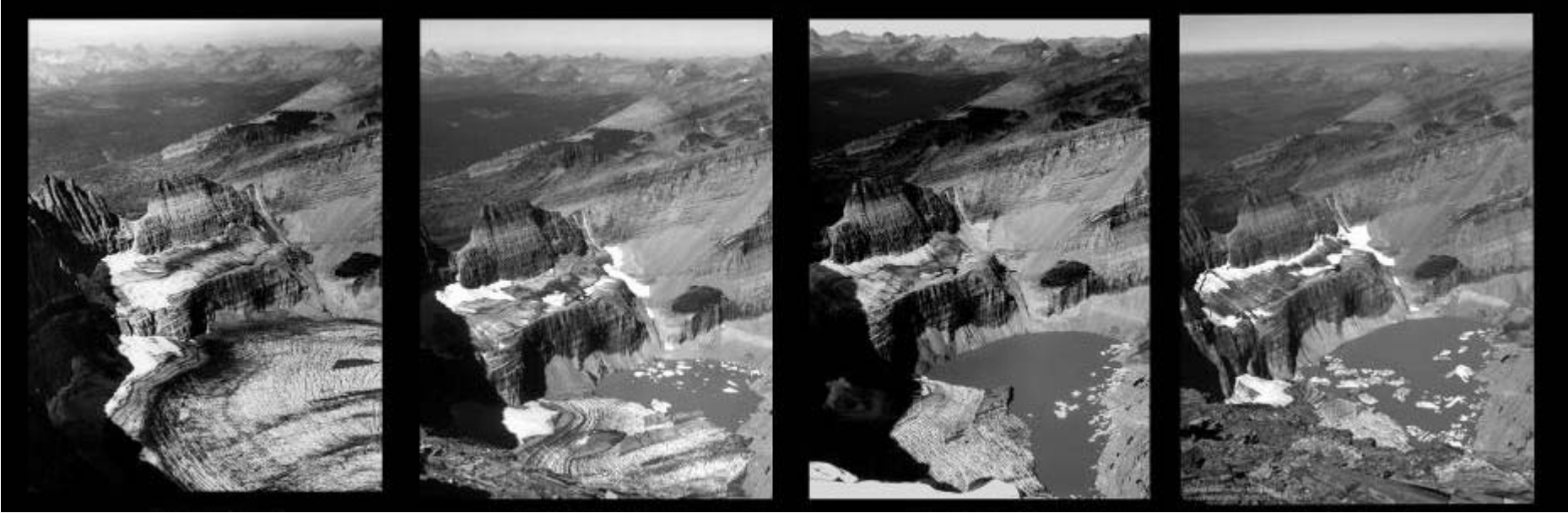


A century of glacier change in the American West



Photos from the USGS, NPS

**Andrew G. Fountain
Portland State University**

Acknowledgements: NSF, NASA, USGS, and to Matt Hoffman, Hassan Basagic, Thomas Nylen, Mark DeVisser, and David Percy



