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

A Report to the Office of Polar Programs, National Science Foundation

Dr. Matthew A. Lazzara, Principal Investigator and Meteorologist
Mr. George Weidner, co-Principal Investigator
Dr. Greg Tripoli, co-Principal Investigator
Dr. John J. Cassano, co-Principal Investigator

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

Department of Atmospheric and Oceanic Sciences
University of Colorado at Boulder

Submitted on August 25, 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. In addition, he is assisting in directly the research and logistic activities of the group, including graduate and undergraduate students.

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 design, installation and tower raise field work in Antarctica. In addition, he is working on the design, engineering, and fabrication of the tall tower AWS that is a part of this project. Diagnosing and analyzing AWS observations to confirm the quality of the observations considering electronic and meteorological factors is part of his activities on the project.

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 PolaFtrec 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. He is also overseeing the application, programming and development of the CR-1000 AWS systems for use in the Antarctic, and testing alternative communications systems for the AWS.

**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.

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**Post-doc**

**Graduate Student**

**Name:** Welhouse, Lee  
**Worked for more than 160 Hours:** Yes  

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

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**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.

**Name:** Czeskleba, Julie  
**Worked for more than 160 Hours:** No  

**Contribution to Project:**
Julie has assisted the AWS project with miscellaneous clerical support.

**Name:** Oswalt, Jacqueline  
**Worked for more than 160 Hours:** No  

**Contribution to Project:**
Jacqueline has aided the AWS project with some accounting tasks.

**Name:** Minier, Julia  
**Worked for more than 160 Hours:** No  

**Contribution to Project:**
Julia has assisted the AWS project with miscellaneous clerical support.

**Name:** Rasmussen, David  
**Worked for more than 160 Hours:** Yes  

**Contribution to Project:**
DJ has worked on a variety of tasks working with the AWS web page, AWS meta data, and recovery and restoration of historical AWS observations.

Name: Schroeder, Nicole

Worked for more than 160 Hours: Yes

Contribution to Project:
Nicole has worked on AWS data distribution and preparations for assisting the AWS project for the 2009-2010 field season. She has also deployed to Antarctica for the 2009-2010 field season to assist with AWS servicing in the field.

Name: Hau, Hoklan

Worked for more than 160 Hours: No

Contribution to Project:
Hoklan has provided technical computing support to the AWS project, especially with computer maintenance, etc.

Name: Uttech, Zach

Worked for more than 160 Hours: No

Contribution to Project:
Zach contributed to the AWS project analyzing AWS observations to ascertain when some sensor observations (specifically wind direction) went out of specification at a few AWS sites impacted by faulting sensor mounting.

Technician, Programmer

Name: Batzli, Samuel

Worked for more than 160 Hours: Yes

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. He is also prototyping an GIS enable relational database system for improved organization of AWS data and metadata.

Name: Bellon, Willard (Bill)

Worked for more than 160 Hours: No

Contribution to Project:
Bill is overseeing the re-casting of the AWS web page to better provide AWS data and information to the community.

Name: Laland, John

Worked for more than 160 Hours: No

Contribution to Project:
John has provided technical computing support to the AWS project, especially with computer maintenance, etc.

Name: Putman, Lee

Worked for more than 160 Hours: No

Contribution to Project:
Lee has provided the AWS project hardware fabrication support - created components used on the AWS systems - mounting structures, sensor boom fixtures, etc.

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
Organizational Partners

University of Colorado-Boulder
The University of Colorado-Boulder/John Cassano's polar meteorology group collaborate directly with the AWS project with help during field season activities, provided the quality control (QC) software used to QC the AWS observations, and will be working on research activity(s) together.

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 Ricerche in Antartide (PNRA)
Japanese Antarctic Research Expedition (JARE)
Chinese Academy of Meteorological Sciences/Chinese Meteorological Administration/Chinese Arctic and Antarctic Administration (CAAA)
Latitudinal Gradient Project (LGP)/Antarctica New Zealand
British Antarctic Survey (BAS)
Mawson's Hut Foundation, Australia

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)
Research Activities (September 2007 to August 2008):
-----------------------------------------------

Field Season activities to repair, update and raise automatic weather stations (AWS).
(please see field season activity presentation in attached file).
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 2007-2008:

European Geophysical Union meeting, Vienna, Austria, April, 2008 (Knuth)
- Presentation on snow accumulation (Knuth)
- Base Precipitation Measurements, Steamboat Springs, CO, April 2008 (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)

Research Activities (September 2008 to July 2009):

Field season activities this year included the installation of two new AWS sites, and repair & raise other AWS sites. Approximately one third of the network was visited. Please see field report in the Activities attached file as well as an overview in the attached findings file.

Data processing, distribution, quality control and archive of AWS observations were an ongoing activity through the year. Efforts included collaborating with the University of Colorado on AWS quality control efforts and other possible collaborators.

Studies of snow accumulation, precipitation and blowing snow using the AWS network sites equipped with Acoustic Depth Gauges (ADG) resulted in the submission of a paper for peer reviewed publication. Episodic snow accumulation events, which are a combination of precipitation events, blowing, and drifting snow events, were analyzed at seven sites. This effort more clearly defined the challenges with observing precipitation and blowing snow, but also defined some of the first short-term systematic climatology information of this kind for the Ross Ice Shelf, Ross Island and Ross Sea regions.

Previous analysis of the ENSO interactions in the Antarctic used seasonal changes, and trends, in temperature and pressure fields to establish a correlation between SOI and these fields. Expanding on this work, we have begun to analyze the AWS observations to determine the spatial extent of these trends in temperature, and pressure correlations, as well as analyze characteristics of the wind flow to determine how far inland these correlations extend. Our analysis will be two-pronged - analyzing temperature and pressure trends around a large portion of the Antarctic, with an emphasis on West...
Antarctica (known to be the center of the impact of ENSO in the Antarctic); and studying the flow pattern changes into the Ross Ice Shelf embayment as well as flow pattern changes around the whole Antarctic continent. We will also include the phase relationship between the Southern Annular Mode (SAM) and ENSO, as recent studies have shown SAM to modulate the effects of ENSO at higher latitudes.

Conferences for 2008-2009:


Presentation at the EGU meeting, in Vienna, Austria, April, 2009 (by Jonathan Thom):


Presentation at the Polar Technology conference, in Madison, Wisconsin, April 2009 (by George Weidner):


Presentations/Poster at the AMS Polar Meteorology and Oceanography, in Madison, Wisconsin, May 2009 (by Matthew Lazzara and Shelley Knuth):


Matthew A. Lazzara, Antarctic Meteorological Research Center/ Univ. of Wisconsin, Madison, WI; and S. Hook, 2009: Bringing Antarctic atmospheric research into the middle school classroom. The Antarctic automatic weather station network: a status report. Tenth Conference on Polar Meteorology and Oceanography, 18-21 May, Madison, WI.


Presentations at the Antarctic Meteorological Observational, Modeling and Forecasting Workshop, in Charleston, South Carolina, July 2009 (by Matthew Lazzara):

MOMFW meeting Charleston, SC.

M.A. Lazzara, G.A. Weidner, J.E. Thom, L.M. Keller, and J.J. Cassano, 2009; Antarctic automatic weather station program: Future plans and discussions. 4th AMOMFW meeting, Charleston, SC.

Research Activities (August 2009 to July 2010):

WS field season activities continued this year, with the visit of 14 AWS sites between UW staff and collaborators. No new stations were installed; however, the installation of 3 new AWS in West Antarctica and the tall tower AWS 100 miles South of McMurdo were attempted, but did not succeed due to weather and other logistical constraints.

