

# Historical note: Canada's Alouette data released from the 1960s

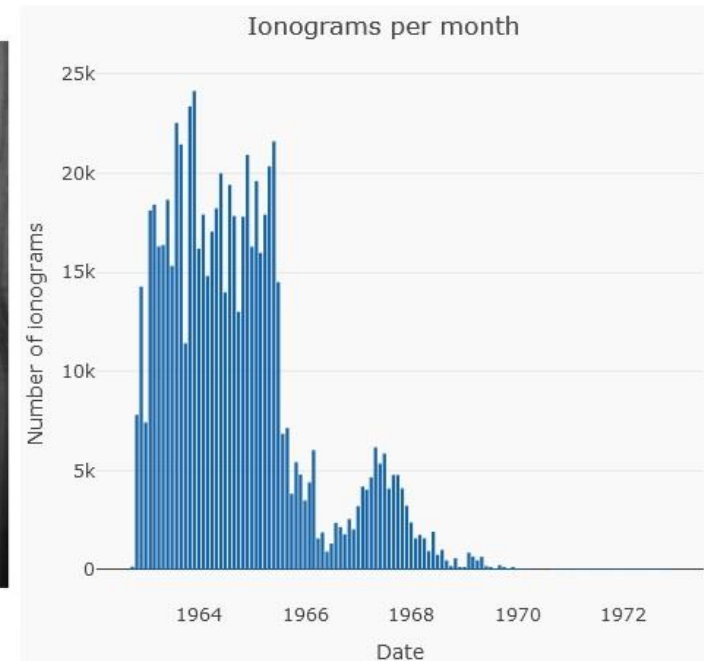
## Alouette 1 and 2 (1962 / 1965) Canadian Space Agency

- first Earth satellites after USA / USSR

The primary purpose of the Alouette mission was to investigate the geographic and diurnal properties of the topside ionosphere at altitudes up to 1000 km



*Dr. John Chapman (L) and Dr. LeRoy Nelms (R) toast the success of the Alouette satellite. August 24, 1970. Credit: Canadian Space Agency.*



Ionosphere images from Alouette 1 / 2 download:

<https://open.canada.ca/data/en/dataset/221c1c75-4c42-4286-a4ce-ca6c3027b7fe>

<https://www.asc-csa.gc.ca/eng/blog/2023/09/27/alouette-i-saving-its-data-60-years-later.asp>

# Environmental change – monitoring with RS

The extended record of remotely sensed imagery enables:

- a. Map current and past land cover
- b. Monitor change e.g. since 1984 (Landsat 5 TM)

There are always changes, but more so with increasing population, resource extraction and impacts, e.g. global warming.

These have various characteristics e.g.

- a. Long / short term
- b. Gradual / catastrophic
- c. Local / global
- d. single event / cyclical
- e. Natural / human induced

# Landsat program (since 1972/1984)

## Satellite imagery

- Minimal distortion
- Similar time of day = ~ consistent lighting
- Consistent scale
- Multispectral data
- Calibrated system



Example from Landsat 5

# **GEOG357: Environmental change exercise 2023**

... the world is your oyster. Pick a good example

Goal: identify an event or change somewhere in (1972) 1984 - 2023,  
and find/download/clip before/after image ... see below

This could also be before/after and then beyond (but not required)  
e.g. before / after fire -> and also regrowth

Download and prepare images in Lab 6: Oct 18

Send your slides to me by Wednesday Oct 24 15:00

Give a 3-4 minute summary in class on Oct 26\*

\* Oct 31 if you can't make it to class on Oct 26

# Google Earth Time Lapse 1984-2023

40 years of Landsat images; >70,000 images - >1 petabytes of data

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

***Note: mountain areas comparison are less effective due to seasonal snow***





## Why not just use the sequence on Google Earth time lapse ?

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

Skill testing question, and you might guess right:

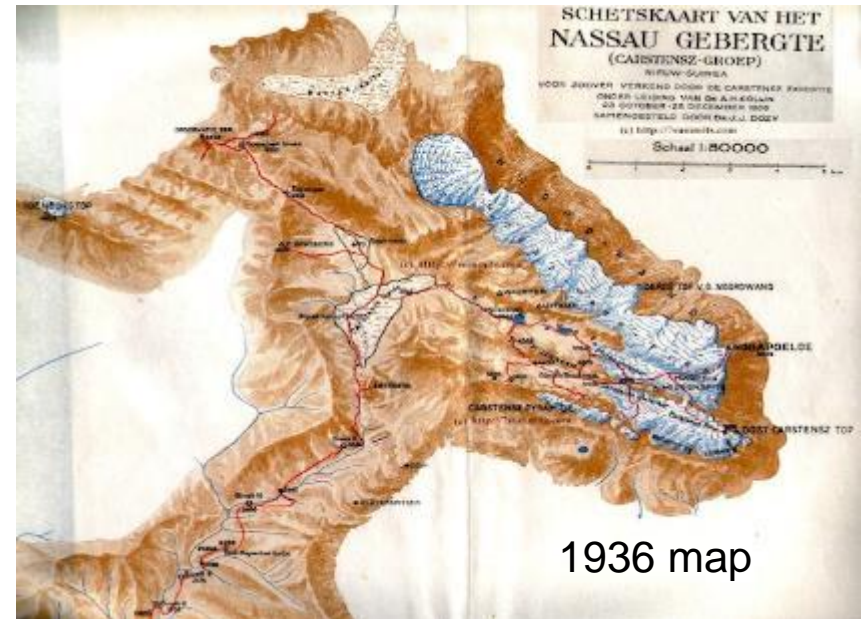
1. GE uses only visible (RGB) i.e. no IR .. you know why that's poor
2. In cloudy climates e.g. mountains, GE images has clouds - snow
3. Mosaics may include Landsat 7 ETM ... with stripes

