Funding
Support:

LARISSA Glaciology:
Climate History, Mass Balance, and Field Plans for the Scar Inlet Area

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Glaciology program for LARISSA

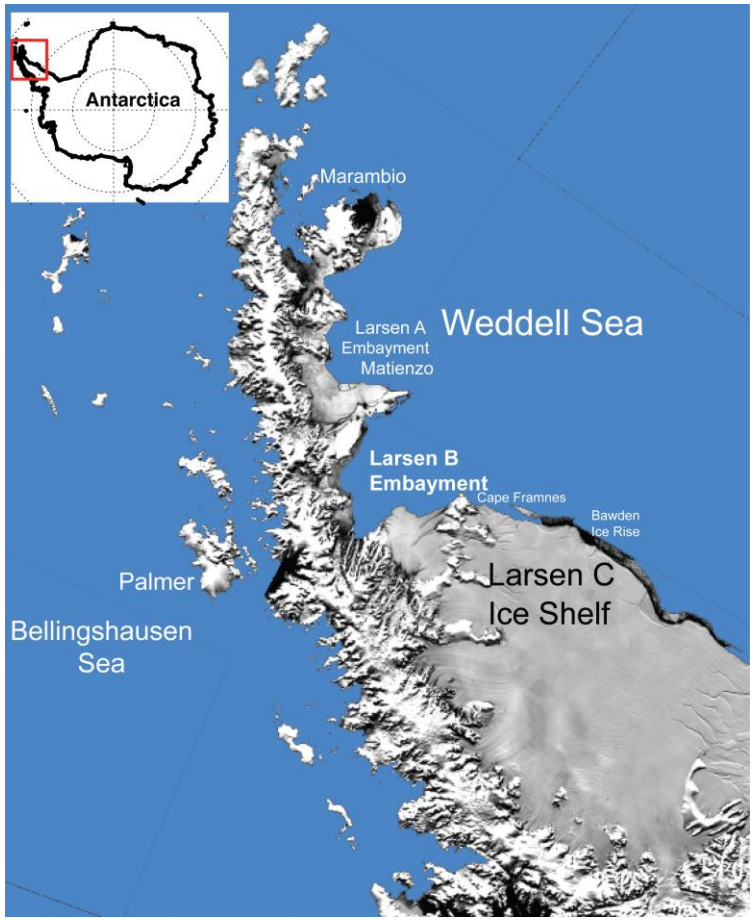
funded by NSF in 2009

Motivations:

- The response of AP glaciers to ice shelf loss are an analogue for larger ice shelf – ice sheet systems
- Recent climate history of the AP shows rapid warming. What about the LIA and MWP periods?
- Scar Inlet Ice Shelf will likely disintegrate in the next few years; expect acceleration of feeder glaciers, Flask and Leppard.
- Rapid changes in ice cover (ice shelf loss) may influence ocean circulation ; Subsequent glacier changes may result from changed ocean flow

Approach:

- Installation of automated systems on ice and rock – (GPS, passive seismic, AMIGOS)
- Ice core acquisition at the summit ridge – (Climate record, borehole temperature inversion)
- Ocean moorings and profiling
- Field GPR/GPS surveys (local surveys, traverses)
- Continued remote sensing work
- Analysis of observational data via closely-tied models



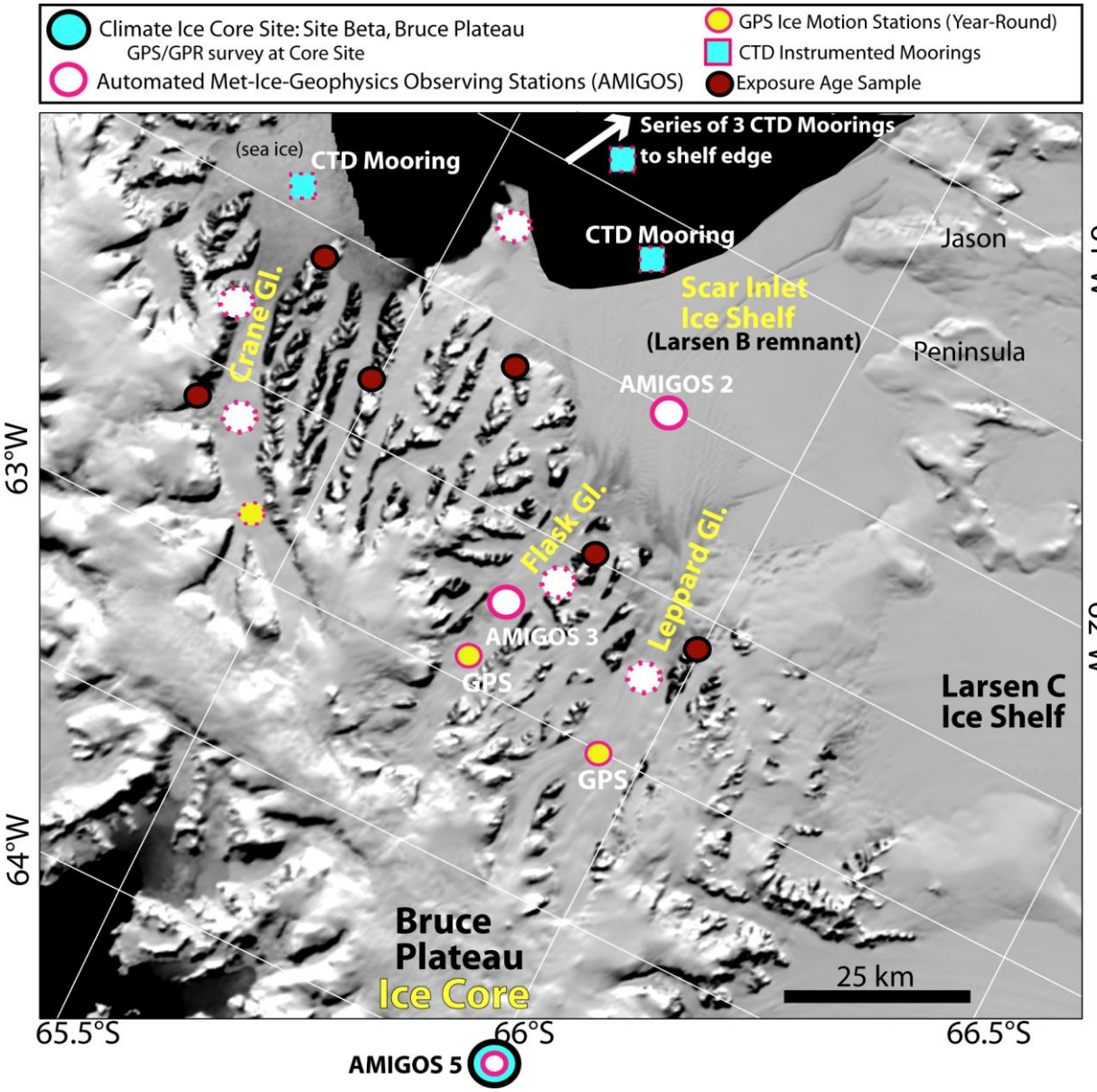
Overview of installations and field work for LARISSA

Guide to this talk:
'Start from the top and flow down'

Ice core site survey
Preliminary ice core results
AMIGOS station
Borehole T results