Data processing, distribution, quality control and archive of AWS observations persist as an on-going activity through the year. Efforts included continued collaboration with the university of Colorado on AWS quality control efforts.

Research efforts focused on the studies of El Nino Southern Oscillation on the surface of Antarctica as seen via temperature and pressure measurements from the AWS and extended by numerical model reanalysis.

Climatology of 2009 was conducted for the entire AWS network, and the results published the Bulletin of the American Meteorological Society's State of the Climate issue.

Conferences 2009-2010:

5th Antarctic Meteorological Observation, Modeling and Forecasting Workshop in Columbus, OH

- Presentation on the 2009-2010 AWS field season (M. Lazzara)
- Presentation on 2010-2011 AWS field plans (J. Thom)
- Presentation on 30 years of AWS in Antarctica (G. Weidner)
- Tribute to Charles R. Stearns (M. Lazzara and G. Weidner)
- Presentation on high wind events in the McMurdo Area (D. Rasmussen)

Solar Technology Conference, Boulder, CO.

- Presentation on the AWS program (M. Lazzara)

Findings: (See PDF version submitted by PI at the end of the report)

Snow accumulation studies:

Torts have studied the snow accumulation at seven AWS sites on the Ross Ice Shelf, Ross Island and Ross Sea region of Antarctica for a 22 month period, providing the first automated observations in this region and providing a look at the complex contributions of precipitation, blowing snow and drifting snow make to snow accumulations at the sites. Blowing snow and drifting snow made a near equal and majority contribution to accumulation while precipitation and unknown processes make up the remainder of the...
Surface Effects of El Nino Southern Oscillation (ENSO):

Studies on the impact of El Nino and La Nino events on the surface temperature and pressure patterns over Antarctica have been conducted using reanalysis datasets, with comparisons to the AWS network. Though the values vary considerably, during the strongest ENSO periods, we note significant warming (cooling) over much of the continent primarily focused in the East Antarctic during El Nino (La Nina) events. Significant high pressure anomalies are found during El Nino events focused in the Amundsen-Bellingshausen Sea regions, and extending to the Ross Ice Shelf and the Antarctic Peninsula. During La Nina events low pressure anomalies are evident throughout the continent.

AWS usage in Reanalyses:

While researching the ENSO signals via reanalysis datasets, it has been discovered that several years of numerical model reanalysis did not use AWS observations, likely impacting the results of the reanalysis. This finding is still being explored and more fully characterized.

2009 AWS State of the Climate Highlights:

Record high mean temperatures for April 2009 were found at Gill AWS - 10 degrees C higher than the long term mean. Ferrell AWS also recorded a 6.3 degree C higher than the long term mean, with December seeing a record high value of -4.5 degrees C for a mean temperature. Byrd AWS was warmer than normal in July, August, November and December; while Dome C II AWS was 7.2 degrees C above the long term mean in July. Possession Island also had a record mean temperature of -17.0 degrees C for the month of July. Record high mean wind speeds were found at Gill AWS and Marble Point AWS - both in April. Higher than normal mean monthly pressure were observed at Byrd AWS in April, July, August and November, but no records set. Record high mean pressures were seen at Possession Island AWS for May and August - 7.5 hPa and 6.5 hPa respectively higher than normal.

Training and Development:

2007-2008:

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

2008-2009:

* Working with Wisconsin graduate and undergraduate students on the AWS platforms as they will be a part of the 2009-2010 field team.

2009-2010:

* Continued working with the Wisconsin graduate student (Lee Welhouse) on the AWS
Outreach Activities:

---.07-2008:

* Participation in the PolarTrec Program during the 2007-2008 field season with Kirk Eckendorff, 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)

---.08-2009:

* Special project with the Lodi Area Middle School (See reference to poster at the AMS solar meteorology and oceanography meeting)

* AWS outreach is cooperatively done with this effort's sister project, the Antarctic Meteorological Research Center:

General Public:

* SSEC Public Tours, UW-Madison, Madison, WI (multiple tours, including University of Wisconsin Science Expeditions/Open House)
  - E-mails answering questions, offering information or providing data to students and the general public including special reports to classrooms and the general public during field deployments.
  - Mount Horeb Public Library, Mount Horeb, WI
  - Wednesday Night at the Lab, UW-Madison, Madison, WI
* Mount Horeb Cub Scouts, Mount Horeb, WI
* West Madison Cub Scouts, Madison, WI
* MidWest Severe Storm Tracking and Response Center, Inc., Monona, WI
* Wisconsin State Fair, West Allis, WI
* Deerfield Cub Scouts, Deerfield, WI (2 visits)
  - University of the Air, Wisconsin Public Radio, Madison, WI

University/College:

* Madison Area Technical College, Madison, WI (multiple-visits)

Middle School:

* Lodi Middle School, Lodi, WI (3 visits)
* Waunakee Intermediate School Family Science Night, Waunakee, WI

Elementary School:

* Deerfield Elementary School, Deerfield, WI (3 visits)
* Sheboygan, WI (Elementary School)
* Pittsville, WI (Elementary School)
* Lincoln Elementary School, Madison, WI

Preschool:

* UW Preschool Lab

McMurdo Station:

Wednesday Night Science Lecture (2 seasons)
Sunday Night Science Lecture

2009-2010:

AWS outreach exclusively is in conjunction with AWS's sister project, Antarctic Meteorological Research Center:

* Madison West Rotary Club, Madison, WI
* SSEC Public Tours, UW-Madison, Madison, WI (over 2 dozen tour groups)
* Deerfield Middle School, Deerfield, WI
* E-mail contacts with the public and Antarctic community
* Deerfield Elementary School, Deerfield, WI
* CIMSS/WSGC workshop, UW-Madison, WI
* Presentation at Deerfield Lutheran Church, Deerfield, WI
* Interview - Channel 15 WMTV - Madison, WI
* Grandparents University, UW-Madison, Madison, WI

Journal Publications


Books or Other One-time Publications

Web/Internet Site

RL(s):
tp://amrc.ssec.wisc.edu ftp://amrc.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 hourly fully quality controlled format. Additional quality controlled formats at 10 minutes, 1 hour and 3 hours have recently started to be made available.

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

Real-time:
Web Site
FTP Site
TS
..clDAS ADDE Server
Antarctic-IDD

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 of meteorological
information for the 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, verification of the Antarctic Mesoscale Prediction System (AMPS) modeling system). The availability of new formatted quality controlled 10 minute, 1 hourly and 3 hourly data sets will increase value to the community.

Here are a selected list of publications in the community that utilize AWS observations:


Contributions to Other Disciplines:

AWS observations are utilized by other disciplines including those in the glaciology community (especially efforts by investigators in the WAIS area), and the oceanography community.

Contributions to Human Resource Development:

Funds from this project are 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 utilize the AWS observations for ENSO studies, analyzing them in conjunction with other data sets and performing Antarctic field work, as well as presenting at conferences and publishing the results in peer reviewed literature.

This project has also partially supported an undergraduate student (Jonas Asuma, Nicole Schroeder, DJ Rasmussen, Zach Uttech) 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:
The AWS project provides the opportunity for the AWS observations to be utilized in educational settings (Lazzara and Hook, 2009). Equipment and tools to maintain the assembly and fabrication of AWS equipment are a part of this effort. Additionally, computational resources are available from this project to support the activities of project members.

