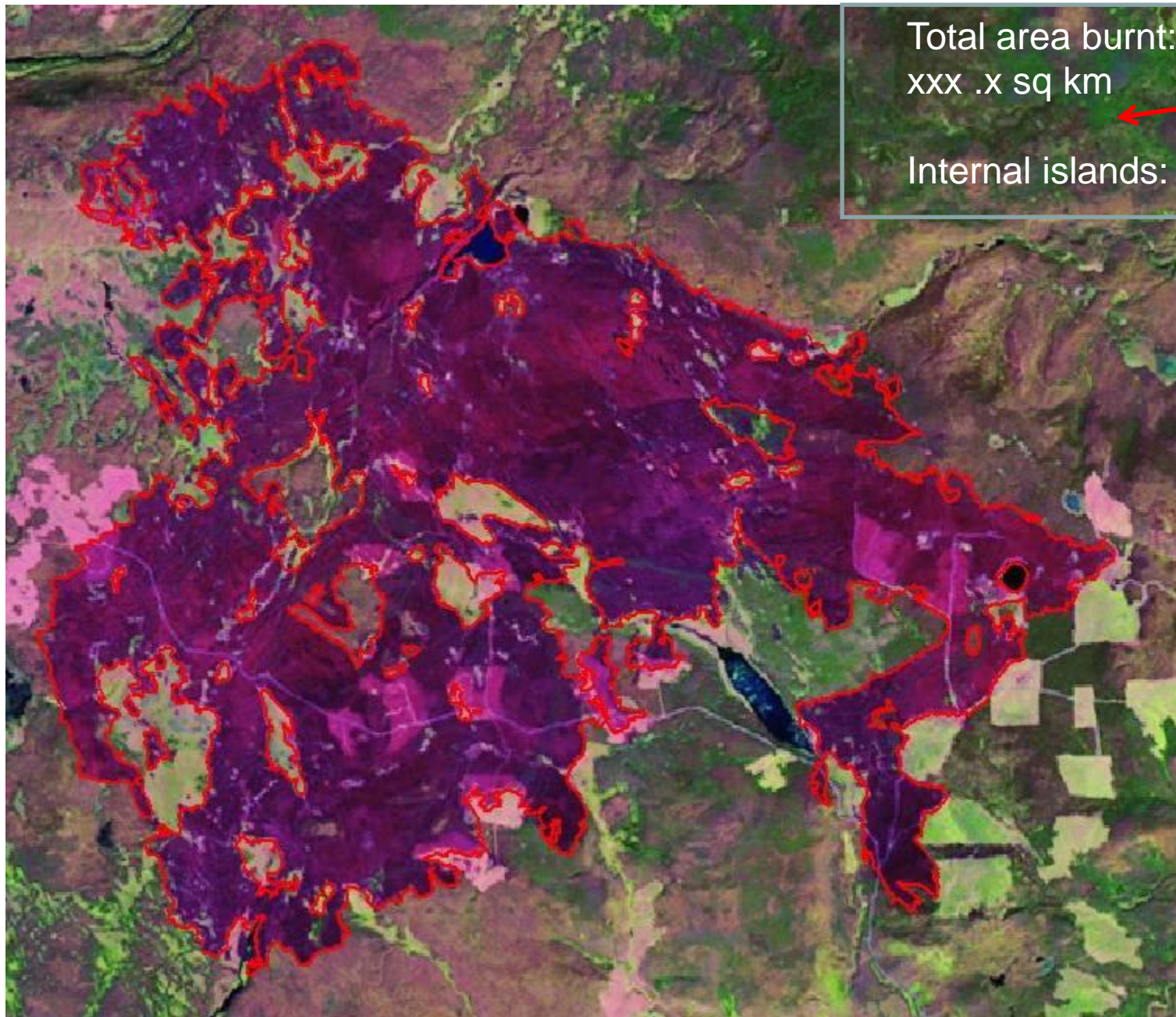


EASI modeling ->feature extraction



Sieve

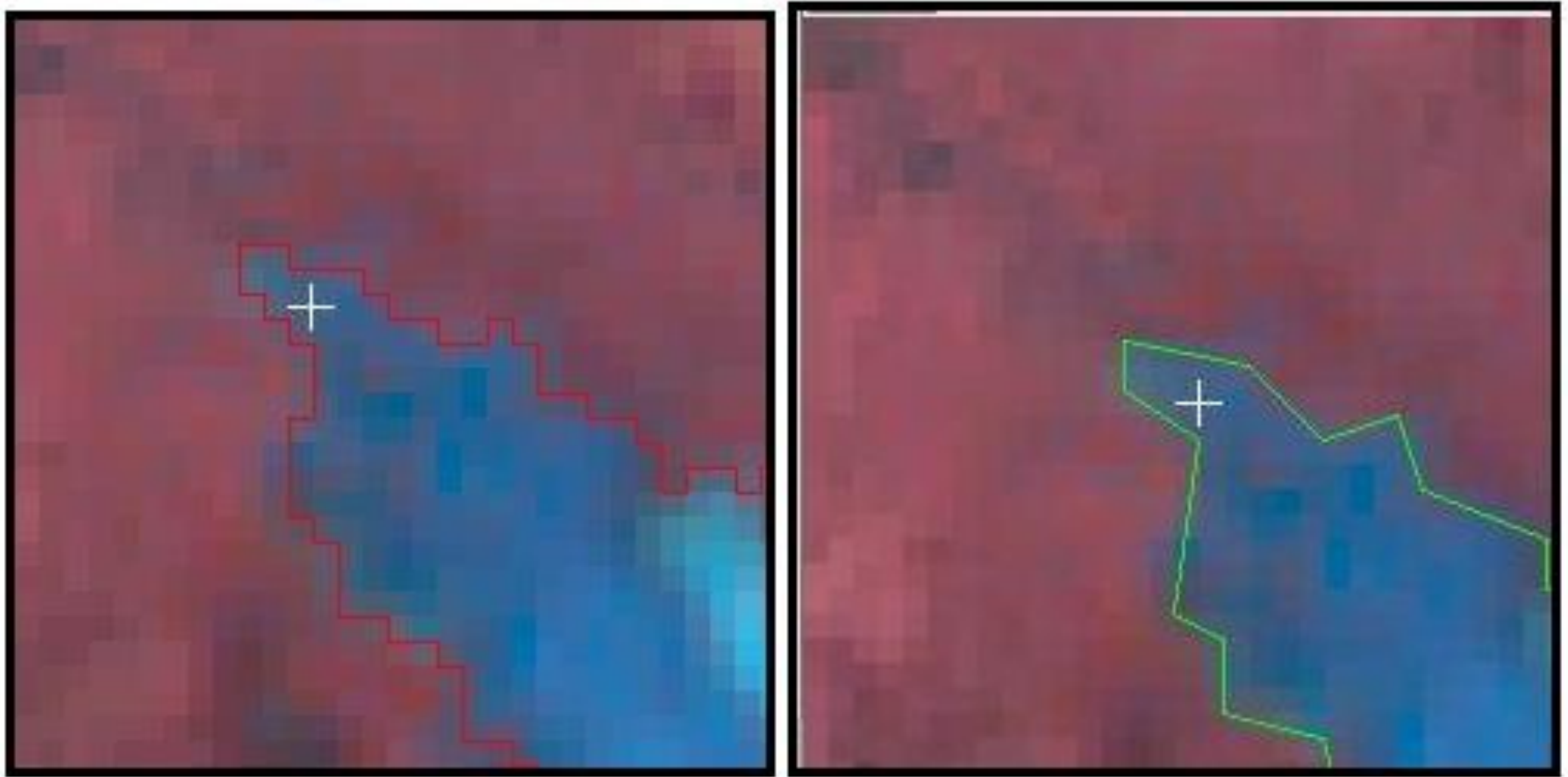
5,6,7: RTV: Raster to vector conversion, smoothing, and tabulation



**GIS tends
to do this
easier !**