Glacier AMIGOS intro

Future Plans, this season and beyond



LARISSA proposal, Domack, Vernet, Scambos

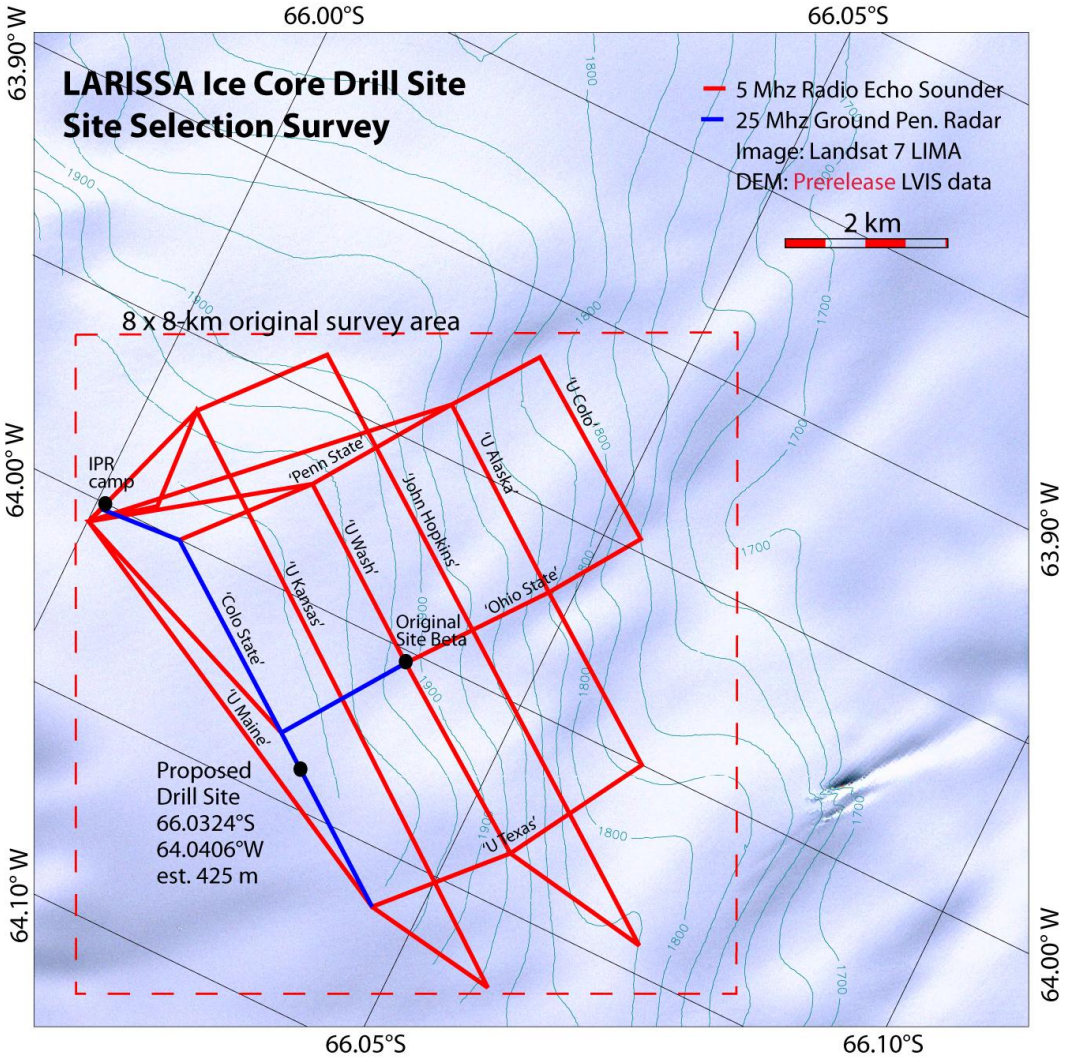
LARISSA Site Beta Field Survey –

Goals: A site with –

- 350 – 500 m ice thickness
- well-behaved layering
- well-behaved, low slope bed

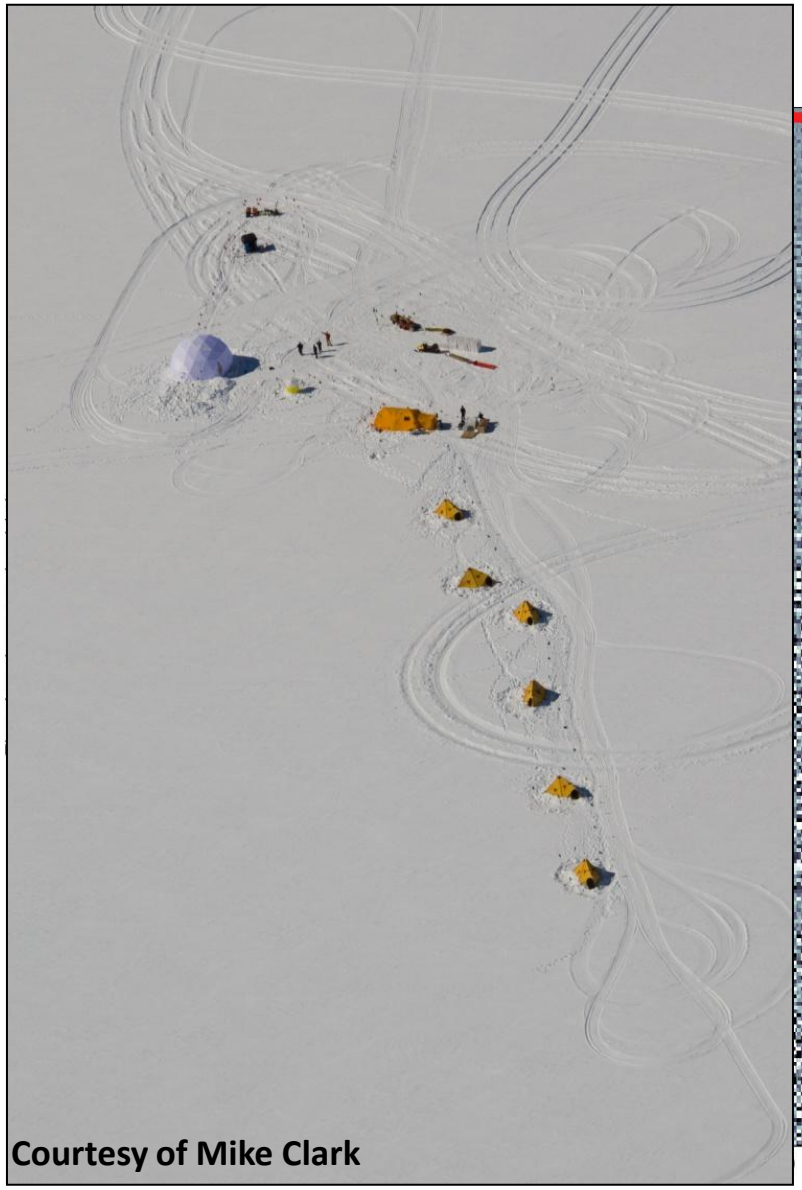
- Surveyed grid is ~800 m by 2.5 km,
  ~60 km total 5 MHz RES lines
  ~ 8 km total 25 MHz RES lines

