Visualisation of changes in alpine glaciers in western Canada

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Mt. Sir MacDonald and Illecillewaet Glacier, 1902 (~end of Little Ice Age (LIA)

Illecillewaet Glacier, Glacier National Park


2011
1931
1907
1906
1896
1887
End of
Trail Marker
Sir Donald / Perley
Rock Trail
Great Glacier Trail


100 HELVETIA
1850–2008 +1.5°
THOMAS KISSLING
2009

Thompson Glacier, Axel Heiberg Island, 1965

Glaciers viewed as constant in 1960s-70s

1981 Columbia Icefield

elevation data are not updated: roads, glaciers from 1980; contours from 1960

WC²N
WESTERN CANADIAN
CRYOSPHERIC NETWORK

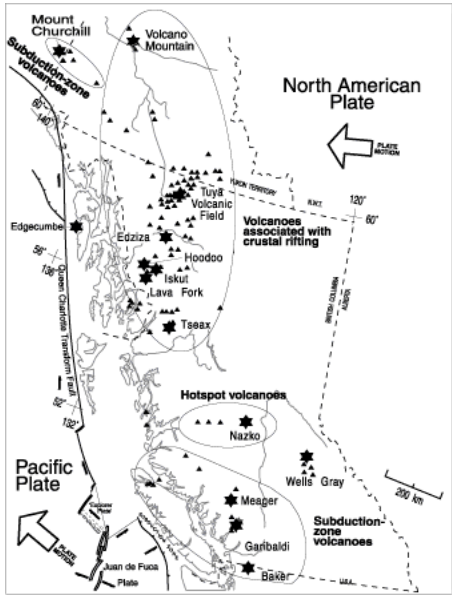
GLOBGLACIER

Western Canada
(BC / Alberta)

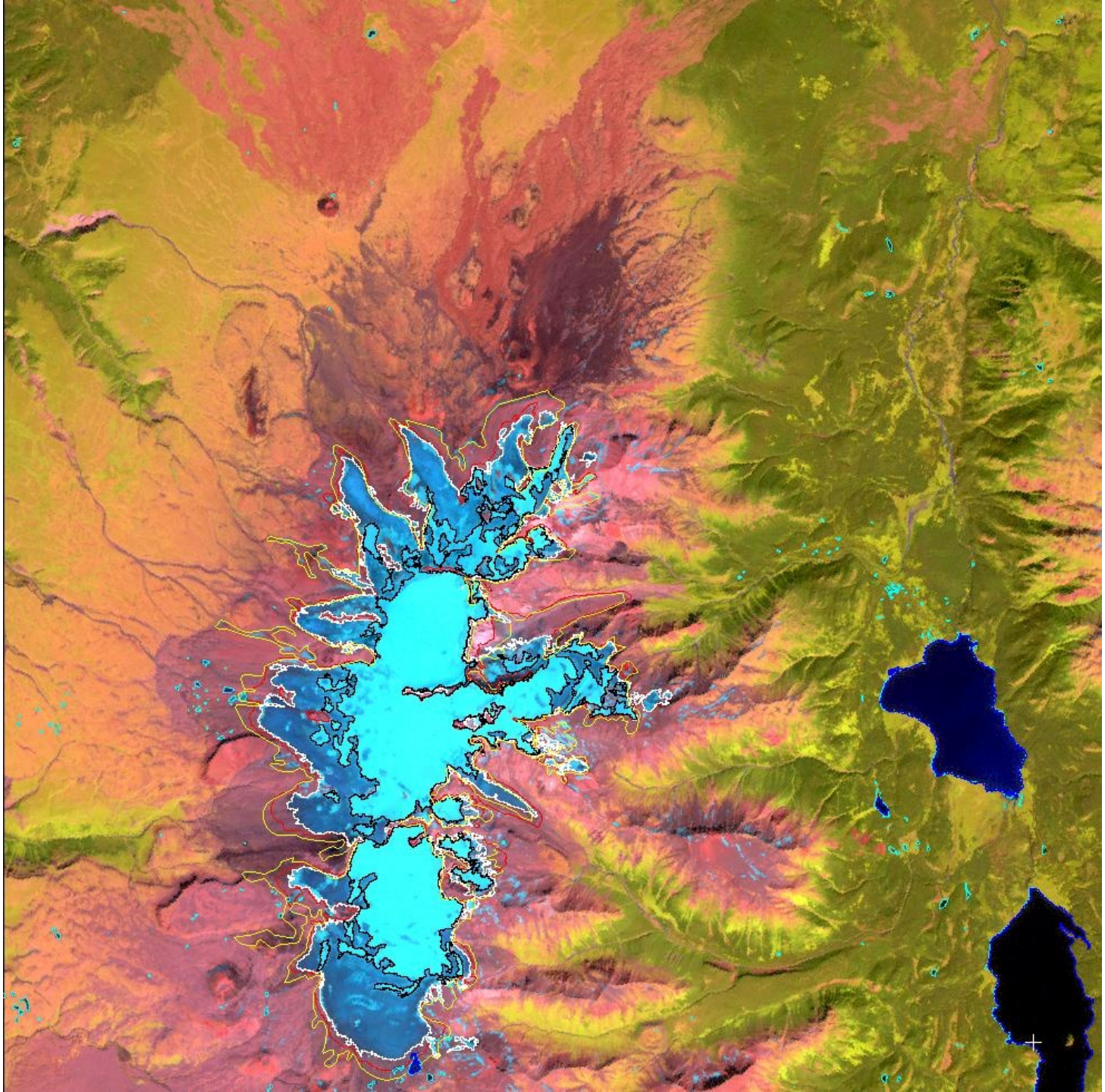
~15,000 glaciers

BC ~25,000 km²

Alberta: 1,000 km²



GLIMS: Global Land Ice Measurements from Space
Using the World's Glaciers to Monitor Climate Change



Mt. Edziza

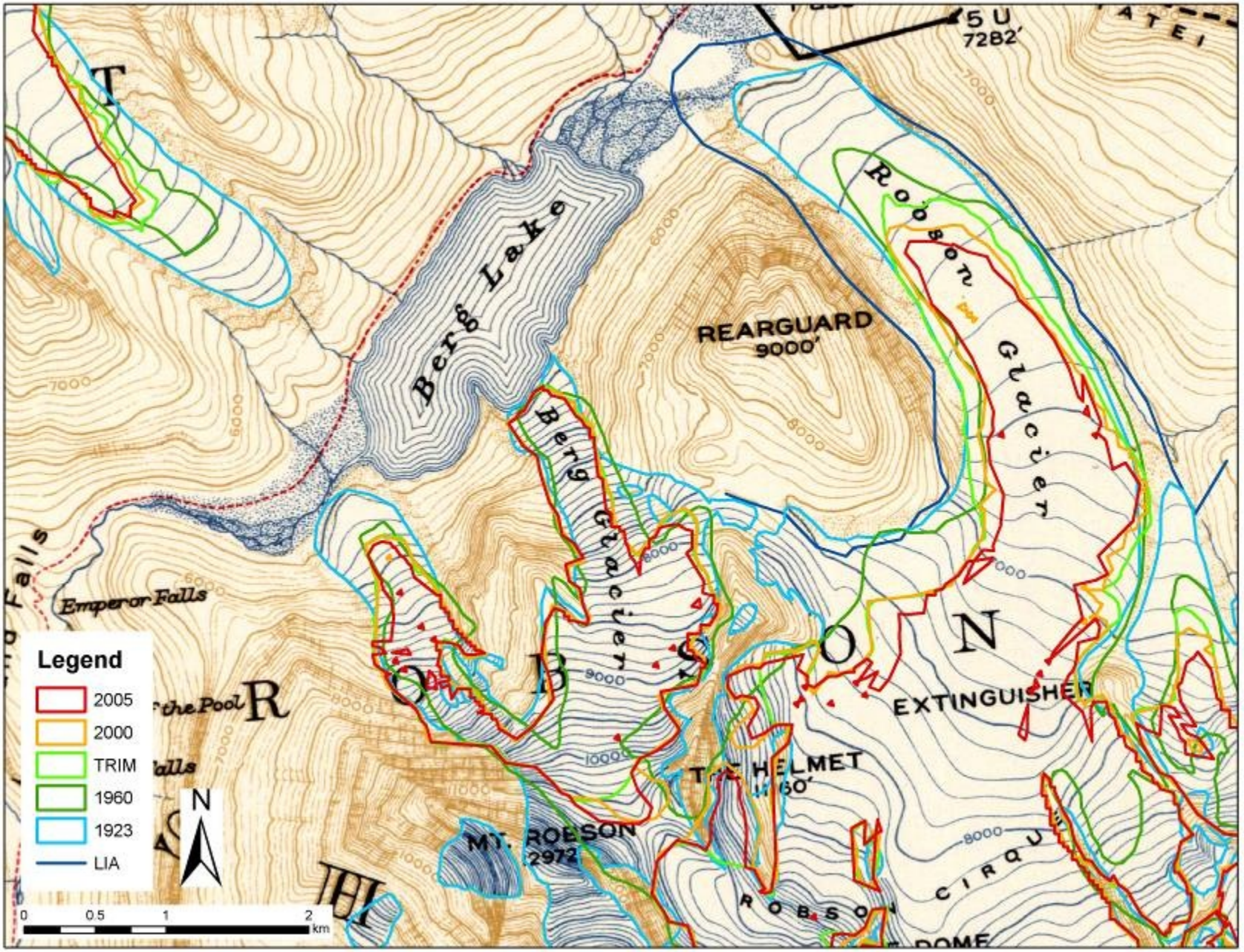
1965 yellow
1982 red
(from air photo mapping)

2005 white
(Landsat)

accumulation area - black

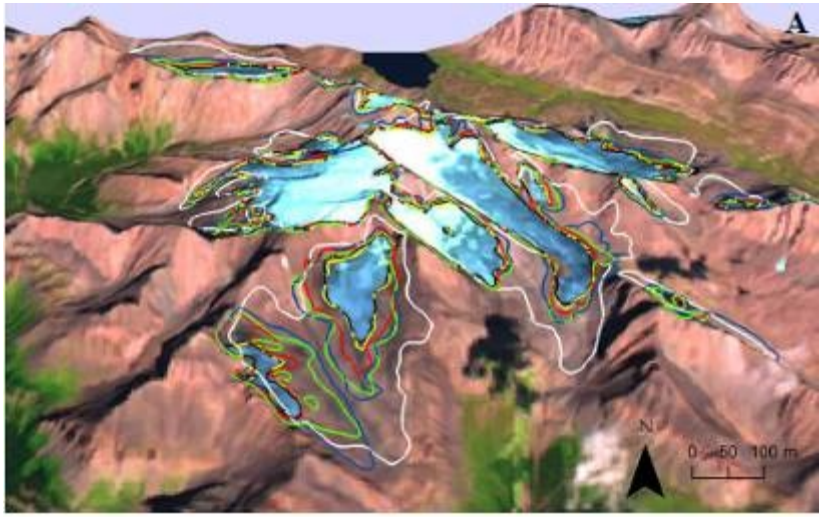
Robson Glacier

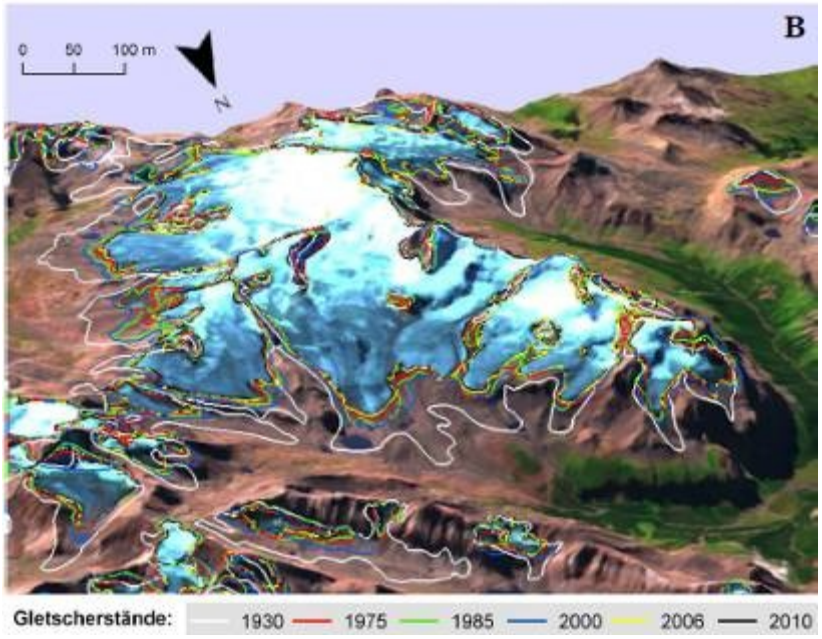
1923 British Columbia-Alberta boundary commission map