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

- Robert McMaster, derived from Douglas-Poiker algorithm

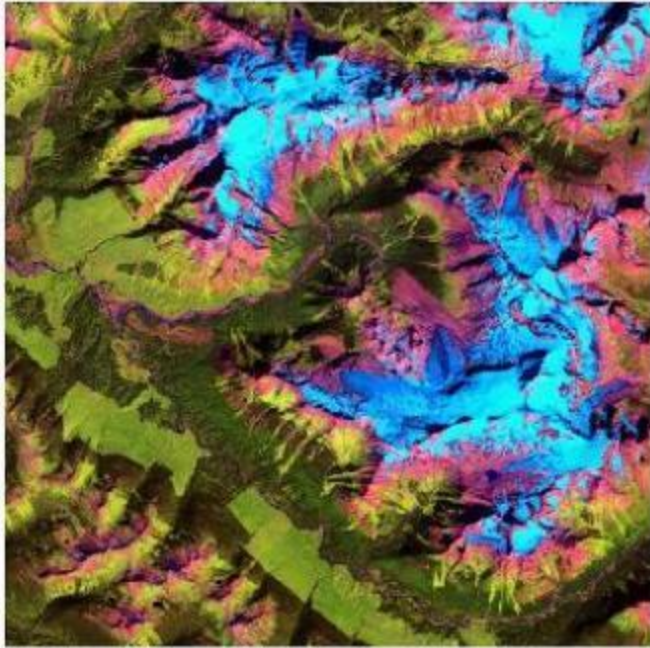


Several different algorithms for line generalisation (from *GIS history*)