Contributions Beyond Science and Engineering:

Conference Proceedings

Special Requirements

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

Categories for which nothing is reported:
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
Outline

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

South Pole - Clean Air AWS
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

* Able to send data via satellite DCS ARGOS

* Small memory storage needs: Current AWS uses 256 bytes

* Built for extreme cold

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

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<th>Variable</th>
<th>Sensor</th>
<th>Specifications</th>
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| Air Pressure   | Paroscientific Model 215 A      | Range: 0 to 1100 hPa  
Resolution: 0.050 hPa  
Accuracy: +/- 0.2 hPa  
(0.2 hPa/year long term drift) |
| Air Temperature| Weed PRT Two-wire bridge        | Range: to -100 C minimum  
Resolution: 0.125 C  
Accuracy: +/- 0.5 C  
* Lowest Recorded is -85.2 C at Dome Fuji 17 July 1996 |
| Humidity       | Vaisala HMP-35A (and other models) | Range: 0 to 100%  
Resolution: 1.0 %  
Accuracy: +/- 5.0 % down to -55 C  
Corrections possible for lower temperatures |
| Wind Direction | 10 K Ohm pot.                   | Range: 0 to 355 Degrees  
Resolution: 1.5 Degrees  
Accuracy: +/- 3.0 Degrees |
| Wind Speed     | Bendix/Belfort RM Young Hydro-Tech | 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 |
| Temperature String | Thermocouple Two junction Copper-Cons. | Resolution: 0.06 C  
Accuracy: +/- 0.125 C |
**AWS Applications**

**Past:**
- Barrier and Katabatic wind studies
- Mesoscale circulations studies
- Sensible and latent heat flux studies
- Southern Ocean GLOBEC

**Current:**
- Long term climatology
- Antarctic ENSO studies
- Precipitation/snow accumulation studies
- RAS near surface wind field
- Boundary Layer Studies
- Weather forecasting
- West Antarctic Ice Sheet Initiative and International Trans-Antarctic Scientific Expedition

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

Uranus Glacier AWS

D-80 AWS

Relay Station 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
Antarctic Automatic Weather Station Program: 2008-2009 Field Season Overview

Matthew A. Lazzara¹, George A. Weidner², Jonathan E. Thom¹, Shelley L. Knuth¹, ³, John J. Cassano³, and Melissa A. Richards³

¹Antarctic Meteorological Research Center, Space Science and Engineering Center
²Department of Atmospheric and Oceanic Sciences
³University of Wisconsin-Madison

Sabrina AWS
AWS Field Team

From Left to Right:

Ms. Melissa Richards
CU – ATOC

Dr. John Cassano
CU – ATOC

Dr. Matthew Lazzara
UW – AMRC/SSEC

Ms. Shelley Knuth
UW – AMRC/SSEC & CU – ATOC

Mr. Jonathan Thom
UW – AMRC/SSEC
AWS Field Work Summary

October-November Field Team

- Minna Bluff AWS: Oct 31
- Linda AWS: Oct 31
- Ferrell AWS: Nov 3
- Lorne AWS: Nov 4
- Williams Field Test AWS: Nov 7
- Margaret AWS: Nov 12

* Institut Polaire Francais – Paul Emile Victor (IPEV) Support
  - D-10 AWS
  - E-66 AWS
  - D-85 AWS

* Mawson's Huts Foundation Support
  - Cape Denison AWS

* PNRA – Italian Antarctic

January-February Field Team

- Pegasus South AWS: Jan 7
- Pegasus North AWS: Jan 11, 24; Feb 5, 6
- Linda AWS: Jan 16, 21
- Ferrell AWS: Jan 16
- Marilyn AWS: Jan 23
- Carolyn AWS: Jan 23
- Vito AWS: Jan 24
- Emilia AWS: Jan 24
- Elaine AWS: Jan 28
- Kominko-Slade AWS: Jan 31
- Sabrina AWS: Feb 2
- Lettau AWS: Feb 2
- Williams Field Test AWS: Jan 8, 12; Feb 5
Minna Bluff

- Issues:
  - Frosted
  - Based not supported
  - Mashed wire
  - Broken cross pieces.

- System Operational
Linda AWS

- **Issues:**
  - Raising electronics, etc.
  - Unable to reboot system
  - Antenna broken, replaced
  - Snow pit dug
  - ADG data downloaded
  - New install (2 attempts)

- System Operational
Williams Field AWS Test Facility

- Issues:
  - Removed iridium & radiation shield test AWS
  - Iridium modem failed
  - Installed new radiation shield test AWS
  - Removed original Wisconsin AWS IIB AWS
    - For redeployment
  - Replacement system installed....

- System Operational
Lorne AWS

• Issues
  – Raised AWS
  – Swapped out antenna
  – Teflon sheathing on wire
    • Broken on one spot

• System Operational
Ferrell AWS

Issues:
- Swapped out ADG memory module
- Visit for ADG replacement

System Operational
Margaret AWS

- New AWS Install
- System Operational

[Map of Antarctica with Margaret AWS marked]
Pegasus South AWS

• Issues
  – Removed
  – Utilized for Redeployment

• Future:
  – Complete removal 2009-2010
  – (Limited utilization)

• System Non-operational
Pegasus North AWS

- **Issues:**
  - Stopped transmitting without cause in fall 2008
  - Check cables, restarted AWS, failed again, removed AWS electronics
    - Utilized for redeployment
  - Installed new electronics
  - Attempted to fix up electronics wiring for boom

- **System Partially Operational**
  - Wind speed and relative humidity not working...
Marilyn AWS

- Issues:
  - Raised AWS
  - 7 foot tower section added

- System Operational
Carolyn AWS

- Issues:
  - Raised electronics
  - No new tower sections added

- System Operational
Vito AWS

- Issues
  - Raised AWS
  - Added 7 foot section
  - Rebooted AWS

- System Operational
Emilia AWS

• Issues:
  – Bolted on tower sections
  – Raised AWS
  – Added 7 foot section
  – Delta-T boom not found
    • (just cables – not hooked up)

• System Operational
- Issues
  - Raised AWS
  - Added 7 foot tower section

- System Operational
Kominko-Slade AWS

• Issues:
  – Not transmitting
  – Replaced electronics
    • Snow temperature sensors unable to be used with replaced electronics

• System Operational
Sabrina AWS

- New AWS Install

- System Operational
Lettau AWS

- Issues
  - Rebooted AWS
  - Raised AWS
  - Added batteries

- System Operational
Maneula AWS

- Issues:
  - Aerovane Replacement

- System Operational
D-10, D-47, D-66 and D-85

- D-10 — new Relative Humidity sensor installed & Operational
- E-66: Off A
- D-85: Operational
- D-47: Operational
Thank you!

Summary:
* Visited over 21 sites
  - 1/3 of the network!
* Most of the network operational
* Minor issues for next season:
  - Pegasus North to be replaced at WINFLY
  - Williams Field to become Argos III test site

Williams Field AWS
A Review of the 2009-2010
Automatic Weather Station
(AWS) Field Season

Matthew A. Lazzara \textsuperscript{1}, Nicole M. Schroeder \textsuperscript{1}, Lee J. Welhouse \textsuperscript{2}, George A. Weidner \textsuperscript{2}, and Jonathan E. Thom \textsuperscript{1}

\textsuperscript{1} Antarctic Meteorological Research Center
Space Science and Engineering Center

\textsuperscript{2} Department of Atmospheric and Oceanic Sciences
University of Wisconsin-Madison
O-283-M/P/S
Visit #1:
• Date: 17/Jan/2010
• Time: 5:15 pm local McMurdo time
• Team members: Matthew Lazza, Nicole Schroeder, and Lee Welhouse
• Measurements to the surface (bottom of the following):
  • Delta-T: 28.24 inches (0.72 meters)
  • Junction Box: 42.50 inches (1.1 meters)
  • Electronics Enclosure: 30.25 inches (0.77 meters)
  • Solar Panel: 86.25 inches (2.2 meters)
  • Boom: 131.25 inches (3.3 meters)
• Battery Voltages: Not measured
• AWS site assessment

Visit #2:
• Date: 24/Jan/2010
• Team members: Matthew Lazza, Nicole Schroeder, Lee Welhouse
• Measurements: None measured
• Battery Voltages: None measured
• UNAVCO GPS: Yes, measure from 9:30 am until roughly 10:15 am local time.
• Repaired/tightened up mounting of wind sensor and re-taped loose cables.

