The Challenge of Estimating Precipitation on Alaska's North Slope

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Collaborators

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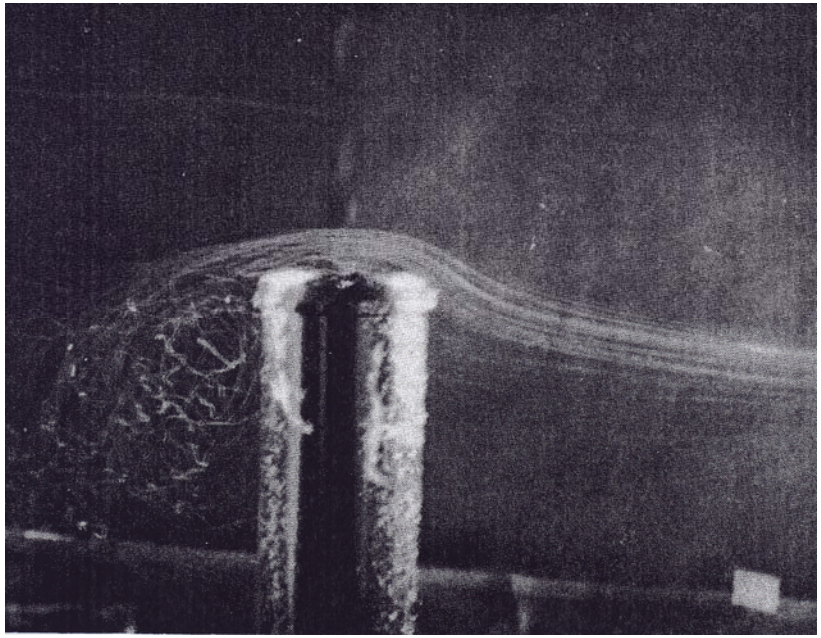
Marc Stieglitz (GaTech), Stephen Déry (UNBC), Bruno Tremblay (McGill), Doug Kane (UAF), Sveta Berezovskaya (UAF), Daqing Yang (UAF)

Outline

- The problem of measuring snowfall near the ground
- Various “solutions”
- New TPS at NSA ARM site
- Modeling and data assimilation
- Value for IOPs and baseline monitoring

Physics of a precip gauge



WMO SPIR, 1998

Mechanical failure of unmanned precip gauge

WMO SPIR, 1998

Bear Mauling

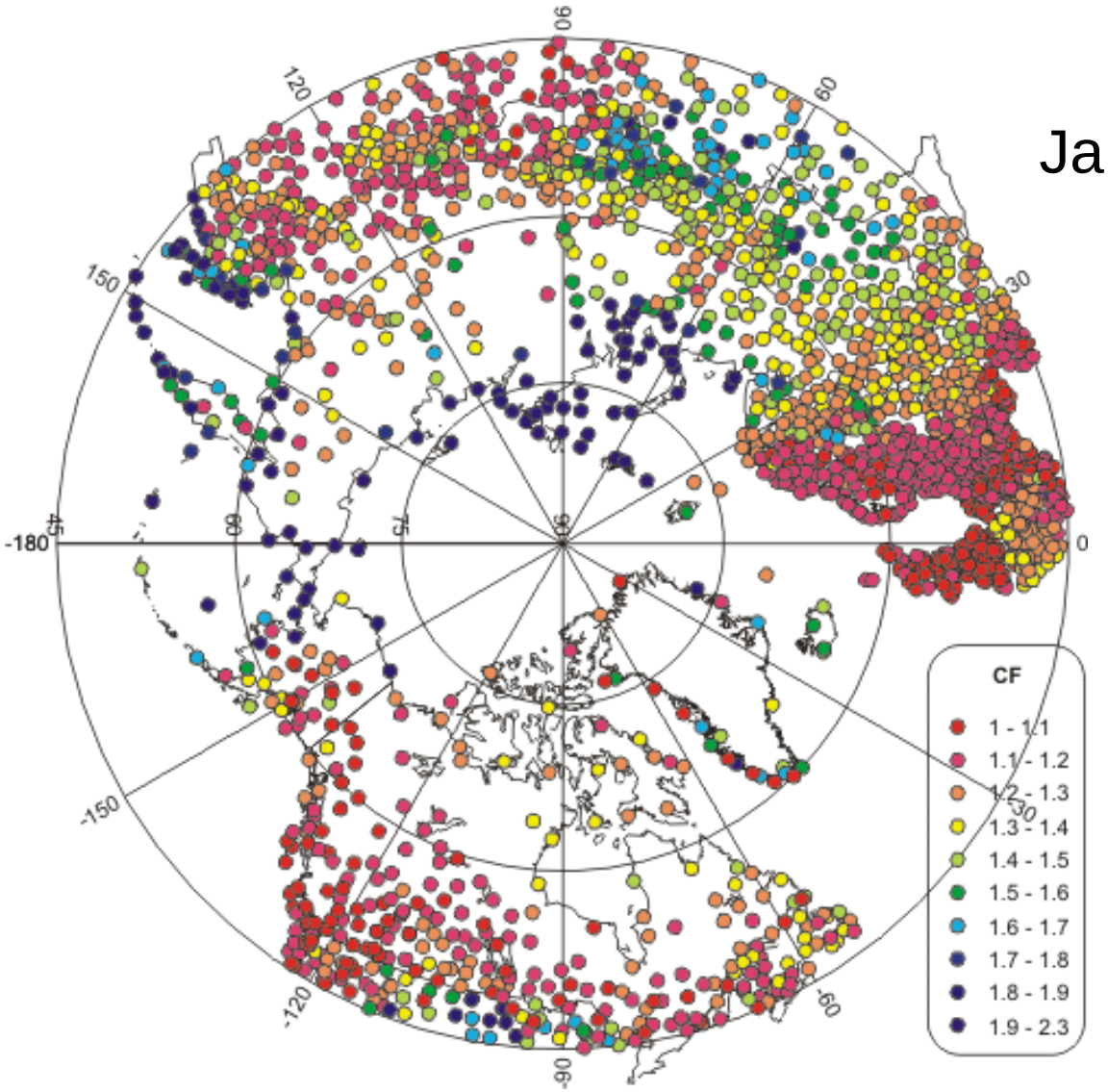
Statistical correction through gauge intercomparison

Barrow was a WMO solid precipitation intercomparison site

Correction can be >100%, Systematic biases only !

Need functional anemometer!

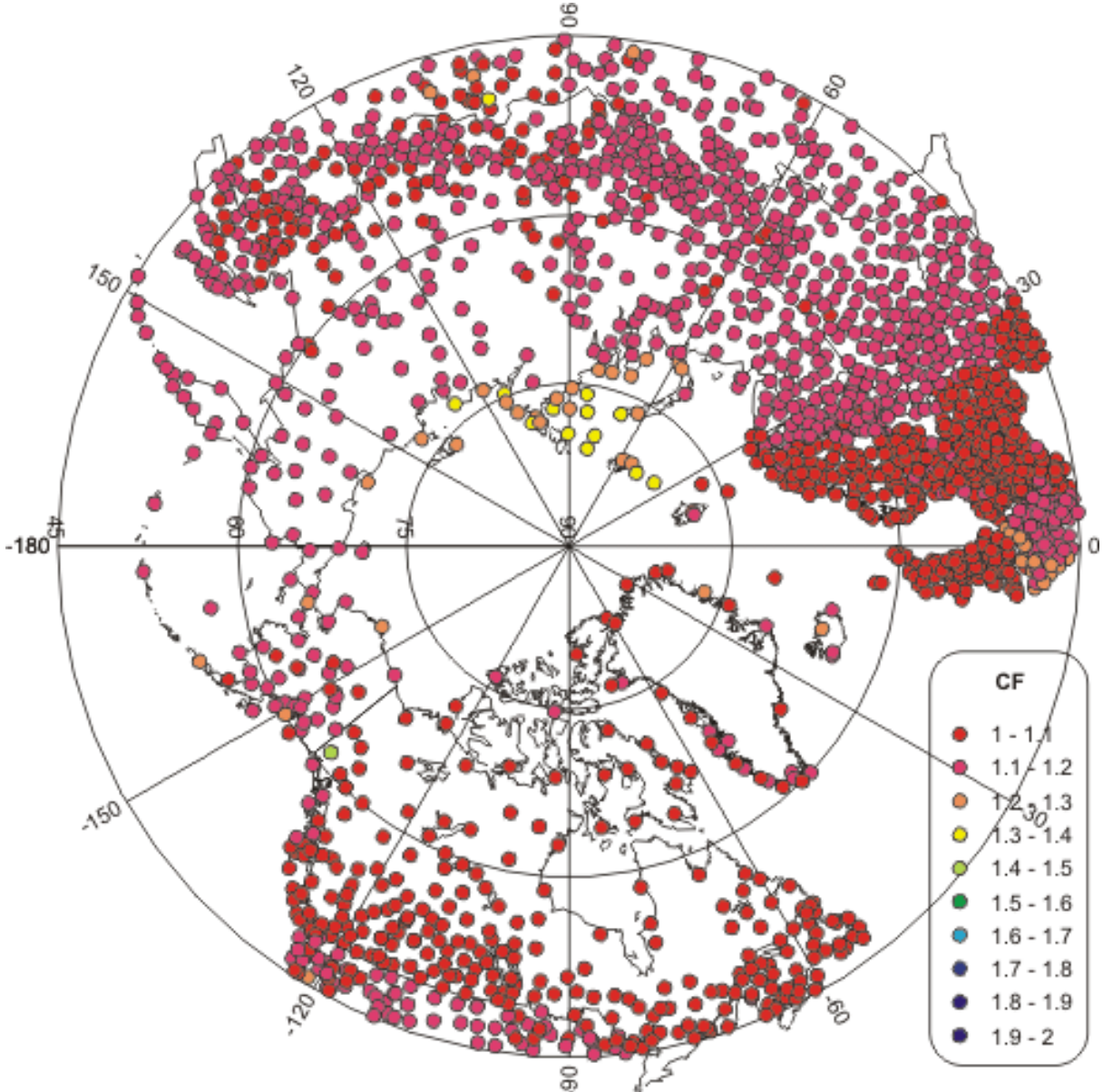
Statistical Correction Factor



January

Yang et al., 2005

Statistical Correction Factor



July

Yang et al., 2005

Our reconstruction approach:

