On the continuing retreat of South Cascade Glacier
or
"The Day After Tomorrow"

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USGS Glacier Monitoring Program

- Measures mass balance at three glaciers, each in a different climate regime: South Cascade, WA, Gulkana and Wolverine, AK.
- Longest record in North America, >forty years in length.
- Glaciers are an indicator of climate variations.
- Glaciers are a water resource.

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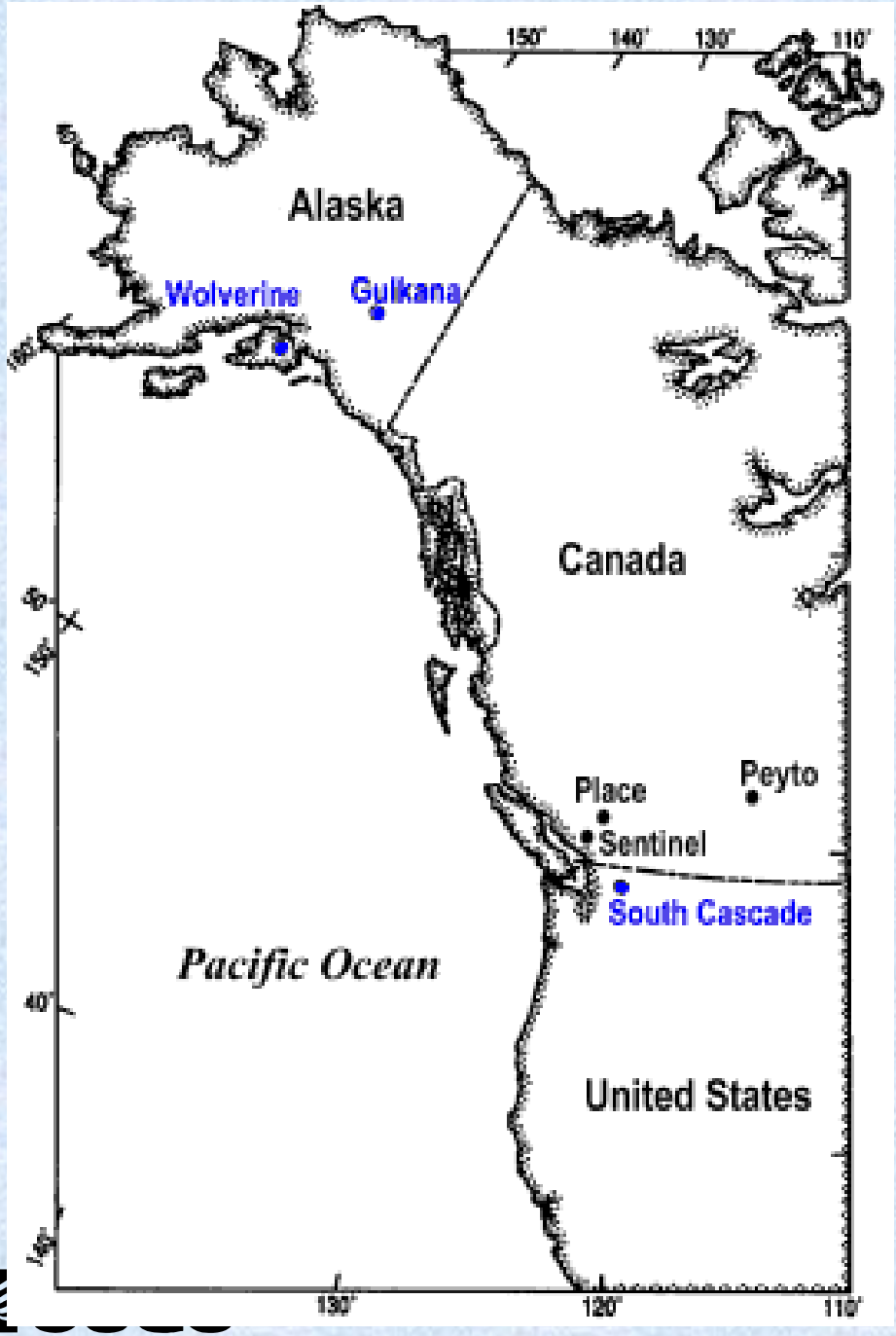

USGS Benchmark Glaciers

Wolverine, Gulkana and South Cascade glaciers, each in a different climate regime.

Retreat of South Cascade Glacier, 1928-1979

1928

1979

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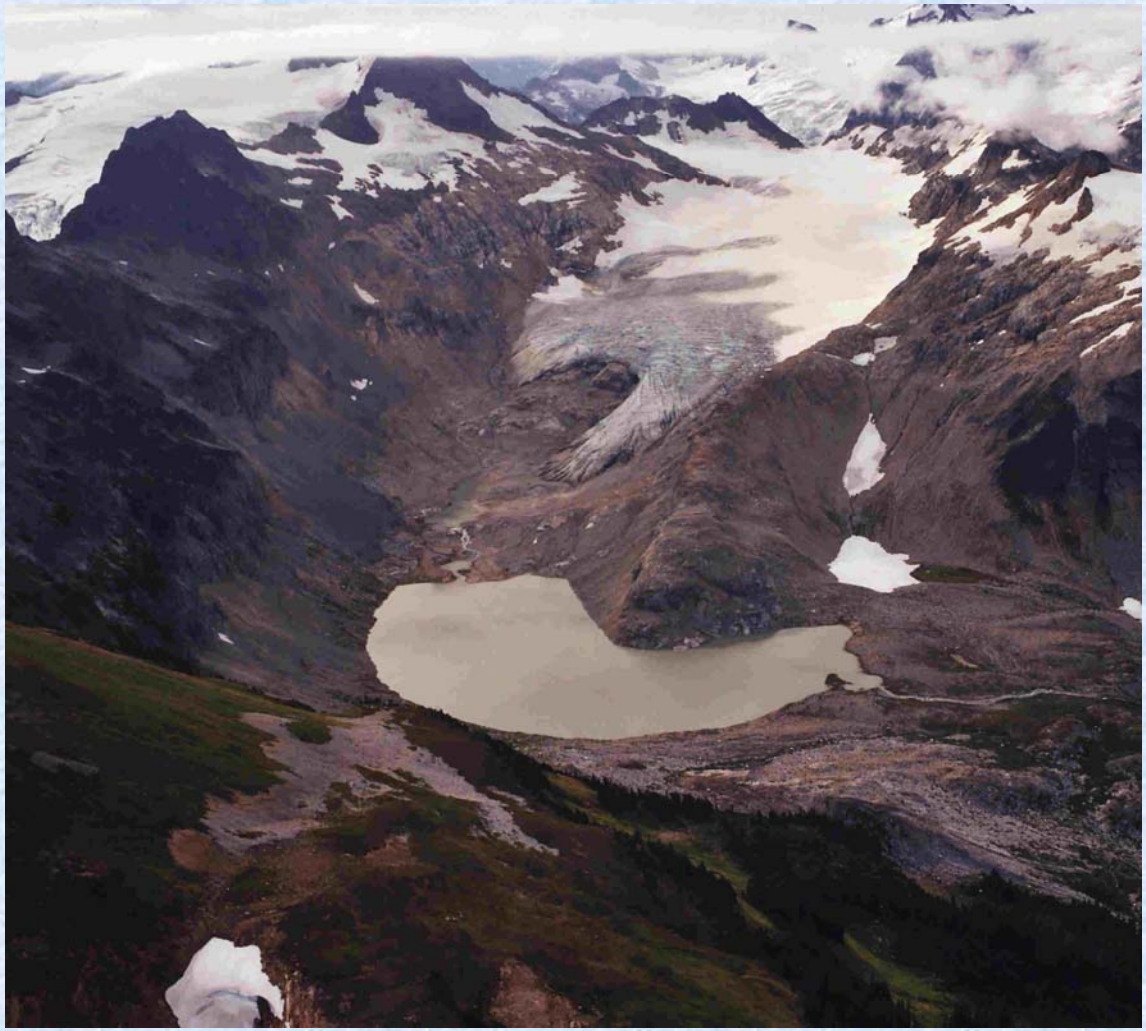