Geologic Hazards

debris flows

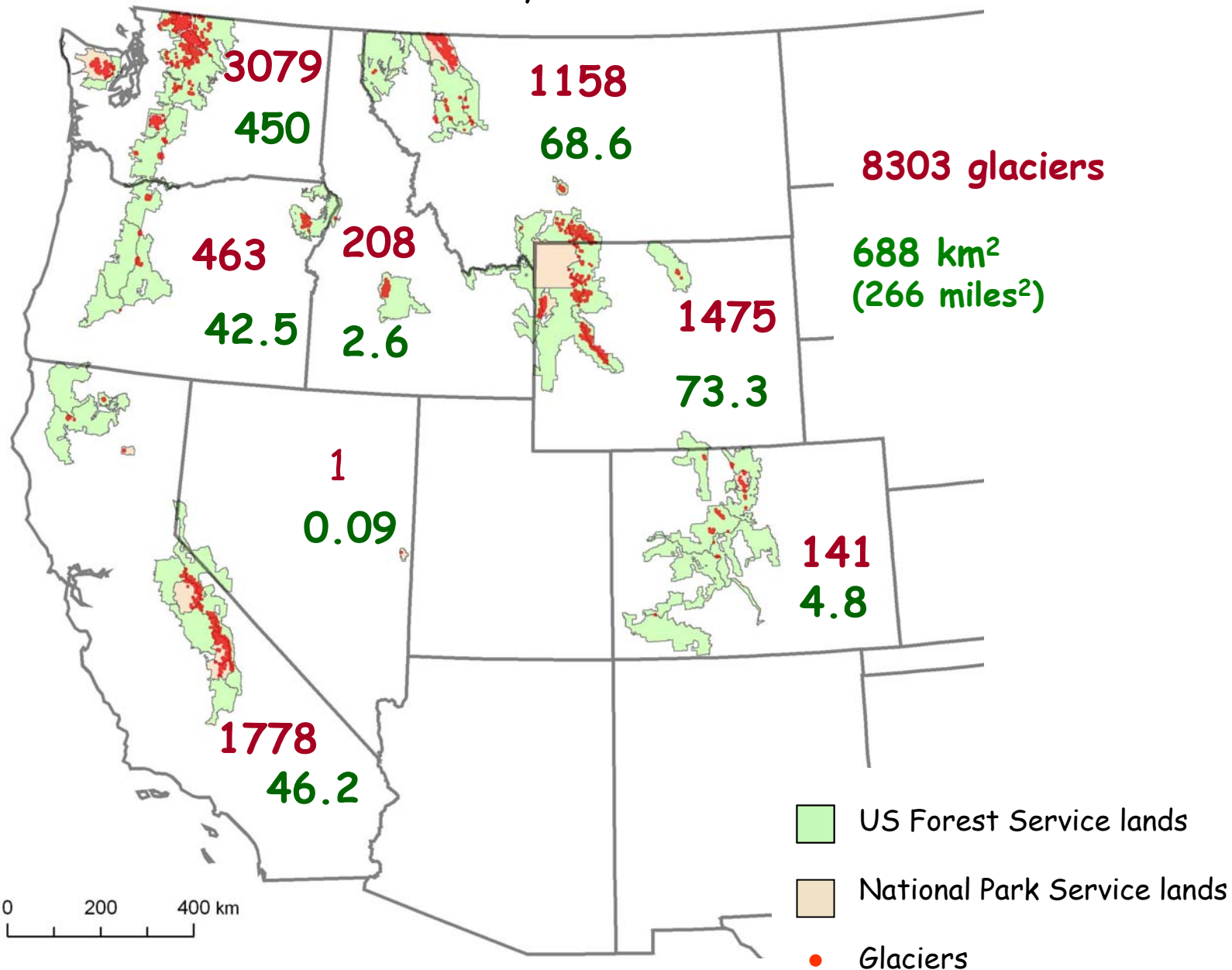


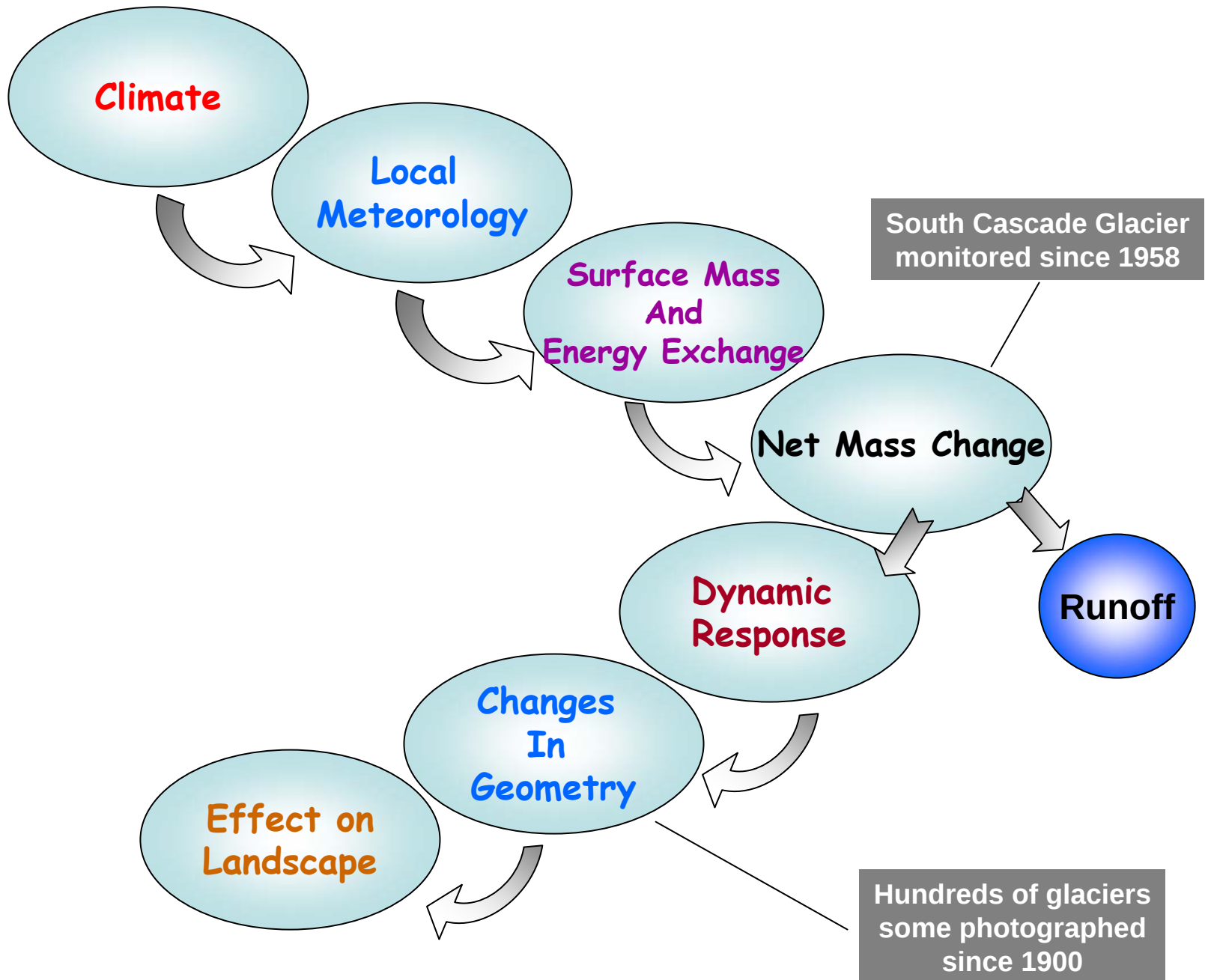
Oregon Highway 35, Nov 7, 2006

Doug Jones

Glaciers in the American West

1 : 24,000







1907

G.K.Gilbert

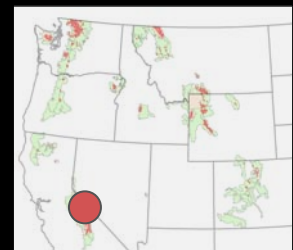
