

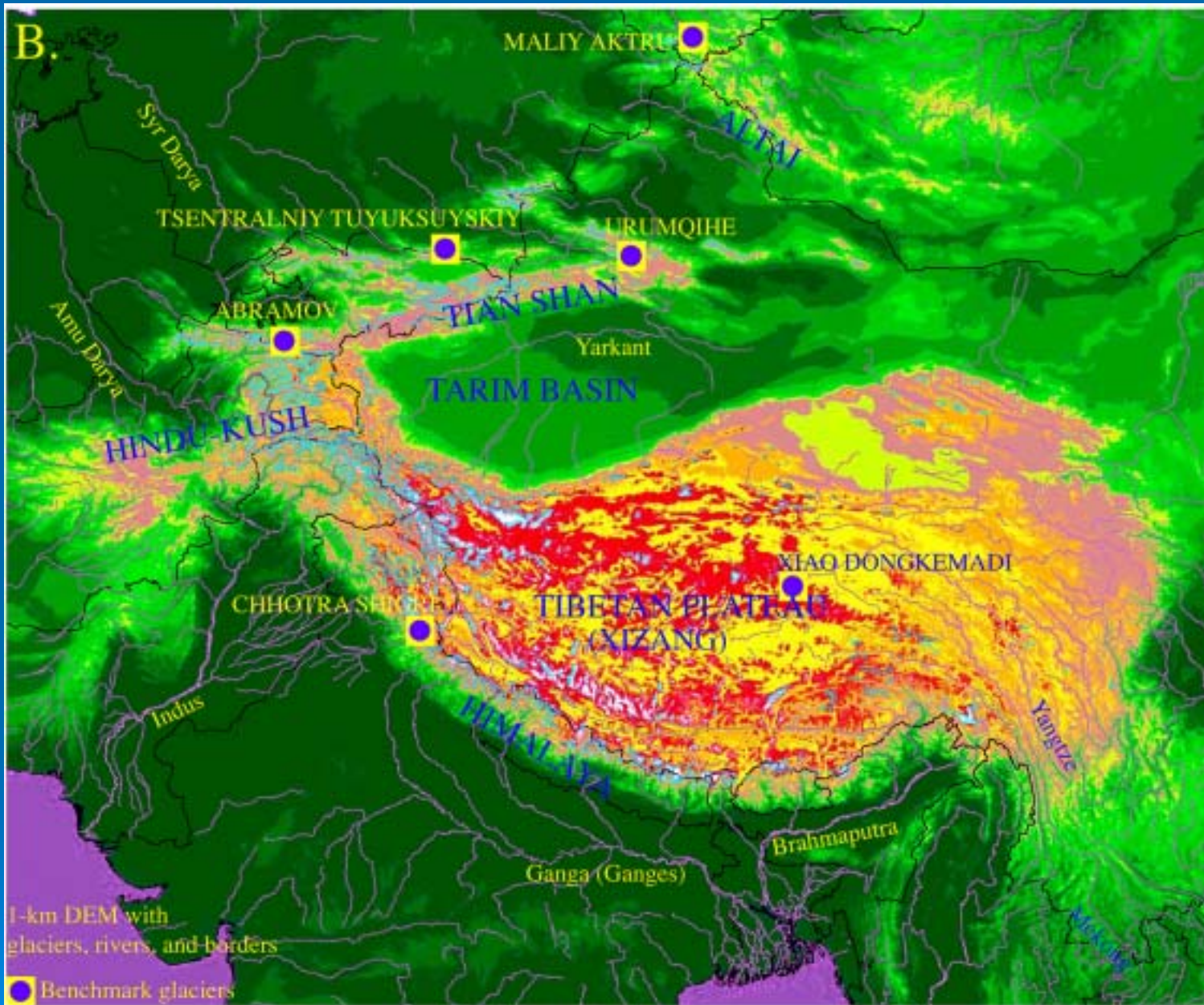
100 Years of Glacier Retreat in Central Asia

XVI INQUA Congress, Reno, Nevada, July 28, 2003

- Jeffrey S. Kargel
- Alan Gillespie
- N.V. Arzhannikova
- S. Arzhanikov
- A. Bayasgalan
- M.P. Bishop
- S. Hasnain
- A. Kaeaeb
- V. Sheinkman
- R. Wessels



MODIS+GLIMS Glacier database



Benchmark Glaciers

07 May 2001

Rongbuk Gl.



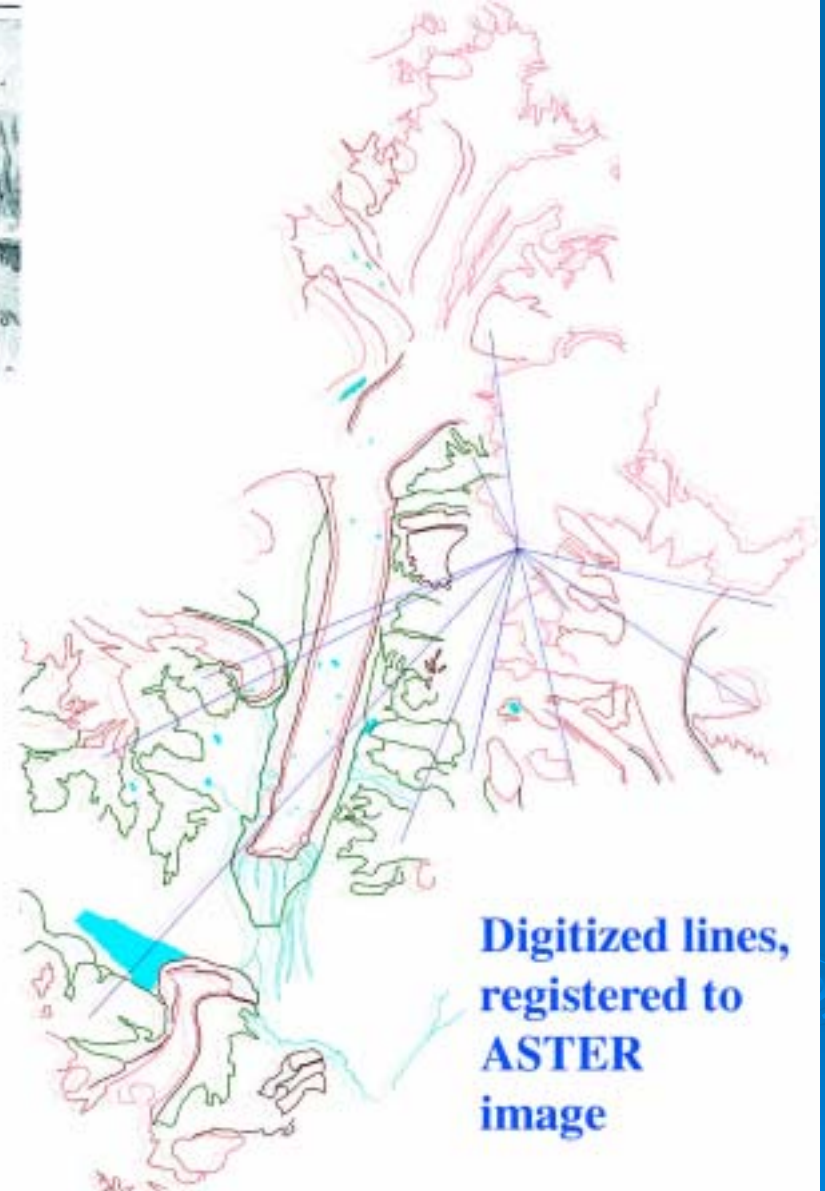
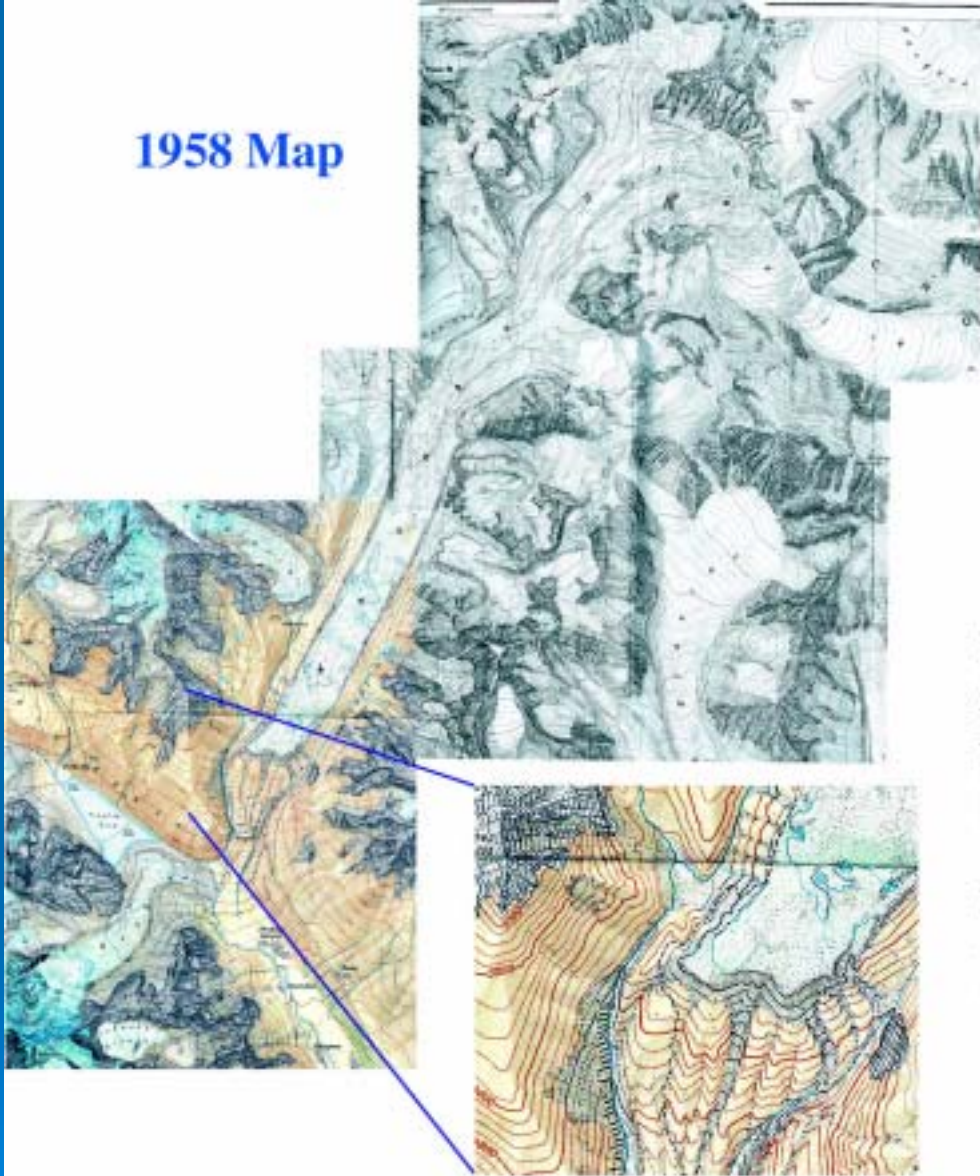
Mt. Everest