you can use GE timelapse to help identify an area of interest

The slides below include student examples from previous years

Puncak Jaya, Indonesia 4°S, 137°E

elevation m. asl: 4884m



1936 map

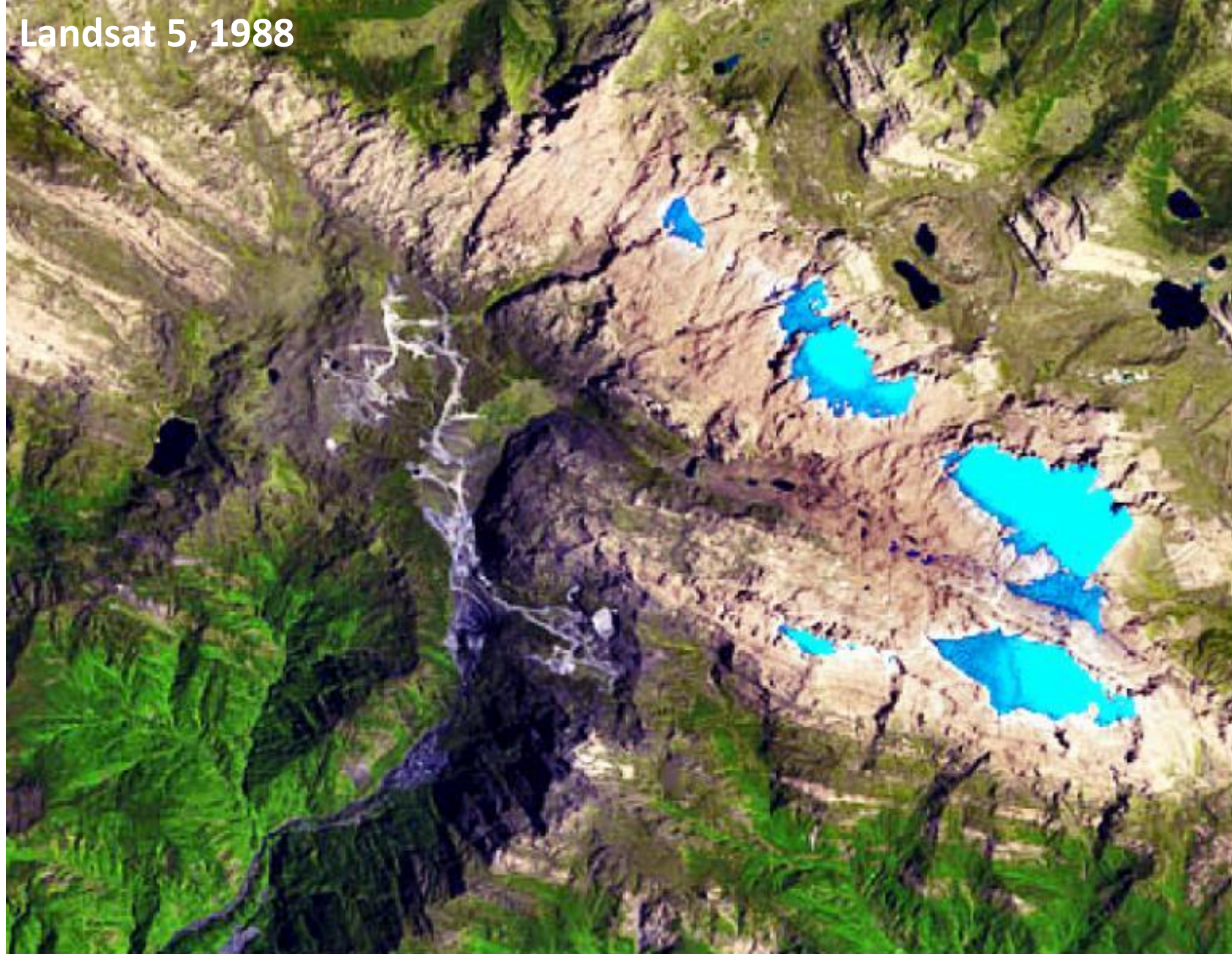
1972



photo: corey rich



Landsat 5, 1988





Landsat 8, 2017



Grasberg gold Mine – largest in the world, diameter 2.3 km

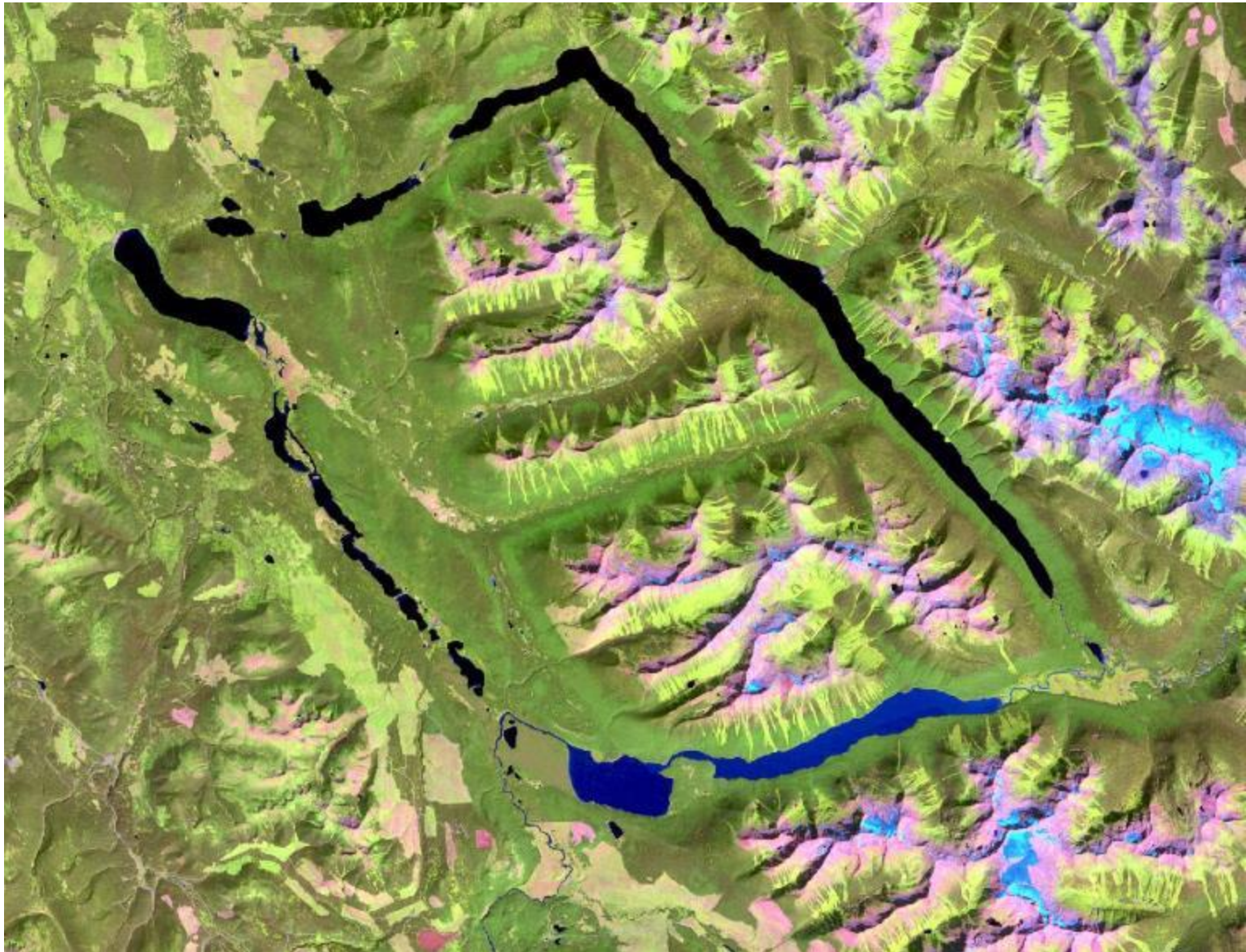


Bowron Lakes 19 August 2016 – visible bands (as in Google Earth)