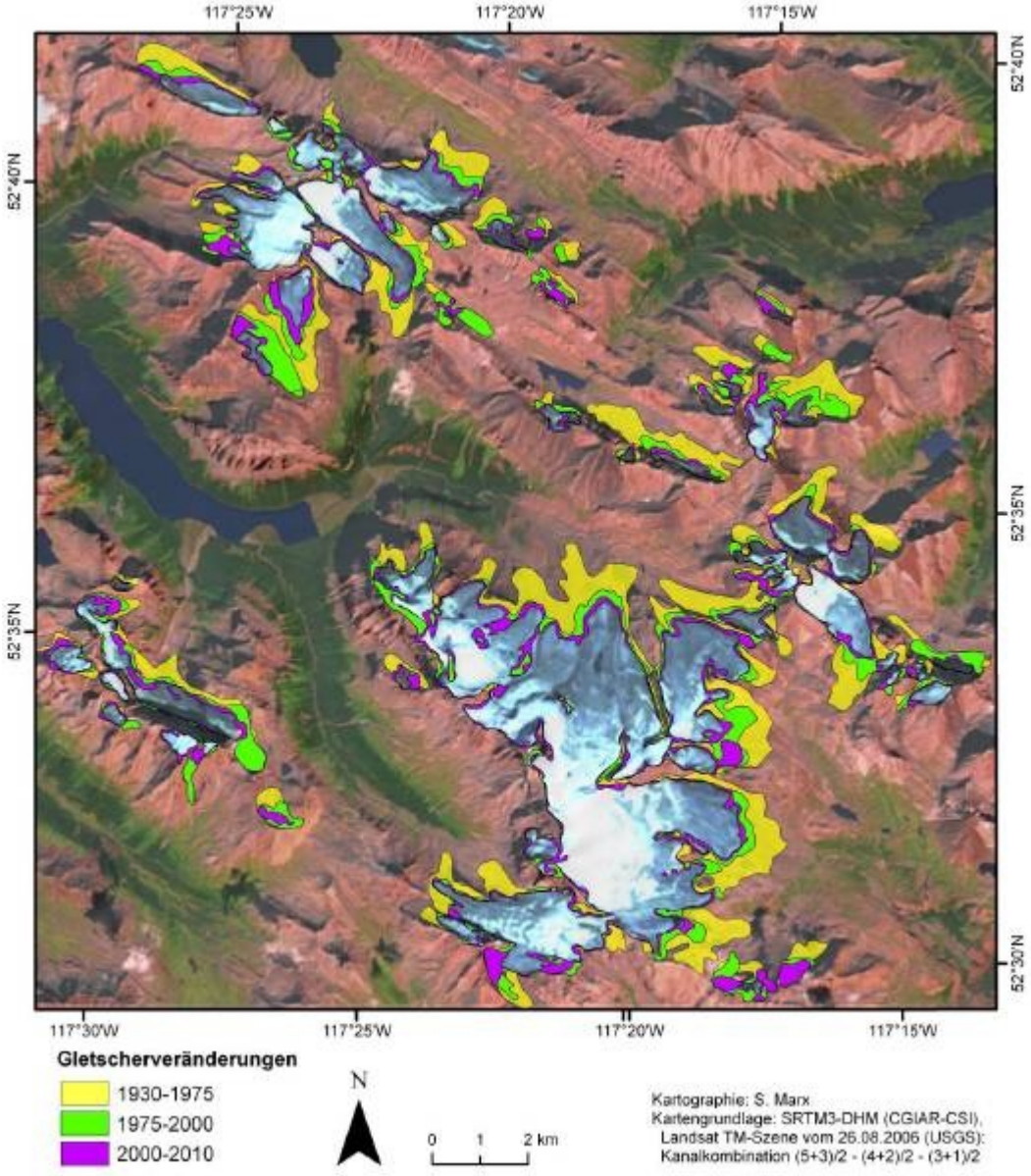


Cambrian Icefield, Coast Mountains

Maligne Lake glaciers, Jasper NP



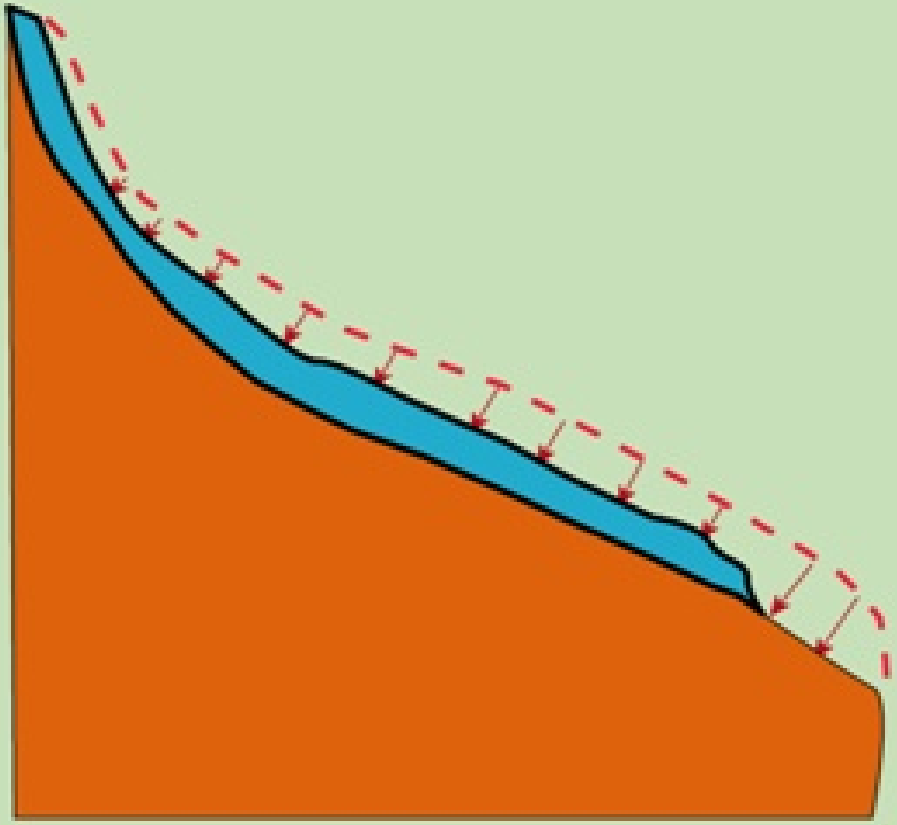




Maligne Lake area 1930-2010: total loss of 33.07 km^2 (from 79.5 km^2) or - 0.52% per year.
Between 2000 and 2010, the rate increased to 2.23% per year

Thinning

Changes in Glacier Thickness

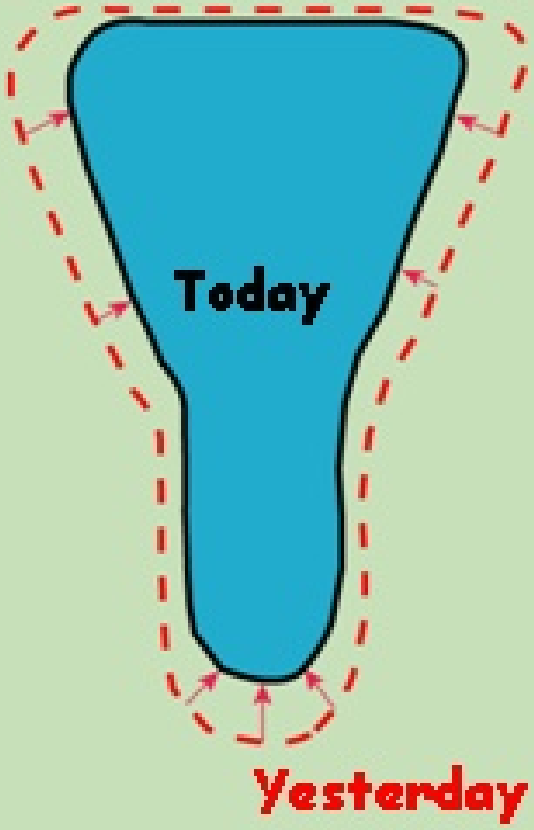


Sources: map contours, stereo photography, spaceborne DEMs: e.g. SRTM, ASTER GDEM

