Collaborative Research: Antarctic Automatic Weather Station Program: 2007-2010

An Annual Report to the Office of Polar Programs, National Science Foundation

Dr. Matthew A. Lazzara, Principal Investigator
Dr. John J. Cassano, co-Principal Investigator
Dr. Gregory J. Tripoli, co-Principal Investigator
George A. Weidner, co-Principal Investigator
Linda M. Keller, Shelley L. Knuth, Jonathan E. Thom - Meteorologists

Space Science and Engineering Center
Department of Atmospheric and Oceanic Sciences
University of Wisconsin-Madison

Department of Atmospheric and Oceanic Sciences
University of Colorado-Boulder

Submitted on August 15, 2008
Title:
Collaborative Research: Antarctic Automatic Weather Station Program: 2007-2010

Project Participants

Senior Personnel

Name: Lazzara, Matthew
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Matthew Lazzara as the Principal Investigator oversees the Automatic Weather Station program, including the coordination of activities and projects within the research group as well as with domestic and international collaborators. Data distribution, data processing and station climatology are some of the efforts he is involved in. He is also active with educational outreach efforts associated with the project.

Name: Tripoli, Gregory
Worked for more than 160 Hours: No
Contribution to Project:
Professor Greg Tripoli's effort in the project includes working with Shelley Knuth on snow accumulation studies as well as academic advisor for graduate student Lee Welhouse.

Name: Weidner, George
Worked for more than 160 Hours: Yes
Contribution to Project:
As co-Principal investigator, George Weidner's role includes assembly and fabrication of automatic weather station, repair and troubleshooting of electronic equipment, as well as installation and tower raise field work in Antarctica.

Name: Keller, Linda
Worked for more than 160 Hours: Yes
Contribution to Project:
The processing and quality control of observations from the automatic weather stations is a critical role executed by Linda Keller. She is also active in investigating Antarctic climatology using the AWS network.

Name: Knuth, Shelley
Worked for more than 160 Hours: Yes
Contribution to Project:
Shelley Knuth's primary activities include snow accumulation and precipitation studies at AWS sites as well as assisting with AWS installations and tower raise efforts in the field. She is also active in educational outreach efforts, as she was the primary contact and the lead for our participation in the PolarTrec project.

Name: Thom, Jonathan
Worked for more than 160 Hours: Yes
Contribution to Project:
Jonathan Thom's role in the project includes the fabrication, installation, repair and raising of automatic weather stations. He also develops and maintains the AWS decoding processing software as well as participates in educational outreach activities for the project.
Name: Stearns, Charles

Worked for more than 160 Hours: No

Contribution to Project:
Dr. Charles Stearns, as the prior Principal Investigator of the automatic weather station project, serves as a consultant on the current effort.

Post-doc

Graduate Student

Name: Welhouse, Lee

Worked for more than 160 Hours: No

Contribution to Project:
Lee Welhouse joins the project as a graduate student. He will be focusing on studies related to the monitoring of El Nino Southern Oscillation via the automatic weather station network.

Undergraduate Student

Name: Asuma, Jonas

Worked for more than 160 Hours: No

Contribution to Project:
Jonas Asuma is an undergraduate student, working on the web page and other data distribution effort that are a part of the project. He also conducted a historical review and literature survey of El Nino/Southern Oscillation connections to the Antarctic.

Name: Bushnell, Amanda

Worked for more than 160 Hours: No

Contribution to Project:
Amanda Bushnell, an undergraduate student, has assisted the project with minor clerical work.

Technician, Programmer

Name: Batzli, Samuel

Worked for more than 160 Hours: No

Contribution to Project:
Samuel Batzli has aided the project with the generation of the maps that summarize the automatic weather station project utilizing GIS tools.

Other Participant

Name: Tucker, Camillia

Worked for more than 160 Hours: No

Contribution to Project:
Camie Tucker has assisted with the AWS project with minor clerical work.

