

Visualisation of changes in alpine glaciers in western Canada

Roger Wheate, University of Northern BC



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

Illecillewaet Glacier, Glacier National Park

1885



1885 THE GREAT GLACIER

NOTMAN
MONTREAL



100 HELVETIA

1850–2008 +1.5°



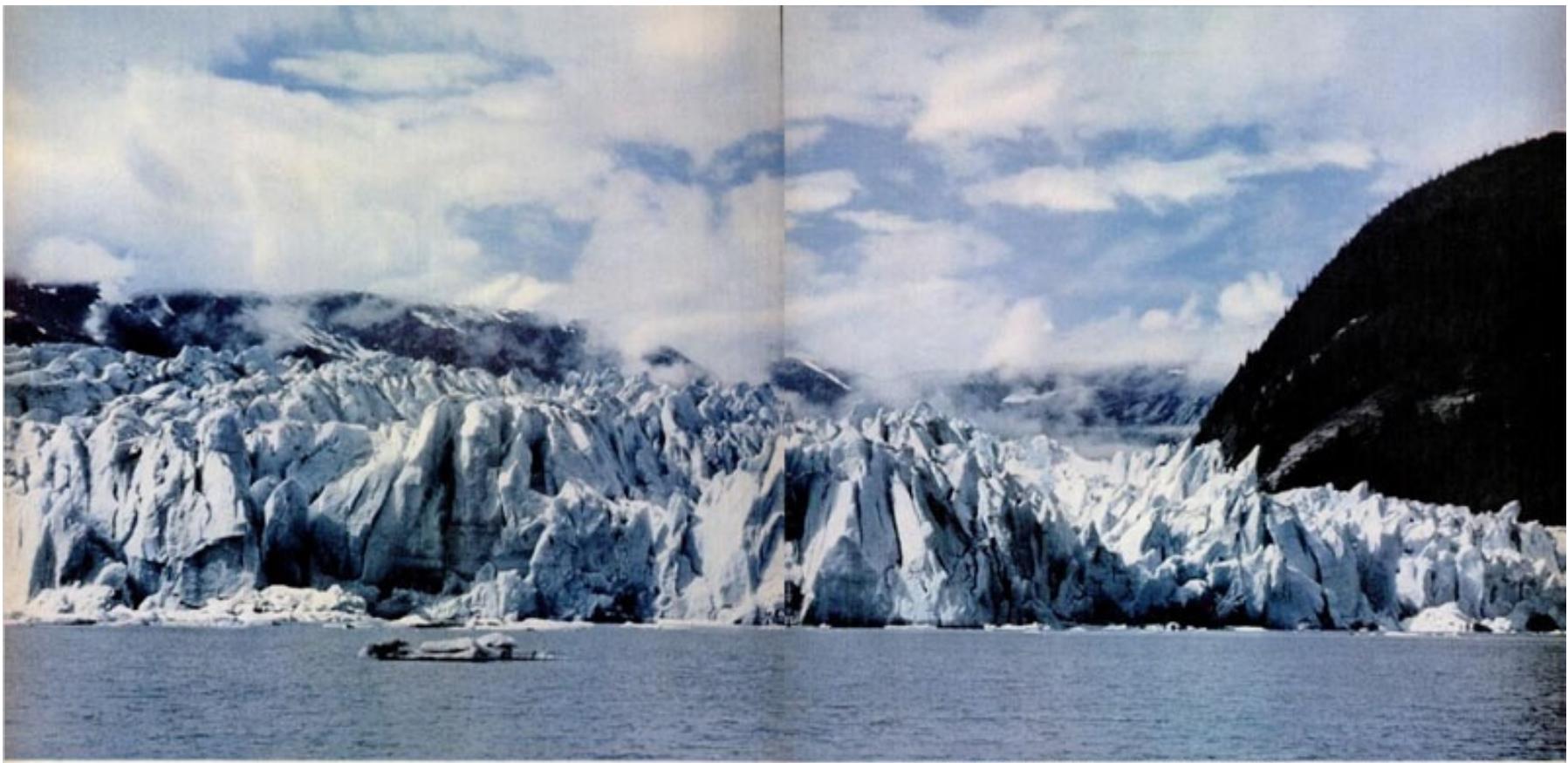
THOMAS KISSLING

2009

Thompson Glacier, Axel Heiberg Island, 1965



Glaciers viewed as constant in 1960s-70s



TWO GLACIER, ALASKA, IS A FIELD OF ICE STRETCHING 270 SQUARE MILES. YET THE PETROLEUM ENERGY HUMBLE SUPPLIED AMERICA COULD MELT IT AT THE RATE OF 7 MILLION TONS A DAY!

EACH DAY HUMBLE SUPPLIES ENOUGH ENERGY TO MELT 7 MILLION TONS OF GLACIER!

This giant glacier has remained unmelted for centuries. Yet, the petroleum energy Humble supplies—if converted into heat—could melt it at the rate of 80 tons each second! To meet the nation's growing needs for energy, Humble has applied science to nature's resources to become America's Leading Energy Company. Working wonders with oil through research, Humble provides energy in many forms—to help heat our homes, power our transportation, and to furnish industry with a great variety of versatile chemicals. Stop at a Humble station for new Enco Extra gasoline, and see why the "Happy Motoring" Sign is the World's First Choice!

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1981 Columbia Icefield

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



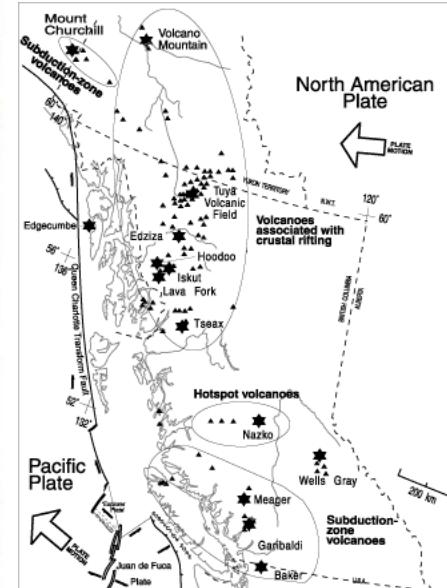


Western Canada (BC / Alberta)

~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

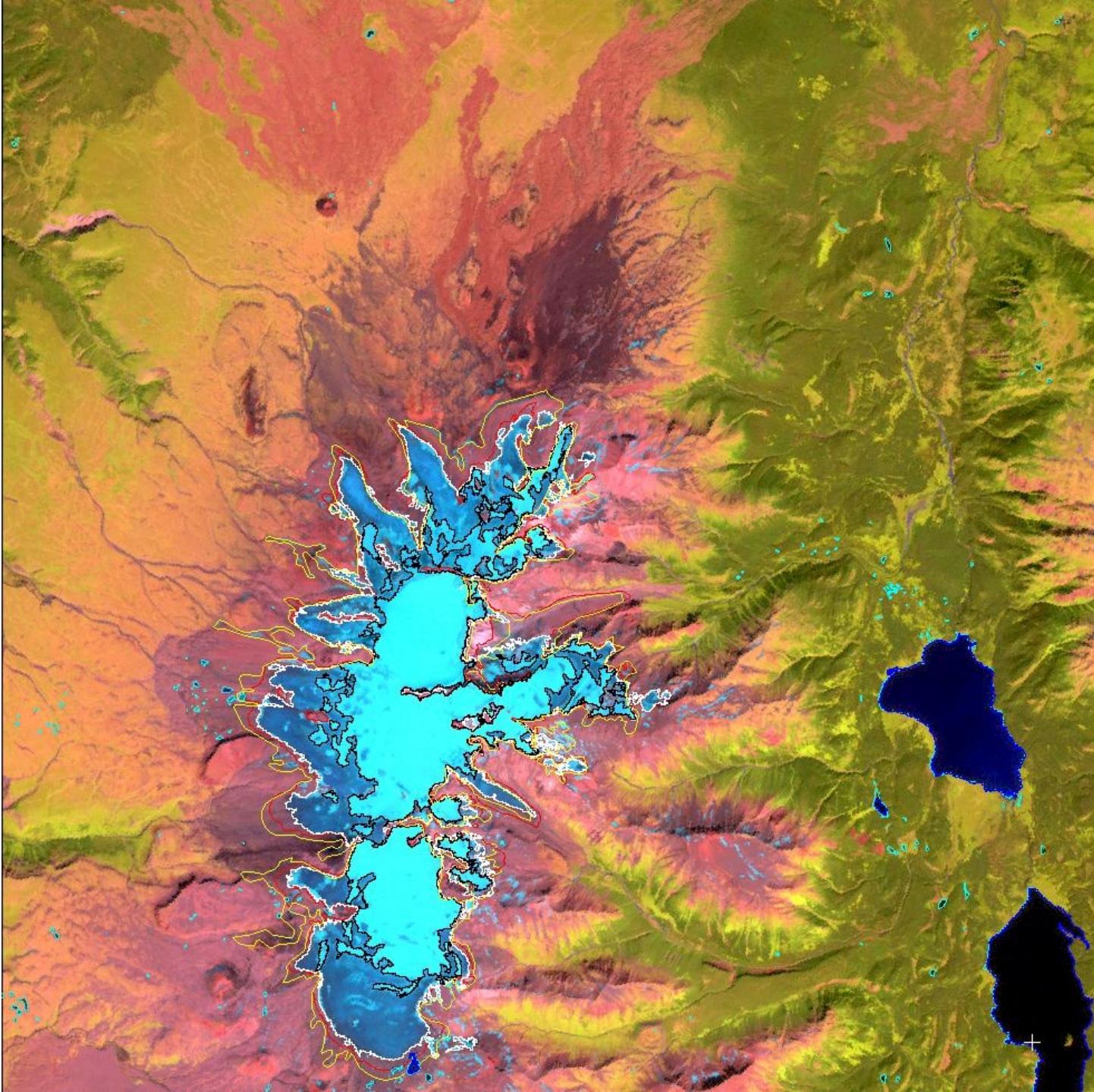


Mt. Edziza

1965 yellow
1982 red
(from air photo
mapping)

2005 white
(Landsat)