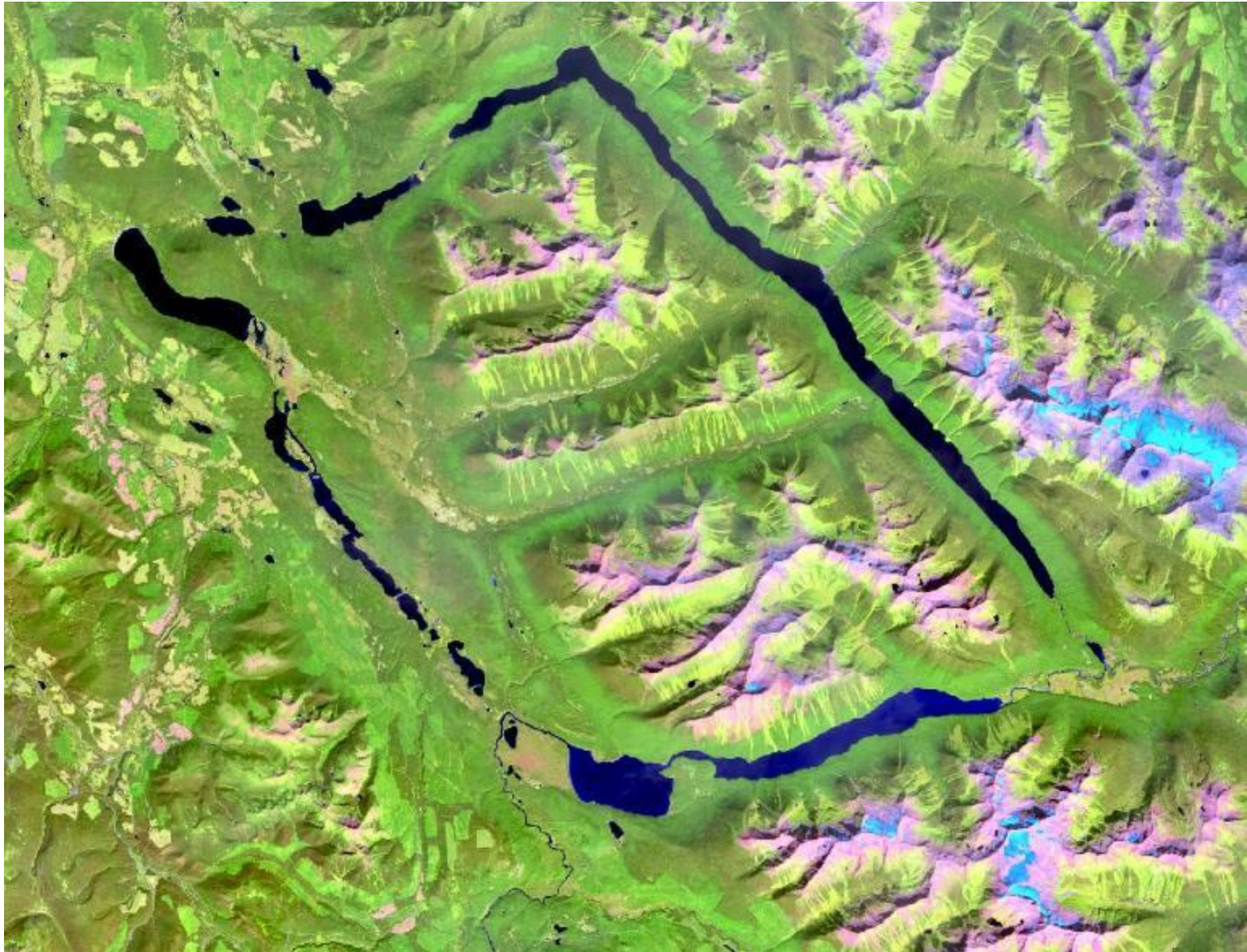


Bowron Lakes 17 August 1992





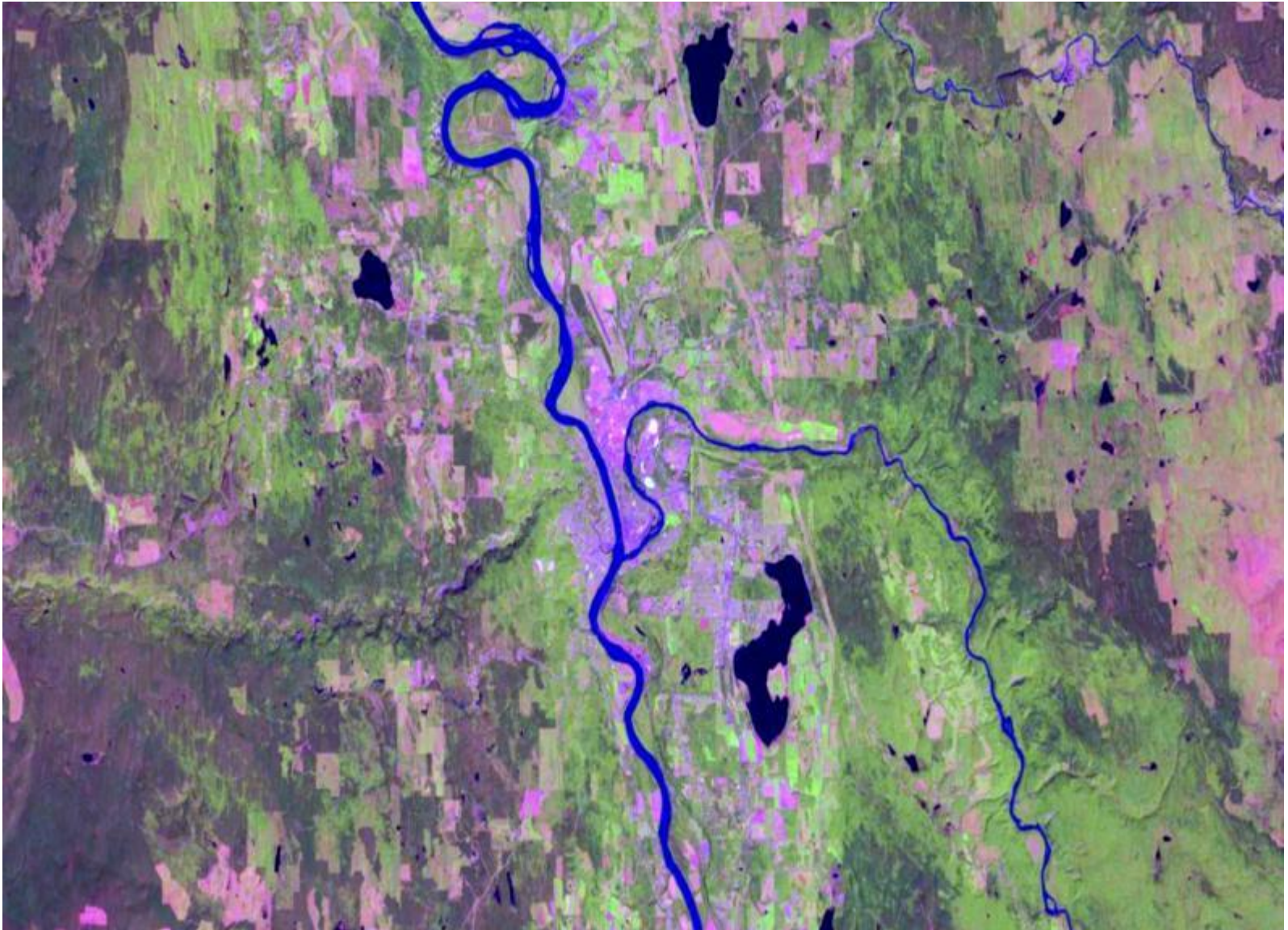
Bowron Lakes 19 August 2016



Changes not that dramatic ...