Implemented in NASA CLSM

$$\mathbf{P_{rec}} = \mathbf{P_{ini}} + \mathbf{S} + \boldsymbol{e}$$

“true” snowfall

Initial guess of snowfall

Excess (+/-)

Model & numerical error

Gauge or change in snow depth

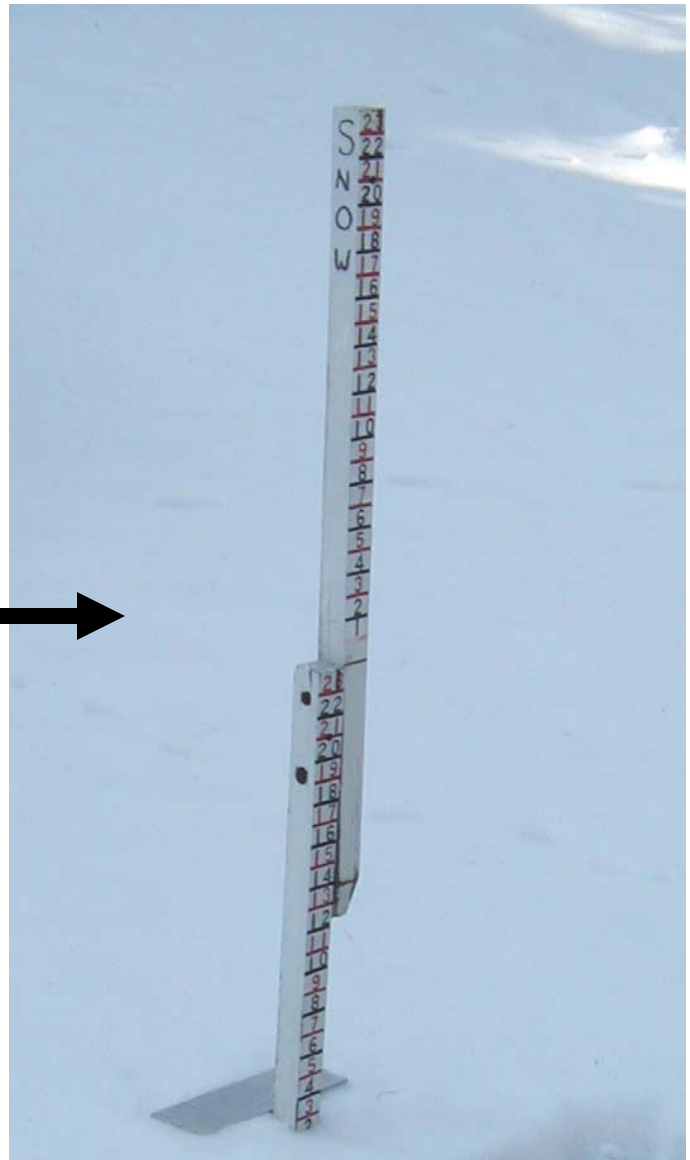
(result insensitive)

Determined by comparing model snow depth to observed snow depth

Estimated w/snowpillow

Snow depth measurement

Device doesn't disrupt the measured quantity as much as a gauge does

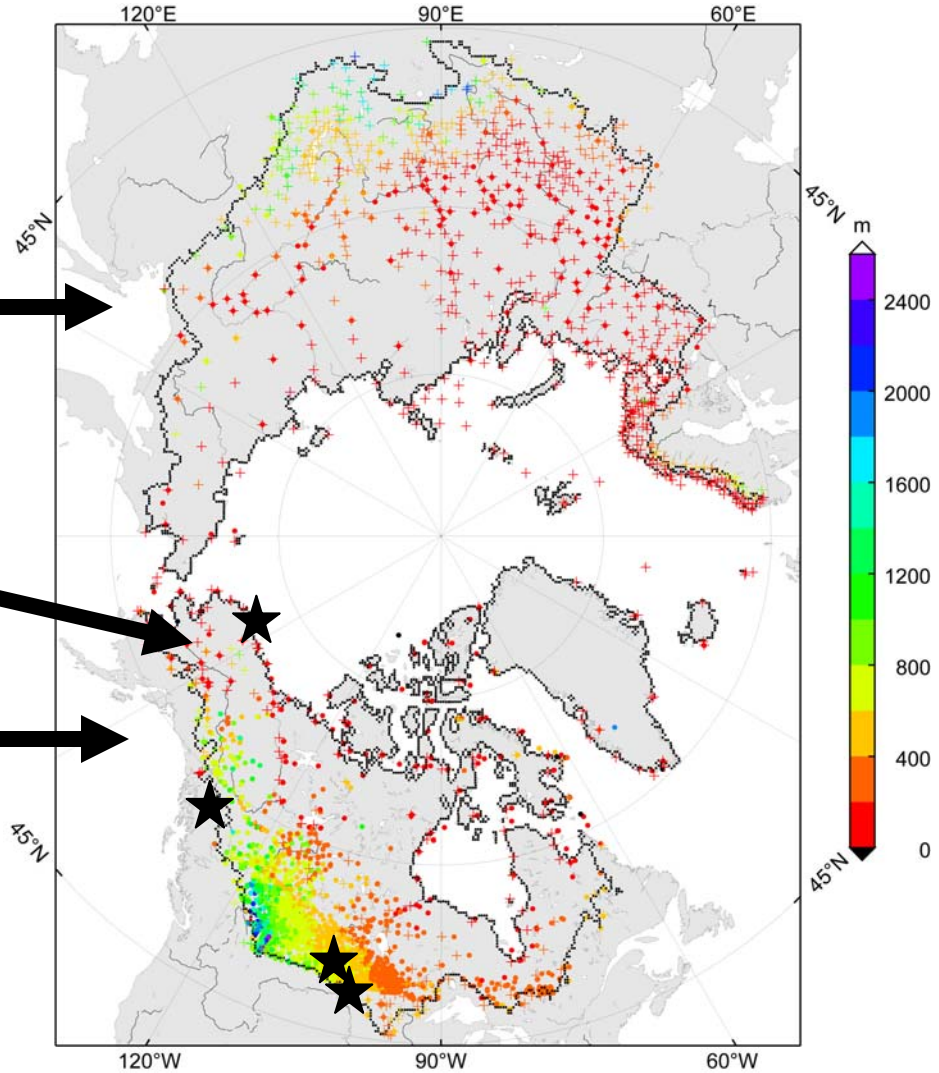


Pan-Arctic Snowfall Reconstruction (PASR) Daily for 1936-2003

Snow depth stations

Test sites

Arctic Catchment



Cherry et al., WRR, 2005; JHM, *2007*

Redesigning Snow Monitoring

Can we do the same reconstruction on sea ice?

Issues are:

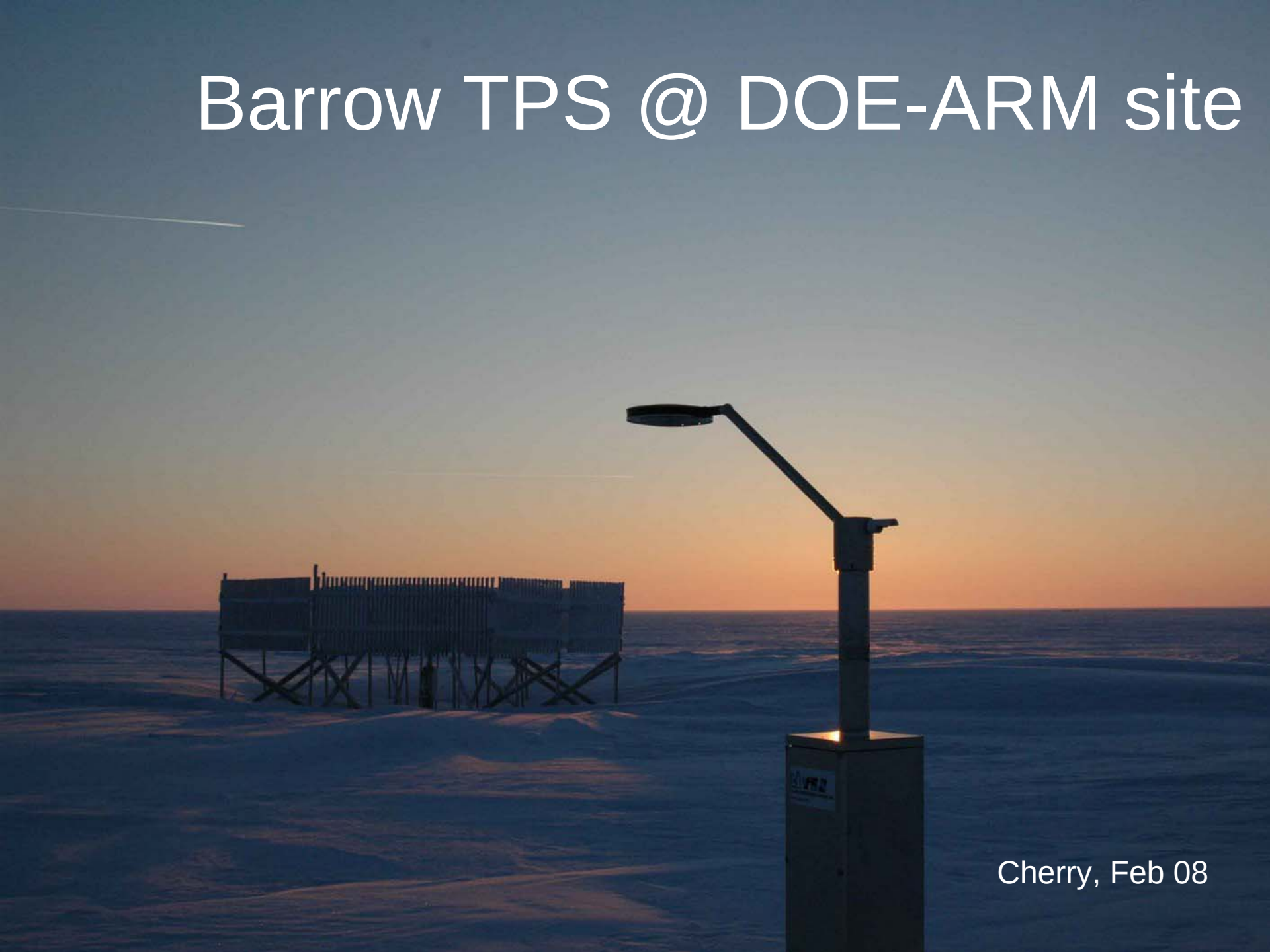
-Different thermal conductivity for soil and sea ice

