Advances in Remote Seismic Station Technology

Polar Technology Conference 2015

IRIS PASSCAL POLAR PROGRAM

NEW MEXICO TECH
SCIENCE · ENGINEERING · RESEARCH · UNIVERSITY

NSF

Overview

- PASSCAL polar program overview
- Battery Testing Updates
- RUTUS tunnel software for RUDICS
- Next generation multiyear seismic station design and installation in Antarctica
- GeoIce MRI Project

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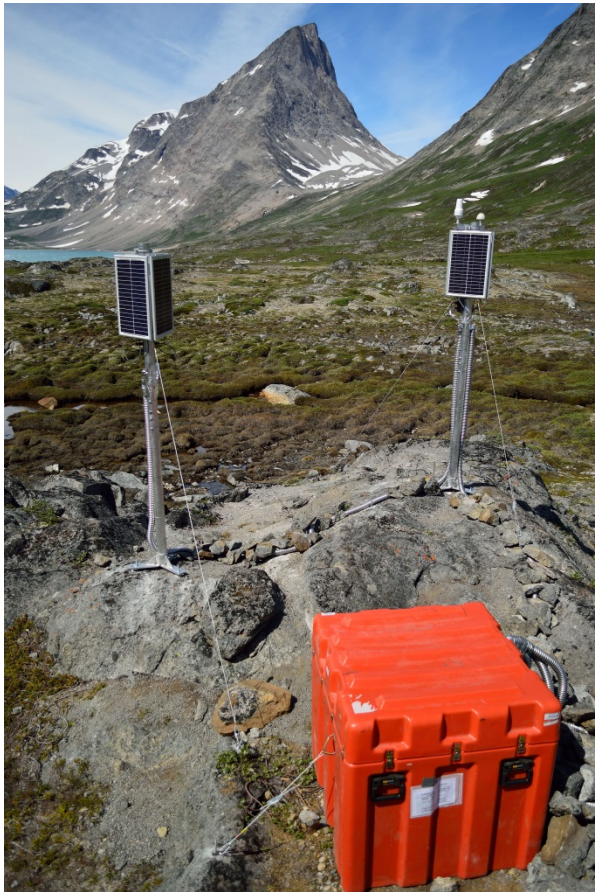
PASSCAL

Program for **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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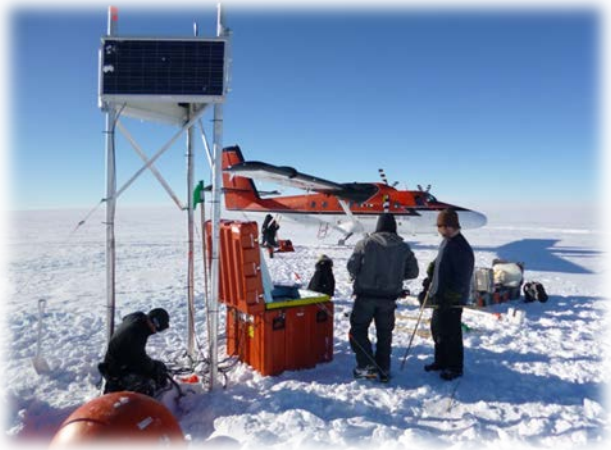
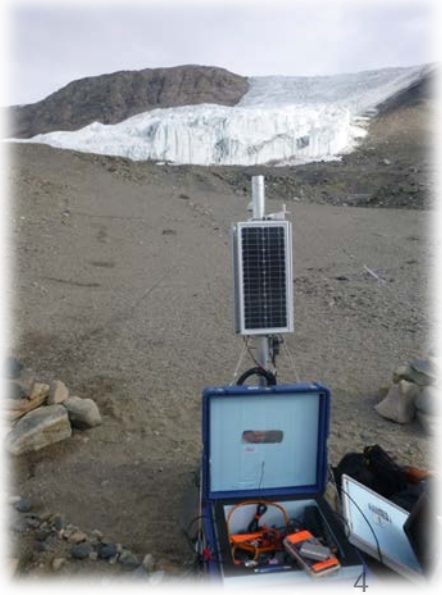
- Five full time employees support all PASSCAL polar experiments
- Team spends ~14 months in the field each year, actual man hours spent is much higher
- Heavy focus on engineering and development due to harsh nature of polar environments





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Battery Testing

1. Long Term AGM Testing:

- 108Ah SunExtender Battery discharged at -20°C and -30°C
- Resistive load discharged battery at C/5840 rate
  - Same rate batteries deployed at year round AGM station in Antarctica experience
- -20°C: 64% of nameplate capacity
- -30°C: 56.5% of nameplate capacity

2. Long Term LTC Testing:

- Test is currently running and should complete in two months
- -30°C test to verify battery performance for two year deployment station design and verify manufacturer's data.