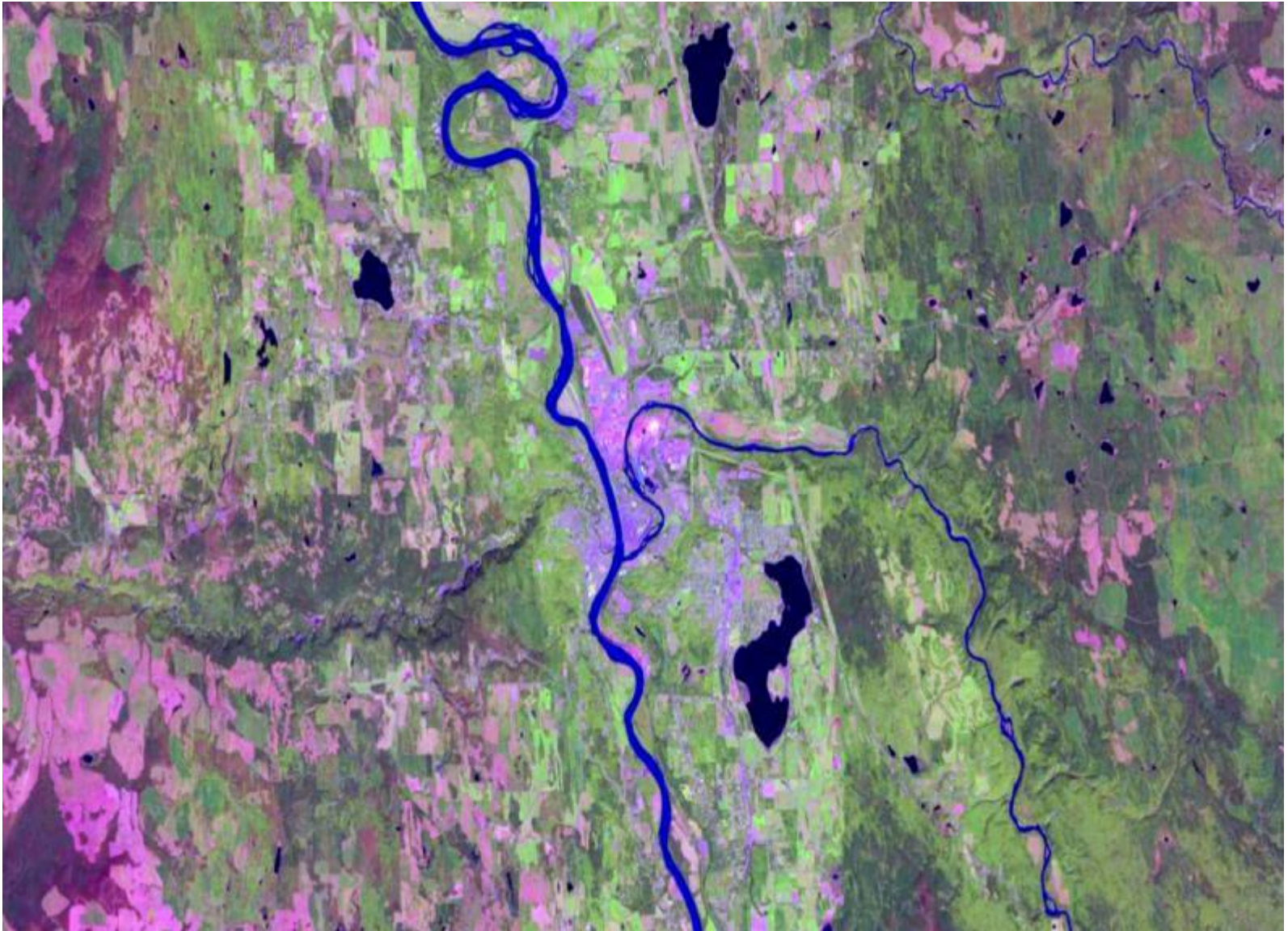


Quesnel: June 2, 1985





Quesnel: June 4, 2009



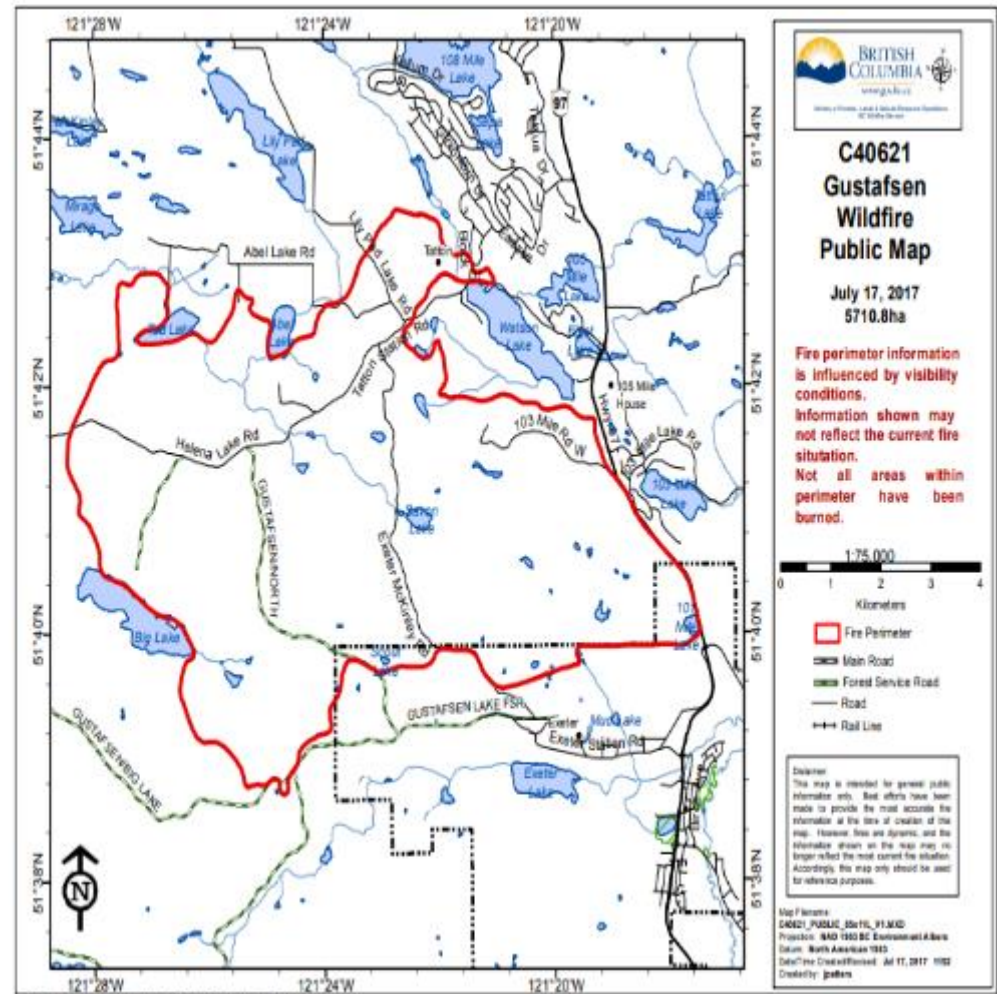


# Gustafsen wildfire

summer 2017: started from  
**firearm use** July 6th, 2017,  
**burned 5,700 ha.** Out by  
July 30th, 2017.

Between 108 Mile Ranch and  
100 Mile House (about 15  
km apart), North of  
Kamloops and south of  
Williams Lake.

My parents ranch and my home is  
near Williams Lake

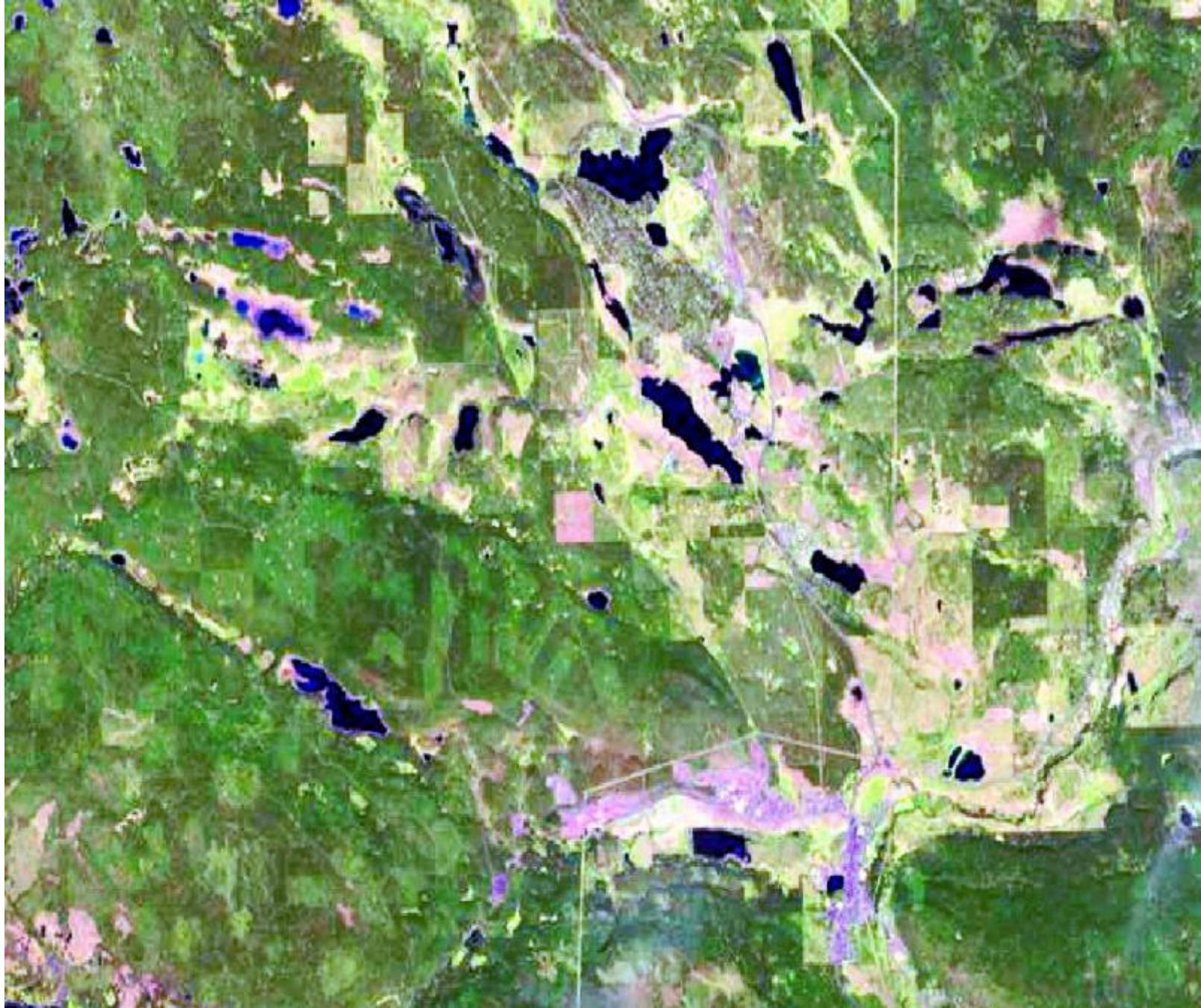


## References:

<https://www.wltribune.com/news/2017-gustafsen-wildfire-was-caused-by-firearm-use-foi-documents-confirm/>  
<http://bcfireinfo.for.gov.bc.ca/hprScripts/WildfireNews/OneFire.asp?ID=619>