- new DEM information from NASA Ice Bridge LVIS sensor, 2009 data



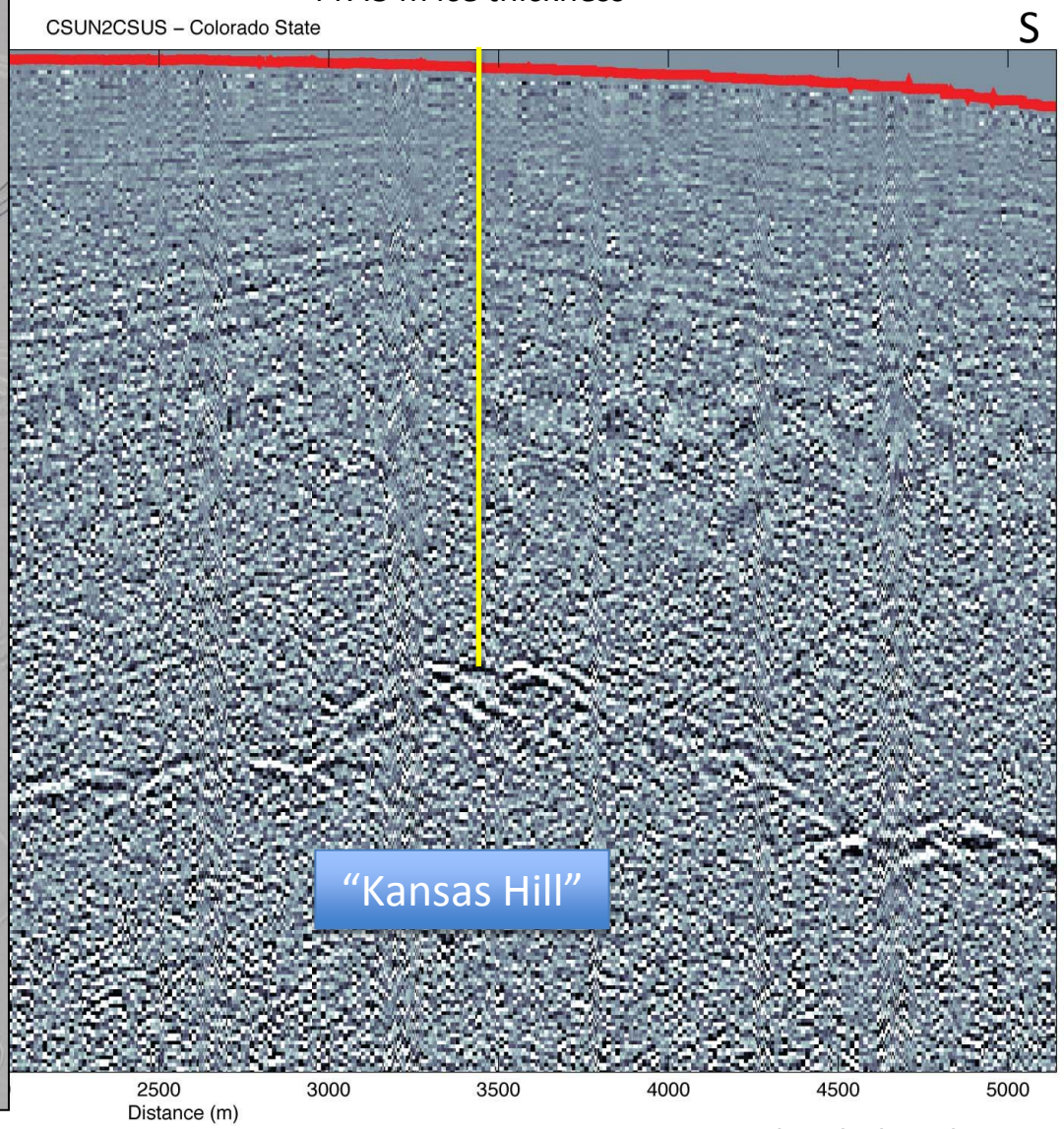
Pettit and others, in prep.

LARISSA Site Beta site selection



Courtesy of Mike Clark

LARISSA Site Beta Ice Core
66.0324°S 64.0406°W, 1980 m
447.5 m ice thickness



Pettit and others, in prep.

Anticipated Data Sets from the Bruce Plateau Core

Continuous records with annual resolution as far back as possible:

Stable isotopic ratios ($\delta^{18}O$ and δD) - temperature
Insoluble dust flux (dustiness)
Major anions, cations, MSA (volcanic history, marine contribution, sea ice variability / atmospheric transport strength & biological activity)
Net mass accumulation
If melt features are present: extent and frequency of melt (rare and modest)

Discrete samples for targeted sections of the core

Trace and ultra trace elements:
Source indicators (rocks & soil dust):
Al, V, Mn, Sr, Rb, U, & Rare Earth Elements
Volcanoes: Pb, Bi, Cd
Oceanic biomass: Hg
Extraterrestrial matter: Ir, Pt

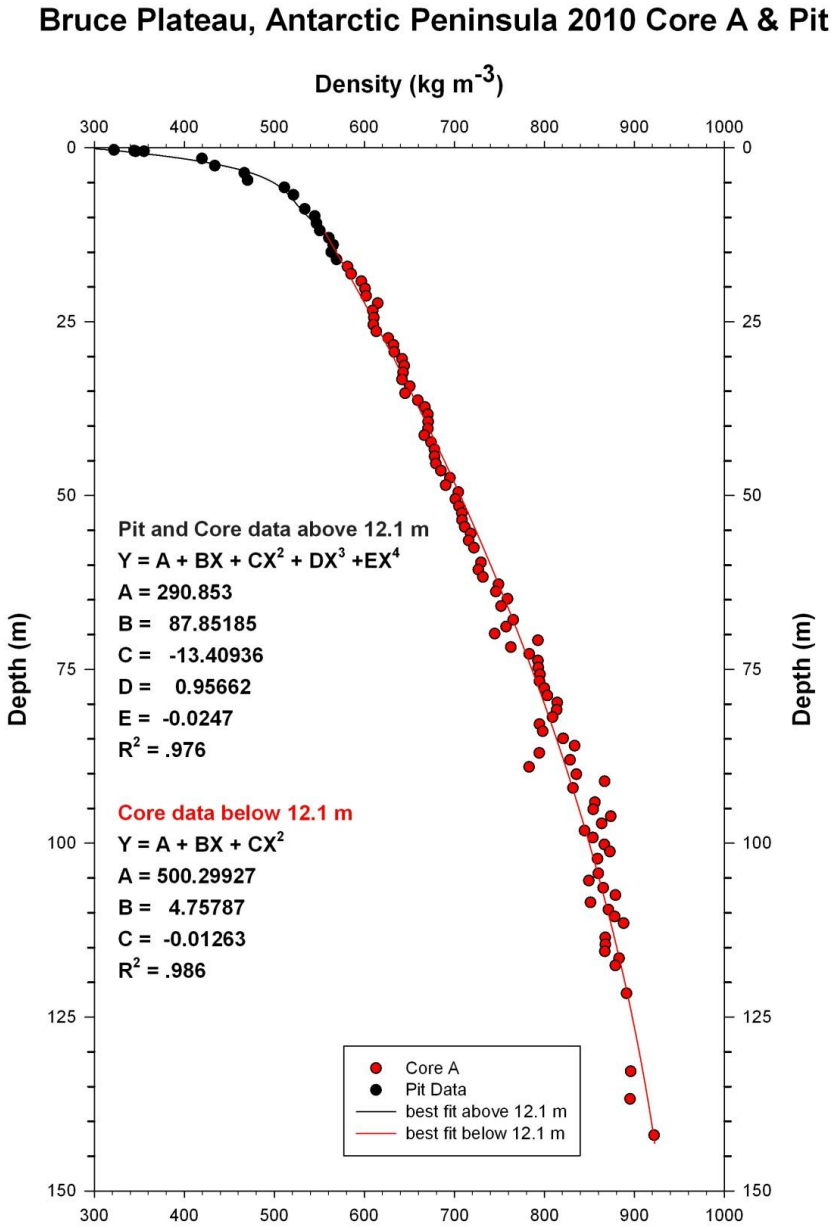
Collaborations with others: trapped gases; other isotopes (N, S)

LARISSA Site Beta Ice Core: preliminary data (Ellen M.-T.)