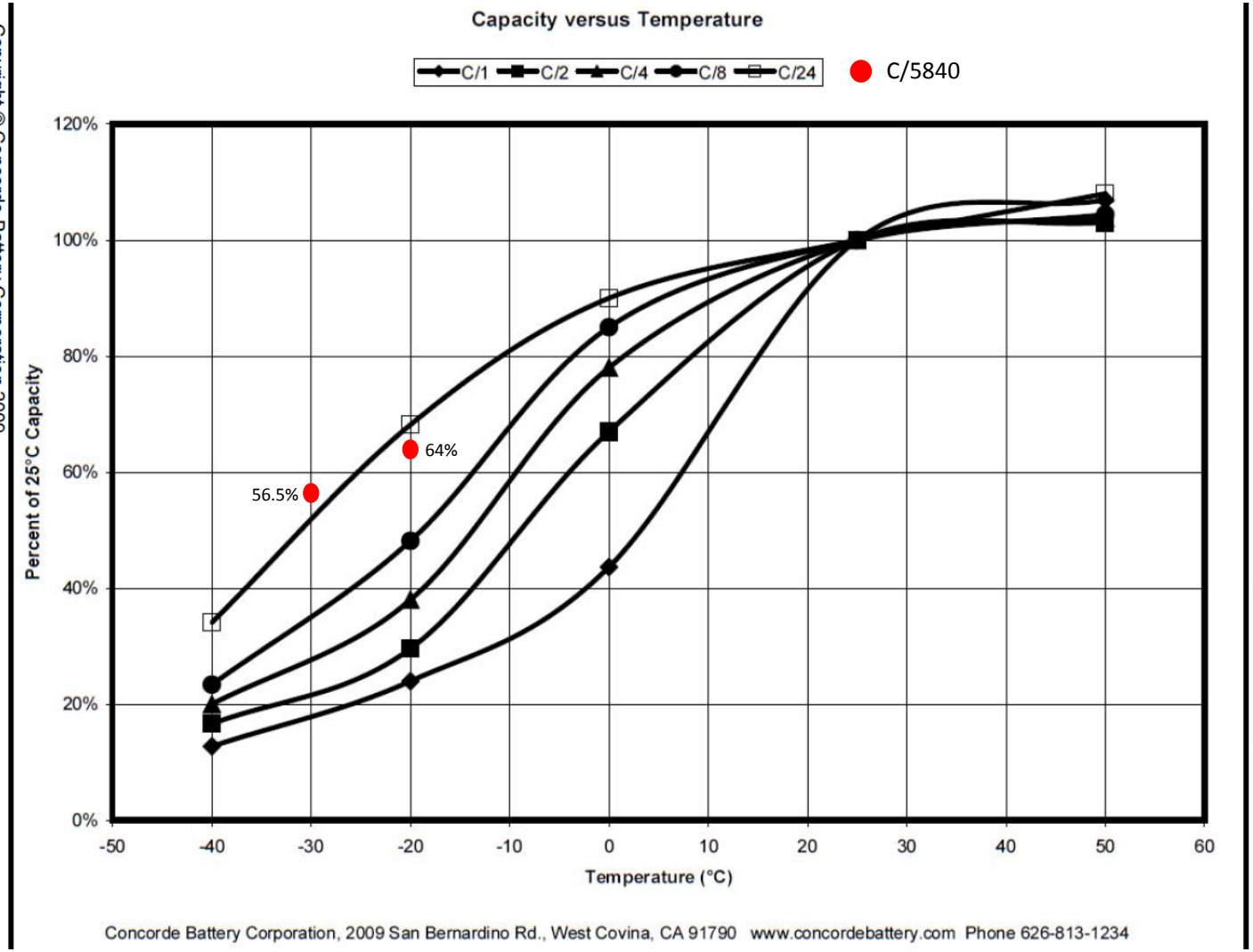
3. Air cell cold testing

- Planned test to characterize the performance of air cell batteries at cold temperatures (0°C to -30°C).
- Materials are purchased and test is scheduled to begin immediately