Research Experience for Undergraduates

University of Colorado-Boulder

Organizational Partners
**Other Collaborators or Contacts**

US Collaborators:
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John Cassano - co-PI of the project at the University of Colorado-Boulder

David Holland (New York University) and Robert Bindschadler (NASA/Goddard Space Flight Center) - Pine Island Glacier AWS

International Collaborators:
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Institut polaire francais Paul Emile Victor (IPEV)

Programma Nazionale di Ricercle in Antarctide (PNRA)

Chinese Academy of Meteorological Sciences/Chinese Meteorological Administration

Latitudinal Gradient Project (LGP)/Antarctica New Zealand

British Antarctic Survey (BAS)

**Activities and Findings**

**Research and Education Activities: (See PDF version submitted by PI at the end of the report)**

Research Activities (Sept 2007 to August 2008):
----------------------------------------------

Field Season activities to repair, update and raise automatic weather stations (AWS).
(Please see attached field season activity presentation).

Estimation of snow accumulation at AWS sites and snow pit verification.

Collaborated with University of Colorado-Boulder on the continued development and improvement of semi-automated automatic weather station quality control software.

Data processing, distribution, quality control and archive of AWS observations.

Long term climatology efforts started for a selection of elemental AWS sites, including routine CLIMAT message generation.

Historical review and literature survey of El Nino/Southern Oscillation and the Antarctic.

Conferences:
-------------

European Geophysical Union meeting, Vienna, Austria, April, 2008 (Knuth)

- Presentation on snow accumulation (Knuth)

Space Based Precipitation Measurements, Steamboat Springs, CO, April 2008 (Knuth)

- Presentation on snow accumulation (Knuth)
Antarctic Meteorological Observations, Modeling and Forecasting Workshop, Madison, WI
June 2008 (Asuma, Keller, Knuth, Lazzara, Stearns, Thom, Weidner, Welhouse)

- Presentation on AWS Field season (Weidner)
- Presentation on Williams Field AWS test site (Thom)
- Presentation on overview of the AWS program (Lazzara)
- Presentation on AWS measurement sampling (Weidner)
- AWS Network Future (Weidner and Lazzara)

Biennial Scientific Committee on Antarctic Research (SCAR) Conference, St. Petersburg, Russia July 2008 (Knuth)

- Presentation on the AWS project (Knuth)
- Poster on snow accumulation (Knuth)

Findings: (See PDF version submitted by PI at the end of the report)
See attached table of the US AWS network and map of all (US and other nations) AWS sites in the Antarctic (updated as of early summer 2008).

Training and Development:
* Working with new AWS platforms, and training for additional team members including collaborators at the University of Colorado-Boulder.

Outreach Activities:
* Participation in the PolarTrec Program during the 2007-2008 field season with Kirk Beckendorff, middle school teacher from Blanco, Texas.

* Special outreach project with Pittsfield, Wisconsin Elementary school (Jelly Bear Outreach Project).

* Additional outreach activities, joint with the Antarctic Meteorological Research Center:
  - Grandparents University, University of Wisconsin-Madison (July 2008)
  - Atmospheric, Earth and Space Sciences Workshop for High School Students, University of Wisconsin-Madison (July 2008)
  - SSEC Building Tours (misc. dates)
  - Lodi Middle School, Lodi, Wisconsin (January 2008)
  - MidWest Severe Storm Tracking and Response Center, Inc., Monona, Wisconsin (January 2008)

Journal Publications


Books or Other One-time Publications
Web/Internet Site

URL(s):
http://amrc.ssec.wisc.edu ftp://amrc.ssec.wisc.edu
http://ice.ssec.wisc.edu ftp://ice.ssec.wisc.edu

Description:
These web and FTP sites host real-time and archived AWS observations, related metadata, maps and other historical and background information. These sites are shared with AWS's sister project, the Antarctic Meteorological Research Center (AMRC).

Other Specific Products

Product Type:
Data or databases

Product Description:
Meteorological observations from the Automatic Weather Stations (AWS) include measurements of temperature, wind speed, wind direction, atmospheric pressure, relative humidity and, in some cases, snow temperature profiles, water temperature, relative snow accumulation, and temperature differences from the top to the bottom of the AWS tower. These observations are made available in a 10 minute gross error checked format, as well as 3 hourly fully quality controlled format. Additional quality controlled formats at 10 minutes, 1 hour and 3 hours have recently started to be made available.

