T-299, IRIS/PASSCAL
Autonomous Seismic Stations

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10-25-2015

NEW MEXICO TECH
SCIENCE · ENGINEERING · RESEARCH · UNIVERSITY

IRIS PASSCAL POLAR PROGRAM

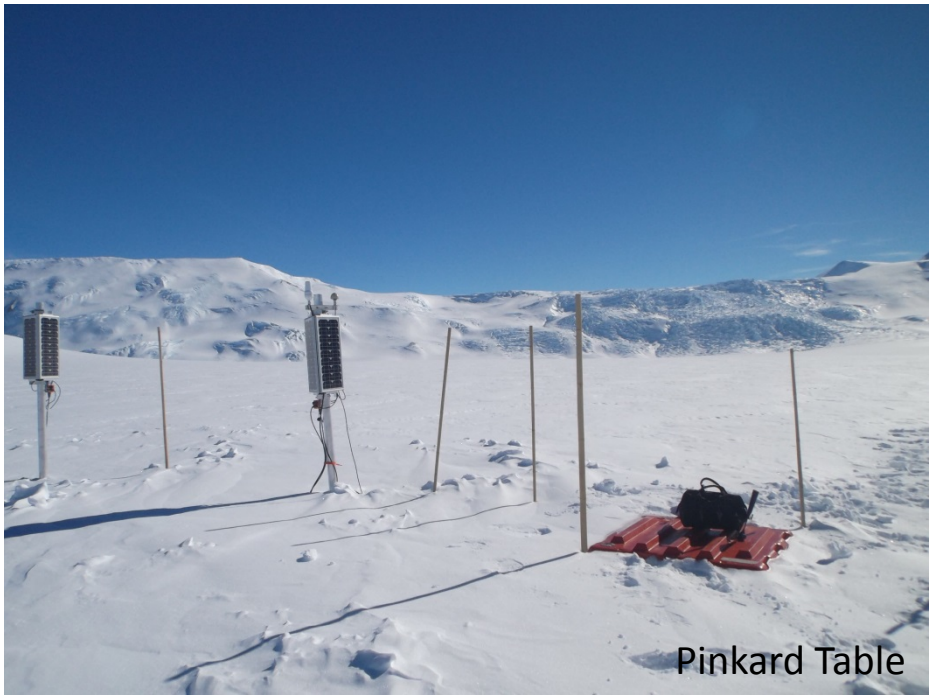
IRIS

NSF

Photo: Bear Peninsula

Overview

- IRIS overview
- PASSCAL overview
- PASSCAL Polar Program overview (T-299)
- PASSCAL equipment
- A typical day in the field


Pinkard Table

IRIS PASSCAL POLAR PROGRAM

IRIS

- Facilitate and conduct geophysical investigations of seismic sources and Earth properties using seismic and other geophysical methods.
- Promote exchange of geophysical data and knowledge, through use of standards for network operations, data formats, and exchange protocols, and through pursuing policies of free and unrestricted data access.
- Foster cooperation among IRIS members, affiliates, and other organizations in order to advance geophysical research and convey benefits from geophysical progress to all of humanity.

IRIS

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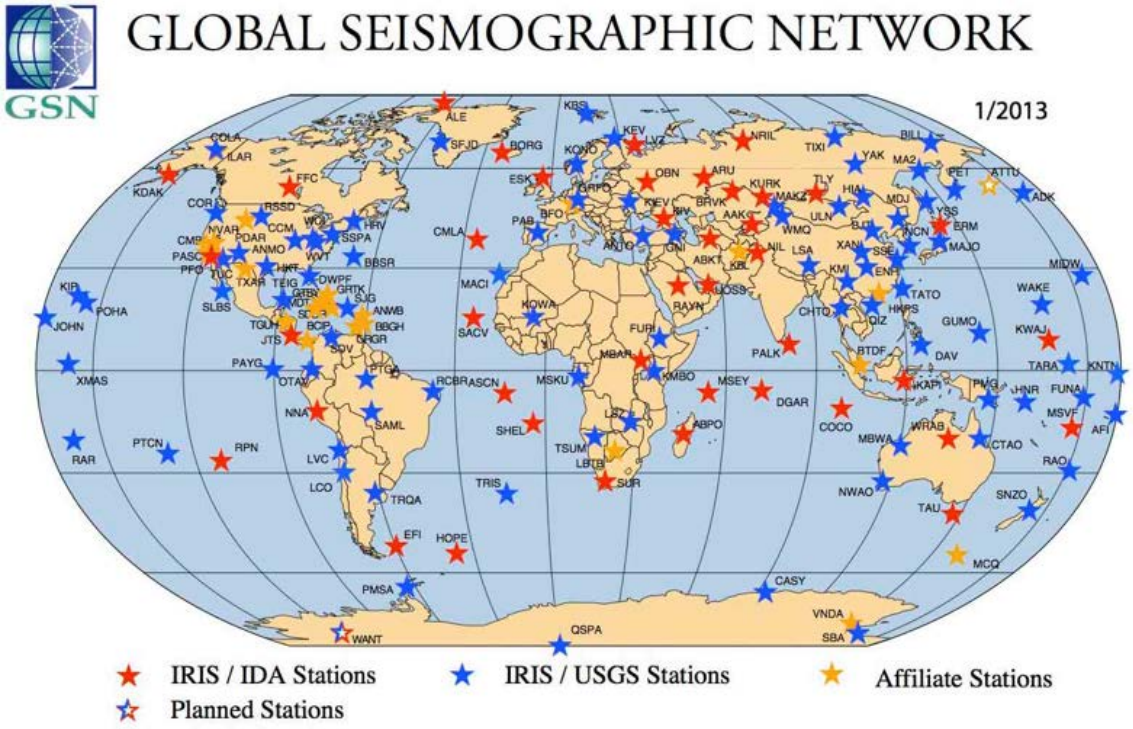
IRIS