-Varying thickness of sea ice (ridges)

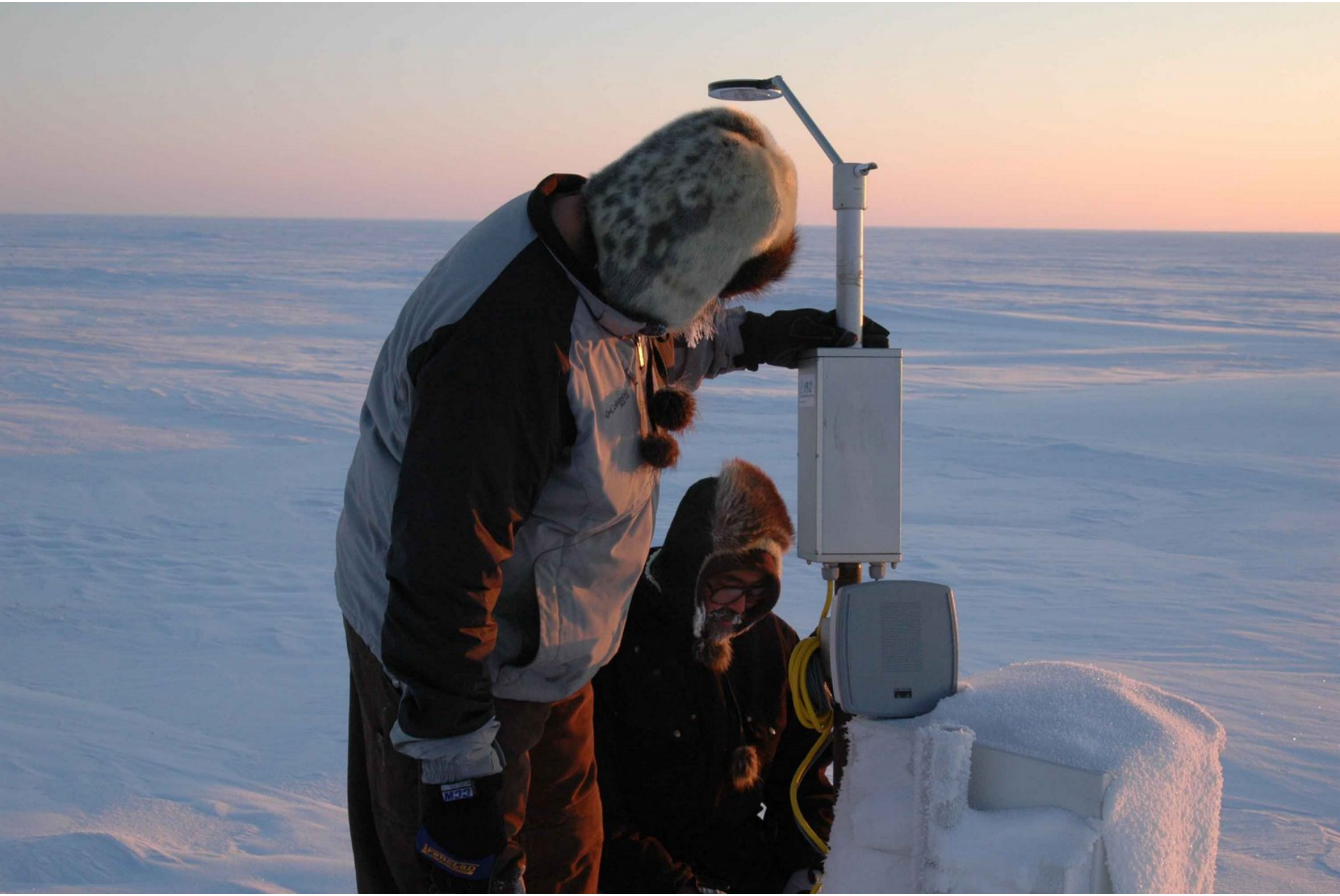
-More events near freezing point

-More trace events

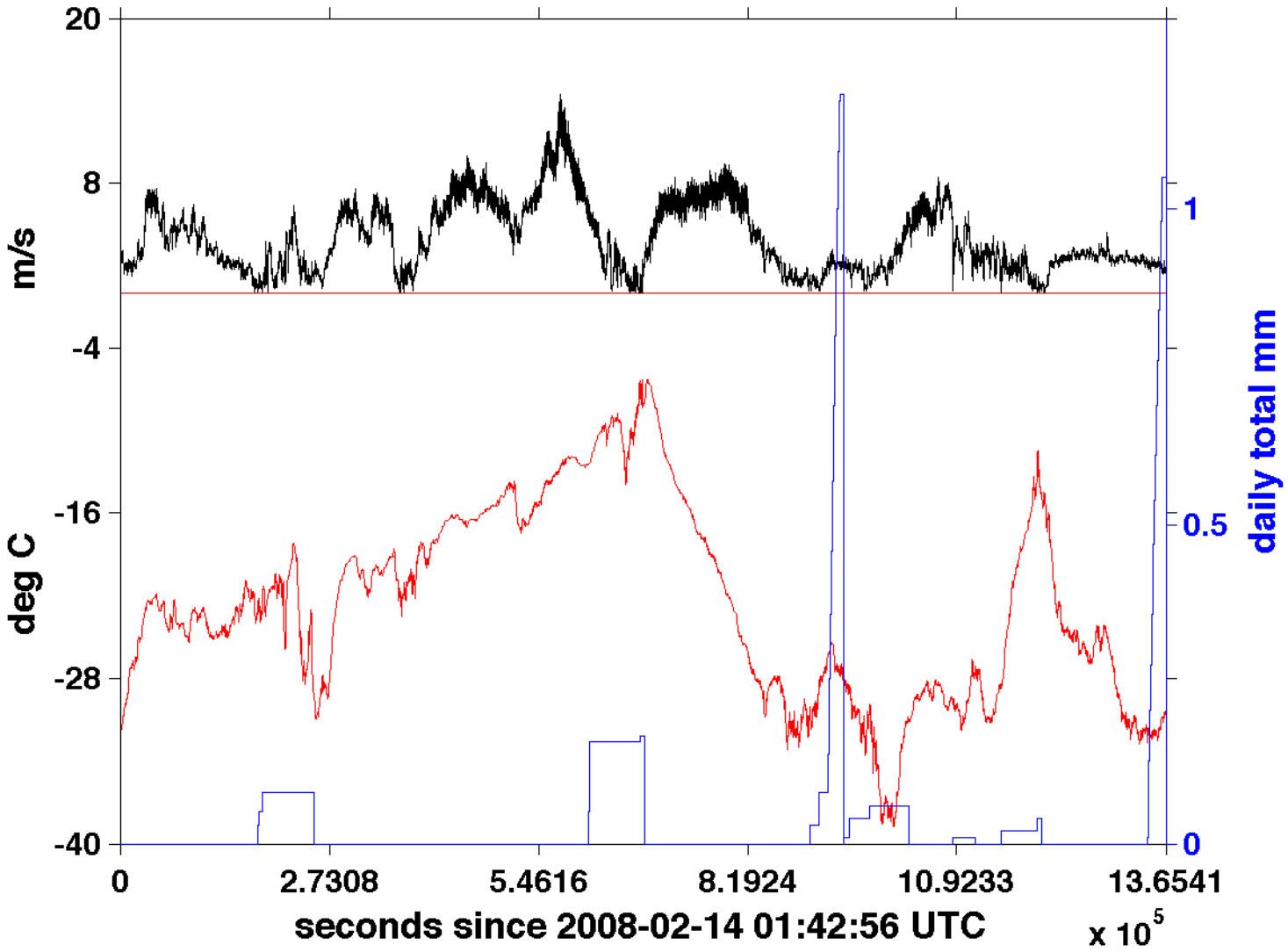
Barrow TPS @ DOE-ARM site



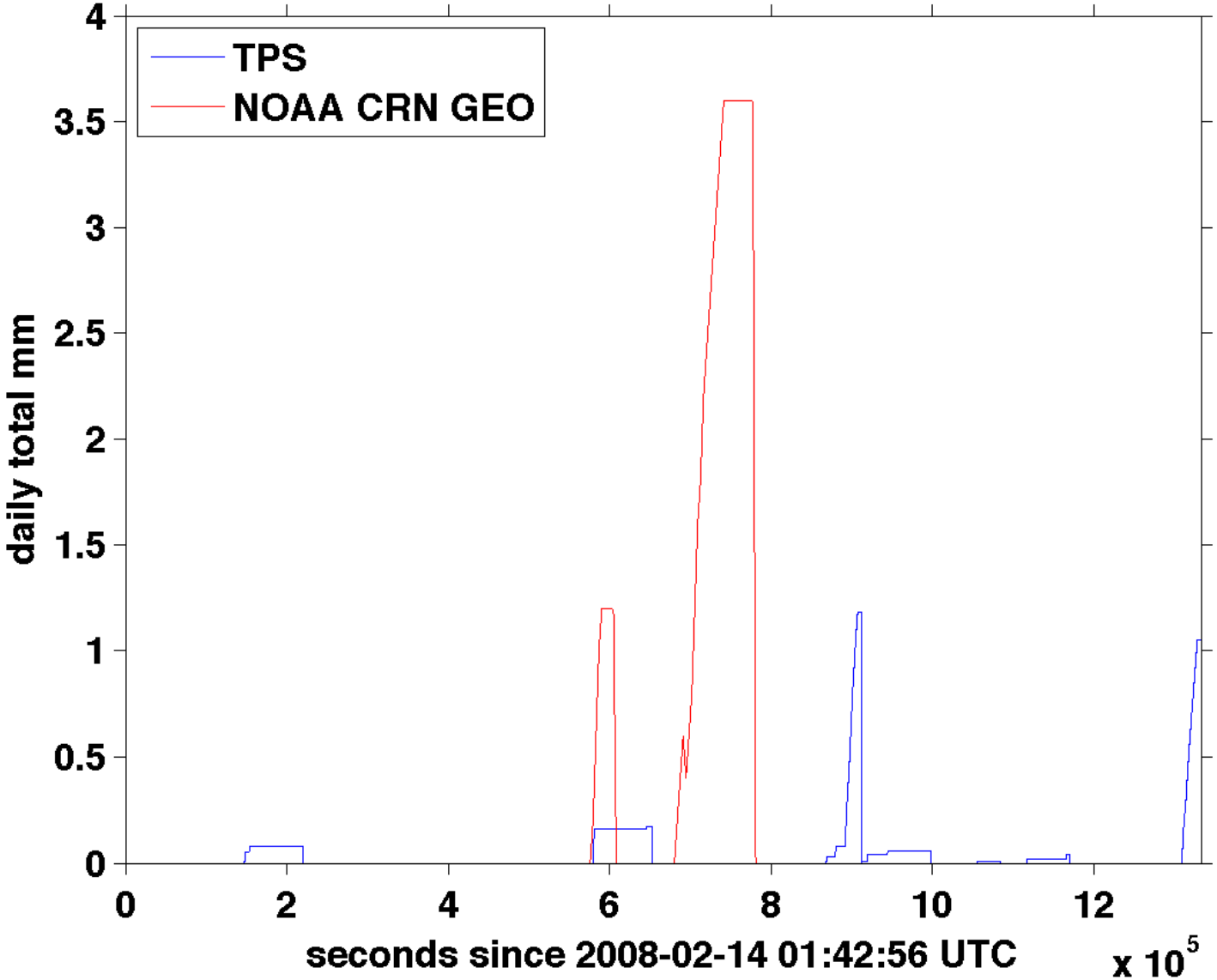
Cherry, Feb 08



TPS Feb 2008


20
8
-4
-16
-28
-40
m/s
deg C
1
0.5
0
daily total mm
0
2.7308
5.4616
8.1924
10.9233
13.6541
seconds since 2008-02-14 01:42:56 UTC
x 10^5