accumulation
area - black



Robson Glacier

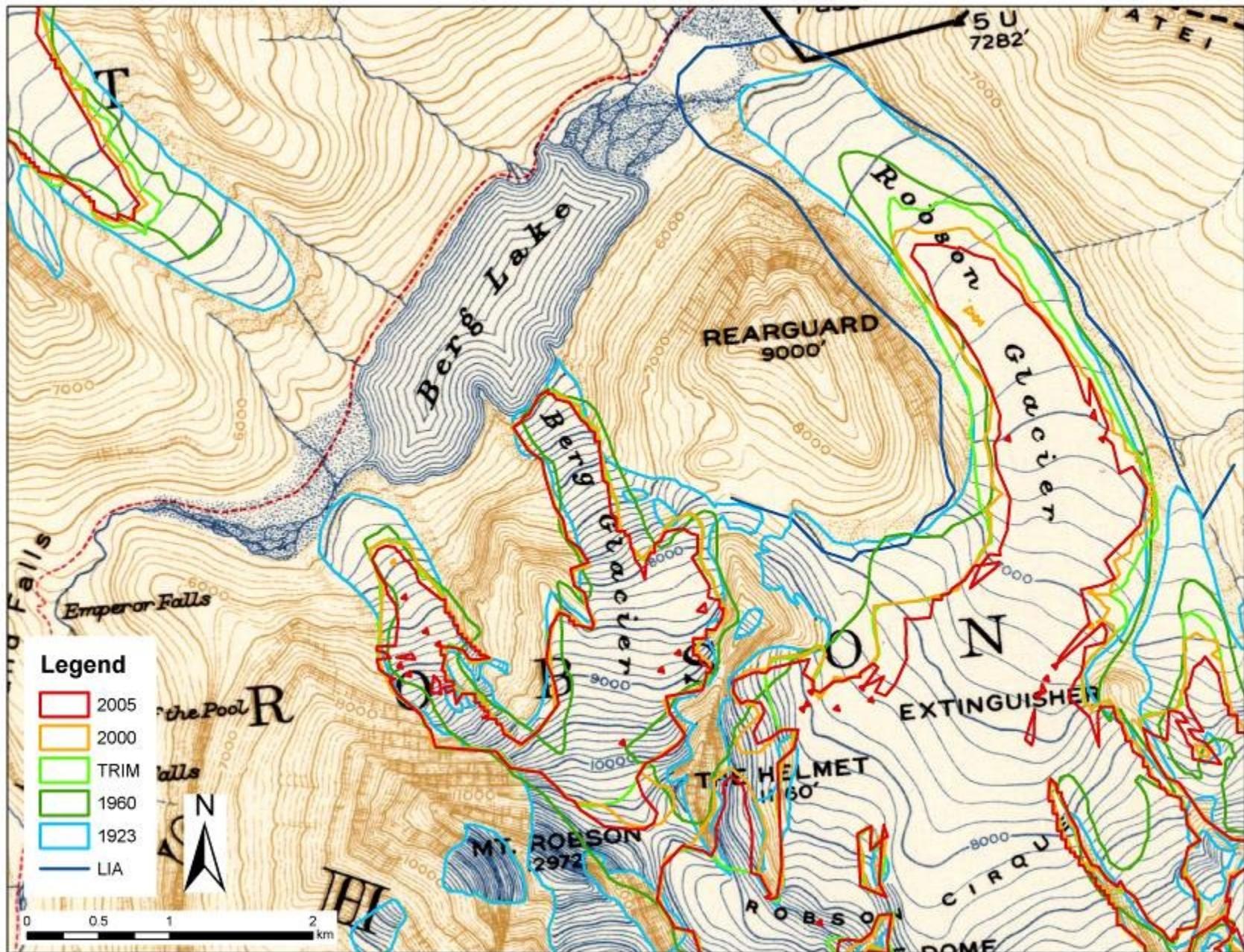


1911 Photo: Whyte Museum of the Canadian Rockies (V263/ NA 6345, Byron Harmon)



2011 Photo: Roger Wheate

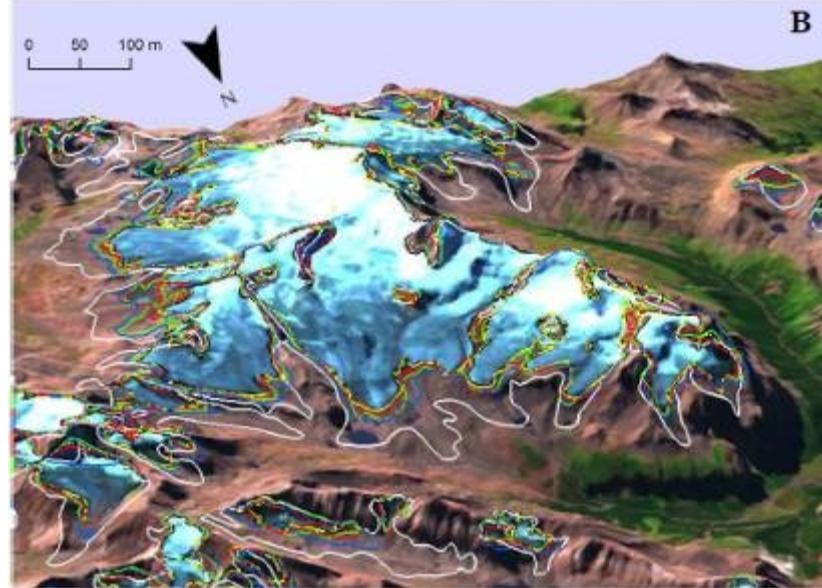
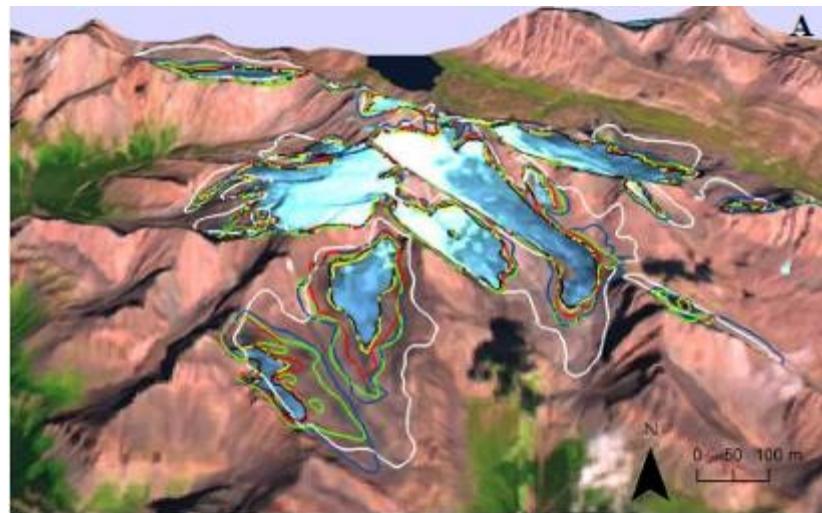
1923 British Columbia-Alberta boundary commission map



Cambrian Icefield, Coast Mountains

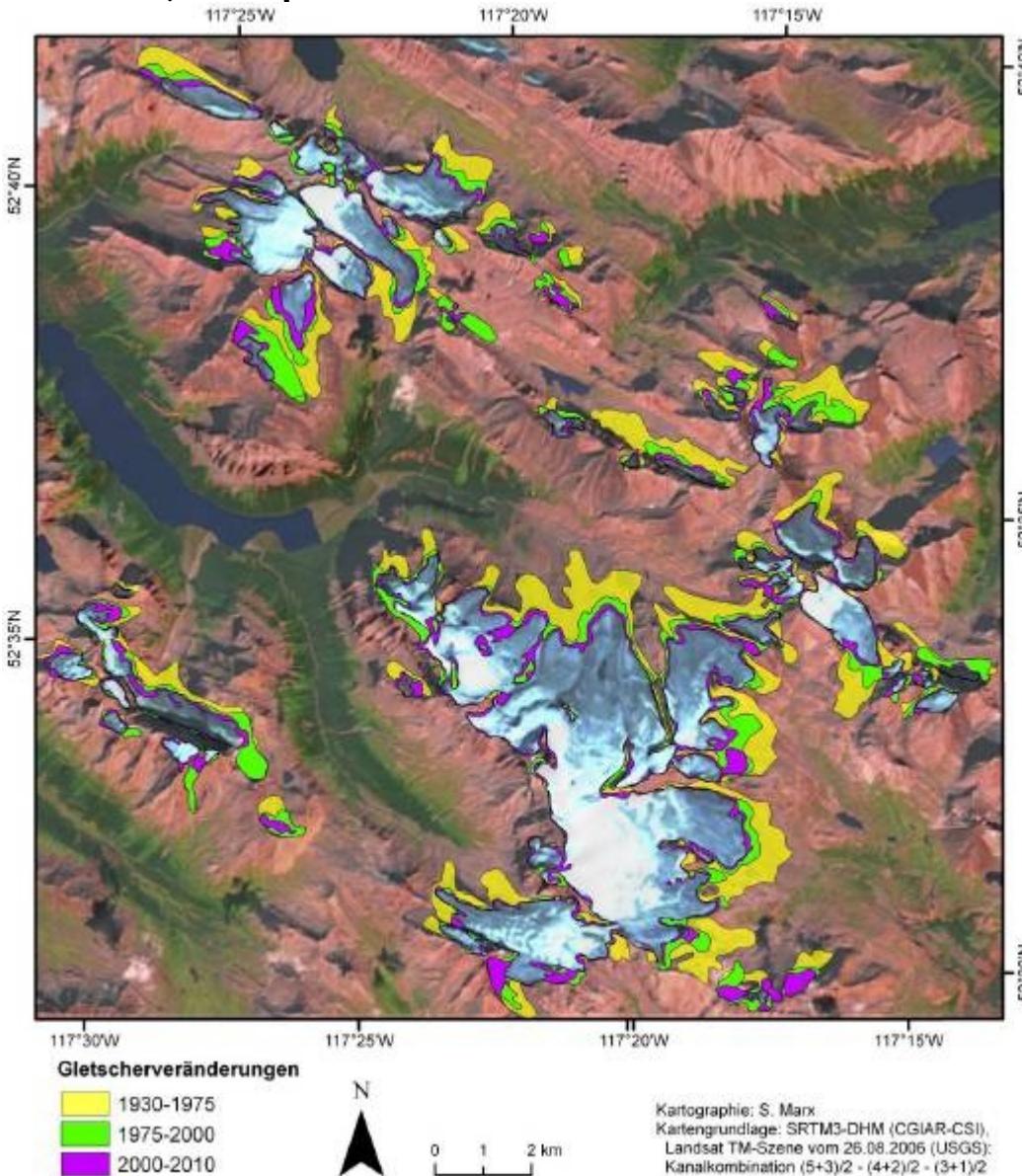


Maligne Lake glaciers, Jasper NP



Gletscherstände:

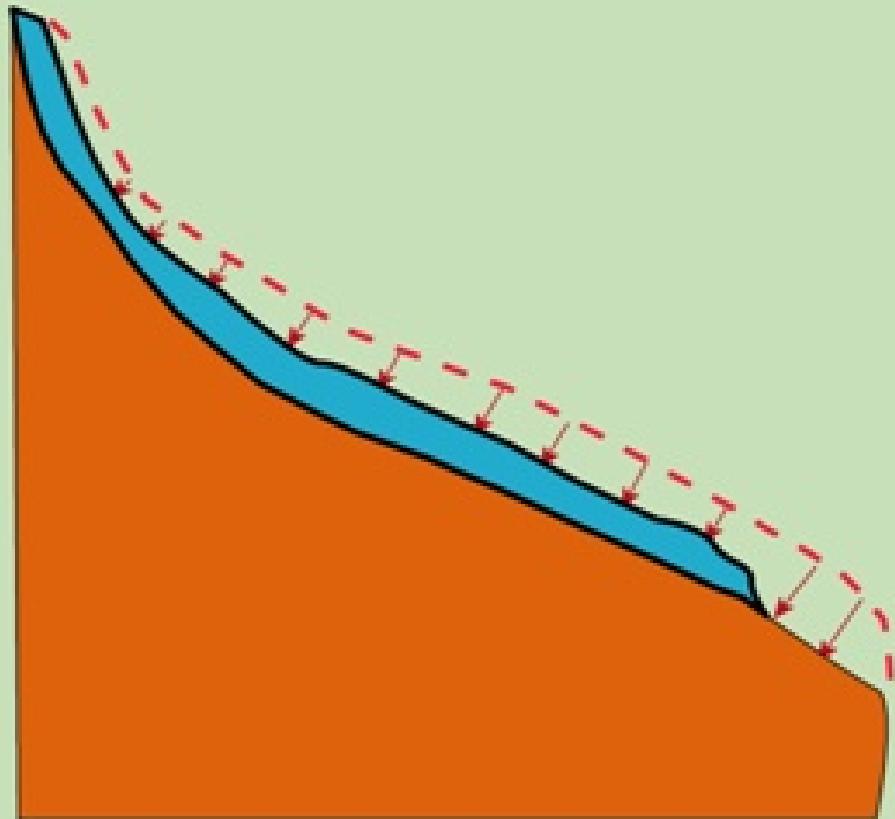
- 1930
- 1975
- 1985
- 2000
- 2006
- 2010



Maligne Lake area 1930-2010: total loss of 33.07 km² (from 79.5 km²) or - 0.52% per year.
Between 2000 and 2010, the rate increased to 2.23% per year

Thinning

Changes in Glacier Thickness

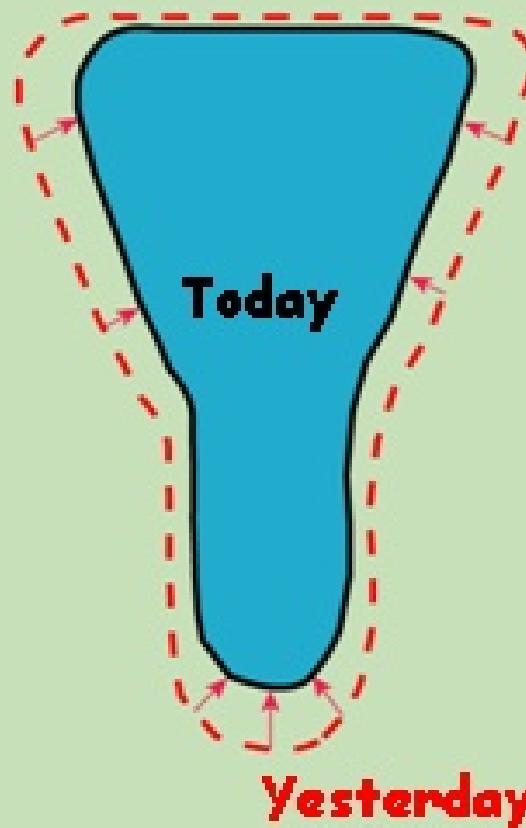


Sources: map contours, stereo photography, spaceborne DEMs:
e.g. SRTM, ASTER GDEM

