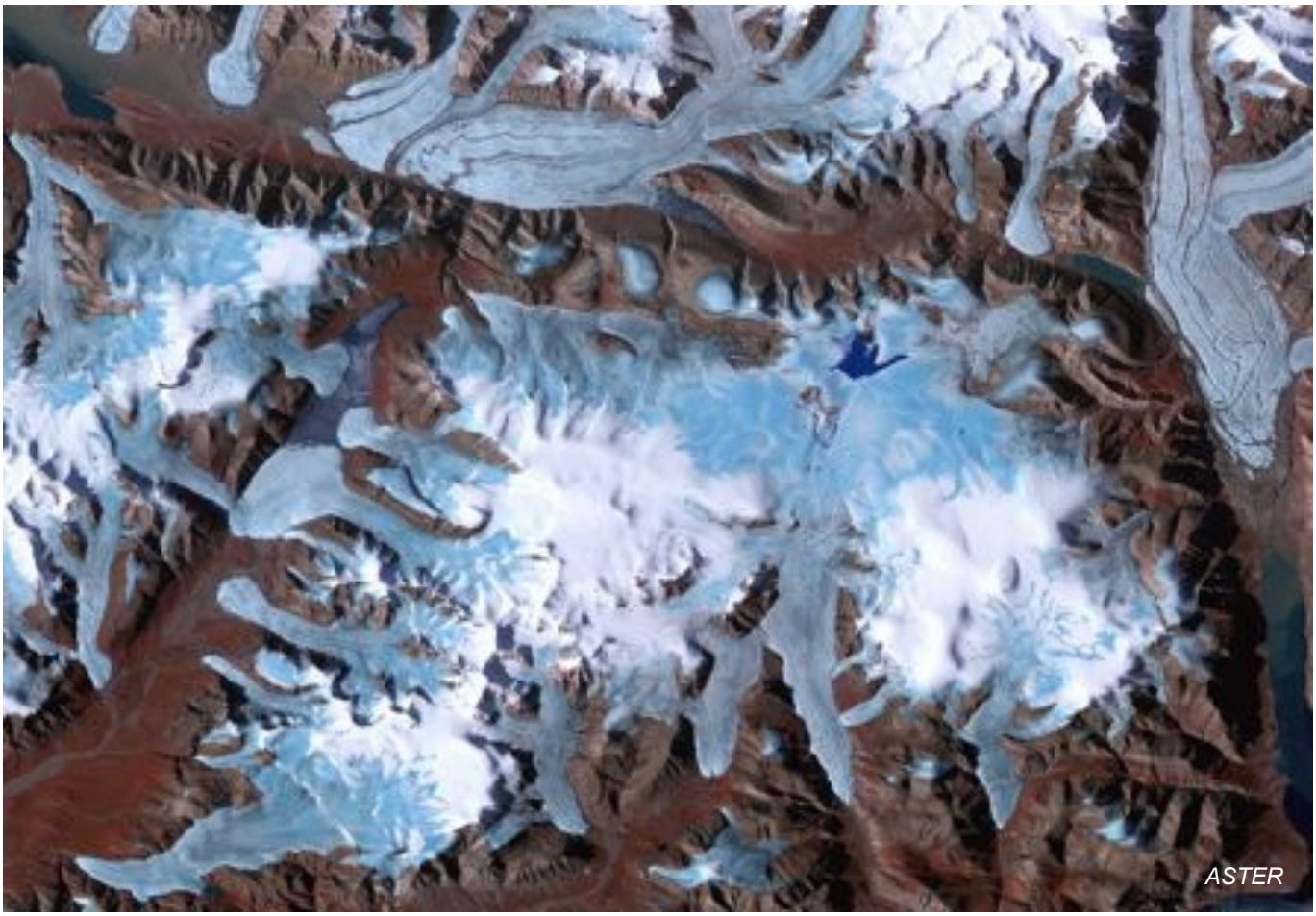
GLACIERS DISAPPEAR - GLOBALLY!

Frank Paul

University of Zurich, Switzerland



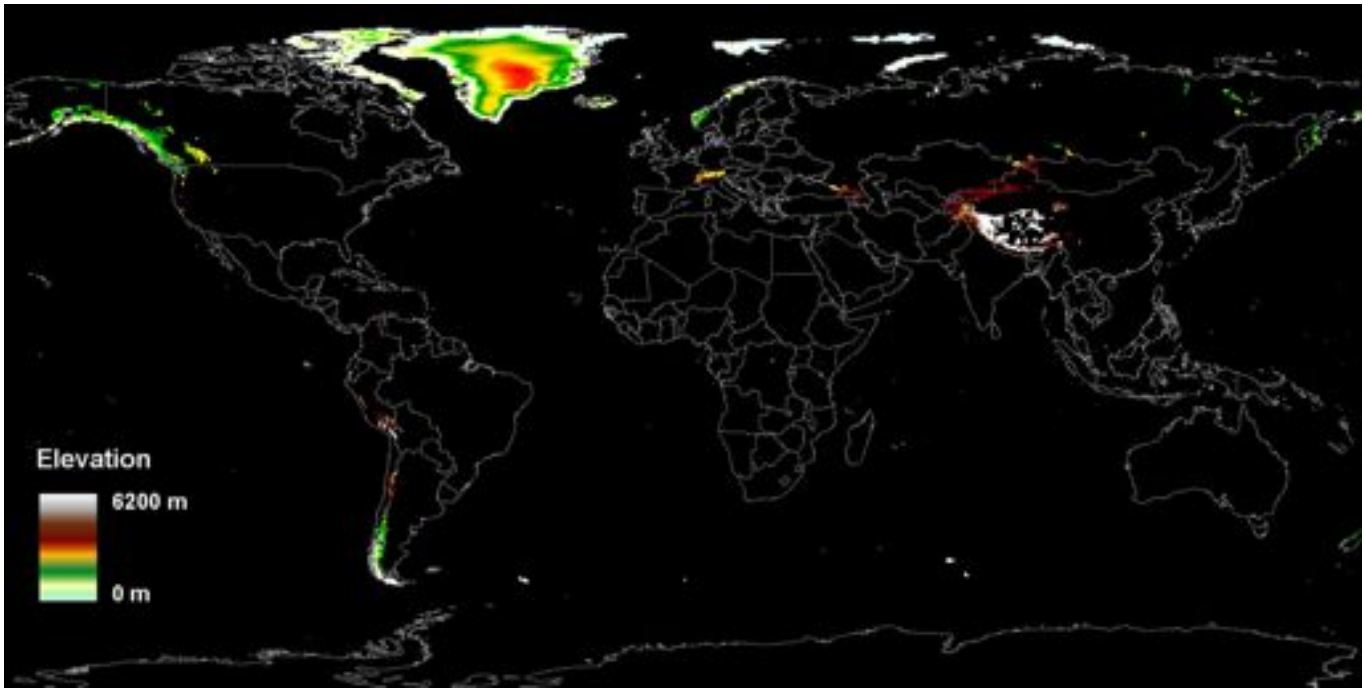
What is a glacier?

A glacier is build from compressed snow, it is not frozen water!