4. Rechargeable LiFePO4 battery testing

- No testing updates from last PTC. A written report of results is available, e-mail polar@passcal.nmt.edu for a copy
- Results of in field testing from the TA-Alaska project are expected soon

Battery Testing



SUNXTENDER ...the heart of your solar system®

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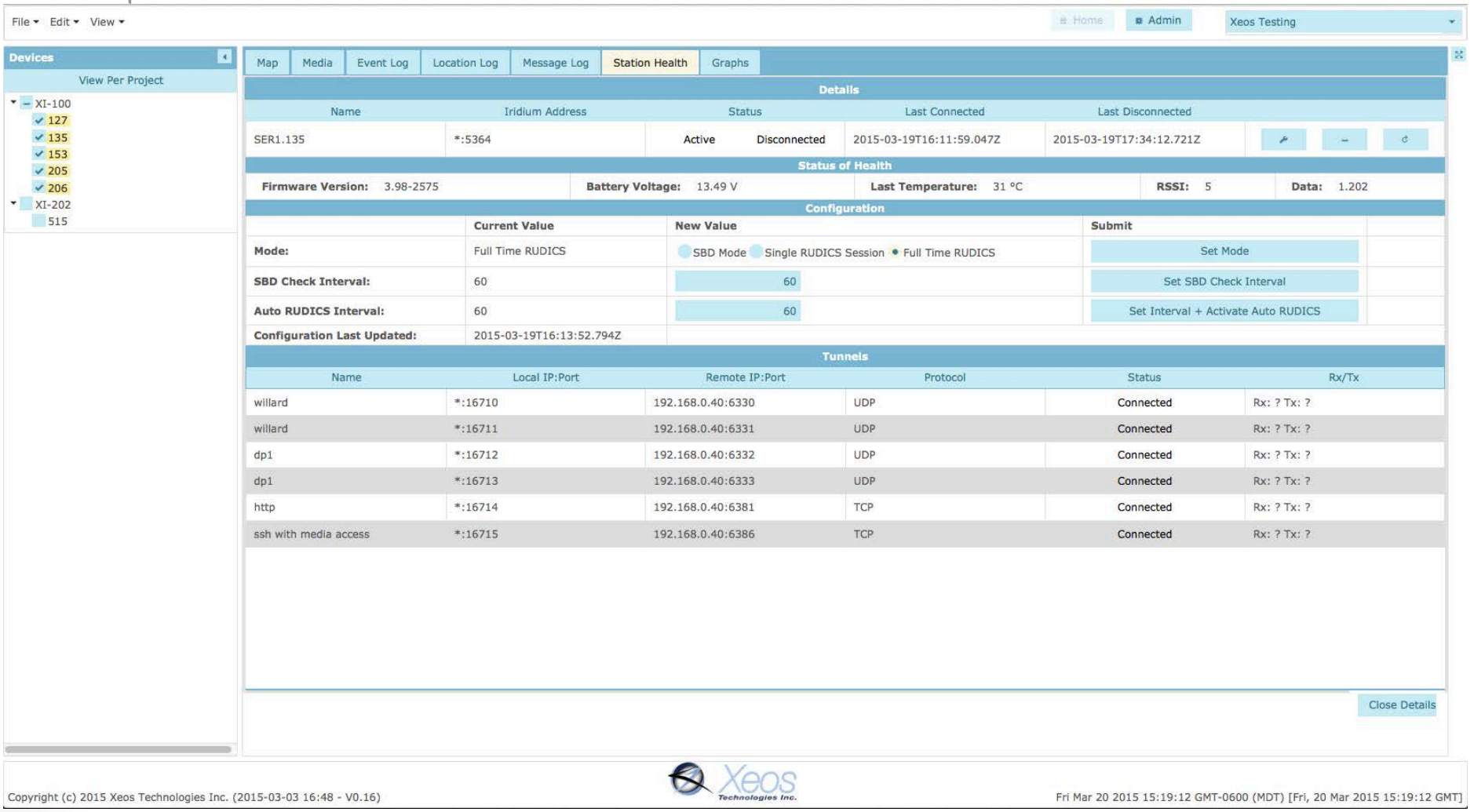
RUdics TUnnel Software (RUTUS)