- Portable Array Seismic Studies of the Continental Lithosphere (PASSCAL)
- Data Services
- Education and Public Outreach (EPO)
- Global Seismographic Network (GSN)
- The Ocean Bottom Seismograph
- Instrument Pool (OBSIP)
- USArray



IRIS

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PASSCAL

Portable **A**rray **S**eismic **S**tudies of the **C**ontinent**a**l **L**ithosphere

- Facility provides instrumentation to NSF, DOE or otherwise funded seismological experiments around the world
- Services include, but are not limited to:
  - Seismic instrumentation
  - Equipment maintenance
  - Software
  - Data archiving
  - Training
  - Logistics and shipping
  - Engineering support
  - Field Support

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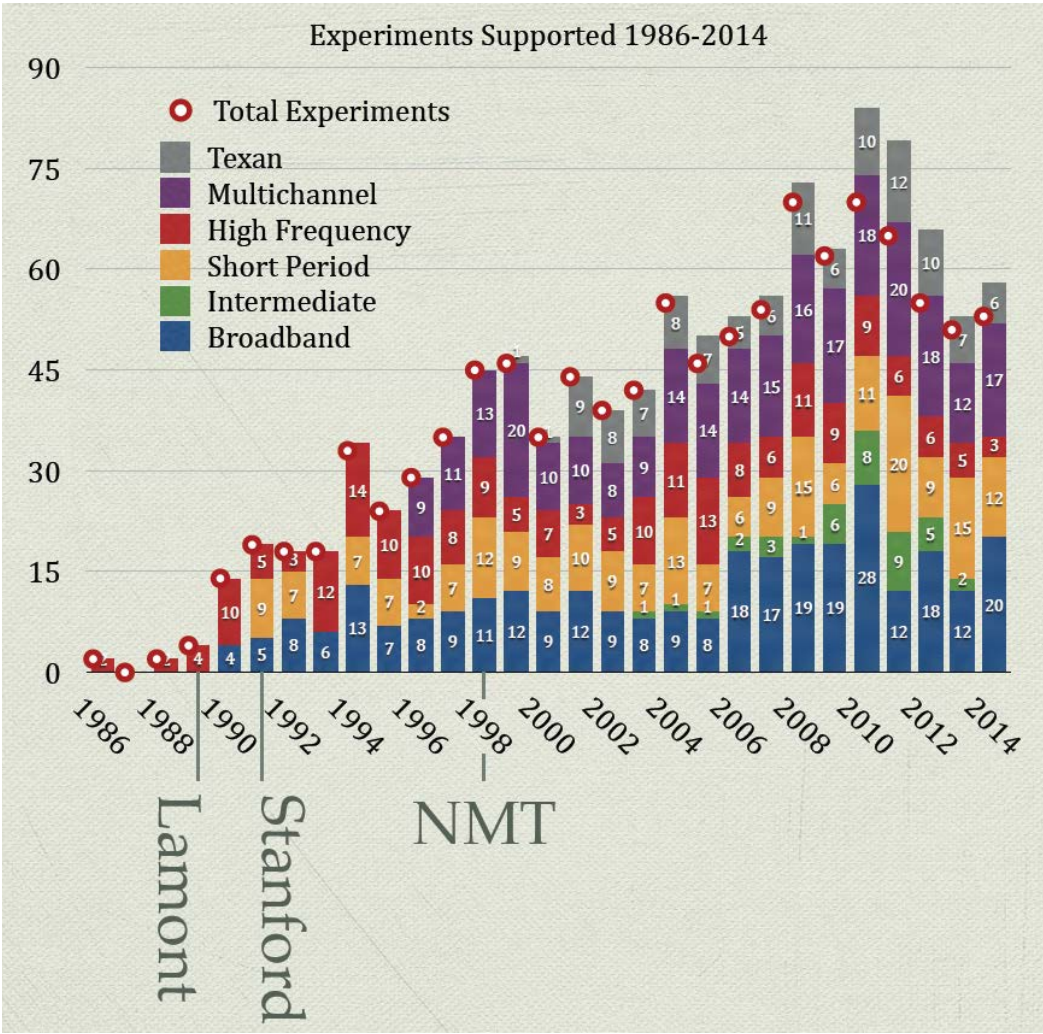
PASSCAL Mission

The mission of IRIS PASSCAL is to advance scientific discovery by providing solutions that enable earth scientists to collect high quality seismic data with flexible arrays.



