

Seismic Instrumentation Temporary Stations: A PASSCAL Perspective

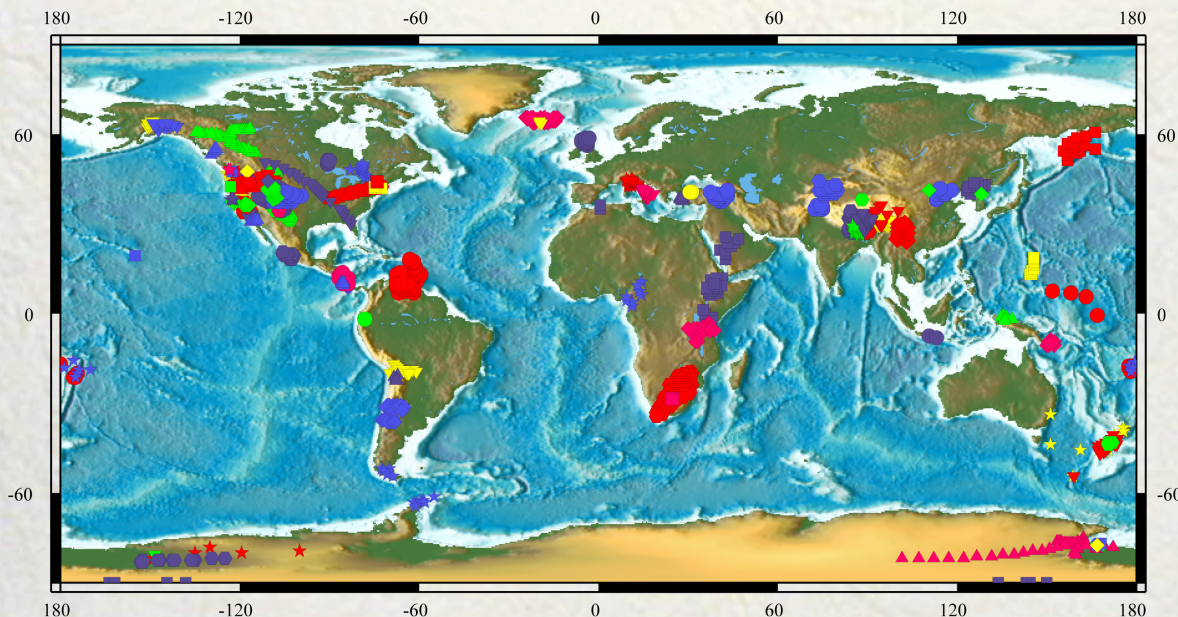
Bruce Beaudoin, Tim Parker, Jim Fowler & Kent Anderson

POLENET: Seismology in the IPY
San Francisco, Dec. 10, 2006

PASSCAL Support

- Average >60 experiments per year
- 5-10% are polar

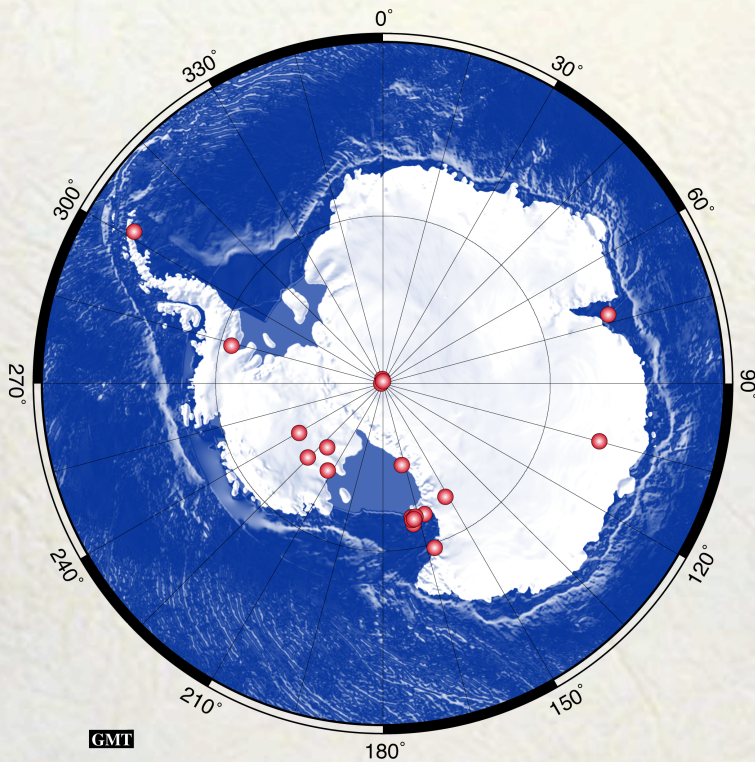
PASSCAL Virtual Network



- Logistics & planning
- Training
- Instrumentation
- Software
- Field support
- Data archiving
- Troubleshooting
- Shipping