Current changes ~ -5m/year

Retreat

Changes in Glacier Area

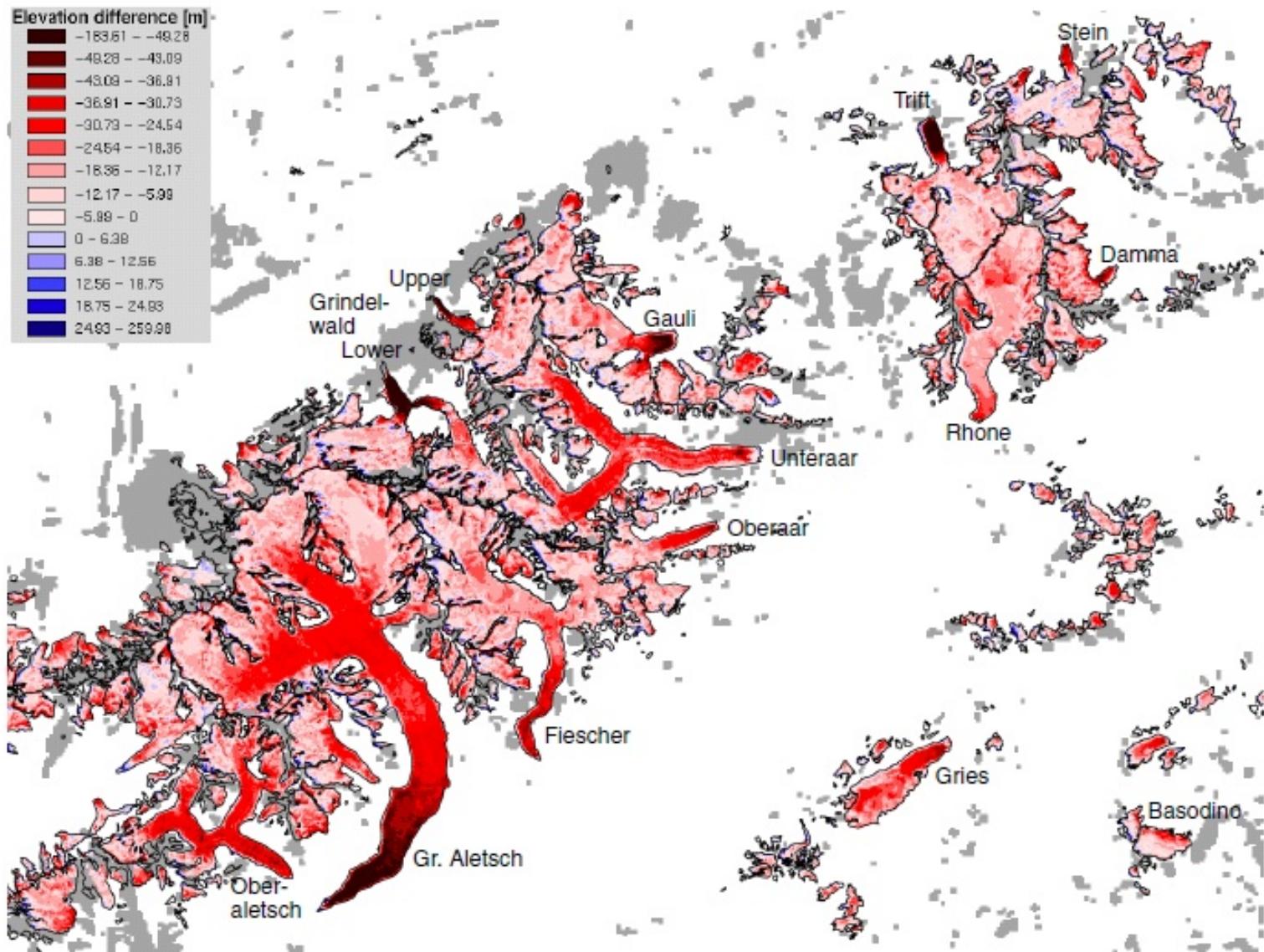


Sources:
maps, air photos, satellite images

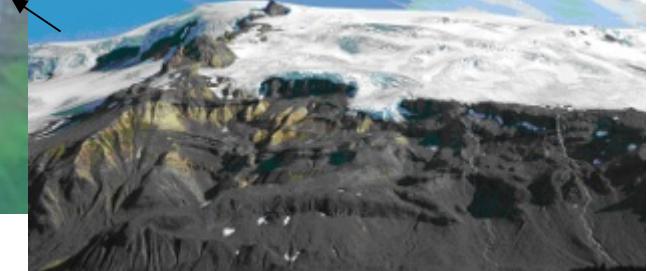
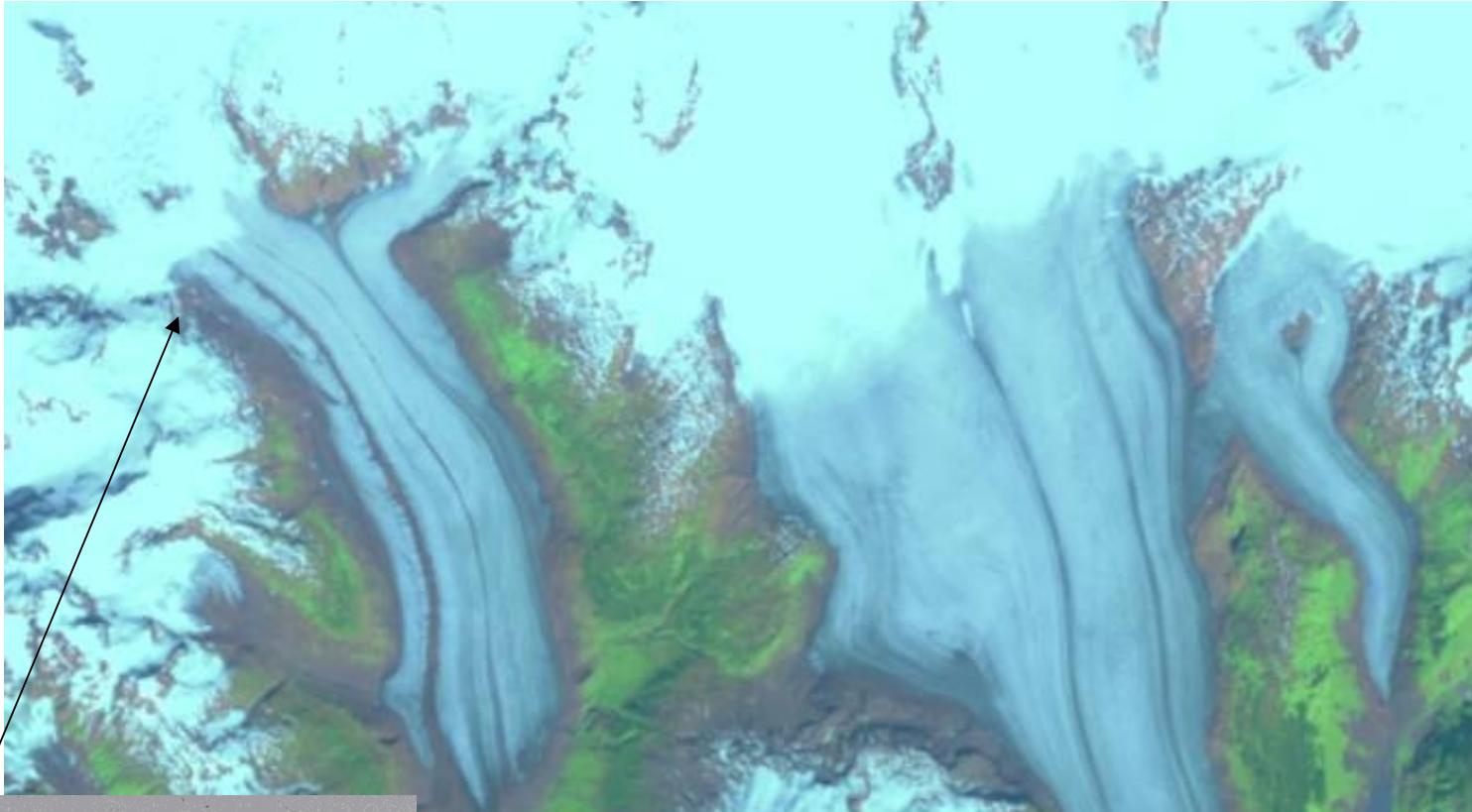
Current changes ~ -20m/year

Techniques for showing elevation change

(DEM subtraction: Haeberli and Paul, 2009)

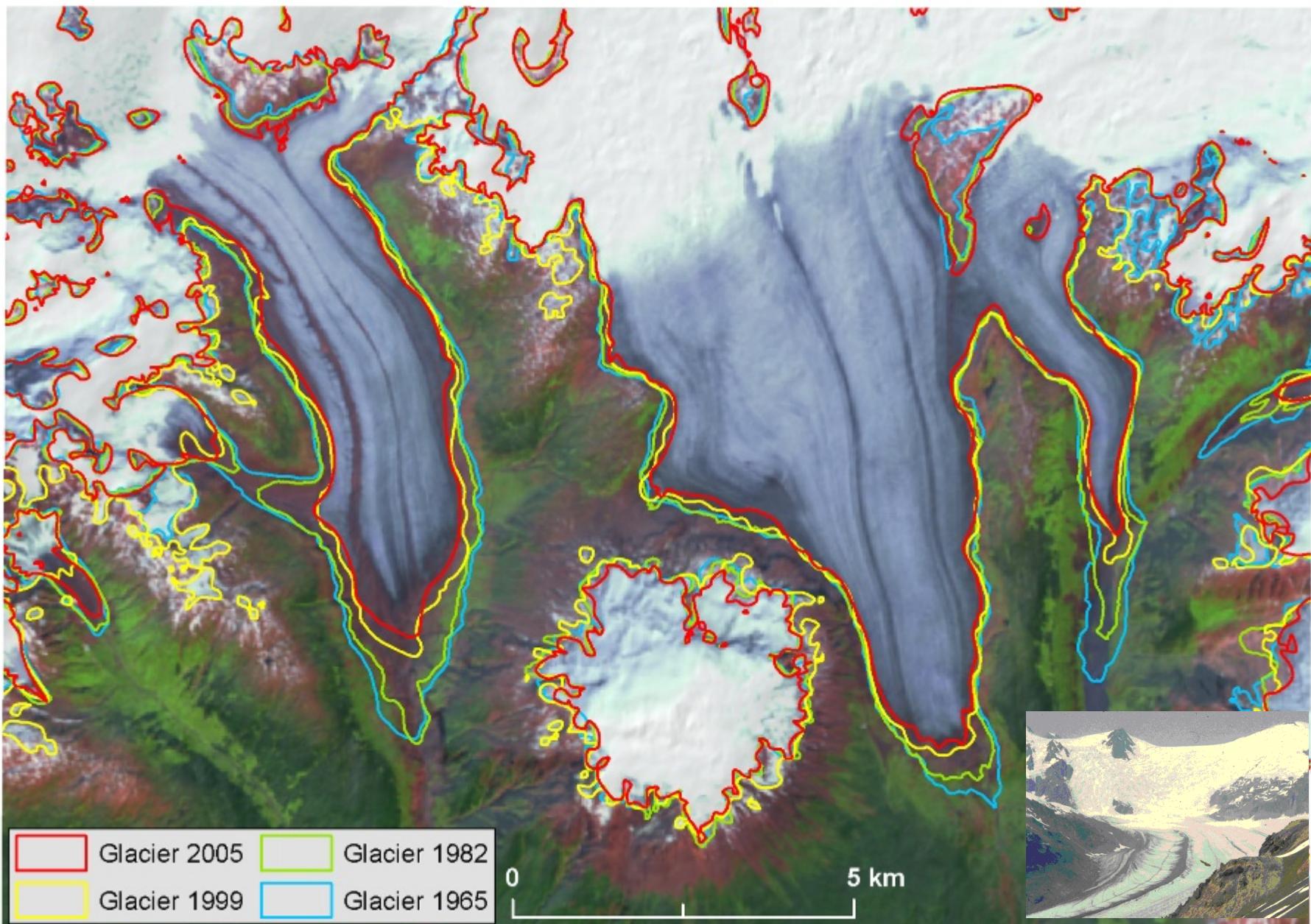


Hoodoo Mountain area: Landsat TM 2010

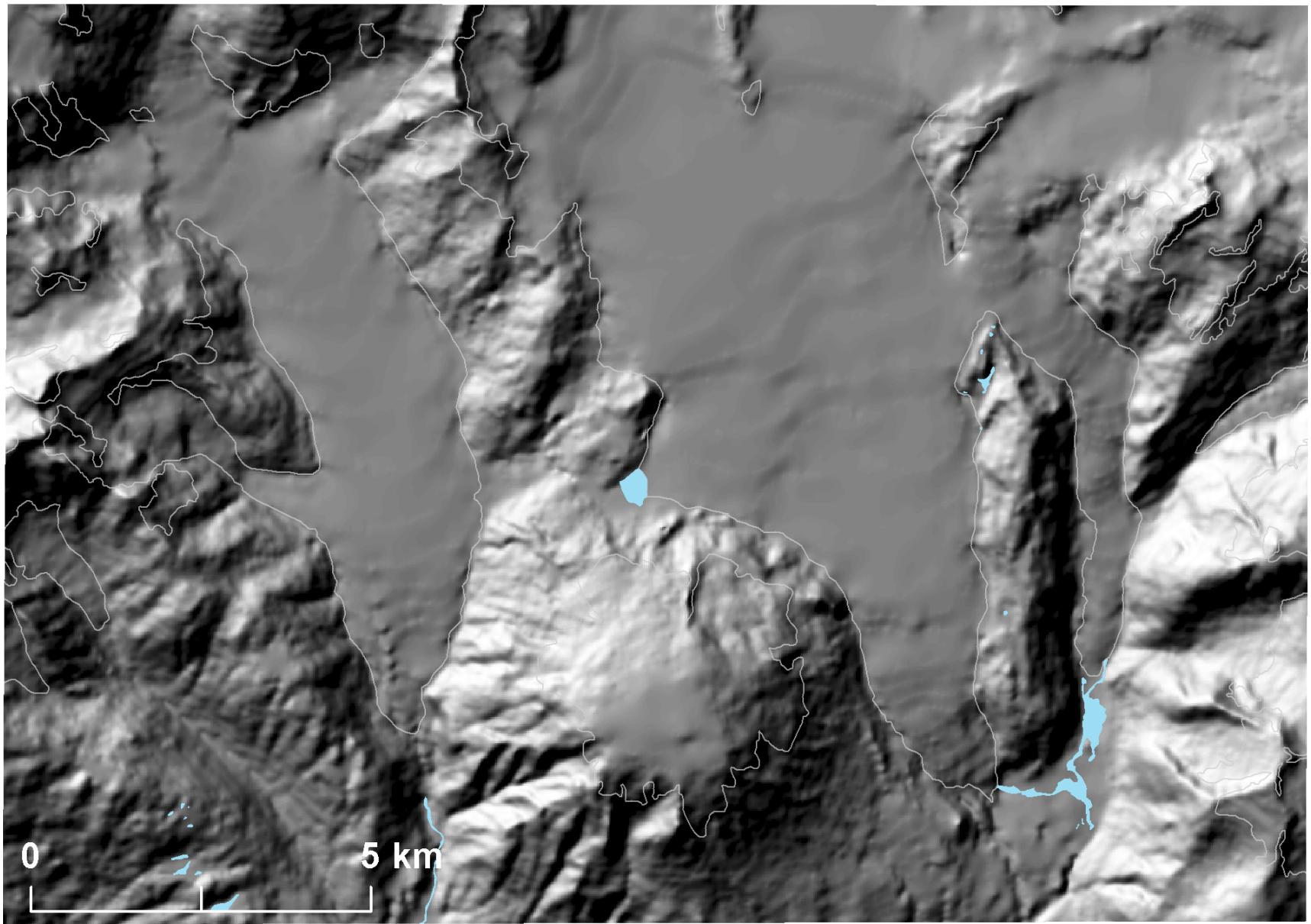


Hoodoo Glacier: extents 1965 to 2005 (overlain on Landsat TM 2010)

