Glaciers of Colorado

From Pleistocene to present

EarthCache
24 Sep 2016

William Armstrong
University of Colorado at Boulder

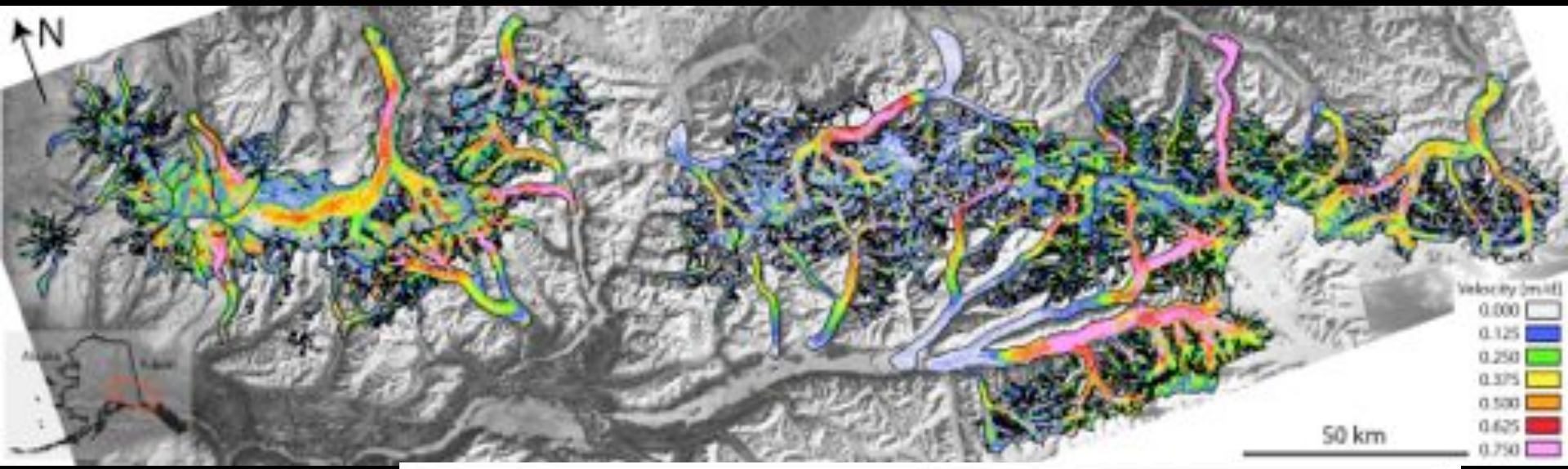
Outline

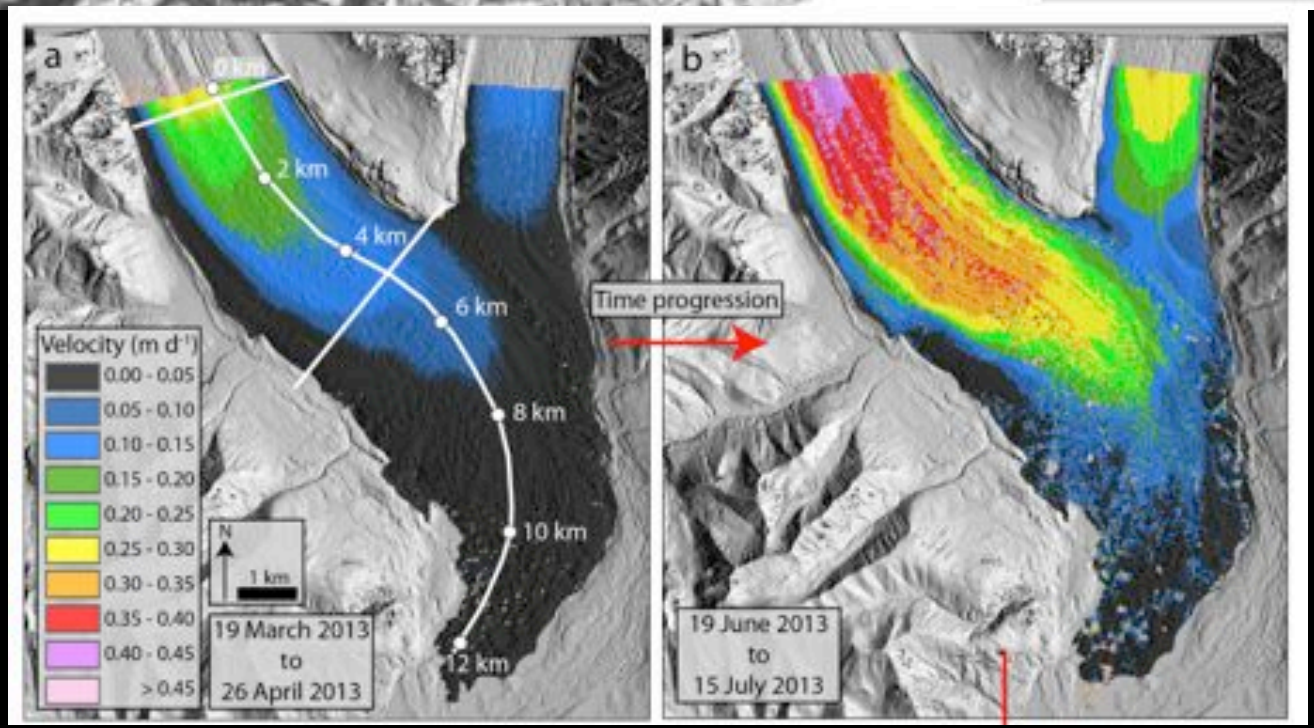
- About me
- Glacier basics
- Colorado glacial history
- Modern Colorado glaciers
- Rock glaciers

About me

- University of Colorado at Boulder
- 5th year PhD
- Glaciology
- Geomorphology

About me • Glacier dynamics from satellite imagery

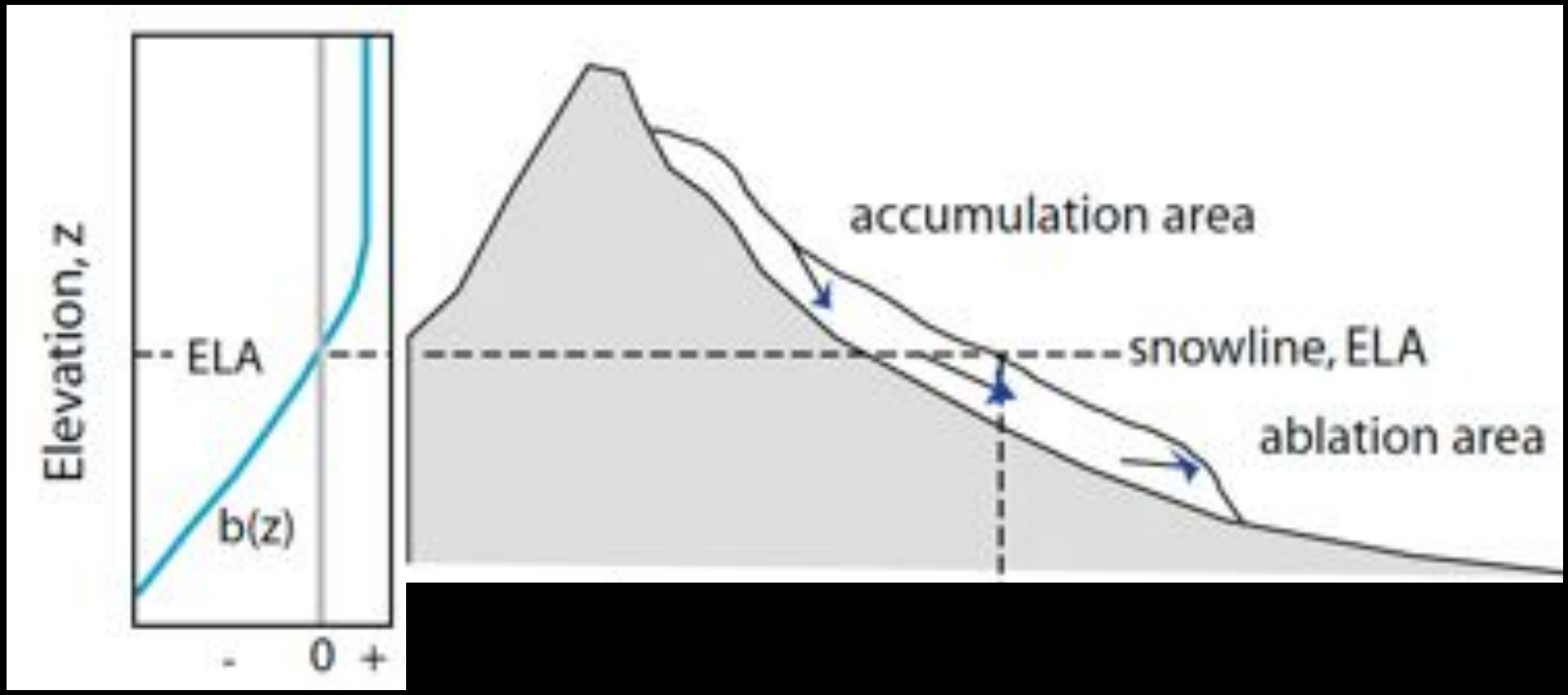




Armstrong et al. [2016]