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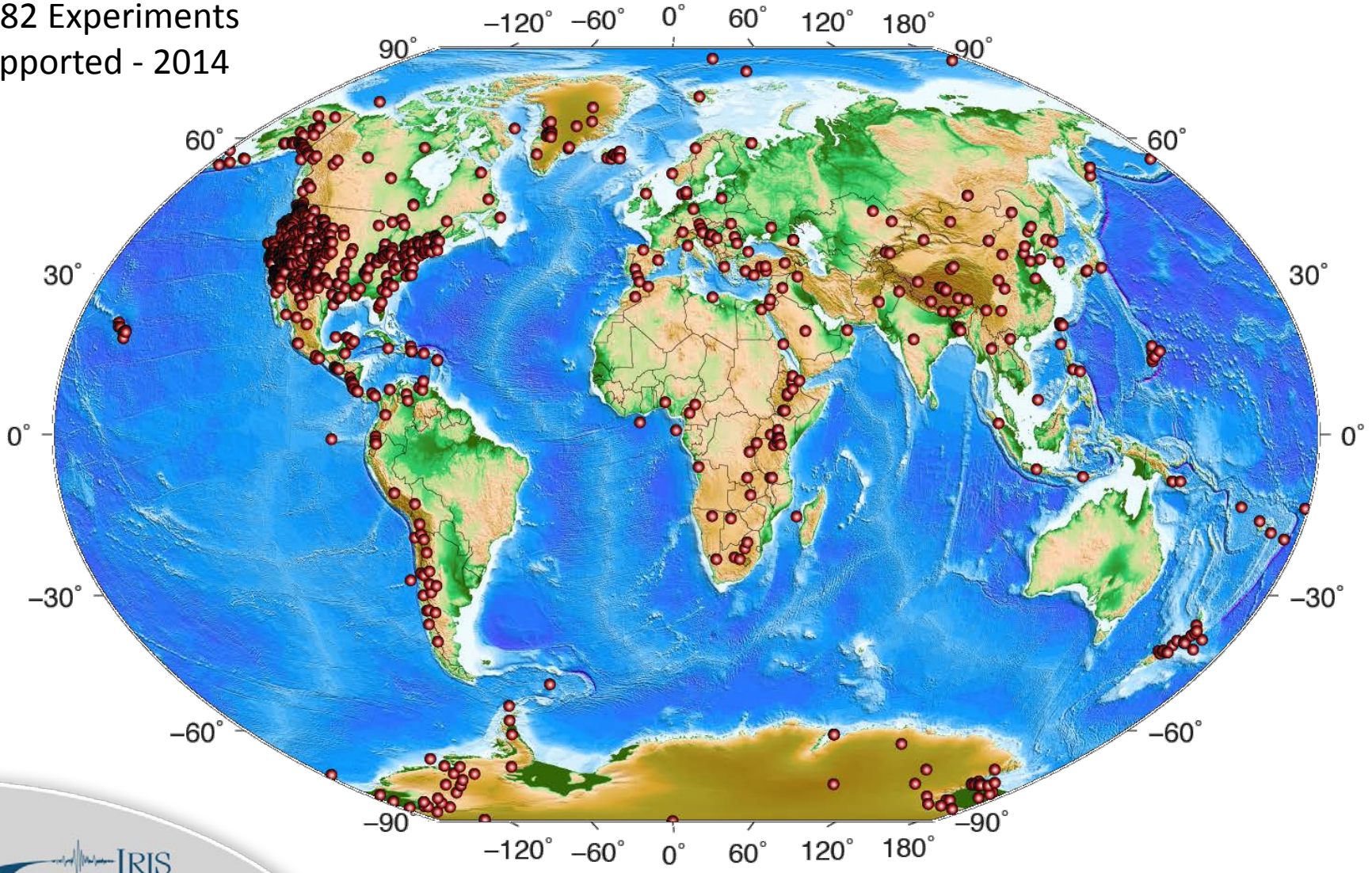
PASSCAL