- Web interface developed by Xeos Technologies Inc. to improve and ease the configuration, control and data throughput of Xeos modems.
  - Old tunnel developed as a prototype. Was slow to use, buggy and offered limited diagnostics.
- Template based configuration for SBD only and RUDICS enabled modems
- Improved data flow and efficiency
- Enhanced command and control of RUDICS including:
  - On/Off for temperature, voltage, data moved, and more!
- Logging of all incoming and outgoing messages and tunnel statistics. All data available for download and analysis
- RUTUS is an ongoing project. The concept and design is general and not specific to seismic data or PASSCAL. The hope is that other groups and facilities can make use of it.
- RUDICS use update:
  - Seven summer time RUDICS sites deployed in Greenland in the Summer of 2014
  - Eleven GLISN sites ran all year with RUDICS and 99% data recovery
    - All data is available to researchers in real time at the IRIS DMC
  - Duty cycled RUDICs development has led to significant power savings

RUdics TUnnel Software (RUTUS)



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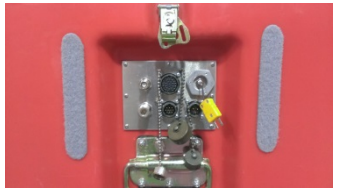
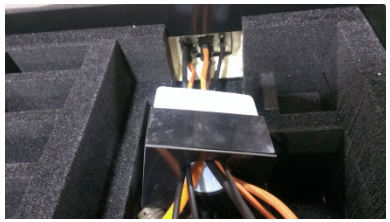
Next Generation Seismic Station





Next Generation Seismic Station

Design and Fabrication Process:

1. 3/18/2014 – Introduction of parties: Pelican, CaseTech, PASSCAL
2. 5/2/2014 – Initial PASSCAL design drawings sent to CaseTech
3. 5/22/2014 – Initial quote received from CaseTech
4. 6/3/2014 – Pelican visit and revised quote
5. 6/20/2014 – PO submitted to CaseTech
6. 6/25/2014 and 7/15/2014 – Design revisions
7. 8/1/2014 – First article of foam insert received at PASSCAL. Minor design modifications made
8. 9/15/2014 – First 36 full units ready at Pelican (PASSCAL visits to inspect and mount cables)
9. 10/1/2014 – Remaining 20 units ready at Pelican

Costs:

Off the shelf case: $600

Modified RIS Enclosure:

1-3	$1,743.00
4-9	$1,699.00
10-49	$1,584.70

Foam Liner:

1-3	$175.10
4-9	$161.65
10-49	$140.10

Tooling and setup charge: $1425.00

NRE Fees: $1235.00

Not included: Bulkhead plate with cables

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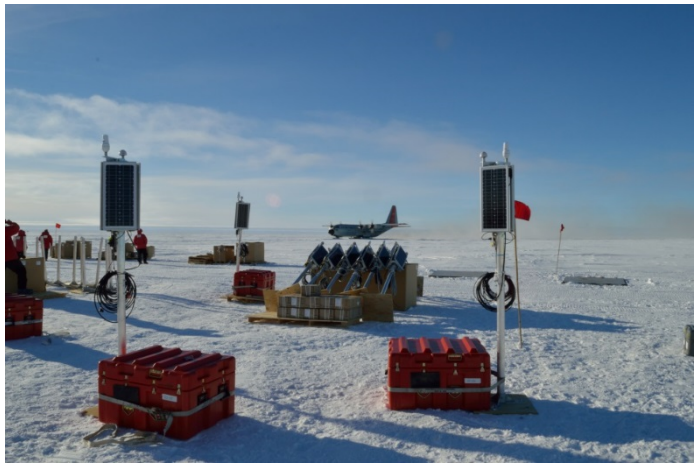
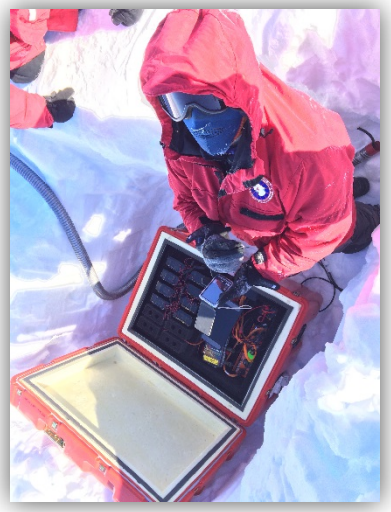
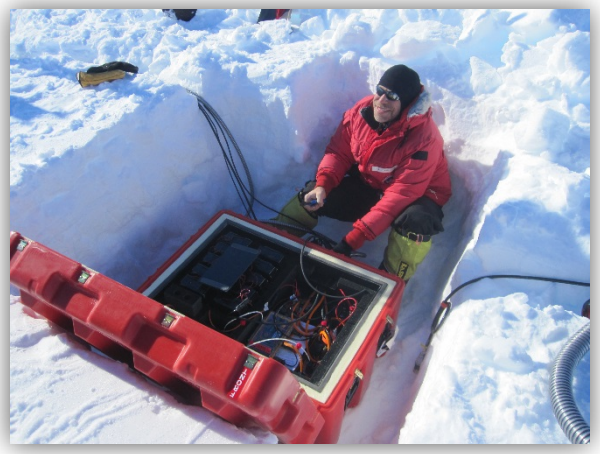
Next Generation Seismic Station