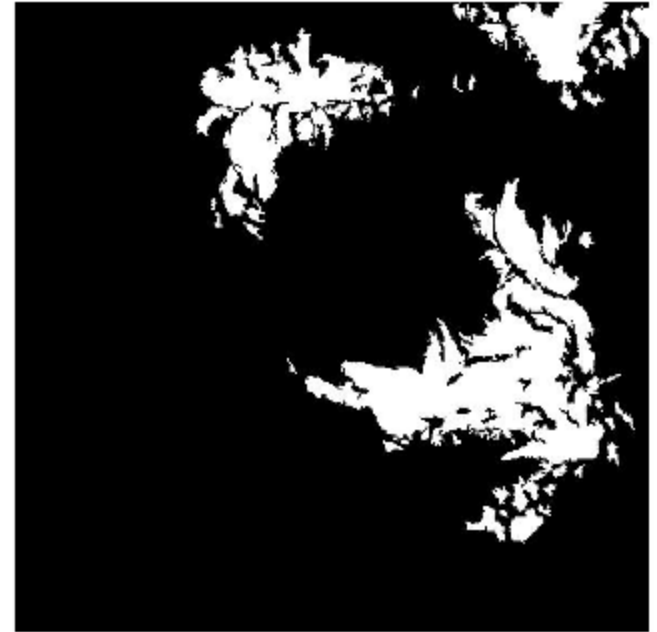
Smoothing - is more faithful to geography, but is it as accurate ?

- Compare with higher resolution PAN band if available or *Google maps*

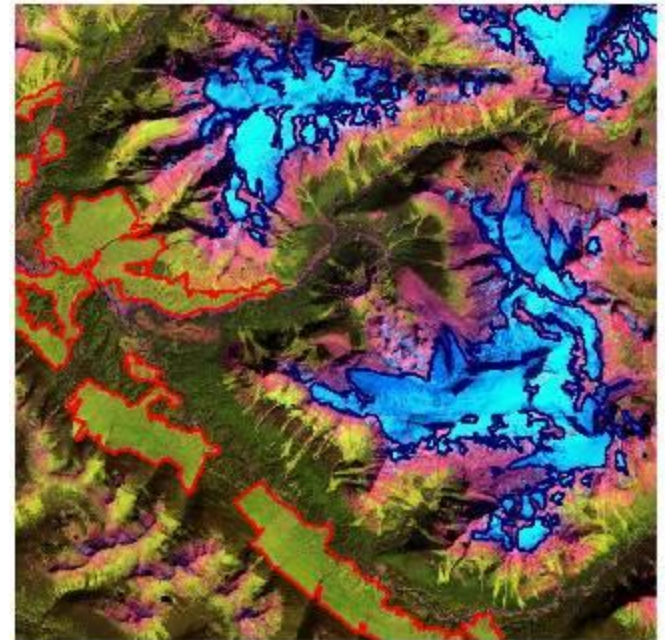
Extracting glaciers and cutblocks in Kakwa



Glaciers/snow
TM 3/5
ratio \rightarrow 2.0



Cut blocks
-Deciduous
 \leq -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