Volume Estimates	
YEAR	km^3
1650	0.49
1890	0.49
1928	0.32
1958	0.24
1970	0.22
1985	0.19
2001	0.16

2003

National Academy of Sciences

www.koshlandsciencemuseum.org

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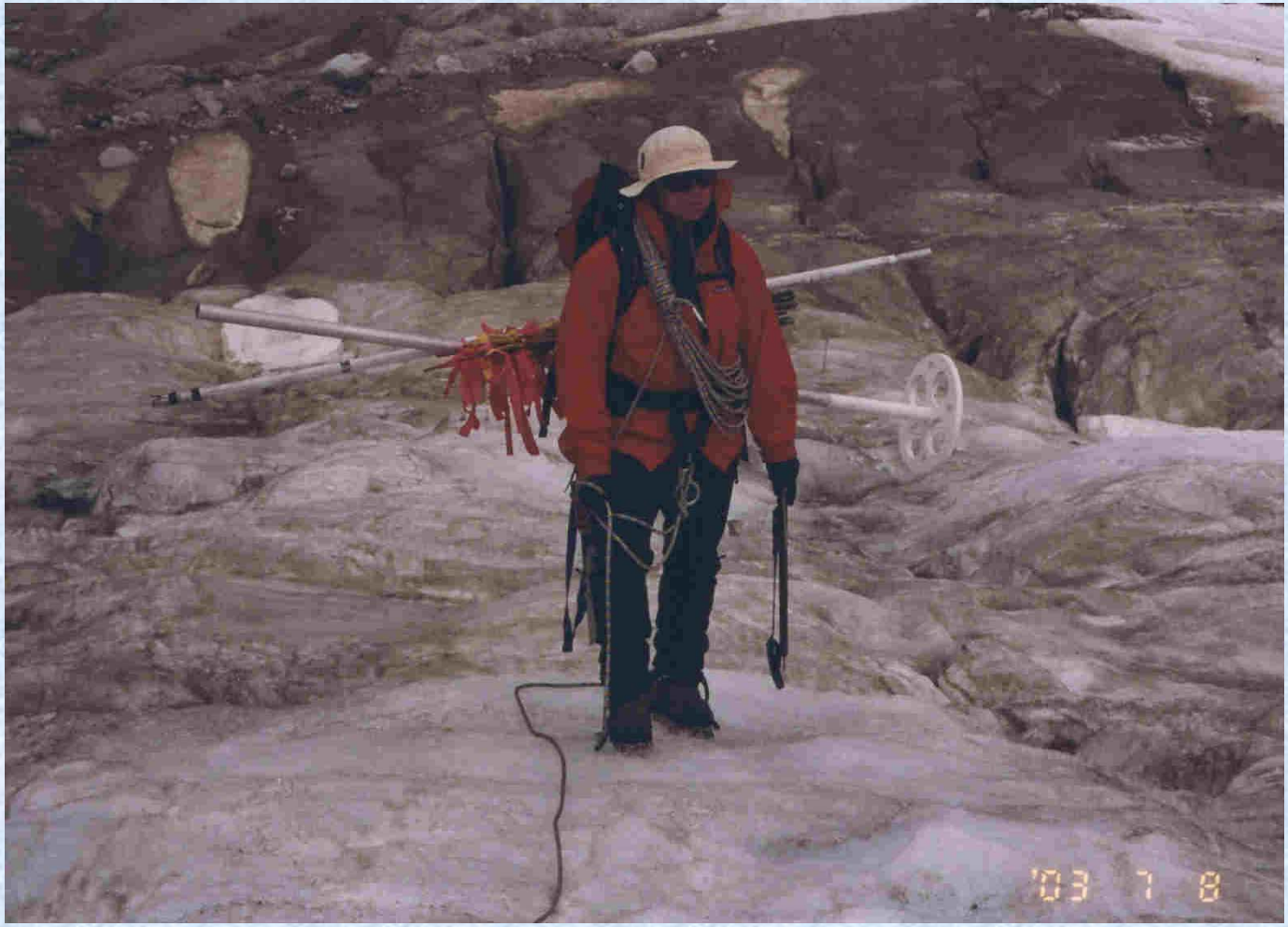
Setting out for the office.



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Field measurements provide seasonal mass balance information.