• Wind Sensor out of alignment (more in near
• Re-secured cables
• Date: 20/Jan/2010
• Time: 9:30 am through 12 noon, 1:30 pm through 3:30 pm
• Team members: Matthew Lazzara, Charlie Bentley, Yvonne Gambini, Bradley Simon, Tony Wendricks
• Measurements to the surface (bottom of the following):
  • Before Tower Raise:
    - Delta-T #1: 21.5 inches (0.55 meters)
    - Junction Box: 16.5 inches (0.42 meters)
    - Electronics Box: 34.0 inches (0.86 meters)
    - Solar Panel: 58.0 inches (1.47 meters)
    - Boom: 73.0 inches (1.85 meters)
    - Delta-T #2: 18.0 inches (0.46 meters)
  • After Tower Raise:
    - Delta-T #1: 70.0 inches (1.78 meters)
    - Junction Box: 80.0 inches (2.03 meters)
    - Electronics Box: 102.0 inches (2.59 meters)
    - Solar Panel: 145.0 inches (3.68 meters)
    - Boom: 160.0 inches (4.06 meters)
    - Delta-T #2: 28.5 inches (0.72 meters)
• Snow temperature probe electronics
  - Enclosure: 48.5 inches (1.23 meters)
• Battery voltages:
  - Solar Panel: 12.78 volts
  - Battery #1: 12.82 volts
  - Battery #2: 12.83 volts
  - 100 Amp/hr battery for snow temp: 13.03 volts
• UNVACO GPS: Yes, measured from 9:30 am until 3:30 pm local time.
• Raised AWS with a 7 foot tower section and installed electronics/battery to record snow temperature string sensors.

• Raised tower
• Installed electronics –
  - recording snow temperature profiles!
• Finally operating over a full year!!
Ferrell AWS

- Date: 29/Jan/2010
- Time: 11:00 am through 12:00 pm local time
- Team Members: Lee Welhouse, Markov Dimov (Helicopter Pilot)
- Took measurements and raised the ADG, lower temperature sensor, and lower enclosure. The measurements of the tower were as follows,
  - Upon arrival (in inches):
    - Lower temperature sensor: 6
    - Lower Enclosure: 8.5
    - Lower Solar: 31
    - ADG: 16.5
    - Upper Solar: 87
    - Boom: 115.5
    - Junction 17.5
    - Upper Enclosure: 56
  - After leaving:
    - ADG: 33
    - Lower Enclosure: 27
    - Lower Temp: 25.5

• Raised lower components
• Swapped out ADG memory module
Windless Bight

Visit #1:
• Date: 25/Jan/2010
• Time: 9:50 am through 12:00 noon
• Team Members: Matthew Lazzara, Nicole Schroeder, Marko Dimov
• Measurements to the surface (bottom of the following):
  • Before Tower Raise:
    • Solar Panel: 57.0 inches (1.45 meters)
    • Junction Box: 0 inches (0 meters) at surface
    • Electronics Box: Subsurface
    • Temp probe on boom: 58.0 inches (1.47 meters)
    • Antenna: N/A
    • Boom: N/A
  • After Tower Raise:
    • Solar Panel: 98.0 inches (2.49 meters)
    • Electronics box: 63.0 inches (1.60 meters)
    • Antenna: 113.5 inches (2.88 meters)
    • Boom: 126.5 inches (3.21 meters)
    • Junction Box: 44.0 inches (1.12 meters)
  • Battery Voltages:
    • Solar Panel: 20.7 volts
    • Battery: 12.87 volts
  • UNAVCO GPS: Yes, measured from 9:50 am through 11:30 am
  • Raised AWS with a 5 foot tower section, removed damaged ADG

Visit #2:
• Date: 29/Jan/2010
• Time: 9:00 am through 10:30 am
• Team Members: Lee Welhouse and Marko Dimov
• Attached new ADG bar at approximately 4 foot 6 inches.

• Raised tower
• Replaced damaged ADG arm moun
Elaine AWS

• Date: 29/Jan/2010
• Time: Arrived at 11:35 am, departed at 4:35 pm
• Team members: Matthew Lazzara, Karl Frei (from RPSC Cargo), Twin Otter Pilots Brian and Phil.
• Measurements to the surface (bottom of the following (Made via a proxy measure):
  • Acoustic Depth Gauge: 48 inches (1.22 meters)
  • Depth of snow temp. probe: ~48 inches (~1.22 meters) (from below the snow surface)
• Battery voltages:
  • Batteries: ~13+ volts on both
  • Junction Box: ~14 volts
  • Solar Panel: 22 volts
• UNAVCO GPS: Yes
• Removed existing AWS system that was not working and installed new AWS system (electronics, sensors, etc.)

* Replaced AWS: New Sensors: ADG & Insolation
• Dates: 31/Jan/2010  1/Feb/2010
• Time: Sunday - ~1 pm to 3:30 pm
  Monday - ~10 am to 1 pm
• Team Members: Matthew Lazzara and Lee Welhouse
• Measurements:
  • Delta-T: 0 inches (0 meters) - raised to 33 inches (0.84 meters)
  • Acoustic Depth Gauge: 22.5 inches (0.57 meters)
  • Lower Solar Panel: 29.0 inches (0.74 meters)
  • Junction Box: 19.75 inches (0.50 meters)
  • Electronics Box: 55.0 inches (1.40 meters)
  • Upper Solar Panel: 131.0 inches (3.32 meters)
  • Boom (I-beam): 153.75 inches (3.91 meters)
• Battery voltages: (AWS Only - taken at the junction box)
  • From Solar Panel - 12.6 volts
  • To Electronics Box - 11.89 volts
• UNVACO GPS: Yes on Monday (not on Sunday)
• Removed Radiation shield test site equipment for installation at South Pole and raised the delta-T sensor and Repaired/tightened up mounting of wind sensor

• Wind Direction out of alignment
• Raised Delta-T sensor arm
Monthly Wind Direction Difference Values - Willie Field 2009

WF - WW threshold value - 28.9 (February 2010)

WF = Willie Field AWS  SB = Scott Base  WW = White Out AWS
South Pole Radiation Shield Test Site

• Date: 4/Feb/2010
• Time: 2:00-3:00 pm and 8:30 pm to 111:45 pm
• Team members: Lee Welhouse and South Pole Meteorology Office
• Measurements:
  • 36 inches between the bottom of the sensor bar and snow surface.
• Installed radiation shield test AWS

• New Install
• CR-1000 AWS
Date: 2/Feb/2010
Time: ~1:50 pm to ~4:30 pm local McMurdo time.
Team Members: Matthew Lazzara, Lee Welhouse, Justin Dye (RPSC - FEMC), Zach Heid (RPSC - VMF), Lexy and Lee (Twin Otter Pilots)
Measurement to the surface (bottom of the following):
Before:
- Solar Panel: 33 inches (0.84 meters)
- Sensor Boom: 62 inches (1.57 meters)
- All other components buried in the snow
After:
- Delta-T: Variable
- Junction box: 52.50 inches (1.33 meters)
- Electronics box: 62.25 inches (1.58 meters)
- Solar Panel: 95.50 inches (2.43 meters)
- Sensor Boom: 122.00 inches (3.10 meters)
- Battery Voltages: 12.75 volts at the power plug
- UNAVCO GPS: Yes
Dug out AWS (half buried in snow), removed old batteries, installed new batteries, raised AWS with a 5 foot tower section.