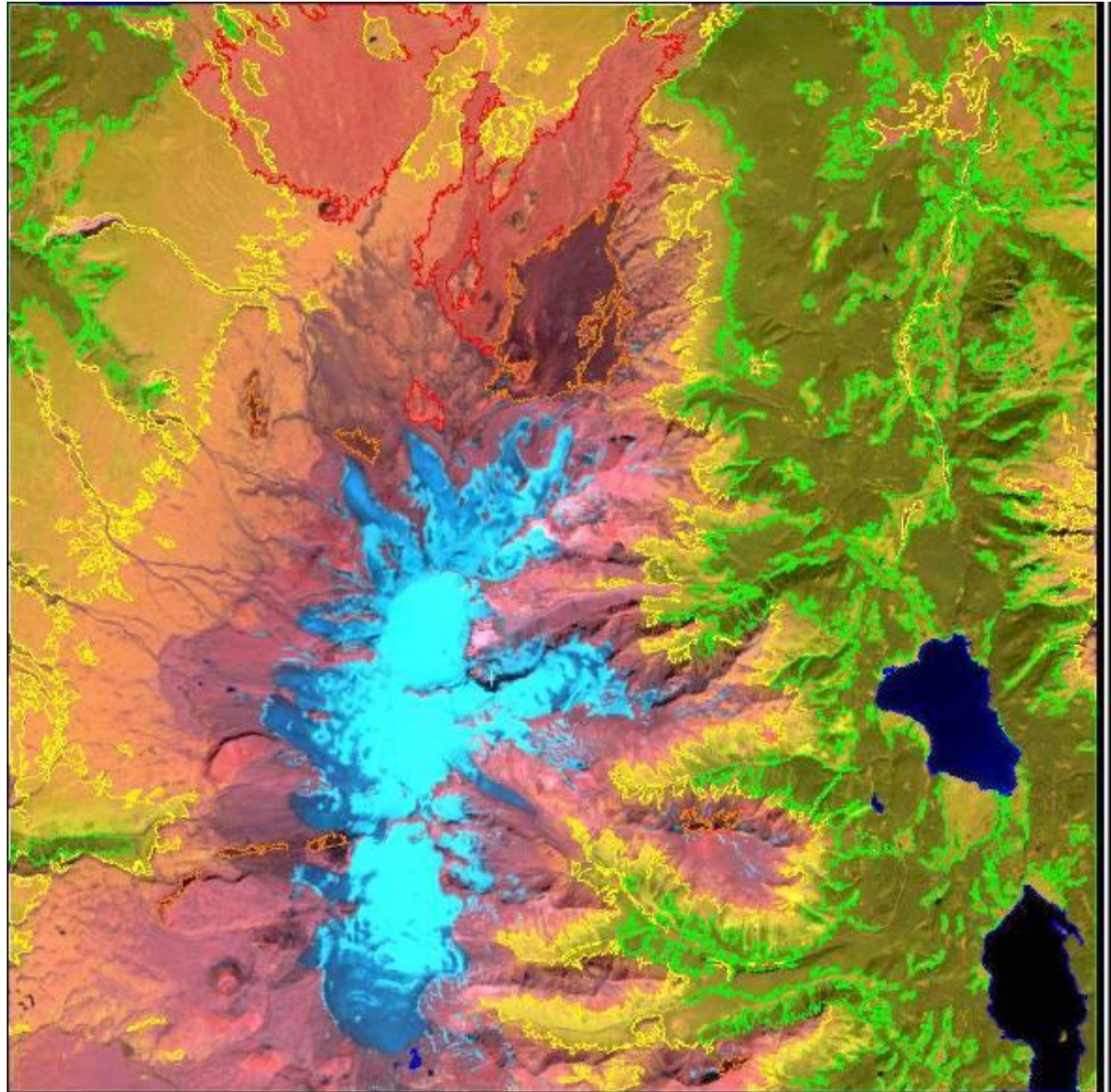
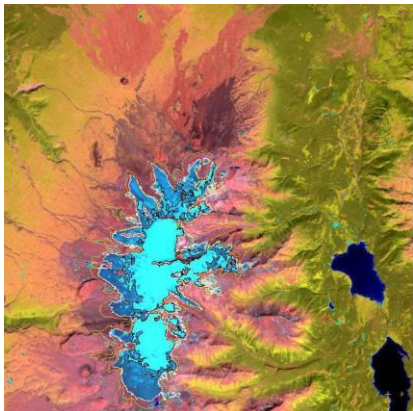
Mt. Edziza, BC