Glacier basics

Mass balance

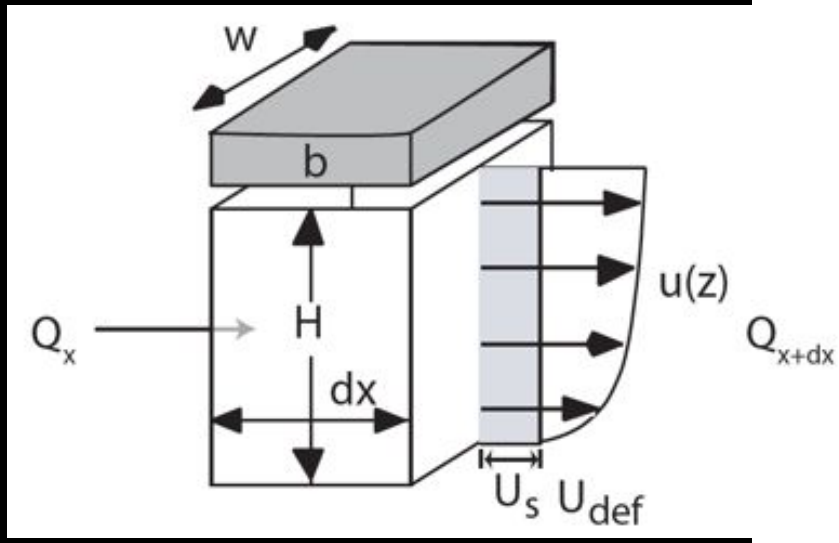


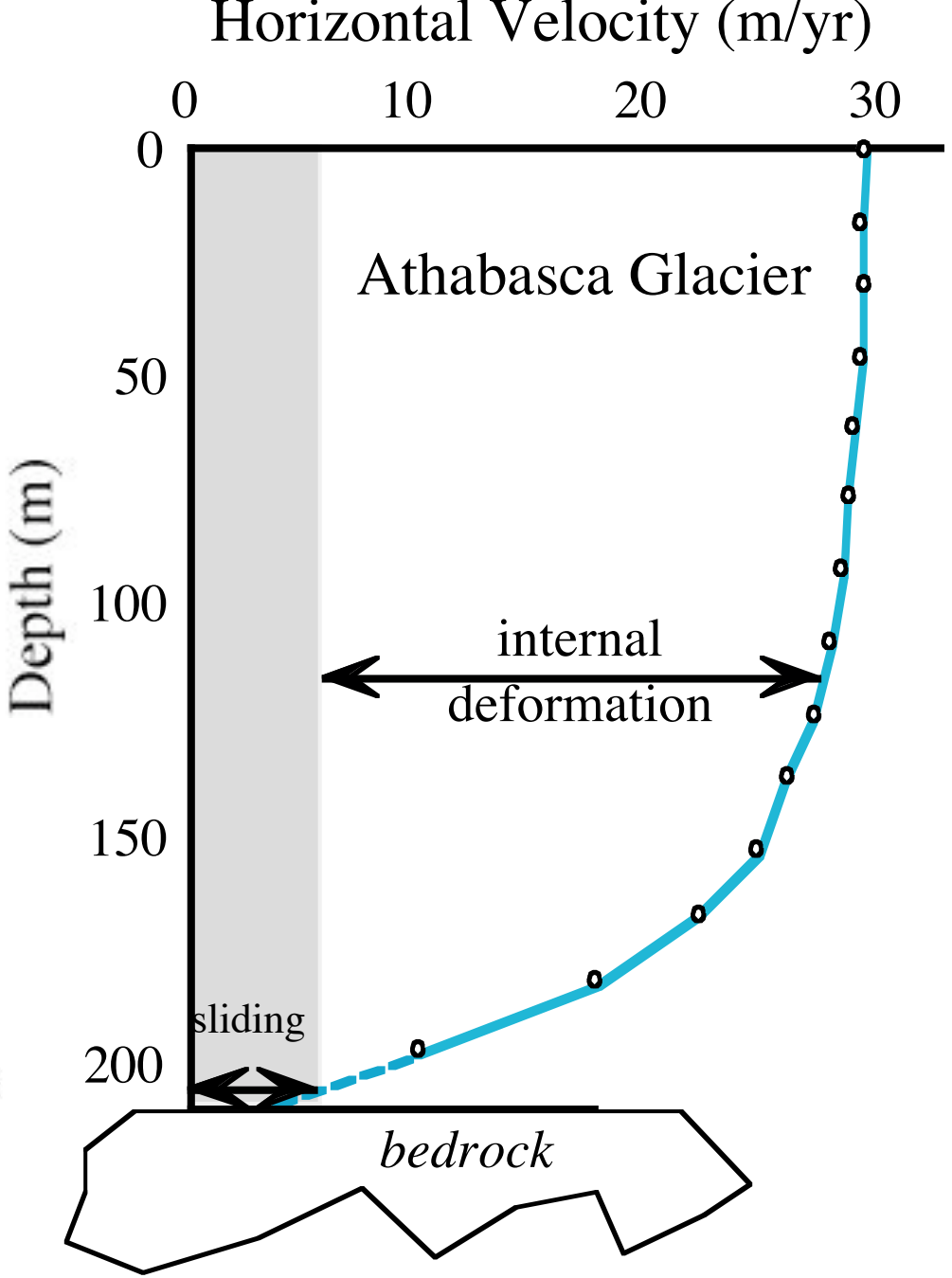
Anderson and Anderson [2010]

Glacier basics

Motion

- Two modes of motion
  - Internal deformation
  - Basal sliding

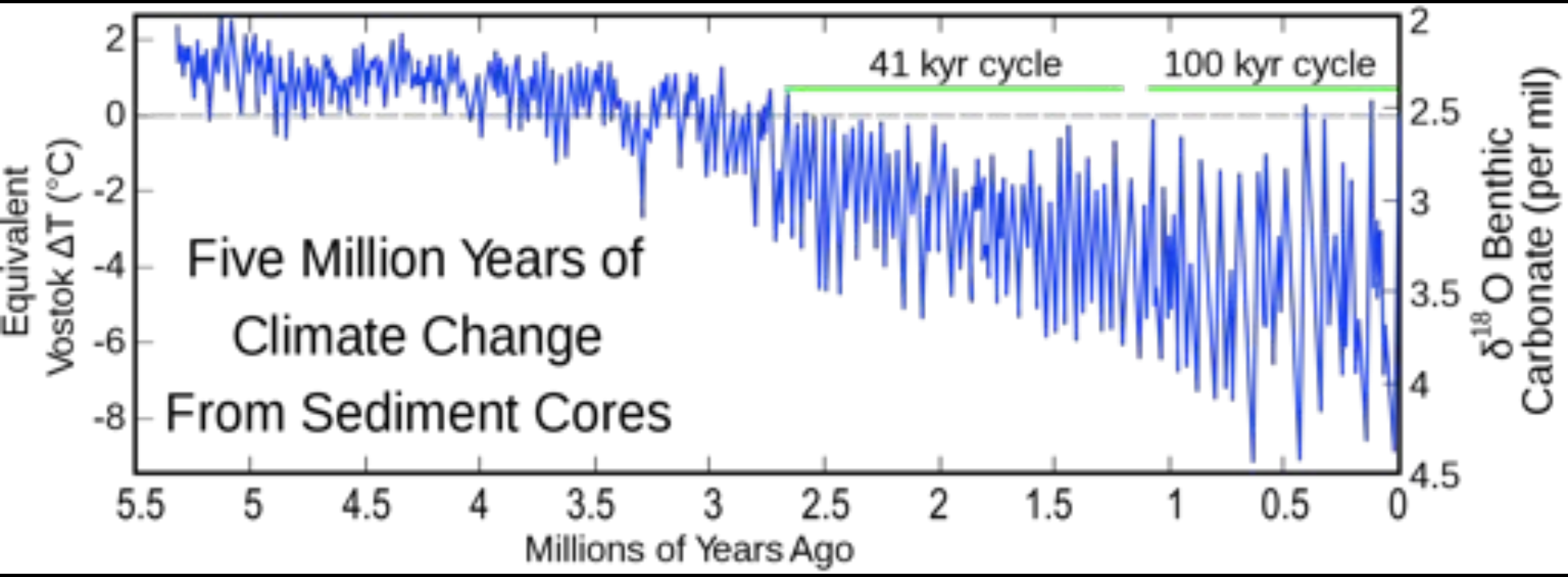




Anderson and Anderson [2010] after *Patterson* [1994]