TPS vs GEONOR



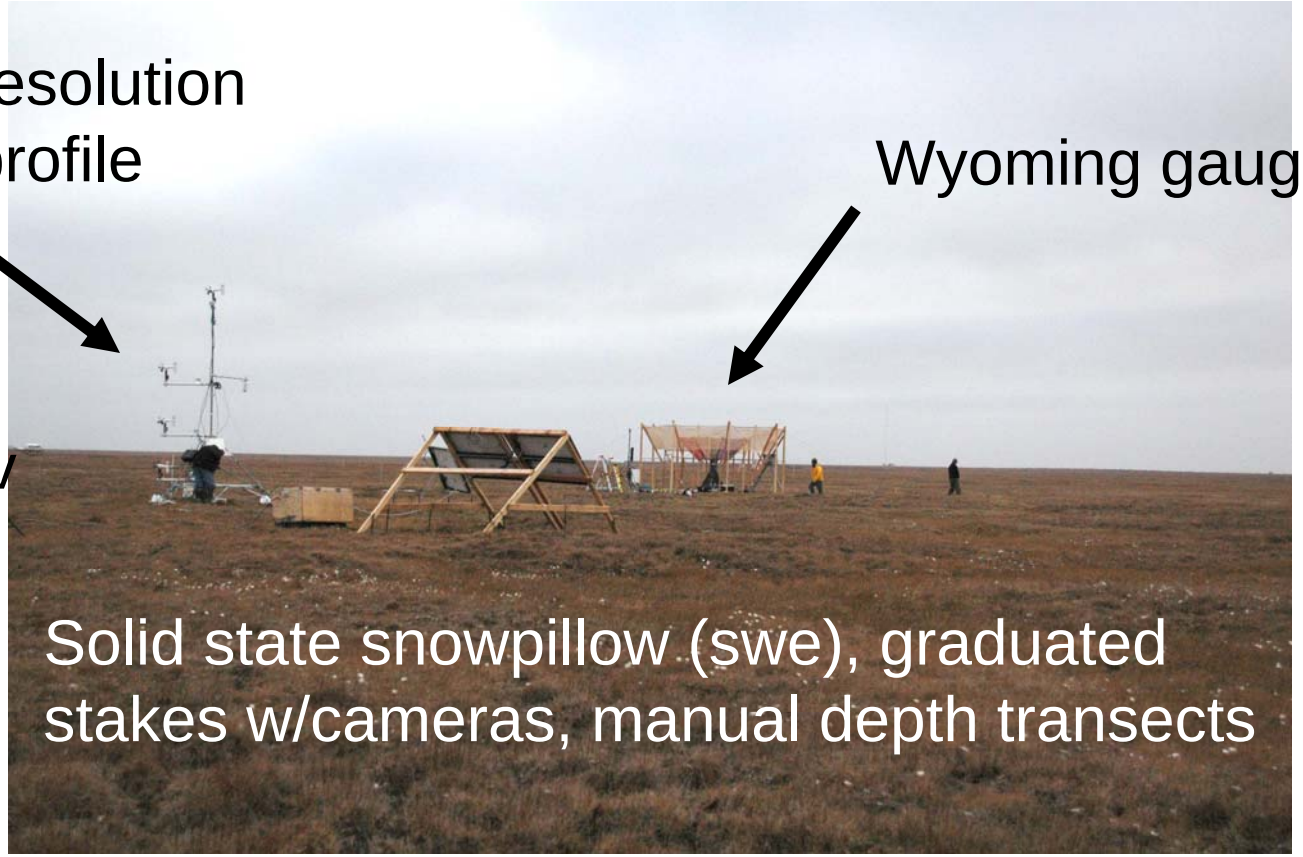
SnowNet site in Barrow

Sturm/Kane/Berezovskaya/Yang

High resolution wind profile

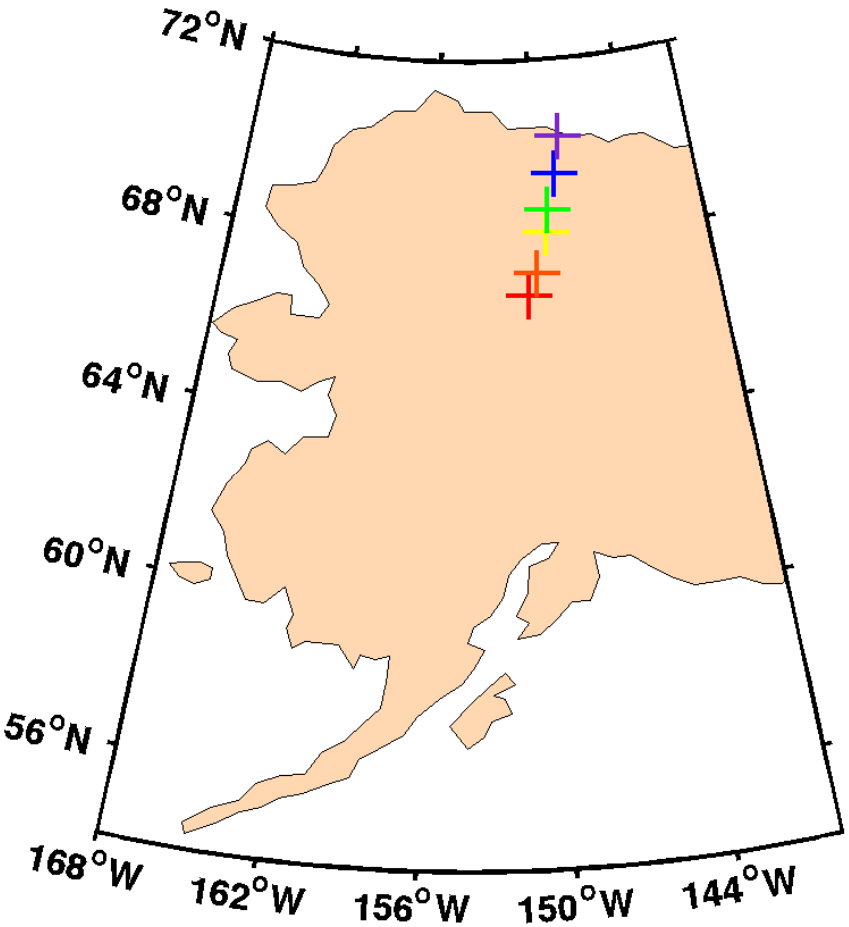
Wyoming gauge

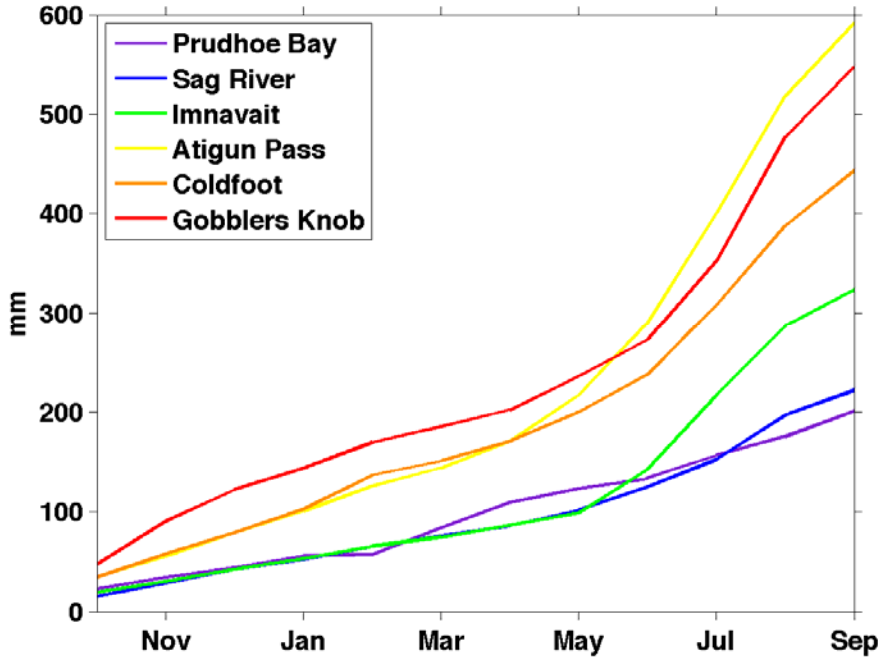
York Univ particle counters

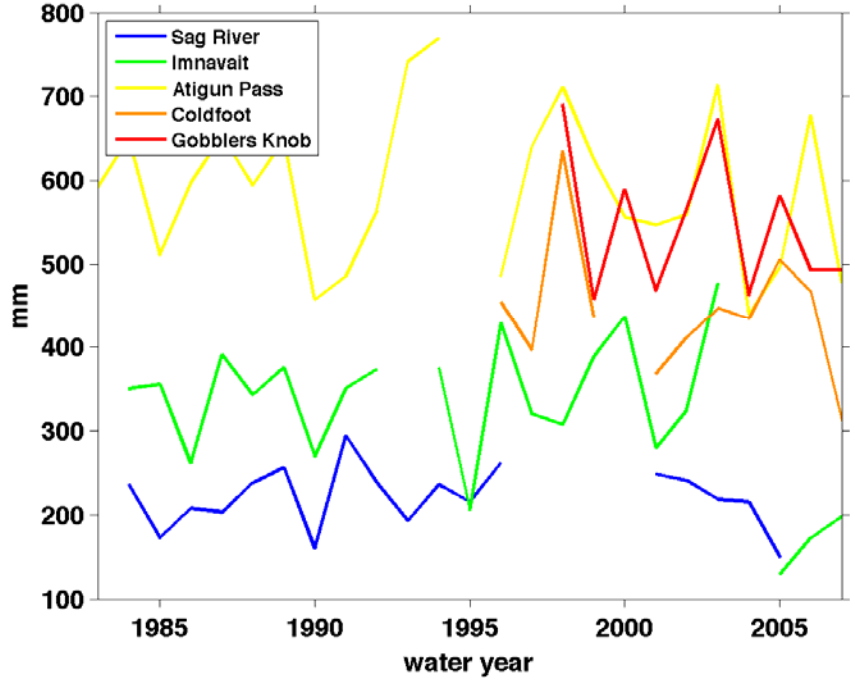


Other NS supersite at Toolik LTER (Imnavait), additional planned at Tiksi, etc.