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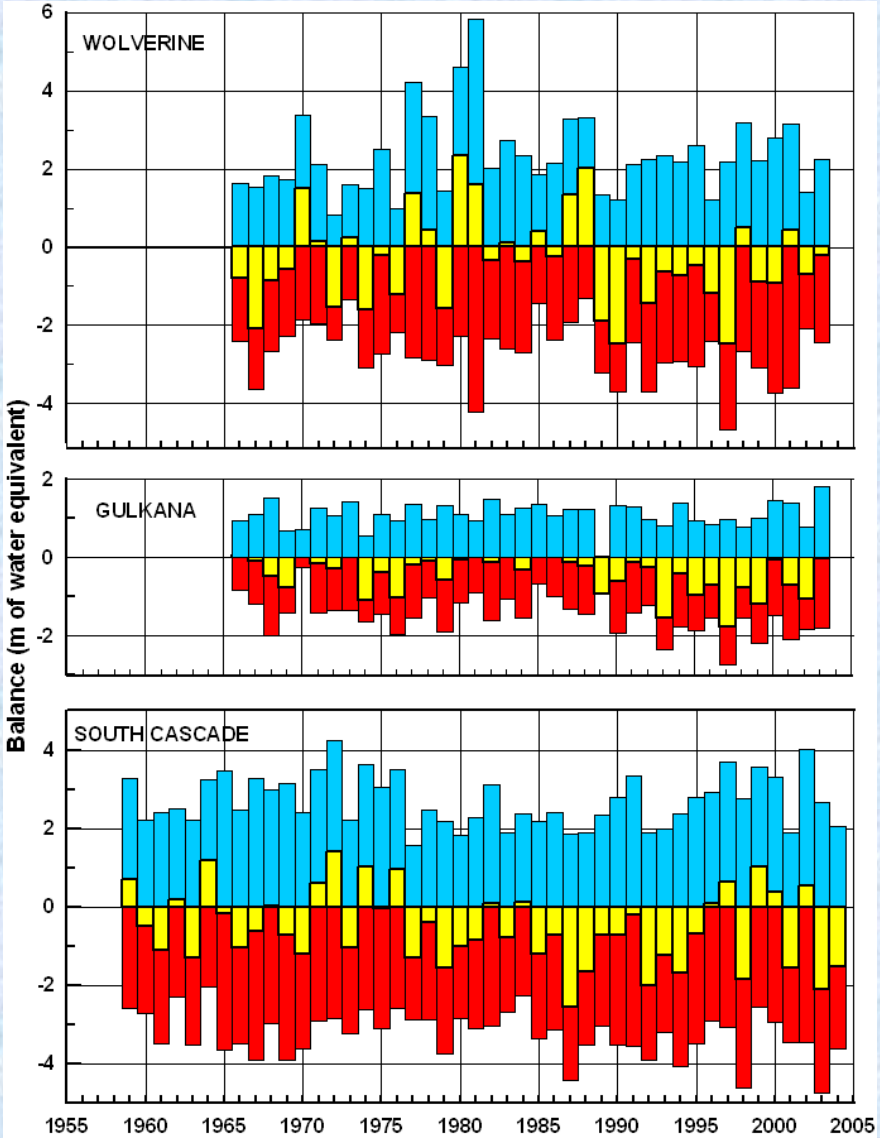
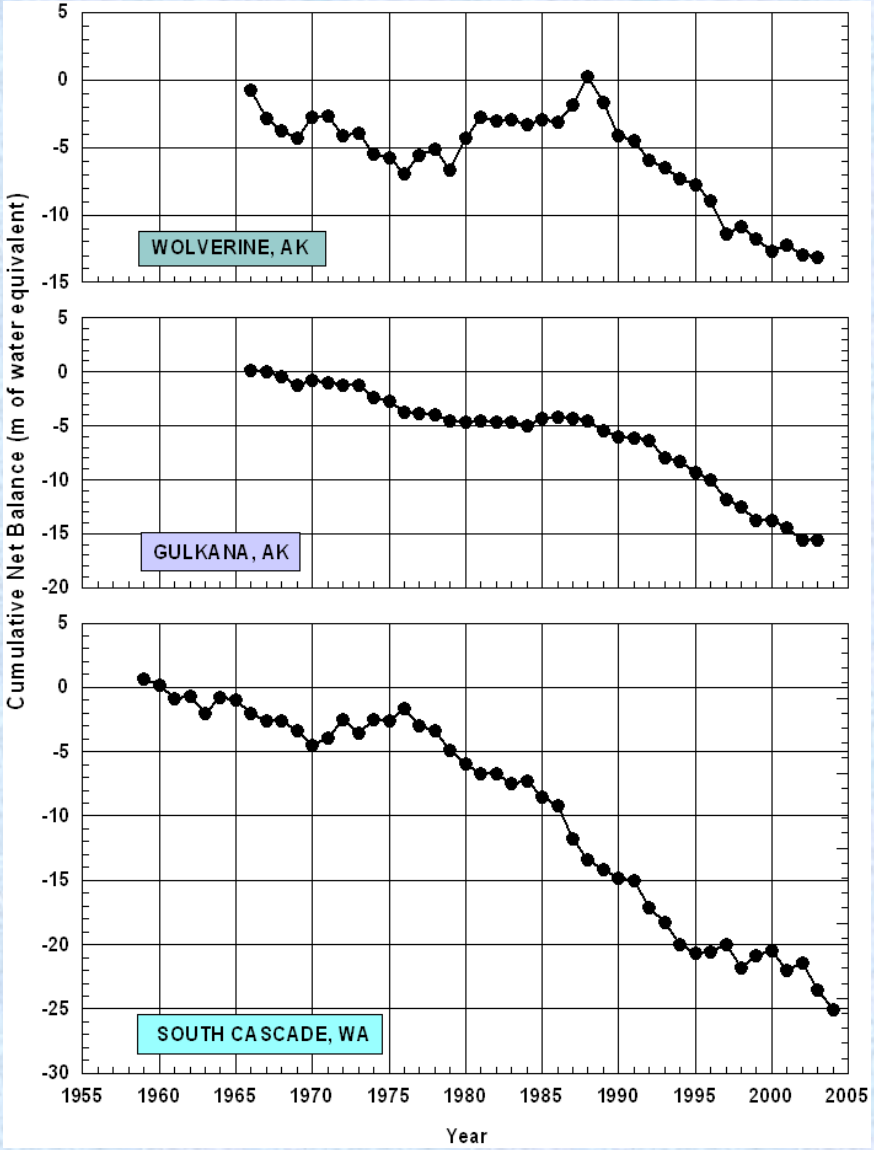
Seasonal Balances