Current changes ~ -5m/year

Retreat

Changes in Glacier Area

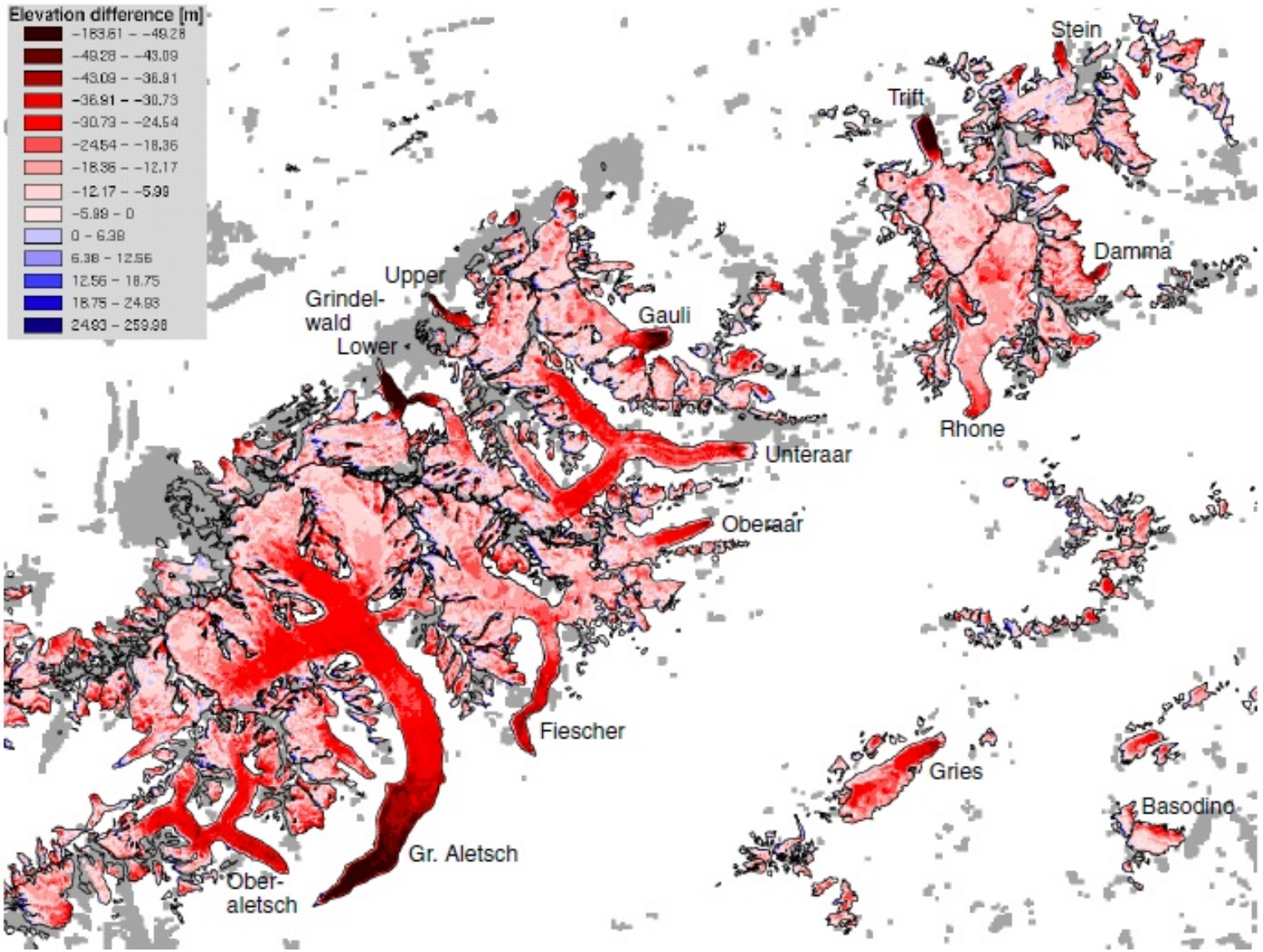


Sources:
maps, air photos, satellite images

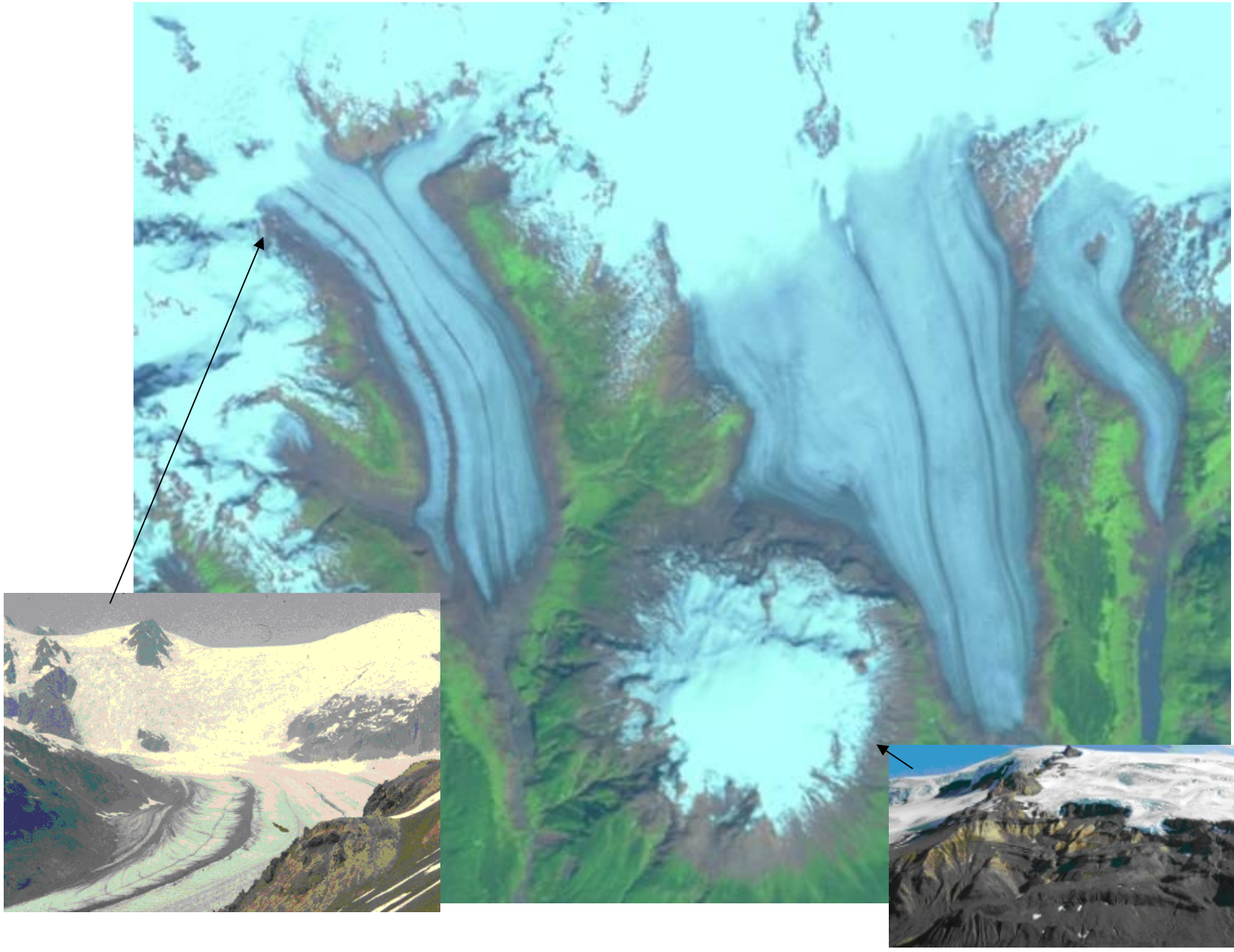
Current changes ~ -20m/year

Techniques for showing elevation change

(DEM subtraction: Haeberli and Paul, 2009)

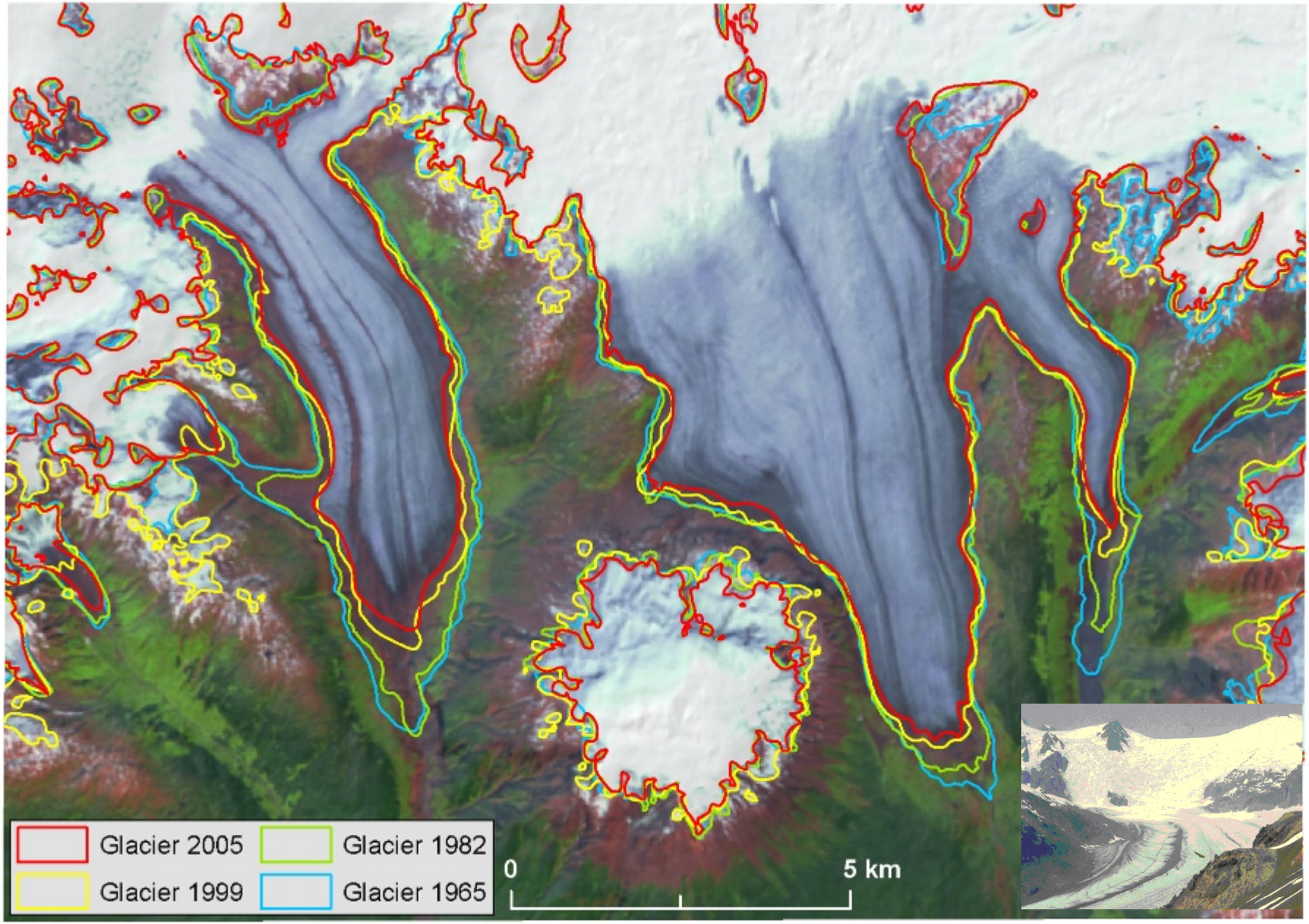


Hoodoo Mountain area: Landsat TM 2010

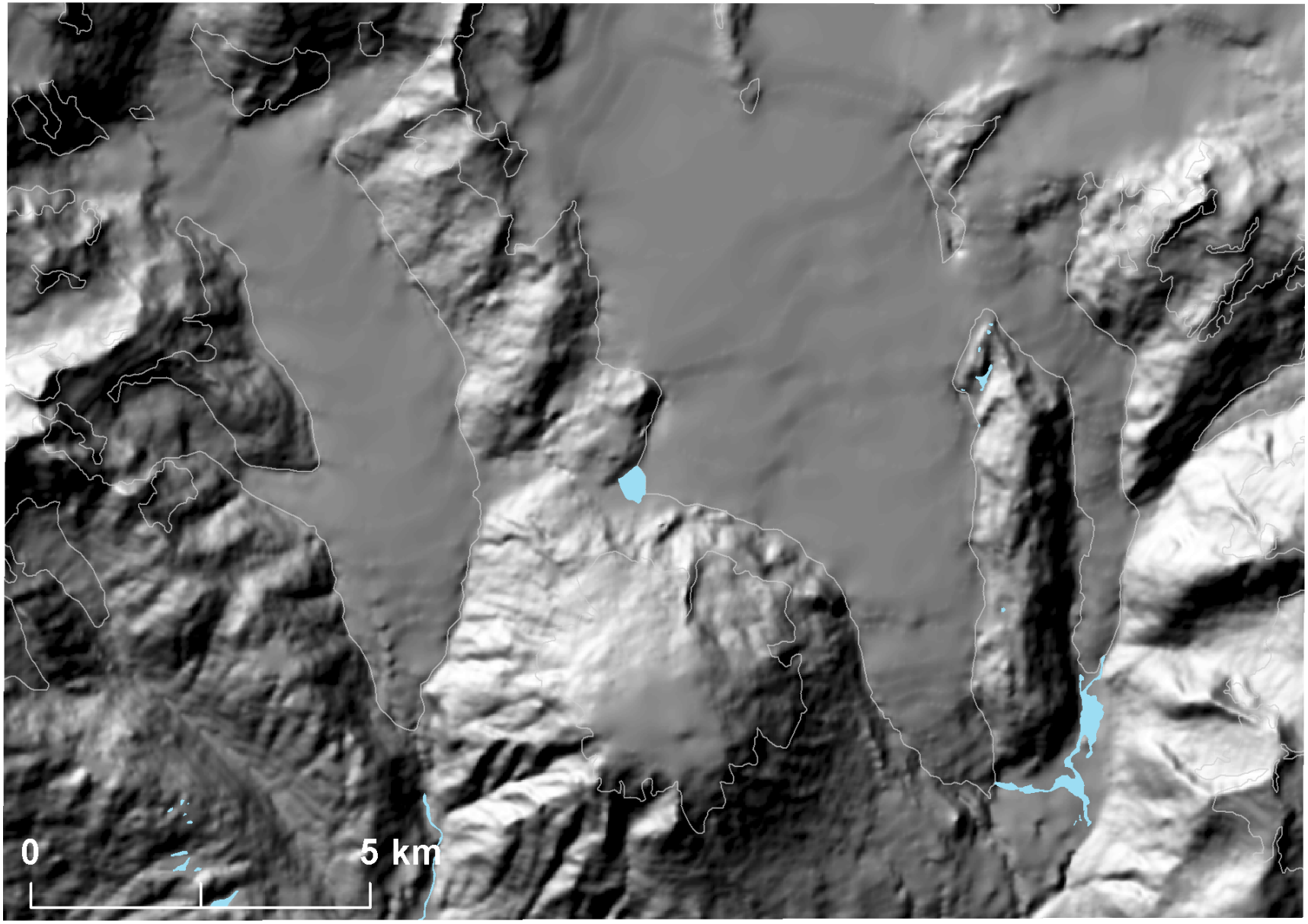


Hoodoo Glacier: extents 1965 to 2005 (overlain on Landsat TM 2010)

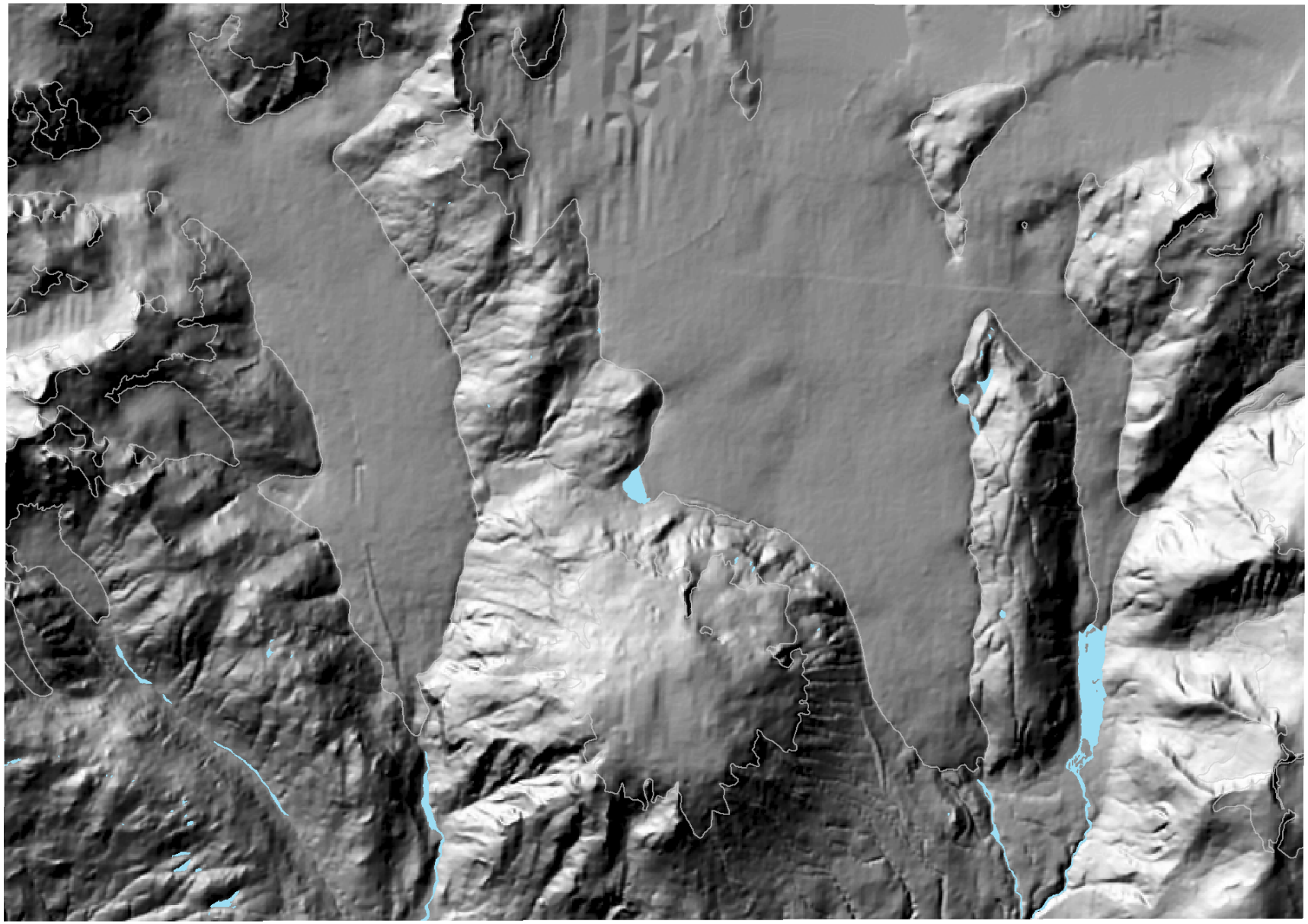
1965, 1982 from aerial photos, 1999 and 2005 from Landsat