Khumbu Gl.



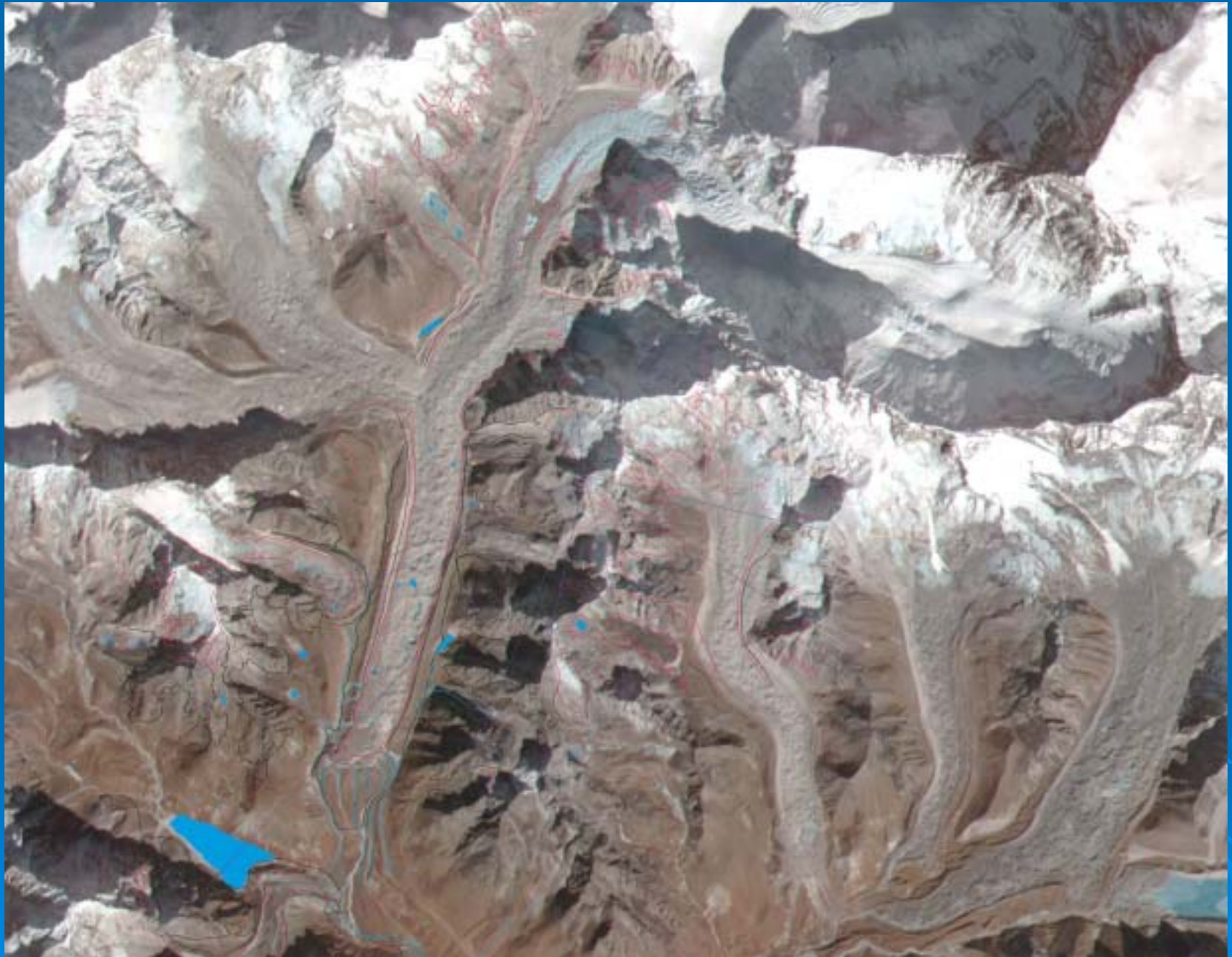
Everest ASTER Mosaic, 2001

1958 Map

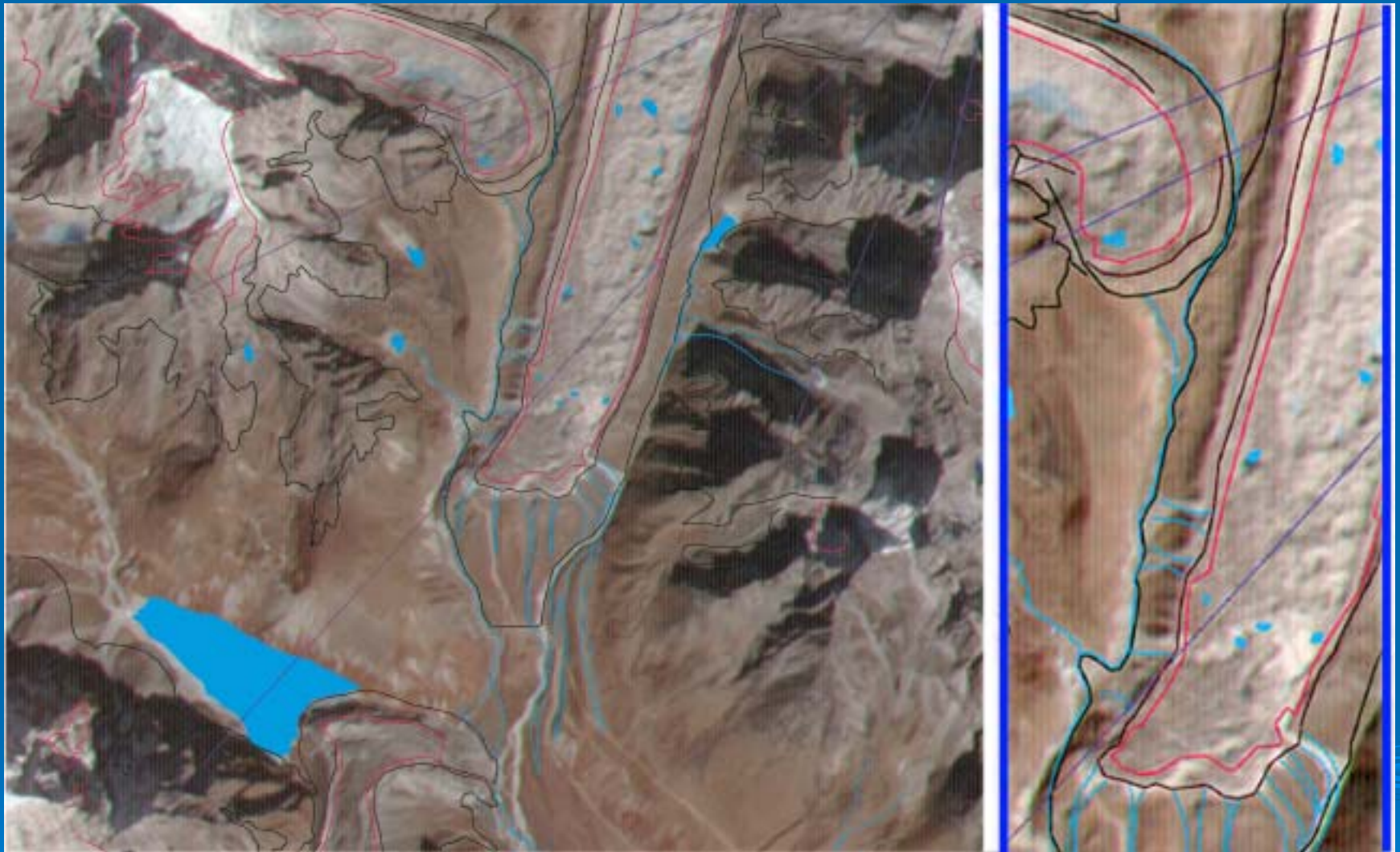


Digitized lines,
registered to
ASTER
image

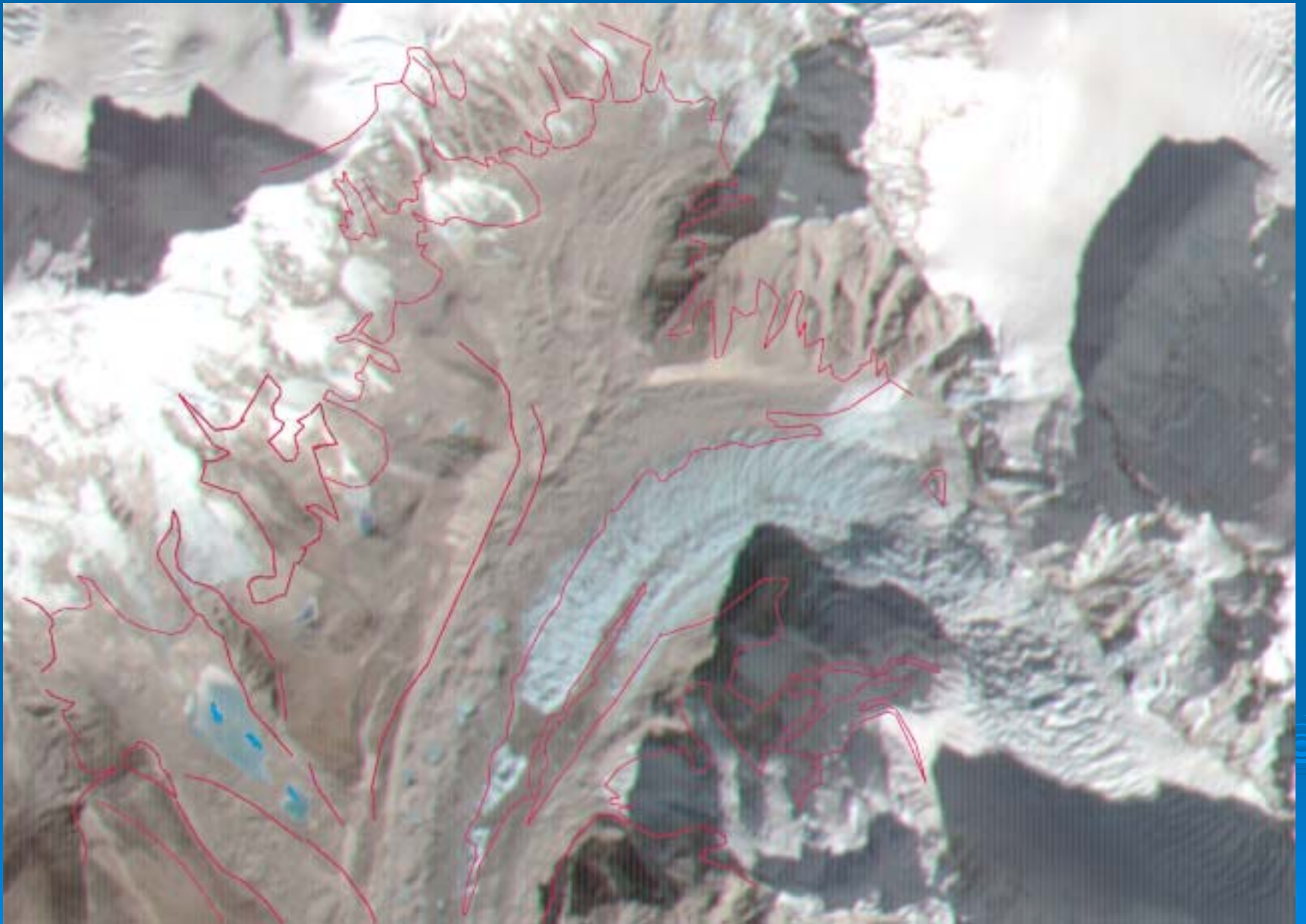
Khumbu Glacier, Nepal, 1958



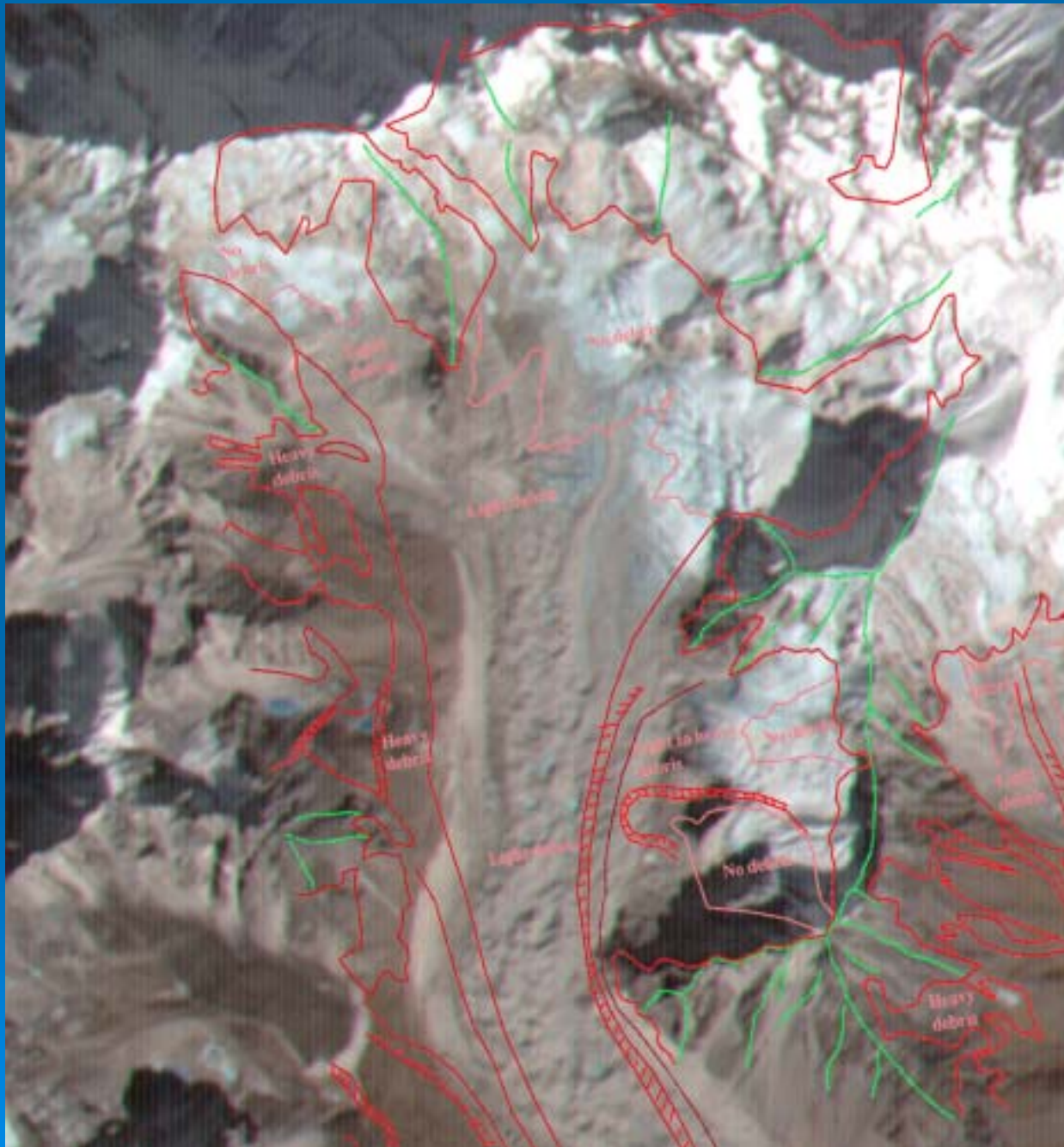
Everest/Khumbu area- 1958 map boundaries overlain on ASTER image