Cumulative Net Balance



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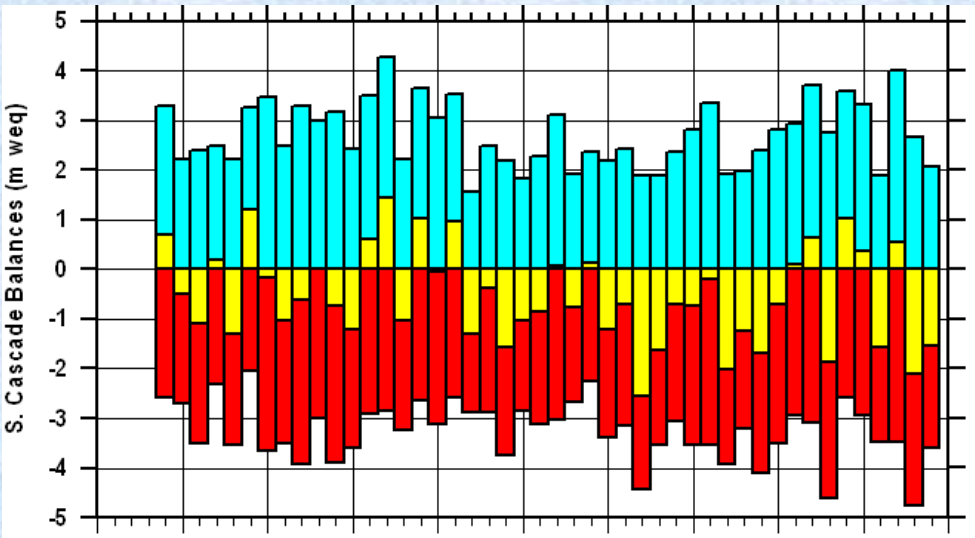
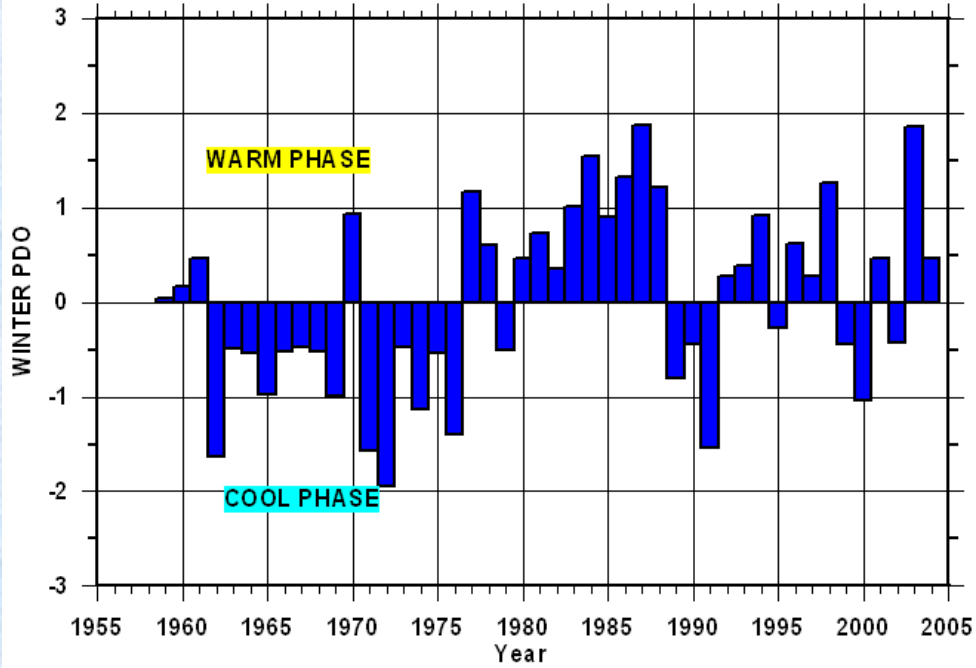


Interannual Variation



Pacific Decadal Oscillation

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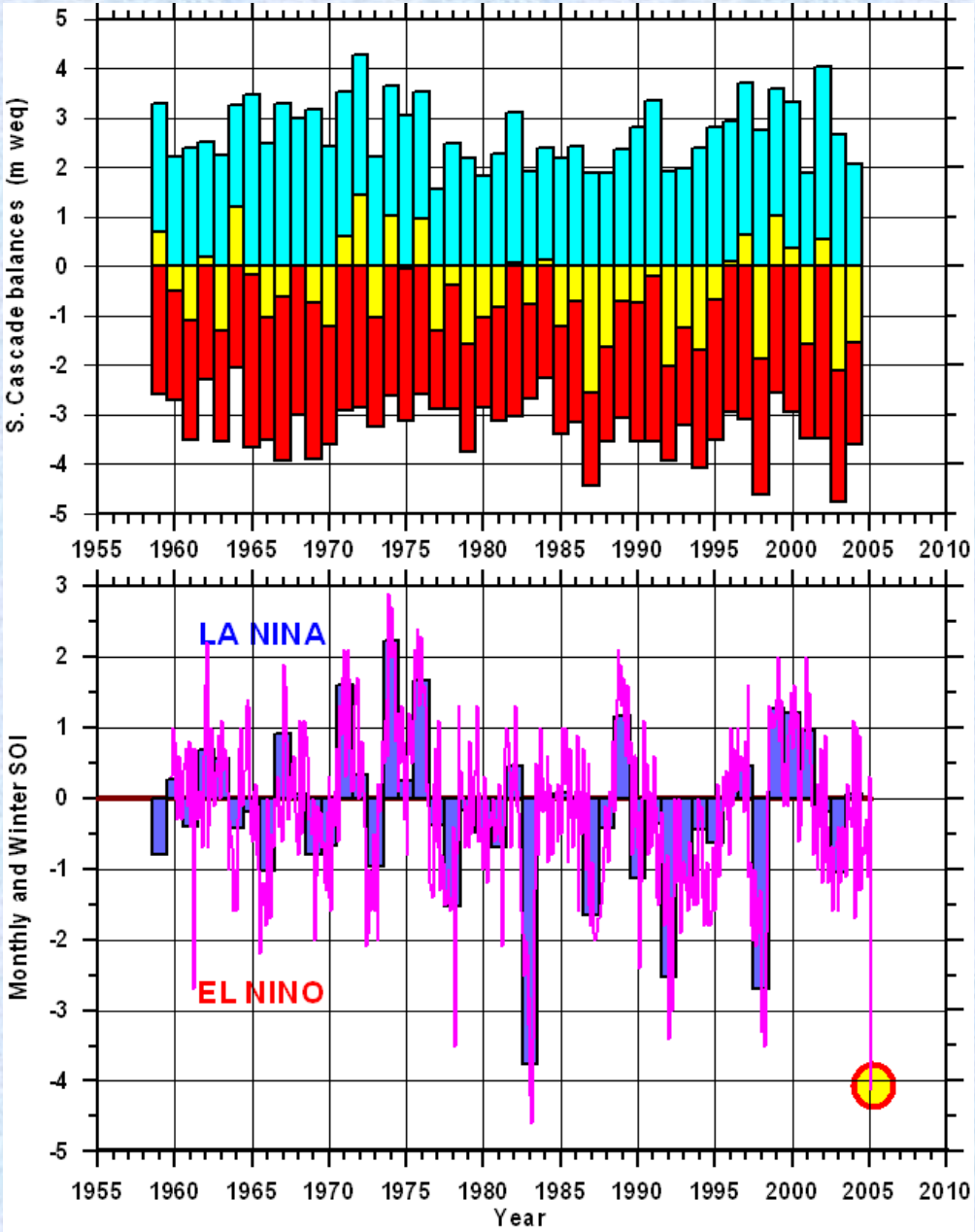