Sharing Information:
Observations from the AWS sites are made available via the following avenues:

1. Real-time:
   - Web Site
   - FTP Site
   - GTS
   - McIDAS ADDE Server
   - Antarctic-IDD

2. Archive:
   - Web Site
   - FTP Site
   - Metadata via DIF with the Antarctic Master Directory at NSIDC and NASA Global Master Directory
   - Data book covering an annual year of AWS summaries

Contributions

Contributions within Discipline:
The automatic weather station program offers a valuable resource for the larger meteorological and atmospheric sciences. These observations cover a significant portion of the Antarctic, and are utilized by the larger community (e.g. NCAR/NCEP reanalysis). The availability of new formatted quality controlled 10 minute, 1 hourly and 3 hourly data sets will increase value to the community.

Contributions to Other Disciplines:

Contributions to Human Resource Development:
Funds from this project will be used to support an MS graduate student (Lee Welhouse) in the
Department of Atmospheric and Oceanic Sciences at the University of Wisconsin-Madison. His efforts here will utilize the AWS observations for ENSO studies, analyzing them in conjunction with other data sets, performing Antarctic field work, as well as presenting and publishing the results in peer reviewed literature.

This project has also partially supported an undergraduate student (Jonas Asuma) in the Department of Atmospheric and Ocean Sciences at the University of Wisconsin-Madison in assisting with the AWS data collection, climatological summaries, etc.

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements: None
Change in Objectives or Scope: None
Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Book
Contributions: To Any Other Disciplines
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering
Title:
Collaborative Research: Antarctic Automatic Weather Station Program: 2007-2010

Project Participants

Senior Personnel
Name: Cassano, John
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc
Name: Seefeldt, Mark
Worked for more than 160 Hours: No
Contribution to Project:

Graduate Student
Name: Richards, Melissa
Worked for more than 160 Hours: Yes
Contribution to Project:

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

University of Wisconsin-Madison

Other Collaborators or Contacts
Matthew Lazarra - lead PI of project at University of Wisconsin

Activities and Findings

Research and Education Activities:
Research activities
Sept 2007 to June 2008

Purchase and setup of new Linux workstation to serve as University of Colorado node on Antarctic LDM network

Development of semi-automated automatic weather station quality control software

Contribute chapter on Antarctic climate and weather to 'Antarctica - Global Science from a Frozen Continent'

Analysis of low-level wind field over the Ross Ice Shelf based on Antarctic Mesoscale Prediction System and AWS data

Comparison of global reanalysis cyclone climatologies for the Southern Ocean with a cyclone climatology derived from a high-resolution regional atmospheric model (Antarctic Mesoscale Prediction System)

Conferences attended / presentations

Antarctic Meteorology, Observations, Modeling, and Forecasting Workshop, Madison, WI, June 2008 (Cassano, Richards, Seefeldt)

Cassano, J.J. and M.W. Seefeldt: Comparison of AMPS MM5 and AMPS WRF Forecasts Using Self-Organizing Maps (oral presentation)

Cassano, J.J. and M.W. Seefeldt: Development and Evaluation of Polar WRF (oral presentation)

Seefeldt, M.W. and J.J. Cassano: A Description of the Ross Ice Shelf Air Stream (RAS) Through the Use of Self-Organizing Maps (oral presentation)

Atmospheric Observation Panel for Climate (AOPC-XIV), Geneva, Switzerland, April 2008

Cassano, J.J.: Atmospheric Observations in Polar Regions (invited oral presentation)

Oden Southern Ocean Workshop, Lejondals Slott, Sweden, Feb 2008 (Cassano)

Findings:
Sept 2007 - June 2008

The analysis of the low-level wind field over the Ross Ice Shelf identified three low level jets in this area. Two of these jets are located in well known katabatic prone regions (near Byrd Glacier and at Terra Nova Bay) while the third low-level jet is located over the southern portion of the Ross Ice shelf adjacent to the Transantarctic Mountains. These low-level jets were identified based on Antarctic Mesoscale Prediction System output and the details of these jets still require observational validation.

Training and Development:

Melissa Richards is a first year graduate student in the Department of Atmospheric and Oceanic Sciences at the University of Colorado, and will be supported as a graduate research assistant on this project starting in fall 2009. Ms. Richards' research will focus on an analysis of the mesoscale atmospheric features in the vicinity of Terra Nova Bay. A secondary research focus will be on evaluating Antarctic Mesoscale Prediction System (AMPS) forecasts. Ms. Richards will take part in the 2008/09 AWS field season, thereby gaining experience in polar fieldwork.