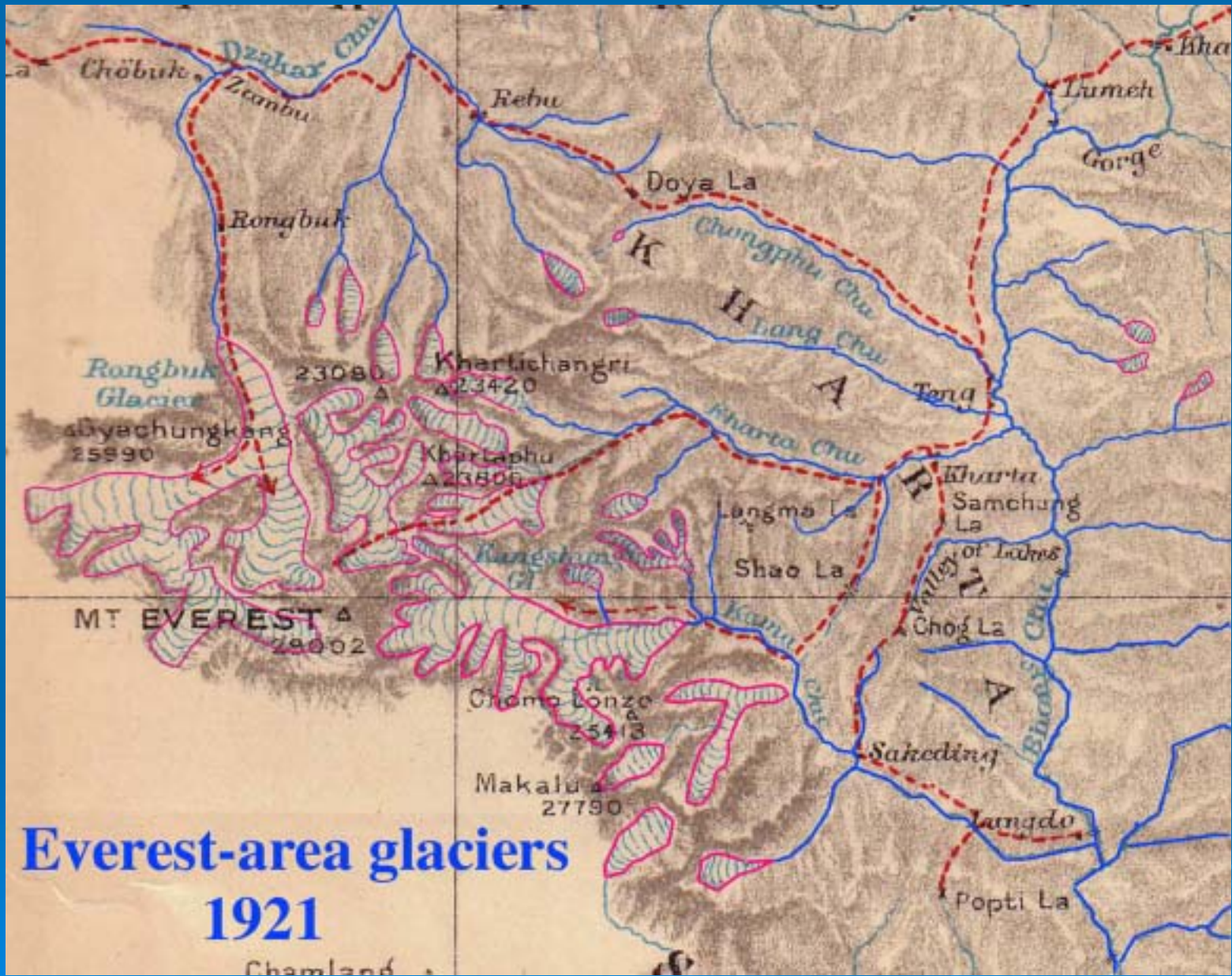
**Khumbu Glacier, Nepal: terminus changes,
1958 map to 2001 (ASTER image)**



Khumbu source areas, changes 1958-2001



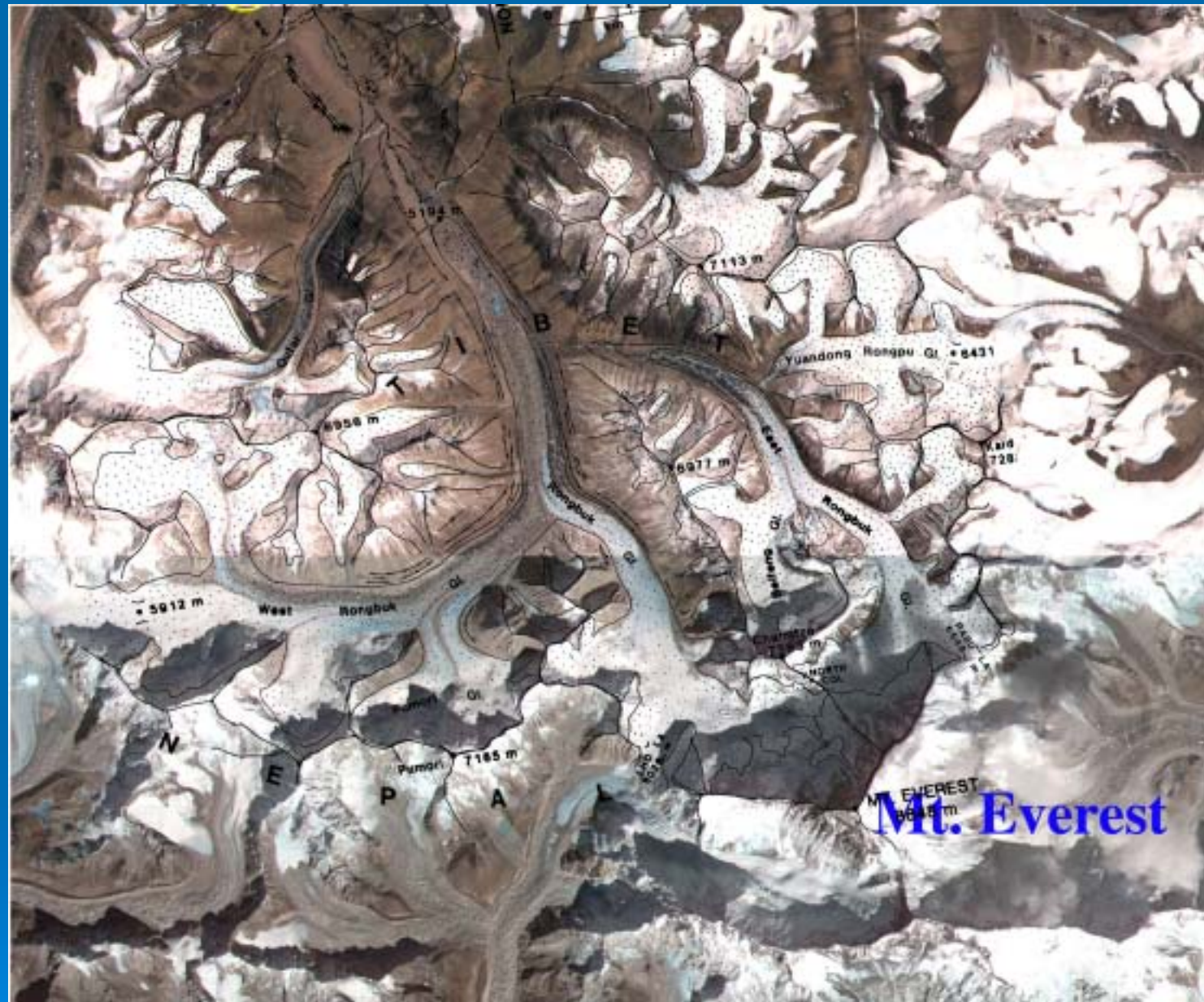
Shrinkage of accumulation zones near Everest, 1958-2001



Everest-area glaciers

1921

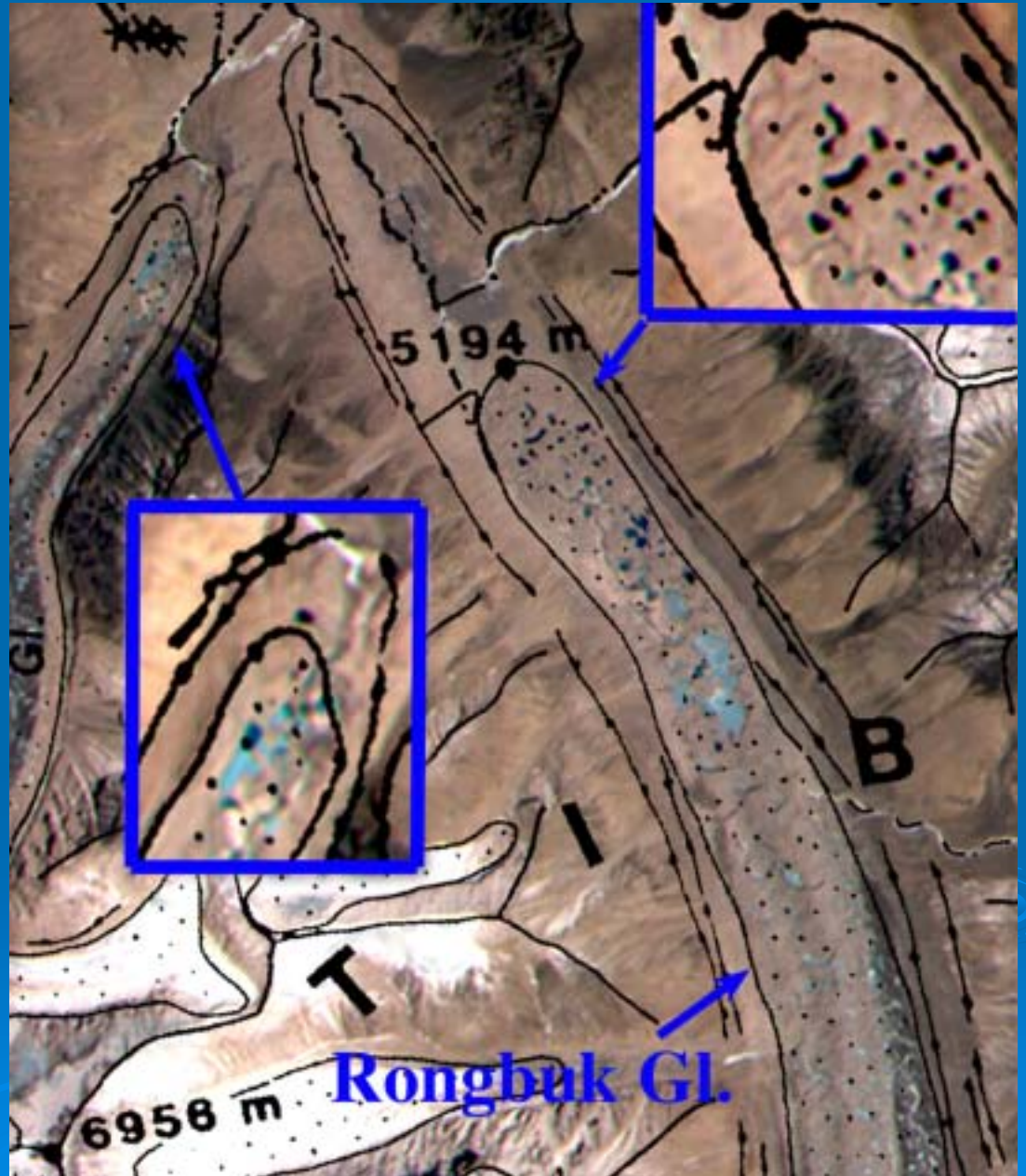
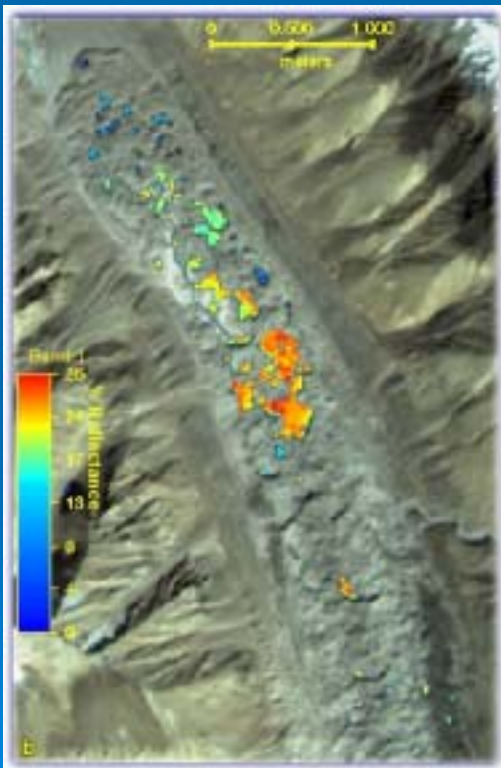
1921 Map