Glacier basics

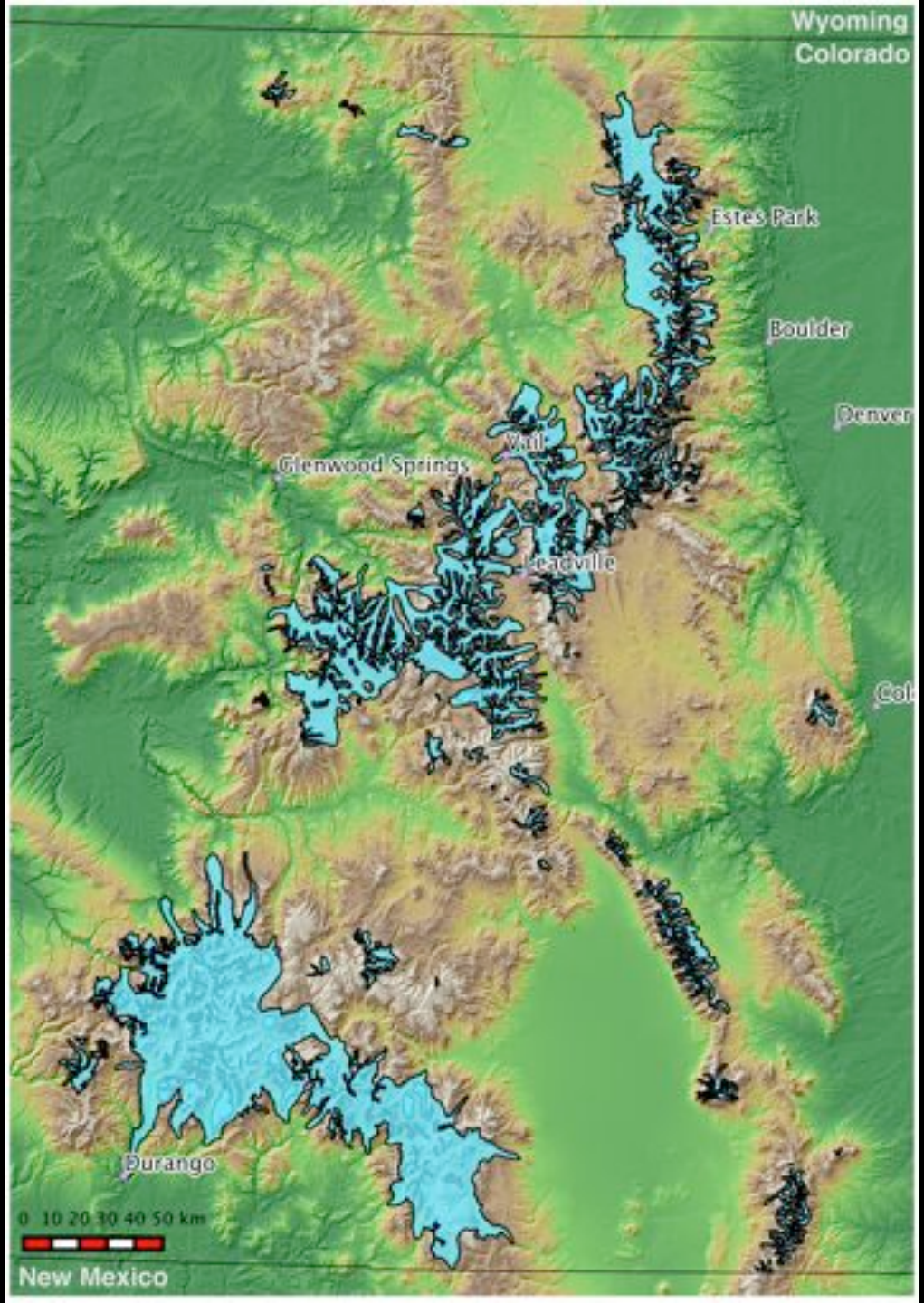
Response to climate



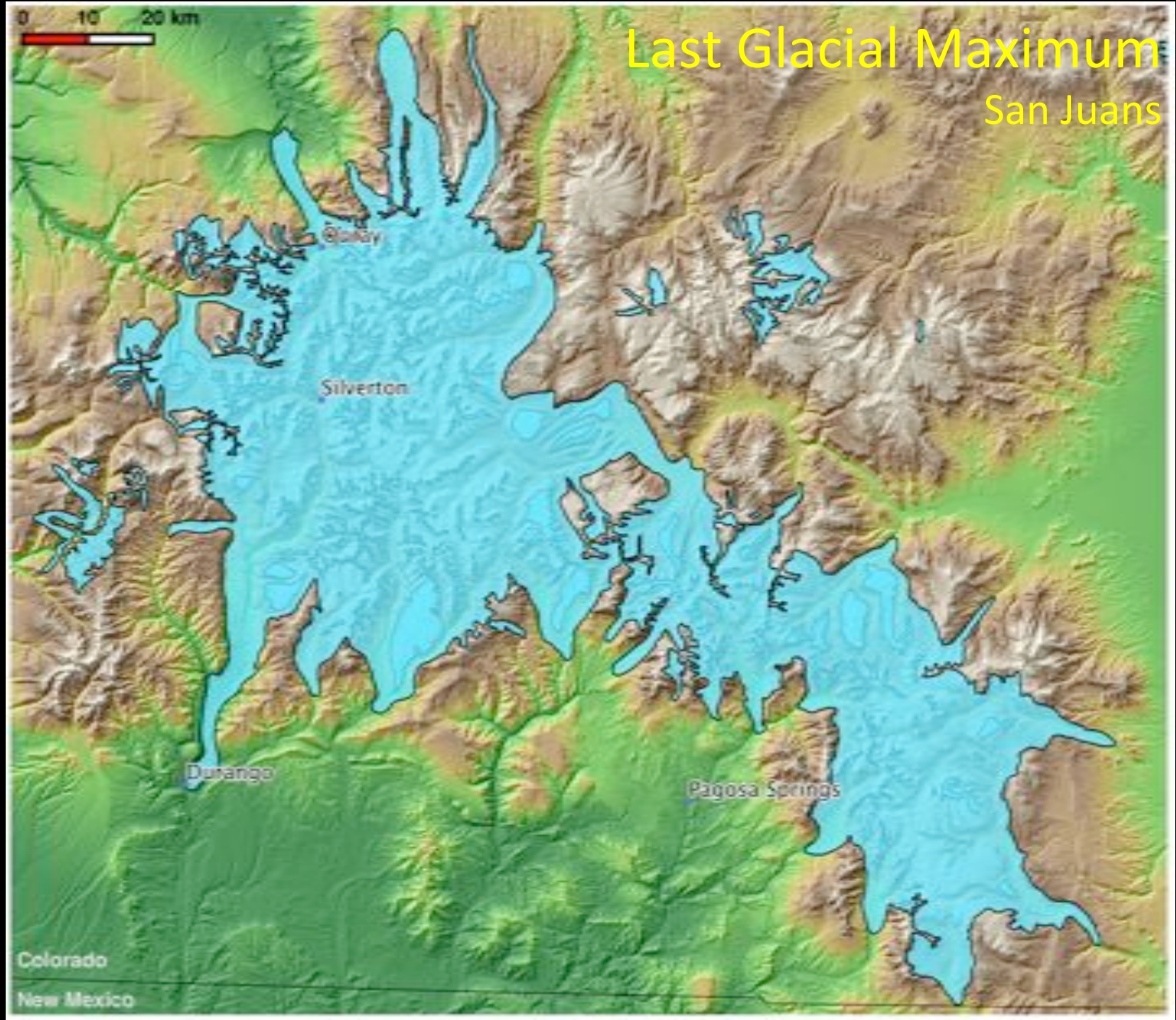
Wikipedia.org

Last Glacial Maximum
Western Colorado

- ~15,000 km^2 glacierized
- ~5% total state area



Glacier extent shapefile from USGS


Last Glacial Maximum
San Juans
0 10 20 km
Silverton
Durango
Pagosa Springs
Colorado
New Mexico