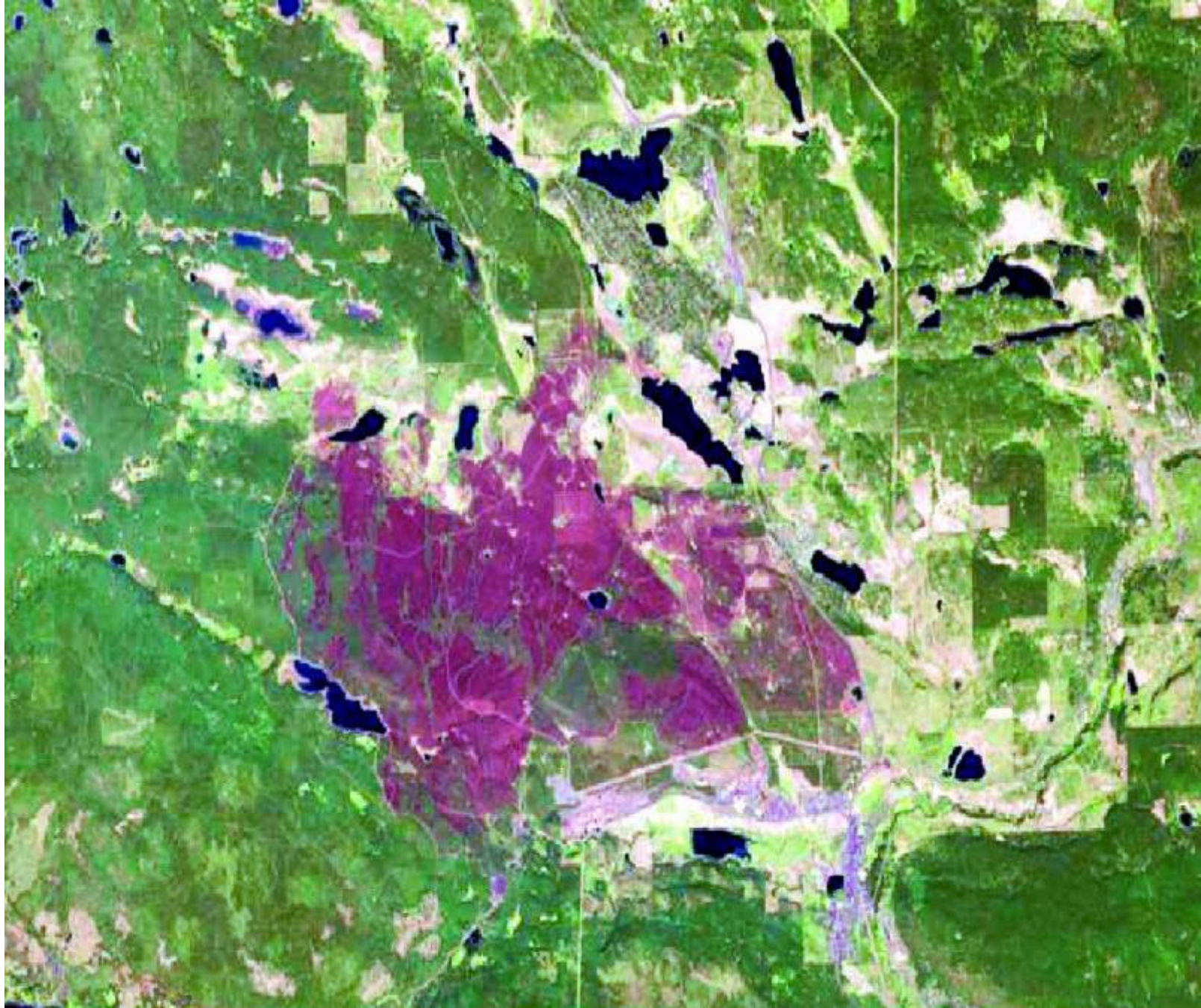
Landsat 8  
August 19,  
2016  
South  
Cariboo



4km



Landsat 8  
August 22,  
2017  
South  
Cariboo



4km



# Selected sensors and available dates

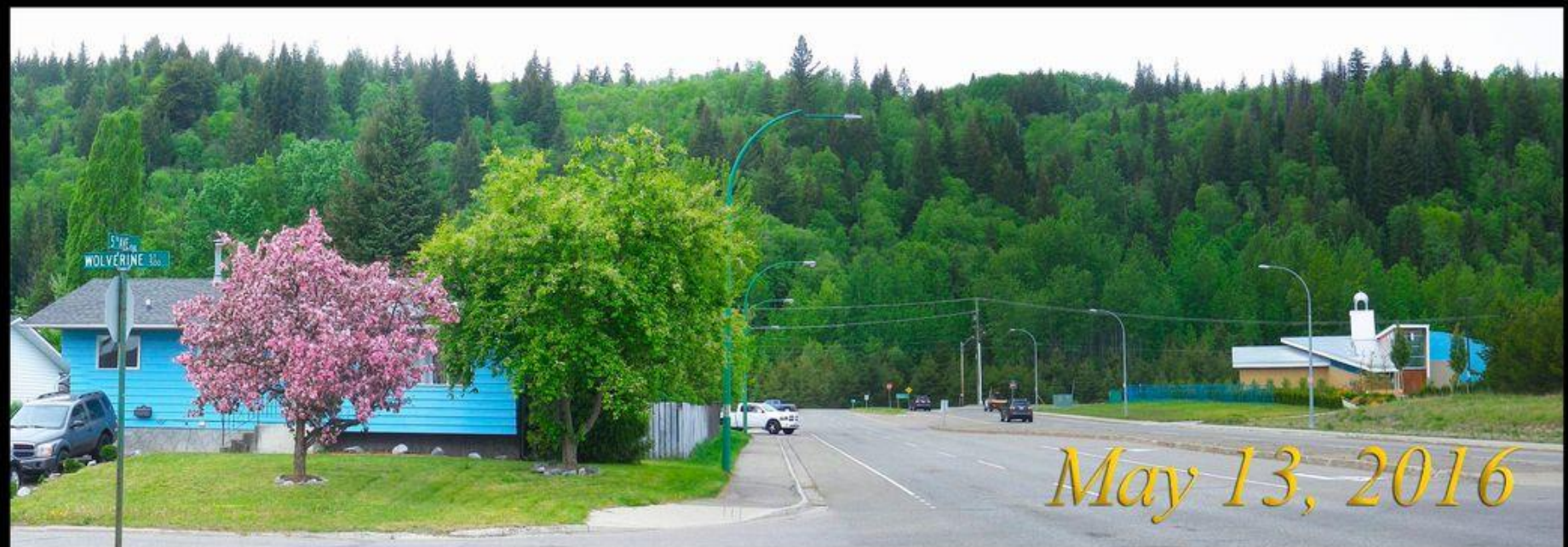
<b>Landsat 1-3 MSS</b>	<b>1972-84</b>	(80m, no SWIR)
<b>Landsat 5 TM</b>	<b>1984-2011</b>	
<b>Landsat 7 ETM+</b>	<b>1999-2002</b>	(afterwards striped except for centre strip)
<b>Landsat 8 OLI</b>	<b>2013-&gt;</b>	
<b>Landsat 9 OLI</b>	<b>2022-&gt;</b>	
<b>Sentinel 2</b>	<b>2015-&gt;</b>	(higher resolution 10m)
<b>ASTER</b>	<b>2000-&gt;</b>	(no SWIR bands after 2008)
<b>MODIS</b>	<b>2000-&gt;</b>	500m- 1km resolution

For visual display, these can be mixed/matched with similar bands

# Change monitoring Considerations 1

## Timing (day/season)

- Time of day affects horizontal sun angle (azimuth)  
... it is consistent with most satellites e.g. Landsats, Sentinels
- Time of year affects vertical sun angle /shadow (zenith)
- Seasonal ground cover - vegetation, snow, crops
- Image data should be collected near Anniversary Dates
- Seasonal phenology - can change by  $\pm 2$  weeks each year





# Change monitoring considerations 2

## Frequency / type of Changes

- short term versus long term e.g. lakes v reservoirs, snow v glaciers
- local versus global e.g. mining v arctic ice, desertification
- gradual versus catastrophic e.g. soil slip v landslide
- cyclical changes – urban, agricultural and forest
- Weather is NOT interesting and clouds are the enemy

Digital Numbers may be composed of three elements:

- Atmospheric interference (e.g. haze)
- Illumination (angle of reflection)
- Albedo (response to surface cover)**

Dubai has the world's largest artificial island, Palm Jumeirah, which is shaped like a palm tree and adds close to 50 miles to the city's coastline. The island is packed with luxury hotels, beachfront villas, and apartments.