Darwin Glacier

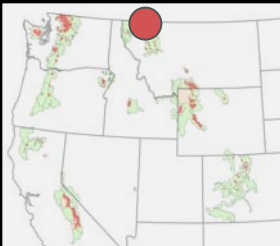
Sierra Nevada
Kings Canyon Nat. Park



2003

Hassan Basagic





Grinnell Glacier

Lewis Range, Montana
Glacier National Park



1938
T. Hileman



1981
C. Key

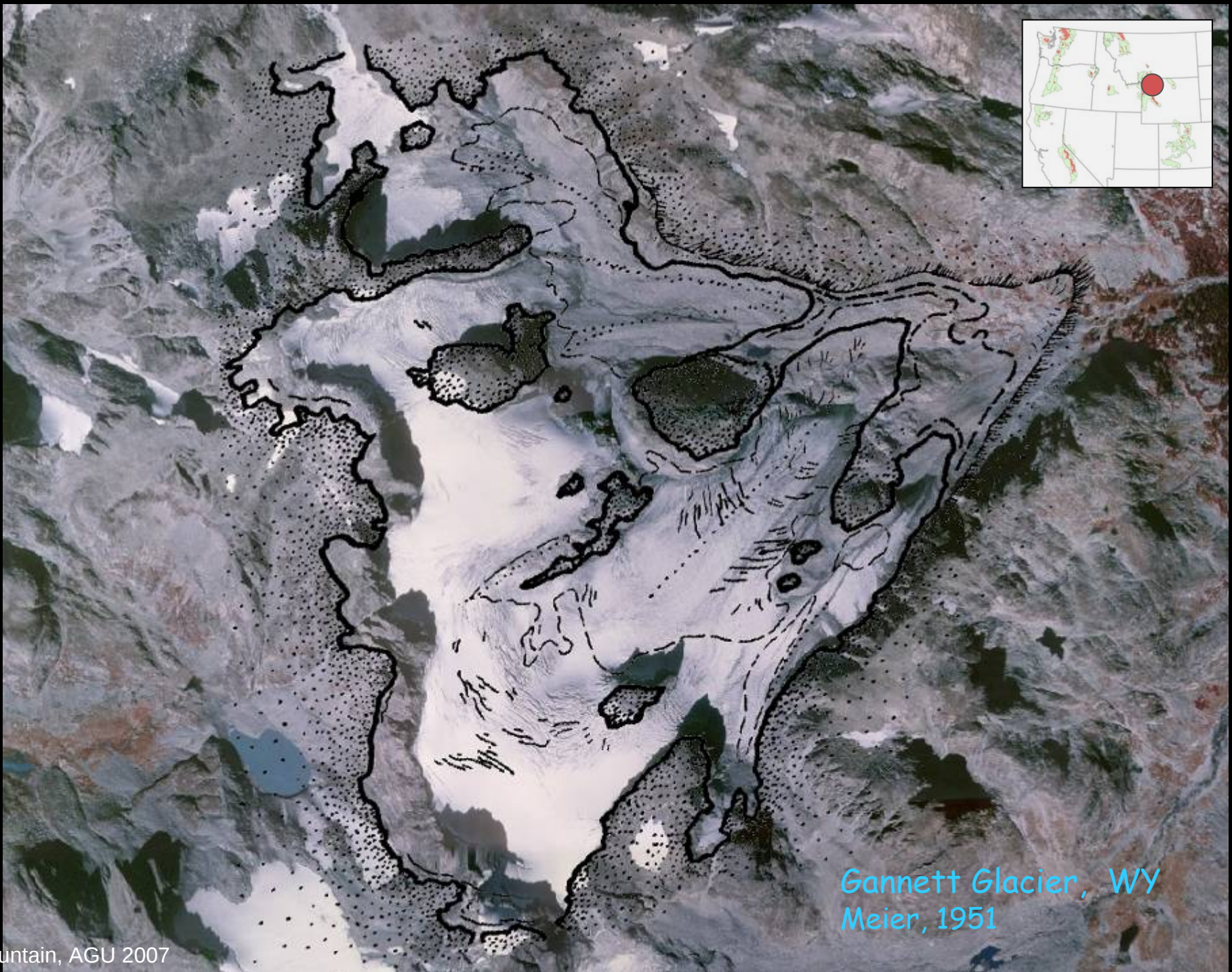


1998
D. Fagre