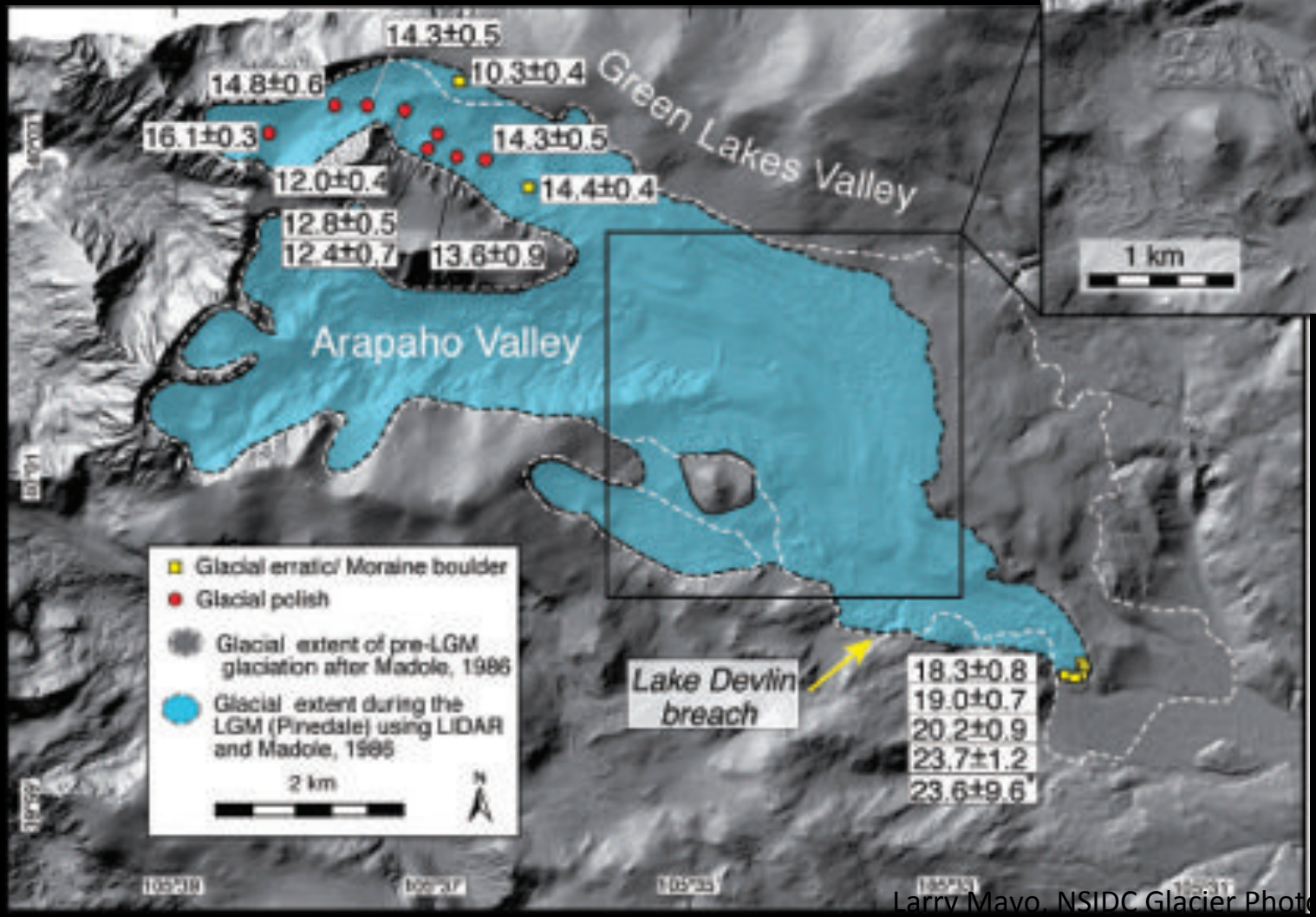
Last Glacial Maximum
Front Range

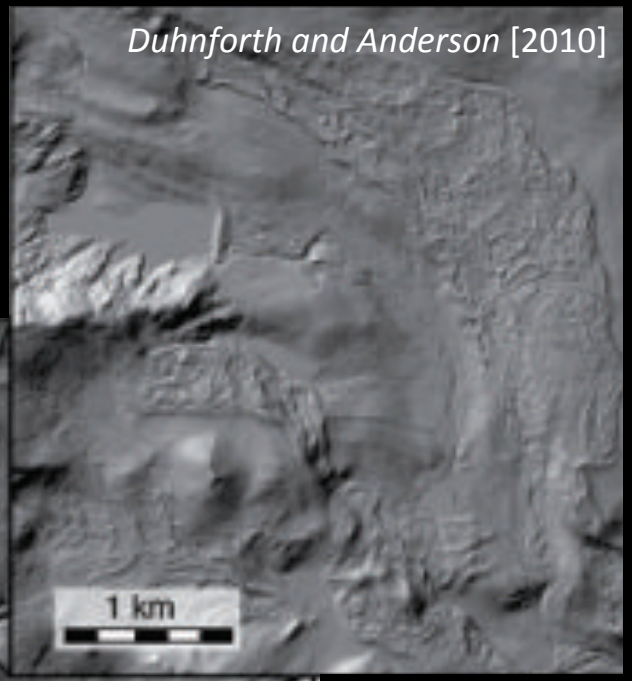
- Glacier modeling and moraines suggest ~6°C colder

Last Glacial Maximum

Deglaciation

- ^{10}Be shows retreat began around 14-18 ka



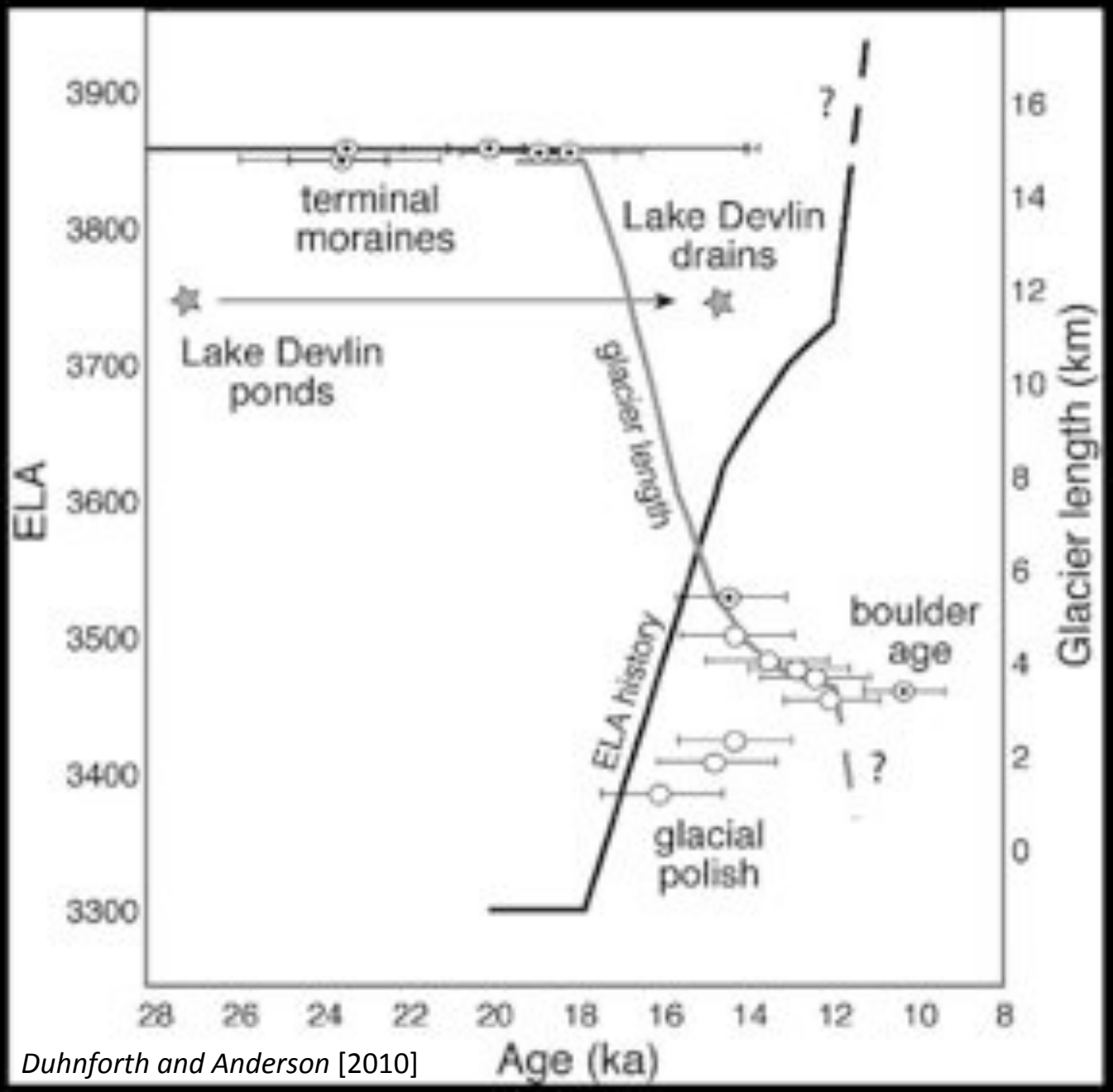


Duhnforth and Anderson [2010]

