

WAIS-D Logging Update

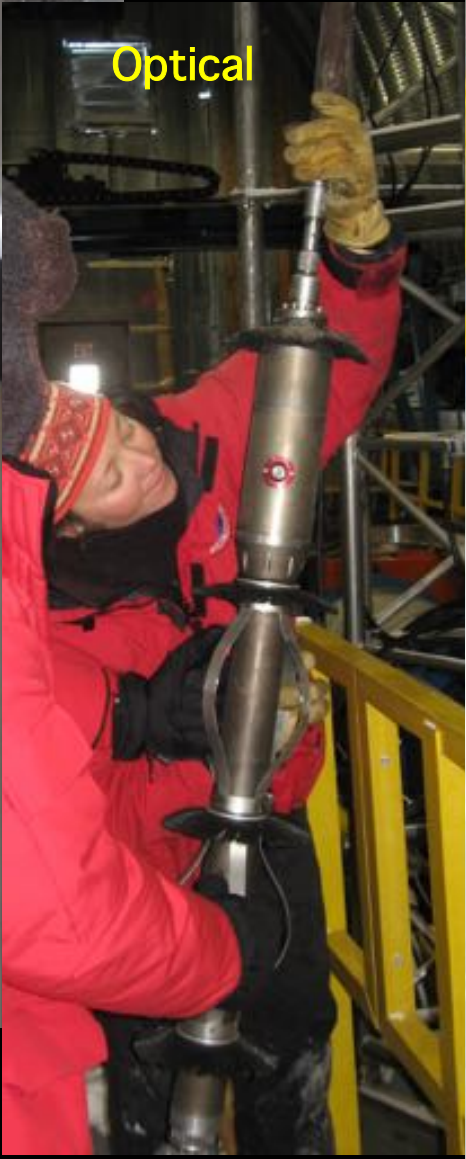
2011-12 Field Season



Temperature



Optical



Sonic Velocity



Seismic

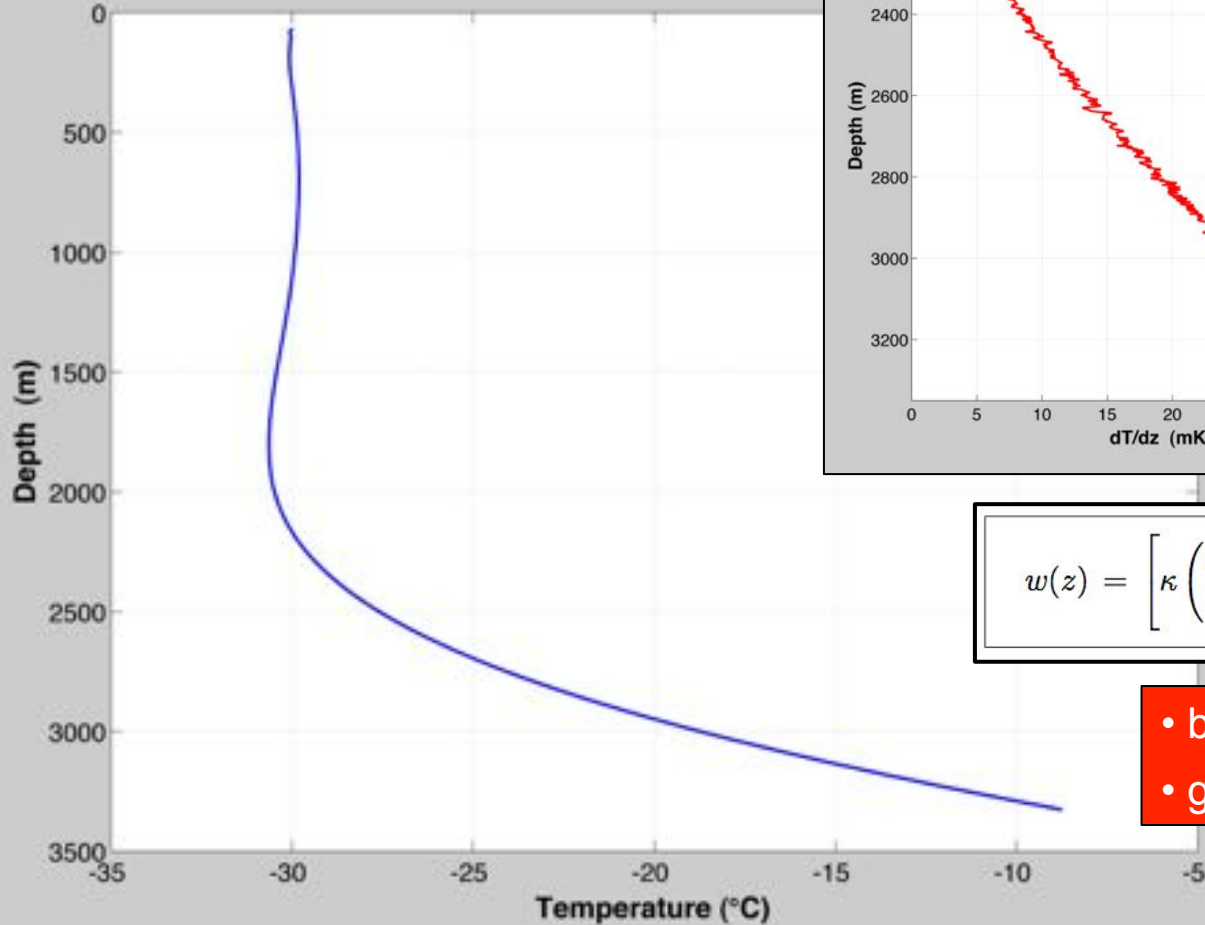


Acoustic

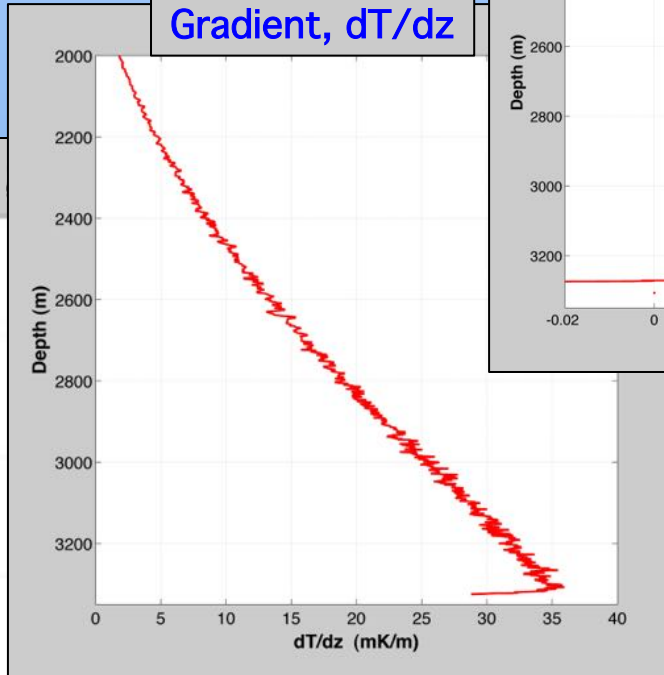


WAIS-D Temperature Profile, Gradient, and Curvature

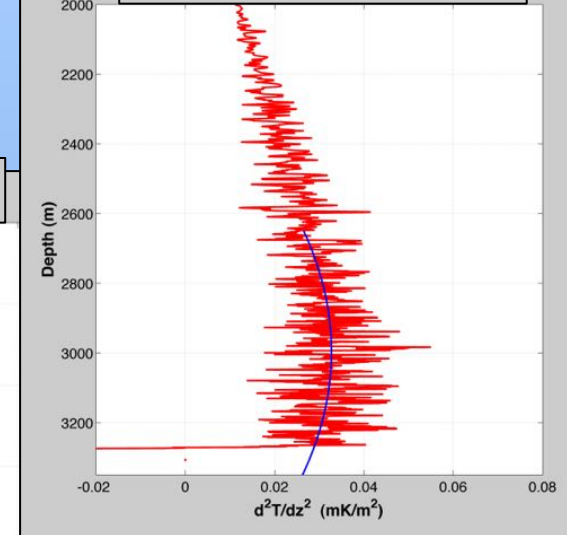
Temperature Profile



Gradient, dT/dz



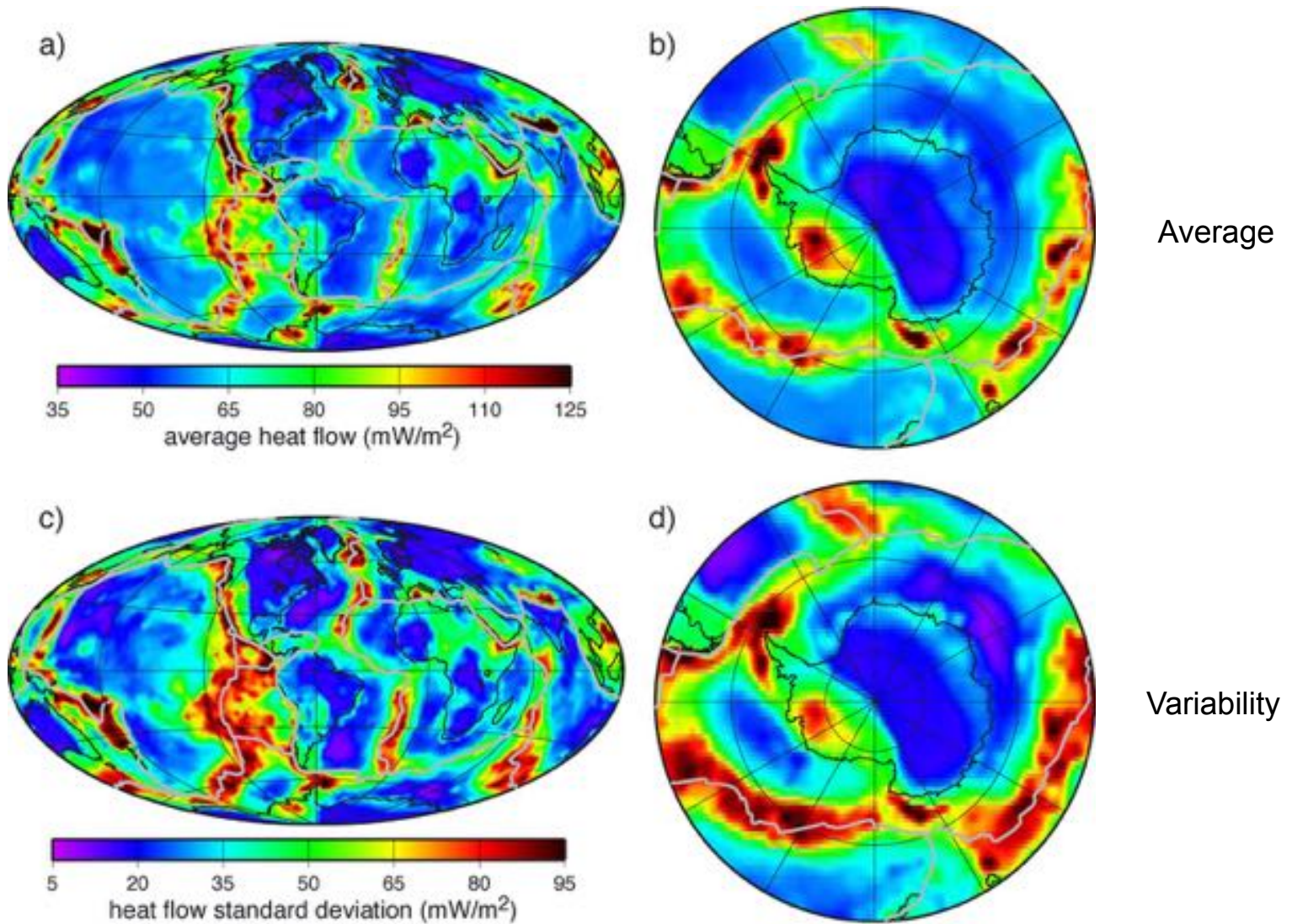
Curvature, d^2T/dz^2



$$w(z) = \left[\kappa \left(\frac{\partial^2 T}{\partial z^2} \right) - b\kappa \left(\frac{\partial T}{\partial z} \right)^2 - \left(\frac{\partial T}{\partial t} \right) + \frac{F}{\rho C_p} \right] / \frac{\partial T}{\partial z}$$

- basal melting rate = 1.5 cm/yr
- geothermal heat flux = 240 mW/m²

Geothermal Heat Flow inferred from Seismic Velocities



Borehole Logging Discussion

Current Borehole Logging Resources

- deep logging winches (USGS 4-km winch)
- intermediate depth logging winches (IceCube project 2.5-km winch)