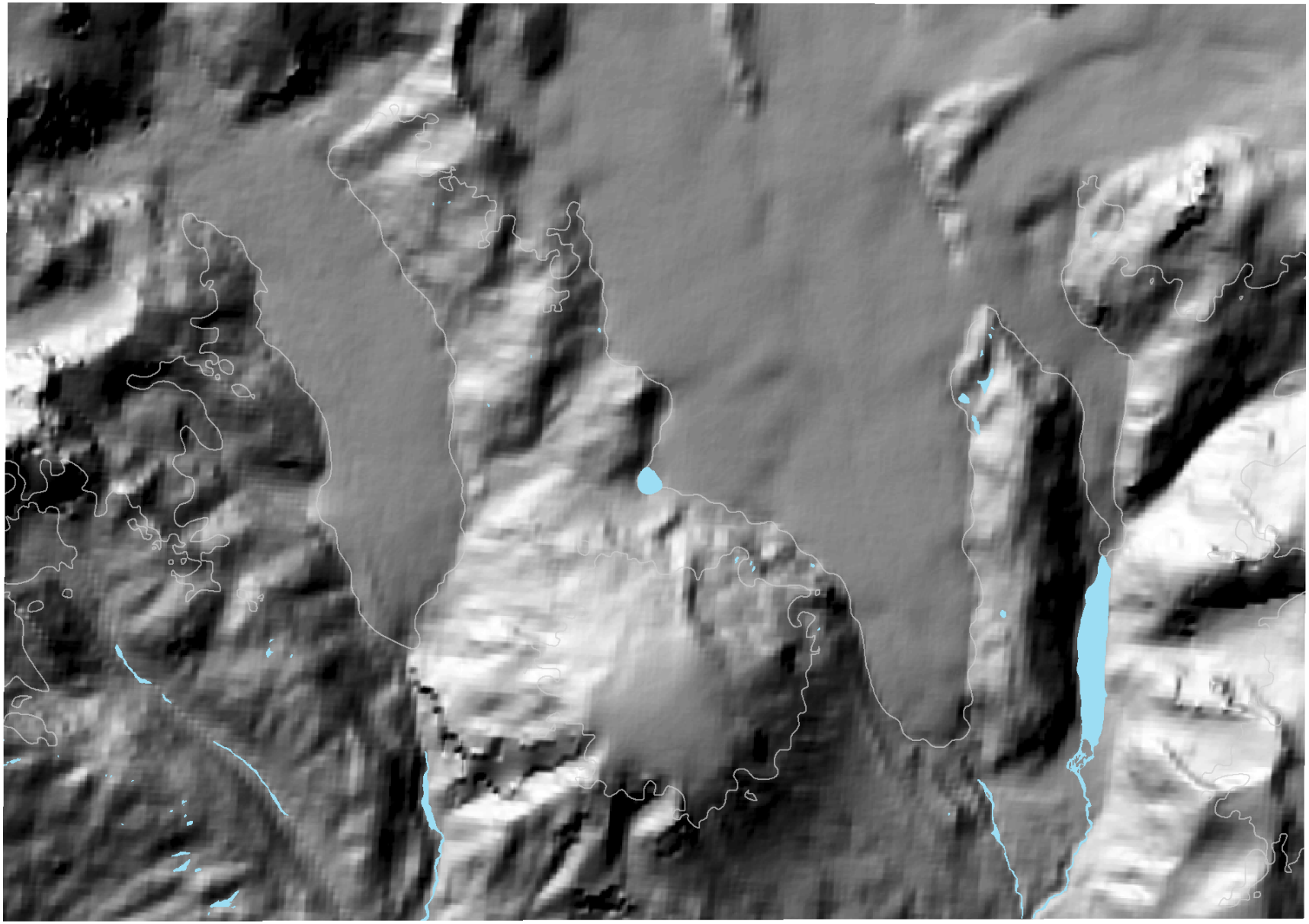
NTDB 1965: DEM from contours; *geogratis.ca*



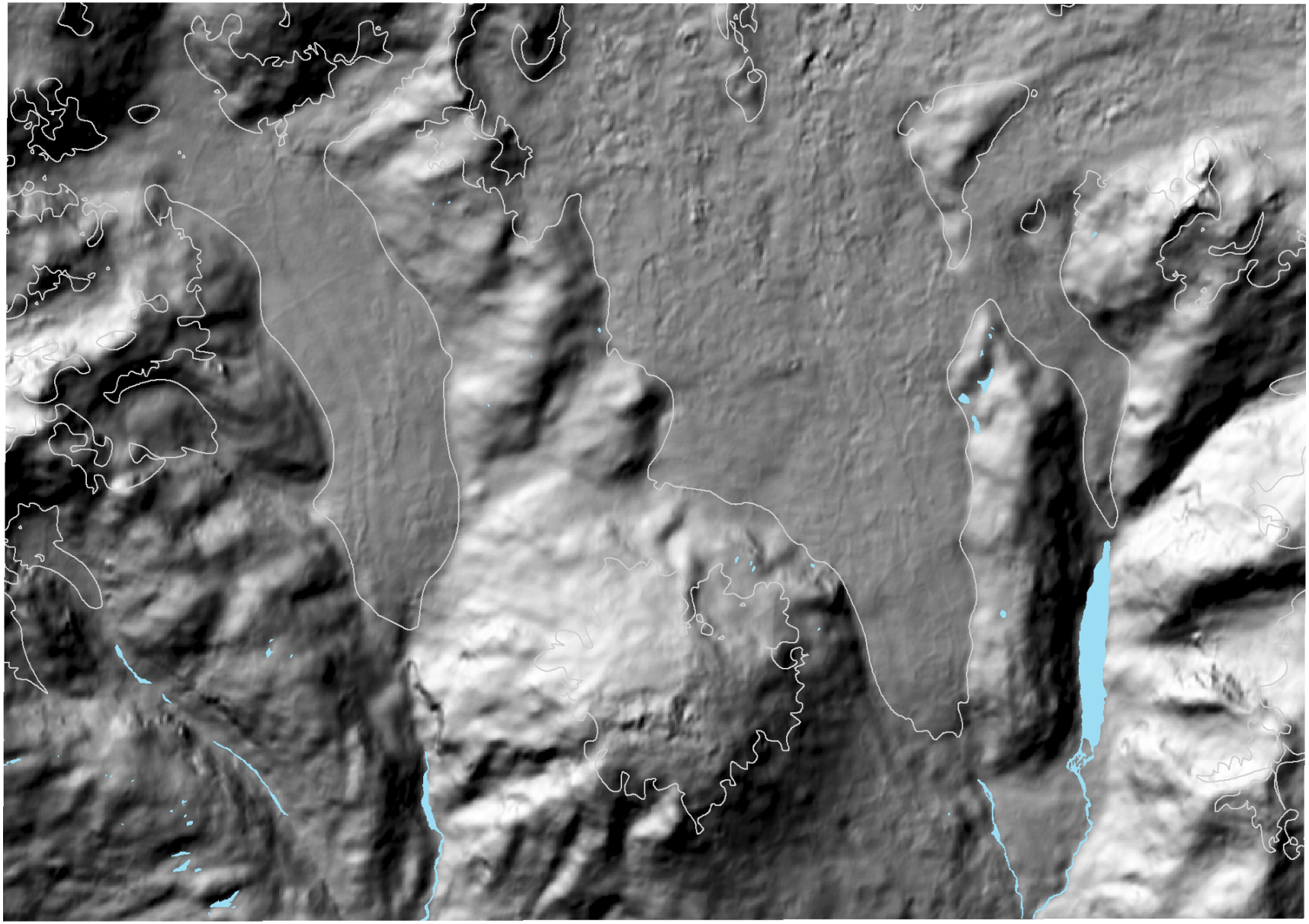
BC 'TRIM' mapping 1982: digital stereophotography; *geobase.ca*



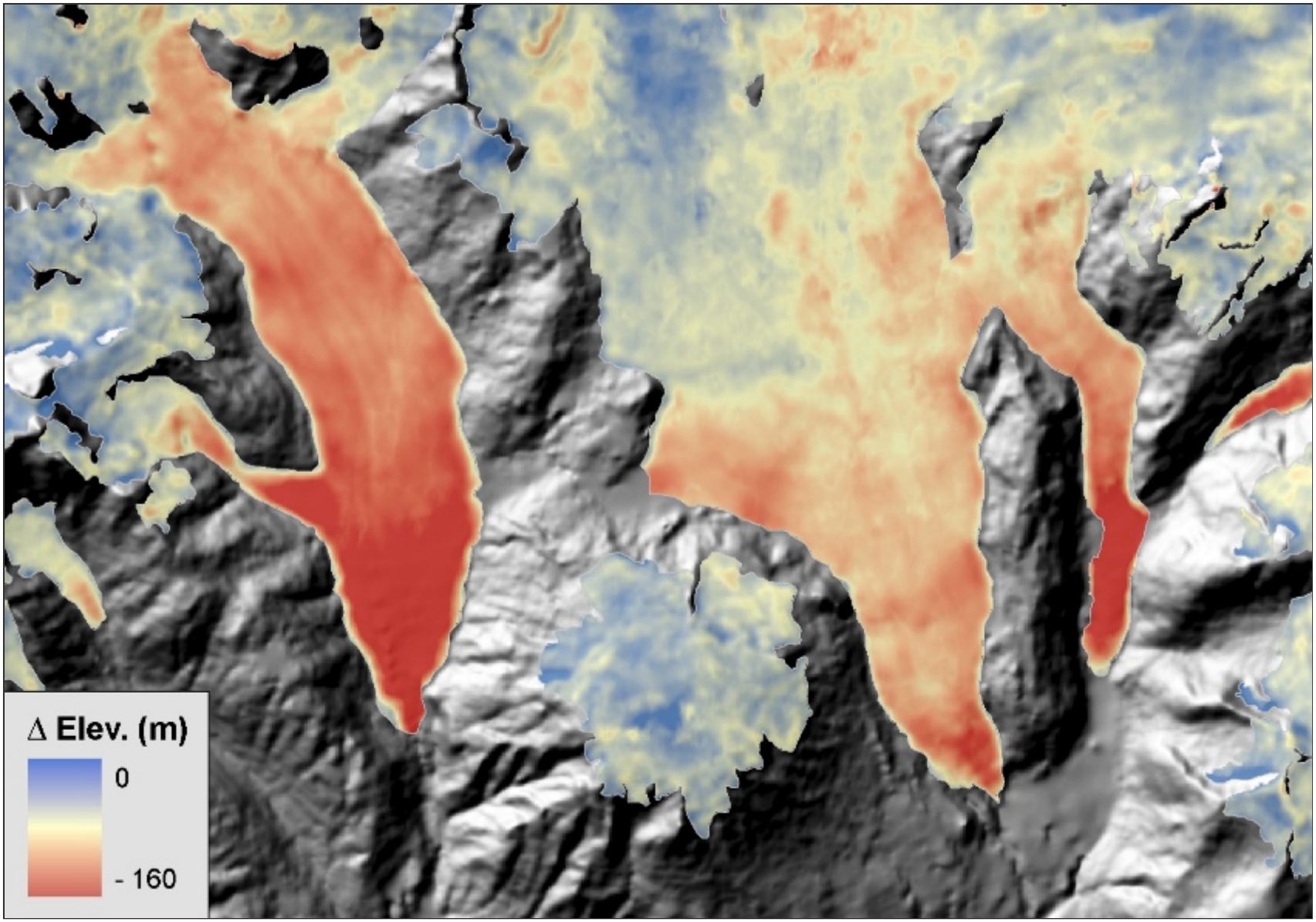
Shuttle Radar Topography Mission (SRTM) 1999 (spaceborne)