- Raised AWS
- Recovered batteries
Lettau AWS

- Date: 30/Jan/2010
- Time: 1:30 pm local - Ground time of less than an hour
- Team Members: Matthew Lazzara, Lee Welhouse, Lexy and Lee (Twin Otter pilots)
- Measurements to the surface (bottom of the following):
  - Boom (to I-beam): 90.00 inches (2.29 meters)
  - Solar Panel: 66.25 inches (1.68 meters)
  - Junction Box: 27.00 inches (0.69 meters)
  - Electronics Box: 41.50 inches (1.05 meters)
  - Delta-T: 11.50 inches (0.29 meters)
- Battery Voltages:
  - Solar Panel: 14.0 volts
- UNAVCO GPS: Yes

* Replaced Battery Box
Byrd AWS

- Date: January 26, 2010
- Field Team Members: Dr. David Holland, Joe Petit, Susha Dore, Hayden (Kiwi mechanic)
  - AWS dug out and raised. Switched to a new tower type and installed new boom and new batteries.

- Raised AWS
  - Switched to "new" tower
  - Installed new batteries
  - Install new sensor boom
Collaboration with France/ IPEV

D-47
• Date: Jan 13, 2010 and Feb 1, 2010
• Field Team: IPEV field/ RAID team
• AWS 8947 removed
• AWS 8916 installed

E-66
• Date: Jan 24, 2010
• Field Team: IPEV field/ RAID team
• Existing poor-performing AWS 8912 removed
• AWS 8947 installed
Adelie Land AWS report

Alain PIERRE
IPEV
Nov 2009 / Jan 2010
• Cargo Problems
• No new AWS at:
  • Cape Denison
  • Port Martin

• New high speed wind systems
• Available for these sites

2) Cape Denison : ID8988
Type : independent anemometer and wind direction sensor (Same as Port Martin)
Electronic : AWS52D
Current Status: HWS is not working
Location : 67°0'S / 142°39'E

This AWS is maintained by Mawson's Hut expeditionners.

NB : For Cape Denison AWS, boxes has to be received at Hobart before end of Nov.

3) Port Martin : ID8909
Type : High wind system anemometer and wind direction sensor (Taylor Scientific)
Electronic : AWS52D with Telenics ST-5
Current status: Not working, Has to be replaced as soon as possible. (scheduled for Nov 2010)

Location : 66°49'S / 141°23'E

Actually Port Martin AWS can only be repaired during Nov, while Astrolabe vessel with 2 helicopters on board are not very far from Port Martin.

This year (Nov 2009) we went at Port Martin but unfortunately it was too windy to do any maintenance on it (80/km/h and higher wind with gusts).  

The only parts which are in good conditions are :
- The mast
- Anchor points with steel chain and steel cable.

All others parts have to be replaced.
• D-10 AWS:
  • Operating nominally

• D-47 AWS
  • Removed 8947
  • Installed 8916

NB: Last summer season, AWS Port Martin box was not complete. One junction box was missing and terminations wire was not adapted at usual junction box plugs. However, replacement could still be done with some electrical adaptations and also because one spare junction box was available at Cap Prudhomme.

For others scientific reasons we have to go to Port Martin in Nov 2010 and we will try to install a new AWS station if AWS boxes are received at Hobart.

NB: Port Martin AWS boxes has to be received at Hobart before 10th of October.

4) D10: ID 30374
Type: RM Young mounted on Bendix base on sensor boom.
Electronic: Campbell CR10X
Current status: Working ok
Location: 66°42'S / 139°50'E

Maintenance schedule:
- Due to annual snow, we will probably add a section mast during 2010-2011 summer season.

D10 AWS (Feb 2010)
D10 AWS: Electronic box

5) D47: ID 8916
(installed in Feb 2010)
Type: RM Young mounted on Pipe all sensors independent mounts to tower
Electronic: AWSCR1000 with Telonics ST-20 PTT ID 8916
Current Status: Transmitting need to check data but would assume is OK
Location: 67°23'S 138°43',4'E

NB: Actual section mast used is smaller (IPEV mast) than AMRC section mast size. Keep in mind for next time when maintenance will be done.

D47. (Janv 2010)
• **E-66 AWS:**
  - Removed 8912 AWS
  - Installed 8947 AWS

• **D-85 AWS:**
  - Operating nominally

---

6) **E66 : ID8947**

installed in Jan 2005 at D47 and removed in Jan 2010 for E66

**Type:** Bendix on sensor boom

**Electronic:** AWS2B with Telonics ST-5 PTT

**Current status:** Working OK

**Location:**

---

Maintenance schedule:
- Due to annual snow, we will probably add a section mast during 2010-2011 summer season.

---

7) **D85 : ID8986**

**Type:** RM Young on Bendix base on sensor boom

**Electronic:** AWS2B Telonics ST-5 PTT

**Current Status:** Working OK

**Location:** 70°25.6'S 134°08.8'E

---

E66 AWS (Feb 2010)
Collaboration with Japan/

JARE

**Dome Fuji**
- Date: 12 January 2010
- Field Team: Dr. Motoyama & JARE
- Removed existing non-working AWS and installed a new AWS.

**Relay Station**
- Date: 31 January 2010
- Field Team: Dr. Motoyama & JARE
- Removed existing non-working AWS and installed a new AWS.
AWS in Antarctica by Japanese Antarctic Research Expedition in June 2010.

listed by Takao Kameda

1. Data Logger Type

Parameters are T: temperature, WS: wind speed, WD: wind direction.

<table>
<thead>
<tr>
<th>Site name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Set up year</th>
<th>Parameters</th>
<th>Interval</th>
<th>Number</th>
<th>WMO No.</th>
<th>Instruments (Data logger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Point</td>
<td>76°47'37&quot;S</td>
<td>31°54'01&quot;E</td>
<td>3742m</td>
<td>2007</td>
<td>T, WS, WD</td>
<td>1 hour</td>
<td>-</td>
<td>-</td>
<td>North One Co. Ltd, KADEC</td>
</tr>
<tr>
<td>Dome Fuji</td>
<td>77°19'00&quot;S</td>
<td>39°42'11&quot;E</td>
<td>3810m</td>
<td>1993</td>
<td>T, WS, WD</td>
<td>1 hour</td>
<td>-</td>
<td>-</td>
<td>North One Co. Ltd, KADEC</td>
</tr>
</tbody>
</table>

2. ARGOS Type

ARGOS-AWS units were set up at four sites as a cooperative program between Japanese Antarctic Research Expedition and University of Wisconsin, USA.