Outreach Activities:
The University of Colorado PI (John Cassano) has contributed a chapter on Antarctic weather and climate to the book 'Antarctica - Science From a Frozen Continent' (in preparation). This book is aimed at a general audience, with the goal of bringing Antarctic science to the public. This book is being prepared as part of the International Polar Year.

Journal Publications


Books or Other One-time Publications

Editor(s): David W. H. Walton
Bibliography: Thames and Hudson

Web/Internet Site

Other Specific Products

Product Type:
Software (or netware)
Product Description:
Semi-automated AWS data quality control program
Sharing Information:
This software has been provided to our collaborators at the University of Wisconsin and has been implemented as part of their AWS quality control procedure.

Contributions within Discipline:
The research activities of this project have contributed to an improved understanding of synoptic and mesoscale atmospheric processes in the Antarctic. Specifically we have several papers in press and in preparation that describe the details of the low level wind field over the Ross Ice Shelf and describe the synoptic climatology of cyclones over the Southern Ocean.

Contributions to Other Disciplines:

Contributions to Human Resource Development:
Funds from this project will be used to support a PhD student (Melissa Richards) in the Department of Atmospheric and Oceanic Sciences at the University of Colorado. Ms. Richards will gain experience in analyzing observational and model based data, performing Antarctic field work, presenting results of her research at national and international conferences, and publishing her research results in the peer reviewed literature.

Contributions to Resources for Research and Education:
A new Linux workstation was purchased using funds from this project. This workstation will serve as the University of Colorado node on the Antarctic LDM network and will also provide computational resources for project participants at the University of Colorado.

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements: None
Change in Objectives or Scope: None
Animal, Human Subjects, Biohazards: None
Categories for which nothing is reported:

Any Web/Internet Site
Contributions: To Any Other Disciplines
Contributions: To Any Beyond Science and Engineering
Overview of the Antarctic Automatic Weather Station Project


University of Wisconsin-Madison

J.J. Cassano

University of Colorado-Boulder

Siple Dome AWS
Outline

- The Team
- History
- Specifications
- Applications
- Data
- International Collaborations

South Pole - Clean Air AWS
The Team

Linda Keller
Matthew Lazzara
Charles Stearns
George Weidner
Jonas Asuma
John Cassano
Jonathan Thom
Shelley Knuth
Greg Tripoli
AWS History

- Stanford University Radio Science Lab
  - Late 1970s
  - Key developments:
    - Low power electronics (Pioneer Spacecraft)
    - Satellite communications (Nimbus-7)

AWS Versions

- AWS I (nimbus)
- AWS II (RTG), IIB, IIC, etc.
- AWS COTS:
  - AWS-10x
  - AWS-1000

- University of Wisconsin-Madison
  - Assumed stewardship
  - Meteorological focus
(Courtesy of Maurice Gibbs)
AWS Specifications

* 1300 Watt-Hours power used all year long (power used to run a 60 watt light bulb for ~1 day!)

* Able to send data via satellite DCS ARGOS

* Small memory storage needs: Current AWS uses 256 bytes

Built for extreme cold

Port Martin AWS 1994
<table>
<thead>
<tr>
<th>Variable</th>
<th>Sensor</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure</td>
<td>Paroscientific Model 215 A</td>
<td>Range: 0 to 1100 hPa Resolution: 0.050 hPa Accuracy: +/- 0.2 hPa/year long term drift (0.2 hPa/year minimum)</td>
</tr>
<tr>
<td>Air Temperature</td>
<td>Weed PRT Two-wire bridge</td>
<td>Range: -100°C minimum Resolution: 0.125°C Accuracy: +/- 0.5°C Fuji 17 July 1996 *Lowest Recorded is 85.2°C at Dome</td>
</tr>
<tr>
<td>Humidity</td>
<td>Vaisala HMP-35A (and other models)</td>
<td>Range: 0 to 100% Resolution: 1.0% Accuracy: +/- 5.0% down to -55°C Corrections possible for lower temperatures</td>
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<td>Wind Direction</td>
<td>10 K Ohm pot.</td>
<td>Range: 0 to 355 Degrees Resolution: 1.5 Degrees Accuracy: +/- 3.0 Degrees</td>
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<tr>
<td>Wind Speed</td>
<td>Bendix/Belfort RM Young Hydro-Tech</td>
<td>Resolution/Accuracy: 0.25 +/- 0.5 m/s Resolution/Accuracy: 0.20 +/- 0.5 m/s Resolution/Accuracy: 0.33 +/- 2% *Maximum speed along Adelie Coast ~50 m/s</td>
</tr>
<tr>
<td>Temperature</td>
<td>Thermocouple Two junction Copper-Cons.</td>
<td>Resolution: 0.06°C Accuracy: +/- 0.125°C</td>
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</table>