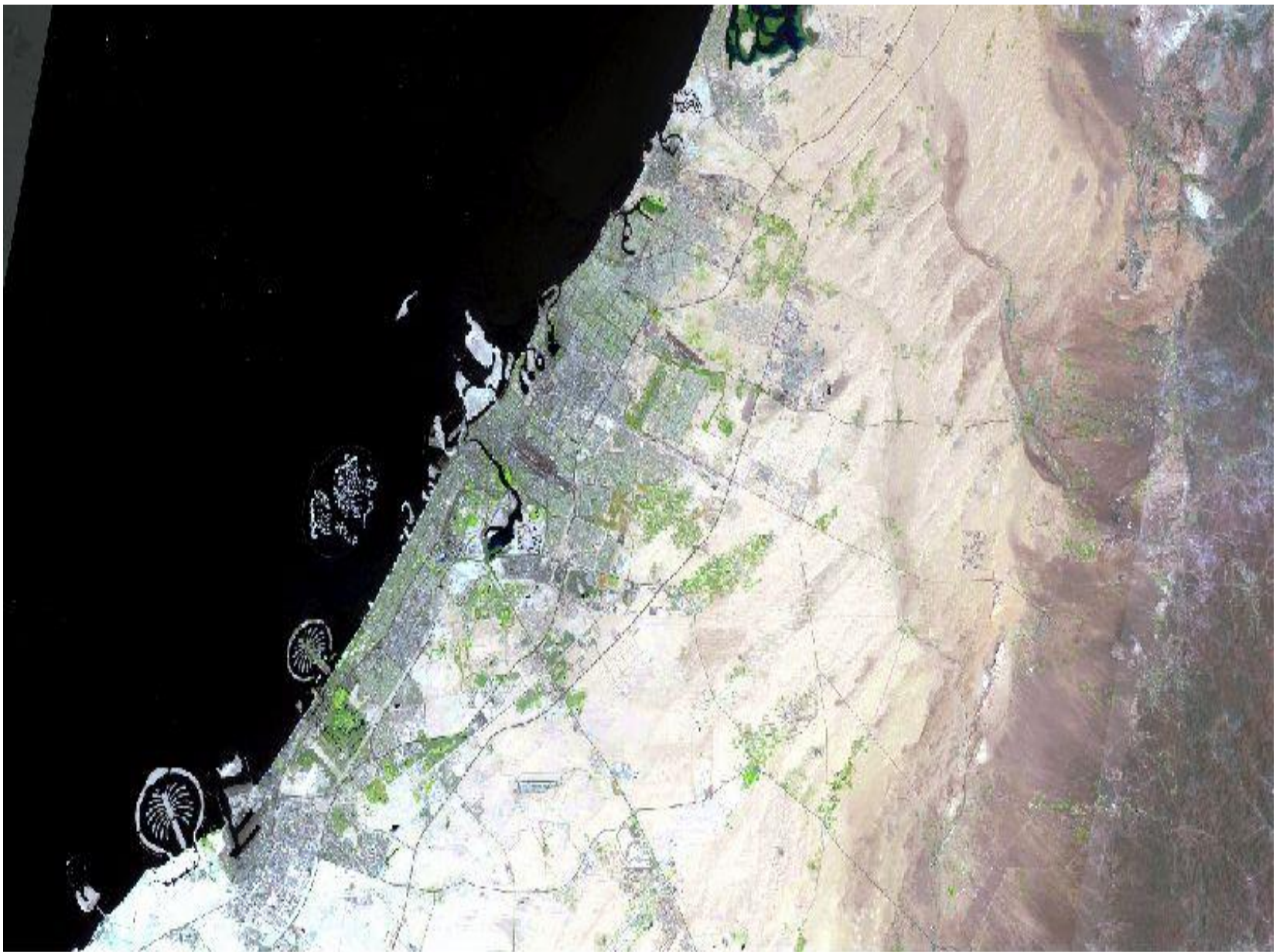






Dubai

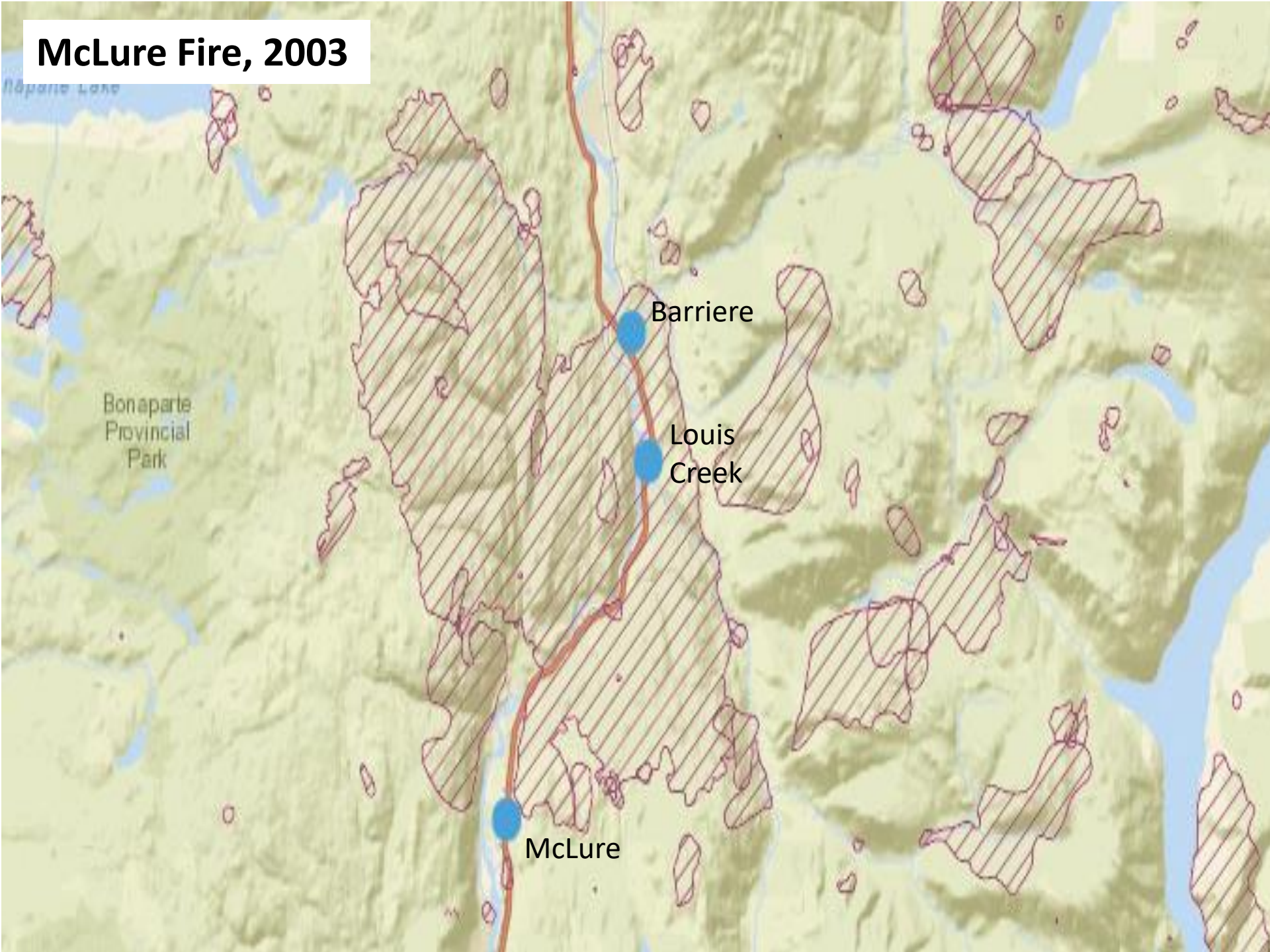
August 24, 2001



Dubai – best to find similar dates by year -> **August 23, 2017**



# McLure Fire, 2003







**June 09, 1995**





**June 01, 2007**



# Three Gorges Dam, China

Dam location: 30°49' North 111°00' East