Parameters are T: temperature, WS: wind speed, WD: wind direction, P: atmospheric pressure

<table>
<thead>
<tr>
<th>Site name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Set up year</th>
<th>Parameters</th>
<th>Interval</th>
<th>Argos ID</th>
<th>WMO No.</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mizuho</td>
<td>70°42'00&quot;S</td>
<td>44°17'21&quot;E</td>
<td>2250m</td>
<td>2001</td>
<td>T, WS, WD, P</td>
<td>10 min.</td>
<td>21359</td>
<td>-</td>
<td>Univ. of Wisconsin., ARGOS</td>
</tr>
<tr>
<td>Relay Station</td>
<td>74°00'29&quot;S</td>
<td>42°59'48&quot;E</td>
<td>3353m</td>
<td>1995</td>
<td>T, WS, WD, P</td>
<td>10 min.</td>
<td>8918</td>
<td>89744</td>
<td>Univ. of Wisconsin., ARGOS</td>
</tr>
<tr>
<td>Dome Fuji</td>
<td>77°19'00&quot;S</td>
<td>39°42'11&quot;E</td>
<td>3810m</td>
<td>1995</td>
<td>T, WS, WD, P</td>
<td>10 min.</td>
<td>8904, 8982</td>
<td>89734</td>
<td>Univ. of Wisconsin., ARGOS</td>
</tr>
<tr>
<td>JASE2007</td>
<td>75°53'17&quot;S</td>
<td>25°50'01&quot;E</td>
<td>3661m</td>
<td>2007</td>
<td>T, WS, WD, P</td>
<td>10 min.</td>
<td>30305</td>
<td>-</td>
<td>Univ. of Wisconsin., ARGOS</td>
</tr>
</tbody>
</table>
Sites Not Installed
(Due to weather, scheduling, etc...)

- South of McMurdo Station:
  - Tall Tower AWS - new
- In Pine Island Glacier (PIG) Area:
  - Thurston Island - new
  - Bear Peninsula - new
  - Pig Helo Camp Site C - new
    - Maybe installed at/near Meyers Nunatak?
    - All of these are co-located at POLENET sites
- Siple Dome AWS (in need of replacement electronics)
- Minna Bluff (in need of a new tower)
South Korea

- Existing AWS at Lindsey Island
- Awaiting updates from Dr. Taejin Choi
- Two *new* AWS at:
  - Cape Burks
    - (near Russkaya)
  - Terra Nova Bay
    - (near Mario Zuchelli)
- Plans for an manned presence at Terra Nova Bay (?)
AWS Issues

- Larsen Ice, Carolyn
  - Off the air
- Panda South
  - Bad data values
- Mizuho and Siple Dome
  - Relative humidity not well
- Harry
  - Wind speed stuck at 1 m/s
- Schwertfeger & E-66
  - Periodic pressure jumps
- JASE2007
  - Lost wind
- Mt. Siple & Possession Island
  - Fading off air (winter)
- Cape Denison
  - Hence no pressure
- Eric AWS
  - Wind direction not reported between 347 and 360 degrees.
- Manuela
  - Speed information gone, wind direction o.k.
- Peter I and Whitlock
  - Installed & not working multiple years.
Thank you!

Acknowledgements:

National Science Foundation, Office Polar Program Grant #ANT-06368783

Thanks to Raytheon Polar Services, PHI Helicopters, Ken Borek Air, IPEV, JARE, 109th NYANG, and Mawson’s Huts Foundation.
Antarctic Automatic Weather Stations
Field Report for 2007-2008

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The National Science Foundation’s Office of Polar Programs funds the placement of automatic weather station (AWS) units in remote areas in Antarctica in support of meteorological research, applications and operations. The basic AWS units measure air temperature, wind speed and direction at a nominal height of 3 meters above the surface. Air pressure is measured at the height of the AWS electronic enclosure. Some units measure relative humidity at 3 meters above the surface and the air temperature difference between .5 and 3 meters above the surface at the time of installation. The data are collected by the ARGOS Data Collection System (DCS) on board the National Oceanic and Atmospheric Administration (NOAA) series of polar-orbiting satellites.

The AWS units are located in arrays for specific proposals and at other sites for operational purposes. Any one AWS may support several experiments and all support operational meteorological services - especially support for weather forecasts for aircraft flights.

Research areas supported include:
- Barrier wind flow along the Antarctic Peninsula and the Transantarctic Mountains
- Katabatic wind flow down the Reeves, Byrd and Beardmore Glaciers, the Siple and Adelie Coast
- Mesoscale circulation and sensible and latent heat fluxes on the Ross Ice Shelf
- The Ross Ice Shelf Air Stream.
- Climatology of Byrd and Dome C sites
- Meteorological support around the South Pole
- Meteorological support for the West Antarctic Ice Sheet Initiative and the International Trans-Antarctic Scientific Expedition
- Long Term Ecological Research (LTER) along the Antarctic Peninsula
- Southern Ocean Global Ocean Ecosystems Dynamics
- Meteorological support for United States Antarctic Program flight operations

The following are supported principal investigators funded by NSF-OPP.
- Dr. Douglas R. MacAyeal: Iceberg Drift in the Near-Shelf Environment, Ross Ice Shelf, Antarctica.
- Dr. Ray Smith, Long Term Ecological Research: Racer Rock, Bonaparte Point, and Santa Claus Island.
- Dr. Robert C. Beardsley, Southern Ocean GLOBEC: Marguerite Bay and the Islands in the area.
- West Antarctic Ice Sheet Initiative and International Trans Antarctic Scientific Expedition: Siple Dome and West Antarctic Divide drilling sites.
- Dr. Tom Parish and Dr. John Cassano: The Ross Ice Shelf Air Stream
- Aircraft Operation: All AWS sites in Antarctic.
- The Antarctic AWS units support many investigators outside of NSF-OPP.

AMRC/AWS collaboration:
- Climatological analysis from the AWS, and other stations (complimenting the activities in the SCAR READER project).
- Continued data collection, archival and distribution of AWS data.
The continued generation and improvement of the Antarctic composite satellite imagery (as outlined in the above section).

Continued educational outreach activities (as outlined in the above section and in the following outreach section).

Utilities developed to generate climatological analyses from AWS observations.

Field work completed for 2007-2008

For the AS 2007-2008 field season, the field team consisted of George Weidner (O-283) and Jonathan Thom (O-283, I-190), and Mathew Lazzara O-202 and O-283), with assistance from Mr Thomas Nylen of UNAVCO during the month of January. Additional assistance from the personnel at the Crary Lab at McMurdo Station, Ken Borek Twin Otter pilots, and Dr. Gordon Hamilton and Ben Parten at WAIS divide field camp and West Antarctic Sites, and finally John Gallagher and the Met Office staff at South Pole. Also, a big thank you to Rob Easther, Coordinator, Mawson's Huts Conservation Expedition 2007, for replacing the wind sensor on the AWS at Cape Denison. Fieldwork was also done through cooperative programs with personnel from the Japanese Antarctic program (JARE), the French Antarctic program Institut Polaire Français - Paul Emile Victor (IPEV) and the British Antarctic Survey (BAS).

Summary of University of Wisconsin – Madison fieldwork follows:

A. McMurdo based operations (See full report of January Field team below)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mullock</td>
<td>8907</td>
<td>New Site with High Wind System</td>
</tr>
<tr>
<td>Ferrell</td>
<td>8929</td>
<td>Retrieve ADG data</td>
</tr>
<tr>
<td>Willie Field</td>
<td>21364</td>
<td>Retrieve ADG data</td>
</tr>
<tr>
<td>Mary</td>
<td>8983</td>
<td>AWS software updated, ADG data</td>
</tr>
<tr>
<td>Mount Fleming</td>
<td>30393</td>
<td>New Site installation</td>
</tr>
<tr>
<td>Windless Bight</td>
<td>8982</td>
<td>AWS raised</td>
</tr>
<tr>
<td>Linda</td>
<td>21362</td>
<td>Replaced defective wind sensor</td>
</tr>
<tr>
<td>Lorne</td>
<td>21356</td>
<td>New installation near old Meeley site</td>
</tr>
<tr>
<td>Marilyn</td>
<td>8934</td>
<td>Replaced defective wind sensor</td>
</tr>
<tr>
<td>Lettau</td>
<td>8928</td>
<td>Raised Aws, replaced 8908 with 8928</td>
</tr>
<tr>
<td>Carolyn</td>
<td>8722</td>
<td>Replaced defective wind sensor</td>
</tr>
<tr>
<td>Emelia</td>
<td>8980</td>
<td>AWS 8919 replaced with CR10X ID 8980</td>
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<tr>
<td>Mt Friis</td>
<td>28339</td>
<td>AWS transferred from Andrew Fountain</td>
</tr>
<tr>
<td>Zoe</td>
<td>2769</td>
<td>Assumed AWS from Megadunes Program</td>
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<tr>
<td>Little Mac</td>
<td>2516</td>
<td>Assumed AWS from Megadunes Program</td>
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</table>

B. West Antarctic based operation

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swithinbank</td>
<td>21355</td>
<td>AWS 21355 installed by Gordon Hamilton (X)</td>
</tr>
<tr>
<td>Kominko-Slade (WAIS)</td>
<td>8936</td>
<td>AWS rebooted by Ben Parten</td>
</tr>
</tbody>
</table>

C. South Pole

- Site | ARGOS ID | Service performed at site
- Erin | 21362 | John Gallagher and field team weather out.