Glaciers only exist where snow can accumulate and survive the summer

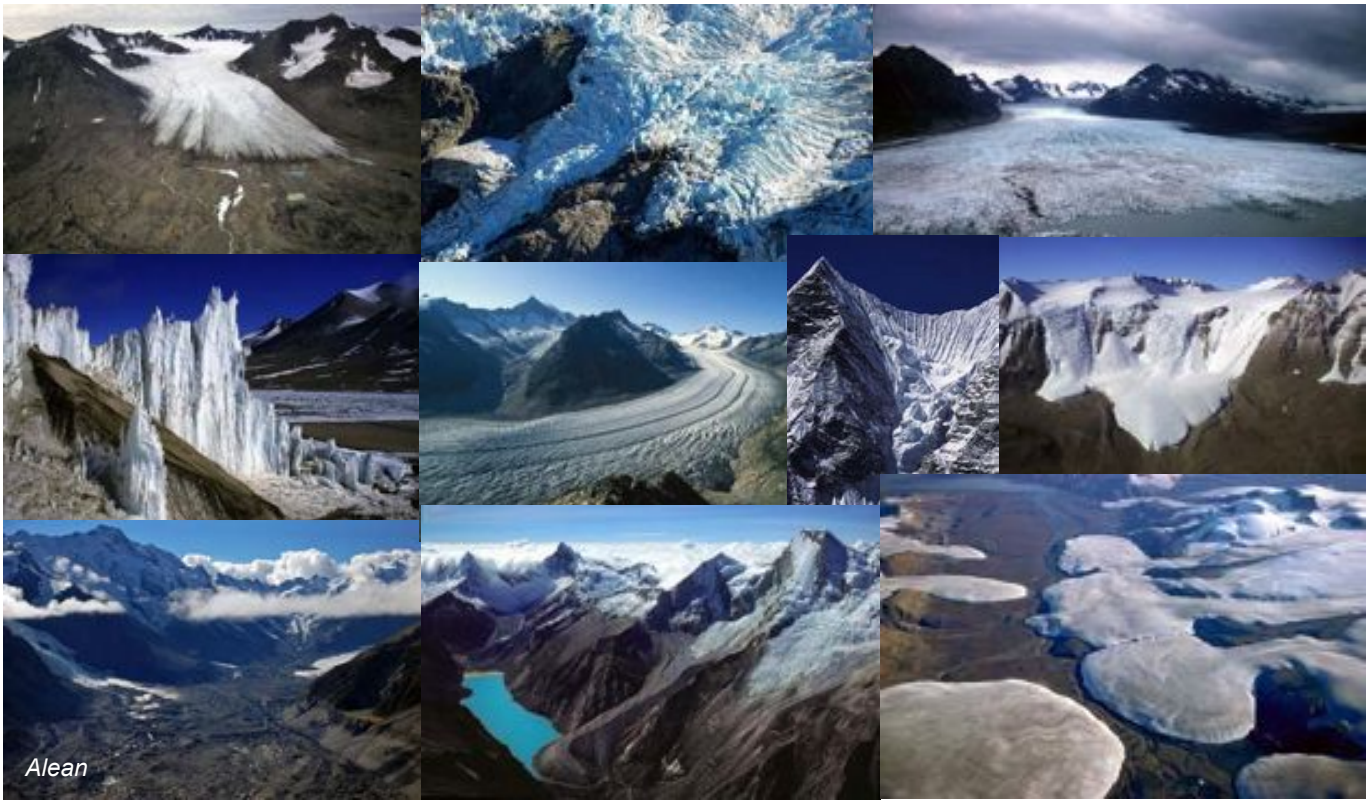
Requires low temperatures, sufficient precipitation and suitable topography

Where are they located?

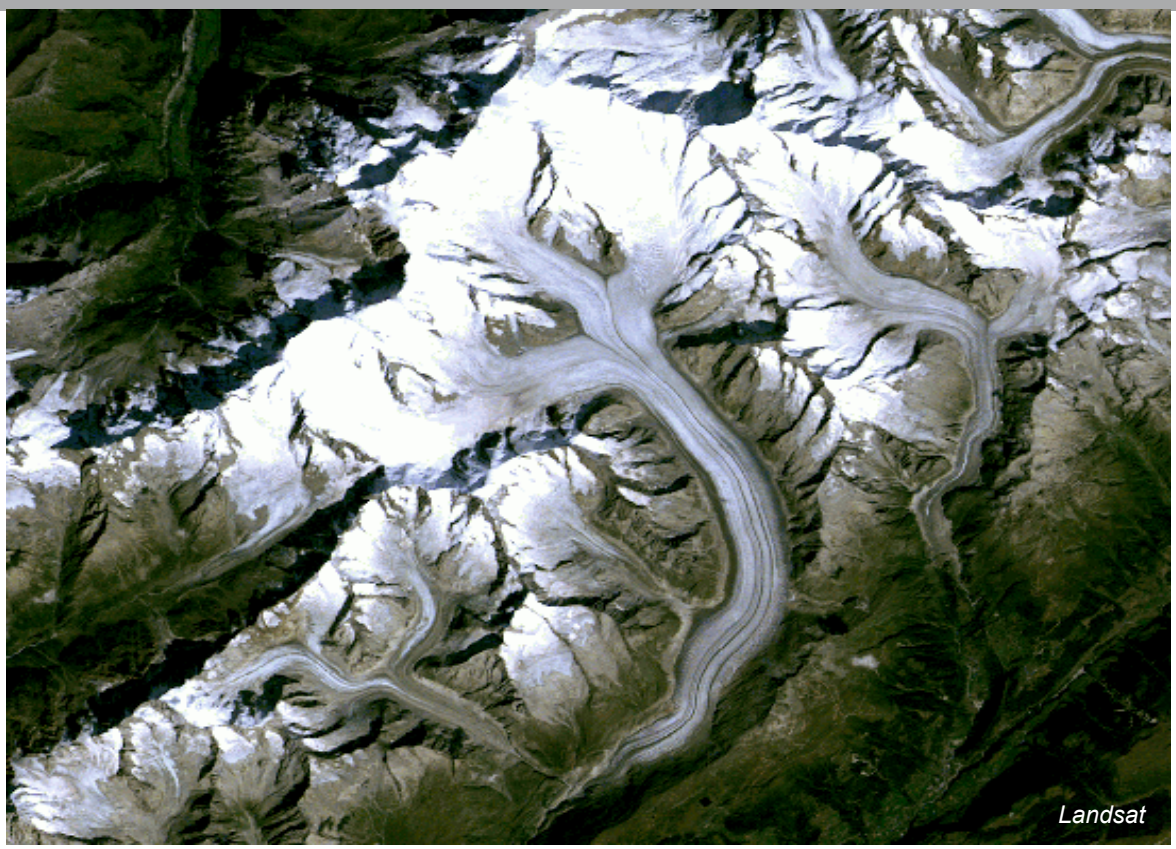


Thanks to satellite data we now have a globally complete glacier inventory

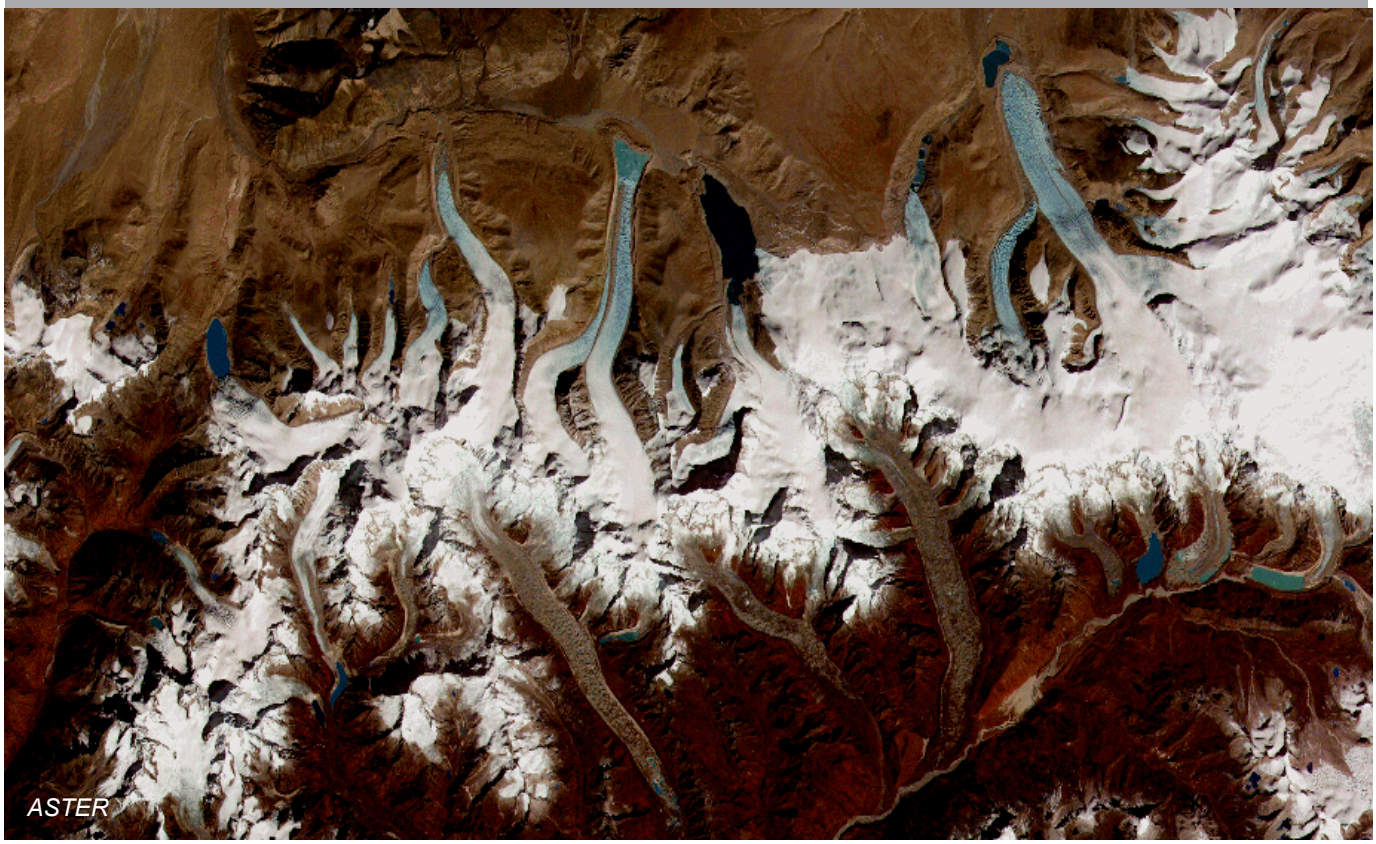
How do they look like?