PASSCAL Polar Support

- Over 25 polar experiments since 1989
- Passive, active, glaciological, climate



- Cold culling of equipment prior to shipment
- Design and fabrication of ‘one-of’ specialty equipment
- Acquisition of specialty equipment (e.g cold chamber, snow streamer, solid state disks)

Equipment for Active Experiments

Single & 3-channel dataloggers and geophones



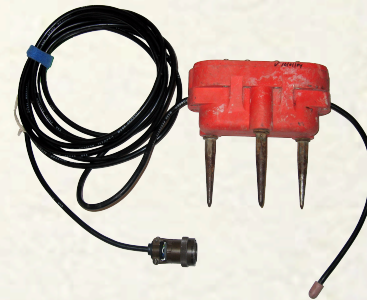
1988



1990



SERIS



Andrill



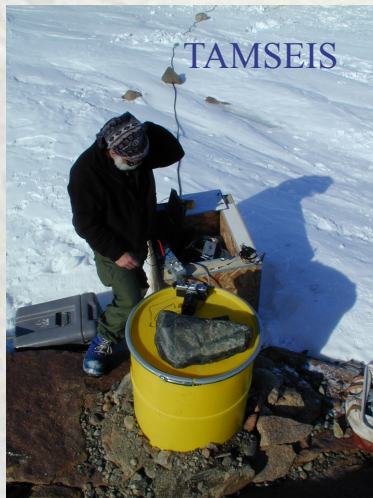
ONSET



60 - channel snow streamer
80' takeouts, 7 12-takeout cables,
Geode adapters.

Elements of a Temporary Broadband Station

- Datalogger w/ on-site storage device
- Seismometer
- Battery and solar power
- Power distribution system
- Station and seismometer enclosures



Instrumentation Operating Specifications

- Q330: Fully spec'd to -40°C
- RT130: -20°C
- Baler: -40C (not media)
- Baler Disk Drive: -20°C
- Flash Media: -55°C
- STS-2 0°C
- 3T: -10°C , cabling -20°C , power controller -20°C



Communication Options

- Wilan - 8 Mbits/sec
- Freewave - 153 Kbit/sec
- Iridium - 2.4 Kbit/sec *
- Argos - SOH only

* Under development



Power Consumption



Batteries at the Truncated Cones seismic station.
(Photograph Courtesy of Jessie Crain - 2001)