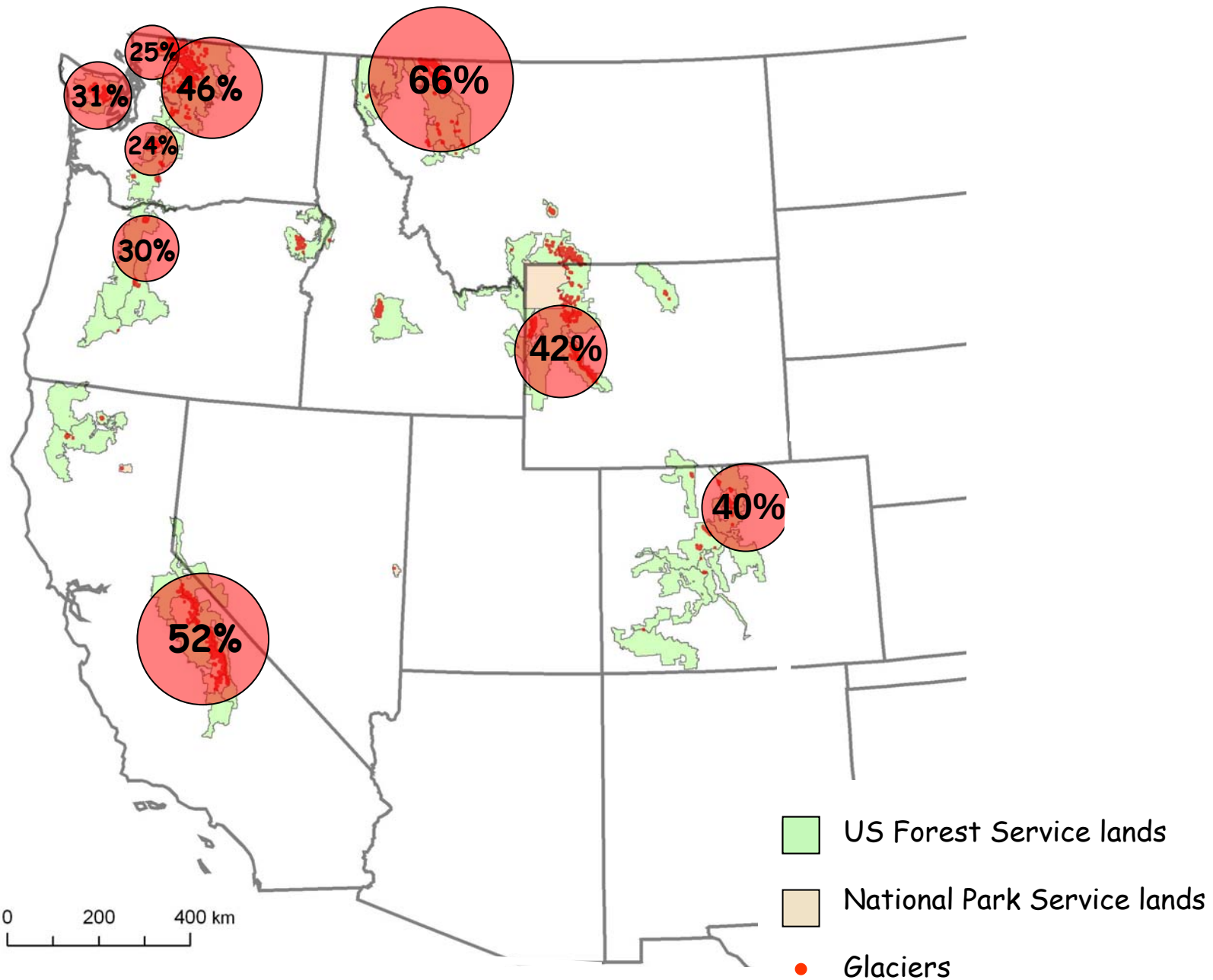
2006
K. Holzer

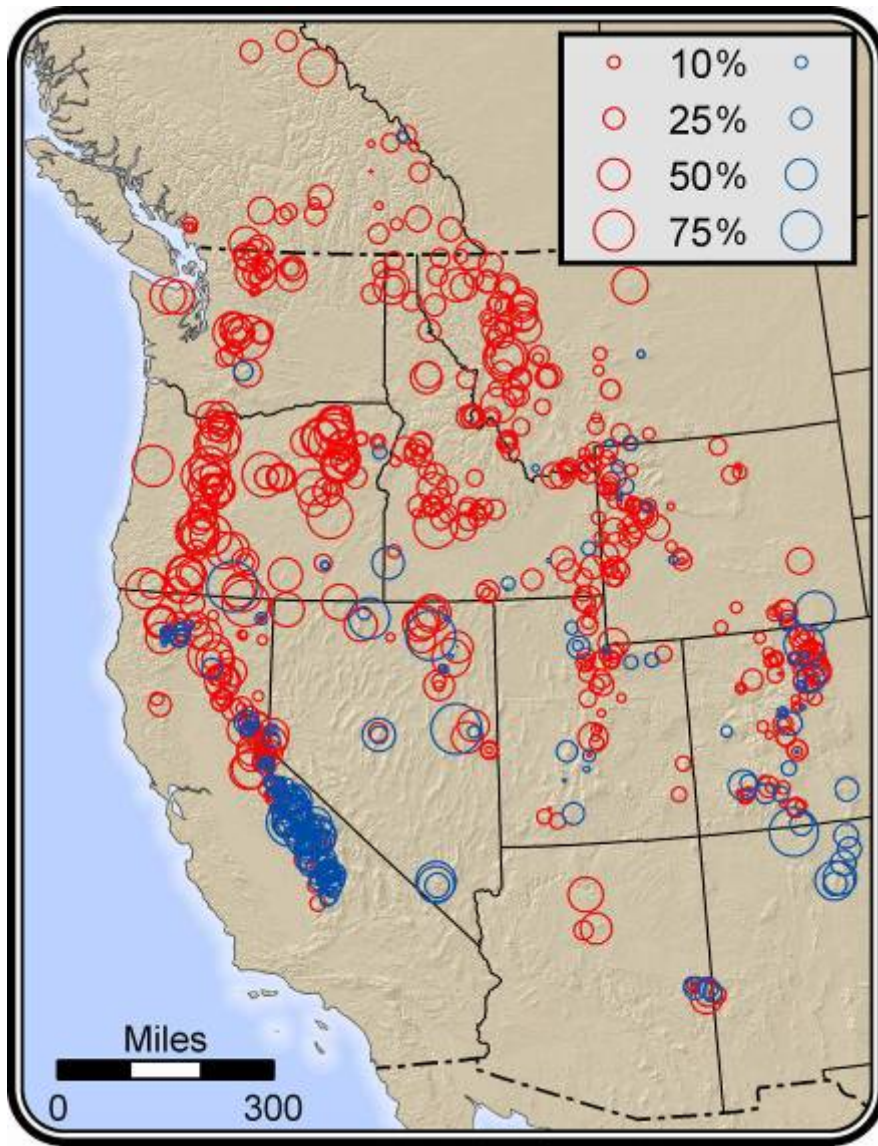
Courtesy Glacier National Park, US Geological Survey



Gannett Glacier, WY
Meier, 1951

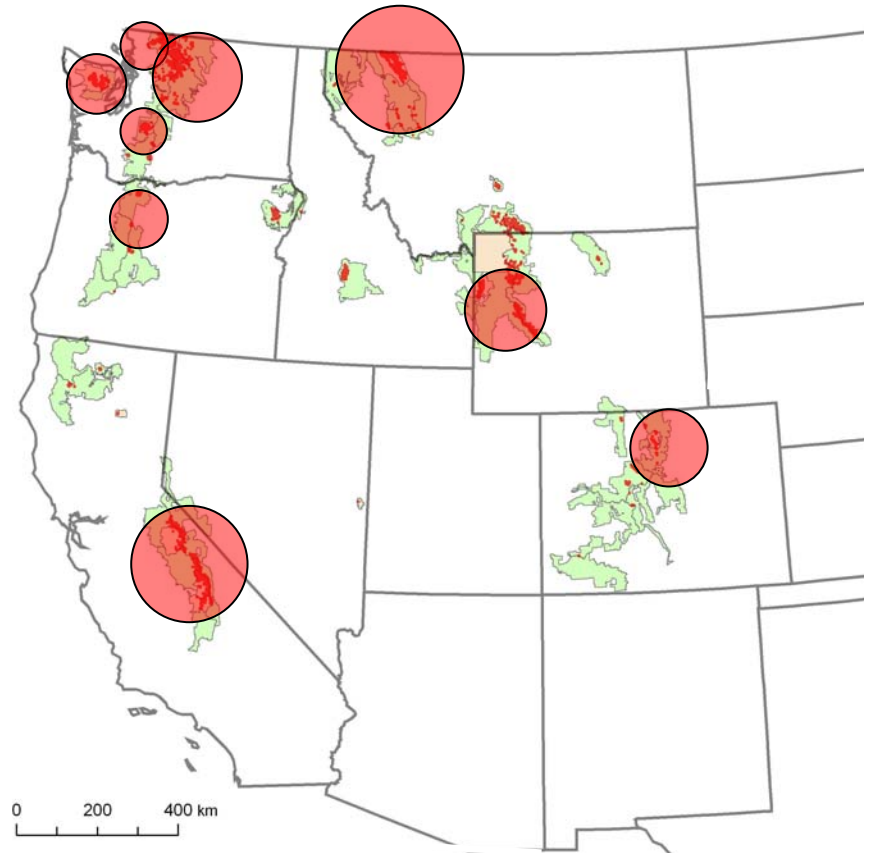
Fraction of Glacier Area Lost since 1900