Larry Mayo, NSIDC Glacier Photo

Last Glacial Maximum

Deglaciation



Duhnforth and Anderson [2010]


Modern glaciers
Front Range
Glacier extent
Modern
Last Glacial Maximum
0
5
10 km

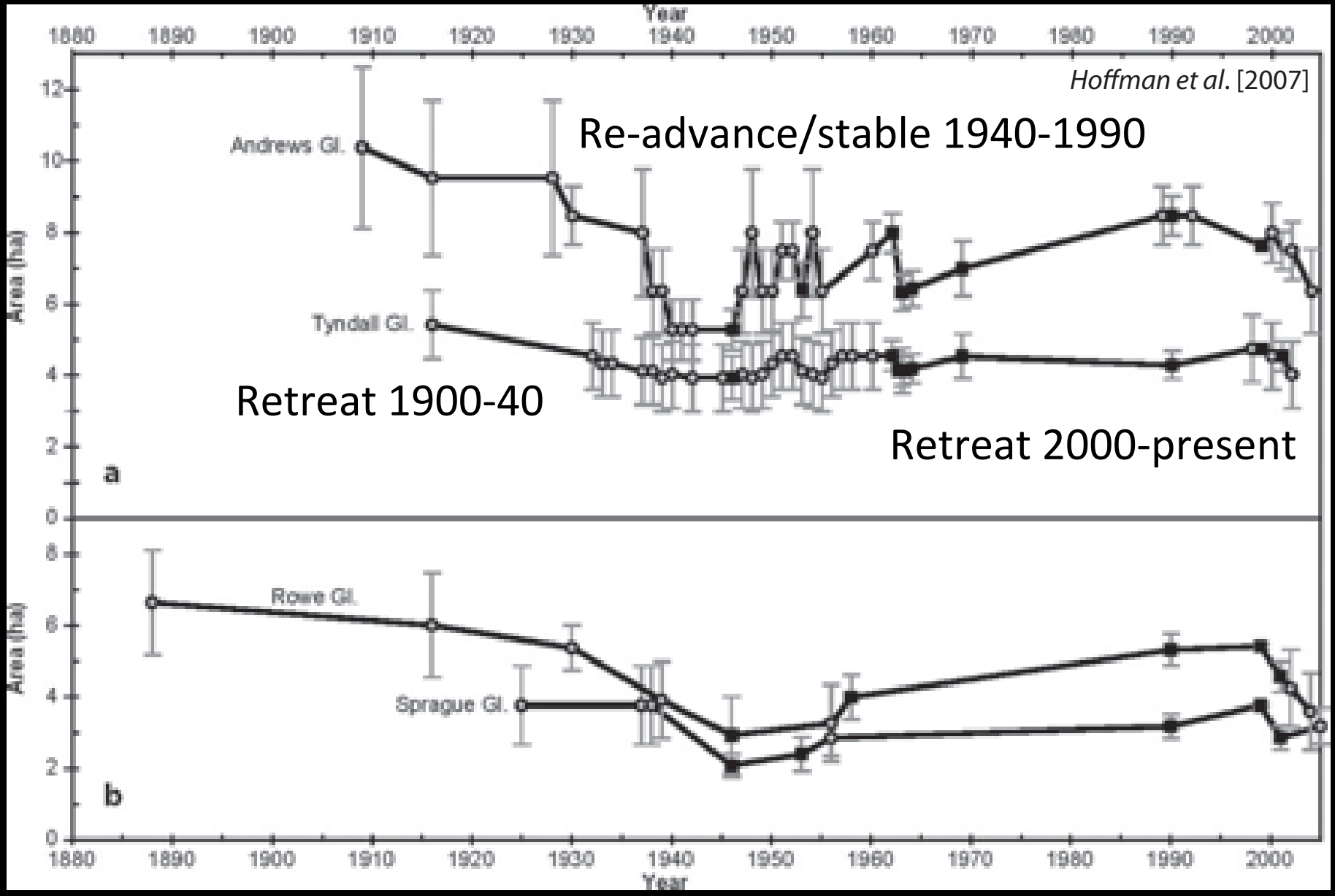
Modern glaciers

Front Range distribution