1082 Experiments
Supported - 2014



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Facility

Photo Courtesy of George Slad

IRIS PASSCAL POLAR PROGRAM

Facility

~35 Full Time Employees

- Polar, Sensors, Hardware, Software, Data, Admin

Large warehouse for equipment onsite storage

Lab space for repairing & testing of seismic instrumentation

Workspace for development of seismic equipment & software

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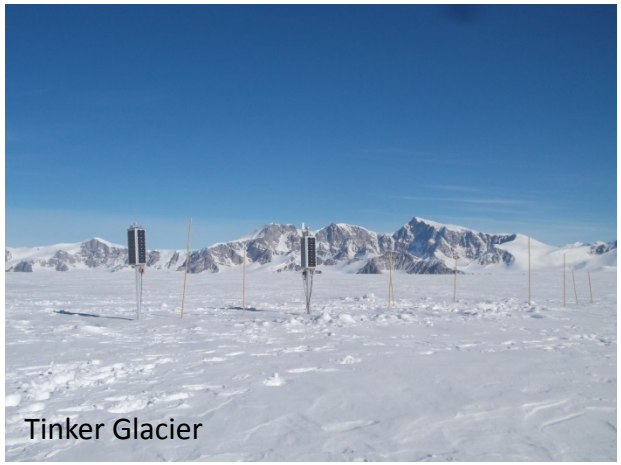
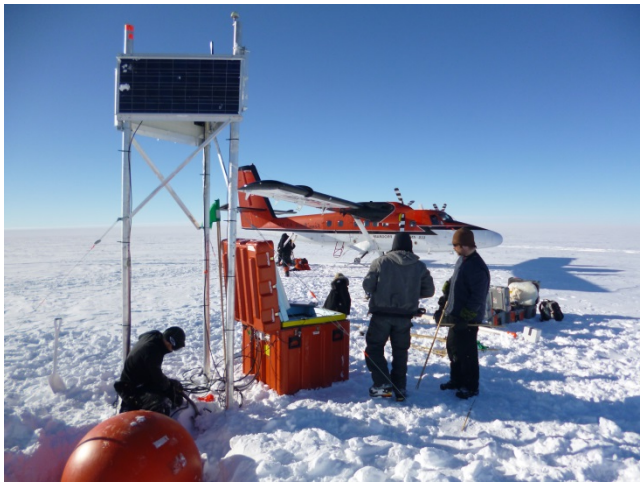
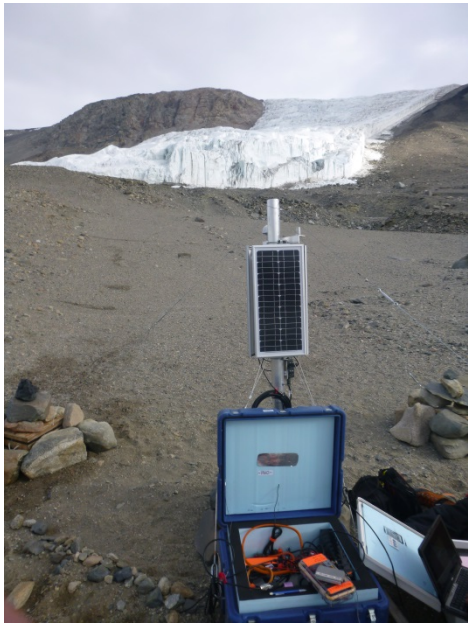
T-299, POLAR Group

- Technical Group – provides specific technical support to other events as needed
- Six, full time, employees
  - Two mechanical engineers, two electrical engineers, one systems engineer, one integration & testing seismologist
  - Rest of facility offers additional support and expertise including equipment testing & repair, shipping & logistics.
- Team spends ~16 months in the field each year, actual work hours spent is much higher ~34 months
- Heavy focus on engineering and development due to harsh nature of polar environments



Tinker Glacier





Blood Falls

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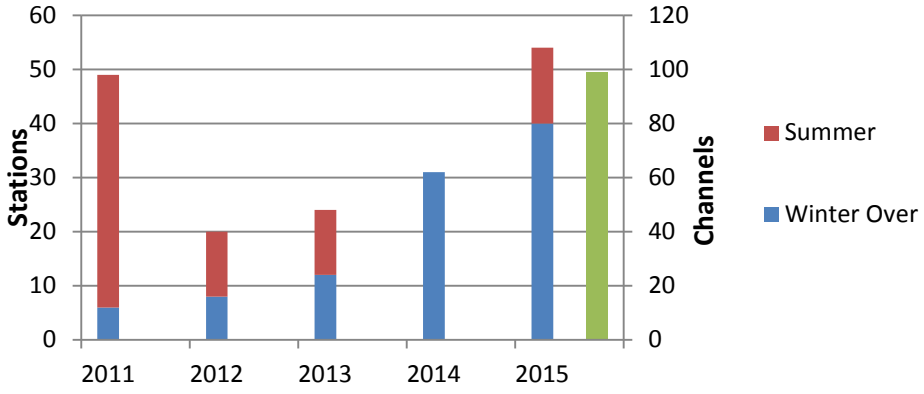
Polar Group Facilities in Socorro

Equipment & Lab Space

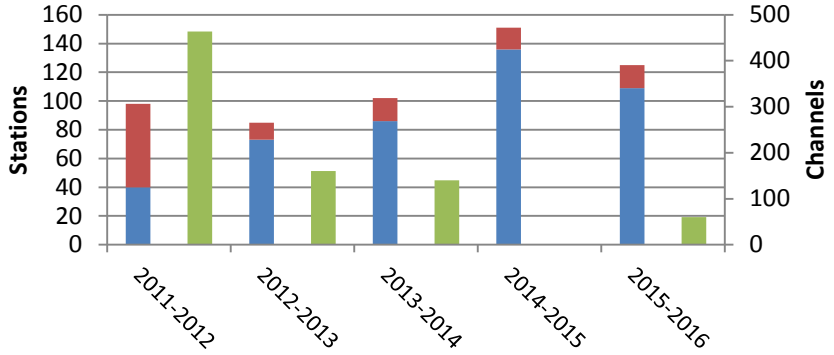
- Lab space for cold testing
  - Iridium & GPS antennas
  - Solar
  - FW and cold bench testing
  - R&D
- 2 Large cold chambers (32 ft^3 & 27 ft^3)
- 2 Smaller cold chambers (~2 ft^3, ~4 ft^3)
- 2 laboratory chest freezers (8.1 ft^3 & 10.6 ft^3)
  - Long term cold testing
- Polar Lab
  - Iridium & GPS antennas
  - Solar
  - FW and basic bench testing
  - R&D, Prototyping