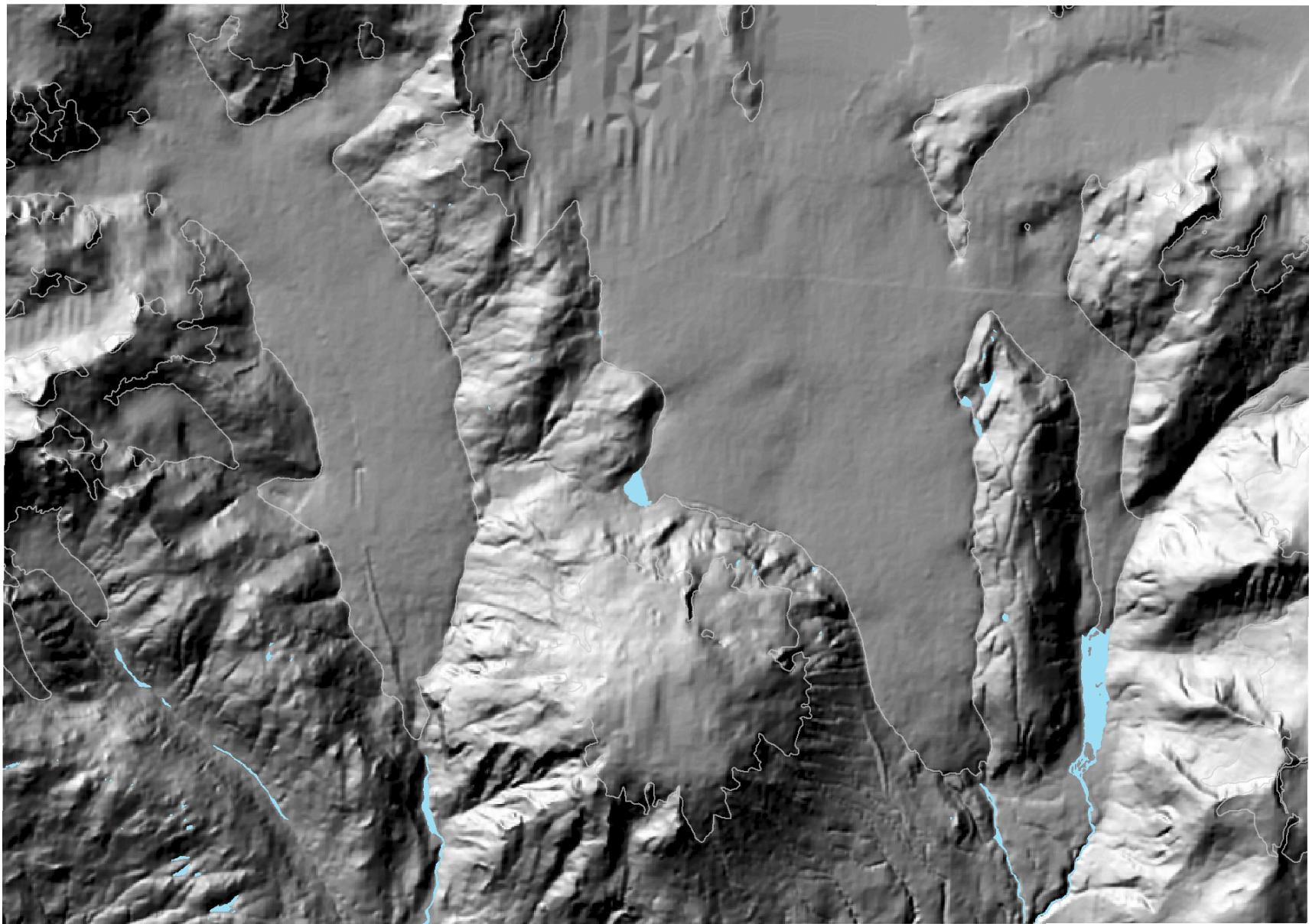
1965, 1982 from aerial photos, 1999 and 2005 from Landsat



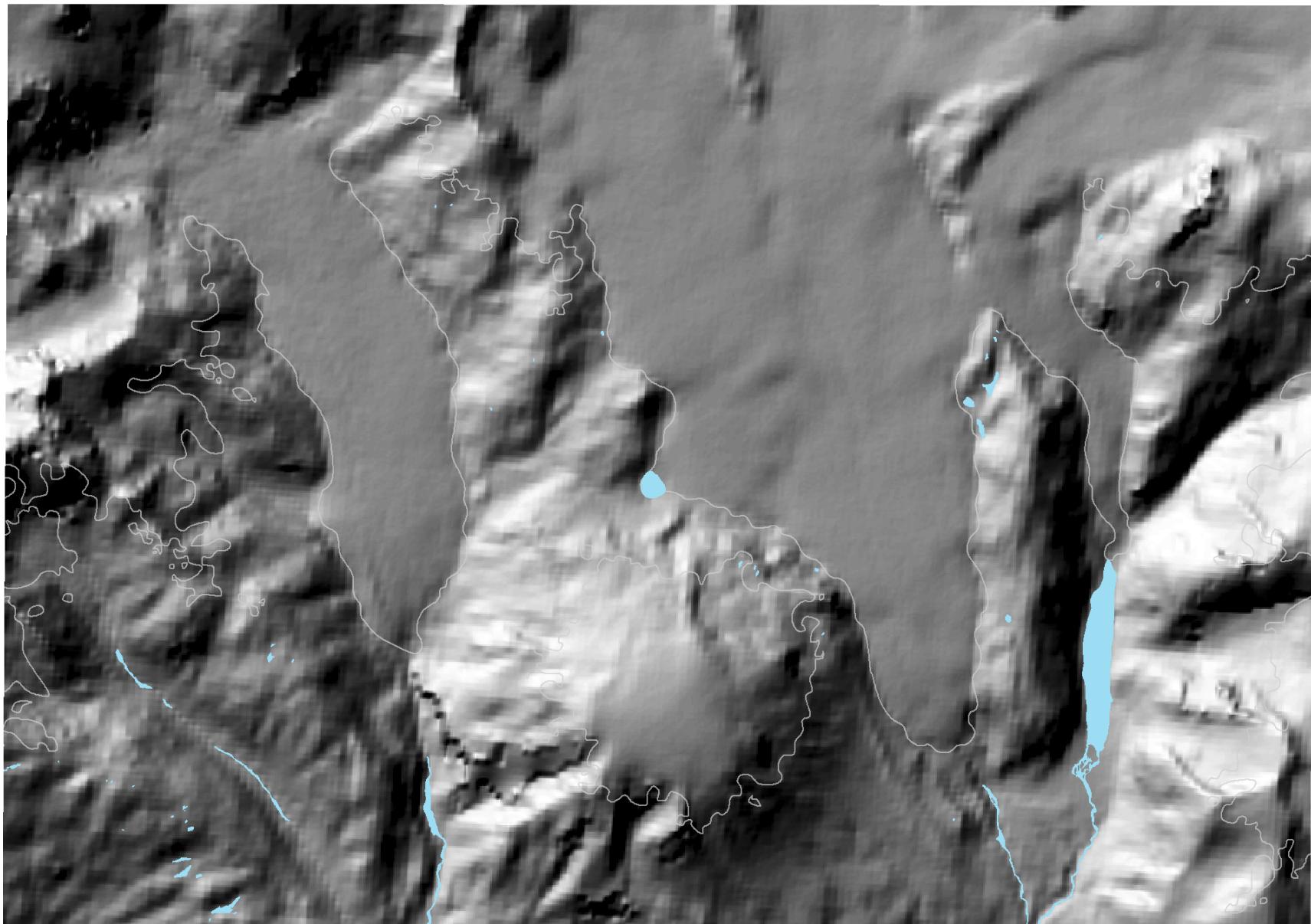
NTDB 1965: DEM from contours; *geografis.ca*



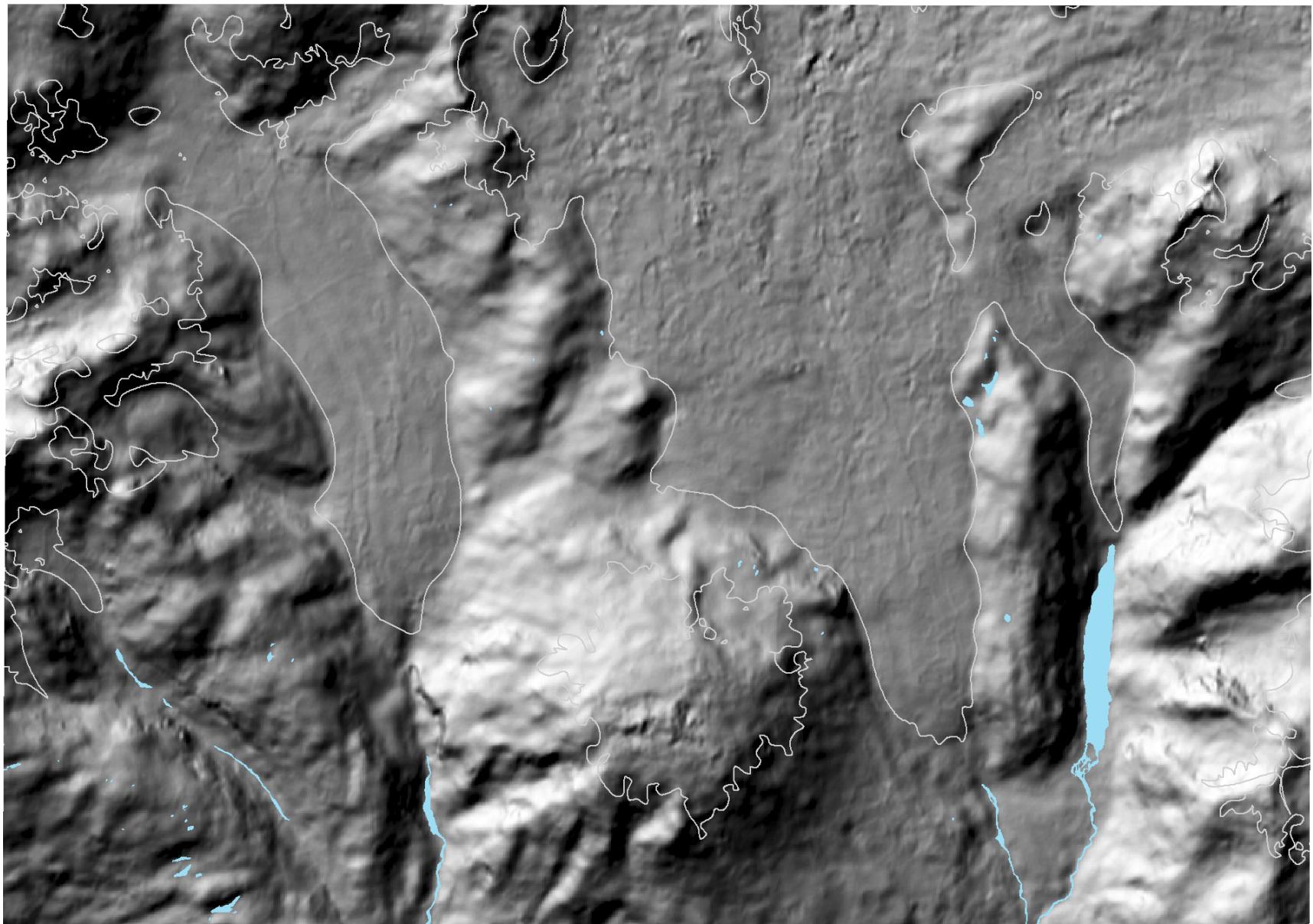
BC 'TRIM' mapping 1982: digital stereophotography; geobase.ca



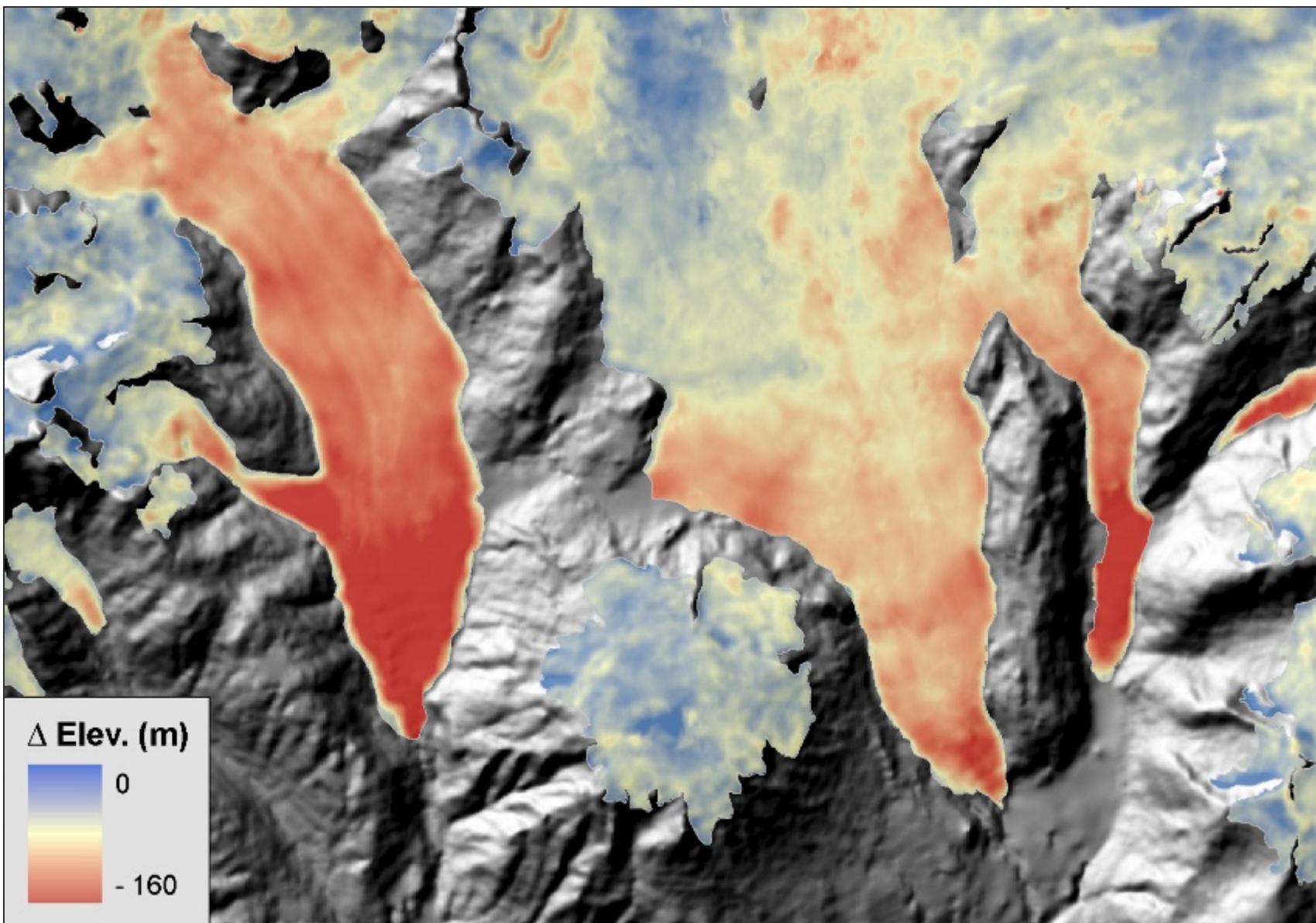
Shuttle Radar Topography Mission (SRTM) 1999 (spaceborne)