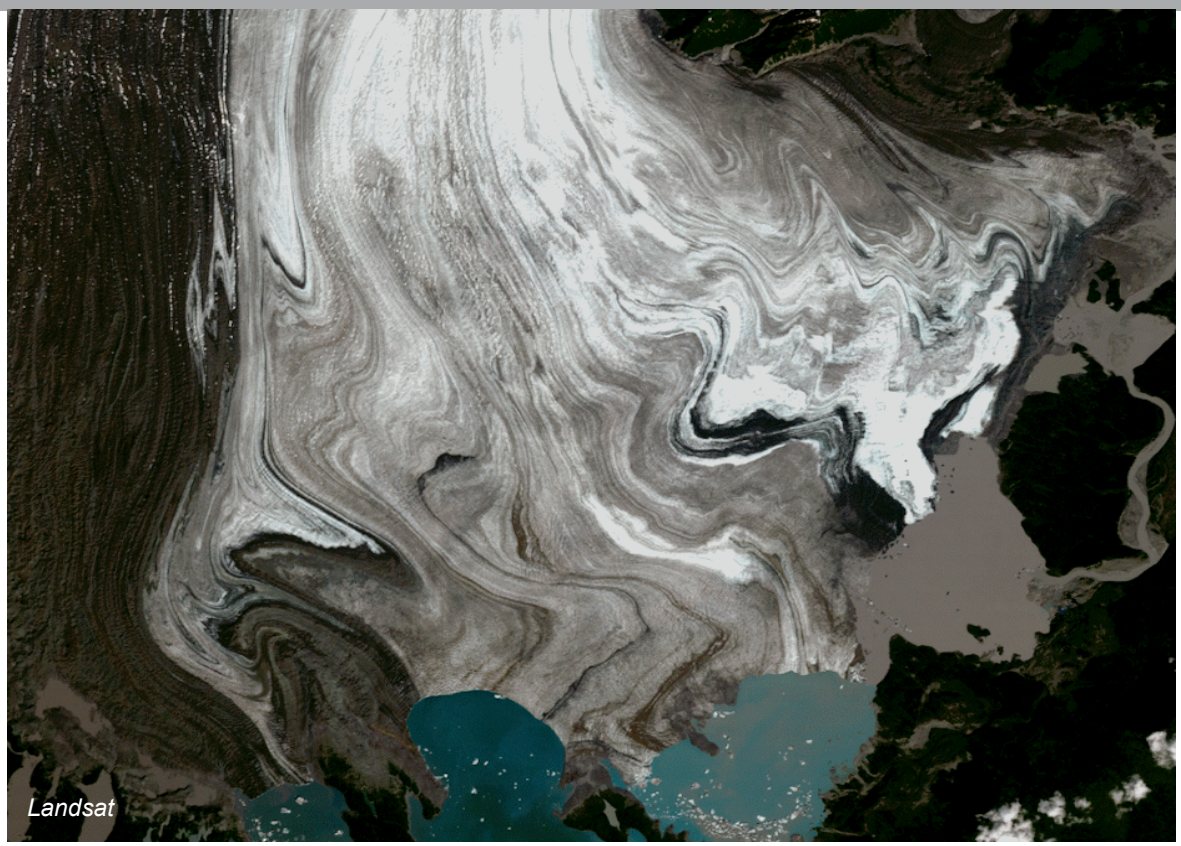
Alps



Bhutan



Alaska



Baffin Island

Why do we care?

Sea-level rise

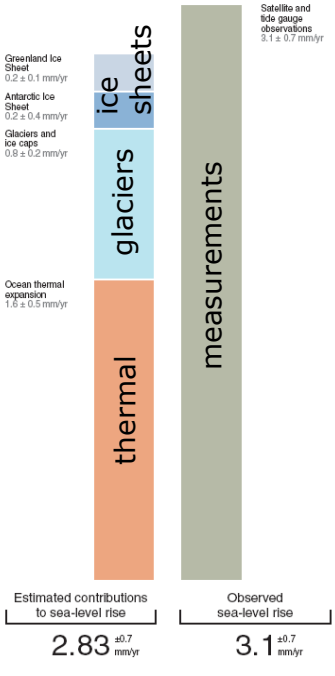


Figure 6C.4: Estimated contributions to sea-level rise from 1993 to 2003 (uncertainty intervals are 5 to 95%).

UNEP (2007)