Polar Seismic Demand

Arctic Seismic Stations & Channels



Antarctic Seismic Stations & Channels



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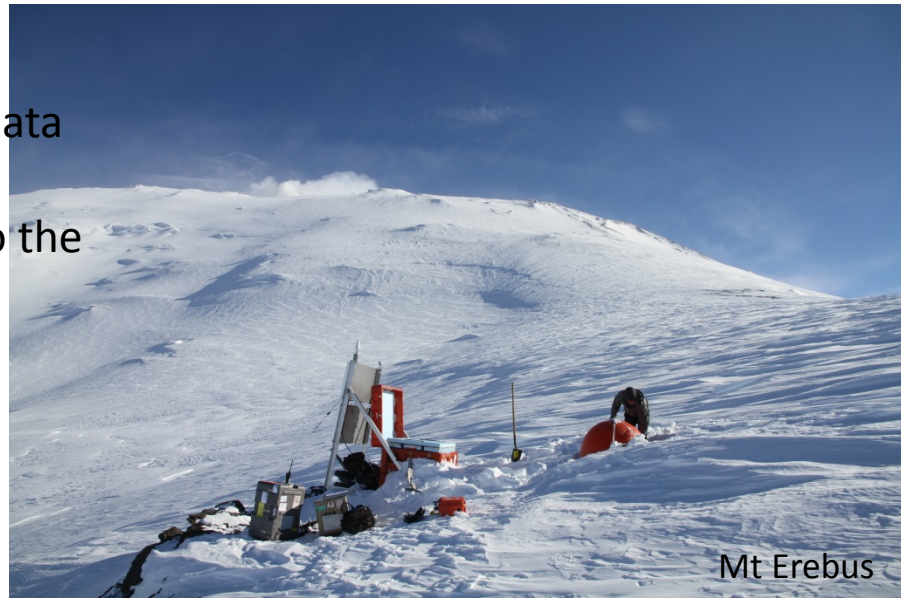
Equipment Support Process

- Researchers submit an equipment request & contact PASSCAL
- Iron out the details
- A letter of support is issued
- Project is funded
- Engineering and development support is offered as needed
- Equipment is prepared
- Equipment is shipped
- Trainings customized to the project are offered (typically in Socorro)
- Experiment begins
- PASSCAL staff assist with the deployment of the equipment as needed
- Data is gathered, PASSCAL assists with questions, problems and archiving of the data
- Equipment returned to PASSCAL
- Equipment is tested, repaired and put in to the warehouse
- Process starts over and equipment is redeployed!



Mt Erebus

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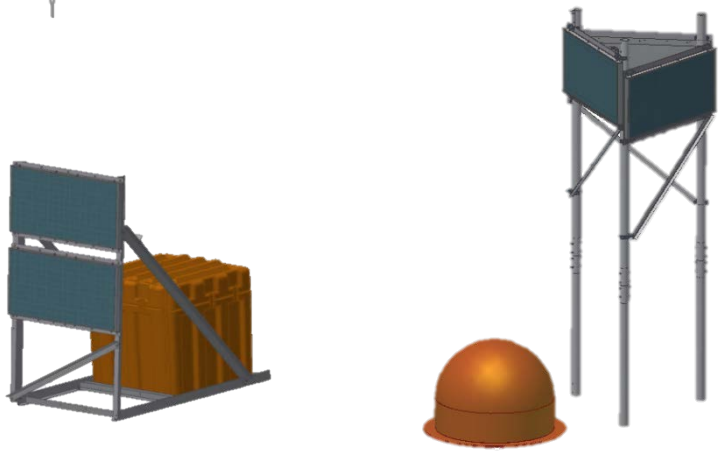
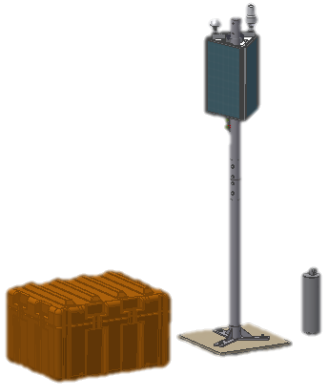
Station Examples



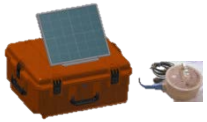
Long Term Extreme Cold Station

- AGM (or $LiFePO^4$) Batteries
- Heavily insulated enclosure
- Broadband Surface Seismometer in insulated vault
- Total weight ~1000 lbs
- 5-10 year battery life



2 year, Moderate Cold Station

- Lithium Primary batteries +1 small AGM
- Moderately insulated enclosure
- Direct bury broadband posthole seismometer
- Total weight ~250 lbs
- 2-3 year battery life



Summer Only Station

- 1 small AGM battery
- Lightly insulated enclosure
- Typically passive sensor
- Total weight ~75 lbs
- 1-2 week battery life

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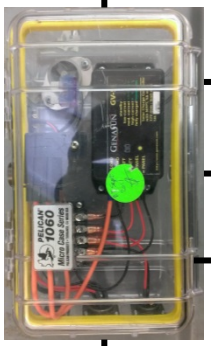
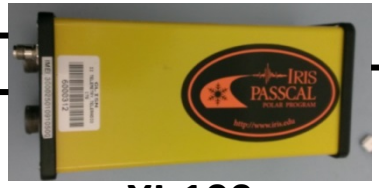
What is in a Seismic Station?