Land cover boundaries

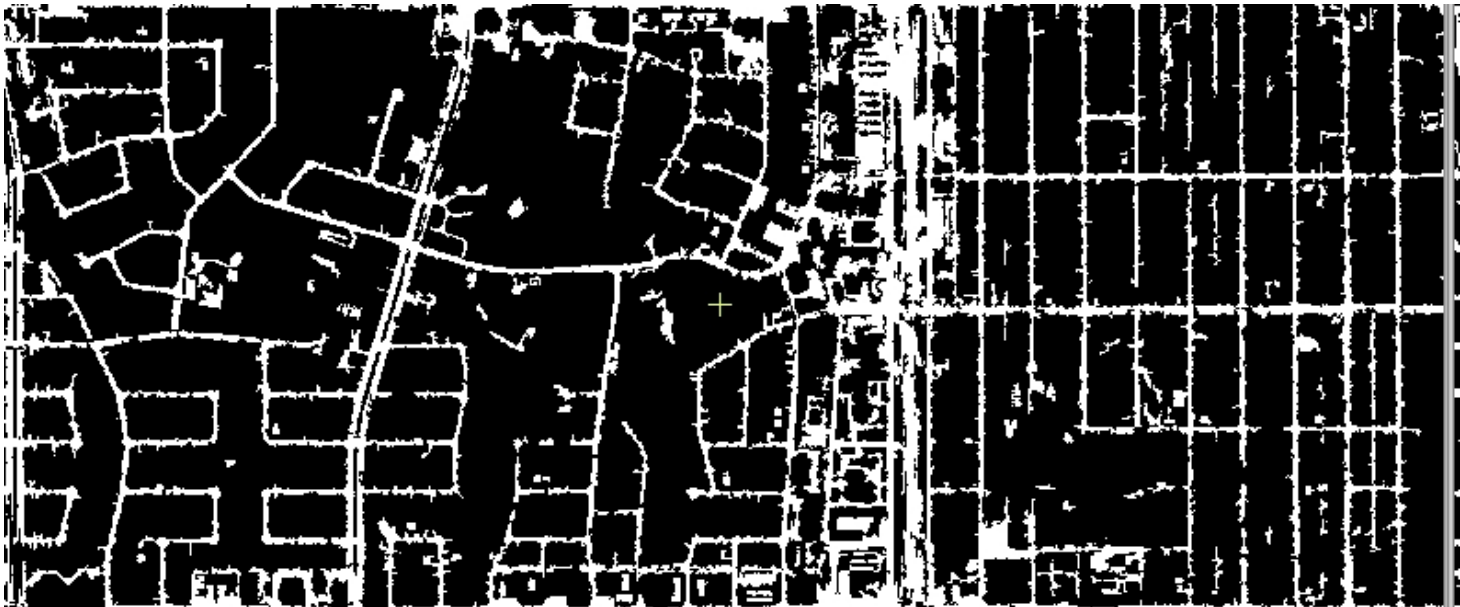
Based on:
Classification or
Greenness

- a. 4/3
- b. NDVI
- c. TCA 2

- Lava flows
- Bare ground
- Deciduous
- Coniferous
- (Glaciers)

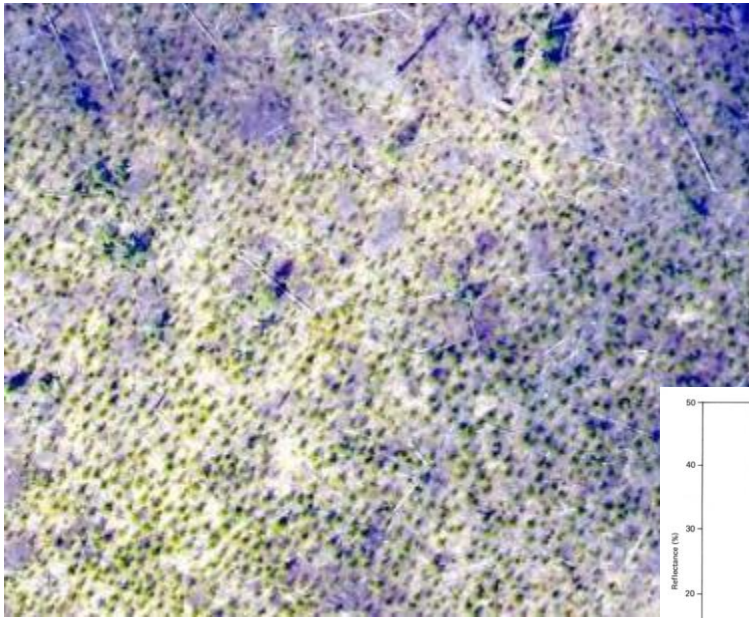


Extraction of road networks – lines – not easy!