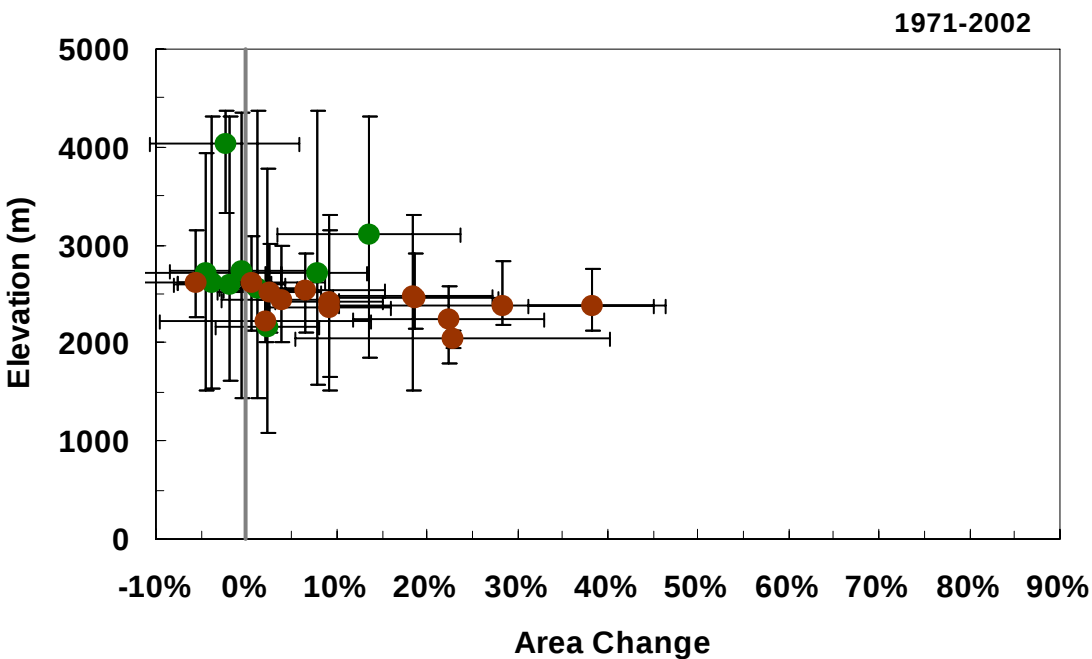
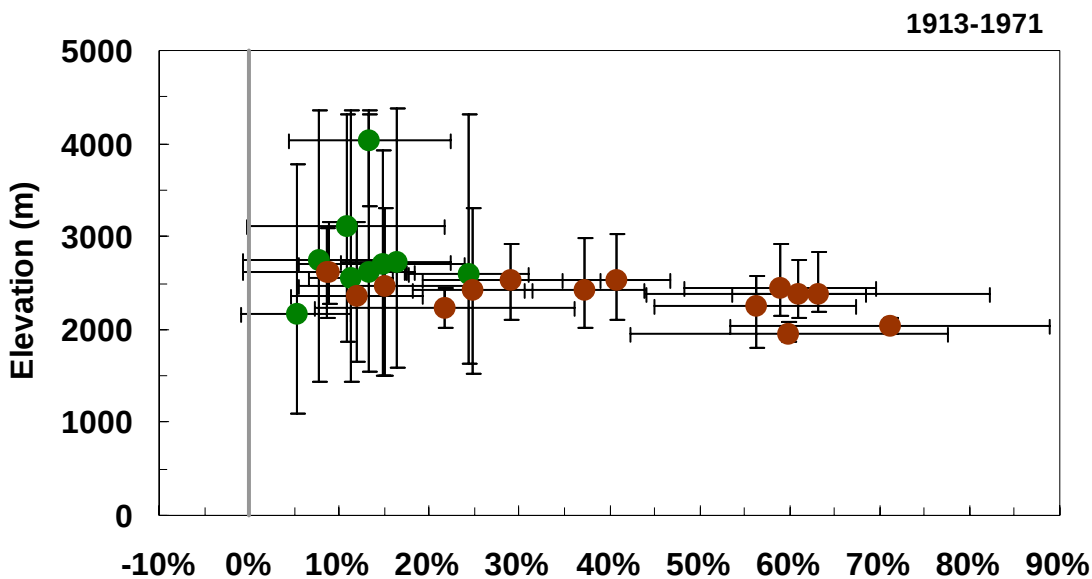
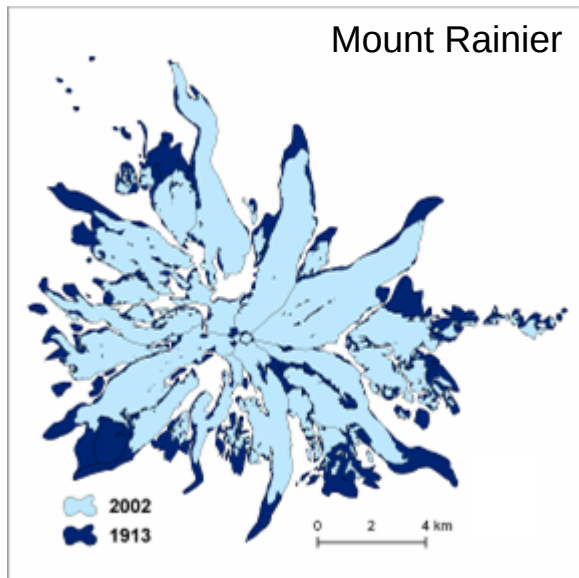