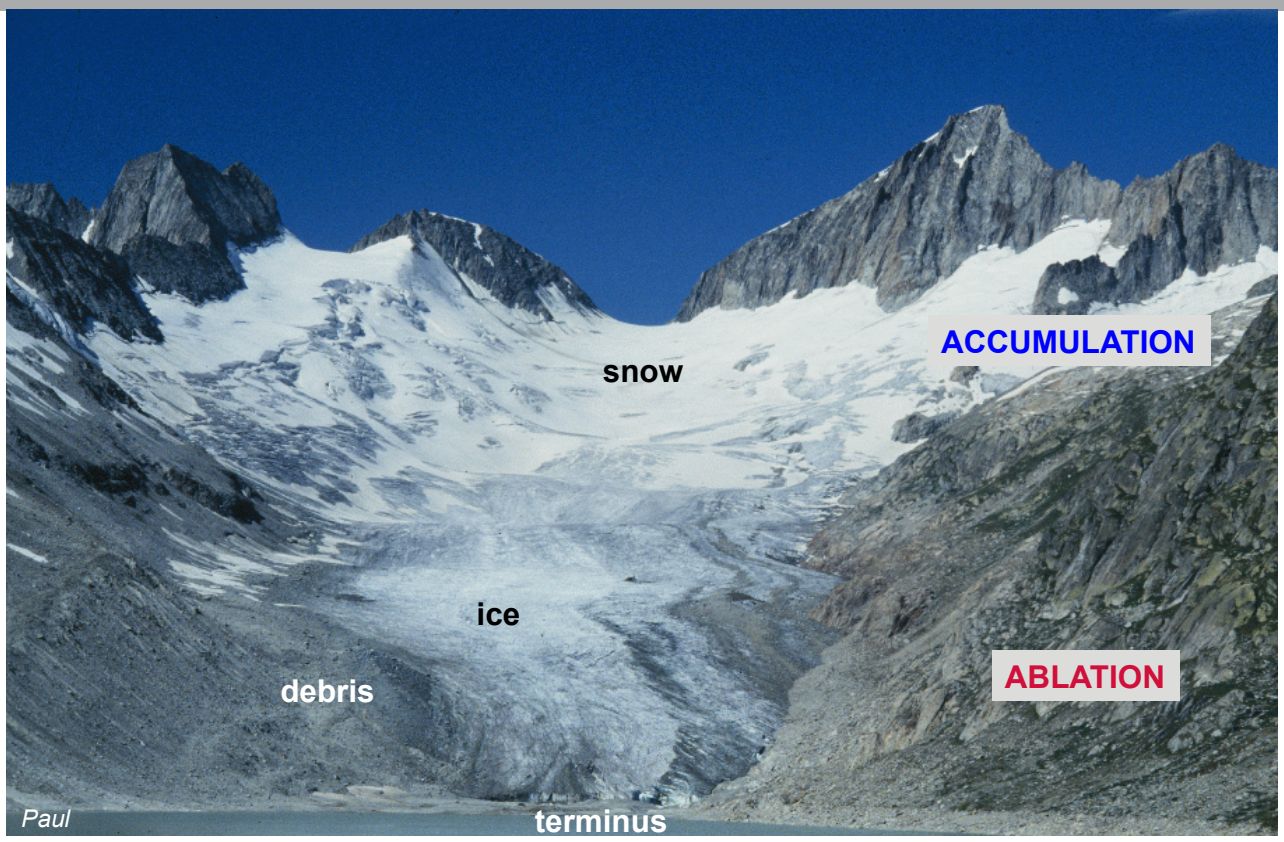
Hydro-power

Alean

Natural hazards

Hegglin

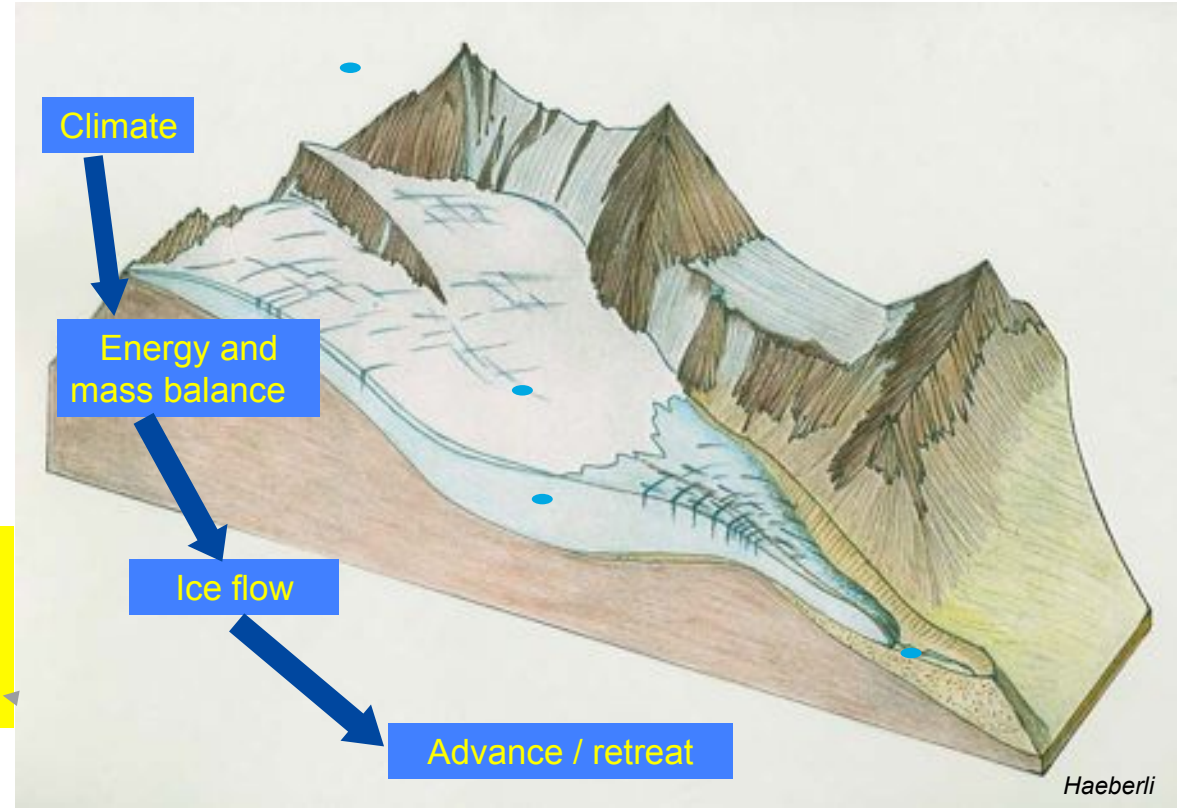
Terminology



Glacier response to climate change

direct, undelayed signal

indirect delayed, filtered and enhanced signal

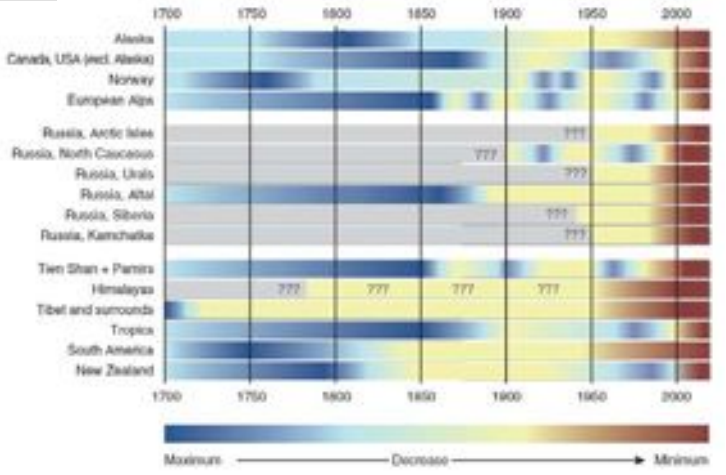


Length changes

Cumulative length changes of 3 Swiss glaciers

Haeberli

Global length change trends

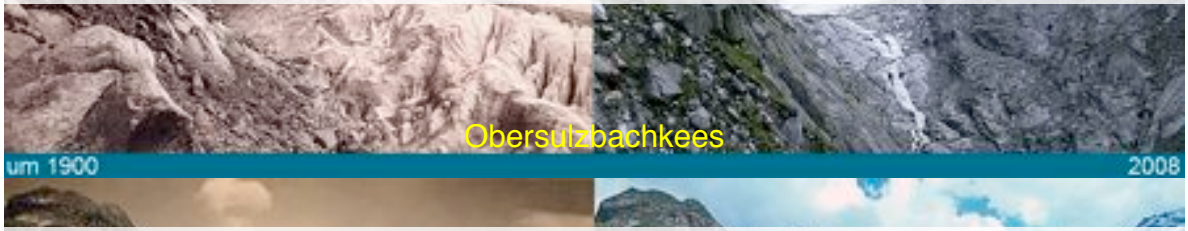


UNEP (2007)

Glaciers do not care for short-term fluctuations of the weather, they react to long-term changes in climate