Snotel Gauge Network



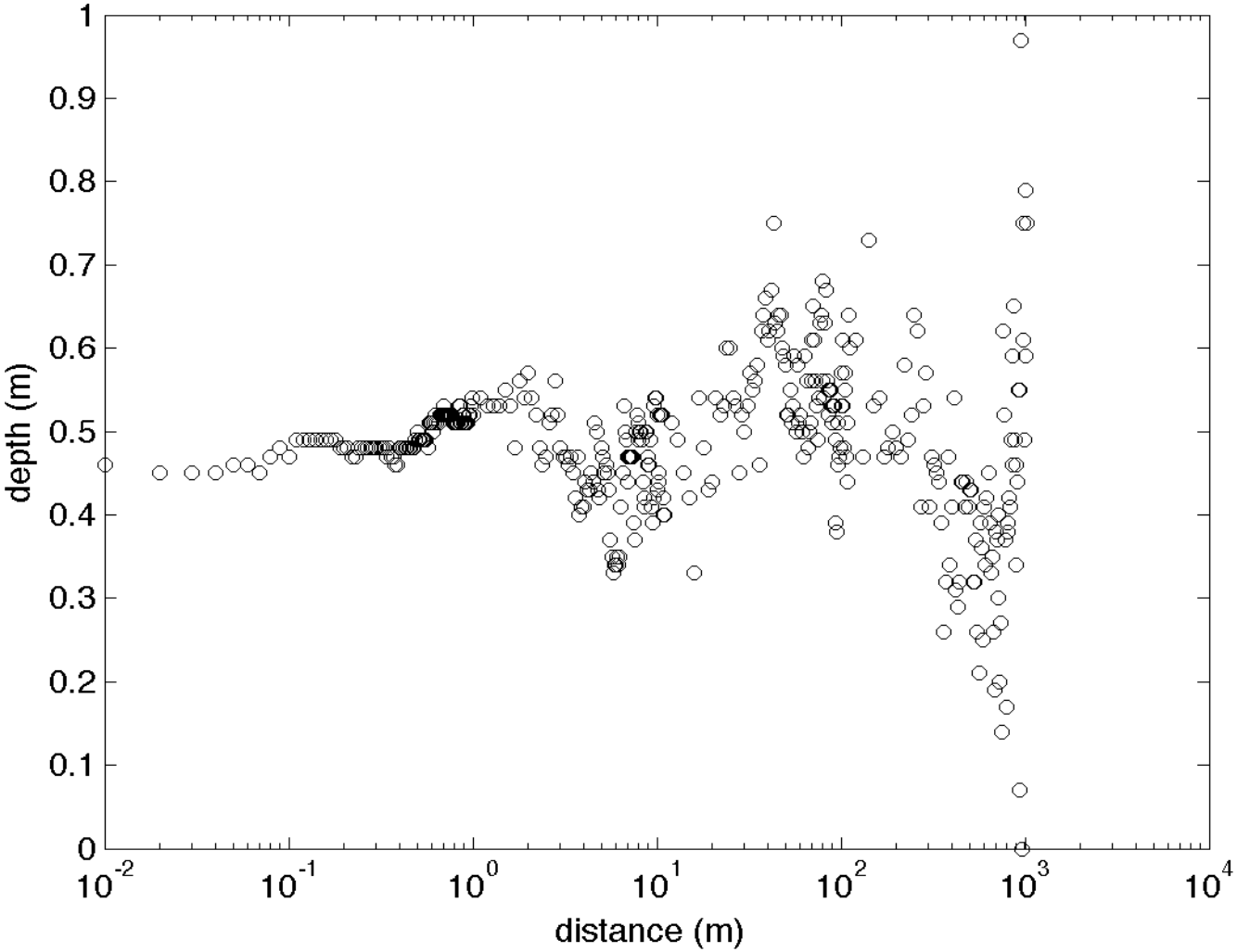




Getting from point measurements to spatial distributions…

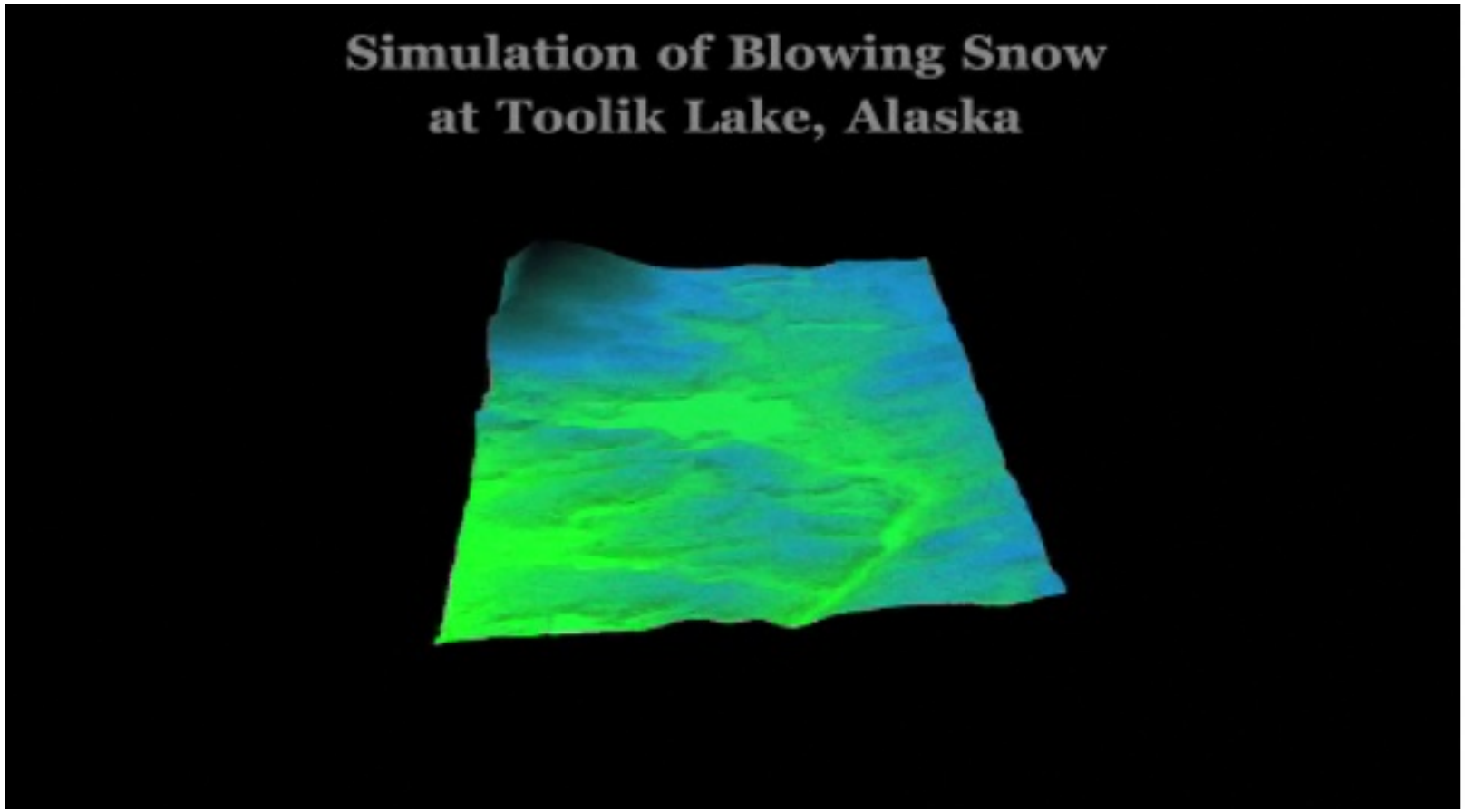
Modeling and data assimilation

Variability of snow depth