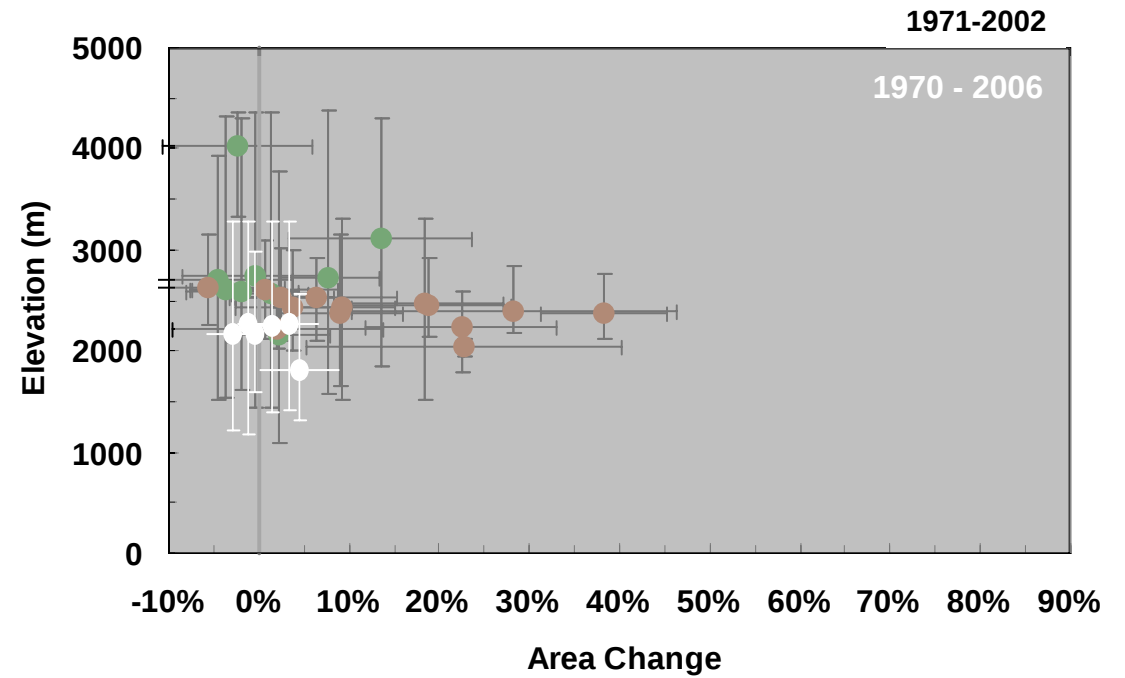
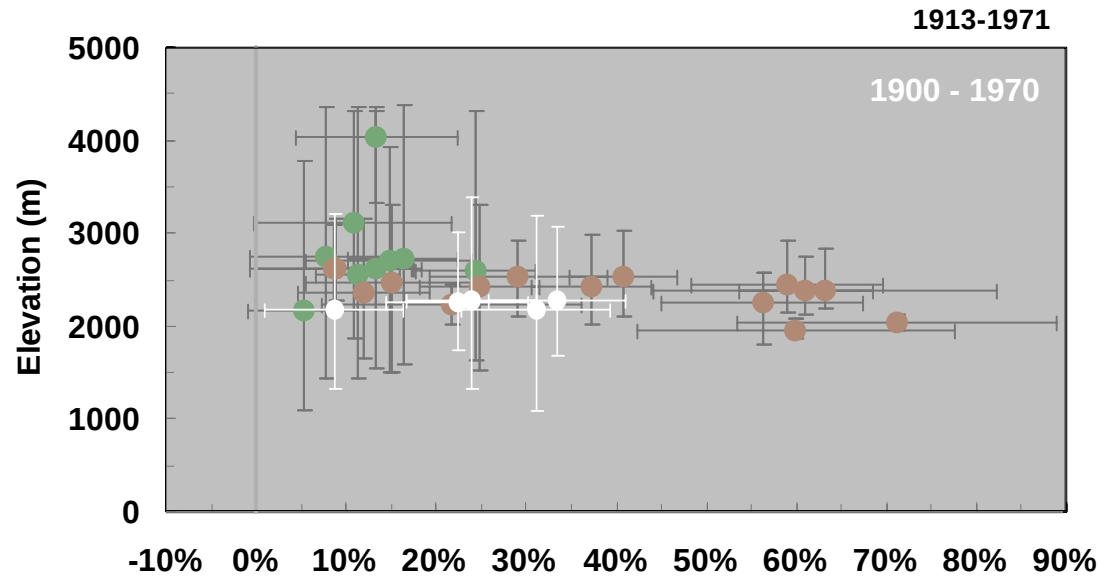
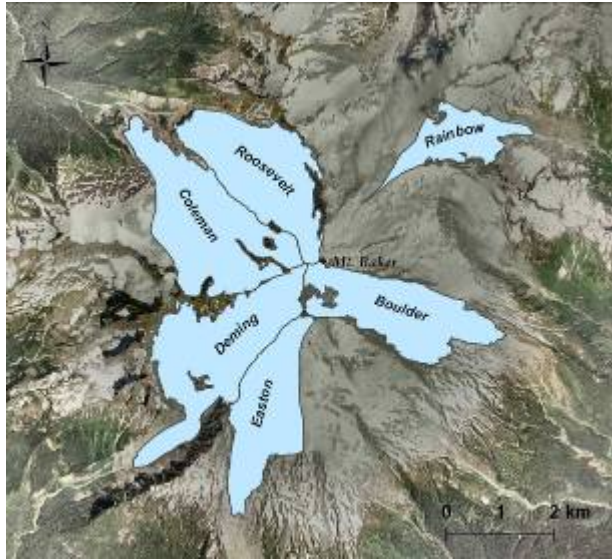
Mote et al., 2005