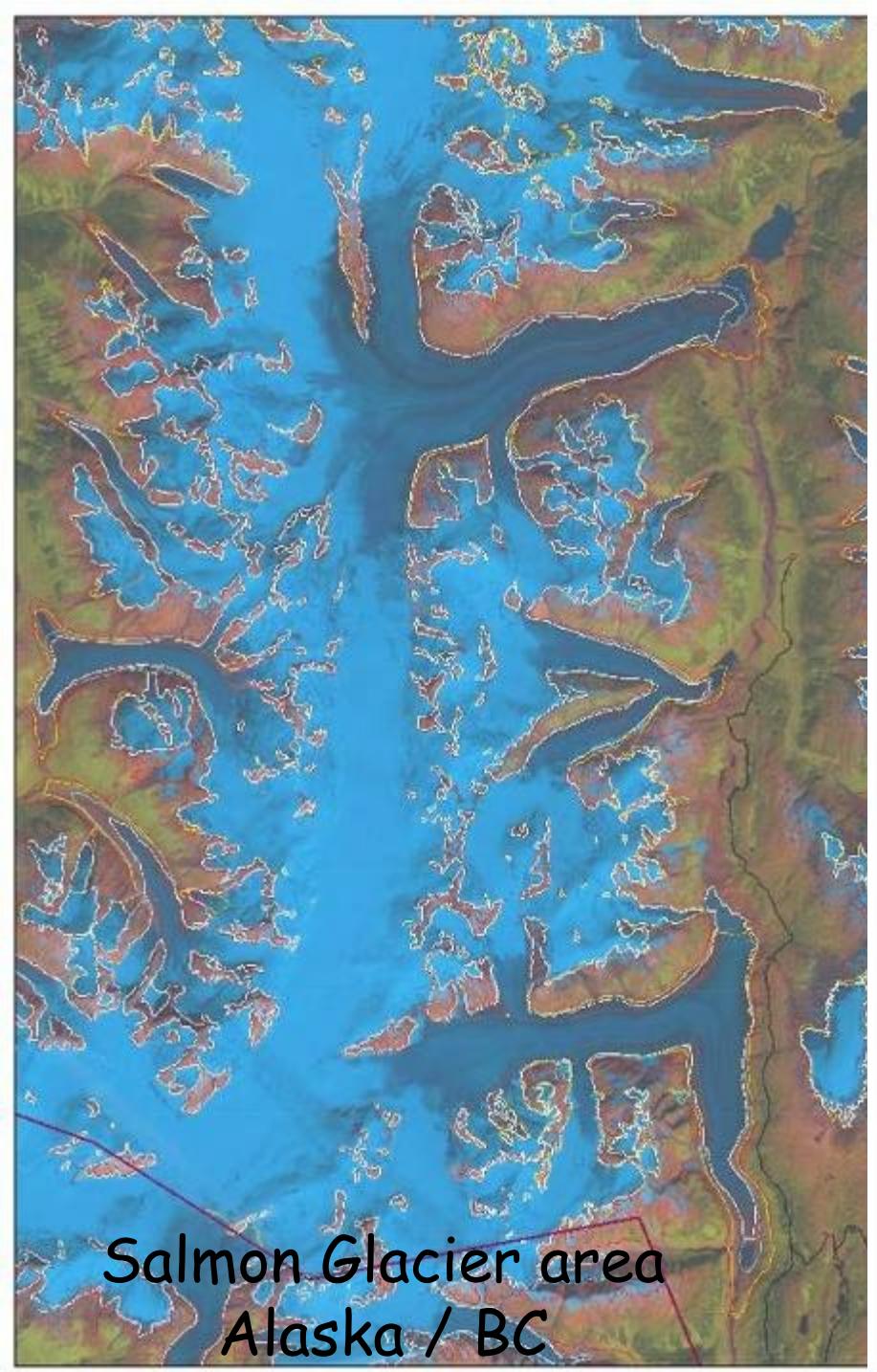


ASTER GDEM 2000 - 2008 (~2004) multiple images

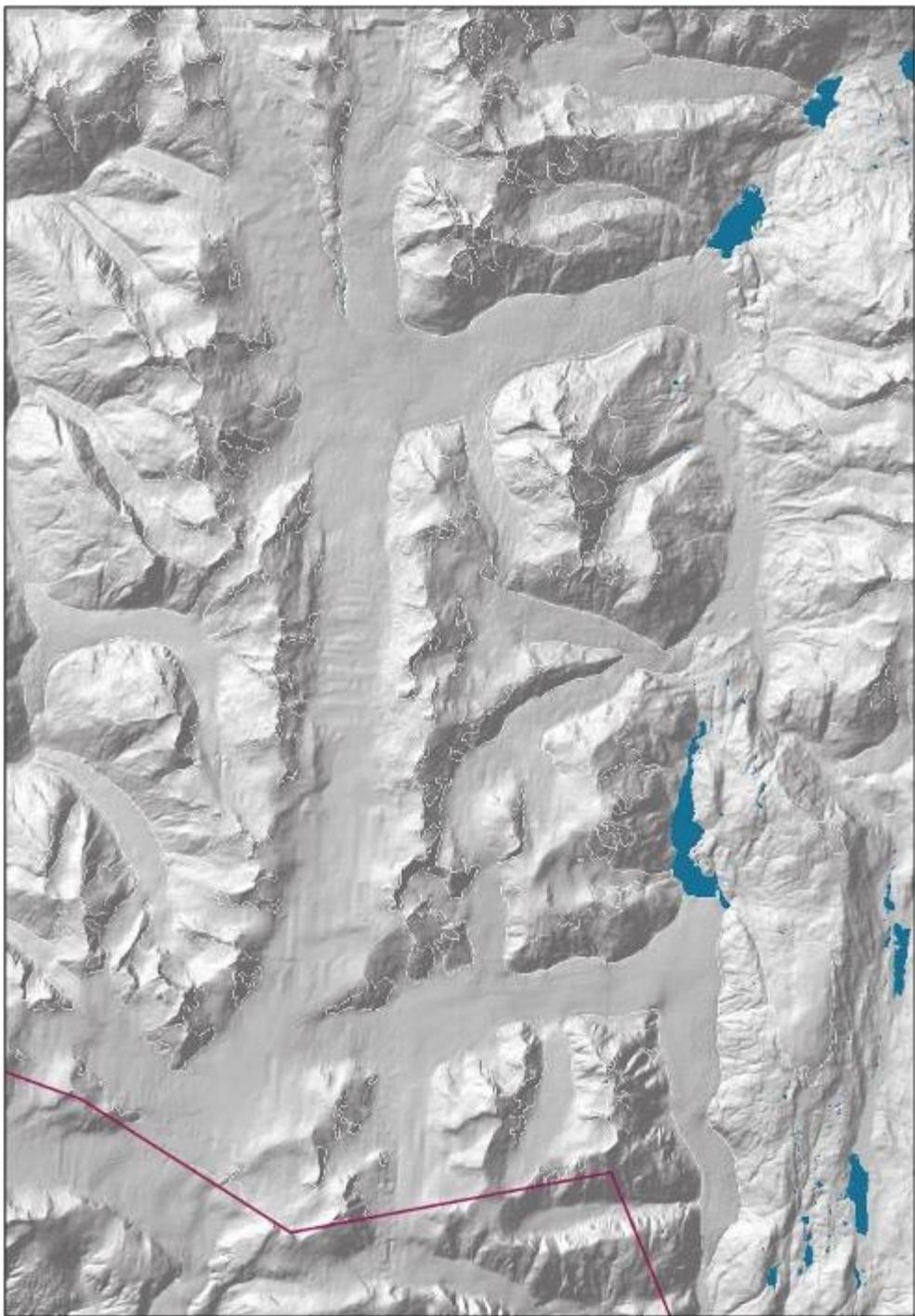


DEM Difference Image: NTDB (1965) - ASTER (2004)