Annual Variations

ENSO monthly and winter average

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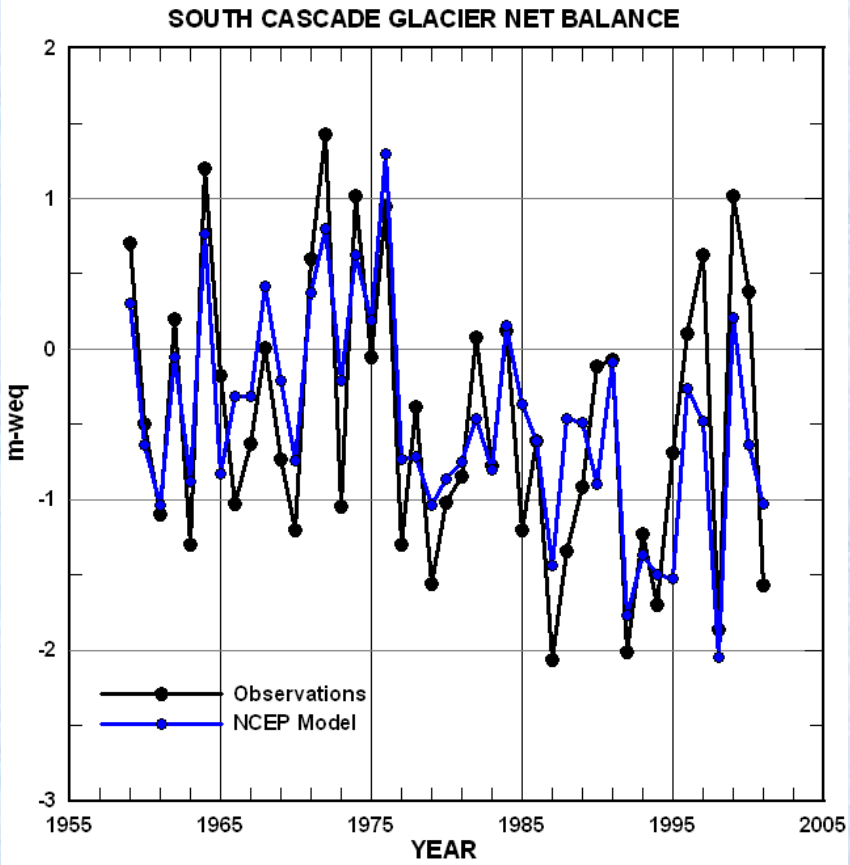
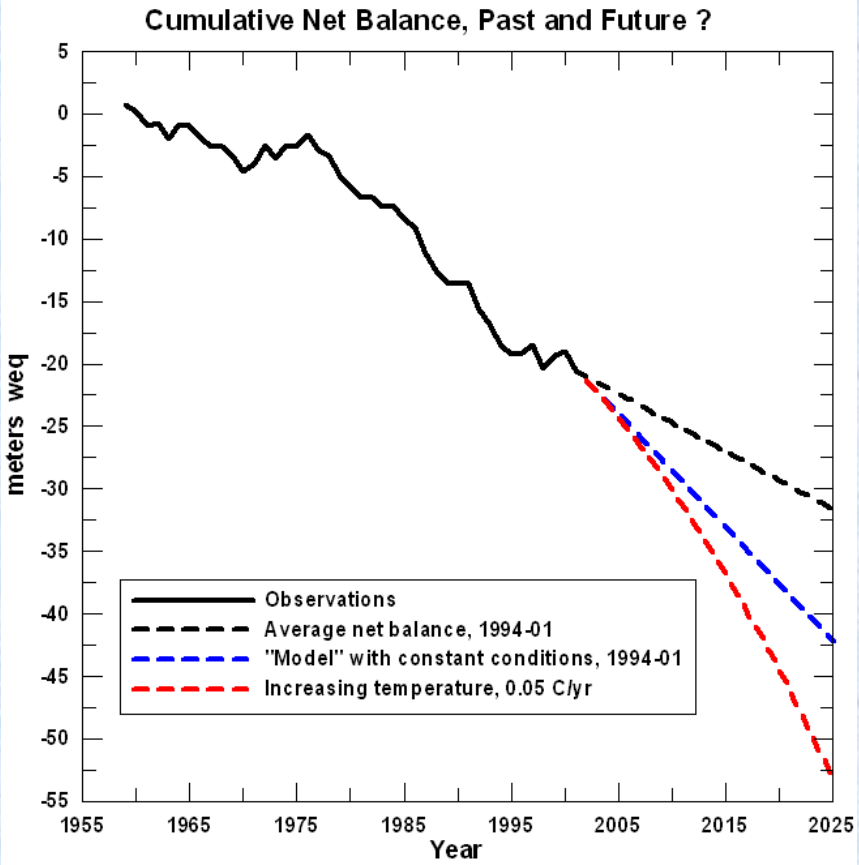
SCG Balance model based on seasonally averaged winter and summer temperatures and winter onshore moisture flux from NCEP reanalysis data.





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Glacier Melt and Runoff Modeling

Approach:

- Apply a robust model at South Cascade Glacier, where ample input and verification data are available.
- Determine minimum data inputs for accurate melt and runoff simulations.
- Apply the model to other glacierized basins.

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Glacier Melt and Runoff Modeling

Model:

- Developed by Regine Hock, Stockholm University, Sweden.
- Distributed temperature-index ice- and snowmelt model incorporating potential solar radiation.
- Inputs include air temperature, precipitation, maps of snow, firn, and ice, and DEM of glacier and nearby terrain.