Trends in Winter Snowpack since 1950



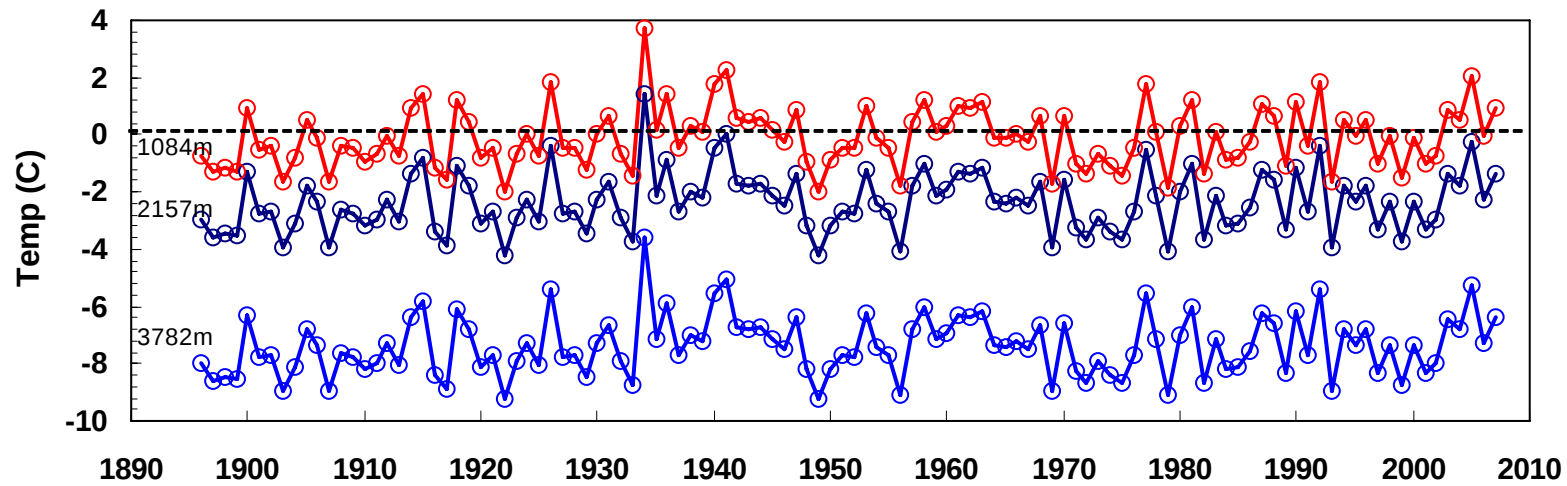
Fountain, AGU 2007





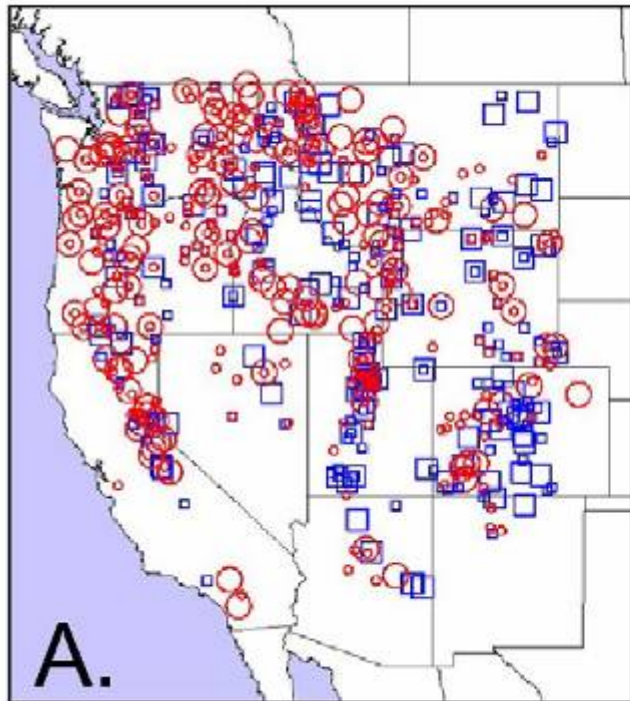
Mount Rainier

4392m

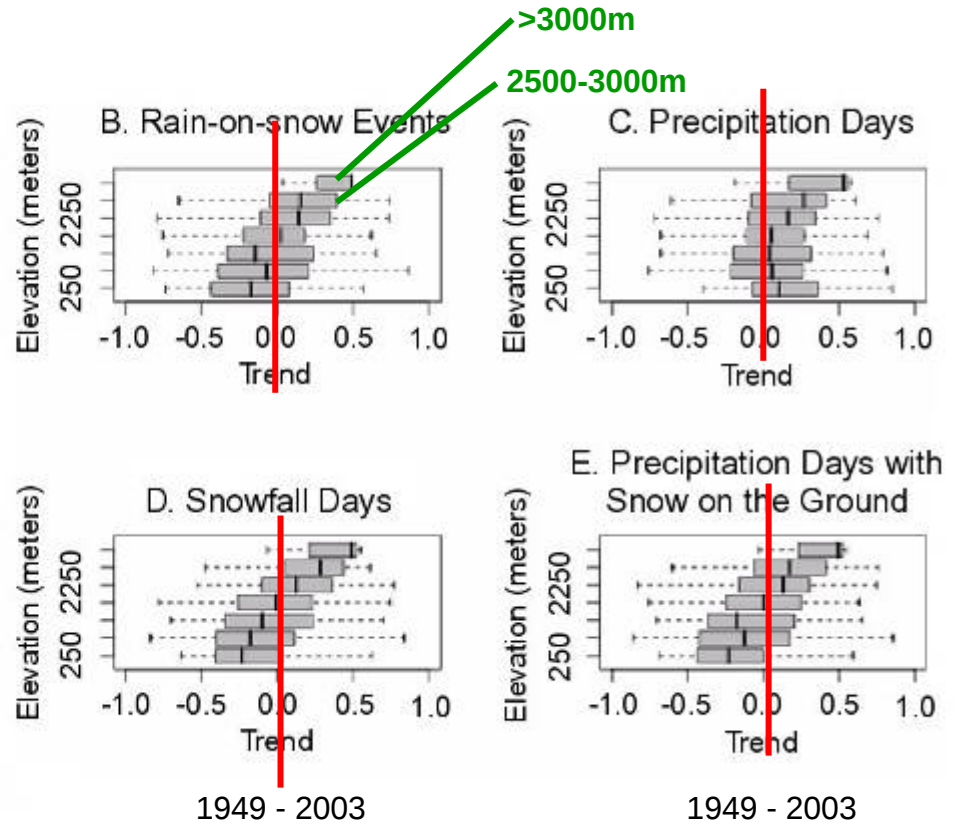


RAIN-ON-SNOW EVENTS IN THE WESTERN UNITED STATES

BY GREGORY J. MCCABE, MARTYN P. CLARK, AND LAUREN E. HAY



Red = decreasing trend
Blue = increasing trend



What's happening in the Sierra Nevada?