The OSU group have conducted a basic characterization of the core ice – required to design the ice core sampling and processing strategy

Key Question:
What is the average annual accumulation?

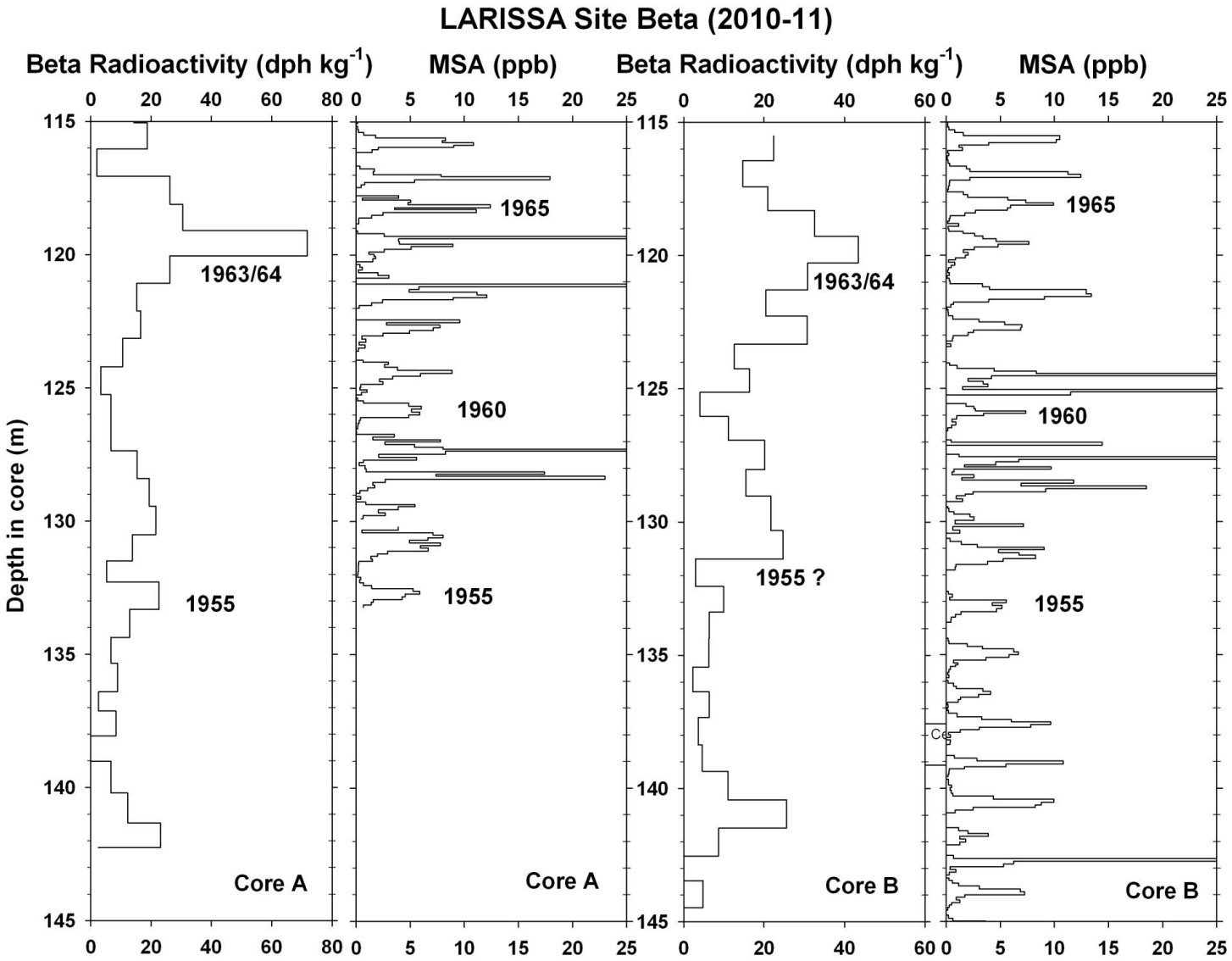
Initial estimate comes from
β-radioactivity and density profiles



Mosley-Thompson, Ohio State, unpublished data

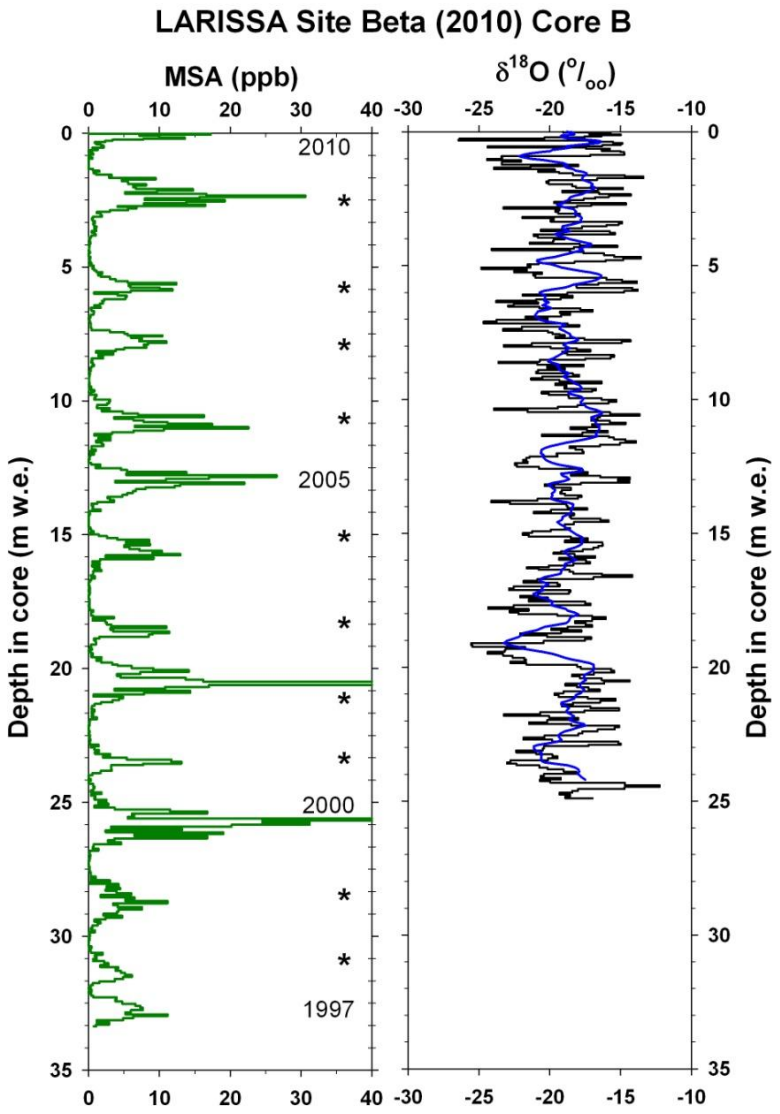
LARISSA Site Beta Ice Core: preliminary data (Ellen M.-T.)