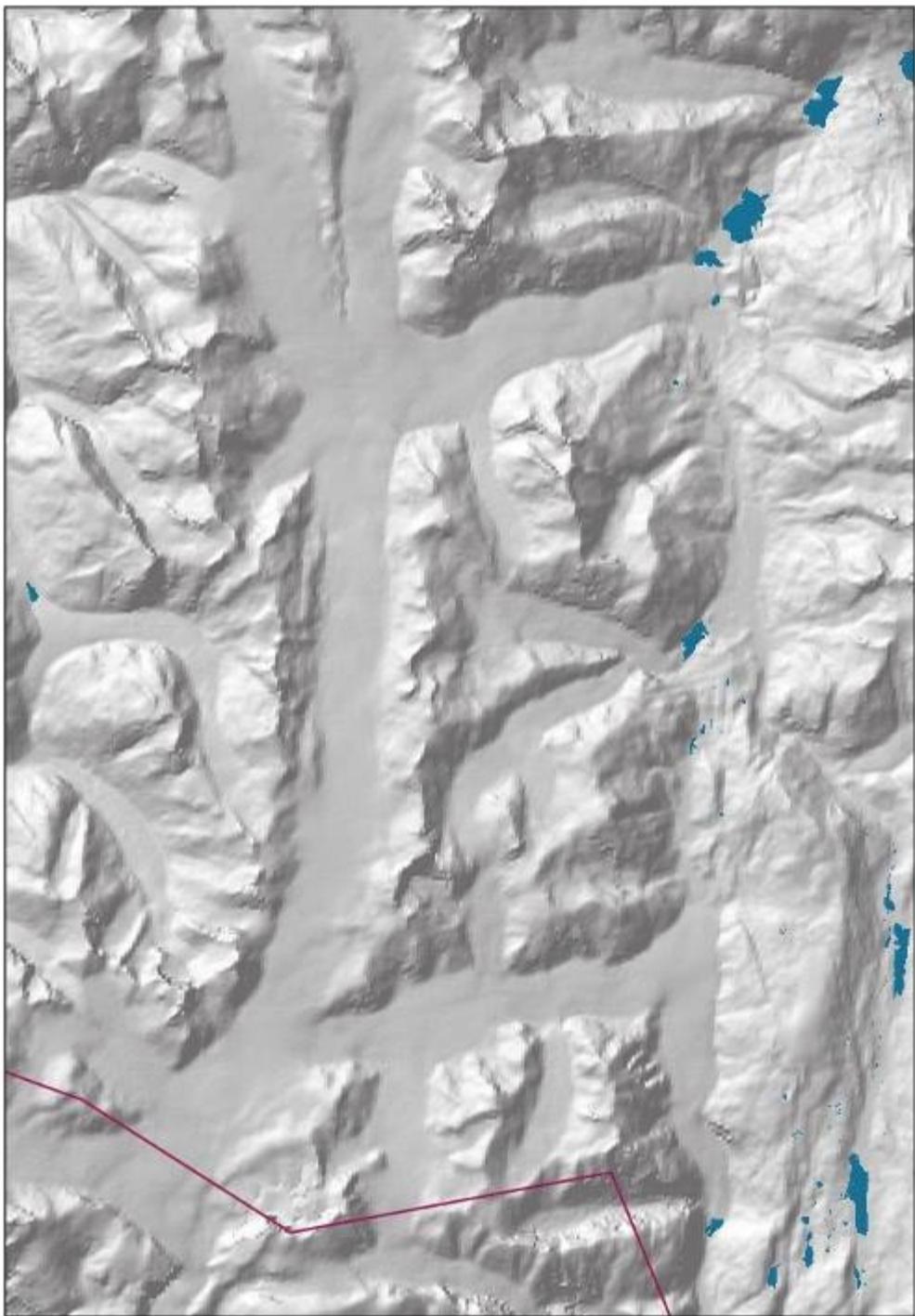




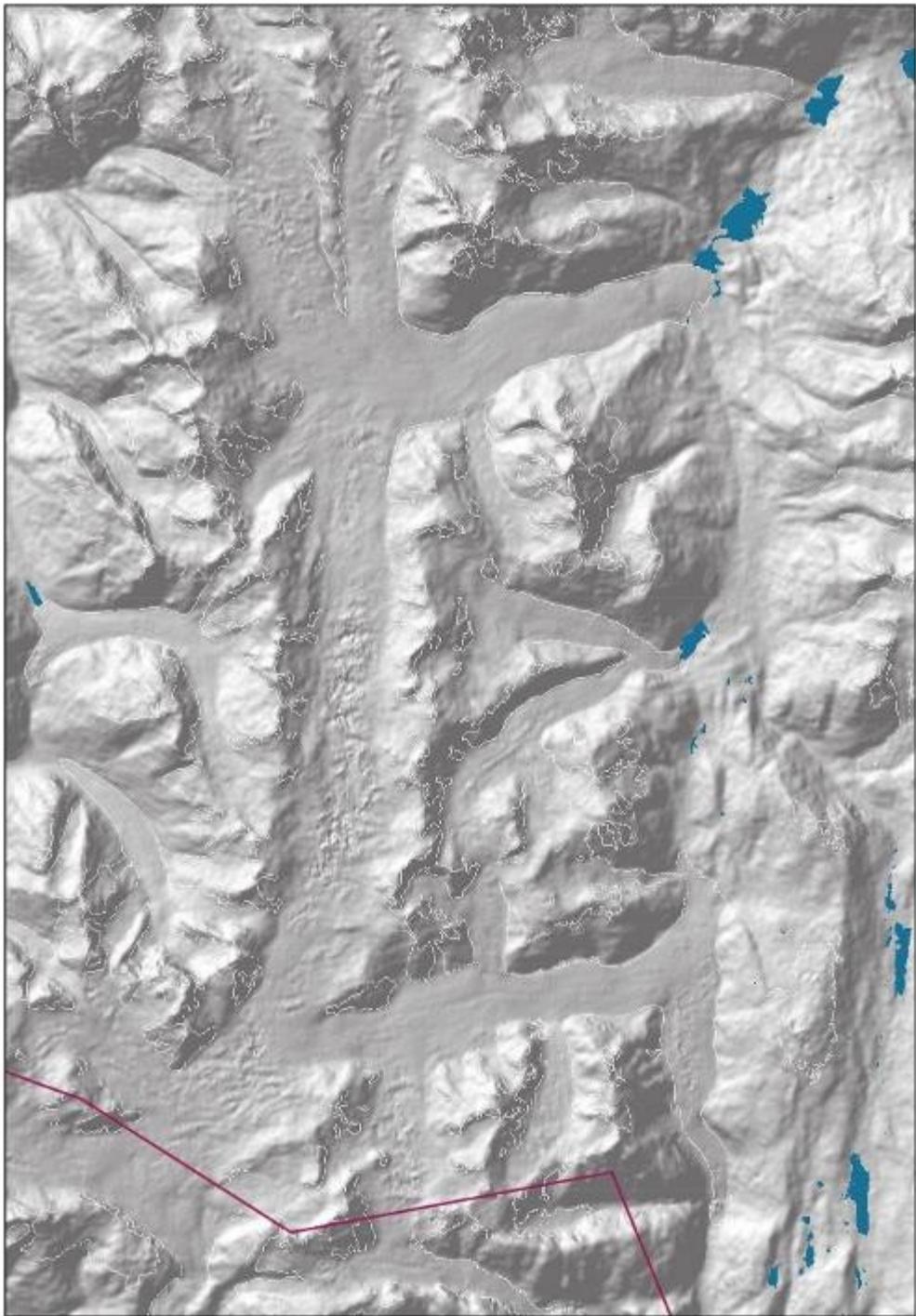
BC TRIM 1985



SRTM 1999

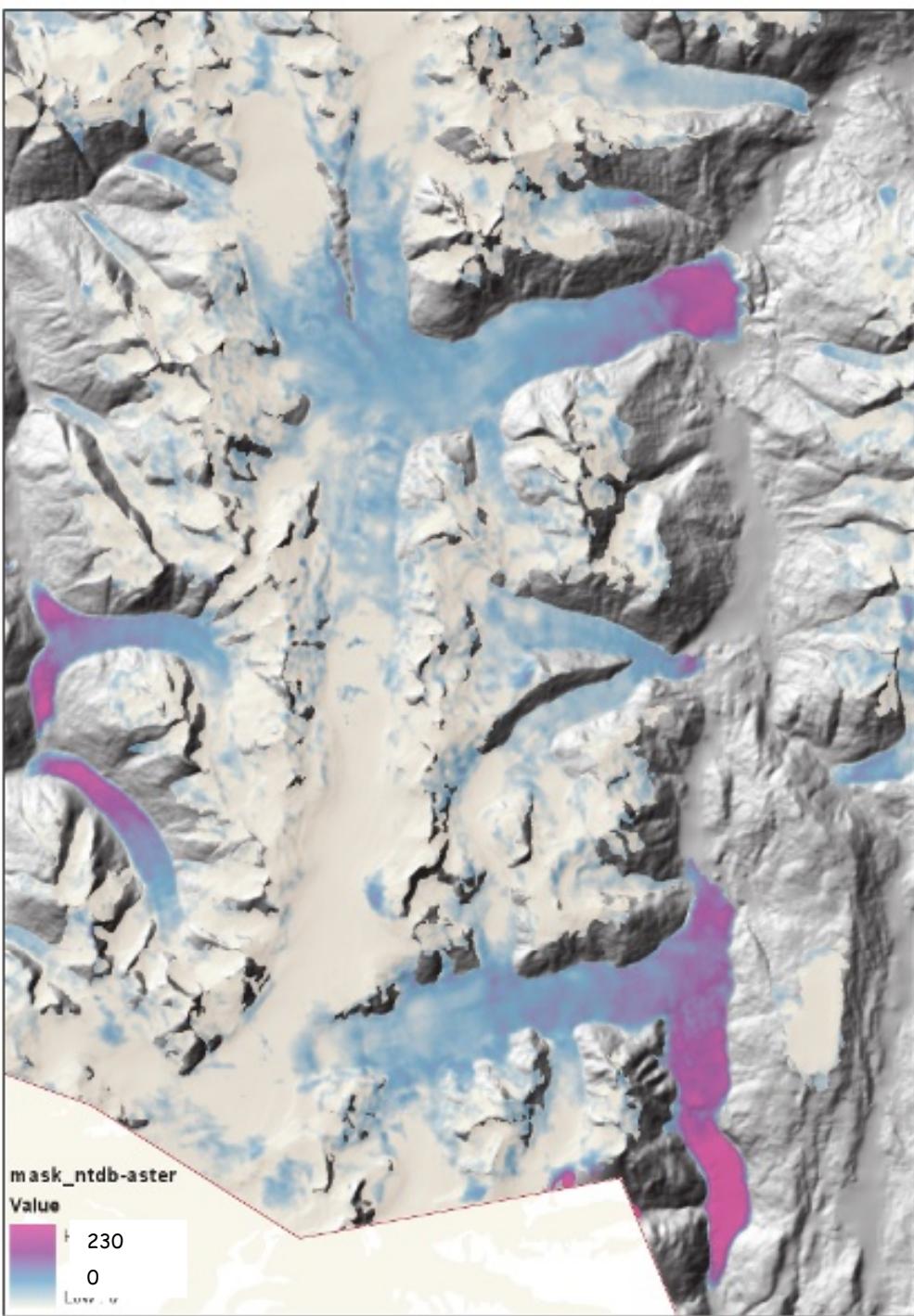


ASTER 2004

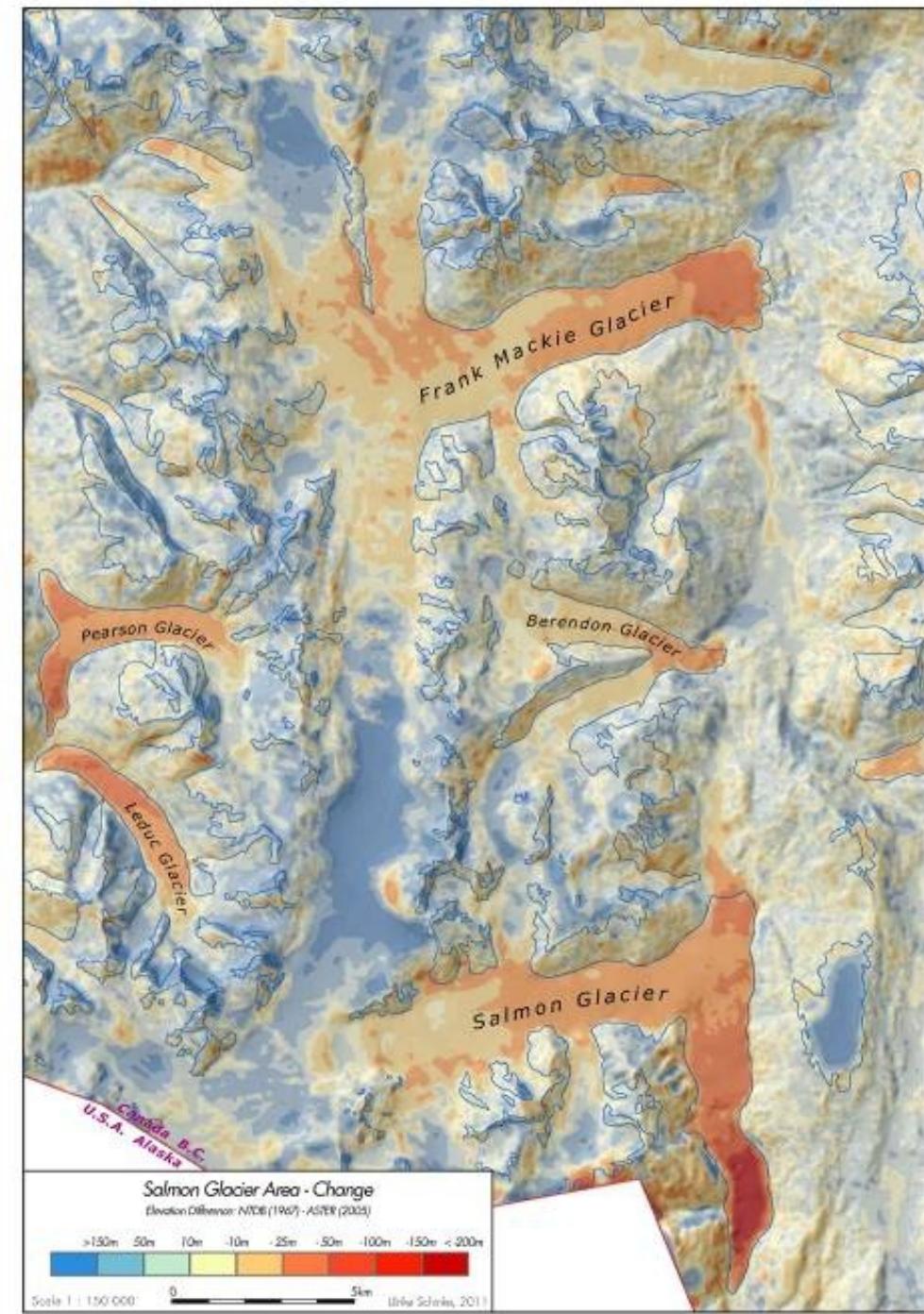


DEM subtraction NTDB - ASTER

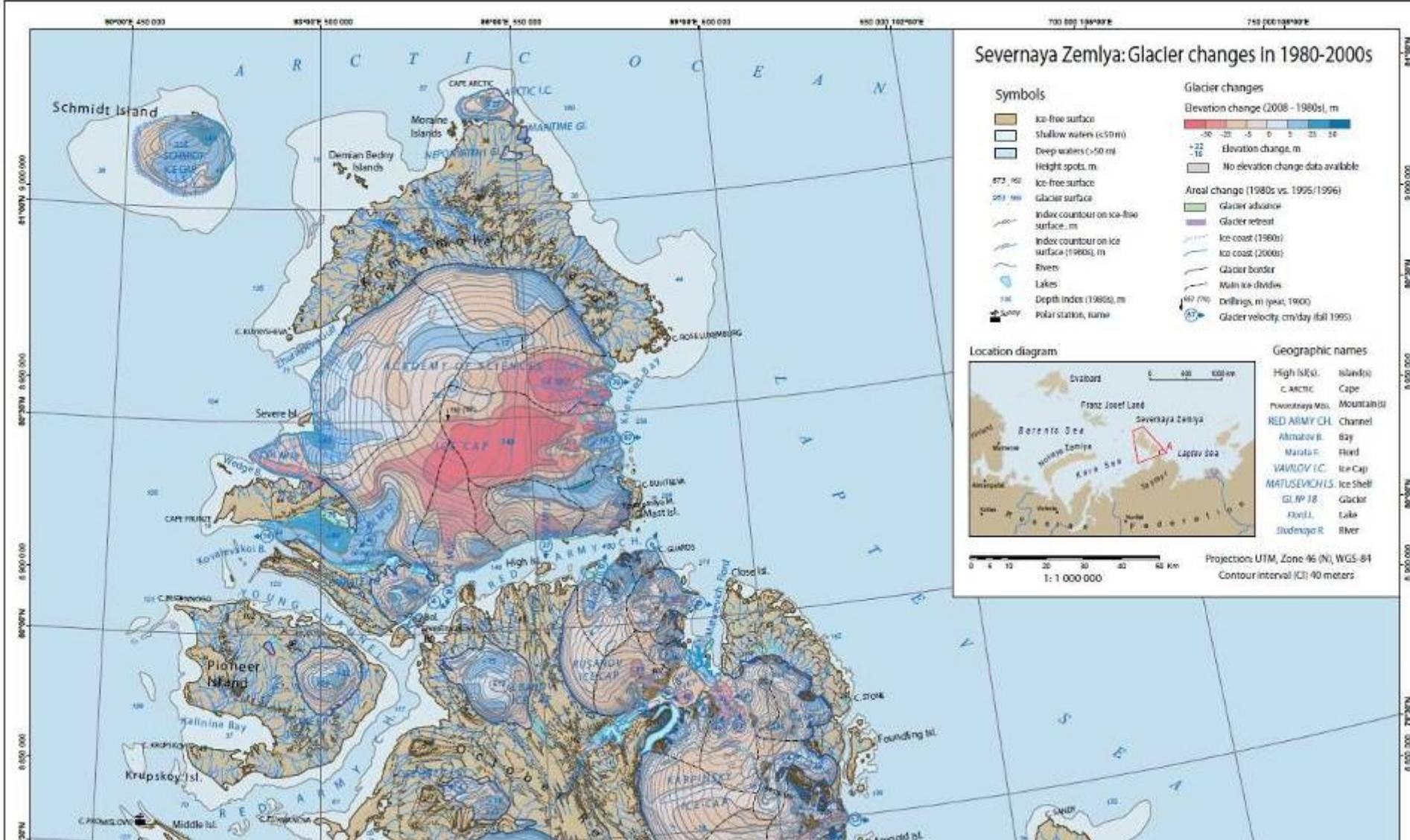
0-230m (unclassed)