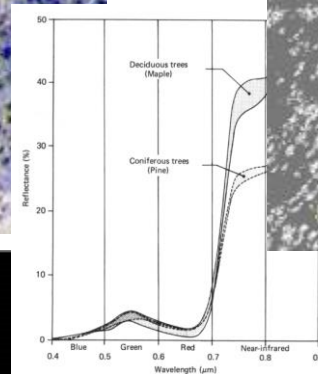
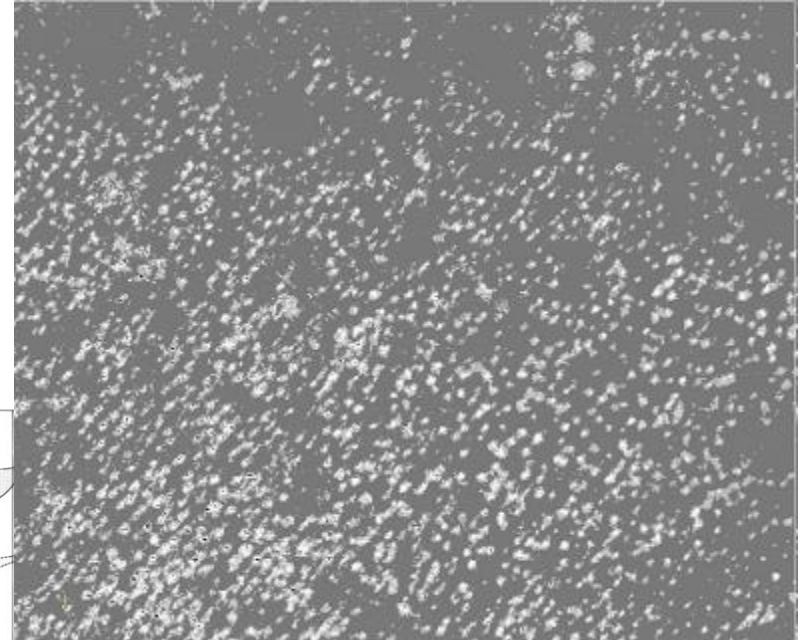


Experiment to extract trees as points to avoid digitising

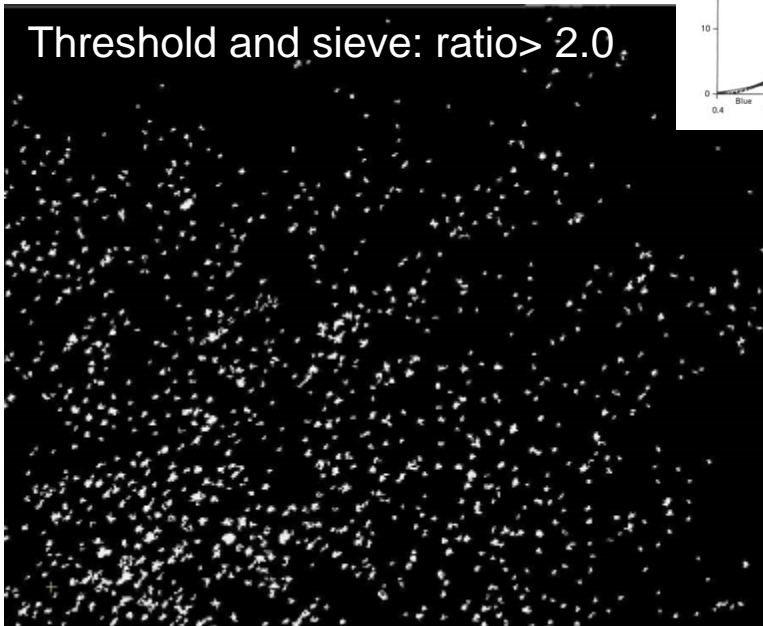
RGB Colour photo



Green / red ratio



Threshold and sieve: ratio > 2.0



Final points
(zoom)