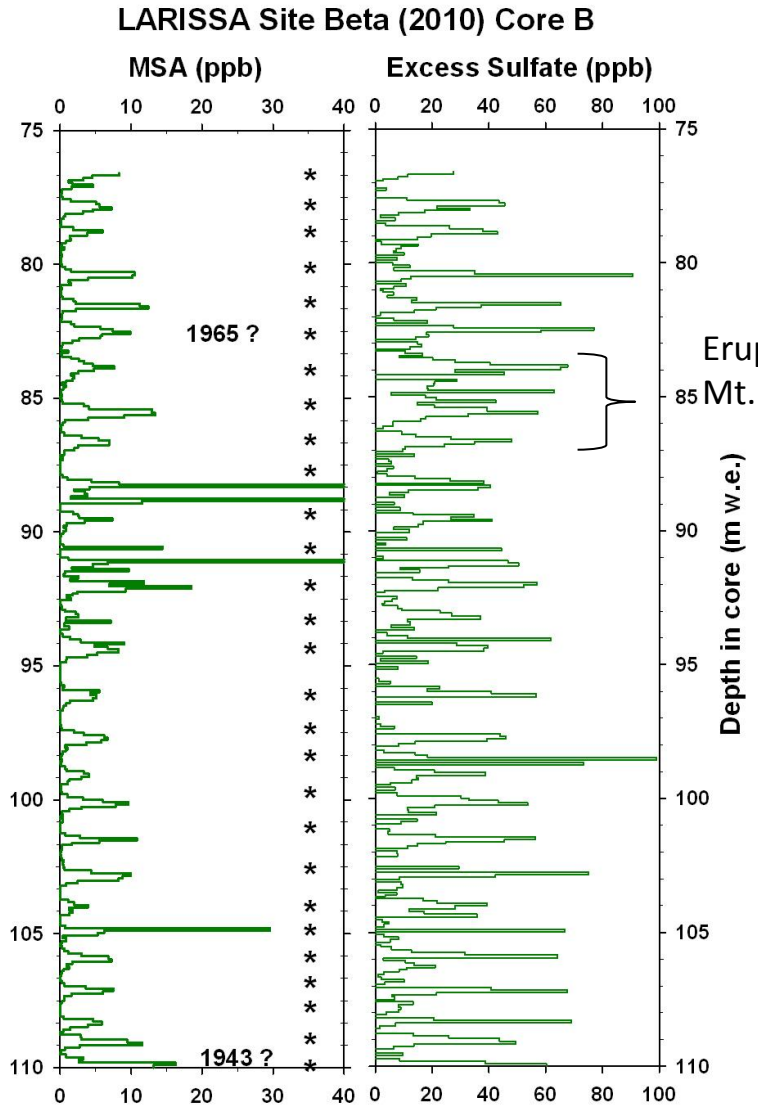
Average annual accumulation from 1965 - 2009 is 1.8 m w.e.



Mosley-Thompson, Ohio State, unpublished data

LARISSA Site Beta Ice Core: preliminary data (Ellen M.-T.)





Eruption of Mt. Agung 1963

A_n = ~2.56 m w.e. Ave = -18.80 °/oo

MSA ave = 3.67 ppb (12 years: 1997 – 2009)

Mosley-Thompson, Ohio State, unpublished data

LARISSA Site Beta Ice Core: summary to date

Accumulation is much higher than we anticipated

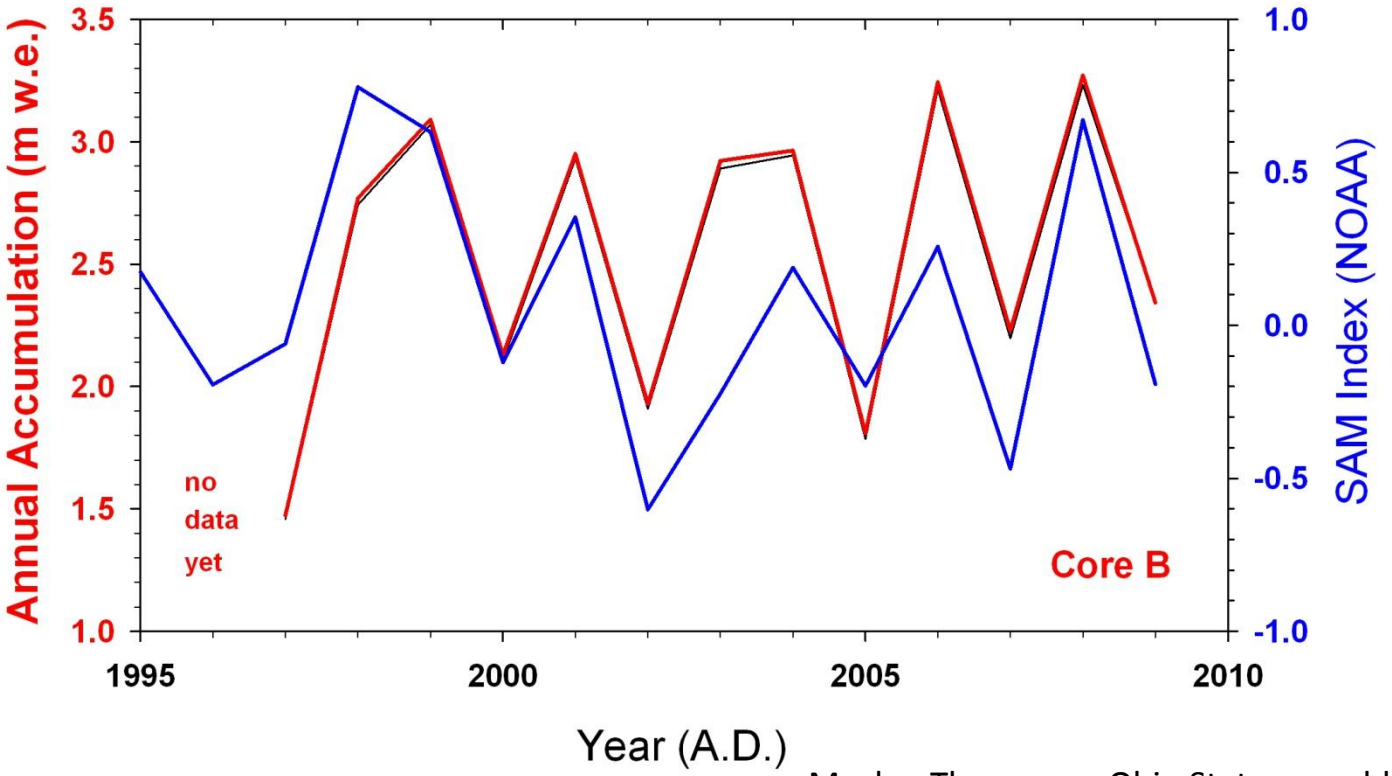
Accumulation in last 2 decades appears to have increased markedly

There are very few melt layers – *important for borehole thermal profile study.*

Question:

Does the Southern Annual Mode (SAM) modulate accumulation at Site Beta?