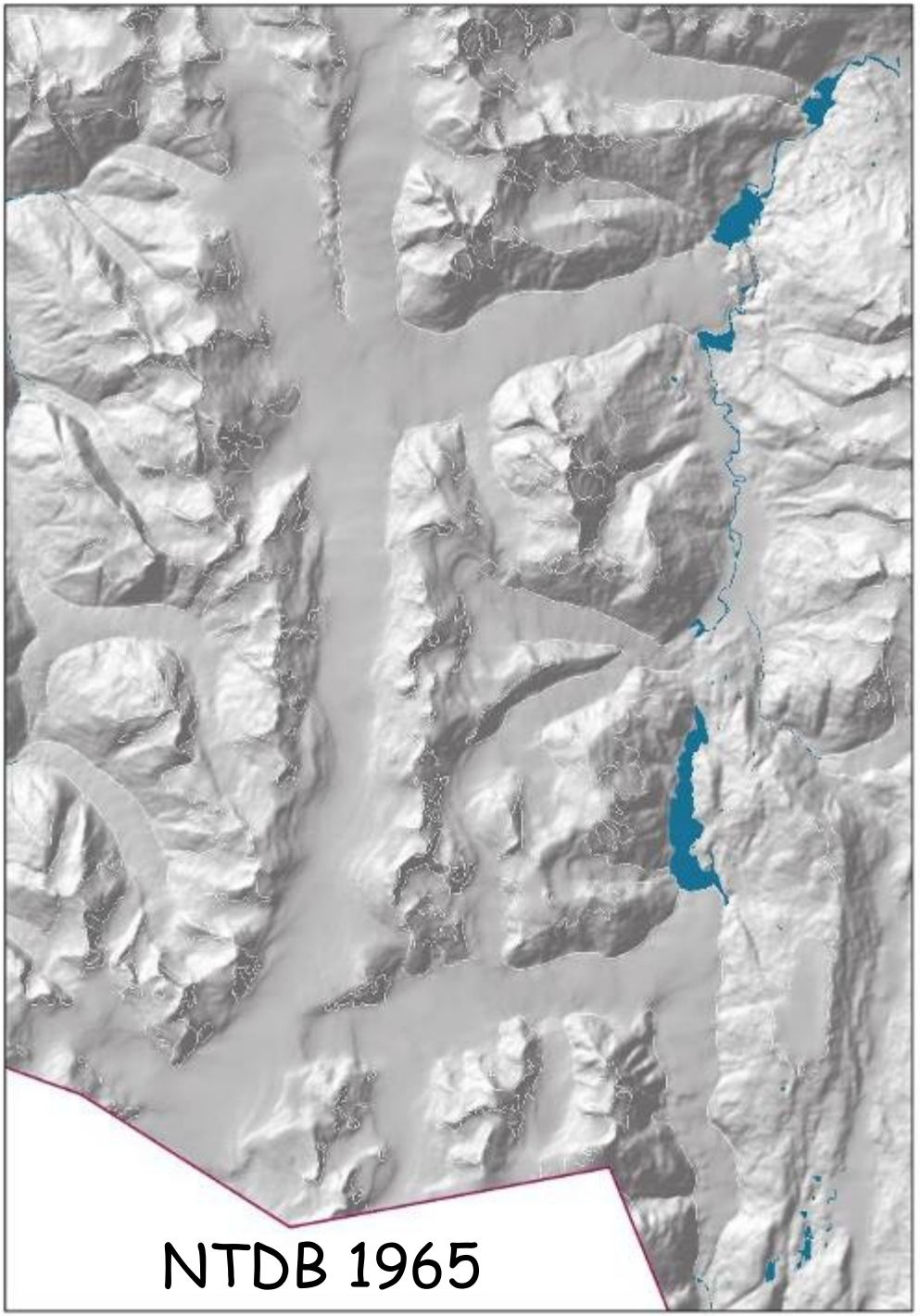
ASTER GDEM 2000 – 2008 (~2004) multiple images



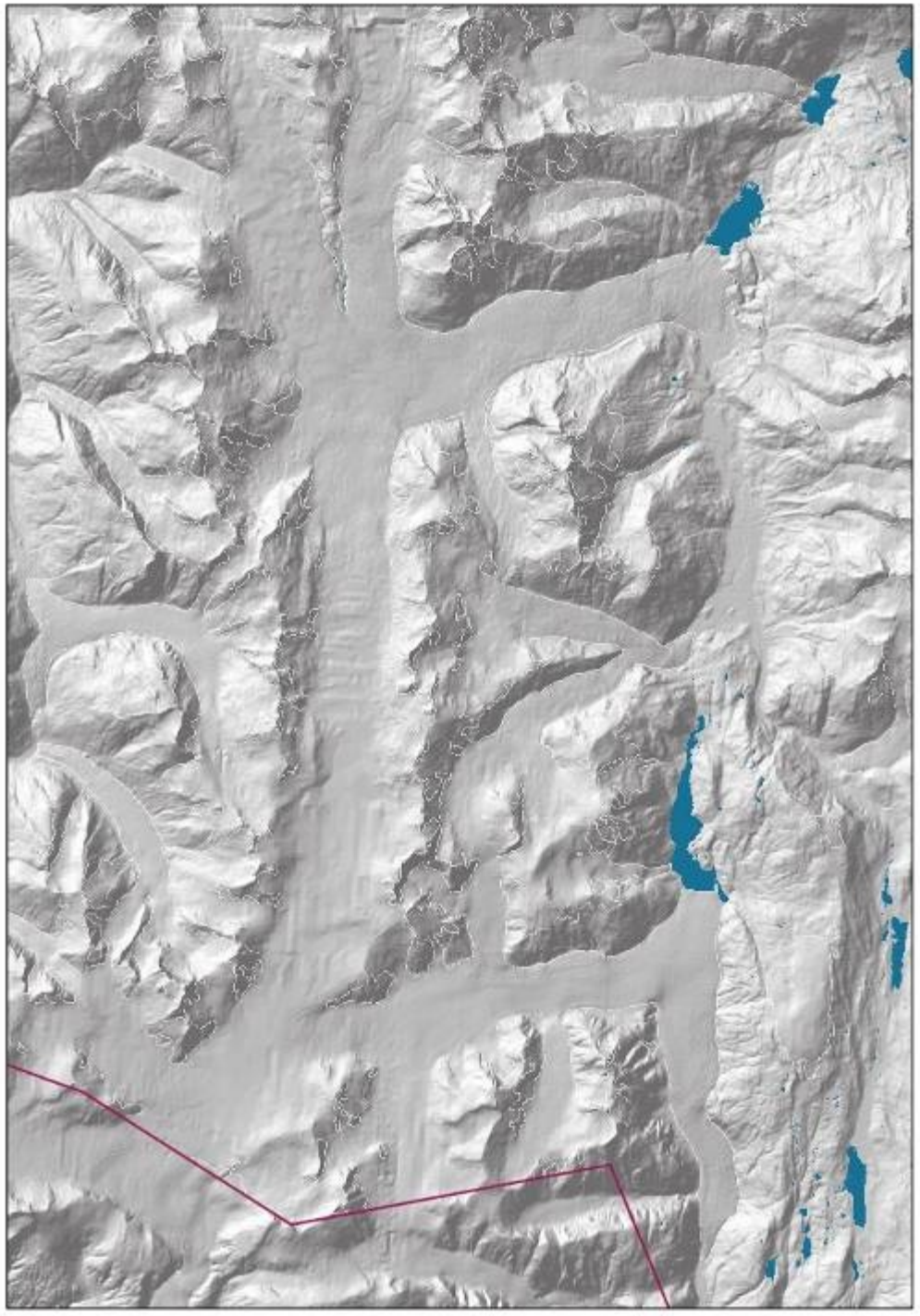
DEM Difference Image: NTDB (1965) – ASTER (2004)