**AWS Sensor Specifications**
Past:
- Barrier and Katabatic wind studies
- Mesoscale circulations
- Sensible and latent heat flux studies
- Southern Ocean GLOBEC
- Long Term Ecological Research
- Weather forecasting
- Research on Ocean-Atmosphere Variability and Ecosystem Response in the Ross Sea
- West Antarctic Ice Sheet Initiative and International Trans-Antarctic Scientific Expedition
- And more...

AWS Applications

Current:
- Long term climatology
- Antarctic ENSO studies
- Precipitation/snow accumulation studies
- RAS near surface wind field
- Boundary Layer Studies
- Weather forecasting
- And more...
Real time
- Ground Stations:
  - HRPT
    - McMurdo Station
    - Palmer Station
  - GAC
    - Gilmore Creek, AK
    - Wallops Island, VA
- Two stage processing:
  - SSEC Desktop Ingestor
    - Signal to DCS hex
  - AWS DCS decoder
    - DCS Hex to ASCII science values
  - Only gross error checked
- Data distribution:
  - Antarctic-IDD
  - ADDE, FTP, Web
  - GTS
- All AWS (and AGO)

Data Flow

Archival
- CD CLS America (Argos) to Wisconsin
  - Last month available
    - ~15th of this month
  - All AWS
    - Gross error checked only
    - .r format (ASCII)
  - CLIMAT AWS
    - Complete QC
      - .r, .dat, .q10, .q1h, .q3h (ASCII)
    - Future - netCDF
  - Wisconsin AWS only
The Data: Quality Control

Methodology

- Real time
  - Only gross error checked
- Archive
  - 10 minute (.r format) only gross error checked
  - 3 hourly (.dat format) full quality control
- Joint Machine-Manual QC mix:
  - Software M.W. Seefeldt
    - Lost time saving to increasing AWS to process

New Data Formats

- QC’ed (all ASCII)
  - 10 minute
  - 1 hourly
  - 3 hourly
    - New format!
- Recently available!
  - CLIMAT AWS station
    - Start April 2007 -
- All AWS sites:
  - Start Oct 2001 -
- Future formats
  - netCDF
  - BUFR?
CLIMAT Message Project

- World Meteorological Organization (WMO)
  - Monthly Climatology Summary
- AWS CLIMAT:
  - "Real-time" from Ferrell, Marble Point, Dome C II, Byrd, Siple Dome, Gill, Possession Island
  - This primarily list to be re-reviewed - NSF/NOAA-NCDC/WMO/UW

- Delivery:
  - NOAA TG
    - Via E-mail
  - Start date: 2006/7
  - AMRC FTP (soon)
- Future:
  - Will do more
  - (As resources allow)

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International Collaborations

- France
- United Kingdom
- Japan
- China

D-80 AWS

Relay Station AWS

Uranus Glacier AWS
Acknowledgements

Thank you to Office of Polar Programs
National Science Foundation OPP-0338147 and ANT-0636873
Thank you to all AWS collaborators and AWS users!

Laurie II AWS
AWS Field Season 2007-2008

3rd AMOMFW Meeting
June 9-12, 2008
University of Wisconsin – Madison
2007/2008 UW Field Team

- George Weidner
- Jonathan Thom
- Shelley Knuth
- Jonas Asuma
- Kirk Beckendorf (PolarTREC)
- Jelly the Bear
- Short timer – John Cassano
AWS schematic
AWS field work summary

- **Station**
- Cape Hallet
- Cape Bird
- Laurie II
- Ferrell
- Windless Bight
- Pegasus South
- Pegasus North
- Mount Fleming
- Mount Friis
- Willy Field
- Brianna
- Theresa
- Swithinbank
- Kominko-Slade (WAIS)
- Nico
- Henry
- Schwerdtfeger
- Mary
- Carolyn
- Penguin Point
- Cape Denison
- Port Martin
- D-10
- D-66
- D-85
- Peninsula AWS
- M83
- Relay Station
- JASE2007 site
- Panda South