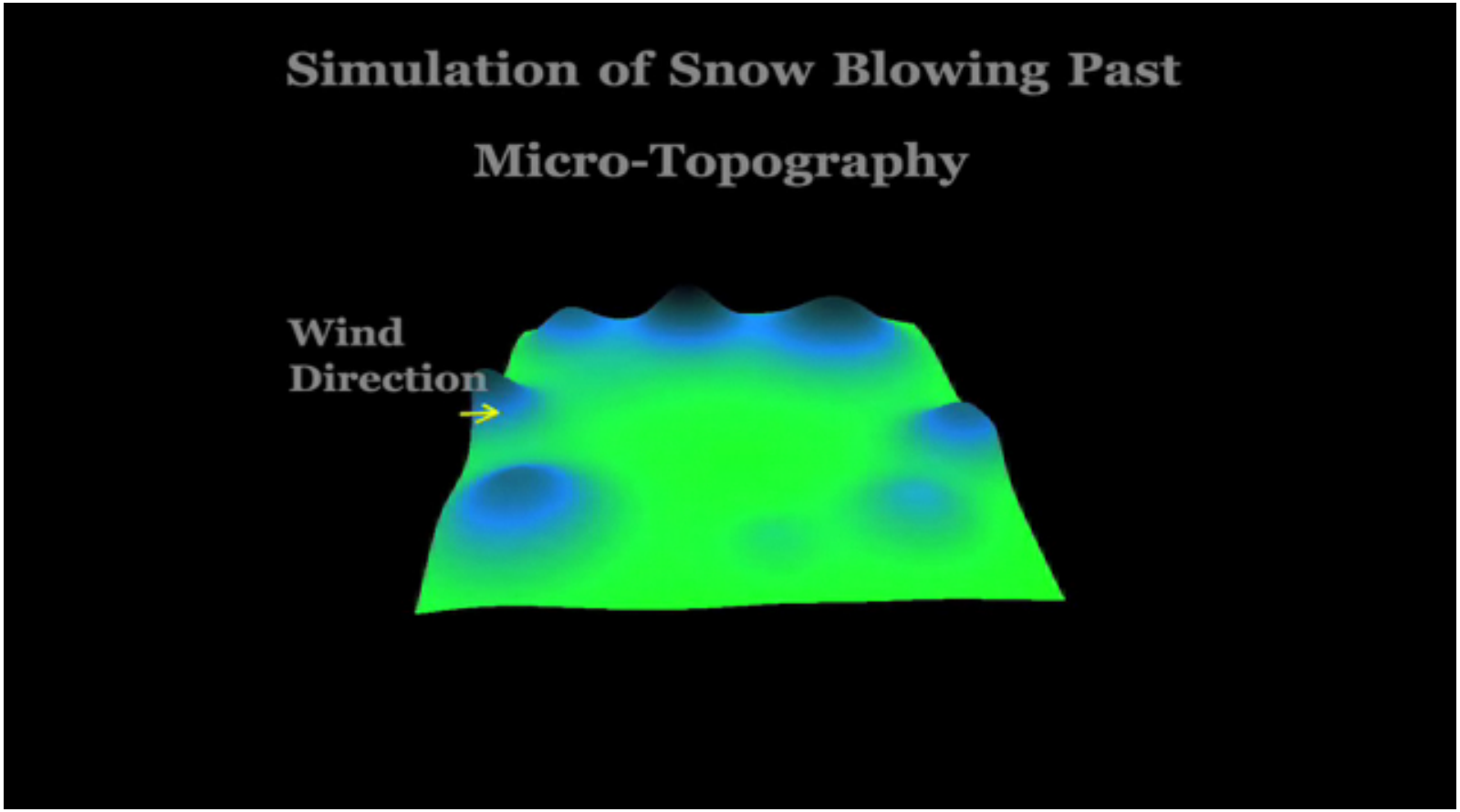
Cherry/Berezovskaya

High Resolution Modeling



M. Stieglitz

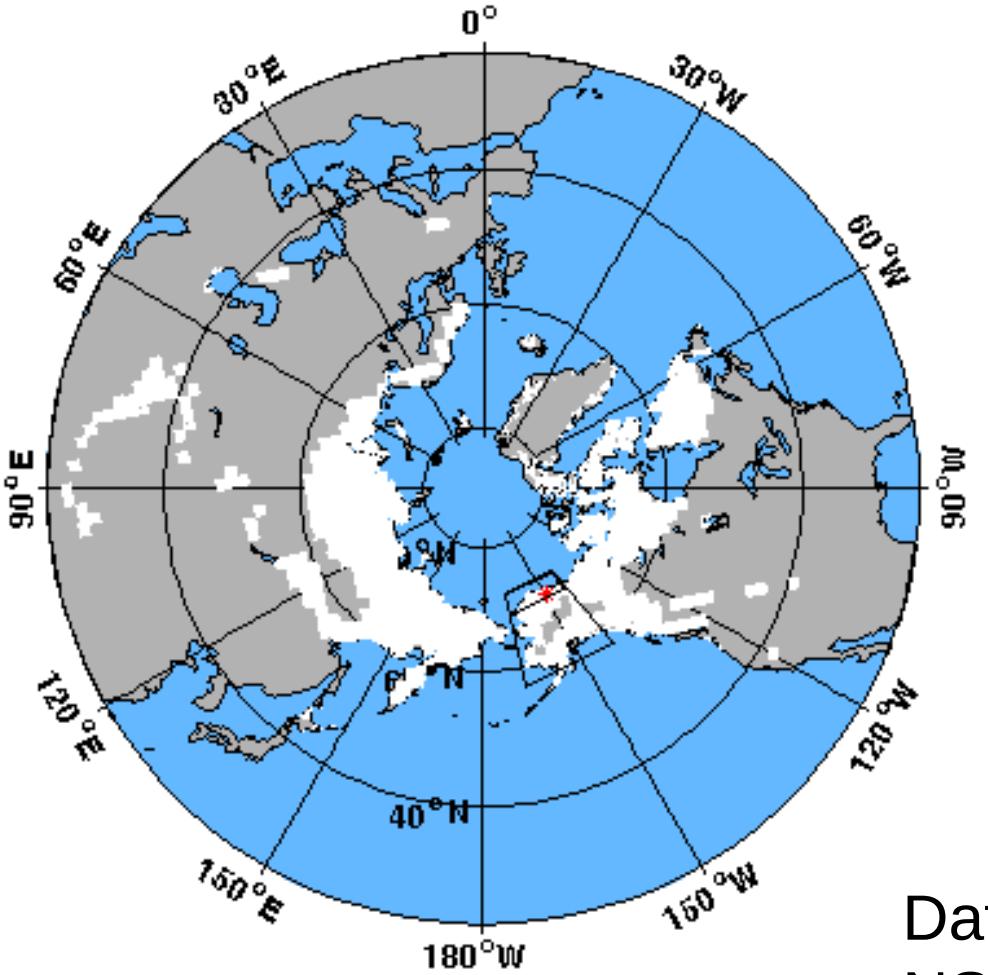
High Resolution Modeling



M. Stieglitz

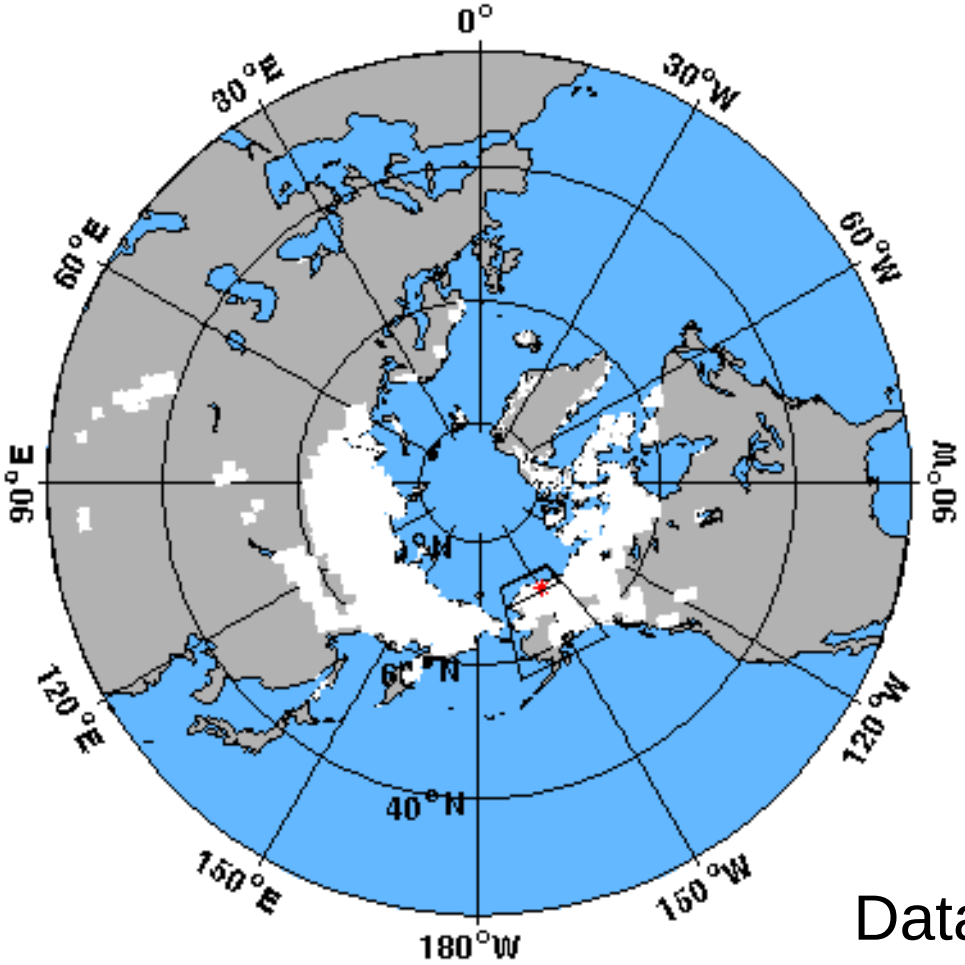
May snow cover mean since 1982 from NOAA