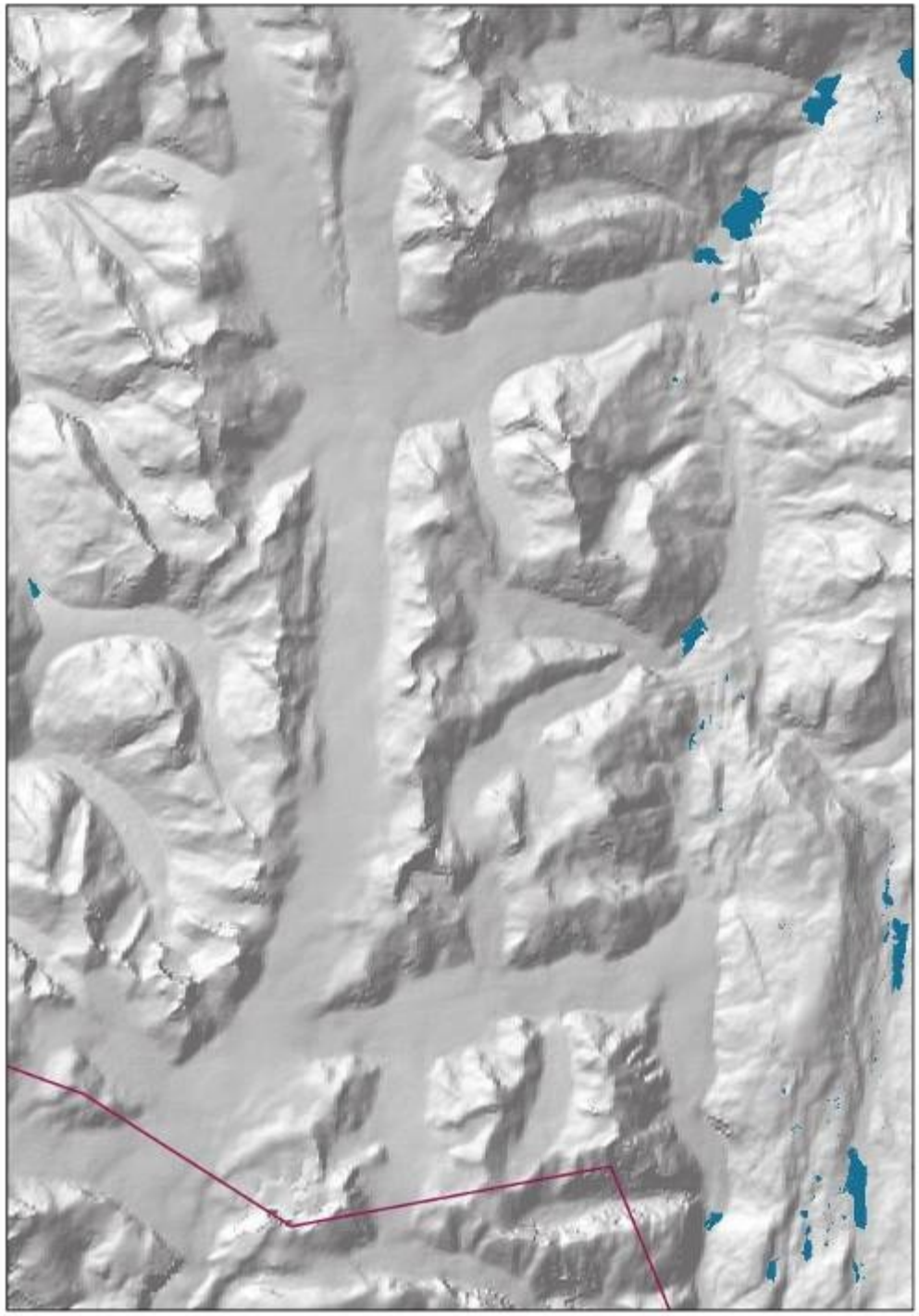

Salmon Glacier area
Alaska / BC


NTDB 1965

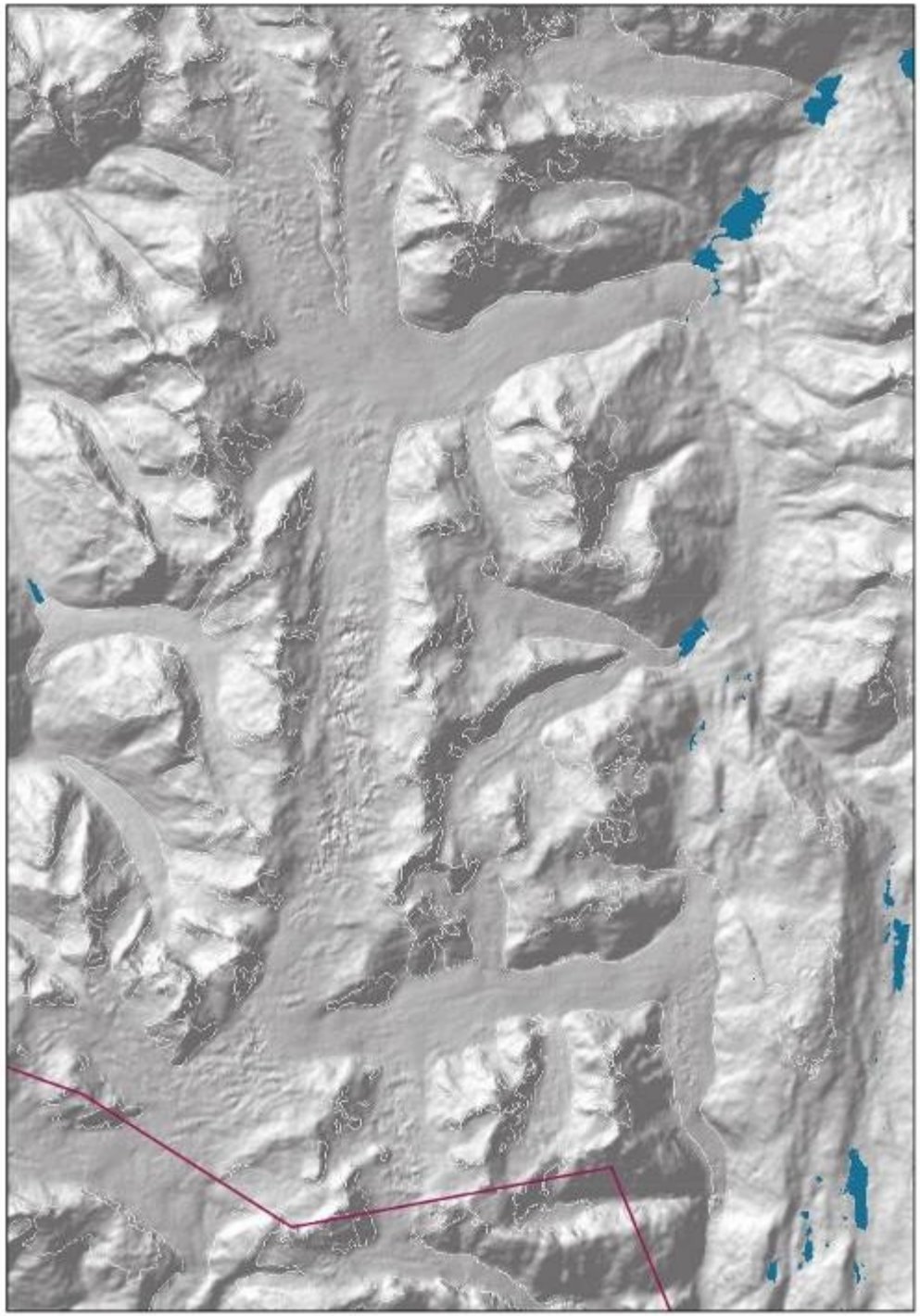
BC TRIM 1985



SRTM 1999

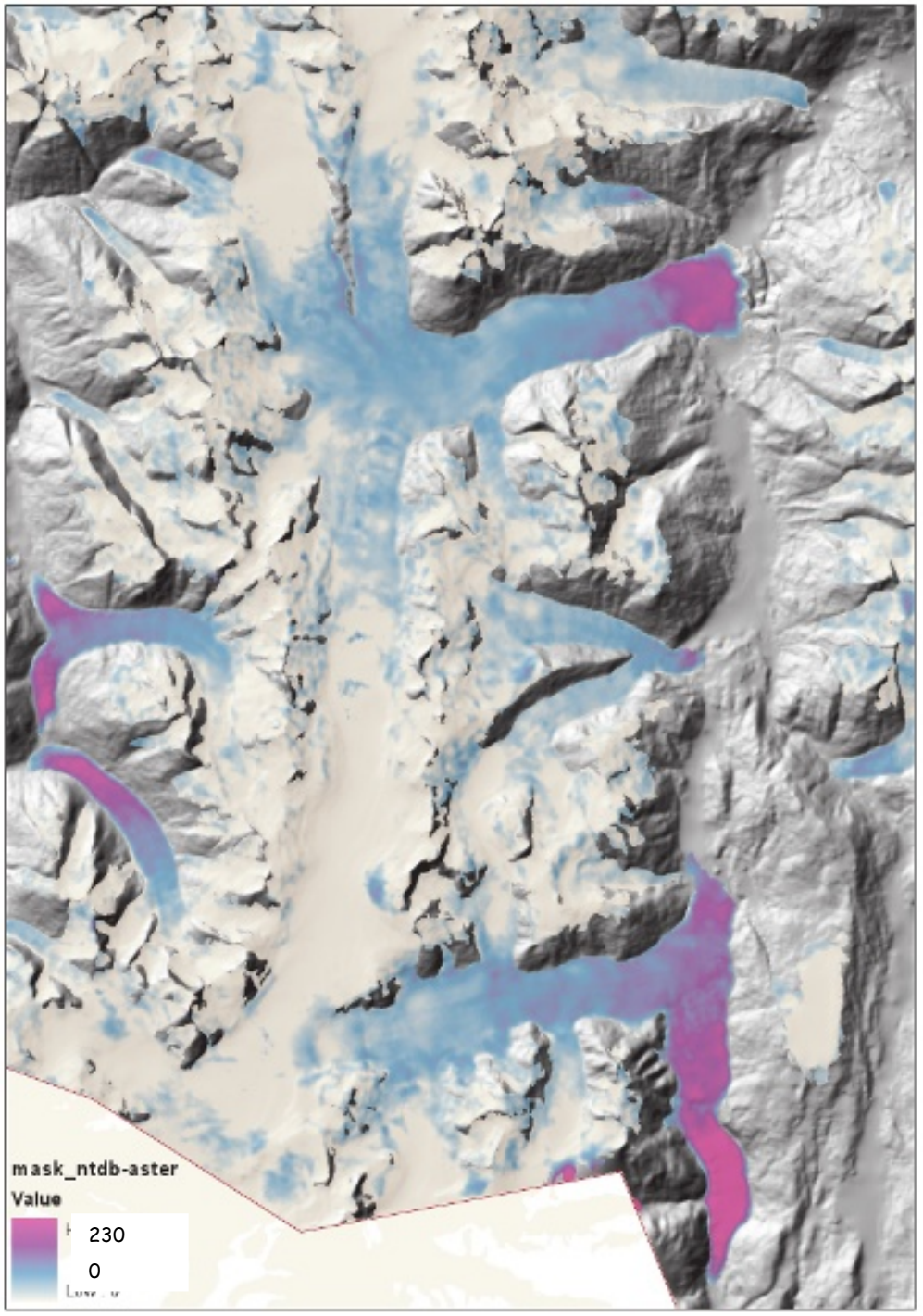


ASTER 2004

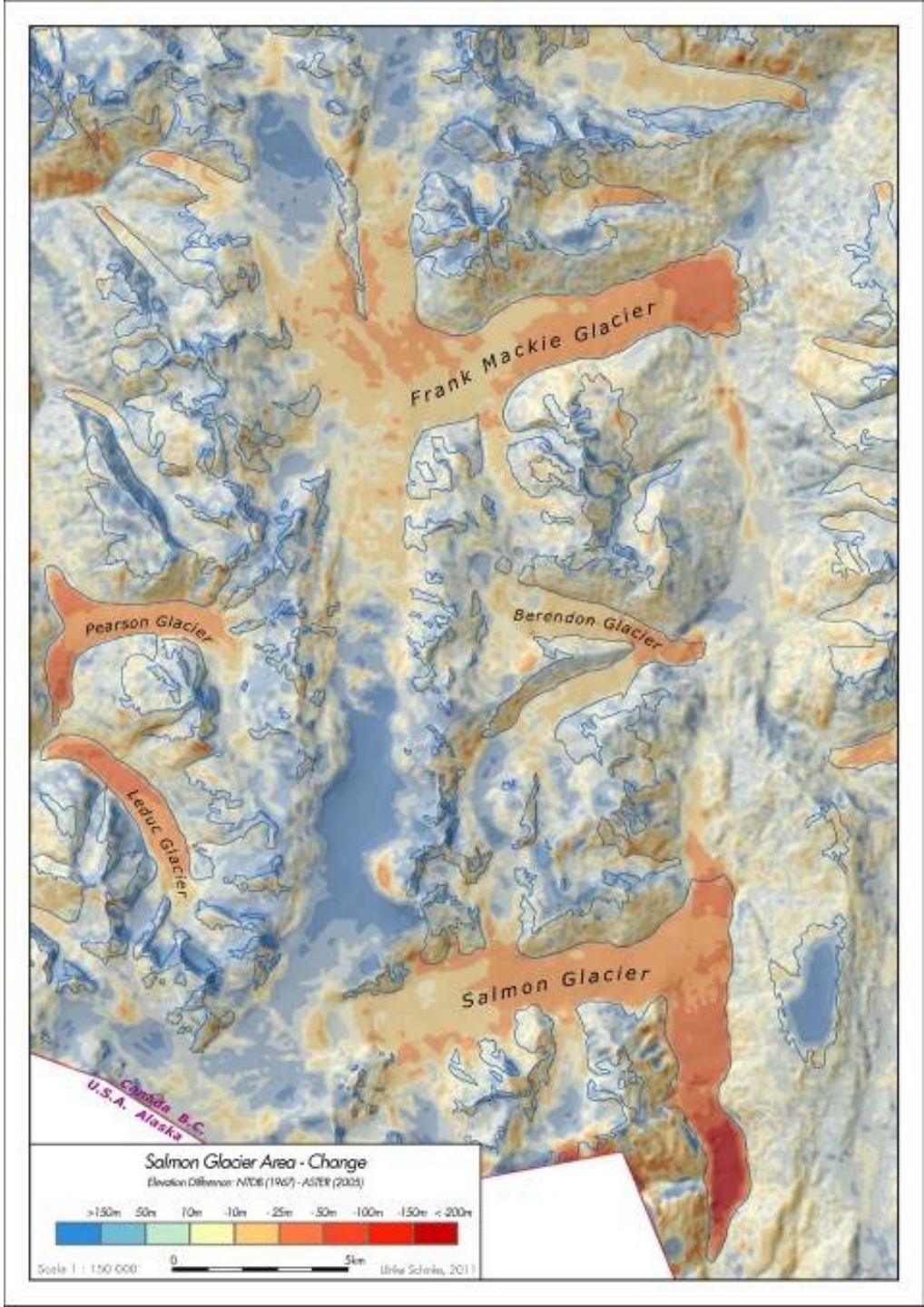


DEM subtraction
NTDB – ASTER

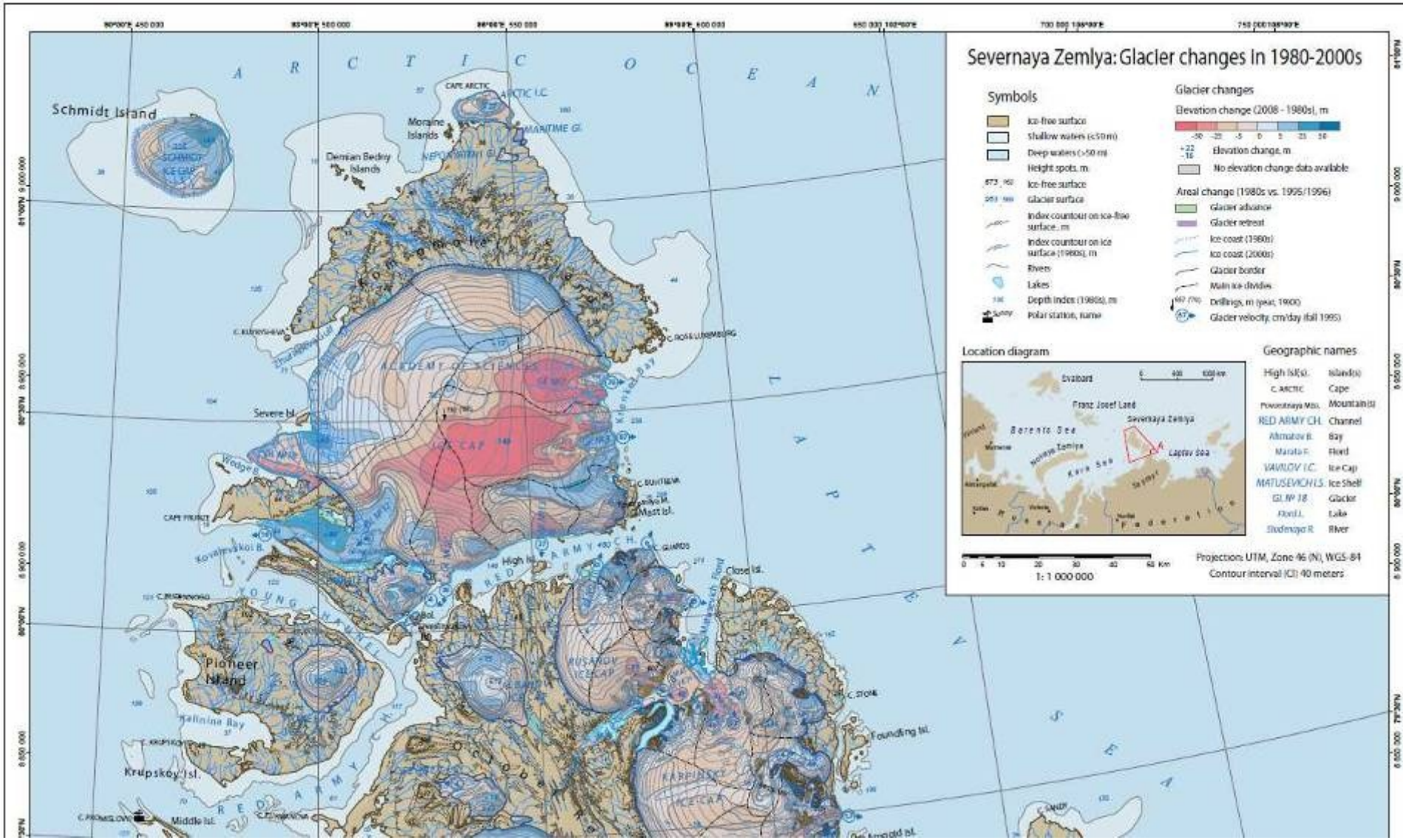
0-230m (unclassed)