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MOVIE
I SURE HOPE THIS WORKS

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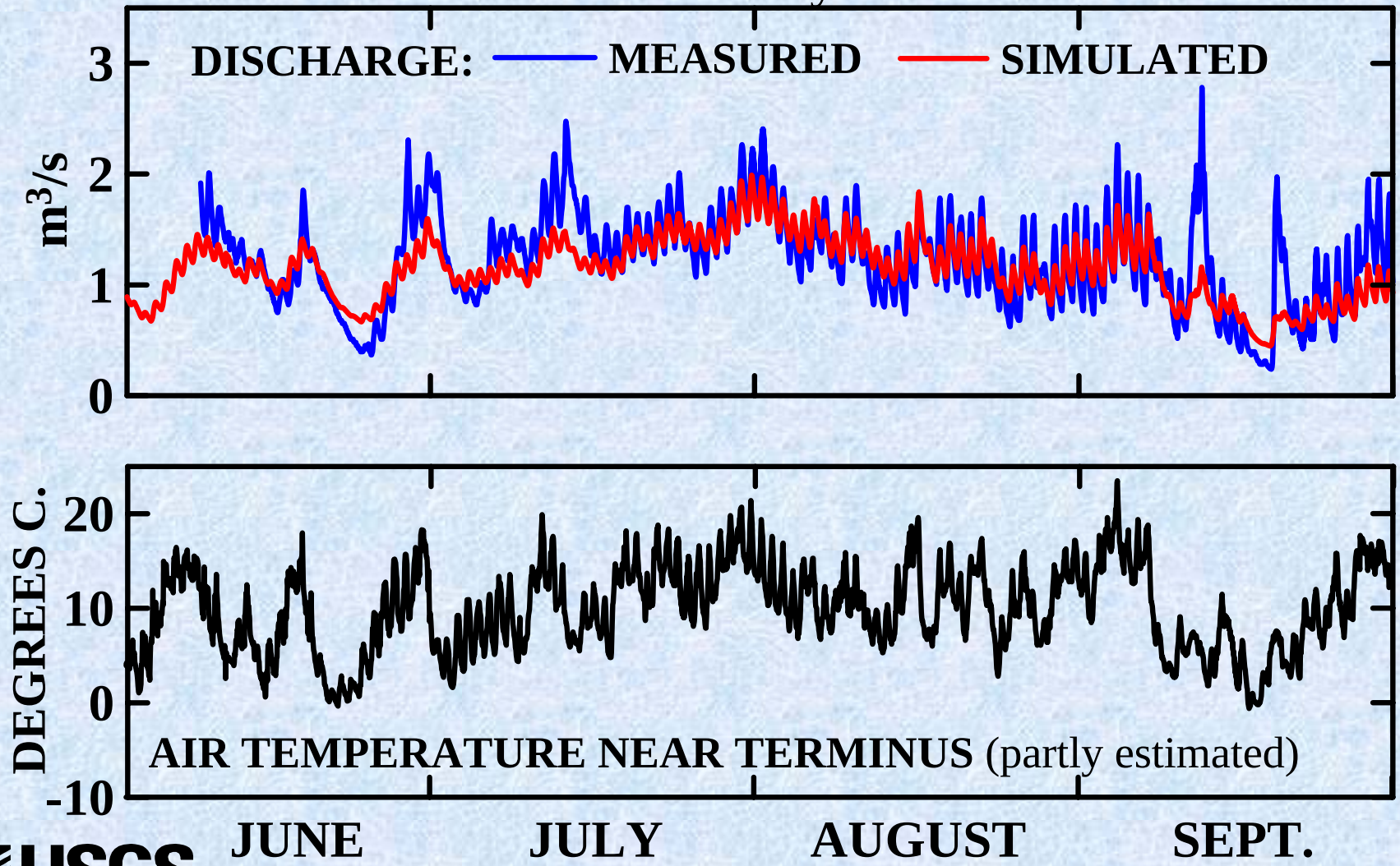
Modeling Melt and Runoff

South Cascade Glacier, 2003

Preliminary



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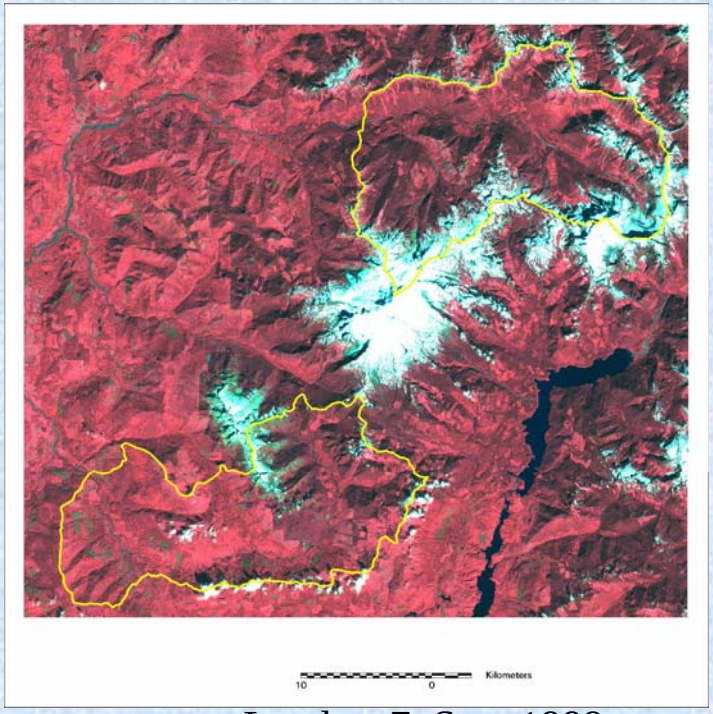
Effects of glaciers on hydrology and extending SCG measurements



•Landsat 7, Sept 1999

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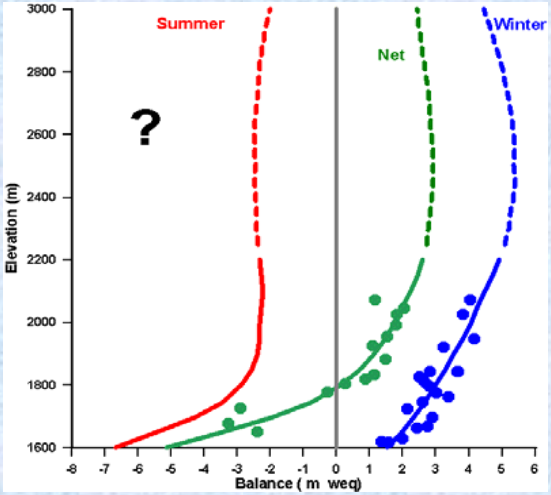

•From SCG Field Measurements

- Amount stored or lost from ice and snow
- Contribution of ice and perennial snow melt to annual stream flow.