- **Action taken**
- Sensors updated and Argos transmitter installed (Thomas Nylen, UNAVCO)
- Wind sensor replaced (O-283)
- Wind sensor replaced (O-283)
- ADG data downloaded (O-283)
- ADG serviced /snow pit (O-283)
- New batteries installed (O-283)
- New wind sensor installed (O-283)
- New tower mount and wind sensor installed (O-283)
- Pressure sensor installed (O-283)
- Test AWS installed with Iridium, test AWS with temperature shields (O-283)
- AWS rebooted (O-283) and batteries added (O-283)
- Tower raised, batteries added and AWS rebooted (O-283)
- New AWS electronics installed (O-283)
- AWS repaired and rebooted (O-283)
- Tower raised and new batteries installed (O-283)
- Tower raised and new batteries installed (O-283), rebooted (Brian*, Simon*)
- Tower raised and new AWS electronics installed, snow pit (O-283)
- Tower raised, snow pit (O-283)
- New wind sensor installed, ADG added, snow pit (O-283)
- AWS removed (IPEV)
- AWS rebooted, new wind sensor installed (Mawson’s Hut restoration team**)
- AWS serviced (IPEV)
- New AWS installed with ADG (IPEV)
- New AWS installed (IPEV)
- New AWS installed (IPEV)
- All sites visited by BAS personnel and data downloaded from storage modules
- New AWS installed (BAS)
- New AWS installed (JARE)
- New AWS installed (JARE)
- New AWS Installed (China)

* Twin Otter pilots Brian and Simon

** Tony Stewart and Peter Morse
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<th>OLD/Status</th>
<th>NEW/Action</th>
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<th>Long.</th>
<th>Alt. (m)</th>
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<td>146.18oE</td>
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_**Adelie Coast Table**_
Adelie Coast AWS Map
Cape Denison AWS

Wind Speed sensor replaced
New antenna installed and
AWS rebooted by
Tony Stewart
Peter Morse

through

Rob Easther
Expedition Manager
Mawson's Huts Foundation, Australia
IPEV RAID
Route
New sites
D85: 70 deg 25.550 min S
134 deg 08.784 min E

D66A: 68 deg 54.700 min S
134 deg 39.300 min E
Penguin Point AWS removed by IPEV field team
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K-S AWS at installation in January 2006
AWS repair at WAIS Divide
Theresa AWS
part two
## Ross Island Sites

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Mt Fleming

Wind system damaged

Wind system replaced

AWS tower rebuilt
Mt Fleming repaired
AWS at Friis Hills

* added pressure sensor and updated program
View from Friis Hills
Cape Hallet AWS

* Sensors replaced
* Argos Transmitter added
* Software updated

Thomas Nylen
UNAVCO
## Ross Ice Shelf Sites

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Carolyn AWS

- Wind sensor replaced
- ADG installed
Shelley in one of her snow pits
Mary Site on arrival
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AWS2B 1983 – present
AWS CR10X

version
CR1000 based AWS
Work delayed until 2008/2009

- Ross Ice Shelf locations for Installations at Roosevelt Island and South Ross Ice Shelf will be determined at a later date.

1. Roosevelt Island may require a fuel depot / refueling depot depending on location relative to Roosevelt Island.

2. The South Ross Ice Shelf site may be located at the refueling site used to reach POLENET sites last season. This will be determined at our AWS meeting in early June. Hence, this AWS could be deployed via a ship of opportunity with a flight to the refueling site by some other program. Current other proposed locations are at for an AWS on the southern part of the Ross Ice Shelf:

85.00 deg S, 150 deg W
84.25 deg S, 170 deg W (this site could be located where the S. Pole traverse route crosses 170 W, making it accessible from the traverse for future servicing).

- Megadunes AWS servicing:

  1. Current proposed work at the Megadunes site is to retrieve the non working AWS 2516, the recording AWS located between AWS 2516 and 2769, and service as necessary AWS 2769.

  2. Two O-283 team members (possibly one O283 and one Mountaineer).
Table 1: AWS for 2008. An ‘@’ in the ‘Altitude’ column indicates a location obtained from UNAVCO GPS. A red line indicates a site visit in 2007/2008. Blue sites were not visited as planned.

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<th>ARGOS ID</th>
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