Rongbuk Glacier changes, 1986 (mapping by Burbank 1991) to 2001 (ASTER image)

Rongbuk Glacier changes, terminus region, 1986 map-2001 ASTER image.

Glacier moraine mapping (right) due to Burbank 1991 (Quat. Res.)



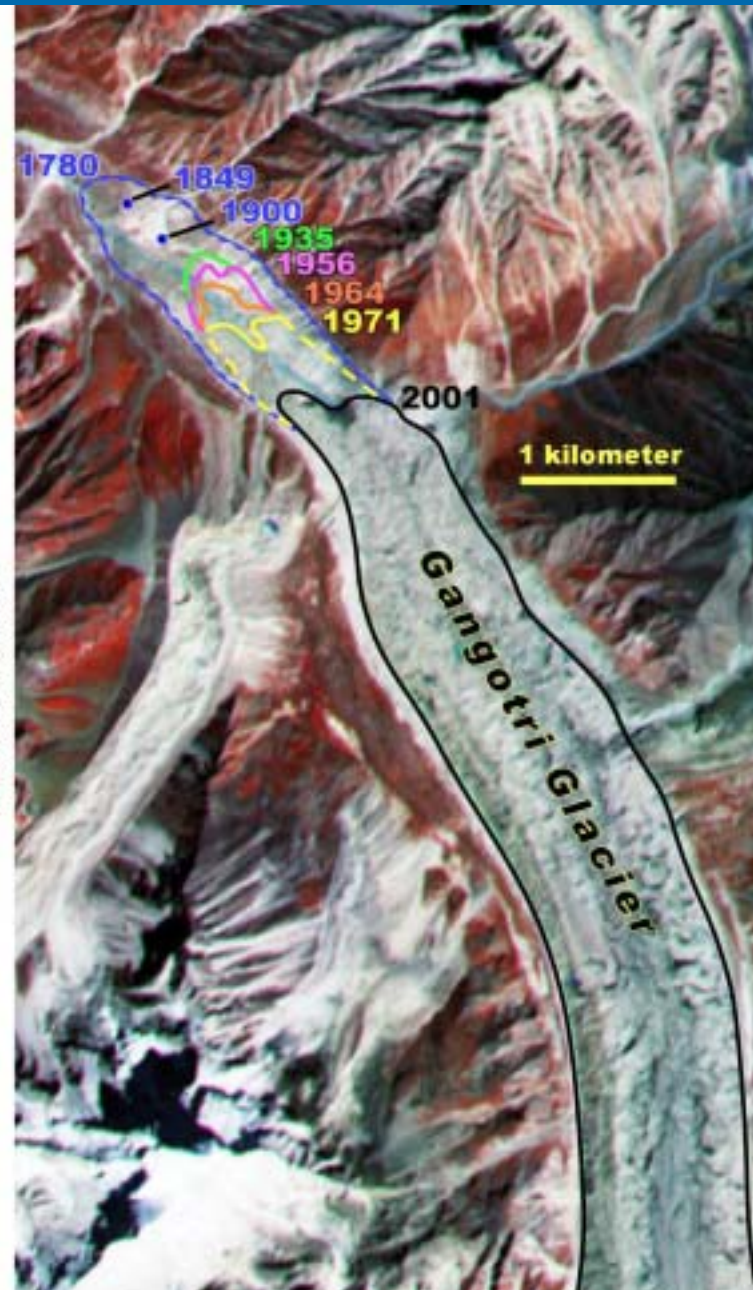
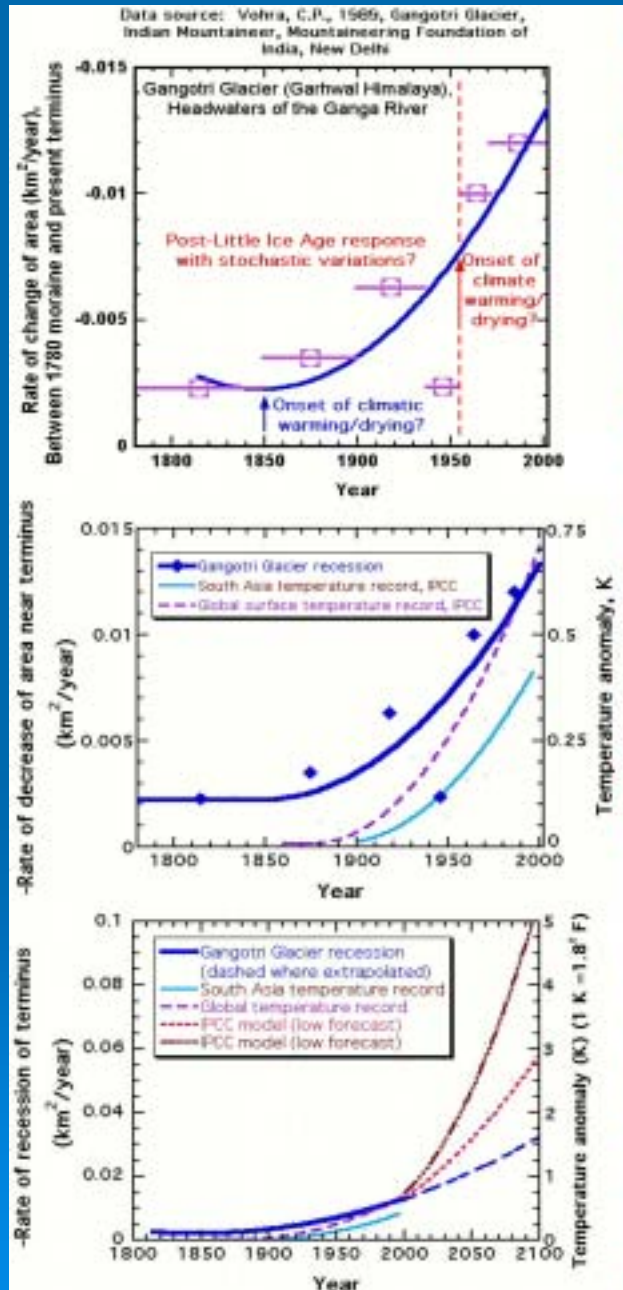
Glacier lake mapping by Wessels, Kargel, and Kieffer 2002, Ann. Glac.)