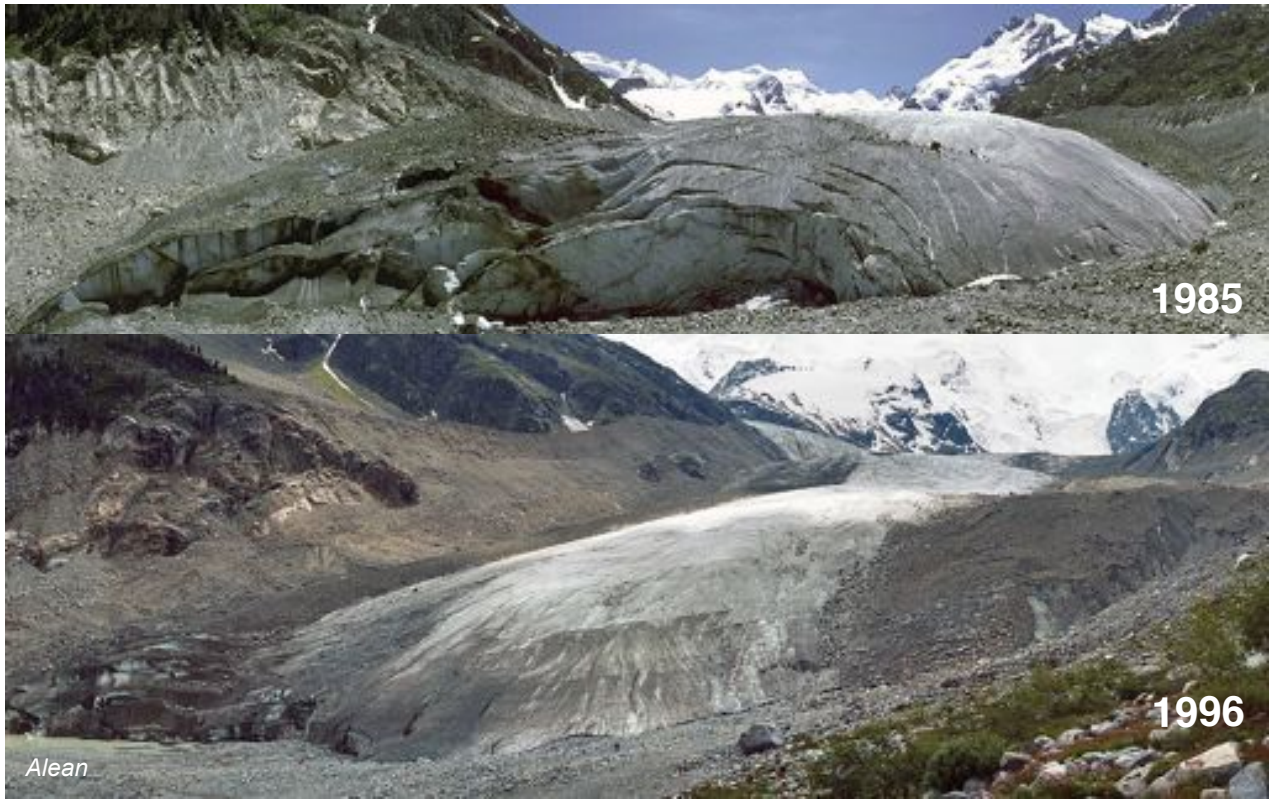
Why are glaciers good climate indicators?

Because small changes in climate cause very large changes in glacier length



Because the ice is at the melting point and each additional energy input is used to melt the ice

Retreat of Morteratsch Glacier



Retreat of Morteratsch Glacier

Why do glaciers disappear?

Glaciers can only exist when the input (snow) is the same as the output (melt)

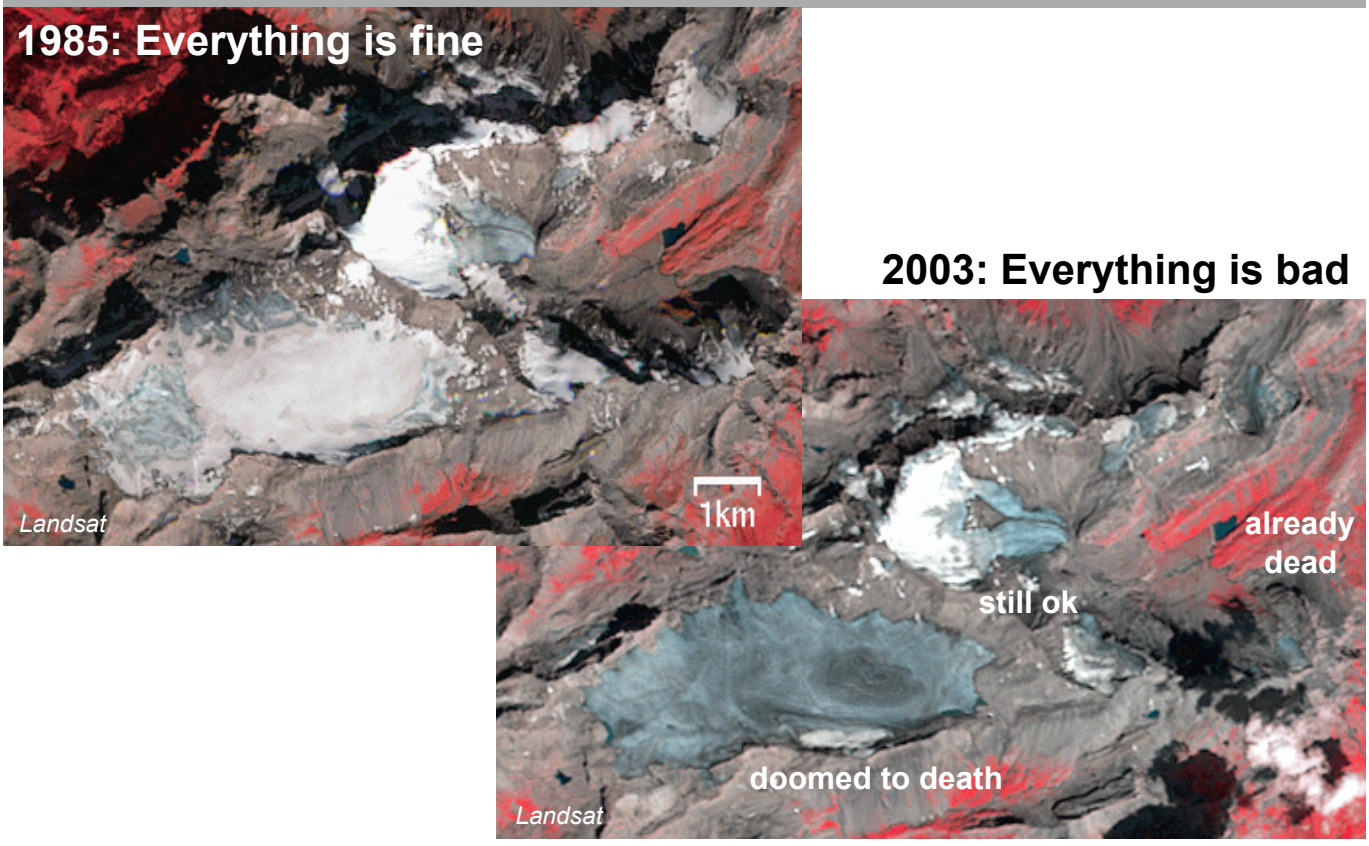
This requires that 1/2 of the glacier area is snow covered at the end of summer