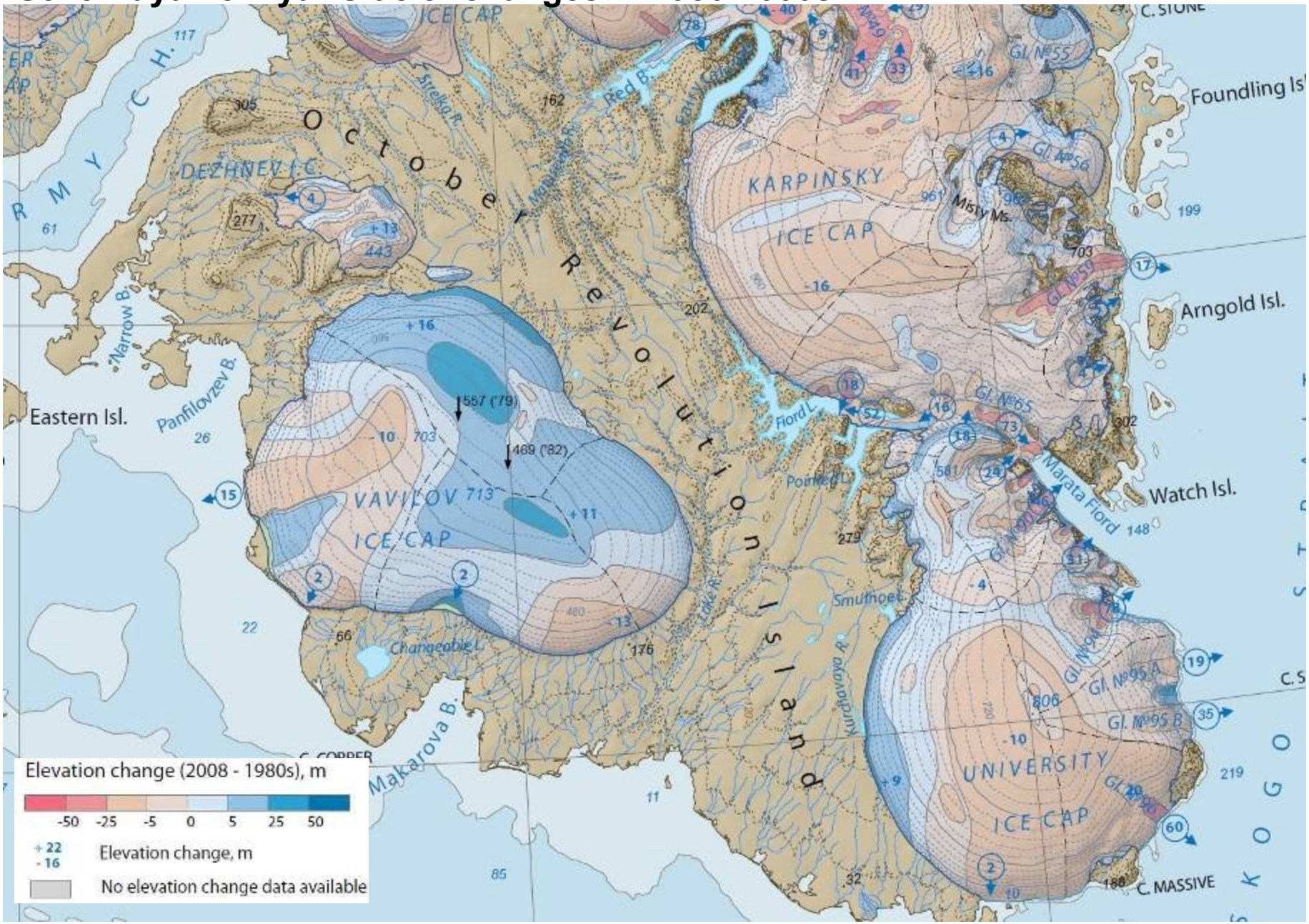
Final map product



Severnaya Zemlya: Glacier changes 1980-2000s *dib.joanneum.at/smaragd*

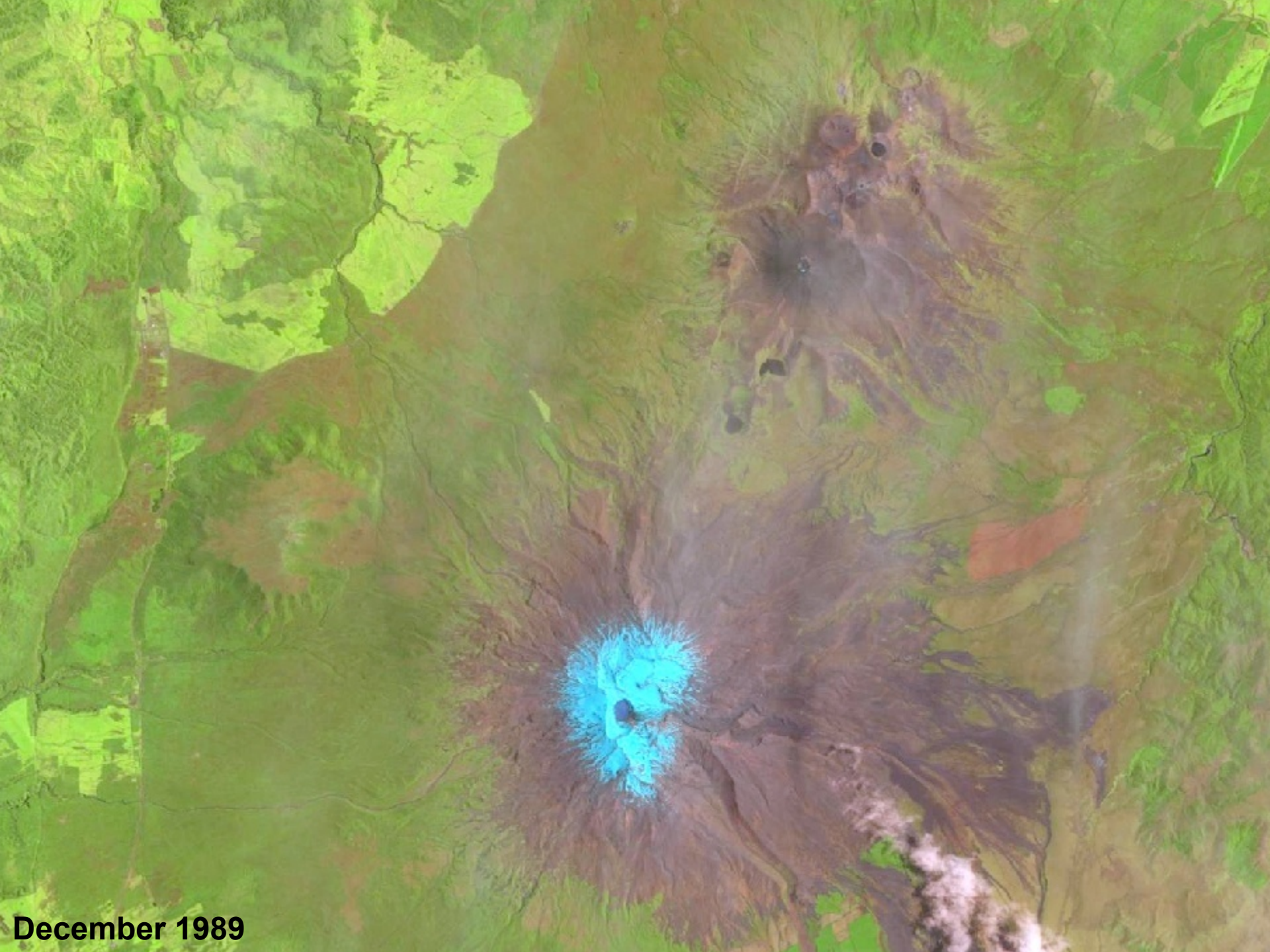


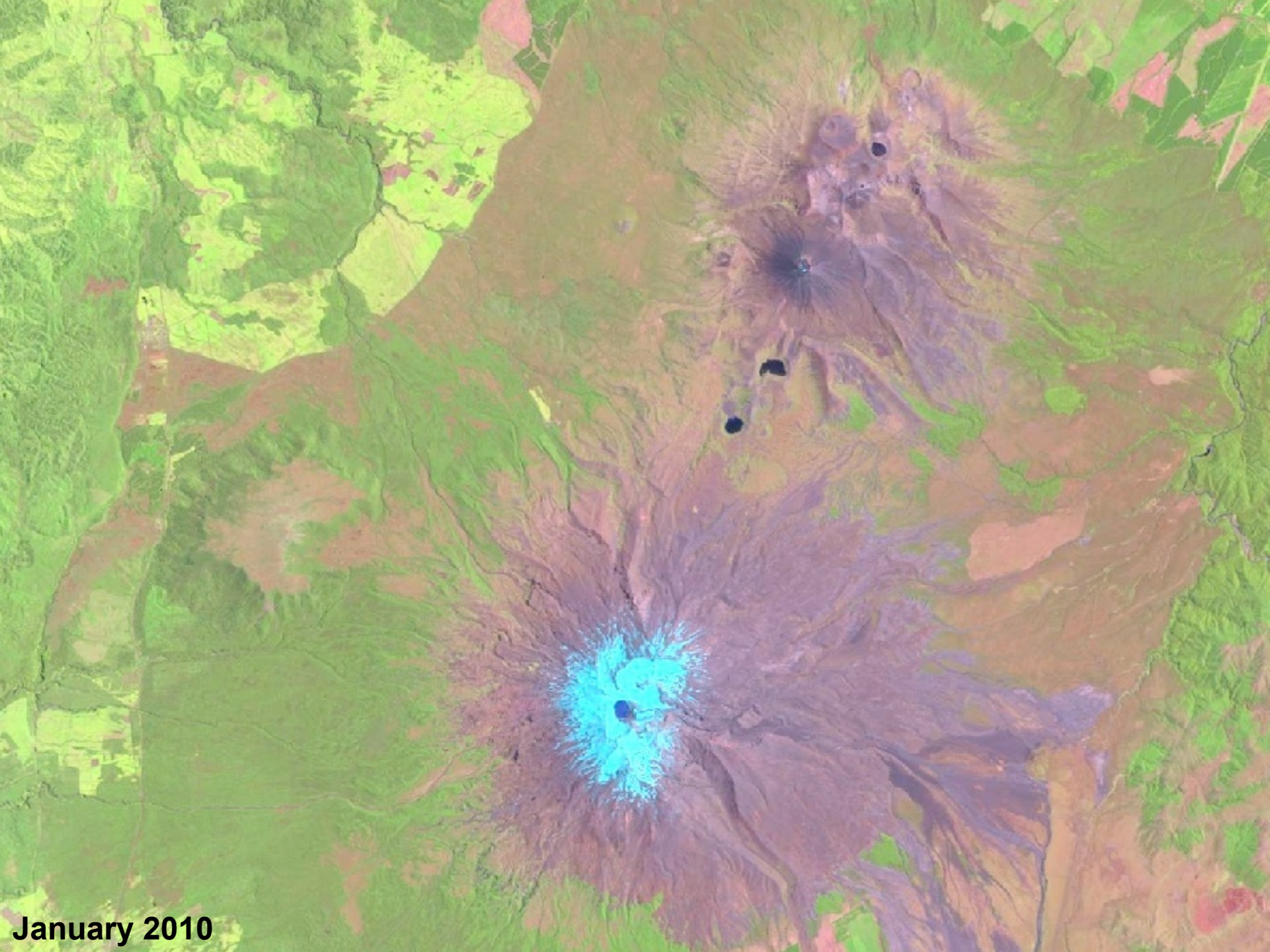
Severnaya Zemlya: Glacier changes in 1980-2000s