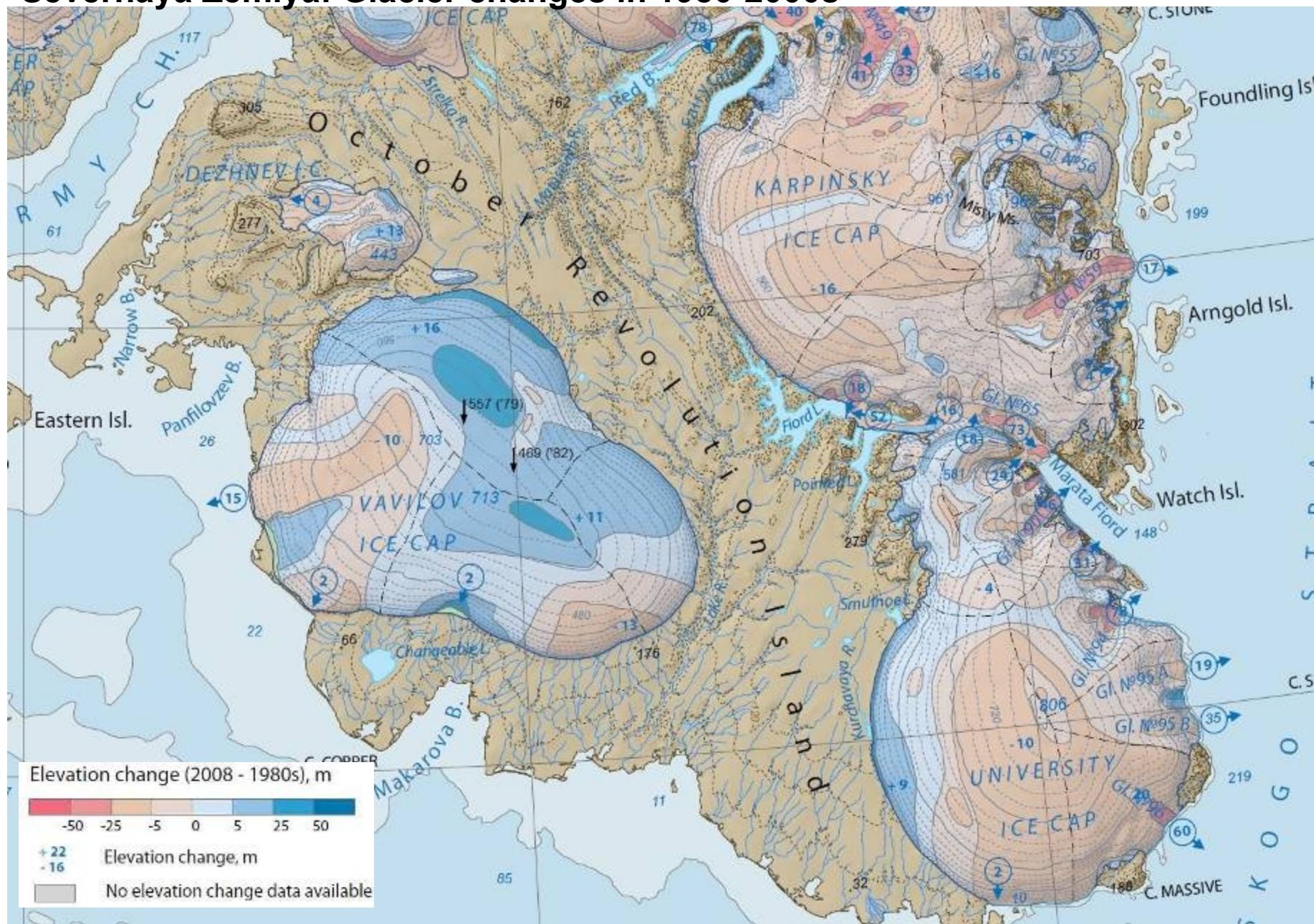
Final map product



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

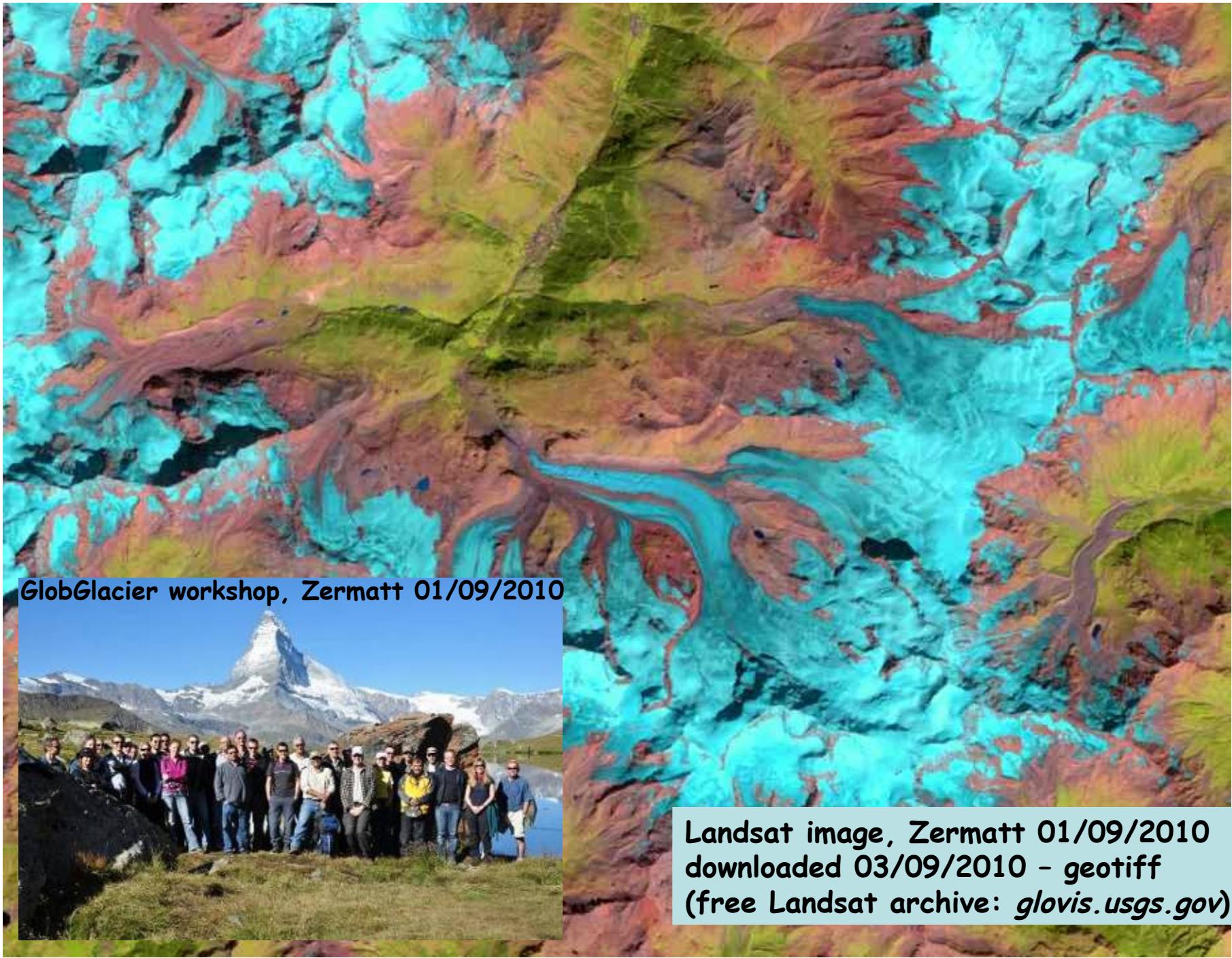


Severnaya Zemlya: Glacier changes in 1980-2000s

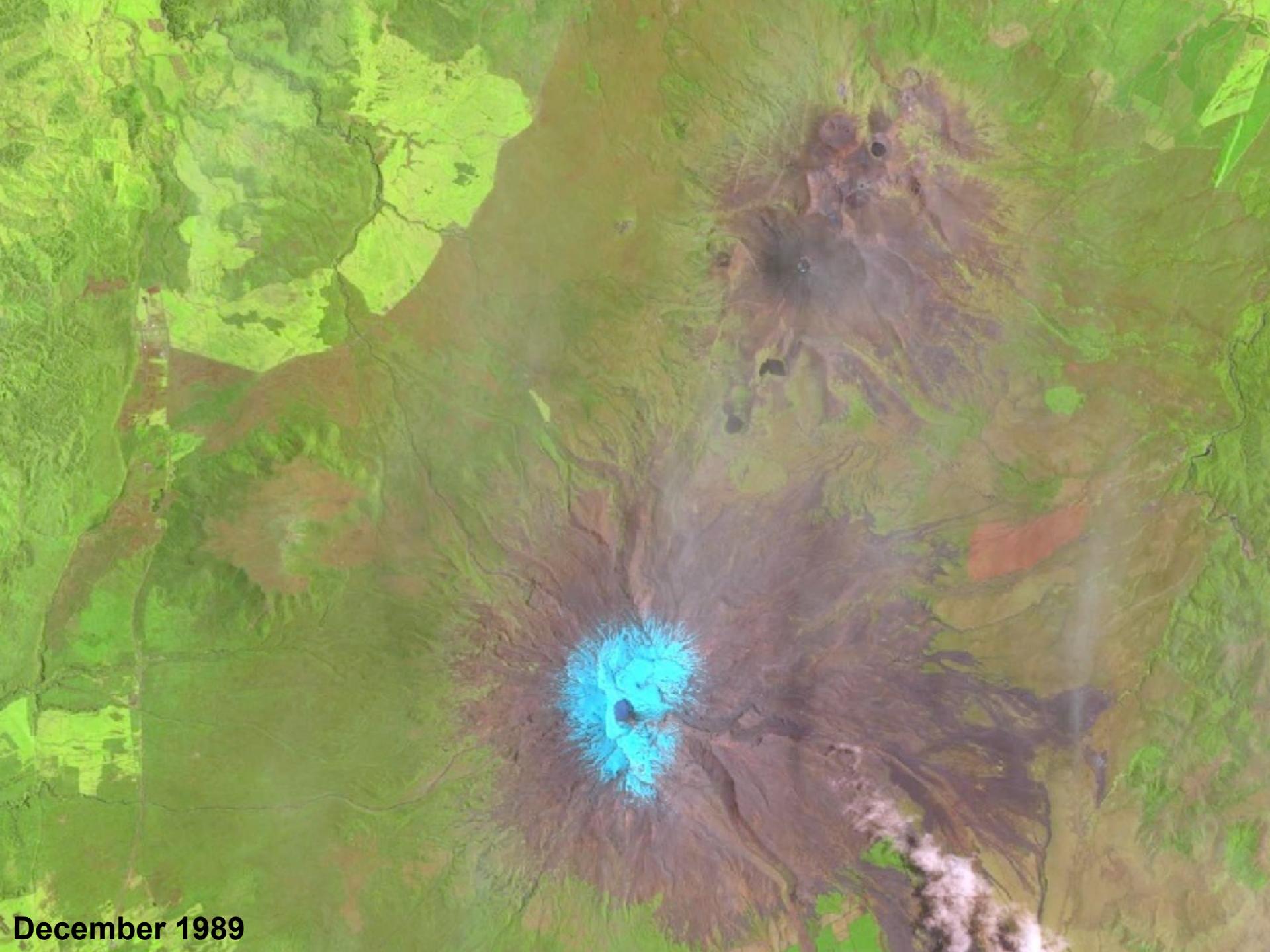




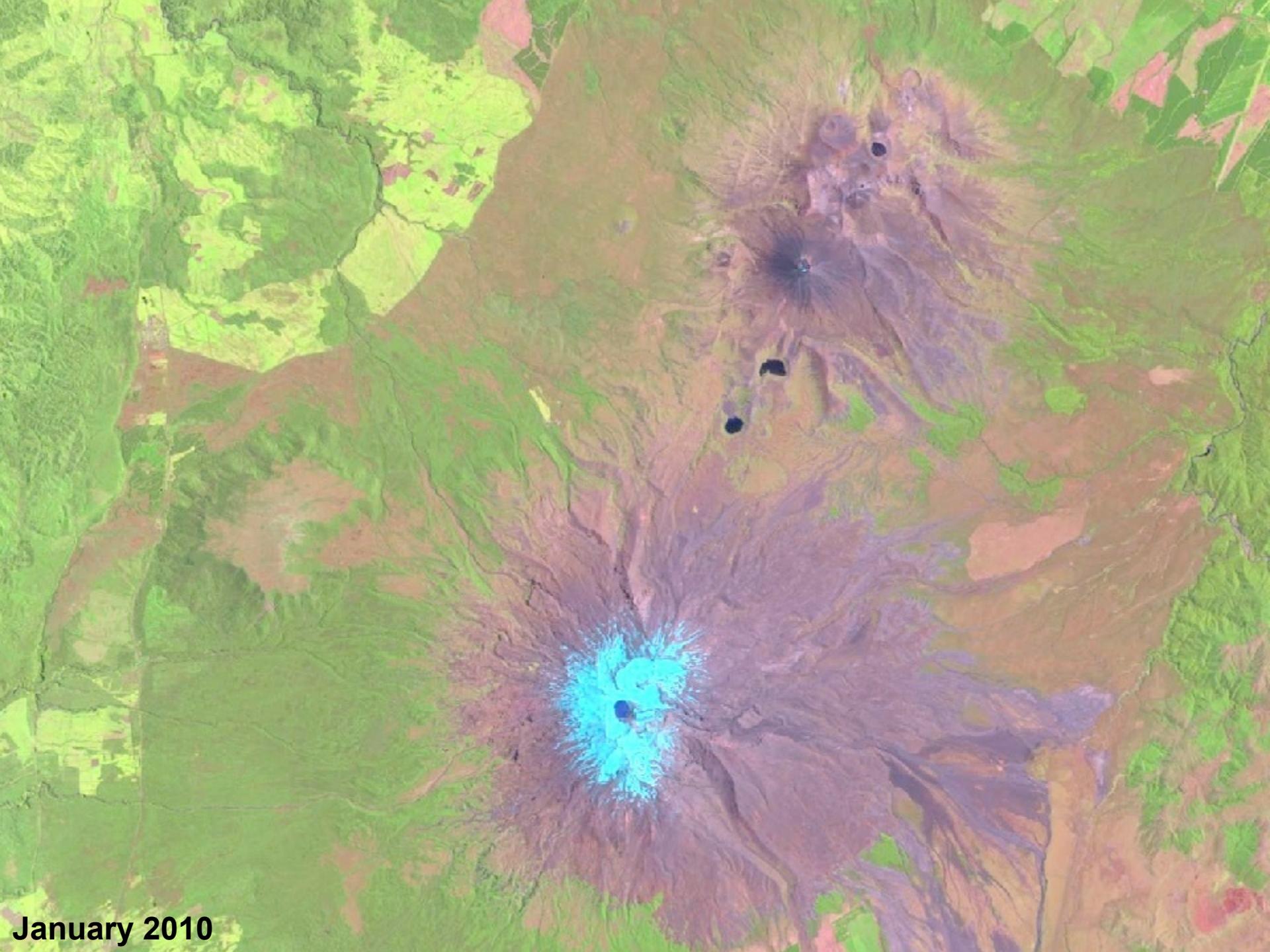
GlobGlacier workshop, Zermatt 01/09/2010