Sensor



Q330

Baler



XI-100

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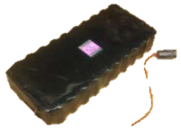
Power Storage






	$LiFePO_4$ Secondary	AGM Secondary	$Li\text{-}SOCl_2$ Primary	Air Alkaline Primary
Gravimetric Energy Density	37 Wh/lbs	21 Wh/lbs	311 Wh/lbs	200 Wh/lbs
Volumetric Energy Density	1.94 Wh/in^3	1.73 Wh/in^3	16.4 Wh/in^3	11.5 Wh/in^3
Cost	1.13 $/Wh	0.168 $/Wh	0.27 $/Wh	0.11 $/Wh
Type	Rechargeable	Rechargeable	Not rechargeable	Not rechargeable
Cold de-rate	Low	~50%	Low	High to Medium
Notes	• Very large number of charge cycles • Haz Cargo		• Haz cargo • Long lead time	• DC–DC Converter • Very temperature sensitive

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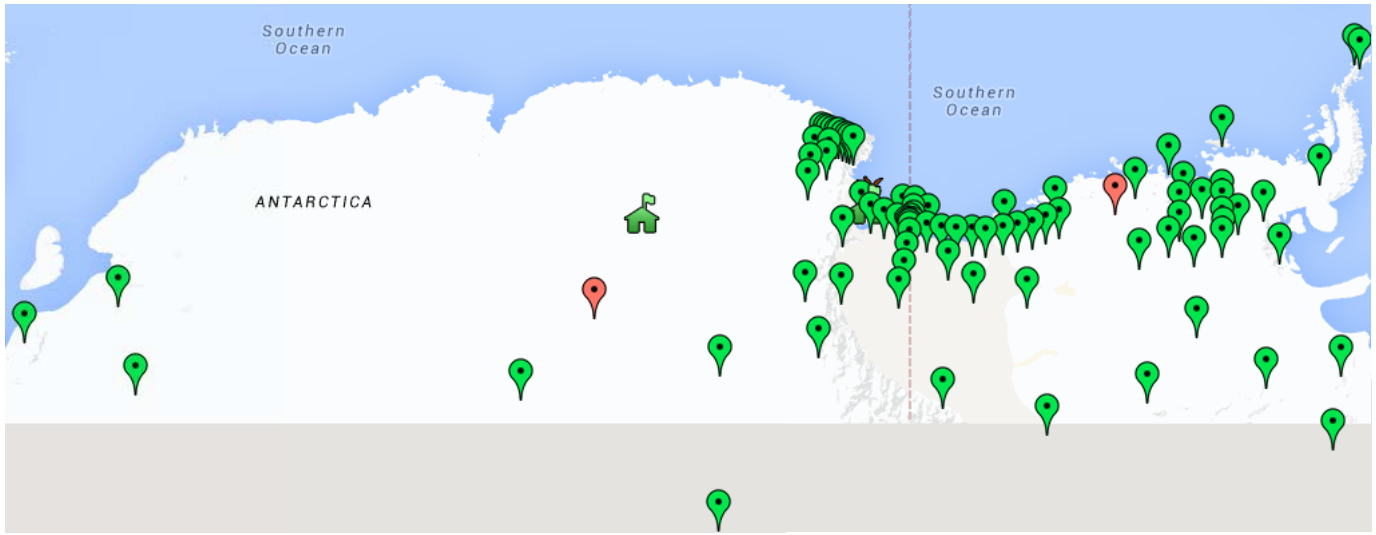
Current Polar Stations with Telemetry



133 Telemetered Stations

XI-202 – 68

XI-100 – 65 (13 with RUDICS)

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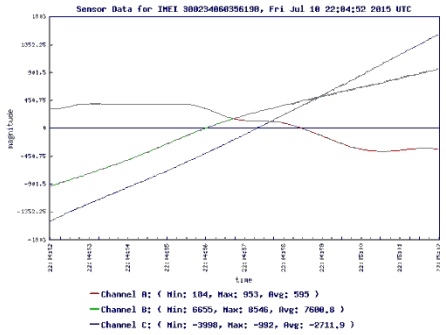
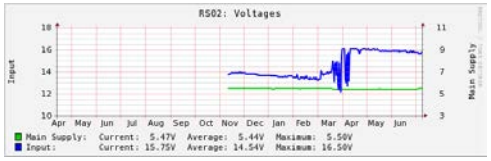
Station SOH User Interface

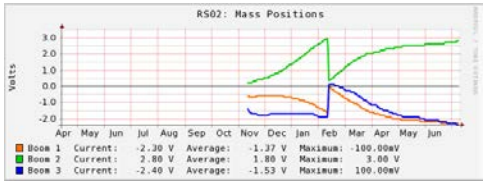
The Iridium Web Console

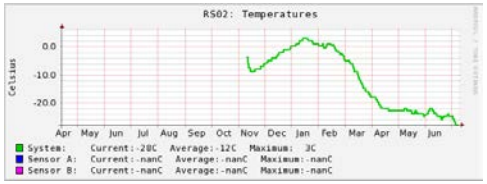
Effective and easy way for users to review station health.