	Watt
RT130	1.5
Q330	0.6
STS-2	0.55
3T	1
Wilan	4
Freewave	1.4
Iridium	4

Power Budget for a PASSCAL Style Station

Q330 (3-ch 40sps) 0.6W

3T 1.0W

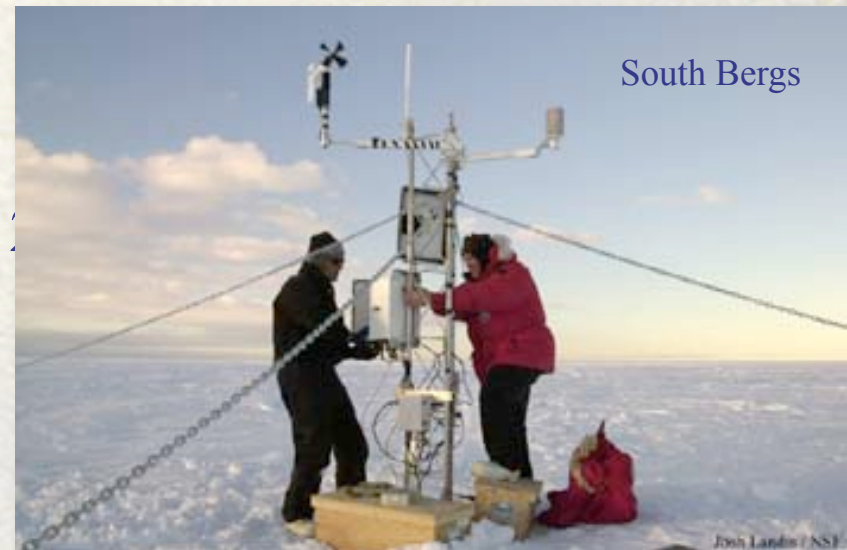
Balance of system* 0.4W

Total

1 Day \approx 50 W-h

1 Month \approx 1500 W-h

0.5 Year \approx 9000 W-h



* Includes Iridium SOH

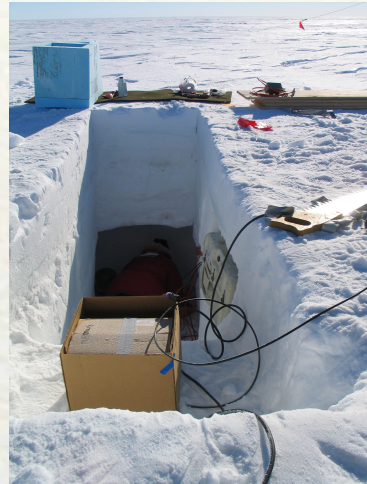
Realtime Data Rates

	Rate
40 sps	180 byte/s
40 sps w/OH	~360 byte/s
100 sps	450 byte/s
Iridium	300 byte/s
Freewave	153 Kb/s
Wilan	1 MB/s

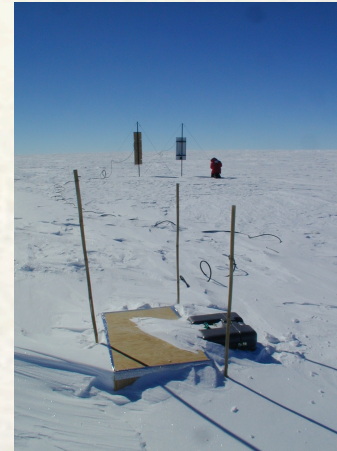


The radio repeater tower at Truncated Cones.
(Photograph Courtesy of Rich Esser - 2002)

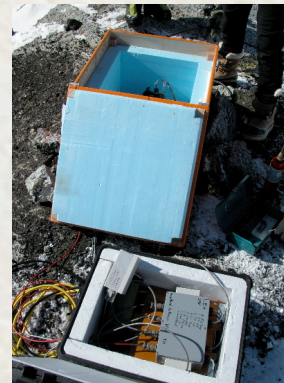
Examples of Enclosures



South Bergs



TAMSEIS



Seismic vault and instrument electronics box at the lower Erebus hut seismic site. (Photograph Courtesy of Rich Esser - 2002)

Examples of Solar Mounts



A-Frame

or something
completely different



Pole
Mounted

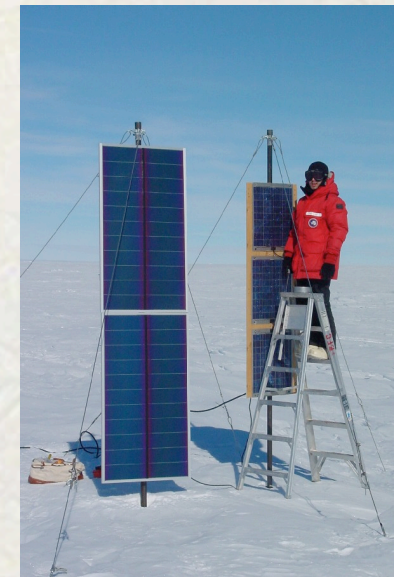


Photo Courtesy of Jerry Bowling

Mostly effective, but time consuming constructions

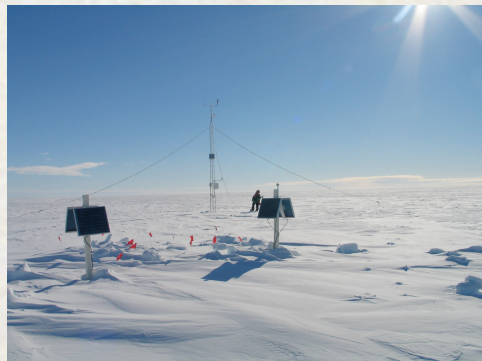
New Directions

- IRIS/UNAVCO MRI
- Collaborations with manufacturers for polar specific development.
- Appointment of Tim Parker as Polar Projects Manager at PASSCAL

IRIS/UNAVCO MRI



- NSF Office of Polar Programs
- **“Collaborative Research: Development of a Power and Communication System for Remote Autonomous GPS and Seismic Stations in Antarctica”**





IRIS/UNAVCO MRI

- Establish test beds at McMurdo & South Pole stations
- Prototype specialized cold station enclosures
- Test primary battery systems
- Test cold rated broadband sensor
- Test Trillium 240
- Field new digitizer firmware tuned for cold