D. Field work in Adelie Land

- Three AWS shipped to Dumont D’Urville (arrived too late for deployment in 2006-2007).
- Cape Denison serviced by Australian Antarctic Historical Society.

E. Field work by the Japanese Antarctic Research Expedition

- Two AWS shipped to Syowa Base for deployment in 2007-2008.
F. Service performed on AWS located near Palmer Station

- New wind system installed on AWS 8923 at Bonaparte Point site.

G. AWS maintained cooperatively with the British Antarctic Survey

**Summary of positions and height**

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<thead>
<tr>
<th>Name</th>
<th>latitude</th>
<th>longitude</th>
<th>height</th>
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<tr>
<td>Butler Island</td>
<td>S 72 12.38</td>
<td>W 060 10.18</td>
<td>205m</td>
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<tr>
<td>Sky Blu</td>
<td>S 74 47.53</td>
<td>W 071 29.31</td>
<td>1510m</td>
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<tr>
<td>Limbert</td>
<td>S 75 54.85</td>
<td>W 059 15.86</td>
<td>40m</td>
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<tr>
<td>Larsen Ice Shelf</td>
<td>S 67 00.70</td>
<td>W 061 32.97</td>
<td>17m</td>
</tr>
<tr>
<td>Uranus Glacier</td>
<td>S 71 21.67</td>
<td>W 068 47.83</td>
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- AWS was removed and relocated to Fossil Bluff in 2006.

**Current status**

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<tr>
<th>Name</th>
<th>Temperature</th>
<th>Pressure</th>
<th>Wind speed</th>
<th>Wind direction</th>
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<td>Sky Blu*</td>
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<td>Limbert*</td>
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</table>

*Stations updated to CSI CR1000 based AWS units by BAS for 2007 to date.

* Data are sampled every 10 seconds then averaged every 10 minutes and transmitted.
* The data are downloaded from the ARGOS website every hour then decoded and error checked.

*Figure 1. AWS sites maintained by the British Antarctic Survey (BAS)*
Table 1: AWS for 2008X. An ‘@’ in the ‘Altitude’ column indicates a location obtained from UNAVCO GPS. Red print indicates a site was serviced and a red@’ is a new value. Blue print indicates 2007 changes or additions/deletions for a site.

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<th>SITE</th>
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<th>Action for</th>
<th>Lat.</th>
<th>Long.</th>
<th>Alt.(m)</th>
<th>Date</th>
<th>WMO#</th>
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<td>2007/2008</td>
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<td>Henry</td>
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<td>Nico</td>
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<td>3353 Feb-95 89744</td>
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<td>Dome Fuji</td>
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<td>Mizuho</td>
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<td>80.775oS 124.526oE</td>
<td>2881 Jan-04</td>
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<td>Panda South</td>
<td>30416</td>
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<td>82.246 S 75.989 E</td>
<td>4027 Jan-08</td>
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<td>Number</td>
<td>Status</td>
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<td>Iceberg AWS stations</td>
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<td>Drygalski Fountain</td>
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Table 2. AWS unit not deployed for 2007

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<th>AWS item</th>
<th>AWS ID</th>
<th>AWS TYPE/TX'er</th>
<th>Current status</th>
<th>2008 use ?</th>
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<tbody>
<tr>
<td>Madison-BAS</td>
<td>8902</td>
<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>New ID/Byrd</td>
</tr>
<tr>
<td>Madison-BAS</td>
<td>8917</td>
<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>New ID</td>
</tr>
<tr>
<td>Madison-BAS</td>
<td>8920</td>
<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>New ID</td>
</tr>
<tr>
<td>Madison-BAS</td>
<td>8925</td>
<td>AWS2B/TEL</td>
<td>Upgrade</td>
<td>Chinese/New ID</td>
</tr>
<tr>
<td>Madison-BAS</td>
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<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>New ID</td>
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<td>Madison-Lettau</td>
<td>8908</td>
<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>ITASE</td>
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<tr>
<td>Madison-Emelia</td>
<td>8919</td>
<td>AWS2B/PRL</td>
<td>Upgrade/TEL</td>
<td>ITASE</td>
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<td>Madison</td>
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<td>Upgrade/TEL</td>
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<td>Madison-CR10X</td>
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<td>CSI CR10X/Seimac</td>
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<tr>
<td>Madison-CR10X</td>
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<td>CSI CR10X/Seimac</td>
<td>Test</td>
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</tr>
<tr>
<td>Madison-CR1000</td>
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<td>CSI CR1000/ST-20</td>
<td>Assemble</td>
<td>IPEV</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8910</td>
<td>CSI CR1000/ST-20</td>
<td>Assemble</td>
<td>IPEV</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8915</td>
<td>CSI CR1000/ST-20</td>
<td>Assemble</td>
<td>Roosevelt Is.</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8935</td>
<td>CSI CR1000/ST-20</td>
<td>Assemble</td>
<td>Franklin Is</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8937</td>
<td>CSI CR1000/ST-20</td>
<td>Assemble</td>
<td>Pegasus South</td>
</tr>
<tr>
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<td>*8934</td>
<td>CSI CR1000/ST-20</td>
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<td>Marilyn</td>
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<td>Madison-CR1000*</td>
<td>*8913</td>
<td>CSI CR1000/ST-20</td>
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<td>Schwertfeger</td>
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<td>*8911</td>
<td>CSI CR1000/ST-20</td>
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<td>Gill</td>
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<tr>
<td>Madison-CR1000*</td>
<td>TBD</td>
<td>CSI CR1000/ST-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madison-CR1000*</td>
<td>TBD</td>
<td>CSI CR1000/ST-20</td>
<td></td>
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<td>Megadunes</td>
<td>2516</td>
<td>CR10X/Seimac</td>
<td>Megadunes</td>
<td>Reuse</td>
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<td>LTER – Bonaparte Point</td>
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<td>AWS2W</td>
<td>LTER</td>
<td>Reuse</td>
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<tr>
<td>GLOBEC – Dismal Island</td>
<td>8930</td>
<td>CR10X/ST-13</td>
<td>GLOBEC</td>
<td>Reuse</td>
</tr>
<tr>
<td>GLOBEC – Kirkwood Island</td>
<td>8932</td>
<td>CR10X/ST-13</td>
<td>GLOBEC</td>
<td>Reuse</td>
</tr>
<tr>
<td>B15 K</td>
<td>9116</td>
<td>CR10X/Seimac</td>
<td>Iceberg</td>
<td>Reuse</td>
</tr>
<tr>
<td>Swithinbank</td>
<td>21355</td>
<td>AWS2B/TEL</td>
<td>WA</td>
<td>Replacement</td>
</tr>
<tr>
<td>Not deployed</td>
<td>28338</td>
<td>CR10X/Seimac</td>
<td>Cape Hallett</td>
<td></td>
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<tr>
<td>Not deployed</td>
<td>30374</td>
<td>CR10X/Seimac</td>
<td>TBD</td>
<td></td>
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<tr>
<td>C25 Fountain AWS (gone)</td>
<td>30416</td>
<td>CR10X/Seimac</td>
<td>Iceberg</td>
<td>Reuse</td>
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</tbody>
</table>
Figure 8. A map of Antarctica showing the locations of the University of Wisconsin’s automatic weather stations for 2007. Identification of the sites is by the site name.
## Tentative AWS Field Work
### 2008/2009 Austral Summer