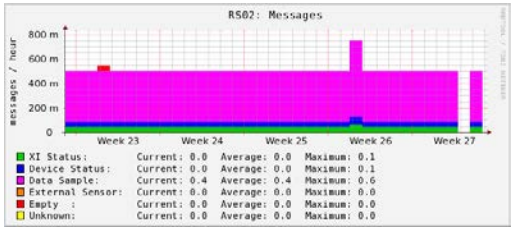
- Graphs of many core SOH metrics
- Graphs on station over view can be click on to view longer durations
- Tables with color coded values
- Data snips, 10s of 1 SPS seismic data
- Mineable database for 100s of other metrics











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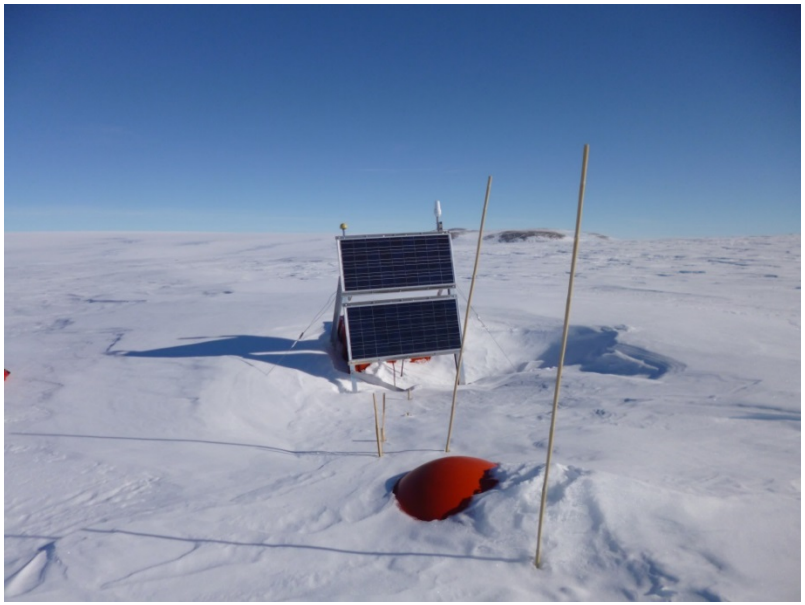
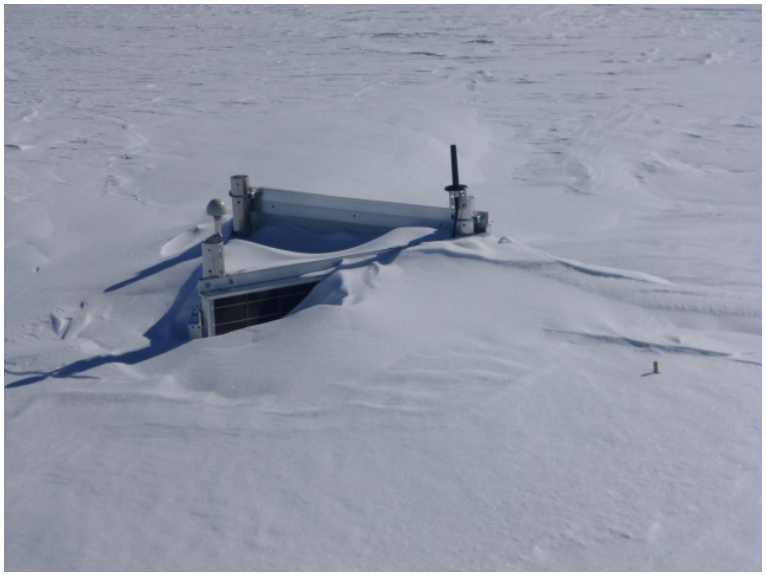
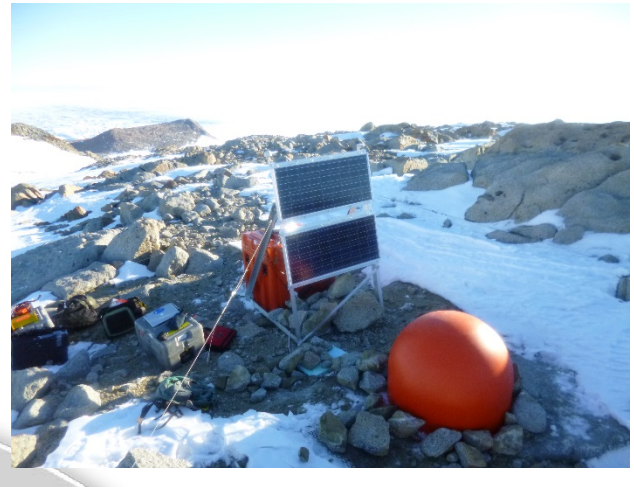
A typical day in the field - Pack up the equipment and travel to the station

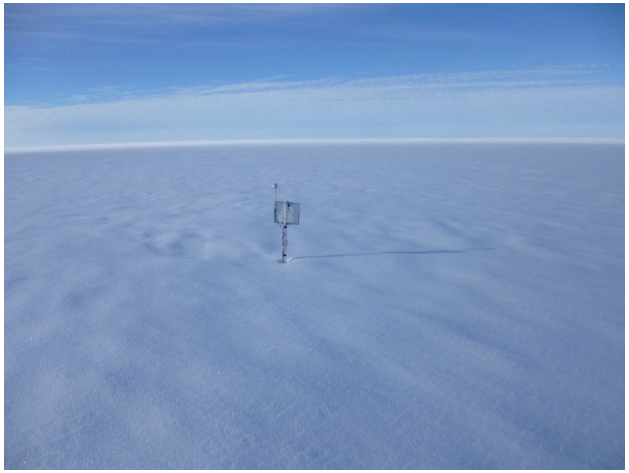
PASSCAL
POLAR PROGRAM

A typical day in the field - Assess the site









Pray for low accumulation and no wind!