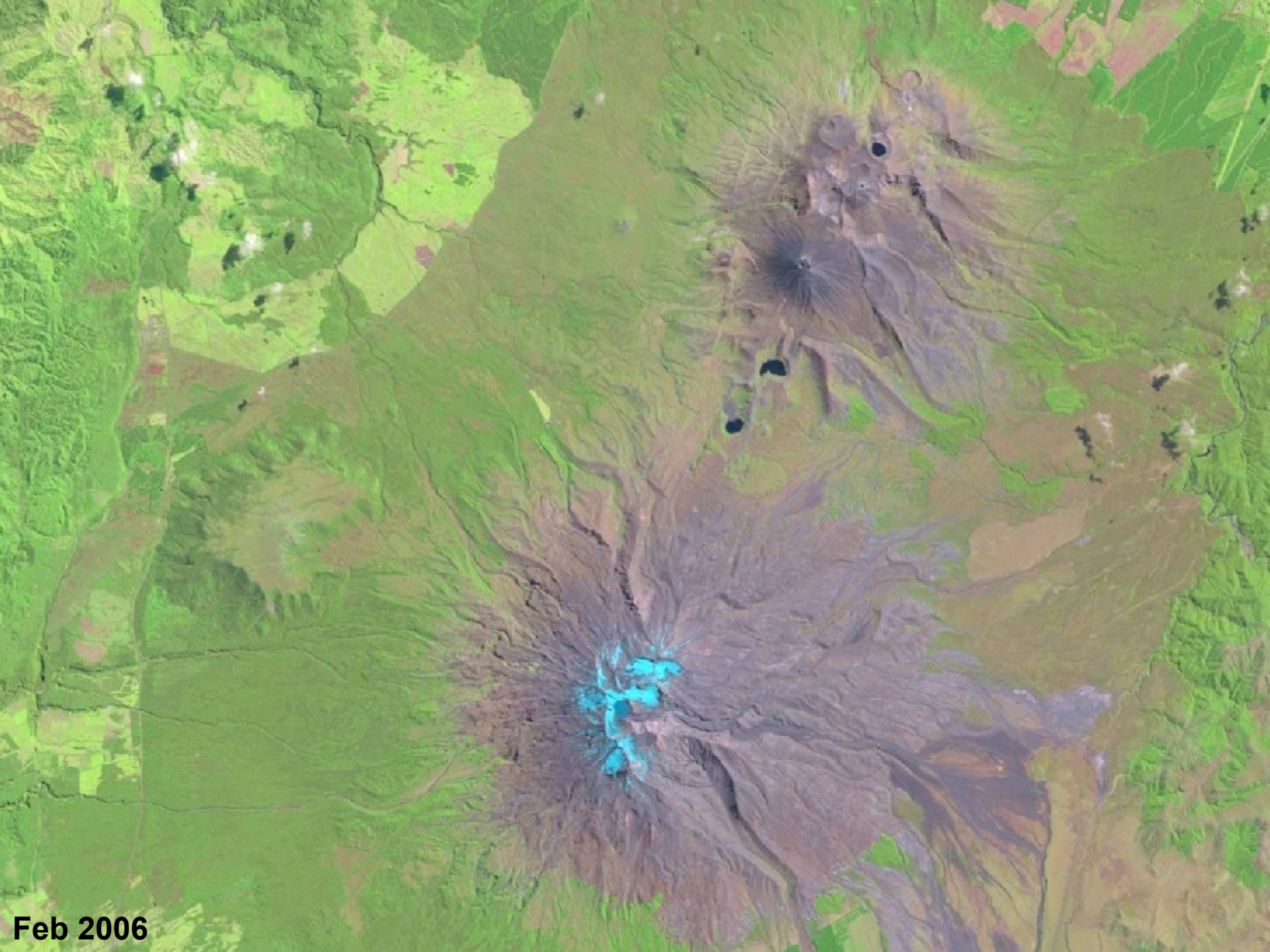


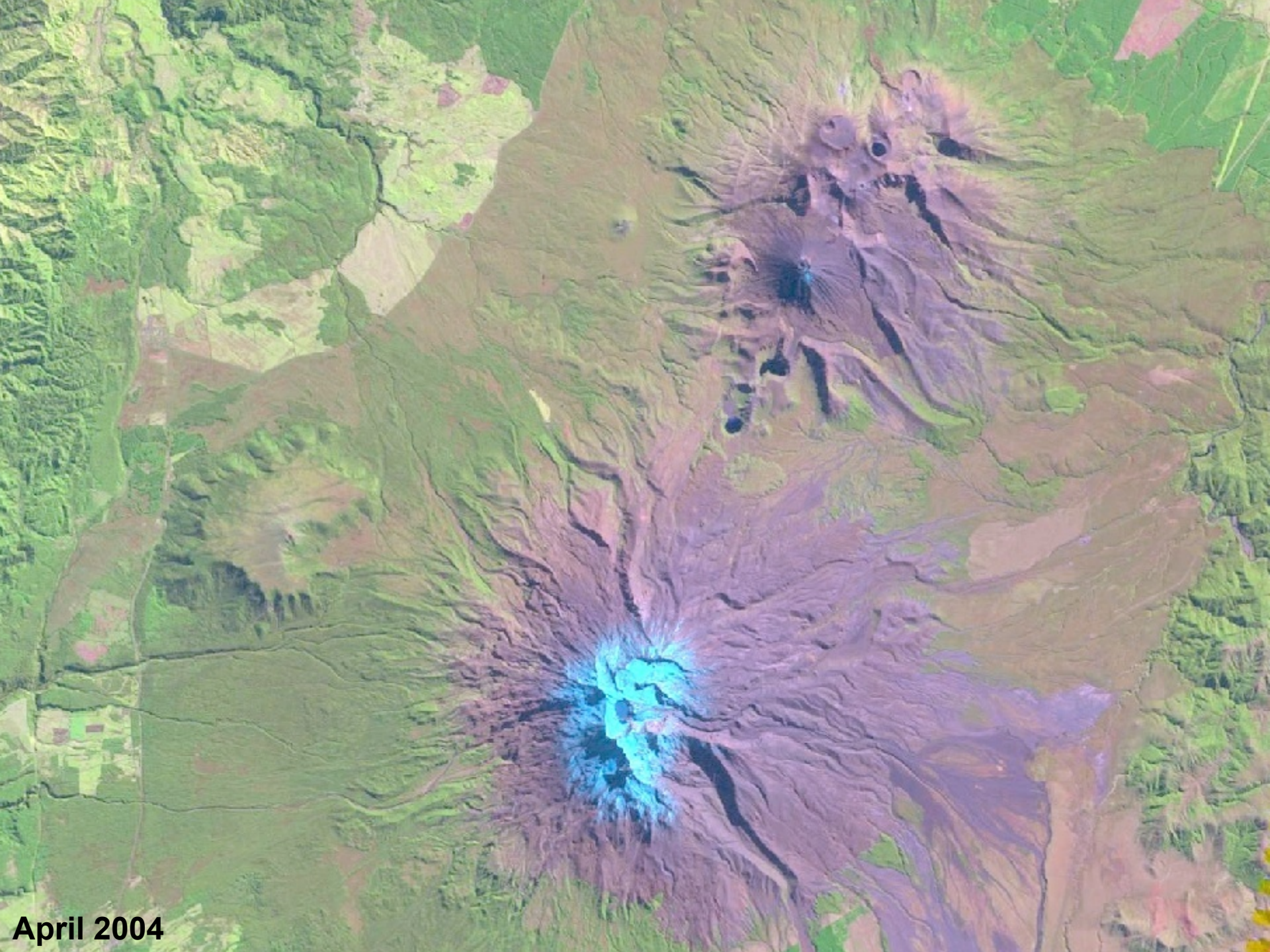
GlobGlacier workshop, Zermatt 01/09/2010

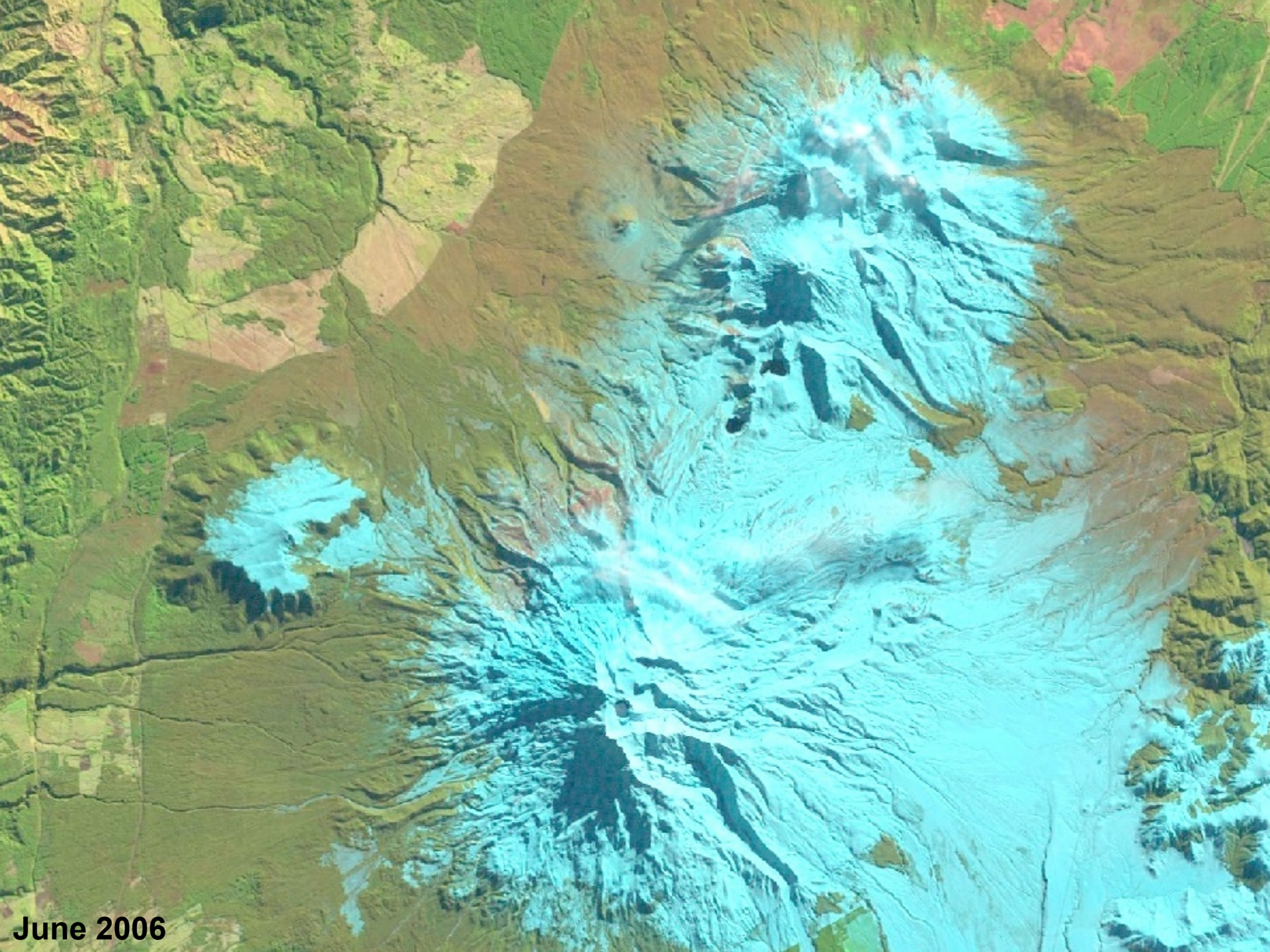
Landsat image, Zermatt 01/09/2010
downloaded 03/09/2010 – geotiff
(free Landsat archive: *glovis.usgs.gov*)

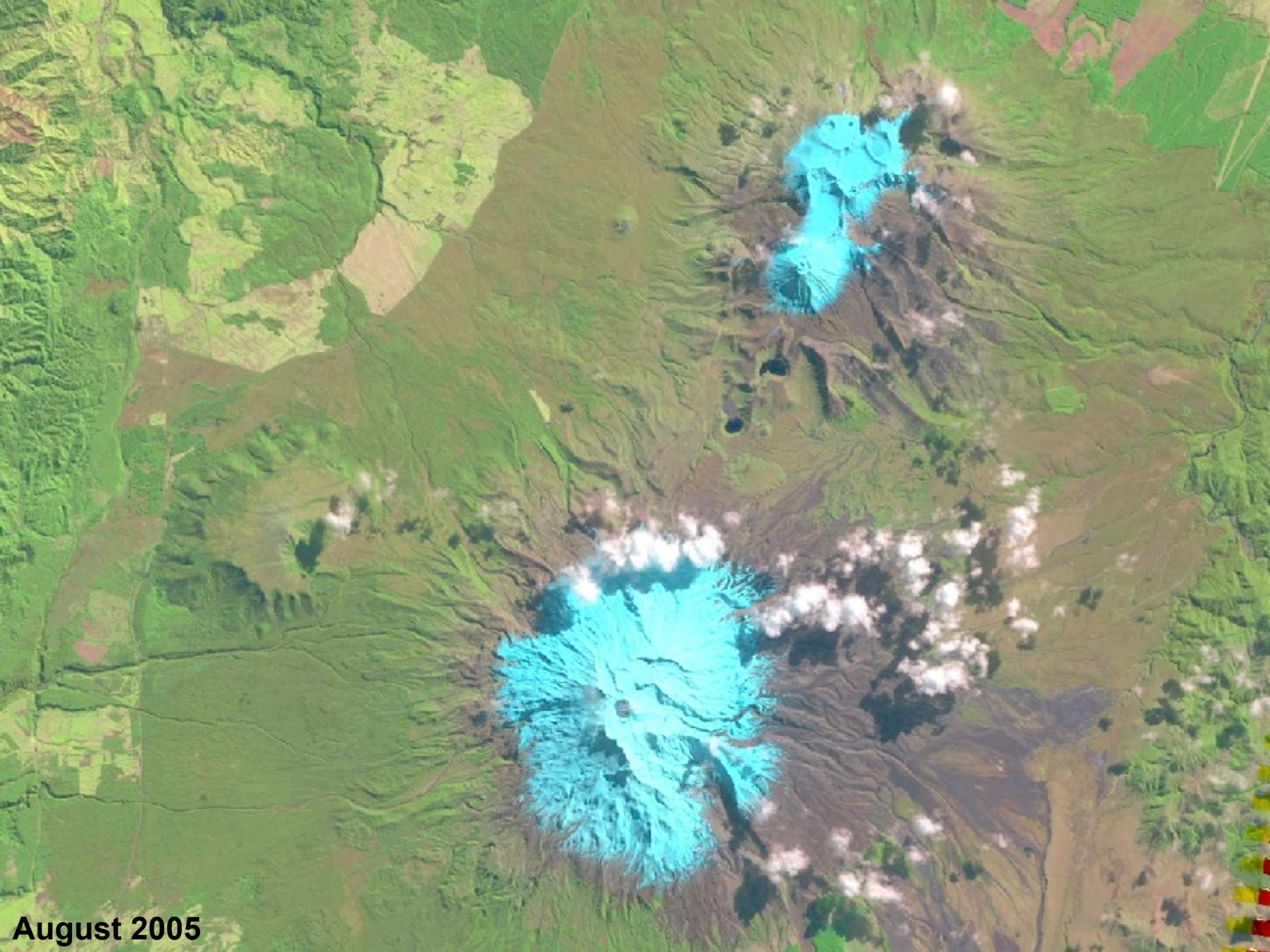

December 1989


January 2010


Feb 2006


April 2004


June 2006


August 2005

Final slide

* Visualisation images to be displayed at: *glacierchange.org*
(public input website run by Ph.D student Matt Beedle)

* New millennium global glacier extents: *glims.org/RGI/randolph.html*

Acknowledgements

Thanks to reviewers comments

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