**Skeletal
remains of a
wasted
glacier near
Everest**

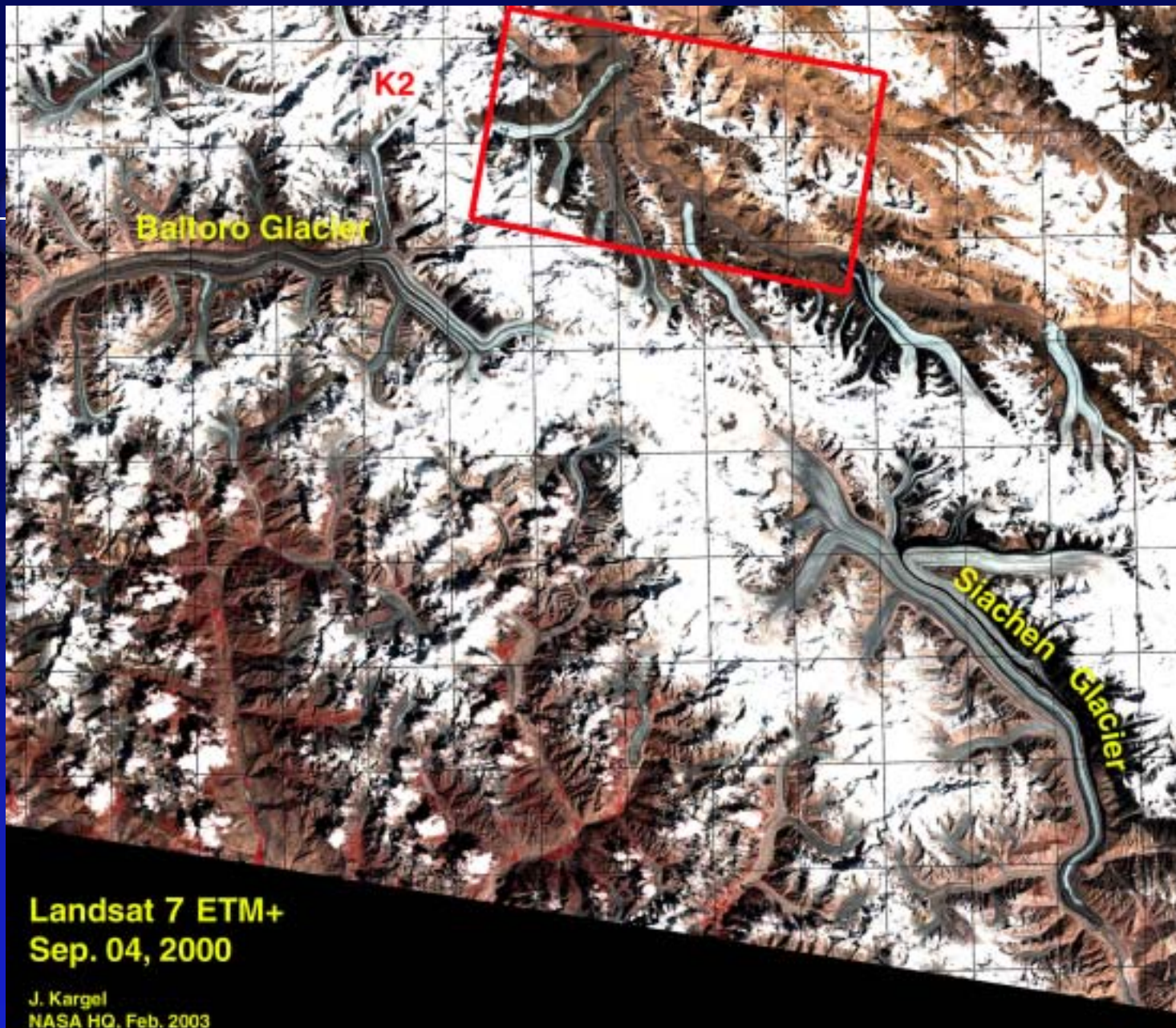


Wasting glacier near Mount Everest, Nepal
Photo by Jeffrey S. Kargel, August 2001.

Gangotri Glacier, Garwhal Himalaya (India)