- shallow logging winches (PI provides)
- logging tools (PI provides)

Near-Term Logging Plans

- deep (1500 - 4000 m)
- intermediate depths (500 - 1500 m)
- shallow depths (0 - 500 m)

Logging Winch Assignments

| Equipment | 2012 Arctic | 2012-13 Antarctic | 2013 Arctic | 2013-14 Antarctic | 2014 Arctic | 2014-15 Antarctic | 2015 Arctic | 2015-16 Antarctic |
|--------------------------|---|---------------------------|-------------|--|-----------------------|--|-------------|--------------------------|
| Intermediate-Depth Drill | | | | | Greenland / Requested | SPole / Requested | | SPole / Requested |
| Kodi Drill | Unavailable | | | | | | | |
| Prine Dog | Unavailable | Unavailable | | | | | | |
| RAM Drill | | | | | | | | |
| Reamer | | | | | | | | |
| Thermal Drill | | | | | | | | |
| Deep - IDDO | | | | | | | | <u>WSD</u> televiewer |
| Intermediate IDDO | | | | <u>Dome F</u> temperature | | <u>Dome F/temp</u> <u>SDM/optical</u> | | |
| Deep - USGS | <u>NEEM</u> temperature sonic seismic? | <u>WSD</u> drill test? | | <u>WSD</u> temperature optical televiewer sonic? | | <u>WSD</u> temperature | | |

Borehole Logging Discussion

Near-Term Challenges

- vetting process for instruments

- *is it ready?*

- *is it safe?*

(potential impact on others)

(risk to borehole, risk to winch)

- requests for large amounts of logging time

- *review in context of other requests*

- *winch operators*

- field protocols

- *missing borehole*

- *blocked borehole*

- *winch failure*

- *logging tool failure*

- *lost logging tool*

(what happens when things don't work?)

Borehole Logging Discussion

Long-Term Logging Plans (beyond 2014-15)

- deep *(ice-core holes, RAID)*
- intermediate depths
- shallow depths

Needed Long-Term Resources, U.S. Program

- deep logging winch(s) *(1500 - 4000 m)*
- intermediate depth logging winch(s) *(500 - 1500 m)*
- shallow logging winch(s)? *(0 - 500 m)*
- winch operators
- community logging tools?
- logging-tool test facility? *(low T, high P)*