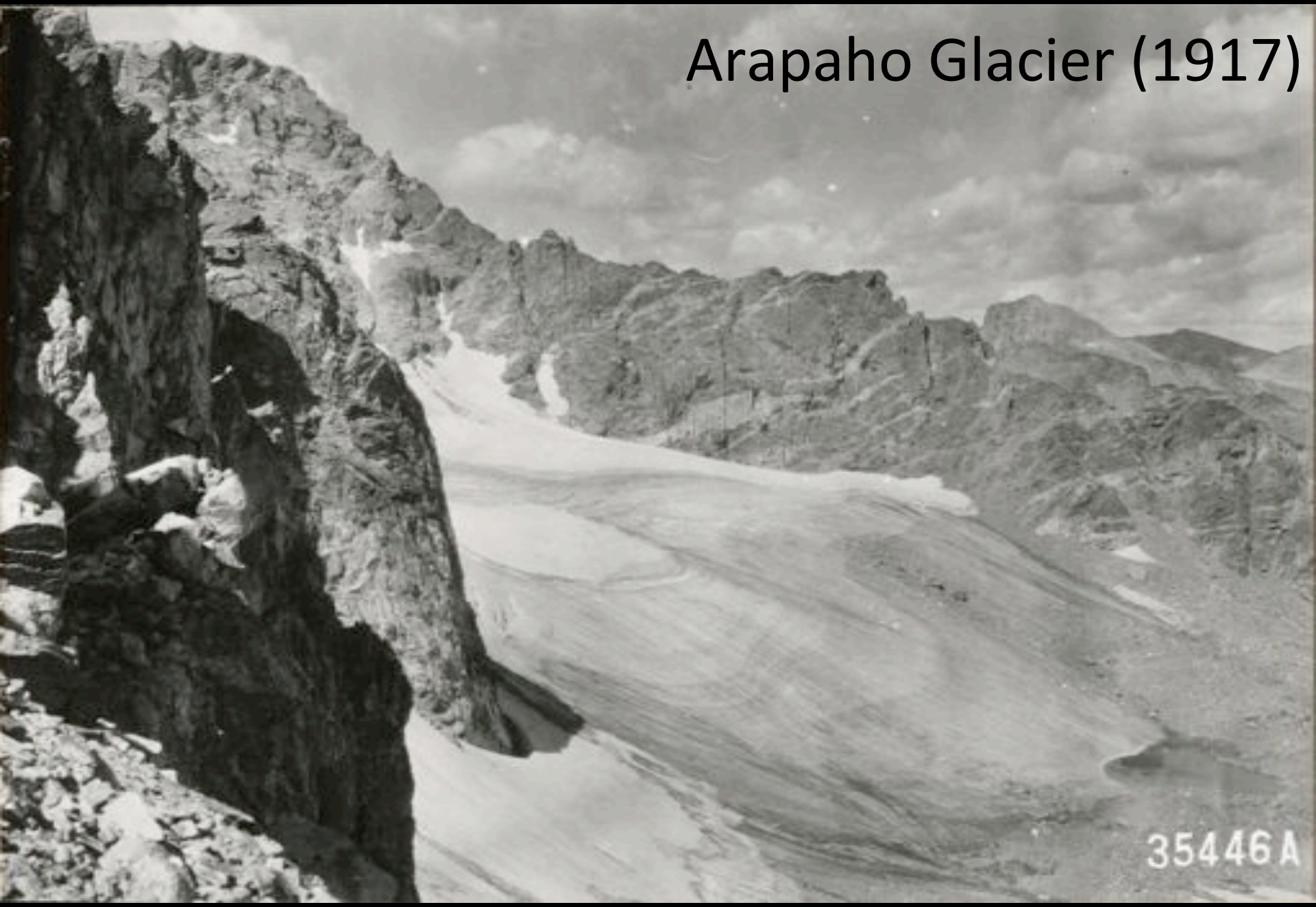
- 48 ice bodies
- Cumulative 2.1 km^2

Modern glaciers

Timeseries of area change

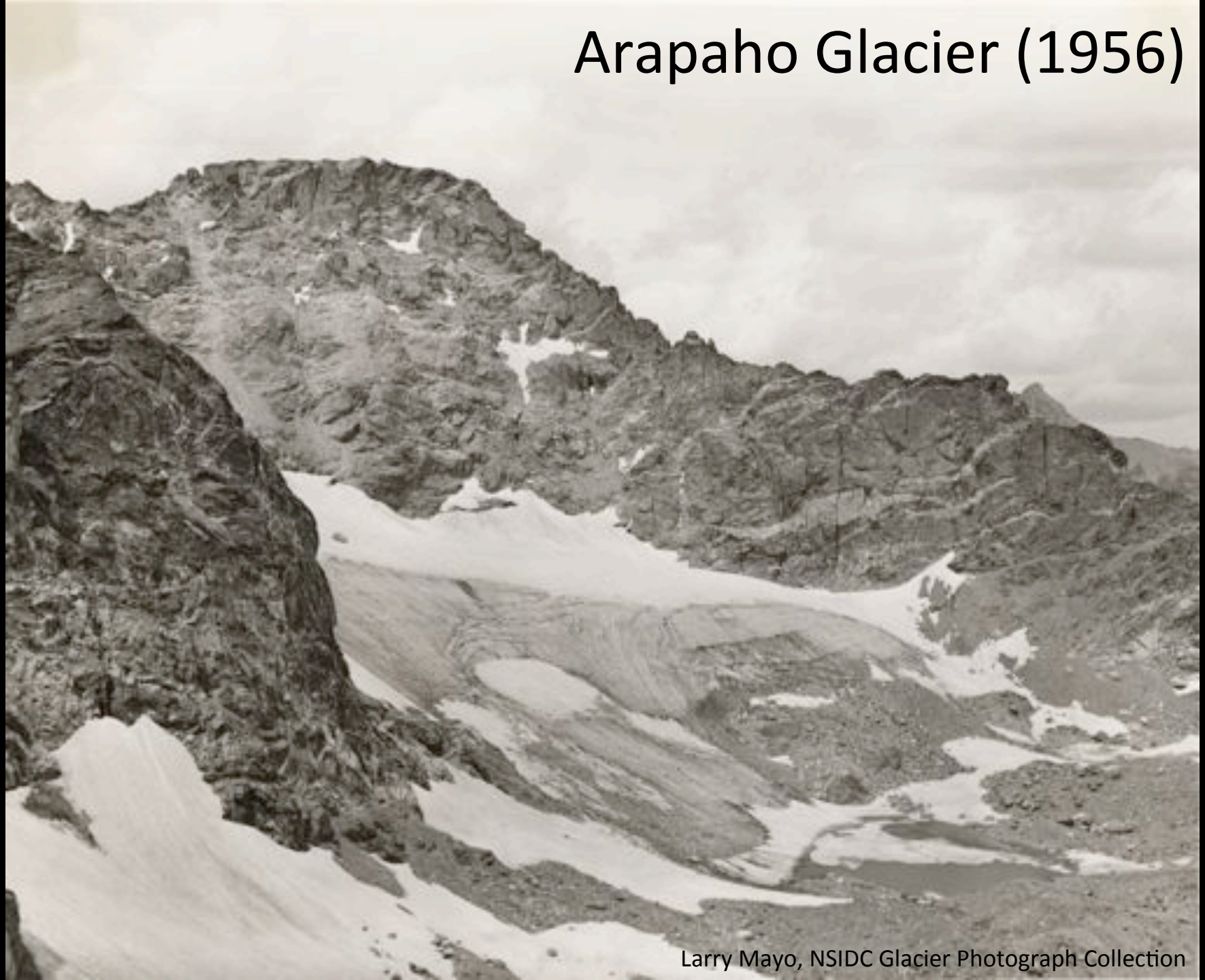


Arapaho Glacier (1917)



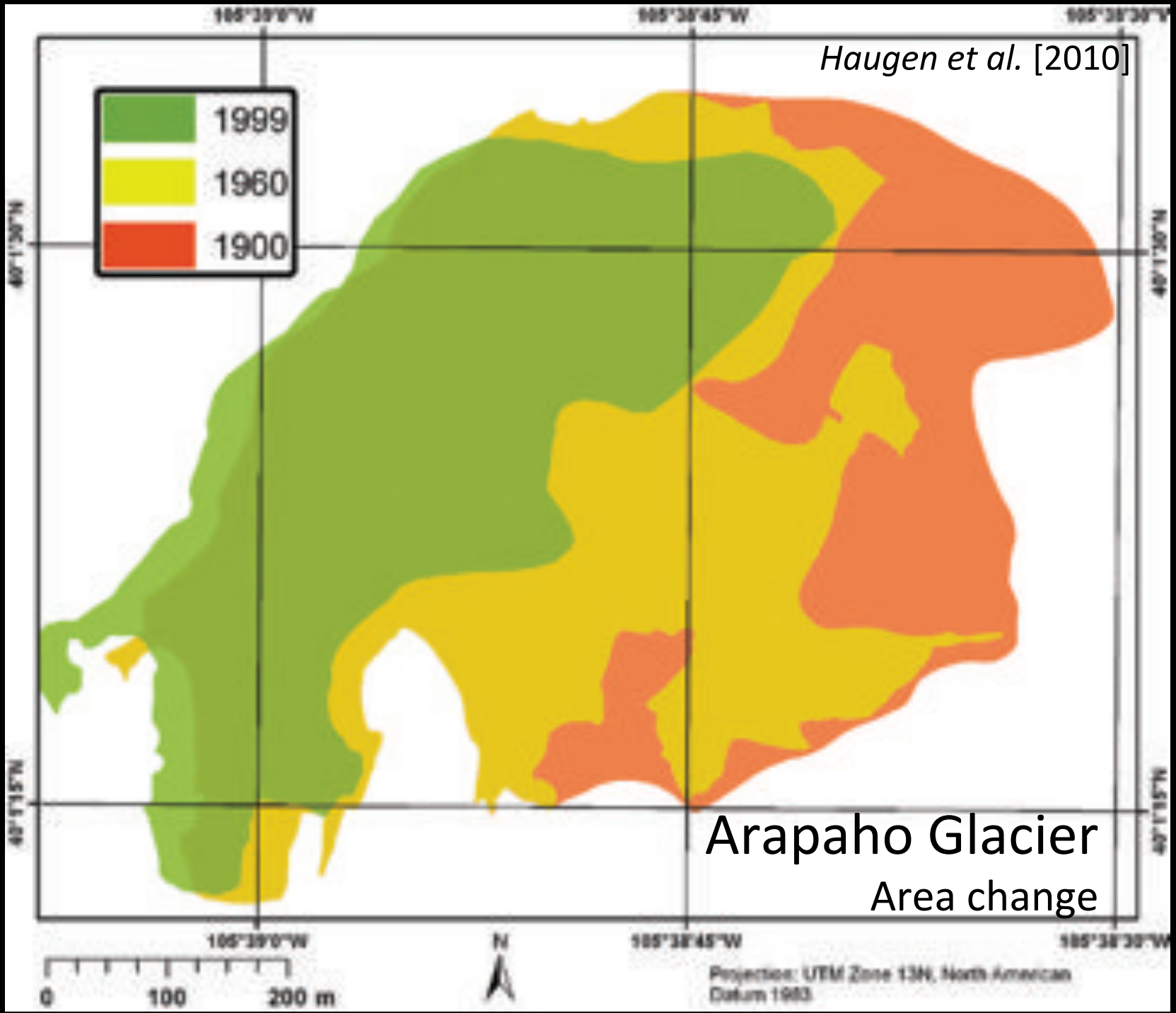
Unknown photographer, NSIDC Glacier Photograph Collection