Glaciers will adjust their size to this ratio or disappear when no snow is left

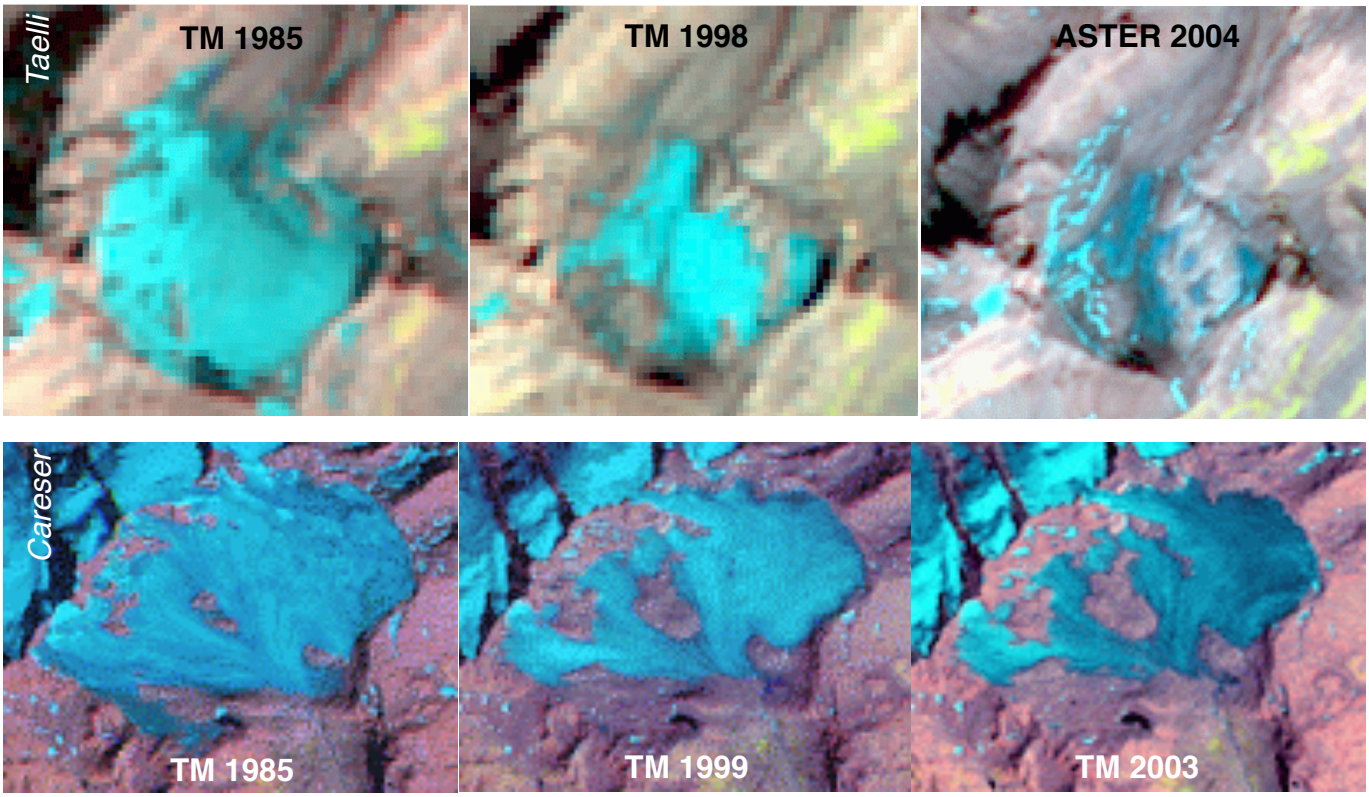
For a 1 degree temperature increase, the snow lines moves 150 m upwards

Google Maps

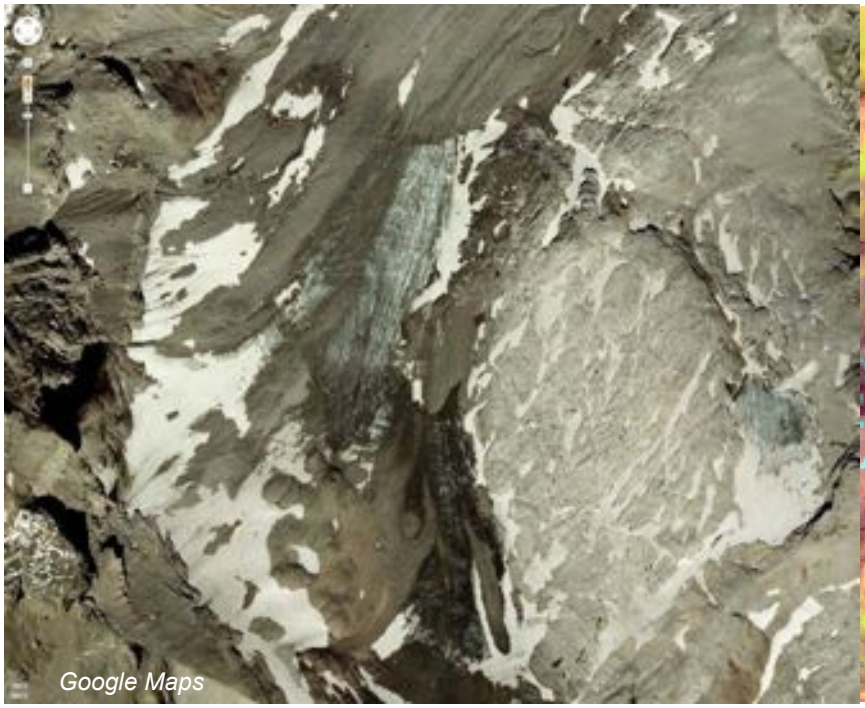
No snow, no glaciers!



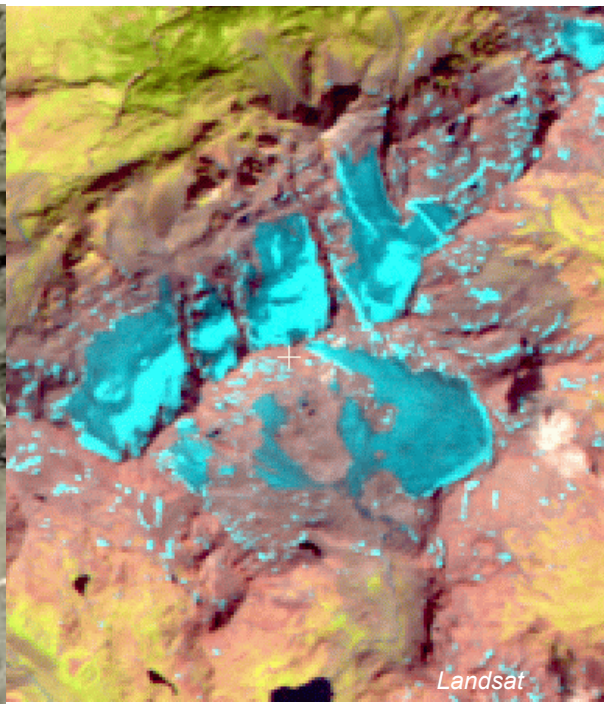
The disintegration of Taelli and Careser glacier