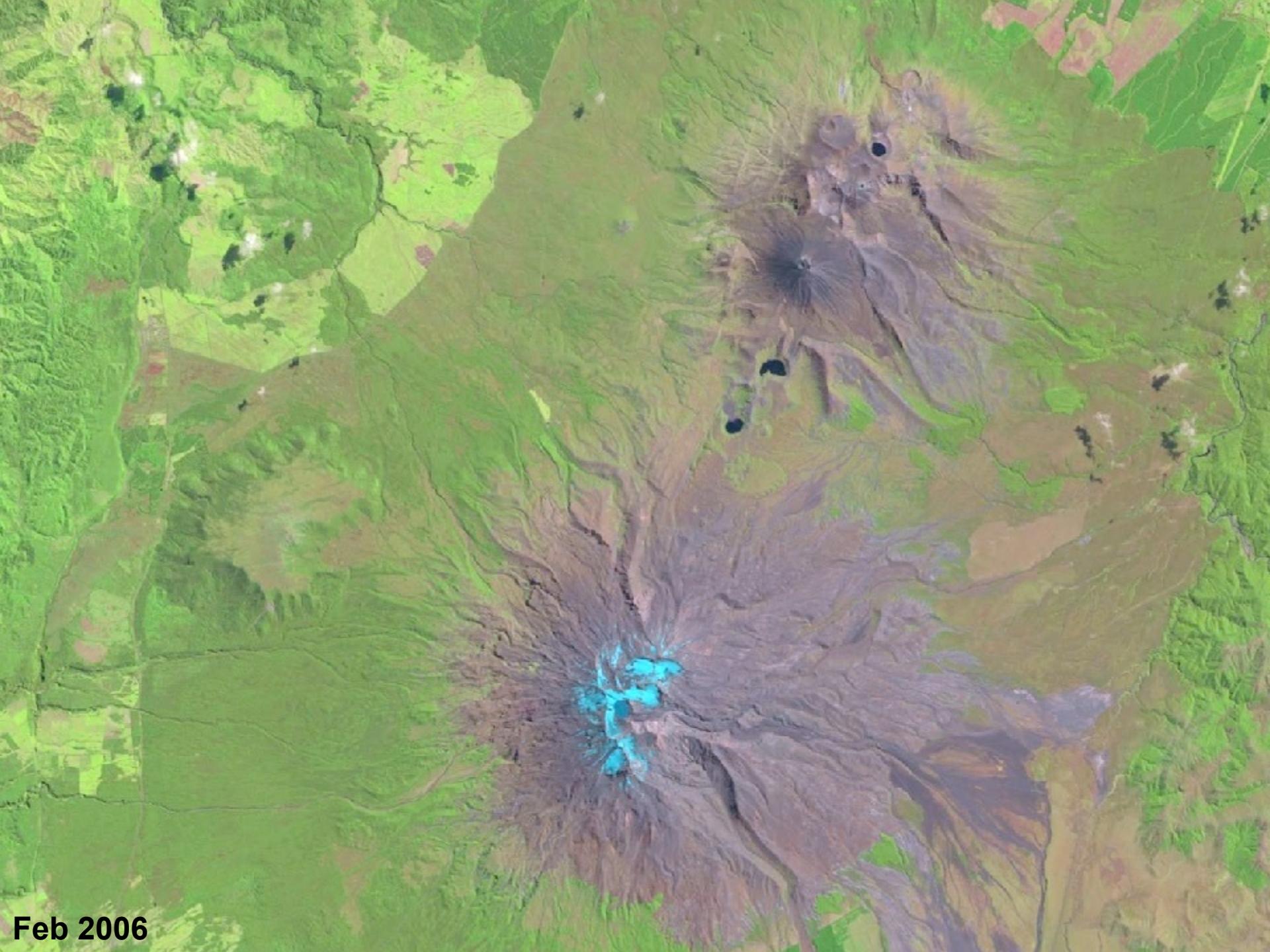
Landsat image, Zermatt 01/09/2010
downloaded 03/09/2010 - geotiff
(free Landsat archive: glovis.usgs.gov)



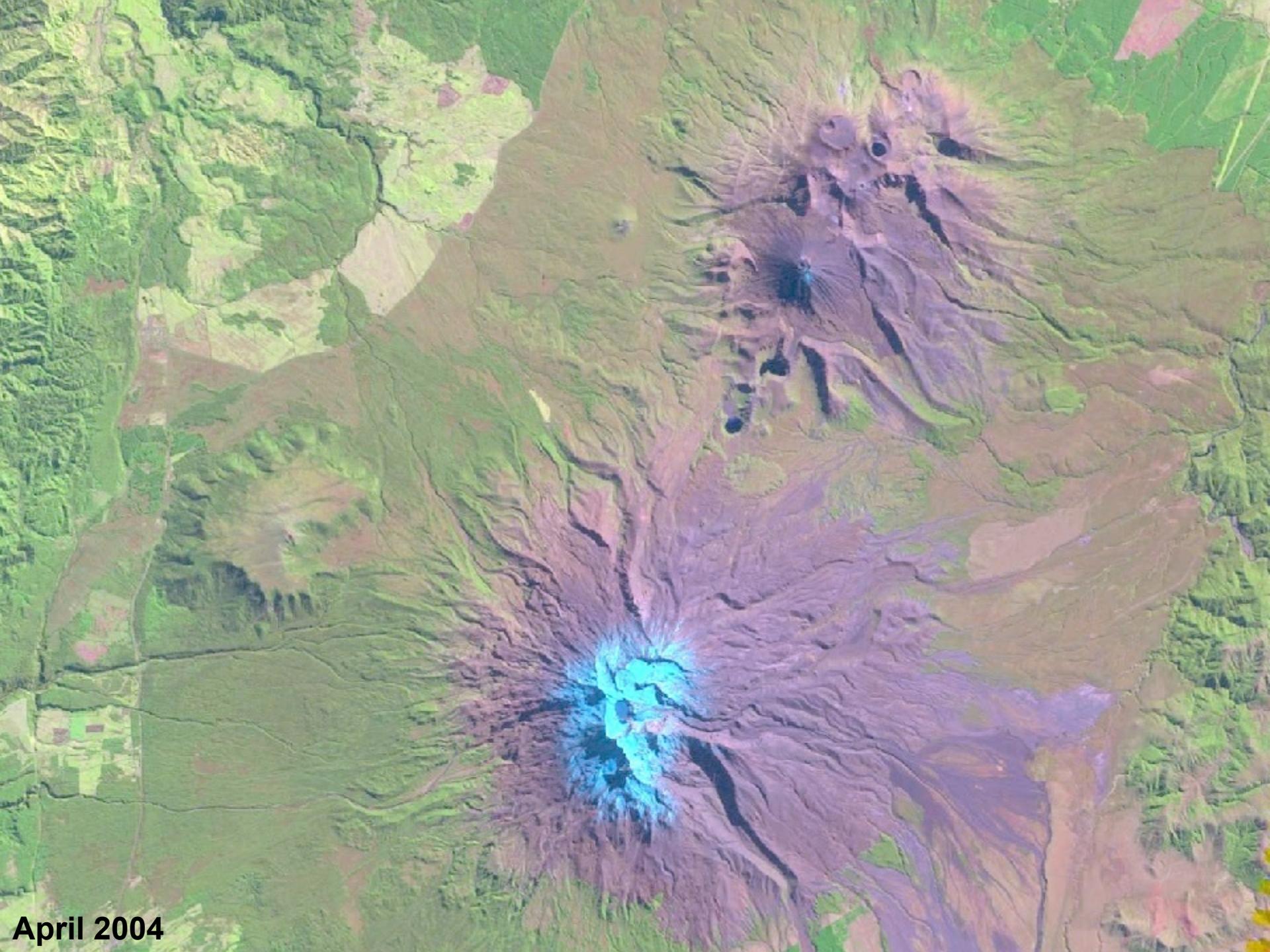
December 1989



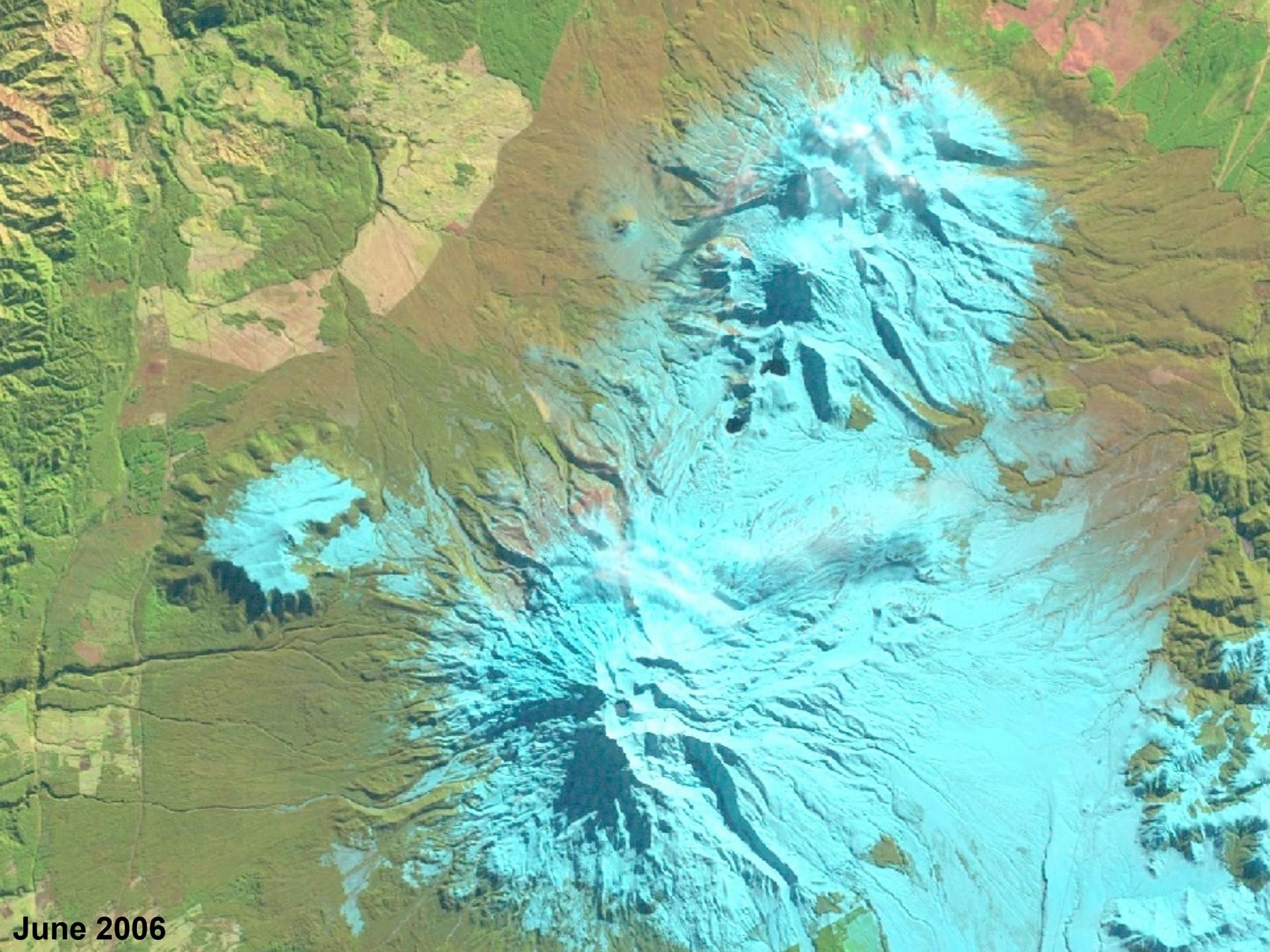
January 2010



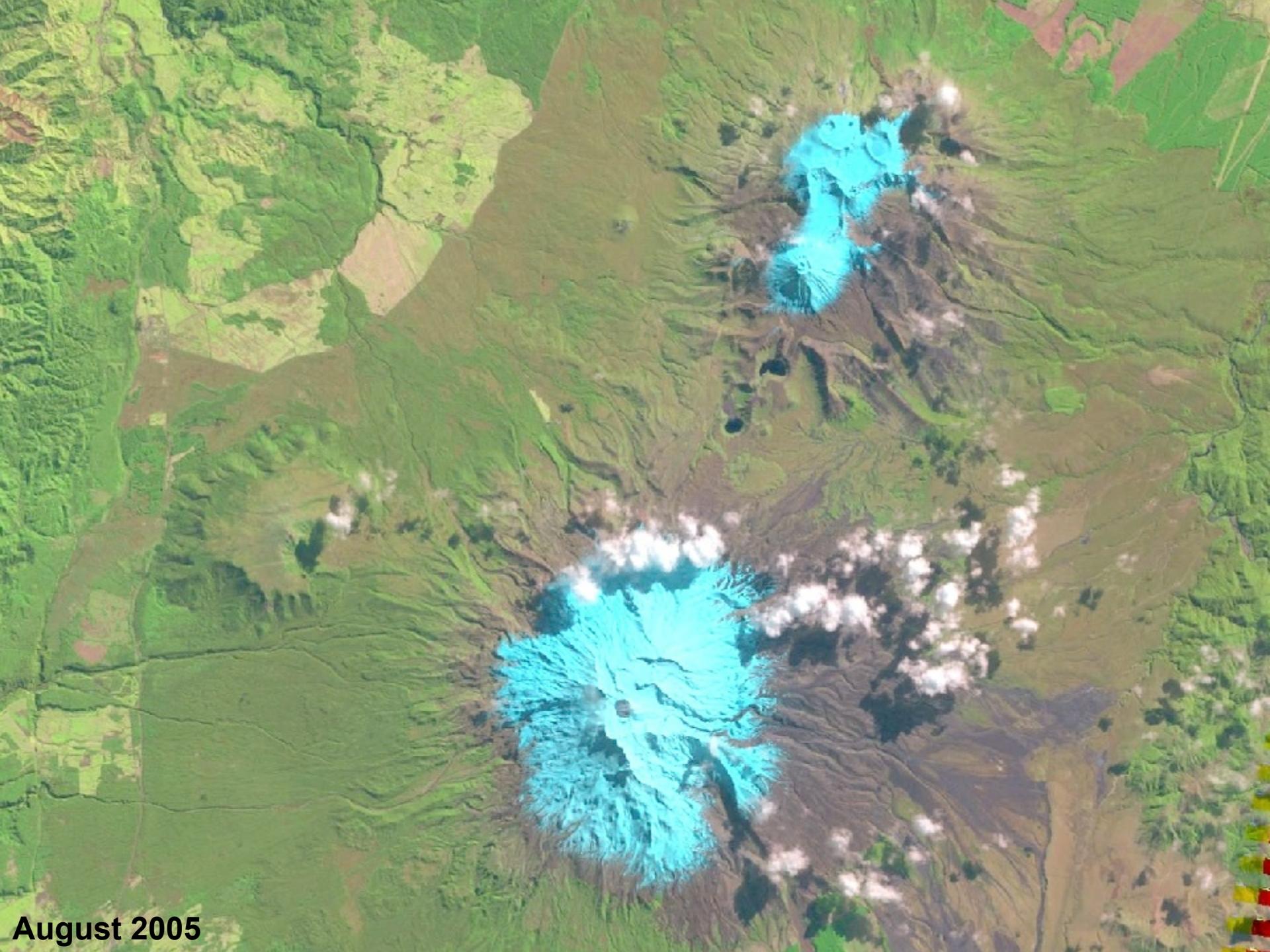
Feb 2006



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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