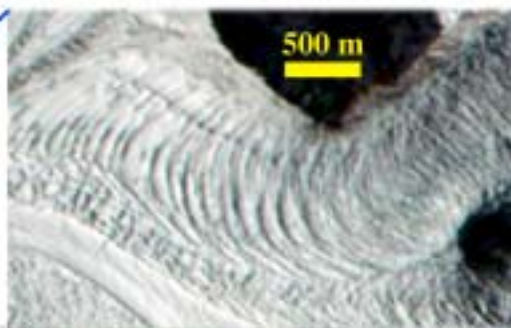
Wessels, Kargel,
and Hasnain



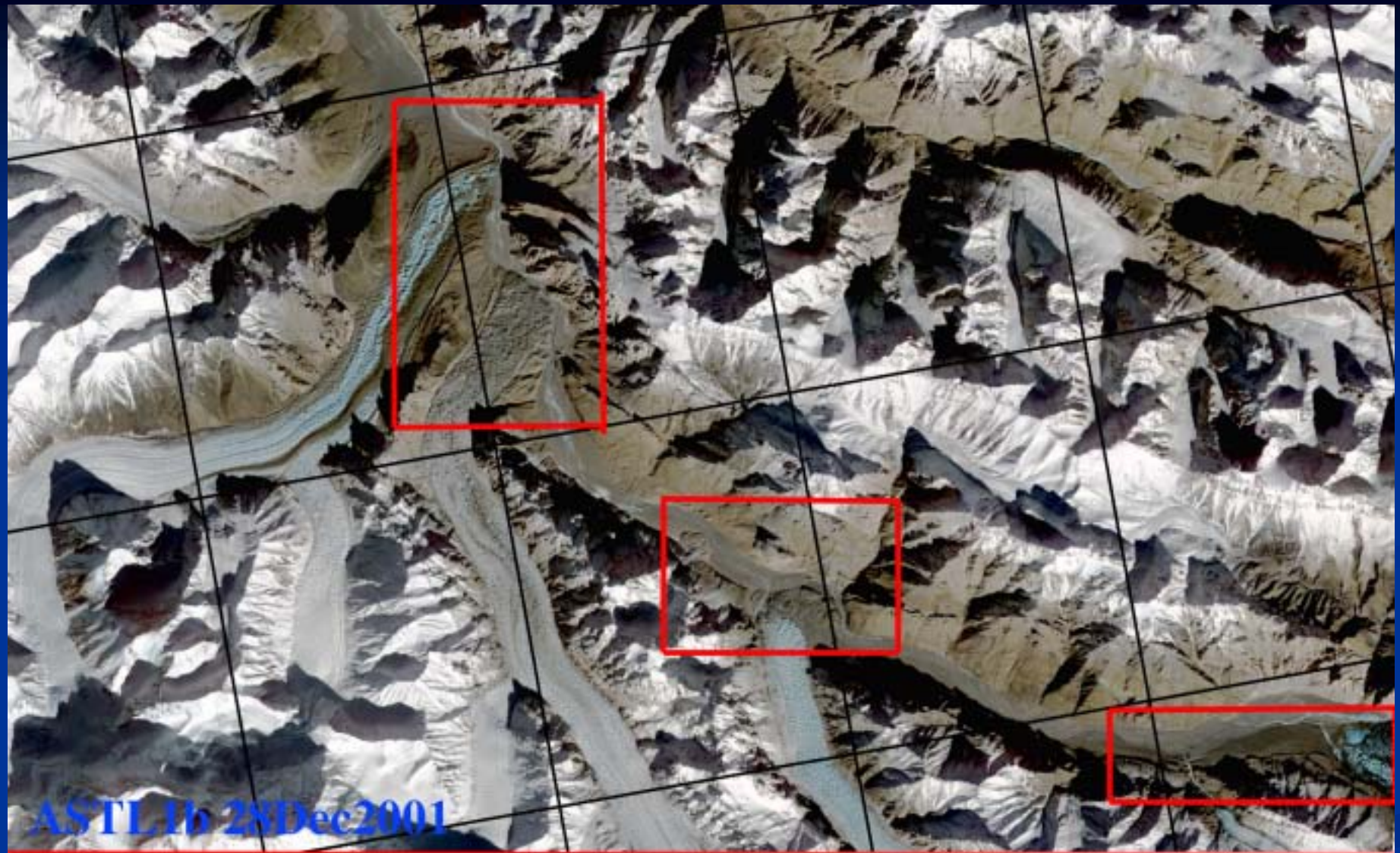
ETM+/Kashmir, 2001

ASTER Winter scene, Baltoro Glacier, Kashmir

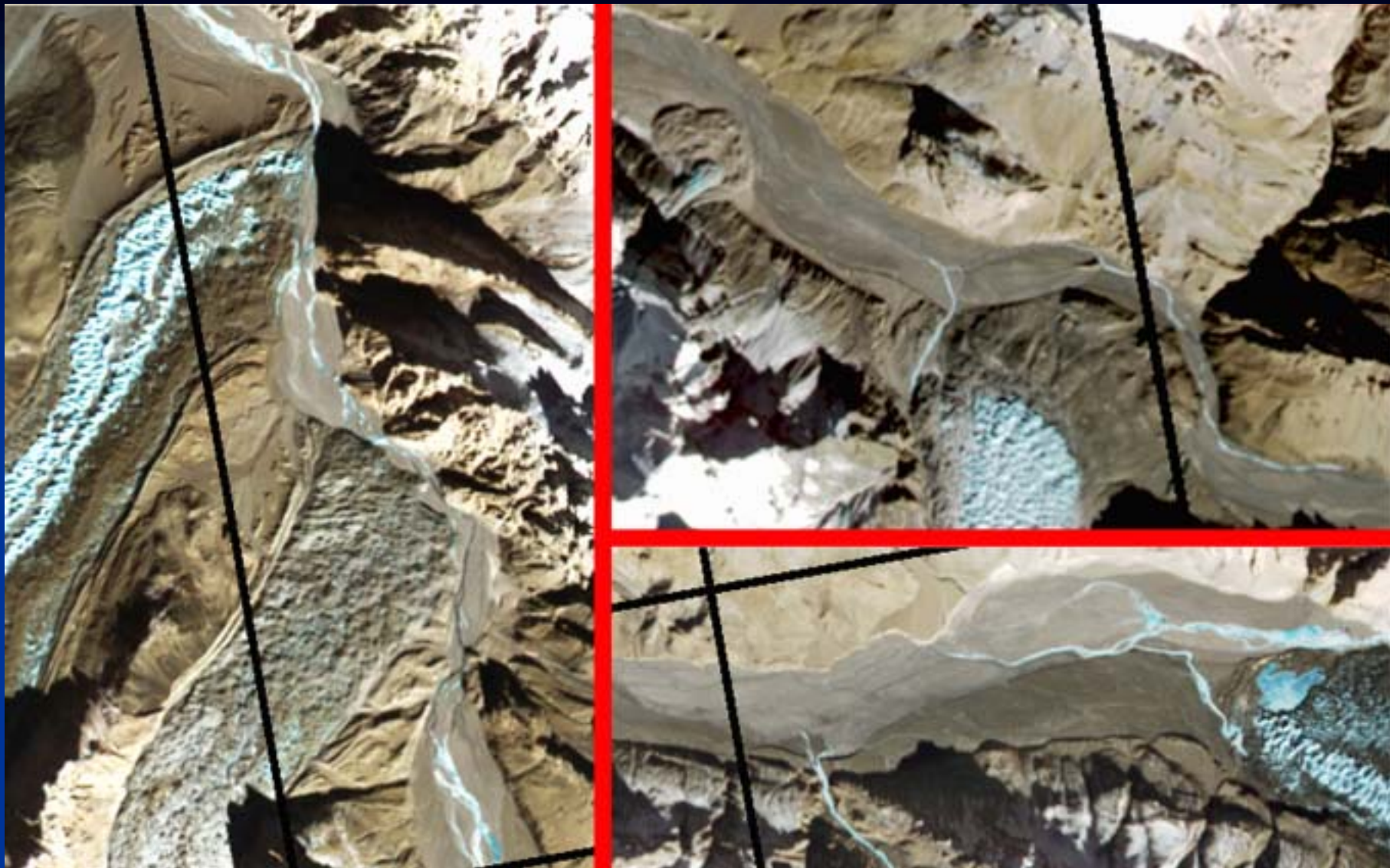




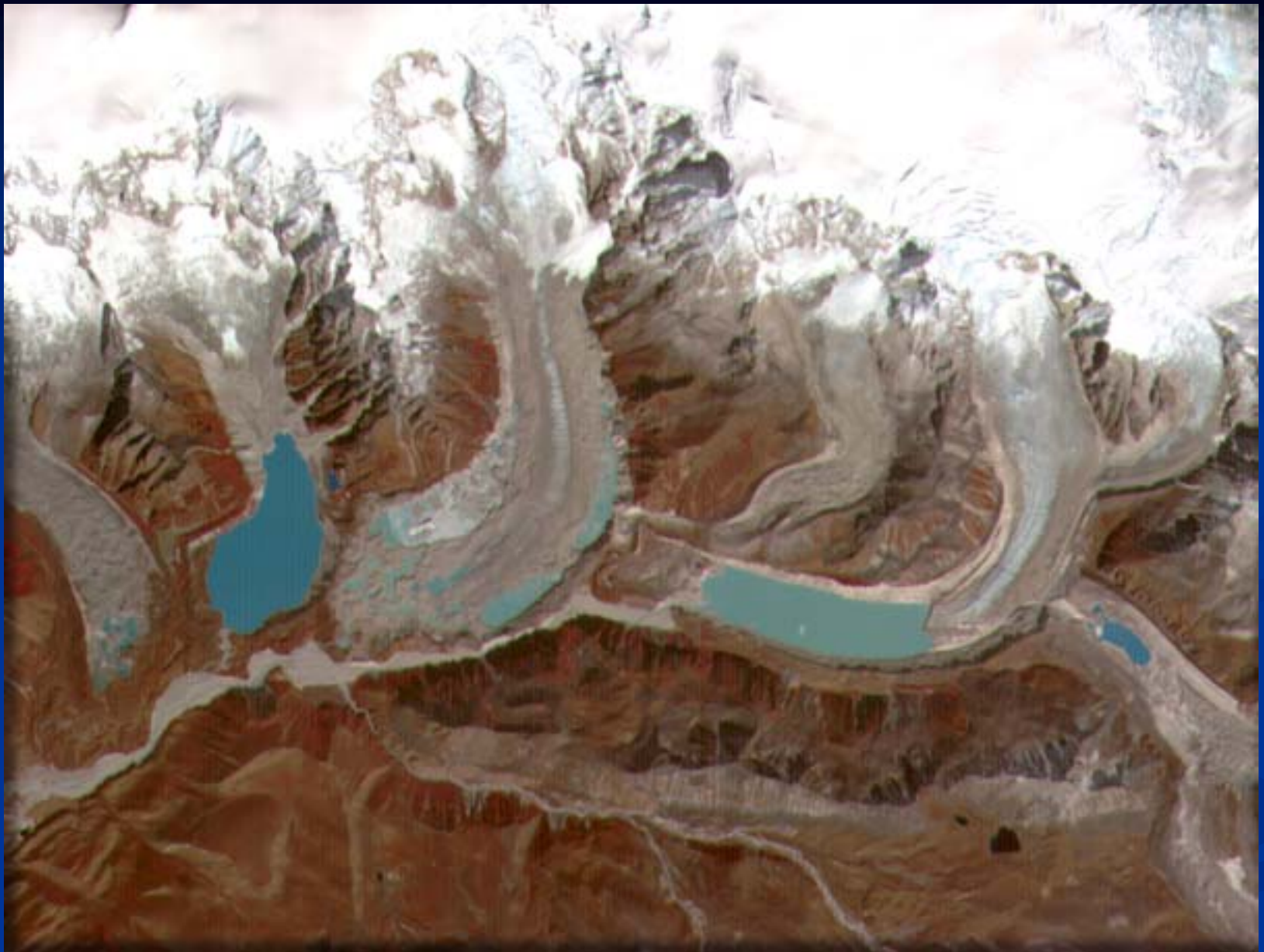