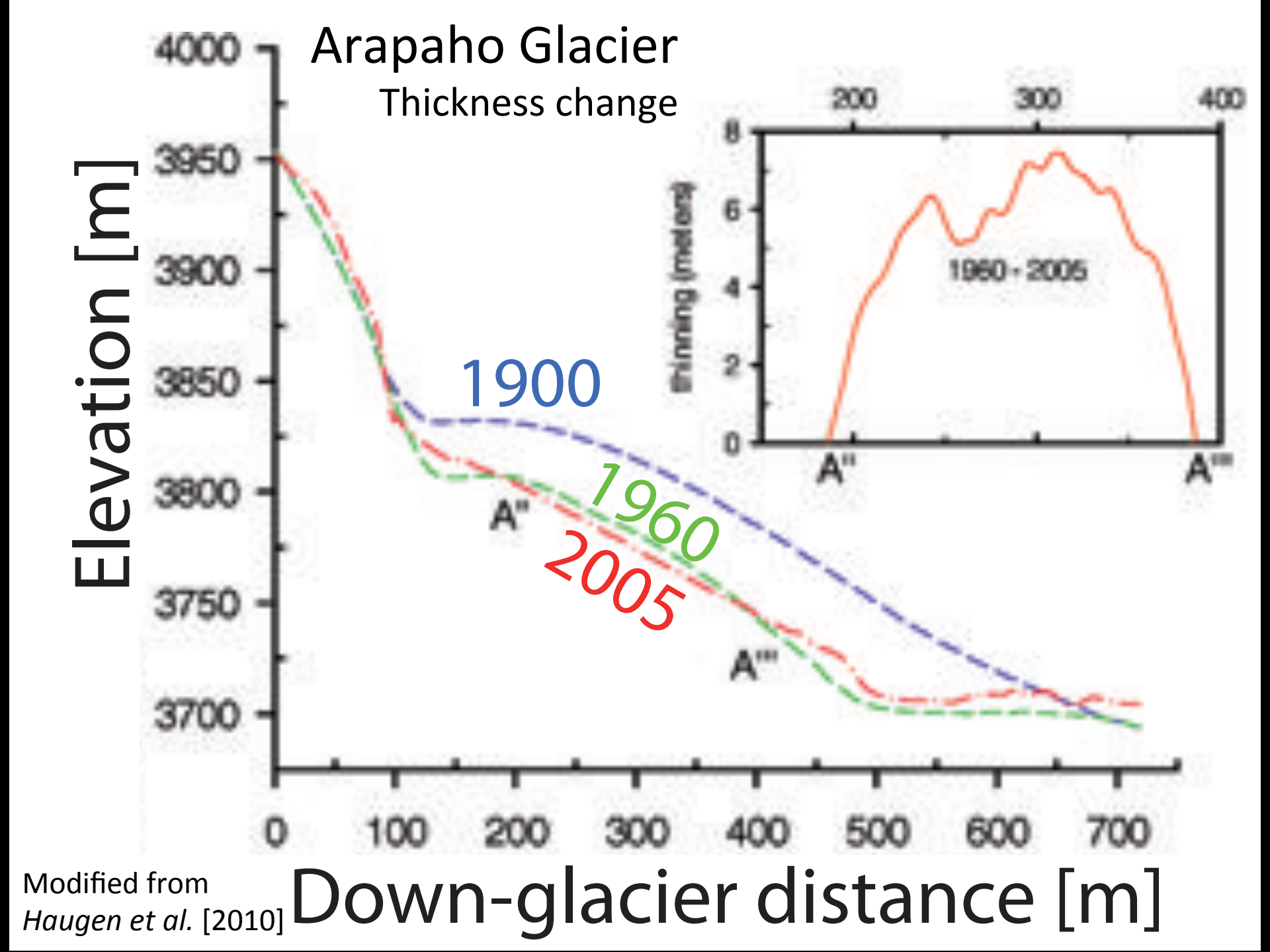
Arapaho Glacier (1956)



Larry Mayo, NSIDC Glacier Photograph Collection


Arapaho Glacier (2016)
Willam Armstrong


Haugen et al. [2010]
1999
1960
1900
Arapaho Glacier
Area change
105°39'0"W
105°38'45"W
40°1'30"N
40°1'15"N
N
0
100
200 m
Projection: UTM Zone 13N, North American Datum 1983



Modified from
Haugen et al. [2010]

Future glaciers

Ice patch archaeology

- Dated animal remains suggest glaciers at minimum extent over last 2 kyr
- What will future hold?

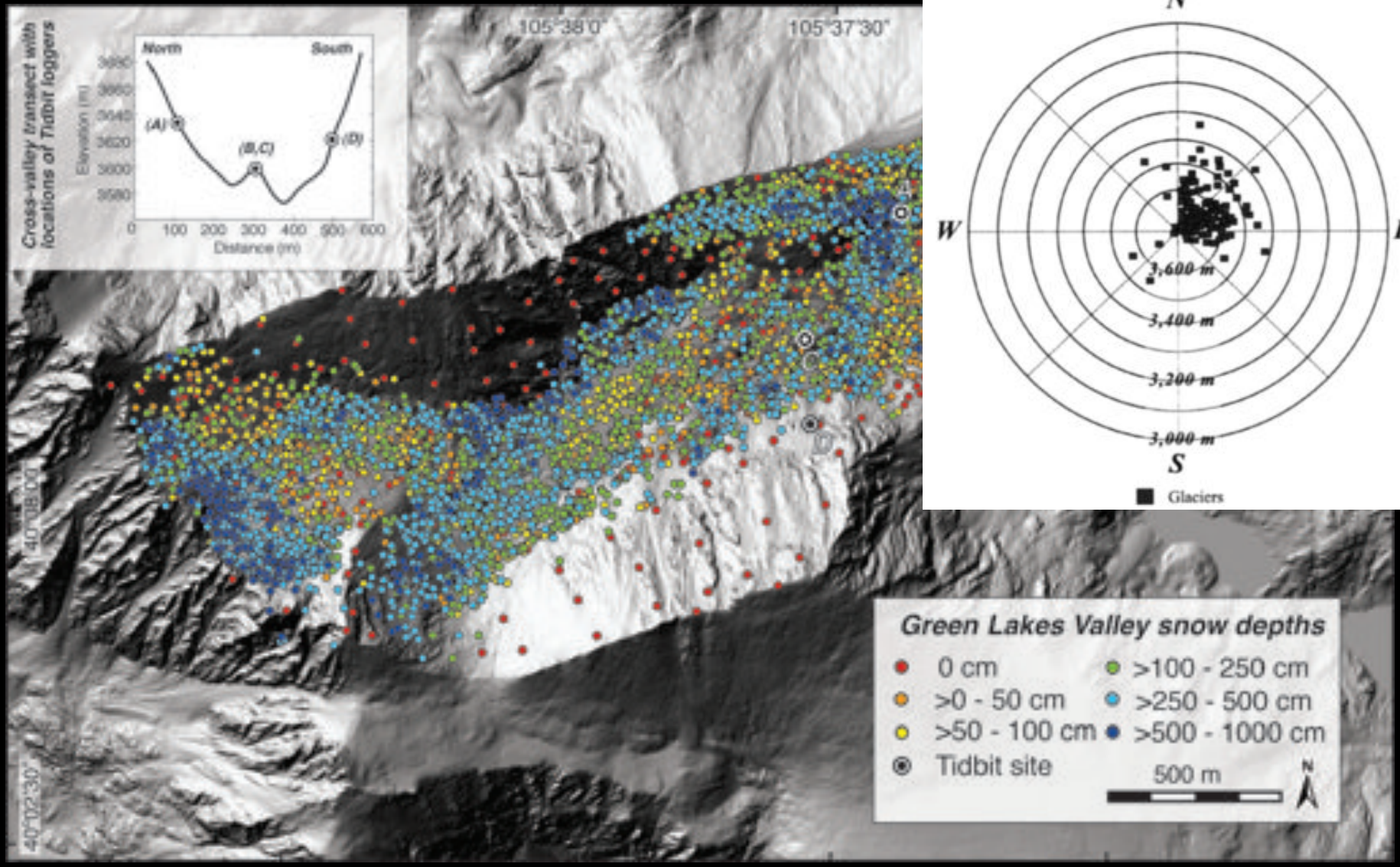
- Artifacts found in Yukon near melting ice patches are 5 kyr old

Mike Thomas via Macleans.ca

Future glaciers

Drift and rock glaciers

- Preferential accumulation
- Topographic shielding



Janke [2007]; *Duhnforth and Anderson* [2010]