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1999 - 2001 Comparison

	1999	2000	2001
N. Fork SCA	51.4 ($km^{2)}$	20.7	12.9
Discharge	775 (10^6 m^3)	766	490
Accumulation	49	43	22
Ablation	33	46	44
Glacier storage or release	**16**	**-3**	**-22**
SCG Balance	*1.02 (mweq)*	*0.38*	*-1.57*

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Calculations with 2001 Snow and Ice cover

Other Washington Glaciers

Most glaciers under study are retreating

- **North Cascades NP glacier monitoring:**
  - **http://www.nps.gov/noca**
- **Mt. Rainier NP glaciers**
  - **http://www.nps.gov/mora**
- **Blue Glacier, Mt. Olympus**
  - **Long-term University of Washington program**
  - **http://www.geophys.washington.edu/Surface/Glaciology/**
- **Glaciers of the Goat Rocks Volcanic Field**

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Conrad Glacier, Goat Rocks Volcanic Field
1970, USGS Ice And Climate Project

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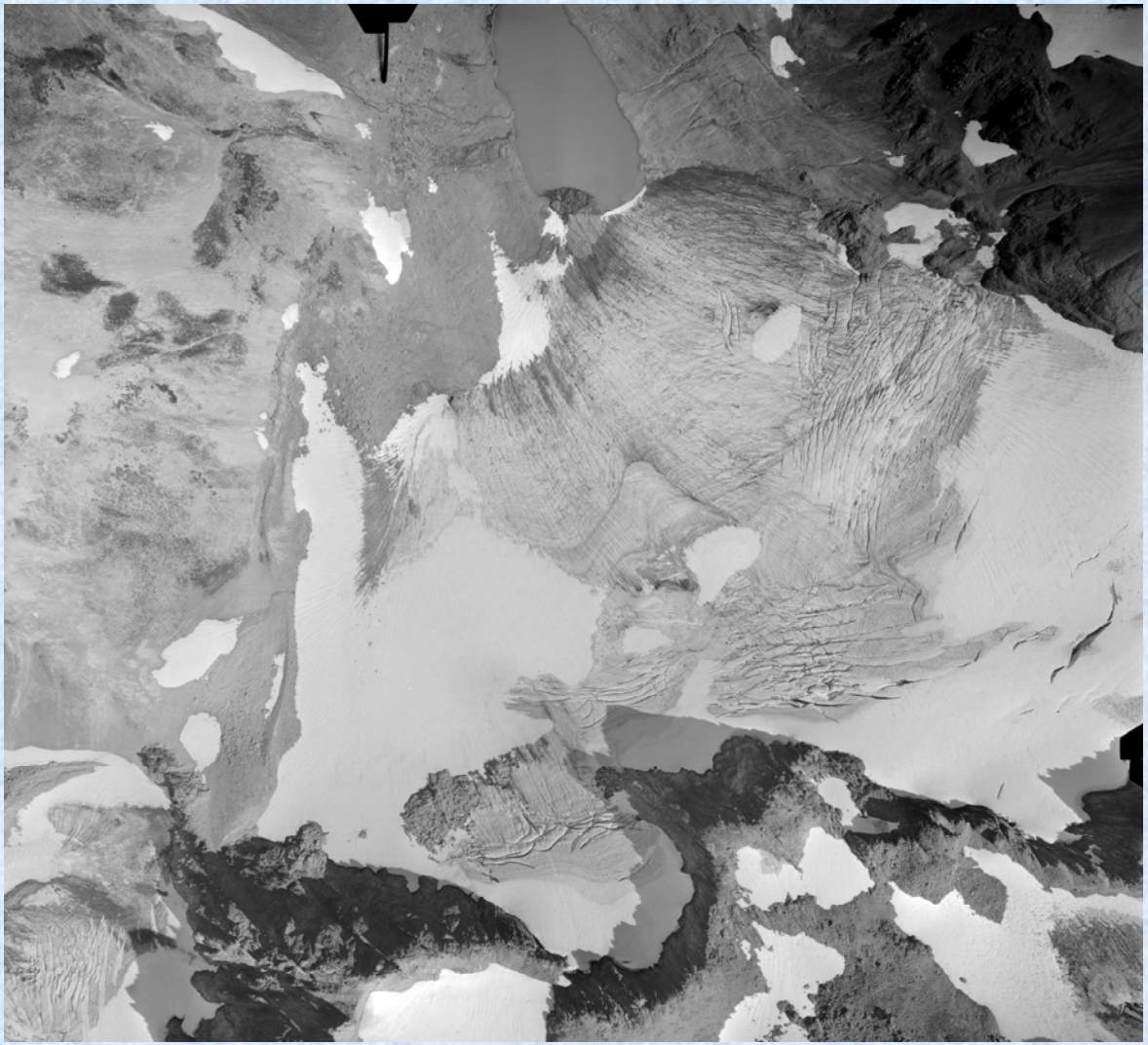

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Conrad Glacier, Goat Rocks Volcanic Field

2004, Austin Post

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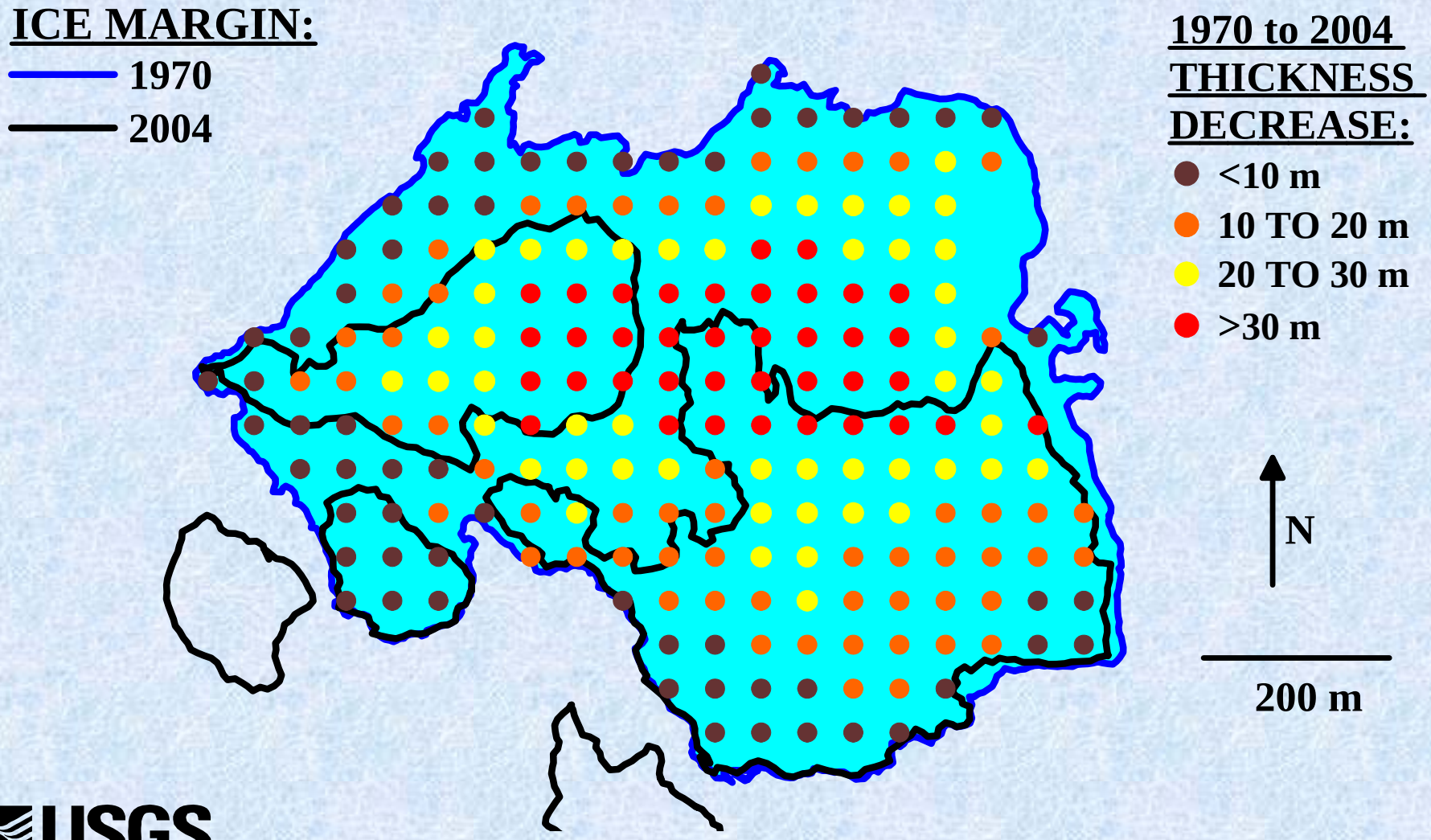
Conrad Glacier: Gone in a Lifetime?