Baltoro Glacier
MTI, 2001



**Kashmir, Dry Side--Vigorous
Glaciers**



Kashmir, dry side of the Himalaya

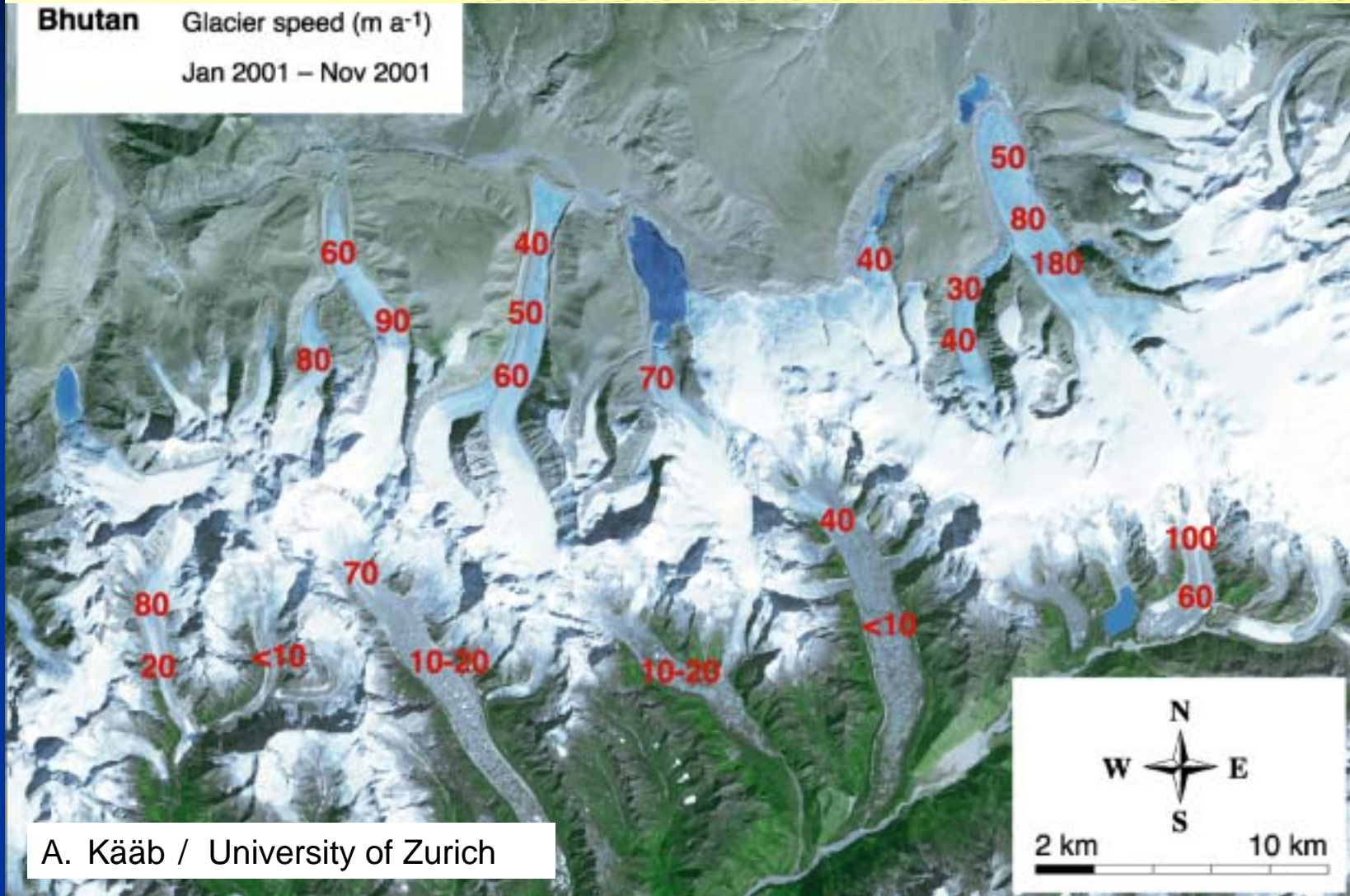


Eastern Himalaya- Glacier stagnation and lake formation in Bhutan (ASTER, Nov. 30, 2001)