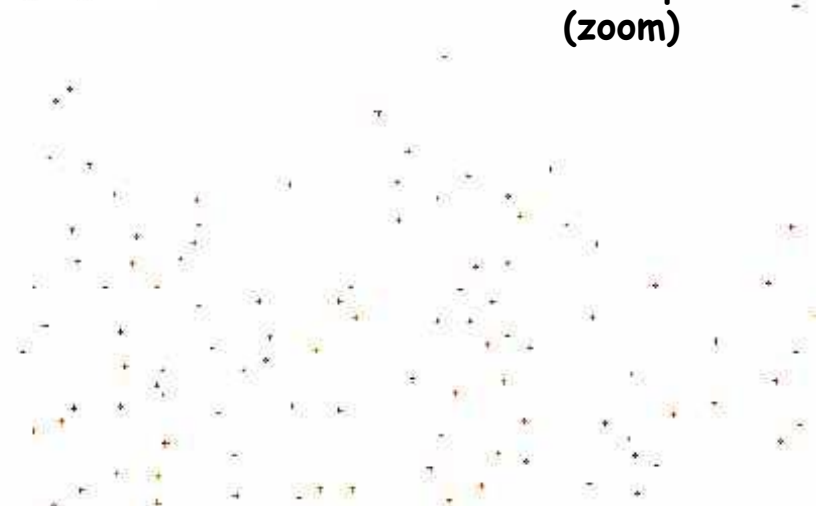
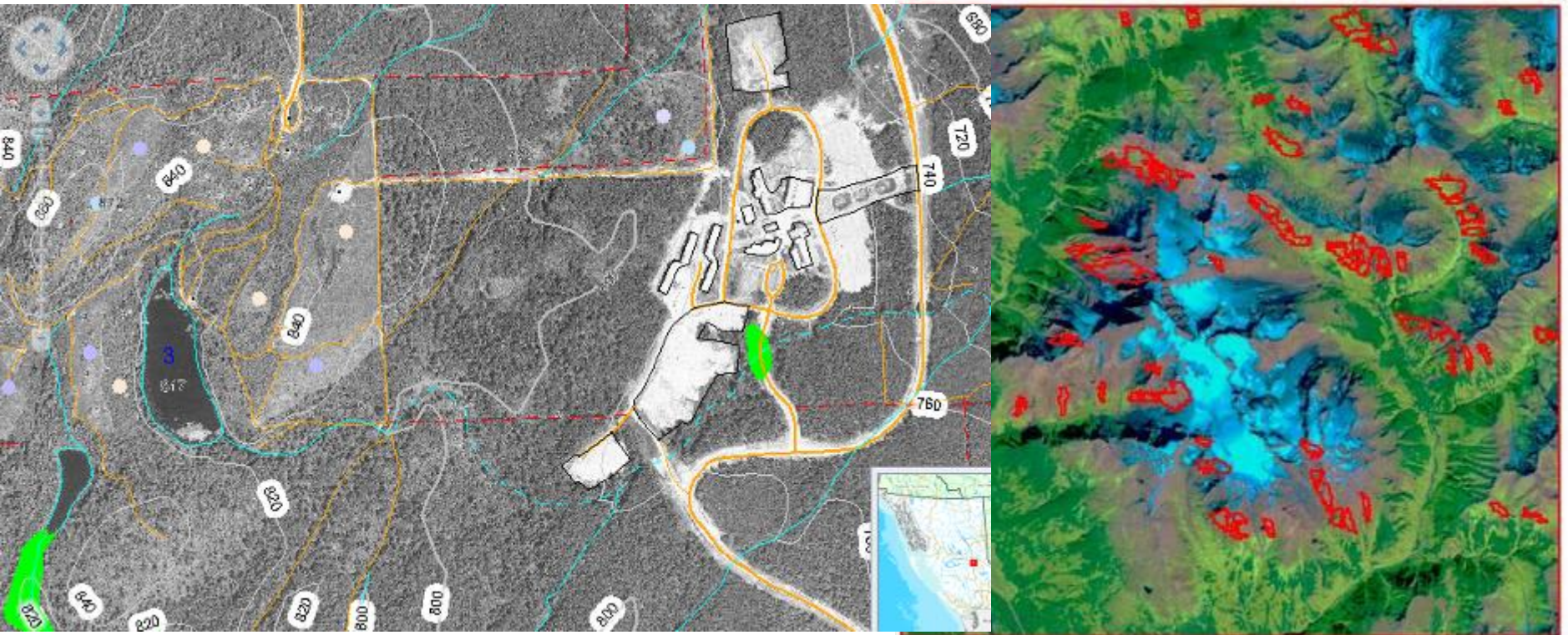


Image interpretation

- The **analogue** data unit is the photograph from a camera;
- the **digital** unit is the scene, composed of pixels, created by 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

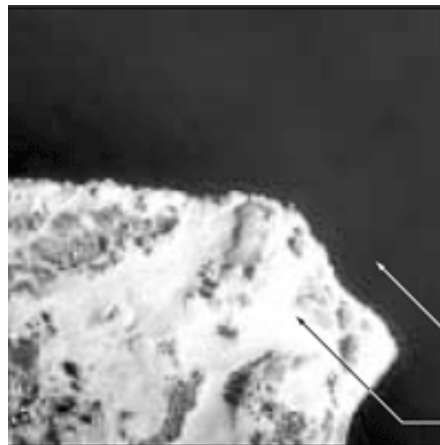
Association/Site: associating the presence of one object with another, or relating it to its environment, can help identify the object (e.g. industrial buildings often have access to railway sidings);