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

Environmental Change



## Sandouping, August 1999



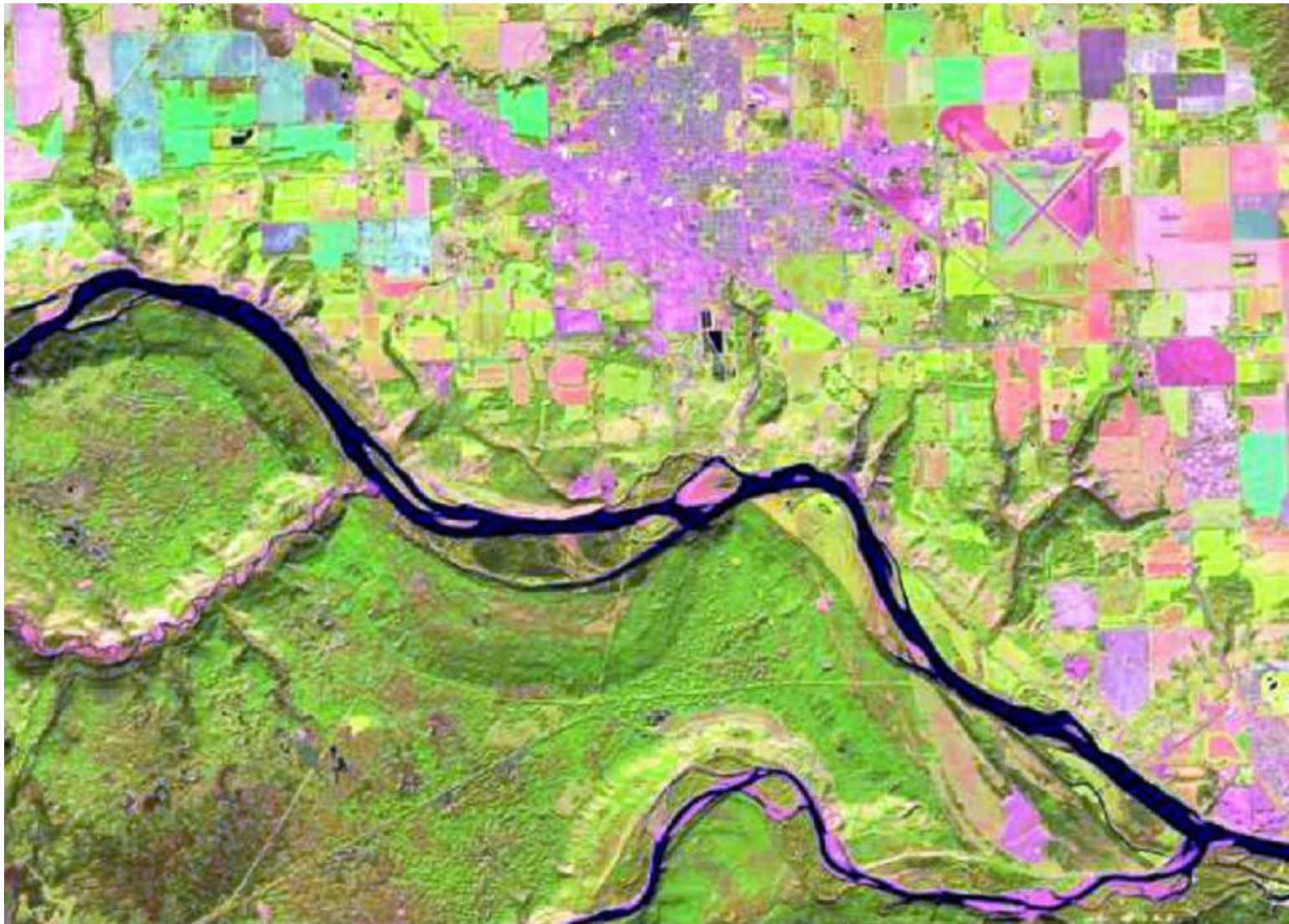


## Sandouping, August 2017





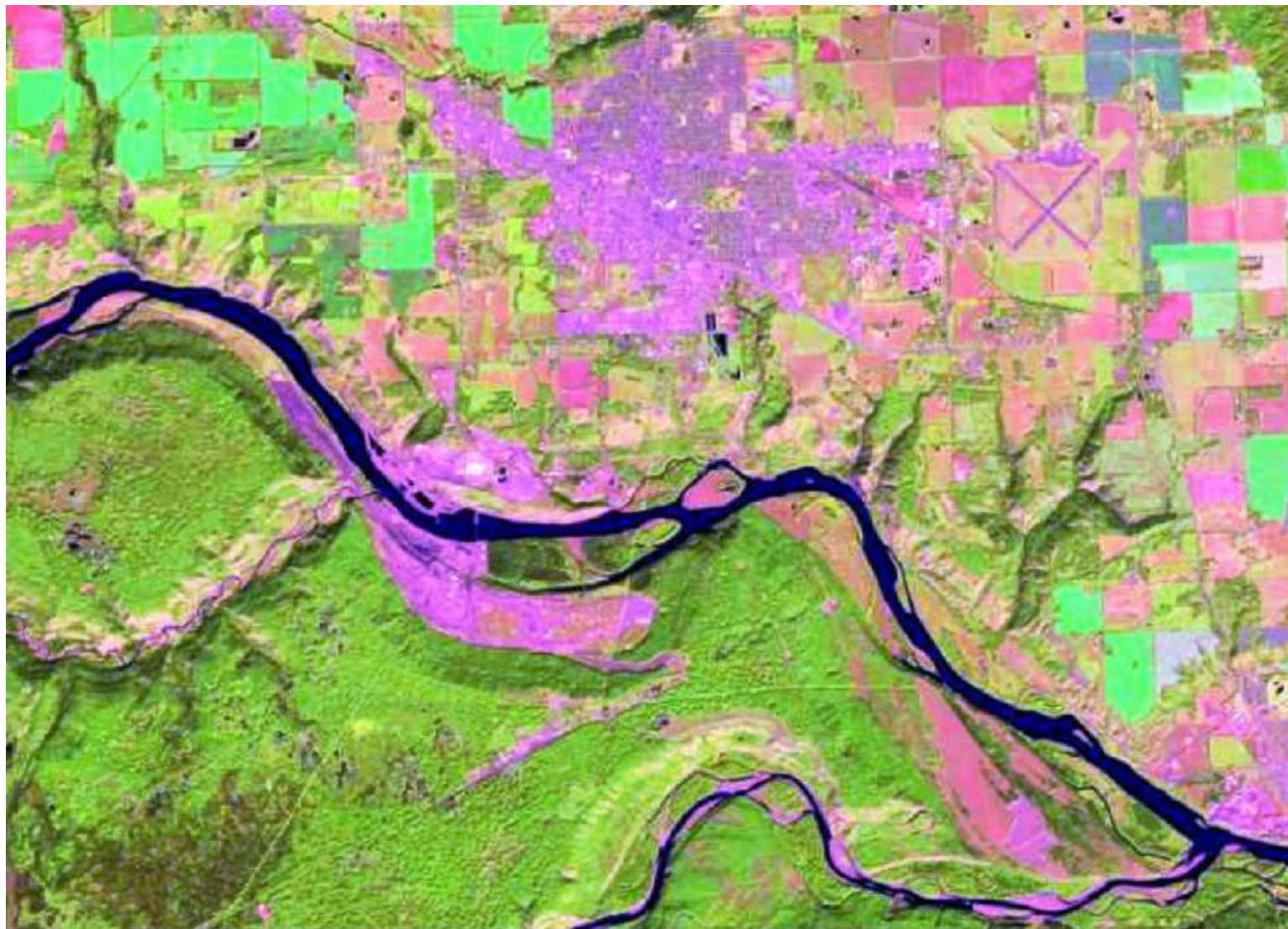
## Site C dam and Fort St. John August 2013