The last remnants of Taellli and Careser glacier



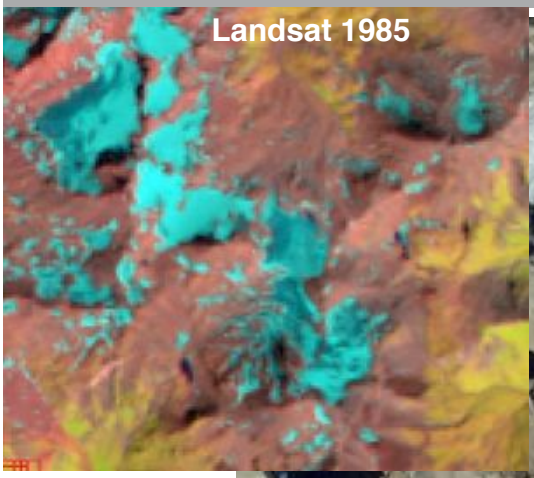
Taelli 2010

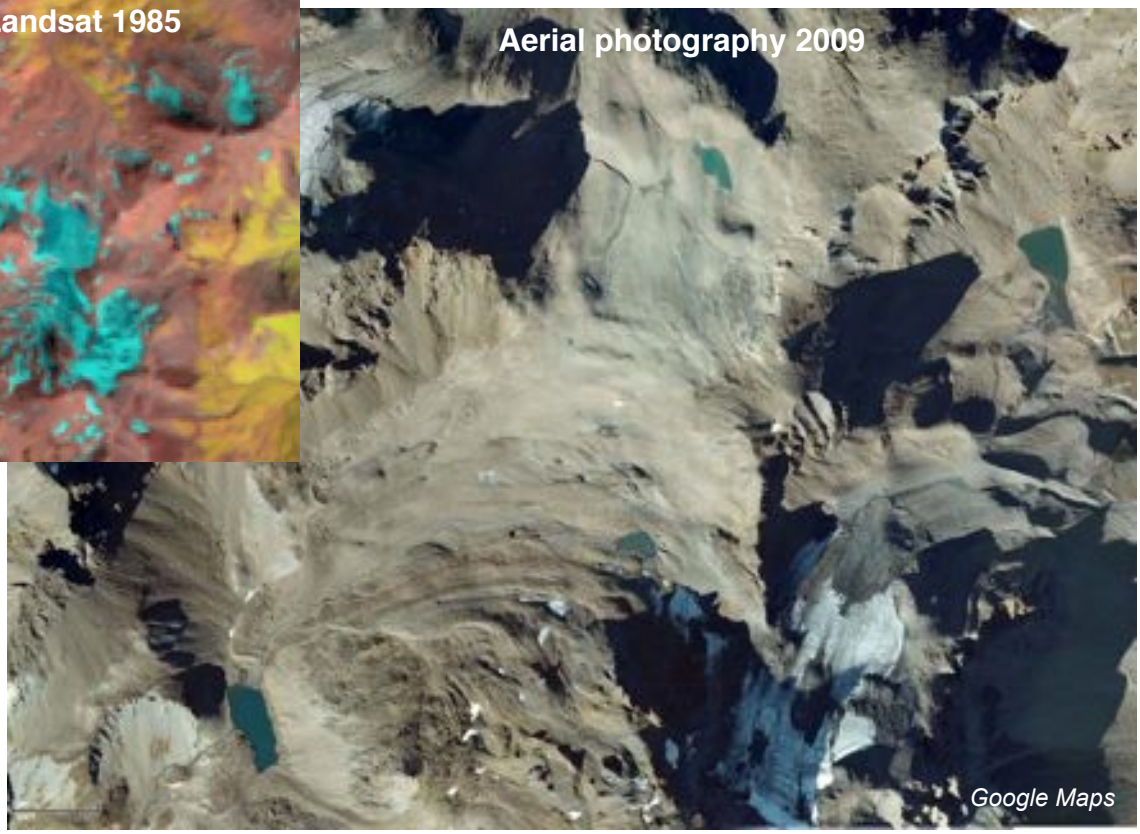


Careser 2009

Glacier de Sarennes, French Alps

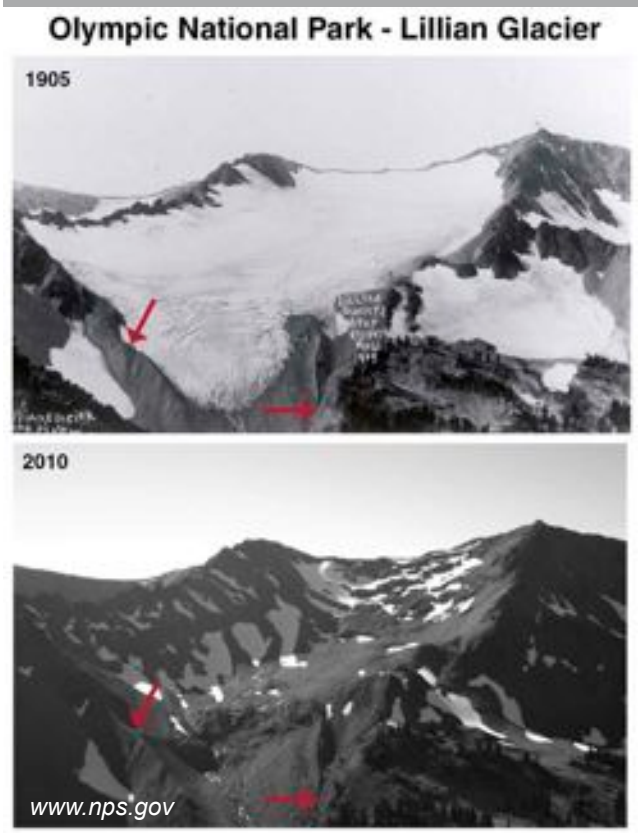
Silvretta (Alps): Why also this one?