Future glaciers
Drift and rock glaciers

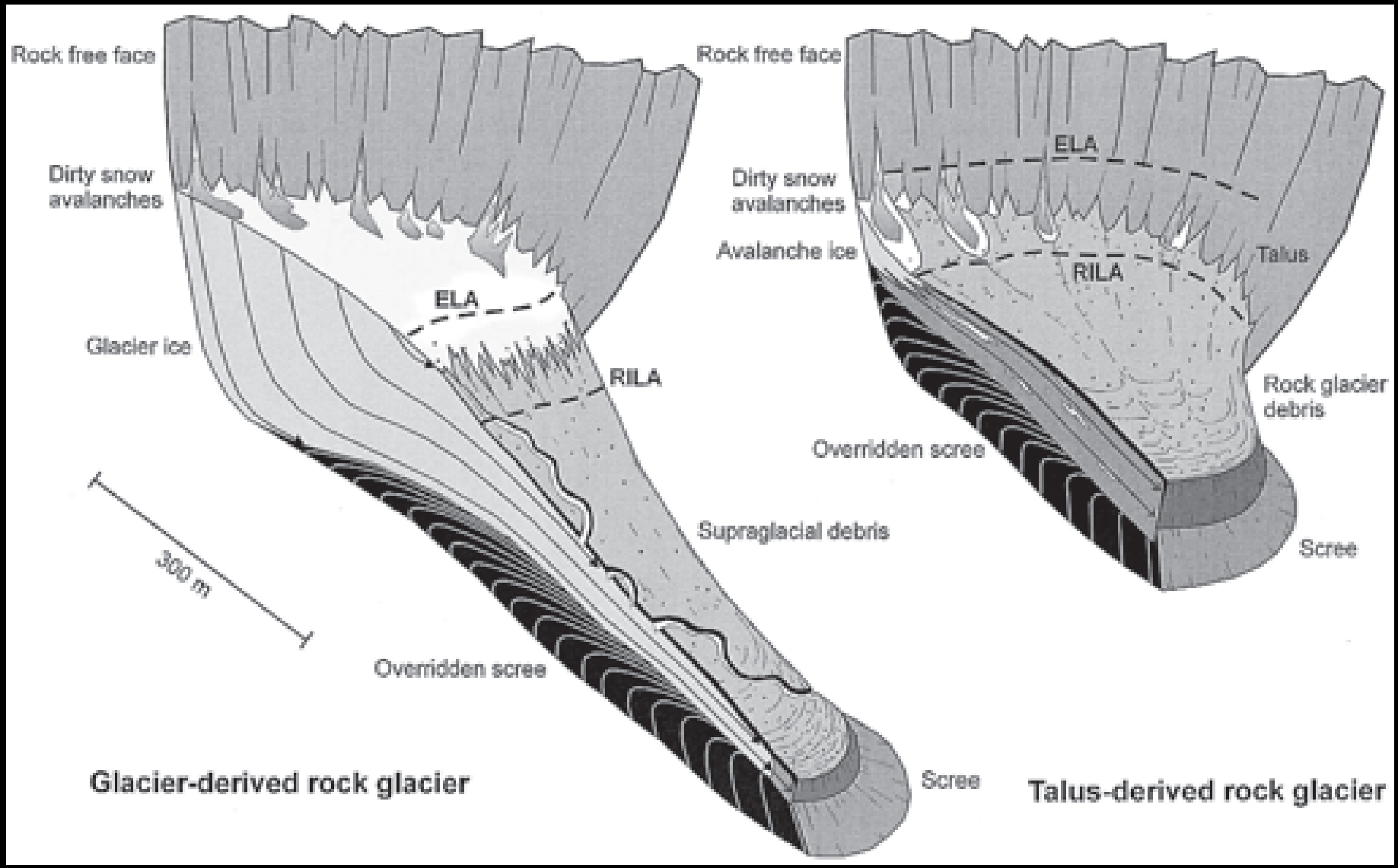
- Drift glaciers
  - Preferential accumulation
  - Topographic shielding
- Rock glaciers
  - Avalanching
  - Debris as insulation

Photo: Rock glacier near McCarthy, Alaska; William Armstrong

Future glaciers

Drift and rock glaciers

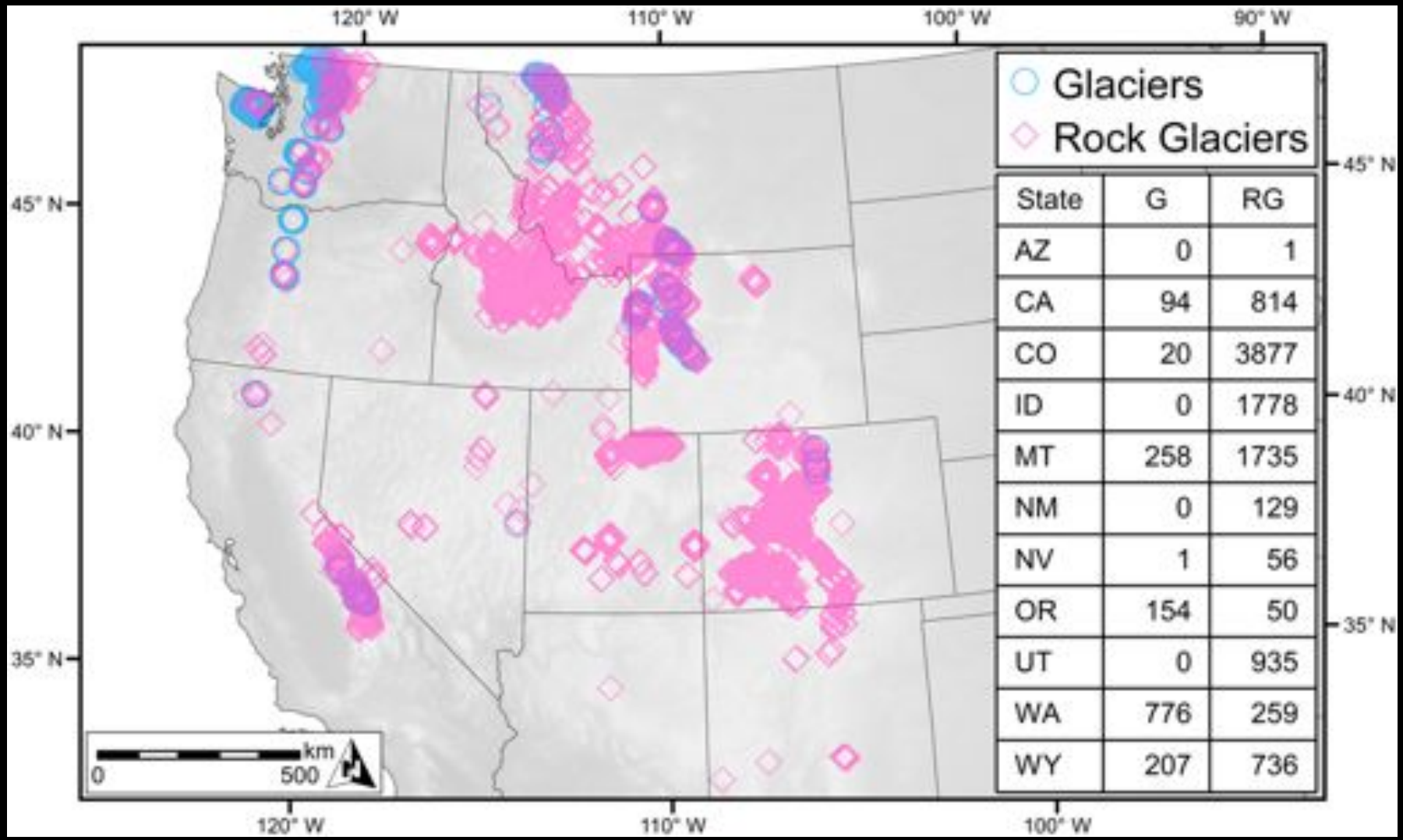
- Avalanching
- Debris as insulation



Humlum [2000]

Future glaciers
Drift and rock glaciers

- Transition from “regular” to rock glacier?



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AZ	0	1
CA	94	814
CO	20	3877
ID	0	1778
MT	258	1735
NM	0	129
NV	1	56
OR	154	50
UT	0	935
WA	776	259
WY	207	736

Fegel et al. [2016]

Thanks!

References

- Anderson and Anderson, 2010.
- Armstrong et al., 2016.
- Duhnforth and Anderson, 2010.
- Fegel et al., 2016.
- Haugen et al., 2010.
- Hoffman et al., 2007.
- Humlum, 2000.
- Janke, 2007.