Himalayas

Bhutan

Bhutan Glacier speed (m a⁻¹)
Jan 2001 – Nov 2001



A. Kääb / University of Zurich

Bhutan / Northern Basin

Theri Kang No 14

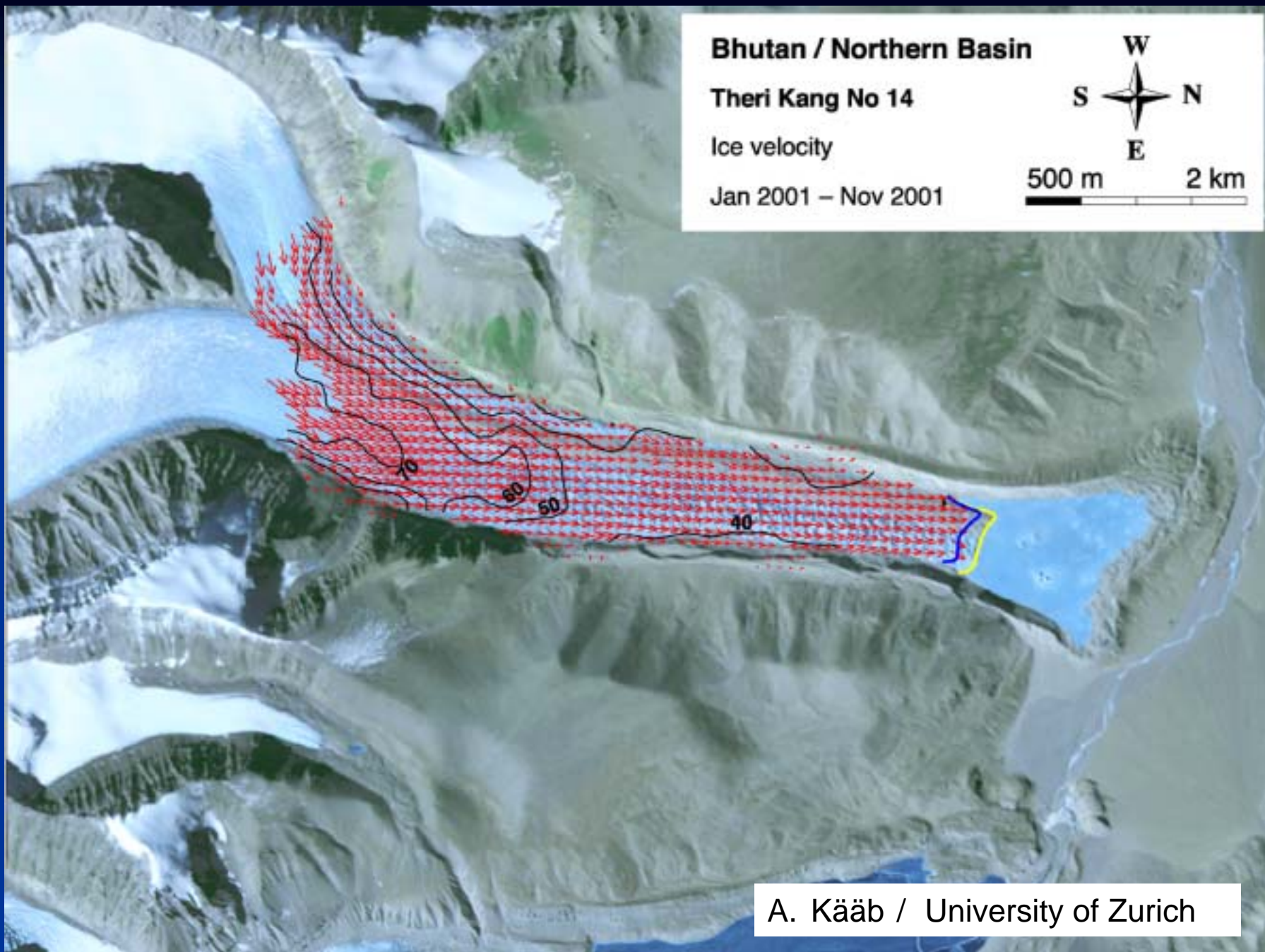
Ice velocity

Jan 2001 – Nov 2001

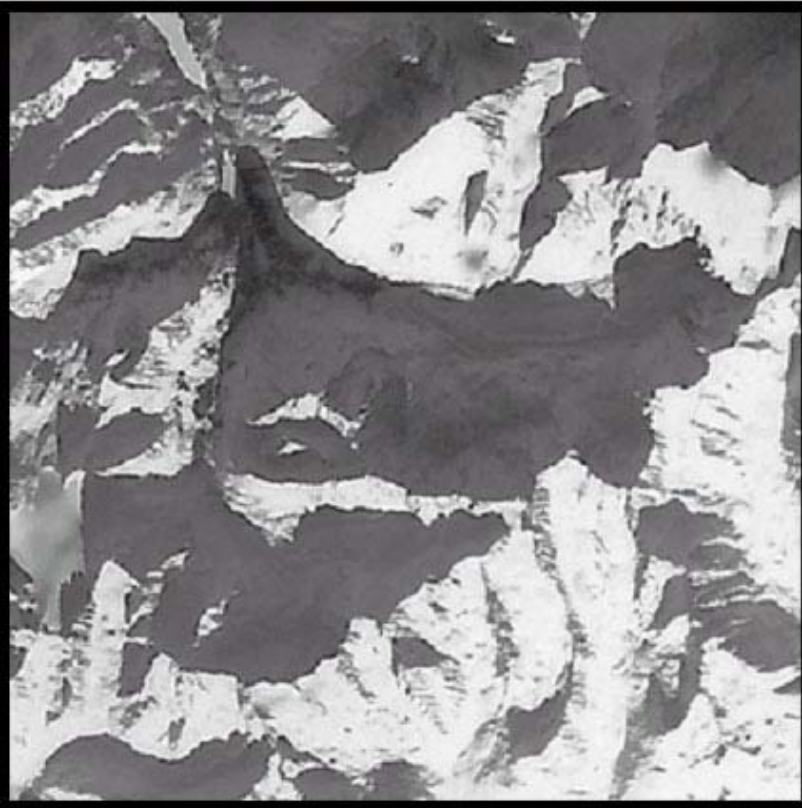


500 m

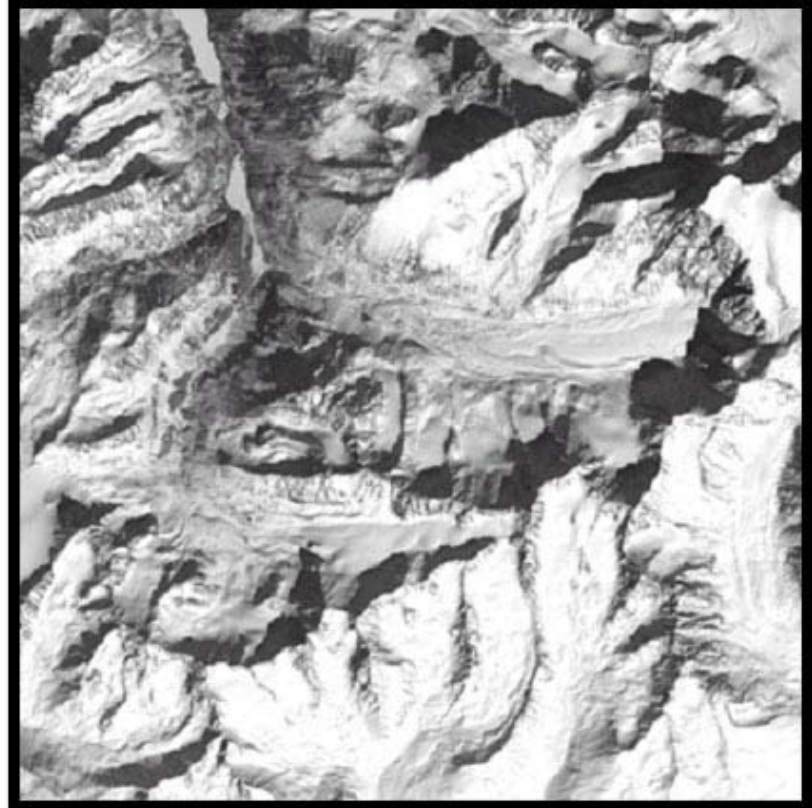
2 km



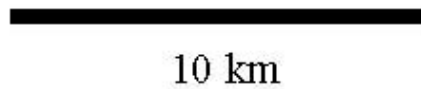
A. Käab / University of Zurich



Corona, 1965



ASTER #3N, 2001



10 km

Recession of Gora Belukha, 1965-2001



100 Years of Glacier Retreat in Central Asia

- Jeffrey S. Kargel
- Alan Gillespie
- N.V. Arzhannikova
- S. Arzhanikov
- A. Bayasgalan
- M.P. Bishop
- S. Hasnain
- A. Kaeaeab
- V. Sheinkman
- R. Wessels

- Most glaciers in Asia have had negative balance since Little Ice Age.
- Many glaciers now have retreating termini.
- Most in the Himalaya are in cycle of i) decades of stagnation but with stable termini followed by ii) decades of lake formation and then sudden retreat.
- Some glaciers are stable or advancing.
- Regional variations:
 - Siberian glaciers have retreating termini.
 - Surge type glaciers are common in Tajikistan, rare in Himalaya.
 - Glaciers of western Himalaya are healthier than in eastern Himalaya.
 - Glaciers on north side of Himalaya are healthier than on south side.