Interesting correlation in upper section , but a longer record of comparison is needed…



Mosley-Thompson, Ohio State, unpublished data

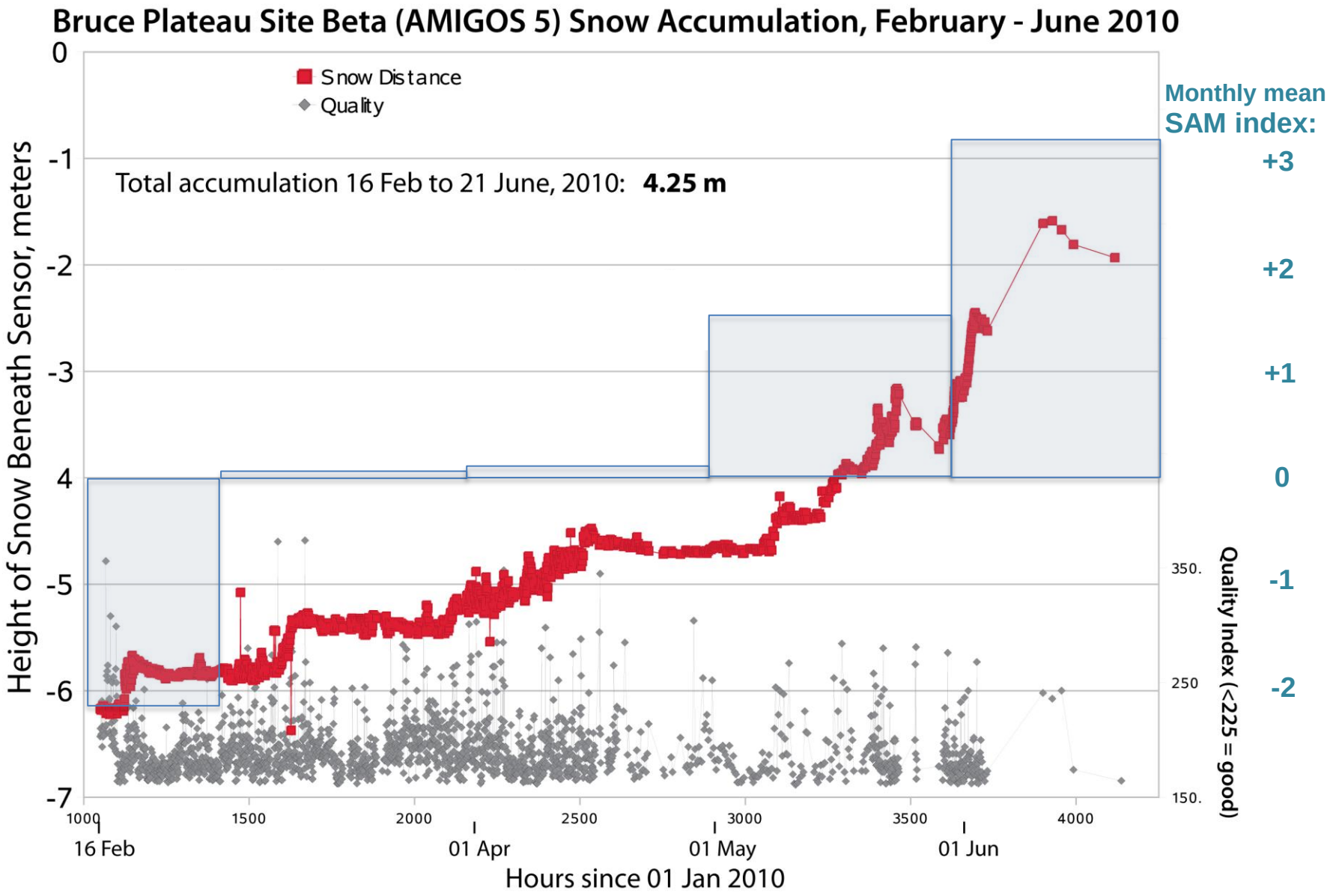
Bruce Plateau AMIGOS System

- Sonic snow height sensor
  accumulation rate
- Weather data
  Vaisala system:
  wind, temp, press, humid
- Albedometer
  solar power, surface melt onset
- Thermistor string (120 m)
  mean annual temperature
  temperature history for past 10-20 yrs.

NO LONGER TRANSMITTING:

SNOW BURIAL RATE ~1m/month

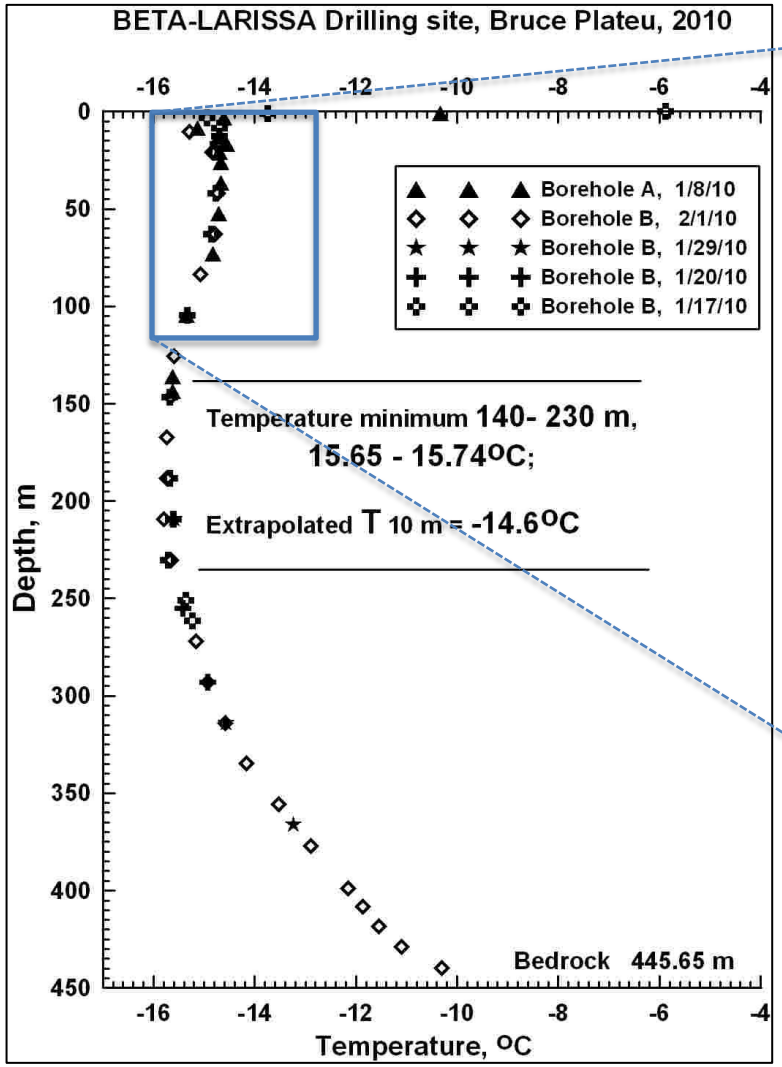
Bruce Plateau AMIGOS System



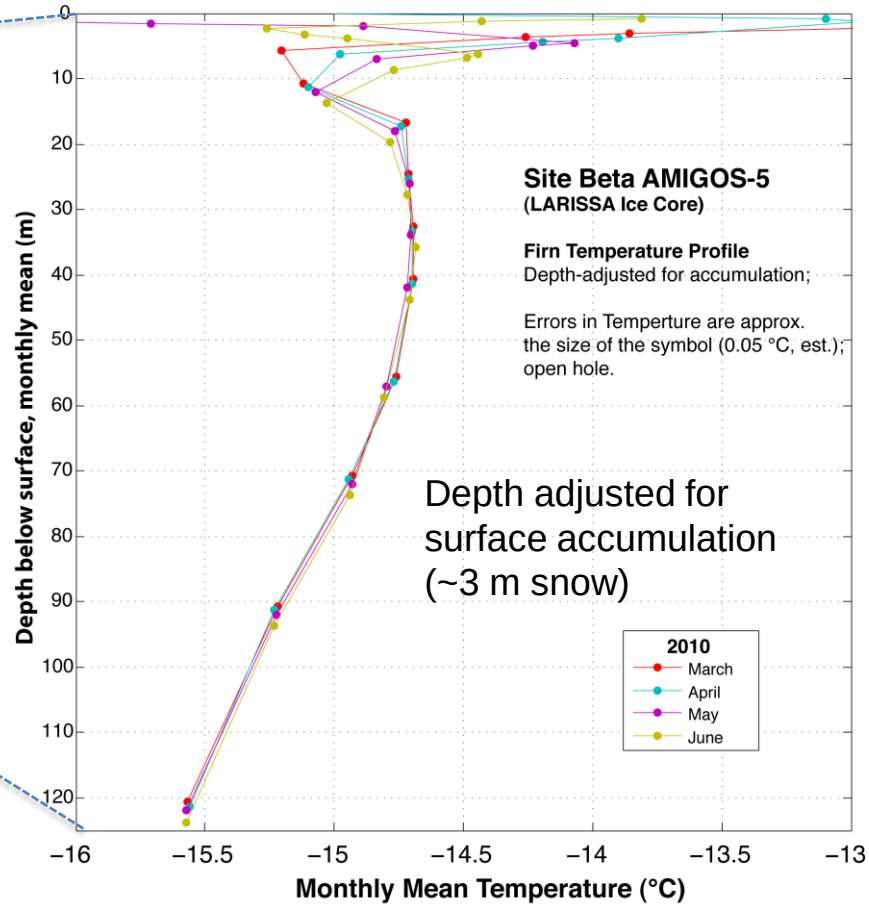
Scambos, Haran, Ross, Petach, unpublished.