Goat Rocks Volcanic Field, Washington

Preliminary



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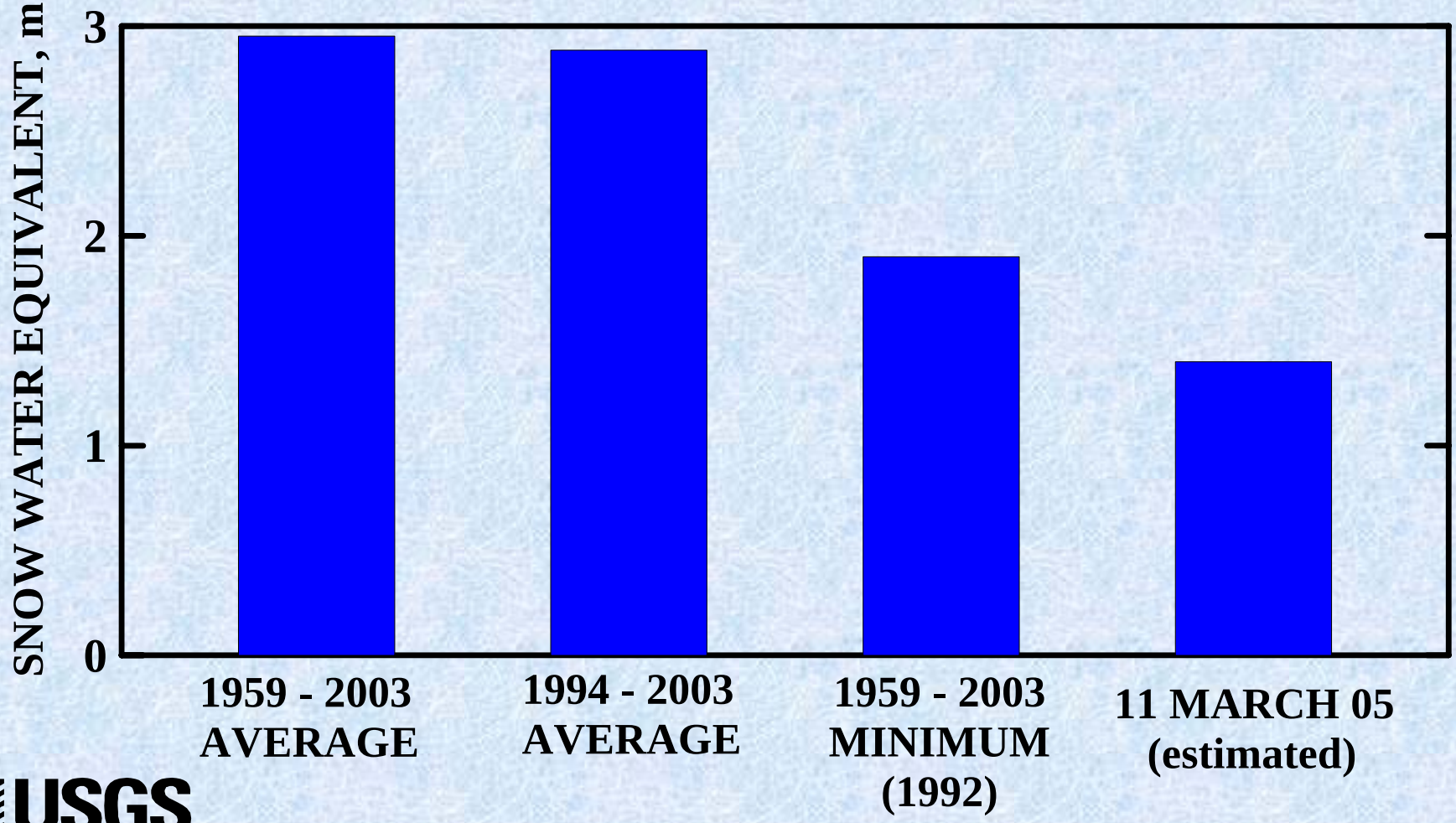
2005: Another Losing Year?

LATE-WINTER SNOW WATER EQUIVALENT
REFERENCE SITE P-1
SOUTH CASCADE GLACIER



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THE END

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Glacier - Climate Correlations

	SCG-W	SCG-S	GK-W	GK-S	WV-W	WV-S
PDO-W	**-0.66**	-0.26	0.04	0.21	**0.55**	0.09
PDO-S	-0.39	-0.17	-0.20	-0.20	0.20	-0.22
SOI-W	0.48	0.38	0.1	-0.3	-0.31	-0.09
SOI-S	-0.05	0.18	-0.15	0.26	0.05	0.09
AO-W	0.22	0.10	0.18	-0.47	-0.38	-0.39
AO-S	-0.03	-0.06	0.02	0.13	-0.21	-0.02

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