low elevation
flat, exposed

Disappearing glaciers in the US



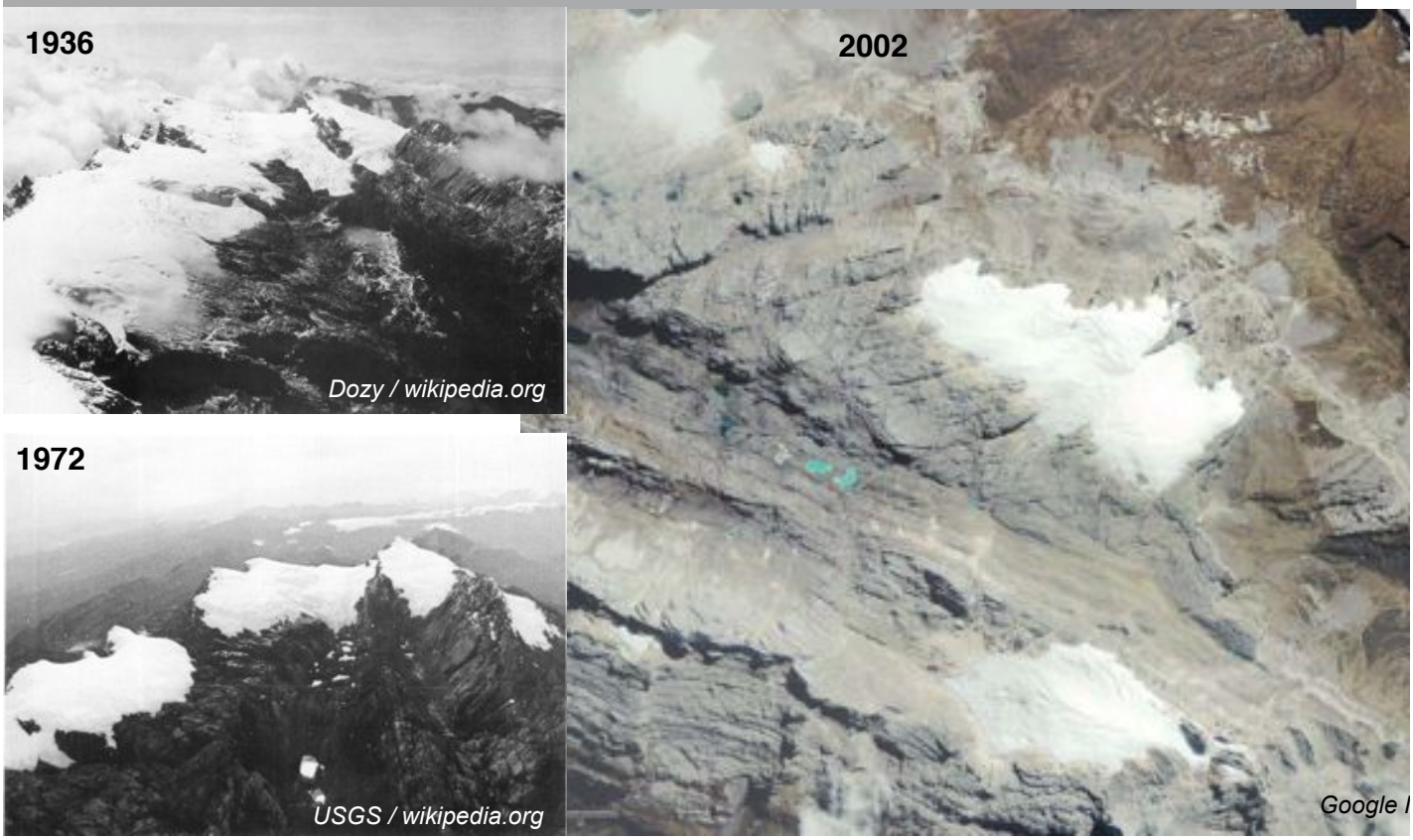
Disappearing glaciers in Alaska

Braasch

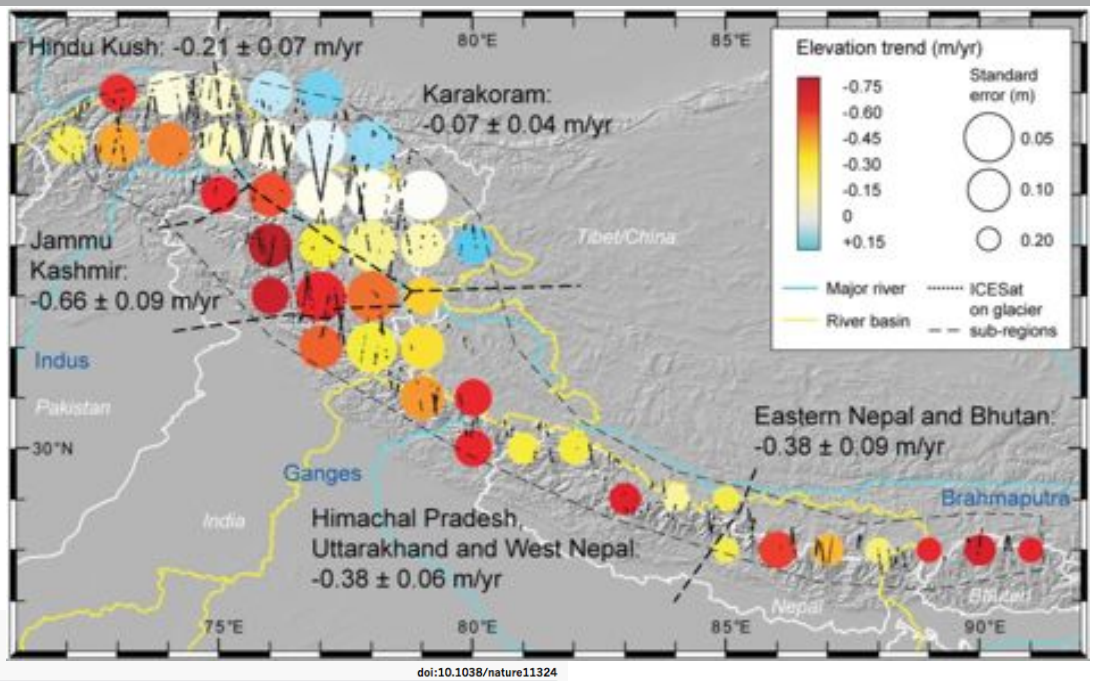
USGS / epa.gov

Cho-Oyu (Himalaya): Kyetrack Glacier

Irian Jaya (Indonesia): Carstensz Glacier



Glacier thickness change in the Himalaya



LETTER

doi:10.1038/nature11324

Contrasting patterns of early twenty-first-century glacier mass change in the Himalayas

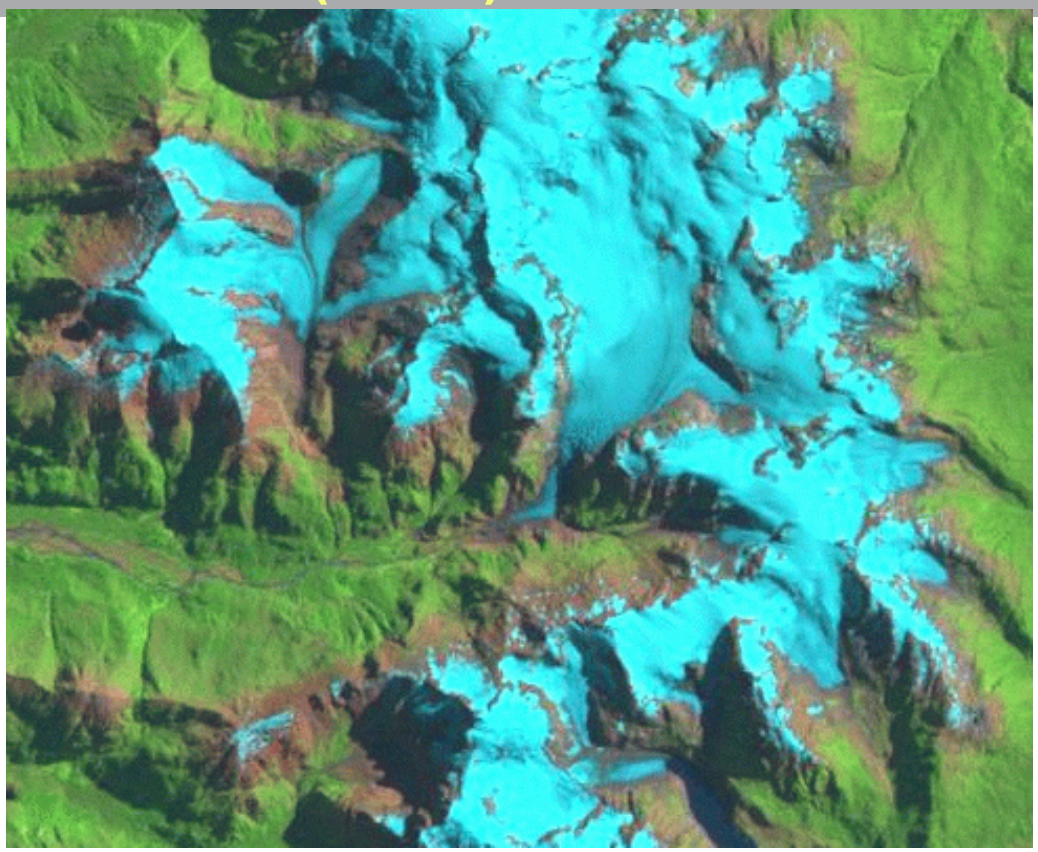
Andreas Kääb[1], Etienne Berthier[2], Christopher Nuth[1], Julie Gardelle[3] & Yves Arnaud[4]

Kääb et al. (2012): **Nature**, 23 August

Dry Andes (Bolivia): Chacaltaya Glacier

treehugger.com

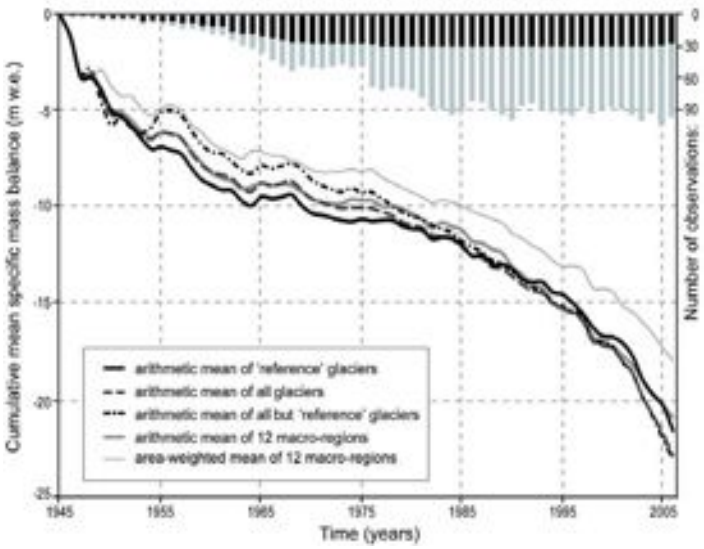
Wet Andes (Chile): 1985 - 2000 - 2009



Landsat

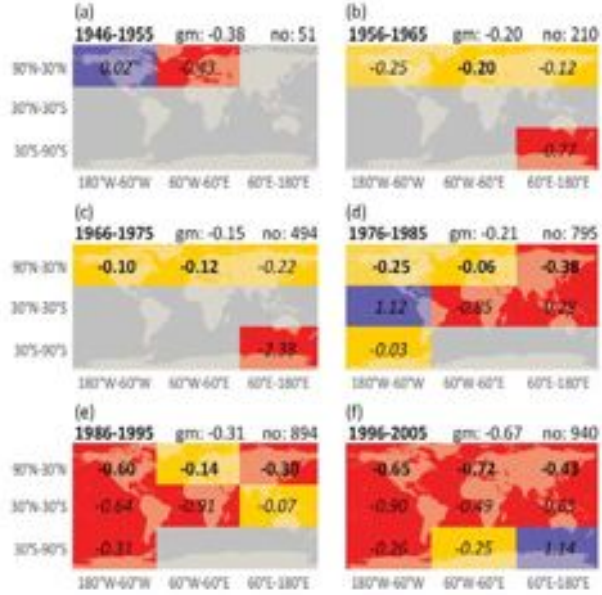
Mass balance

Cumulative mass balance (global averages)



Zemp (2009)

Global mass balance trends



WGMS (2008)

If you want to know more:

http://www.unep.org/geo/geo_ice/

http://www.grid.unep.ch/glaciers/

Thank you for attention!