Site Beta Ice Core – Borehole temperature study

Repeat thermistor profiles



PRT monitoring, 4 months post-drilling (AMIGOS-5 unit)



Accuracy/precision ± 0.02° to 0.05° C; no evidence of long-term thermal perturbation from drilling

Zagorodnov, Nagornov, Scambos, Muto, Mosley-Thompson, submitted.

Site Beta Thermistor and PRT study –

Bracketing range of likely mean climate, accumulation, and heat flux conditions:

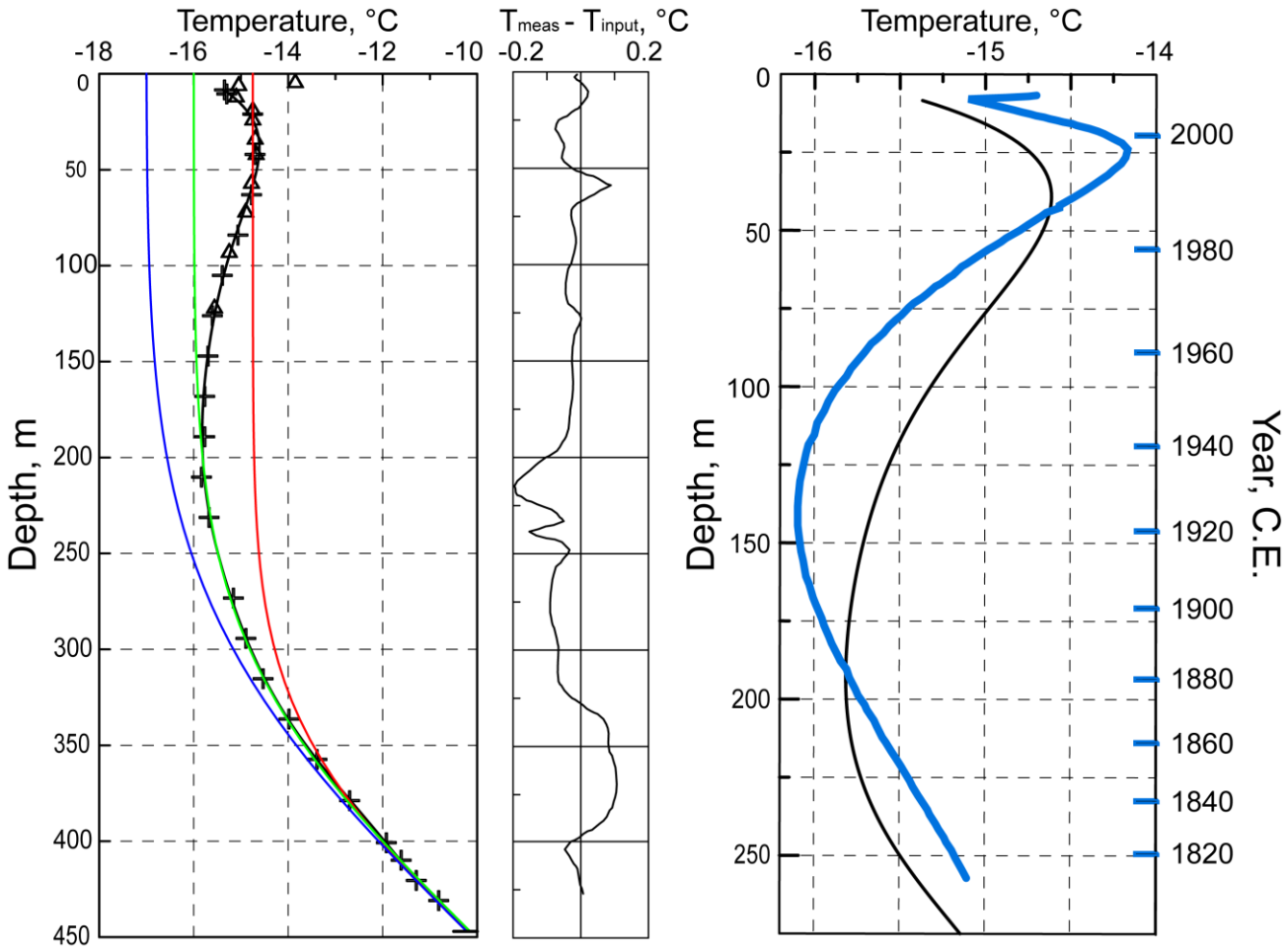
Red:
-14.78 C, a = 1900 kg/m^{-2}; *q*= 88 mWm^{-2}

Green:
-16.0 C, a = 1200 kg/m^{-2}; *q*= 88 mWm^{-2}

Blue:
-17.0 C, a = 900 kg/m^{-2}; *q*= 85 mWm^{-2}

INVERTED CLIMATE MODEL RESULT:

Heavy blue line.



Zagorodnov, Nagornov, Scambos, Muto, Mosley-Thompson, submitted.