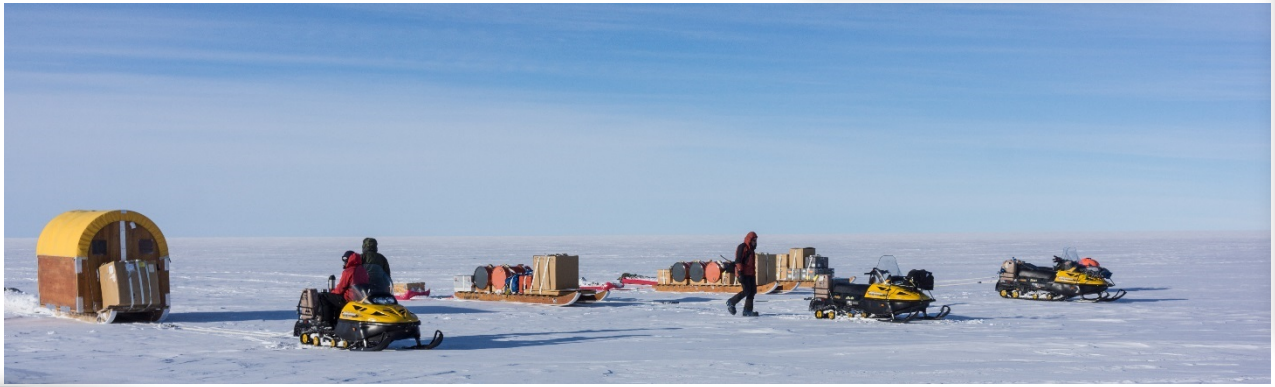
44 RIS Enclosure Systems installed in the 2014-2015 Antarctic Season

Benefits of system:









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GeoIce MRI

MRI – Partnership between Central Washington University and IRIS to develop new instrumentation specifically for polar regions. Will include a mixed phase array consisting of broadband and intermediate band seismometers complete with power systems and enclosures.

- Low power, both types integrate a digitizer and post hole seismometer for installation in snow/ice
- Environmentally sealed, built for limited and difficult logistics
- Improved tilt tolerance
- Target is 125 element array
- Two Nanometrics “All-in-one” units, a Meridian Compact, intermediate band instrument and a Meridian 120 broadband unit currently operating at South Pole SPRESSO site

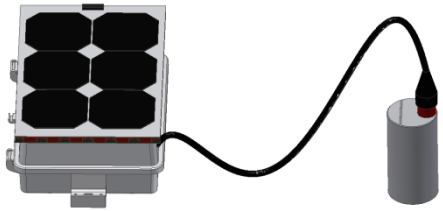
GeoIce MRI

Initial Station Design Concepts- Summer Only:

- 20Ah $LiFePO_4$ battery
- Custom high-efficiency, lightweight solar panel (Sunpower cells, 22% efficiency)
- Modular configurations for a variety of installation requirements
- Nanometrics Meridian Compact “All-in-one” sensor

Carbon Fiber “Dipod”

- Ultra-light, can be deployed on foot
- Solar and cabling raised to prevent drifting and animal damage
- 23.5lb total station weight



Box only

- Ground mounted for short deployments or sites where drifting/flooding is not a concern
- 21lb total station weight

Aluminum “Dipod”

- Can be deployed with or without supports
- 30.5lb total station weight

Plan to have prototype station testing this Summer!