Andrews Glacier
Front Range, Colorado



Climatically Sensitive and Insensitive Glaciers

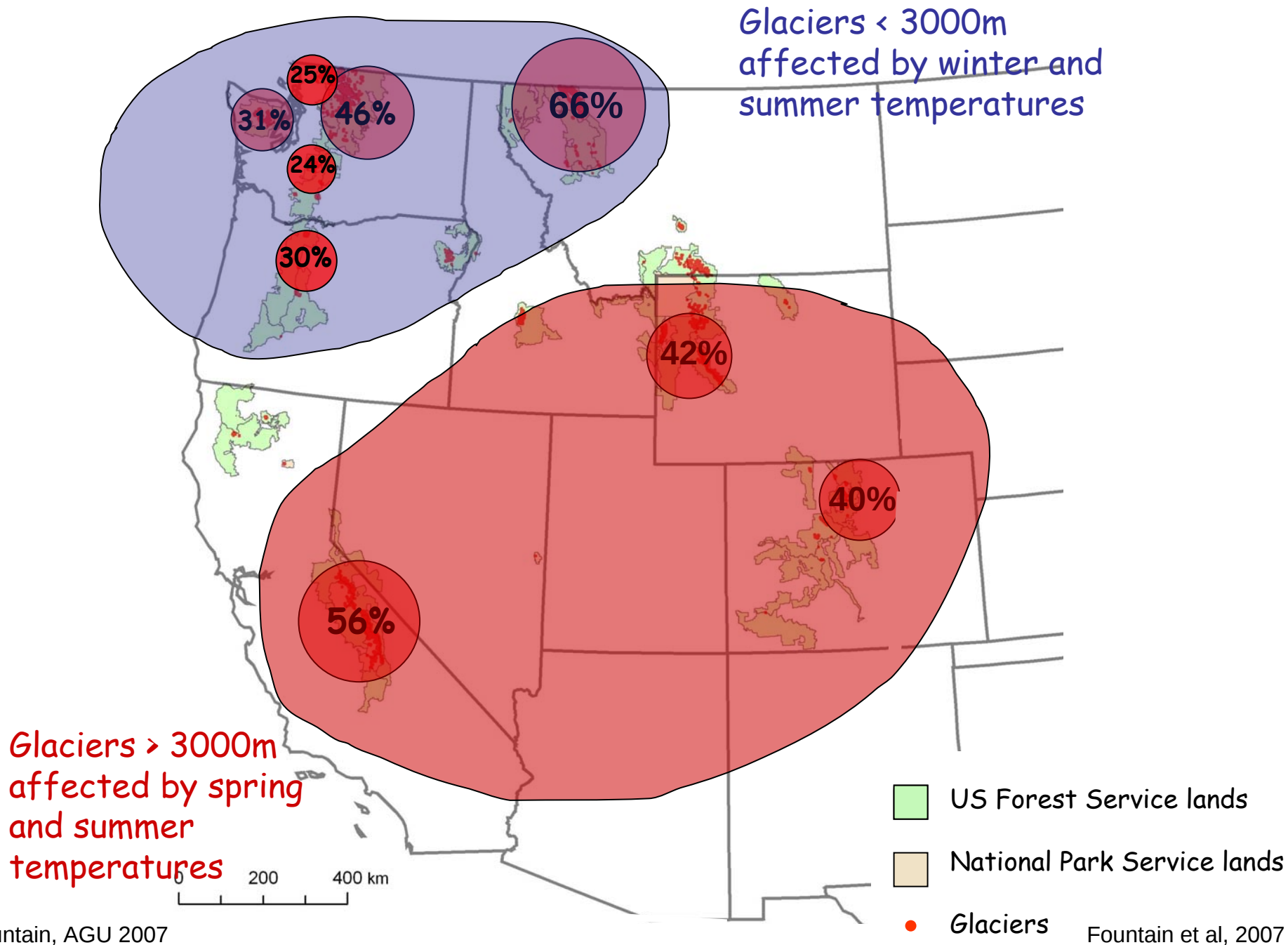


Snow accumulation = $\bar{S} + S'$

$$\text{Ablation} = f[\bar{R} + R', \bar{T} + T', \bar{H} + H', \bar{W} + W']$$

where $\bar{R}$ is the direct 'unabstracted' value

*R' is the topographically induced
perturbation*



Conclusions



Reid Glacier, Mt. Hood
2007 John Scurlock

Glacier behavior is consistent with broad climatic trends, however identifying regional factors requires a local understanding of the climate and glacier setting.

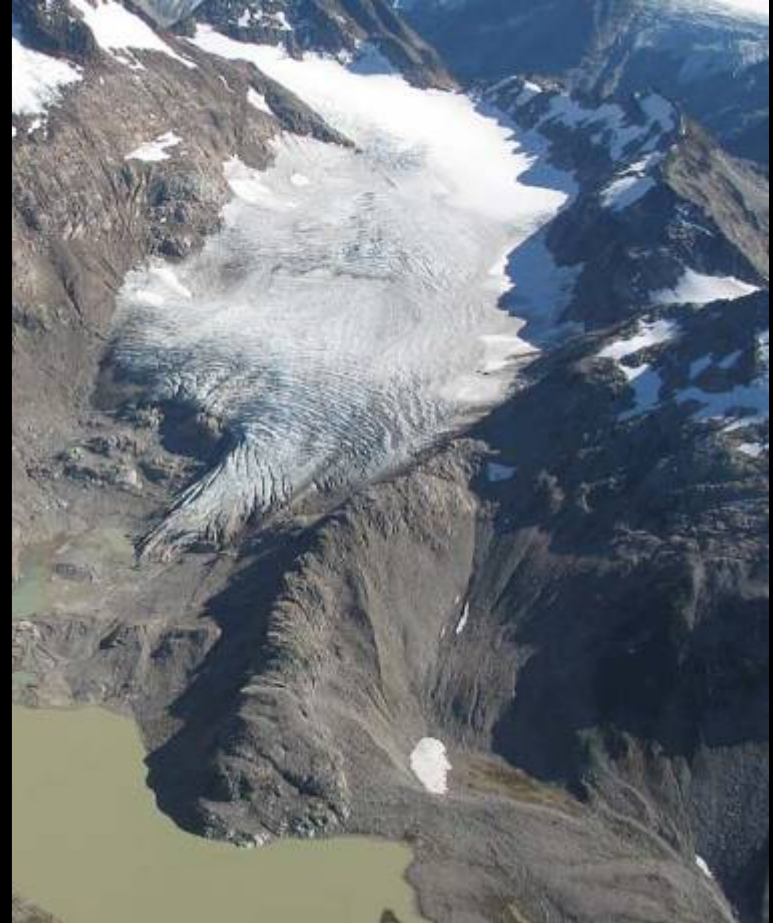
The role of local topography is important to understanding the spatially varying response of glaciers to climate change.

In general, regions of thermally susceptible snowpacks (near the melting point) suffer from both increases in winter and summer temperature increases. Whereas the small but high elevation glaciers appear to be responding to spring/summer temperatures.

South Cascade Glacier, WA



1960 USGS



2004 John Scurlock