MRI Enclosures

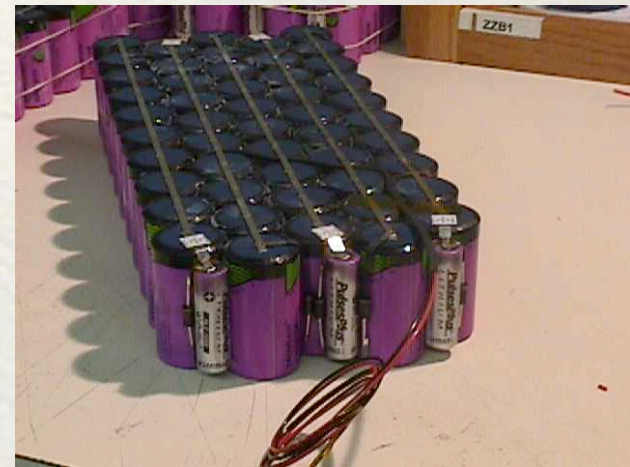
- R-50 vacuum panel station box
- R-5 blue-foam surrounding box
- Sensor at ambient sitting on phenolic base





MRI Power System

- Lithium primary battery pack for winter operations
 - 190 A-h/unit between 18.5-15.5V
 - Testing both 4 and 10 unit packs
 - 10 unit pack
 - 30,000 W-h at room temperature
 - 23,000 W-h at -30°C
 - 16,500 W-h at -55°C



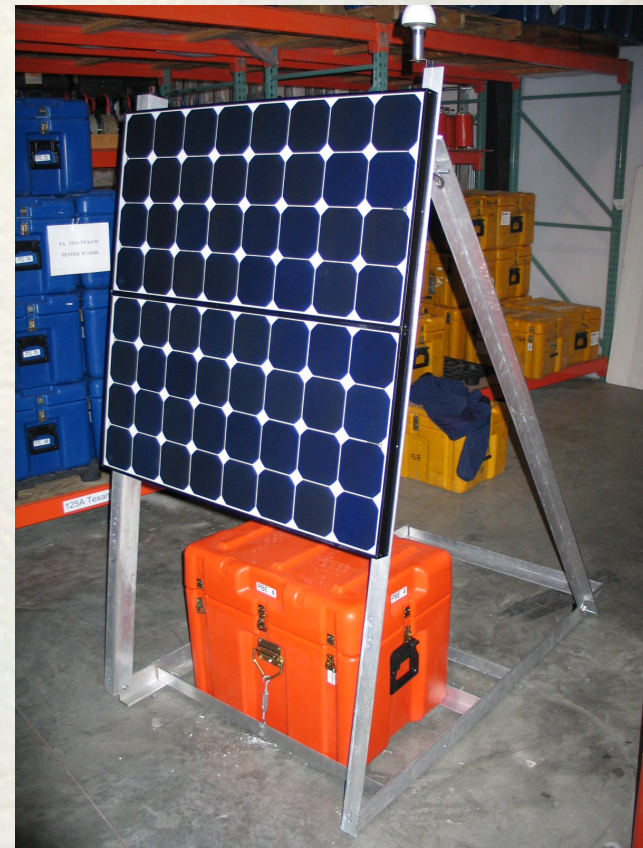
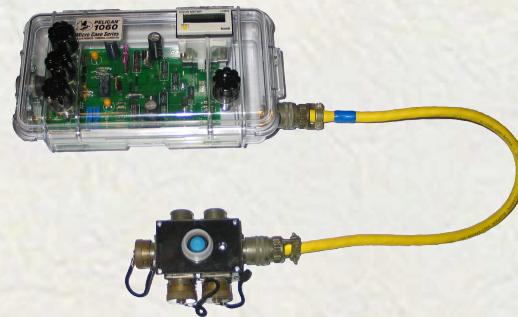
190 A-h unit prior to shrink wrap





MRI Power System

- AGM secondary batteries
- 'Quick' deploy solar mounts
- Univ. of Alaska power board (-40°C rated and field tested)
- Polar 'simplified' power-box design



MRI Cold Rated Broadband Sensor Test



- Leveraging development initiated by GSN for a -55°C rated borehole seismometer
- Cold chamber testing of a surface version this season
- Installation at South Pole next season



MRI Datalogger Firmware



- Quanterra has tuned their firmware to allow the datalogger to remain operating to -60°C
- Flash drive affords on-site storage operating to -55°C



MRI More Information



S41A-1314 Bipolar Seismology I Posters
Thursday 0800 MCW Level 2

Development of a Power and Communications System for Remote Autonomous Polar Observations

*B Johns, *K R Anderson, B C Beaudoin, J Fowler, T
Parker, S White*



Related Efforts

- Contracted development of an Iridium controller
 - Phase 1: allows for SOH transmission, command and control, and limited data retrieval
 - Phase 2: Transmission of event data
- Continued exploration of alternative energy sources

Future Efforts

- Pursuing a cold sensor pool
- Investigating the establishment of a manned-as-needed McMurdo instrument center and storage facility