5 km



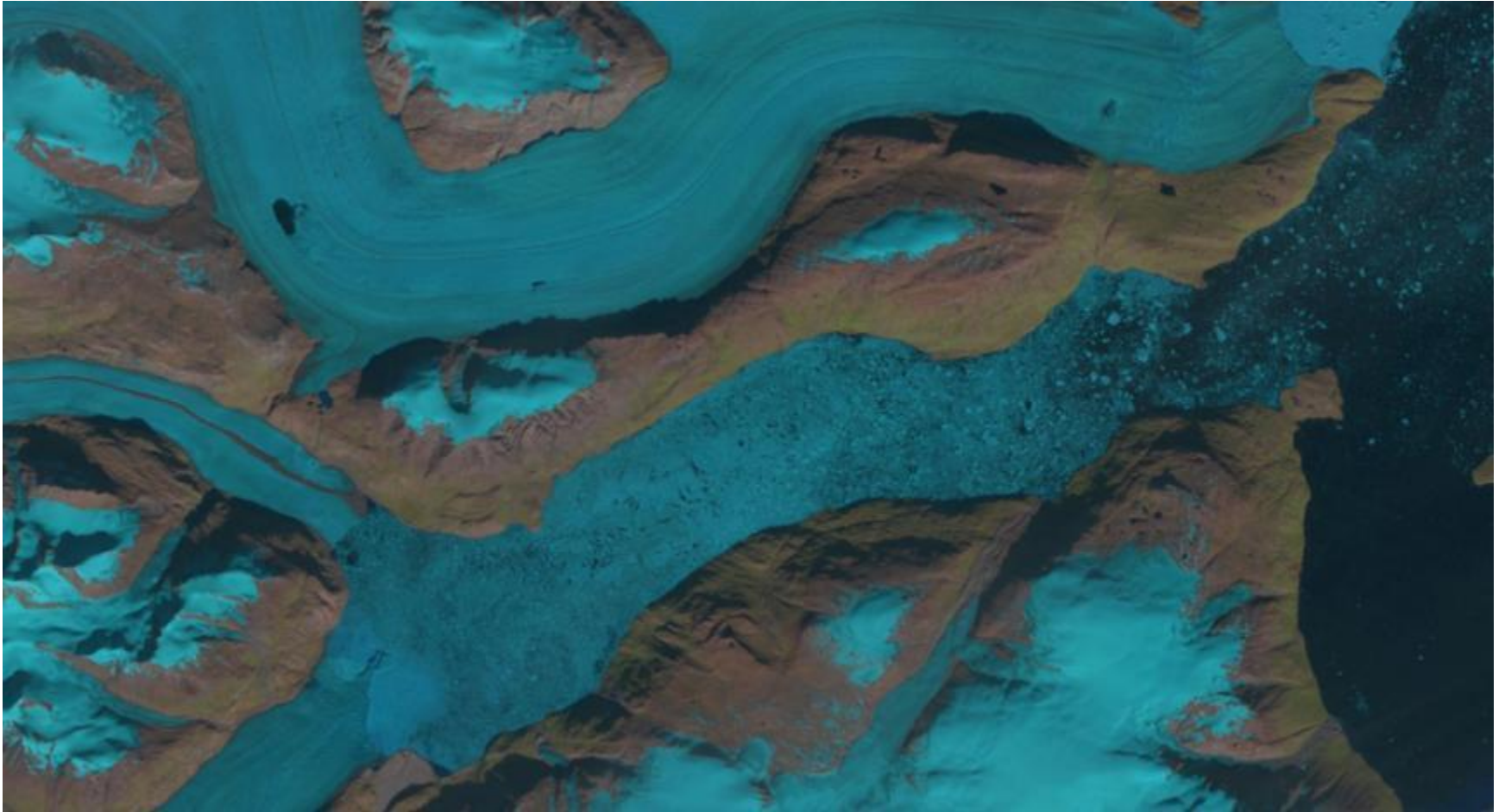
## Site C dam and Fort St. John August 2017



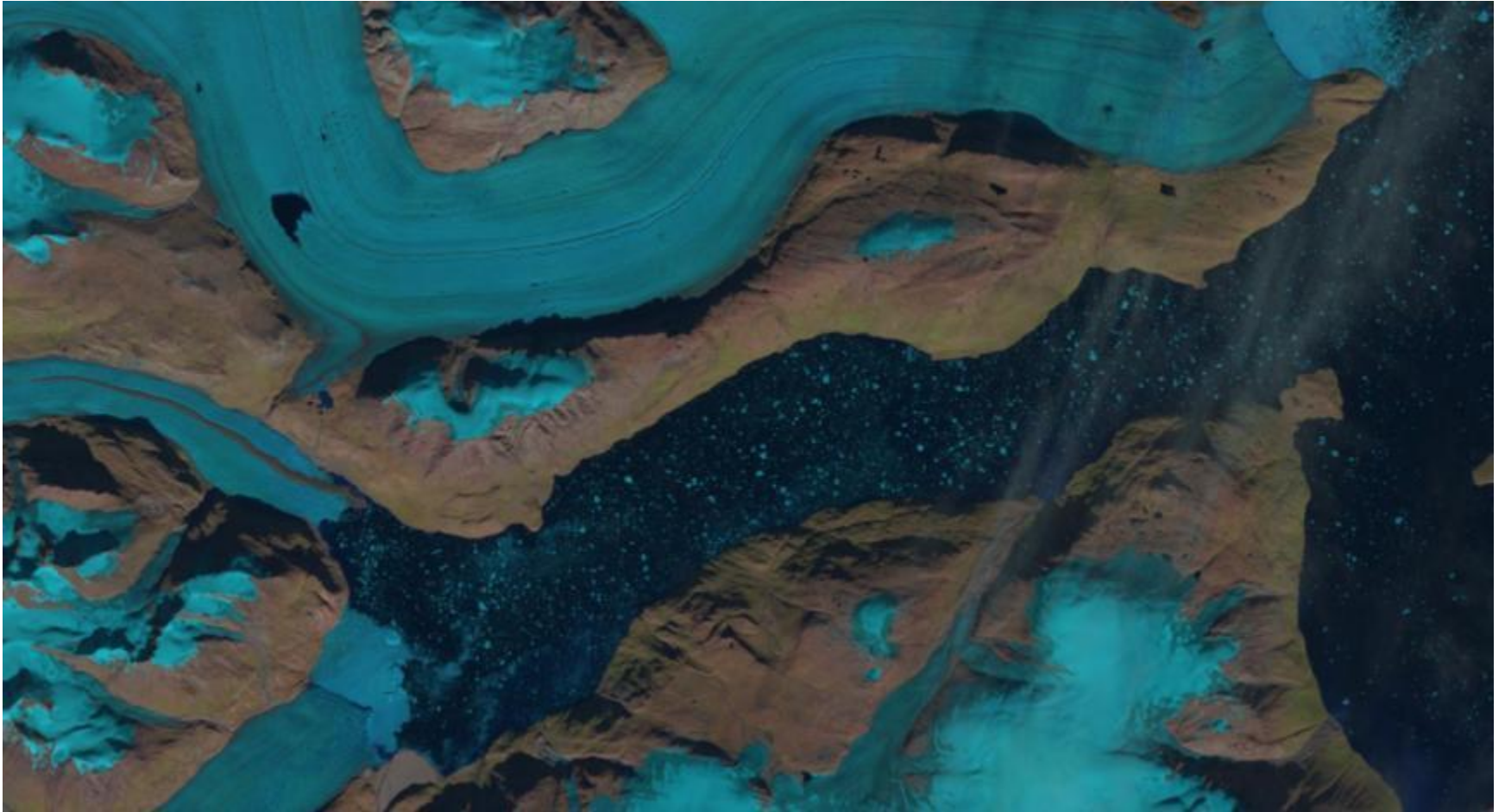
5 km



# Southeast Greenland, Aug 22, 1987



# Southeast Greenland, Aug 23, 2016





# Solar Power plants

## Ivanpah, CA – Primm, NV



35 degrees North, 115 degrees West

September 18, 1989 (LS 5 TM)





September 23, 2014 (LS 8 OLI)



# **Environmental change assignment (10%)**

## **Summary of deliverables**

powerpoint slides (best to avoid using backgrounds)

1. Intro slide: general location, describe the event / change  
– could include a ground photo (or bing / google map)

2. Before image with date/year

3. After image with date/year

Include a scale bar and location - name or lat/long (degrees/minutes)

x. Possible extra image as needed

Some themes: forest cover, glaciers, urban development, volcanic eruptions etc..