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A typical day in the field – Dig!

IRIS PASSCAL POLAR PROGRAM

A typical day in the field – More digging!!

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A typical day in the field – Install or check the seismometer

Must be level, oriented to True North and placed on a stable base

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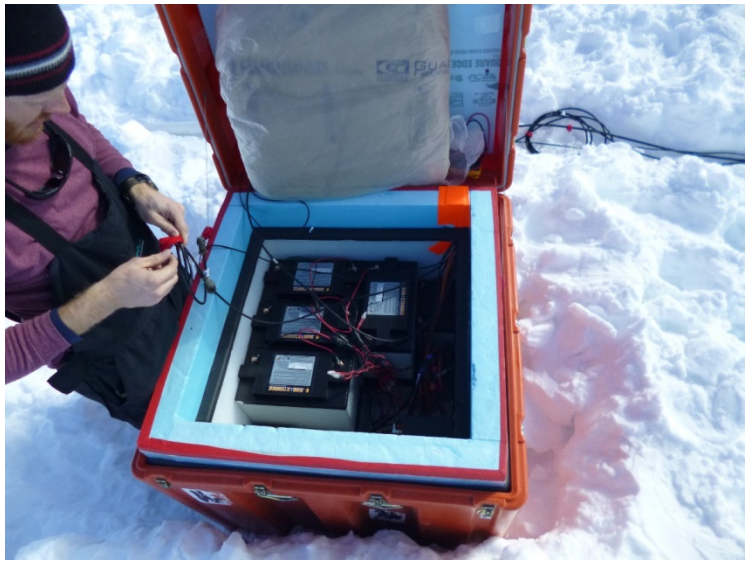
A typical day in the field – Install or check the electronics



Install or service the enclosure with batteries and data recording equipment. Recover data and document station status.

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A typical day in the field – Install or check solar and antennas

Install or inspect the solar panels, GPS and Iridium antennas

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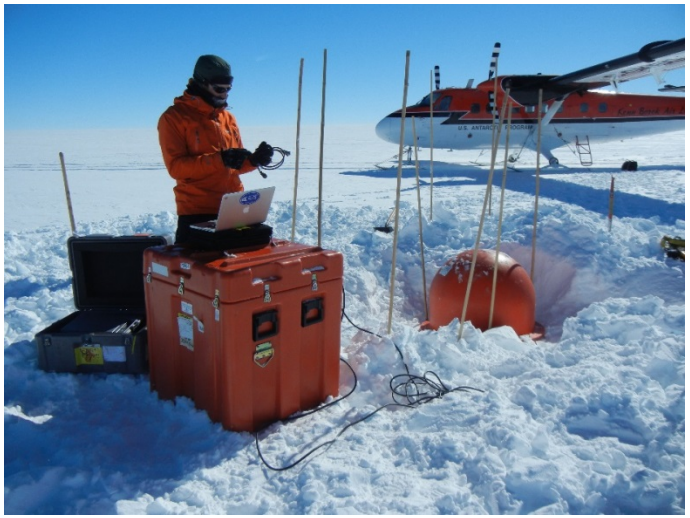
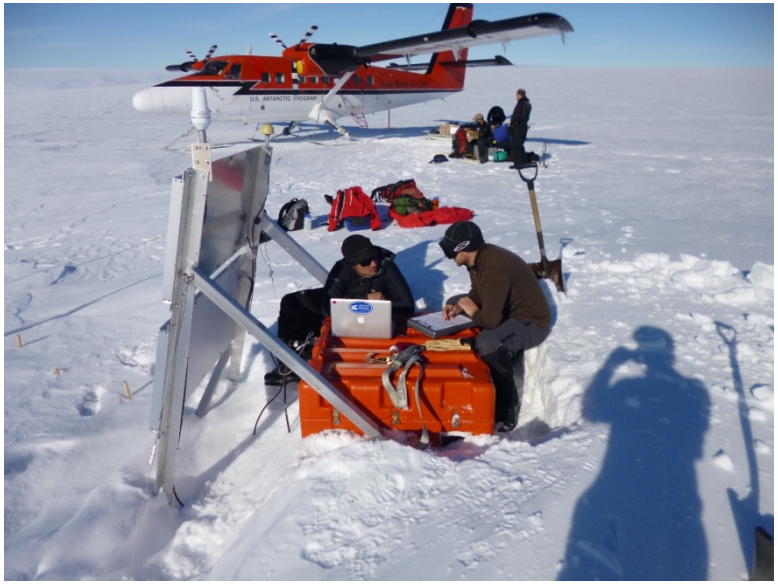
A typical day in the field – Checks, Notes and Photos





Double check everything is working!

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A typical day in the field – Pack up & head back

IRIS PASSCAL POLAR PROGRAM