Site Beta Thermistor and PRT study – comparison with other records

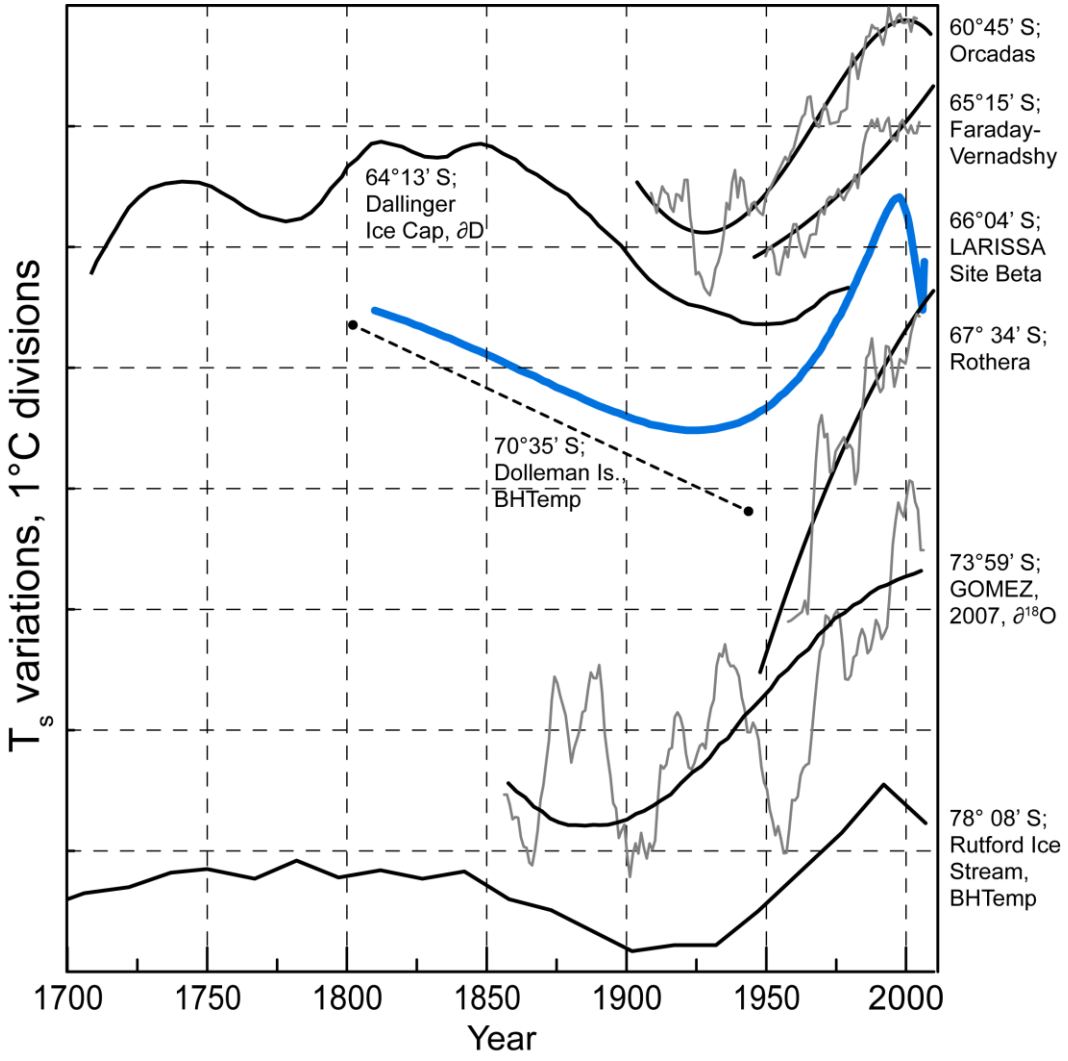
Comparison with other century-scale climate records;

Latitudinal transect,
60° – 78° South ;

Cool period 1890-1950; 0.5 to 1°C

Warming since 1930 of 1° to 2° C.

Recent flattening or reversal of warming trend



Zagorodnov, Nagornov, Scambos, Muto, Mosley-Thompson, submitted.

Plans for Further Installations in 2011 and early 2013

- **Cape Disappointment -2011**
  Hi-Res Ridge Cam AMIGOS

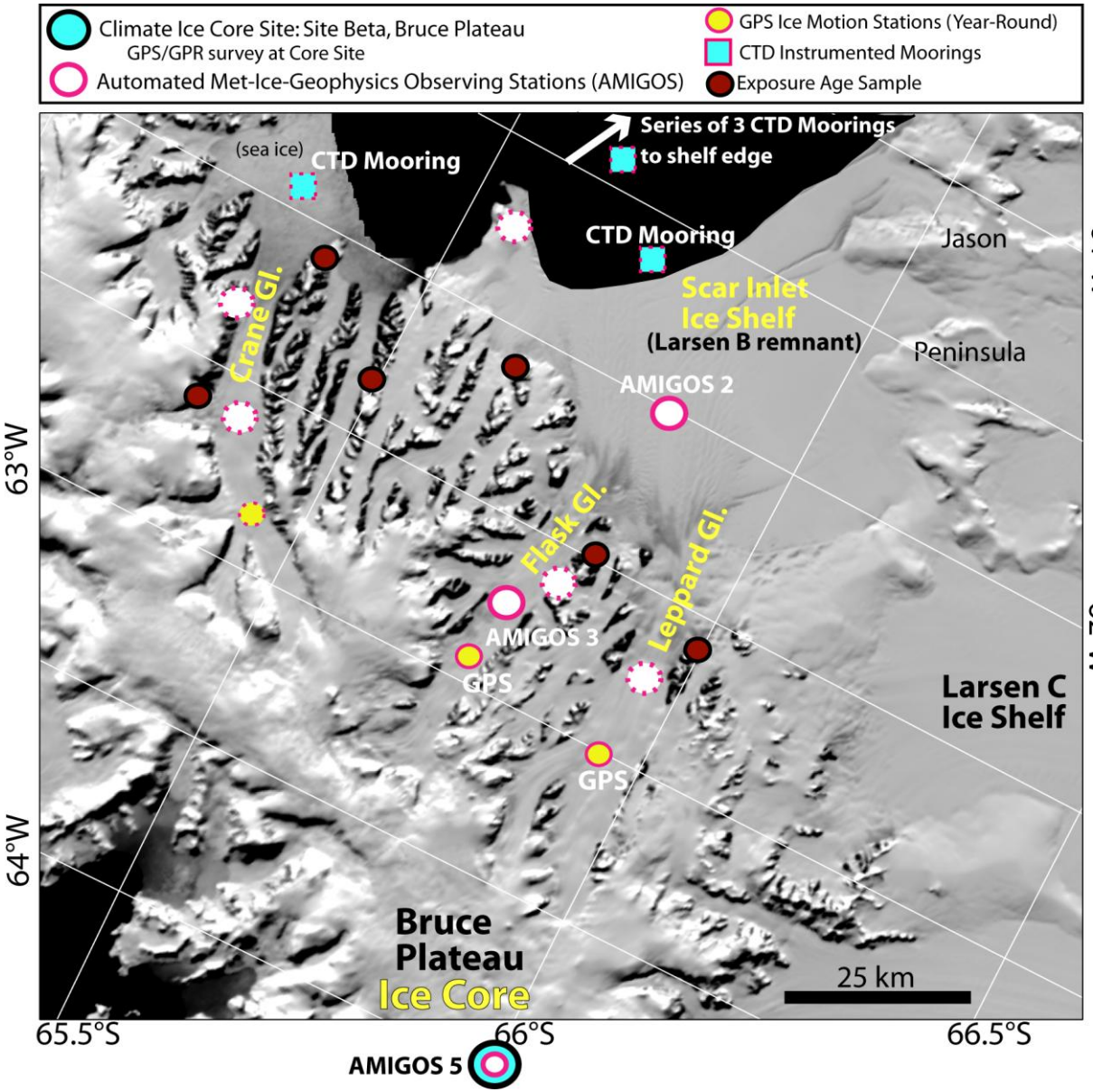
- **Crane Glacier-2013**
  Glacier AMIGOS
  UNAVCO iceGPS

- **Cape Disappointment-2013**
  Passive Seismic station?
  UNAVCO cGPS rock site?

- **Leppard Glacier-2013**
  Glacier AMIGOS - KOPRI

Re-Survey of Flask w/GPR-2013

Other possible KOPRI 2013 Sites:
Lower Flask
Jorum Glacier
SCAR Inlet Shelf #2



'Ridge Cam' AMIGOS System, for high-resolution images overlooking the glaciers or ice shelves

AMIGOS:
Automated **M**et-**I**ce-**G**eophys. **O**bserving **S**tations

- Hi-Res Camera
  three 12 megapixel images,
  2x /day
  surface processes,
  crevassing, calving

- Weather data
  Vaisala system:
  wind, temp, press,
  humidity

- Albedometer
  solar power,
  surface melt onset

NOT YET INSTALLED;

4 Hours Ground Time

Cape Disappointment

(and AMIGOS -2,
Cape Framnes again)

Thank you.