RS ≠ground



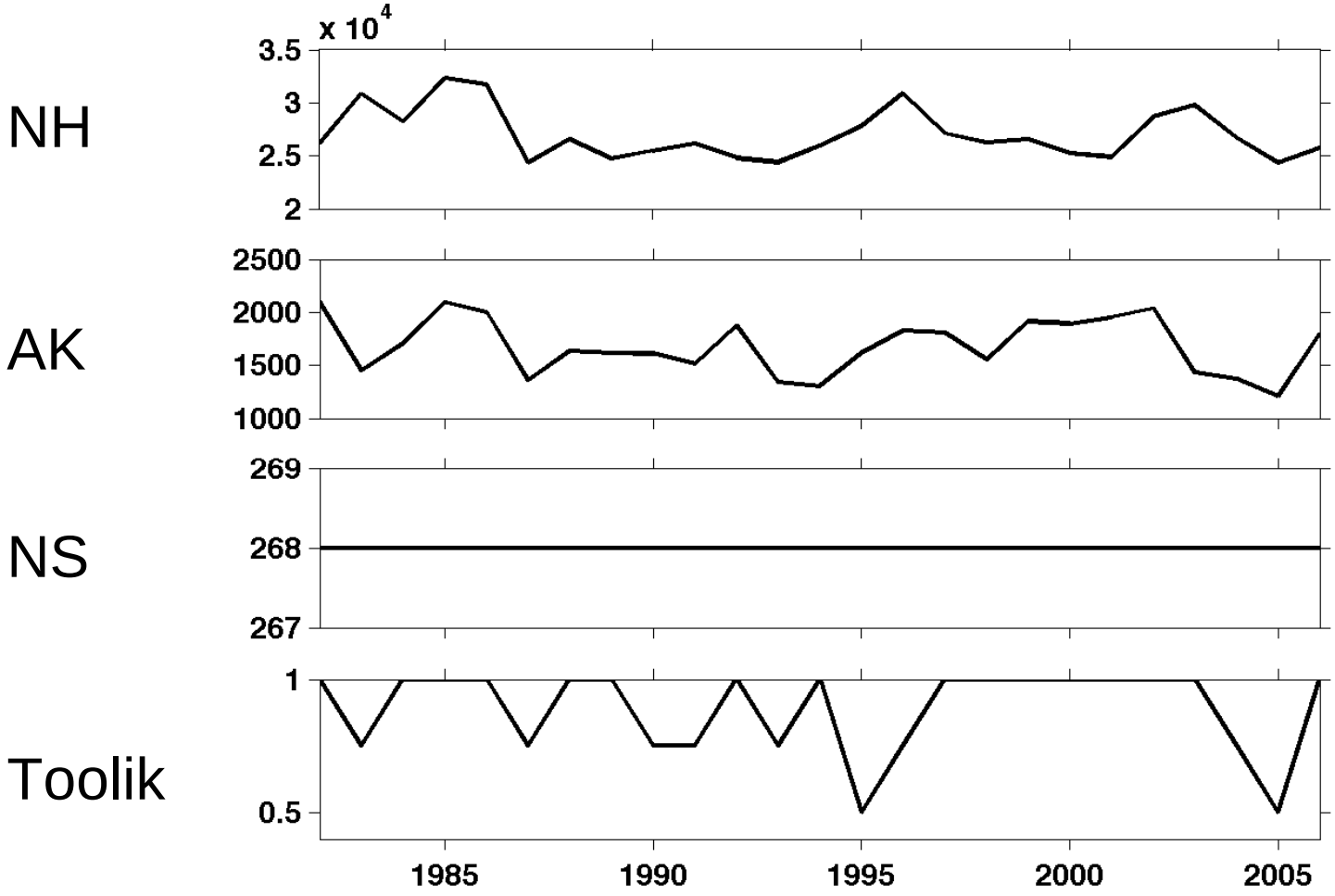
Data: NSIDC/Robinson

October snow cover mean since 1982

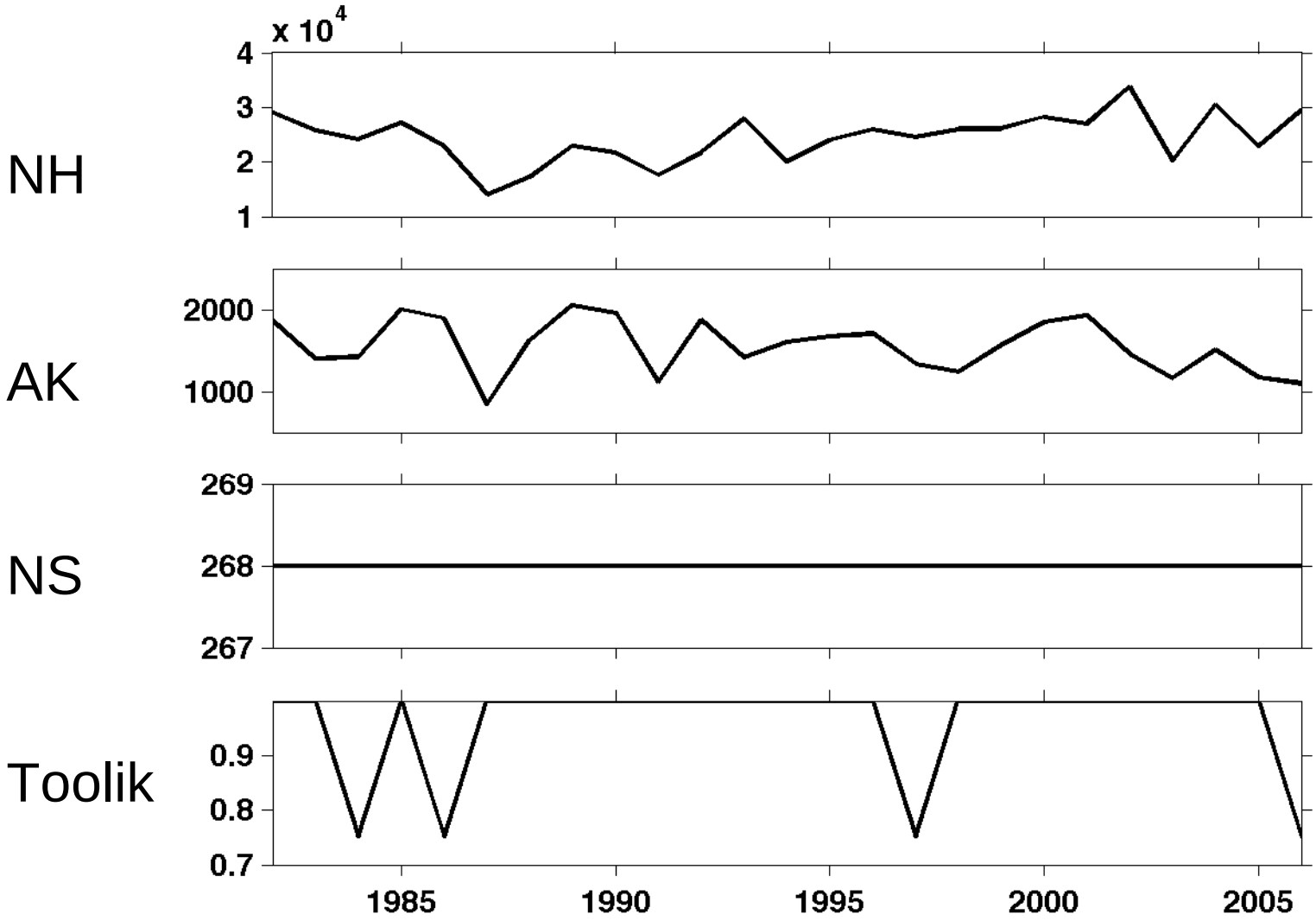


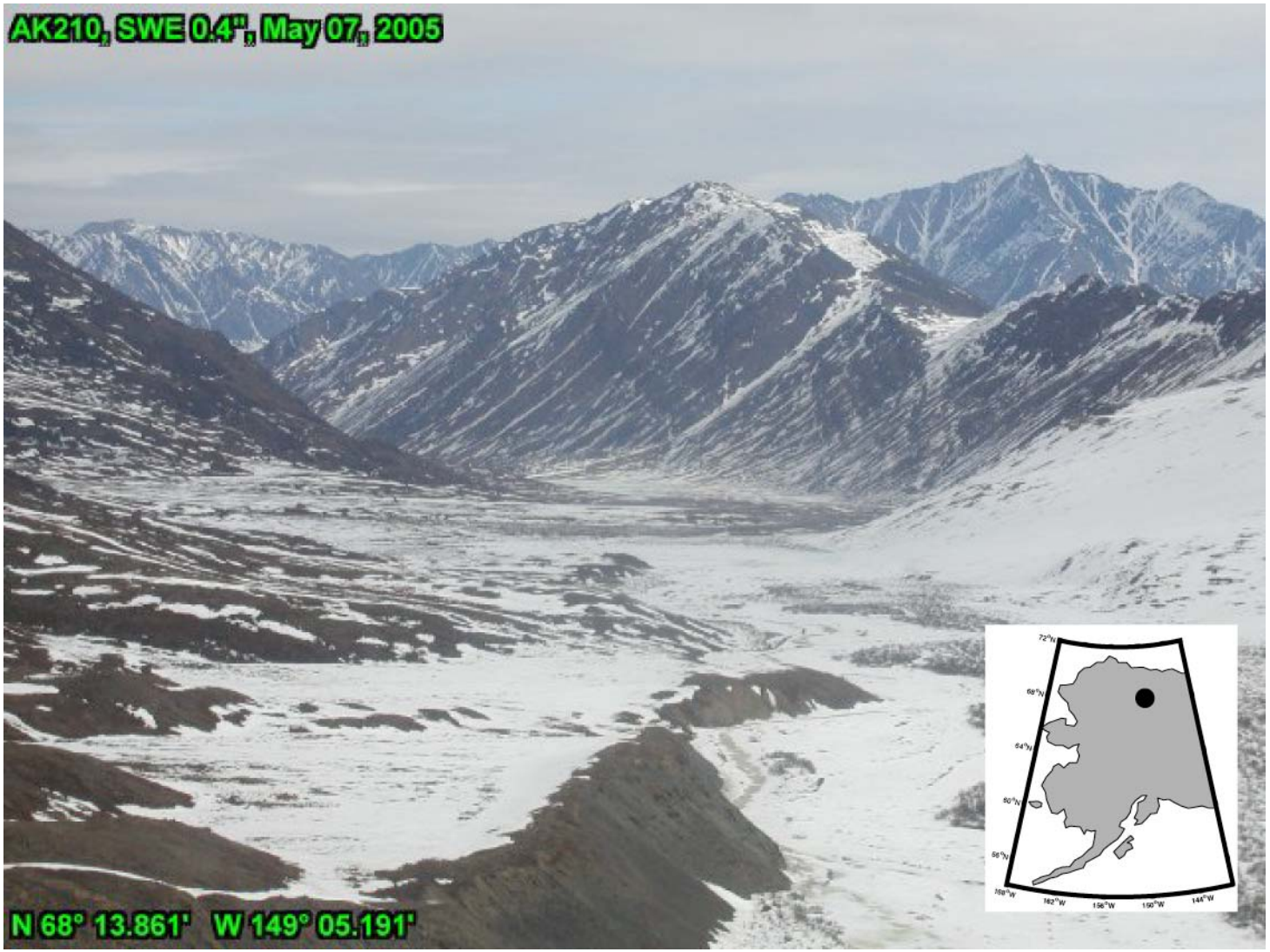
Data: NSIDC/Robinson

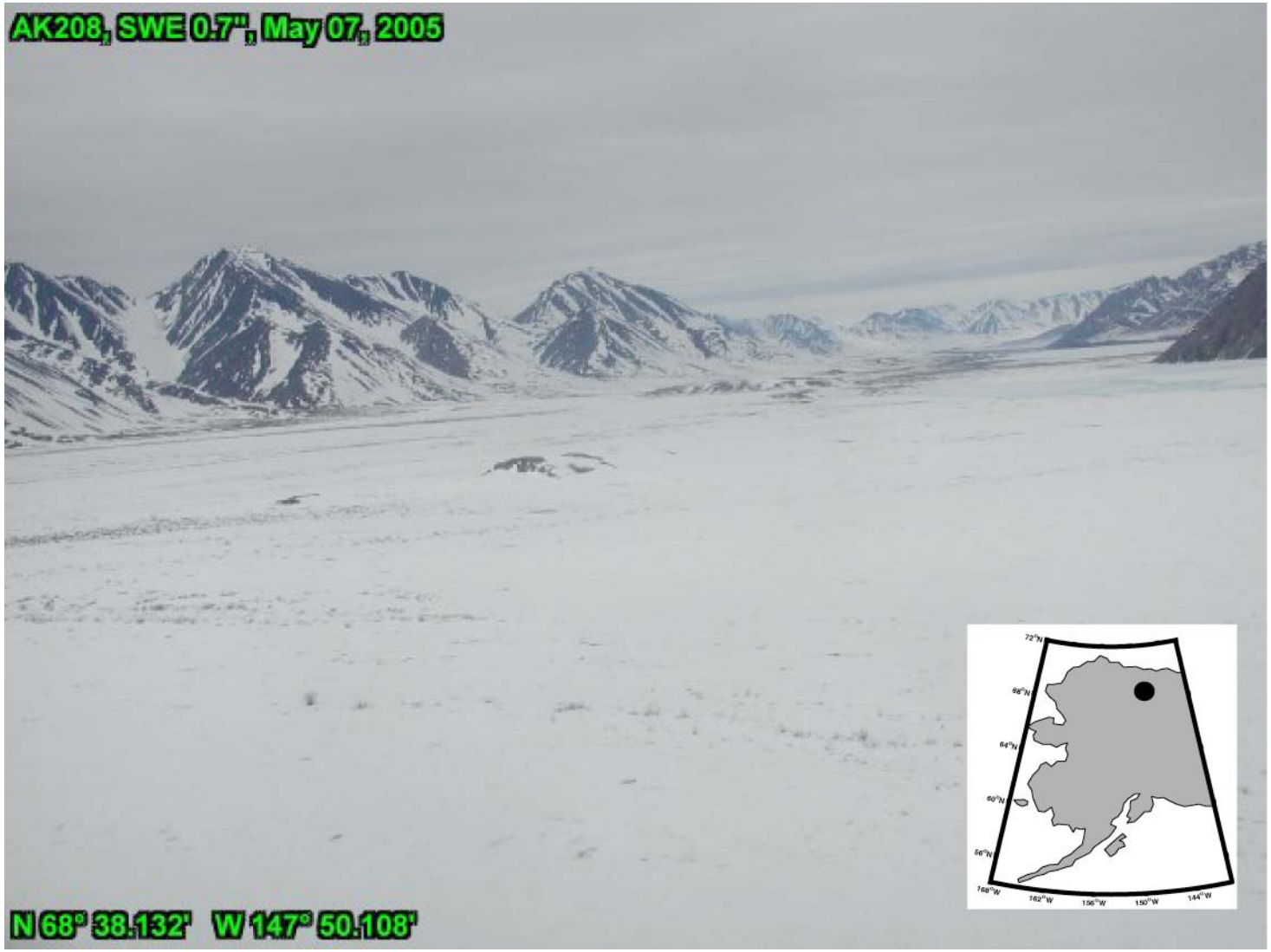
Variation in May Snowcover



Variation in October Snowcover




AK210, SWE 0.4", May 07, 2005
N 68° 13.861' W 149° 05.191'

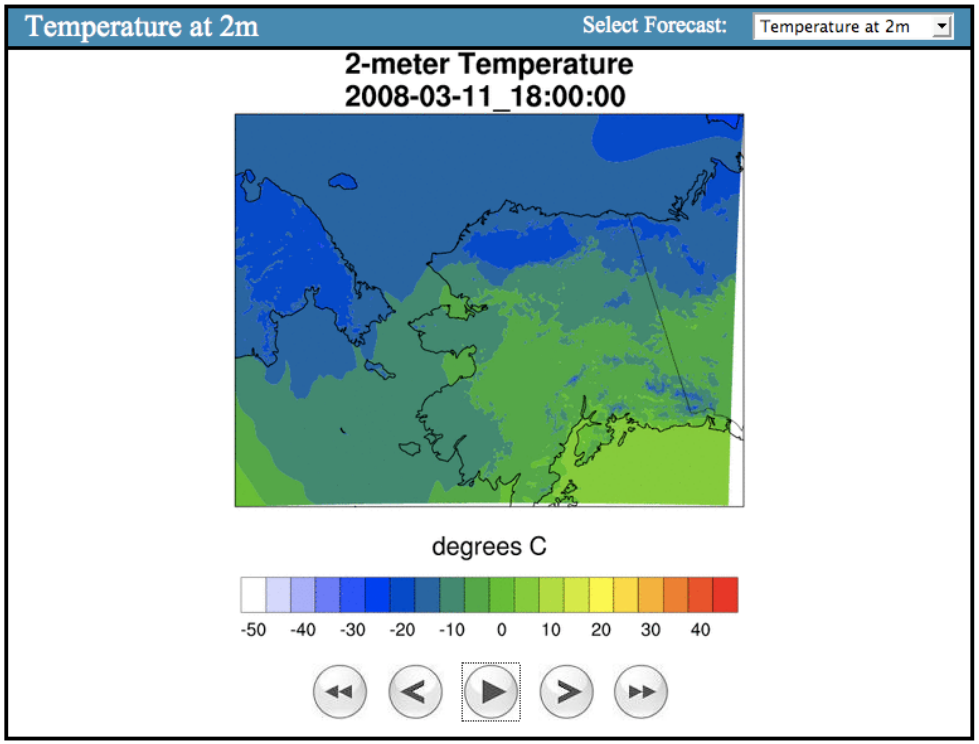

AK208, SWE 0.7", May 07, 2005
N 68° 38.132' W 147° 50.108'
72°N
68°N
64°N
60°N
56°N
168°W
162°W
156°W
150°W
144°W

2008 ISDAC IOP NSA

- Snowfall Value Added Product for Barrow area
- Sensor intercomparison, spatial variability and error estimates
- Potential users?

ARSC's WRF
http://weather.arsc.edu

Arctic Region Supercomputing Center



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Weather Home

The 2008 Little Alaska Weather Symposium (LAWS '08)

12-13 May 2008

University of Alaska Fairbanks

http://weather.arsc.edu/Events/LAWS08/

Thanks

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