427949-186 (July 1993)
Esquimalt Harbour, British Columbia



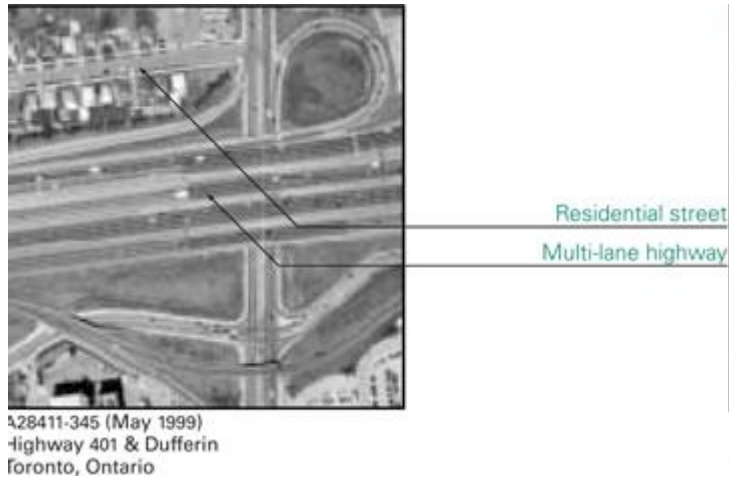
Tone/Colour: the colour characteristics of an object, relative to other objects in the photo (e.g. sand has a bright tone, while water usually has a dark tone; tree species can be determined by colour of leaves at certain times of the year);



426999-20 (August 1986)
Sandbanks Provincial Park
Picton, Ontario



Size: a measure of the object's surface area (e.g. single-lane vs. multi-lane highways);



Time: temporal characteristics of a series of photographs can be helpful in determining the historical change of an area (e.g. looking at a series of photos of a city taken in different years can help determine the growth of suburban neighbourhoods;

Shape: the form of an object on an air photo helps to identify the object. Regular uniform shapes often indicate a human involvement;



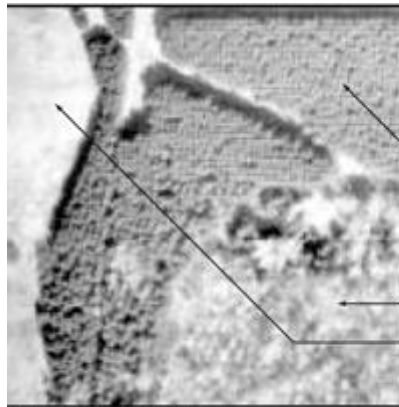
A15183-37 (September 1955)
Chinchaga River, Alberta



"U"-shaped oxbow lakes



Pattern: similar to shape, the spatial arrangement of objects (e.g. row crops vs. pasture) is also useful to identify an object and its usage;



A26458-82 (May 1984)
CFB Uplands
Ottawa, Ontario

Plantation forest
Natural forest
Open field



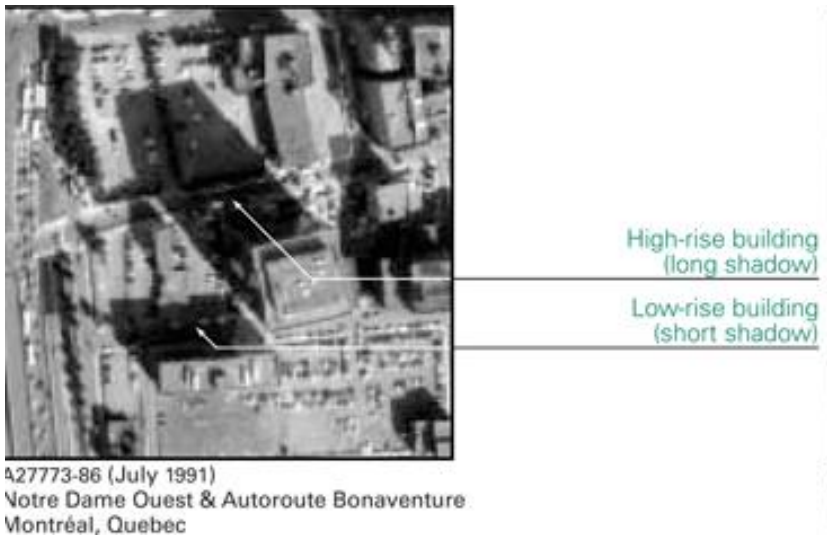
Texture: the physical characteristics of an object affects how they appear

e.g. calm water has a smooth texture;
a forest canopy has a rough texture



PCI Catalyst: 'TEX'

Shadow: a shadow provides information about height, shape, and orientation



Shadows: usually from the SE (~10am)



Northern hemisphere example – Mt. Robson

Great Barrier Reef, Australia (20°S)





Deriba Caldera, Sudan (13°S): from the Space Station – sun in NE in southern hemisphere