### A. AWS servicing based from Mcmurdo as of June 2007.

<table>
<thead>
<tr>
<th>Region</th>
<th>Site</th>
<th>Action</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ross Island Region</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ferrell</td>
<td>8929</td>
<td>Download ADG data</td>
<td>77.865oS</td>
<td>170.819oE</td>
</tr>
<tr>
<td>Pegasus South</td>
<td>8937</td>
<td>Replace AWS</td>
<td>77.990oS</td>
<td>166.568oE</td>
</tr>
<tr>
<td>Minna Bluff</td>
<td>8939</td>
<td>Check HWS</td>
<td>78.555oS</td>
<td>166.691oE</td>
</tr>
<tr>
<td>Mt Fleming</td>
<td>30393</td>
<td>Wind Sensor upgrade</td>
<td>77.533 S</td>
<td>160.276E</td>
</tr>
<tr>
<td>Mount Friis</td>
<td>28339</td>
<td>Check wind system</td>
<td>77.747 S</td>
<td>161.516 E</td>
</tr>
<tr>
<td><strong>Ross Ice Shelf</strong></td>
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</tr>
<tr>
<td>Marilyn</td>
<td>8934</td>
<td>Replace Belfort, Raise AWS</td>
<td>79.954oS</td>
<td>165.130oE</td>
</tr>
<tr>
<td>Schwerdtfeger</td>
<td>8913</td>
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<td>Gill</td>
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<td>178.611oW</td>
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<td>Service</td>
<td>83.134oS</td>
<td>174.169oE</td>
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<td>Lettau</td>
<td>8928</td>
<td>Replace Belfort</td>
<td>82.518oS</td>
<td>174.452oW</td>
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<tr>
<td>Carolyn</td>
<td>8722</td>
<td>Replace Belfort</td>
<td>79.964oS</td>
<td>175.842oE</td>
</tr>
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<td>Mary</td>
<td>8983</td>
<td>Raise AWS</td>
<td>79.303oS</td>
<td>162.968oE</td>
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<tr>
<td>Nascent</td>
<td>28336</td>
<td>Temp string install</td>
<td>78.127oS</td>
<td>178.497oE</td>
</tr>
<tr>
<td>Roosevelt Island</td>
<td>TBD</td>
<td>Install new AWS</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

### B. AWS operations from the icebreaker (as a wish list).

1. The following AWS sites would be visited for installing a minimal (dog house AWS on an opportunity basis from a ship, preferably an icebreaker).

<table>
<thead>
<tr>
<th>Region</th>
<th>Site</th>
<th>Action</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scott Island</td>
<td>TBD</td>
<td>67.37oS</td>
<td>179.97oW</td>
<td>Deploy new AWS</td>
</tr>
<tr>
<td>Young Island</td>
<td>TBD</td>
<td>66.229oS</td>
<td>162.275oE</td>
<td>Deploy new AWS</td>
</tr>
<tr>
<td>Whitlock</td>
<td>8935</td>
<td>76.144oS</td>
<td>168.392oE</td>
<td>Deploy new AWS</td>
</tr>
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</table>

### C. AWS operations in West Antarctica

1. Service West Antarctic Sites – replacing old Bendix/Belfort wind systems and servicing as many AWS as needed from WAIS Divide camp/ Siple Dome or ?

<table>
<thead>
<tr>
<th>Region</th>
<th>Site</th>
<th>Action</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byrd Station</td>
<td>Upgrade 8903</td>
<td>90.007oS</td>
<td>119.404oW</td>
<td>1530</td>
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<tr>
<td>Brianna</td>
<td>8931</td>
<td>83.889oS</td>
<td>134.154oW</td>
<td>@525</td>
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<tr>
<td>Elizabeth</td>
<td>21361</td>
<td>82.607oS</td>
<td>137.078oW</td>
<td>@519</td>
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<tr>
<td>Erin</td>
<td>21363</td>
<td>84.904oS</td>
<td>128.828oW</td>
<td>@990</td>
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<tr>
<td>Harry</td>
<td>8900</td>
<td>83.003oS</td>
<td>121.393oW</td>
<td>945</td>
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<tr>
<td>Theresa</td>
<td>21358</td>
<td>84.599oS</td>
<td>115.811oW</td>
<td>1463</td>
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<tr>
<td>Mount Siple</td>
<td>8981</td>
<td>73.198oS</td>
<td>127.052oW</td>
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<tr>
<td>Siple Dome</td>
<td>8938</td>
<td>81.656oS</td>
<td>148.773oW</td>
<td>@666</td>
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</table>
D. Tentative field work supported by the Institut Francais Pour la Recherche et la Technologie Polaires (IFRTP) at Dumont D’Urville.

1. Two installations are planned with other sites to be serviced as necessary.

<table>
<thead>
<tr>
<th>Site</th>
<th>Code</th>
<th>Lat</th>
<th>Long</th>
<th>Alt</th>
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<tbody>
<tr>
<td>Swithinbank</td>
<td></td>
<td>81.201oS</td>
<td>126.177oW</td>
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<tr>
<td>WAIS Divide (K-S)</td>
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<td>79.334oS</td>
<td>111.077oW</td>
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</table>

*D May be serviced from South Pole

<table>
<thead>
<tr>
<th>Site</th>
<th>Code</th>
<th>Lat</th>
<th>Long</th>
<th>Alt</th>
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<tr>
<td>Dome C II</td>
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<td>75.121oS</td>
<td>123.374oE</td>
<td>3250</td>
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<tr>
<td>Port Martin*</td>
<td>8909</td>
<td>66.82oS</td>
<td>141.40oE</td>
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<td>Cape Denison</td>
<td>8988</td>
<td>67.009oS</td>
<td>142.664oE</td>
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<td>Penguin Point*</td>
<td>8910</td>
<td>67.617oS</td>
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</table>

* Need to be replaced
E. Tentative Field work by the Japanese Antarctic Expedition from Dome Fuji.

- One new installation is planned at the midpoint between the Japanese Dome Fuji Station and the German Kohnen Station.
- At this time Relay Station is not transmitting and an updated AWS will be sent to replace the current AWS.

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
</tr>
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<tbody>
<tr>
<td>Relay Station</td>
<td>8918</td>
<td>74.017oS</td>
<td>43.062oE</td>
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<td>Dome Fuji</td>
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<td>77.31oS</td>
<td>39.70oE</td>
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<tr>
<td>Mizuho</td>
<td>21359</td>
<td>70.70oS</td>
<td>44.29oE</td>
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<tr>
<td>New installation</td>
<td>30305</td>
<td>70.00oS</td>
<td>20.00oE</td>
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</table>
Antenna new mount just below R M YOUMG

AVYS 80305 works with R M YOUNG
0049 replacement does NOT
F. AWS Fieldwork to be done by the British Antarctic Survey based at Rothera Station.

<table>
<thead>
<tr>
<th>Location</th>
<th>AWS Code</th>
<th>Action</th>
<th>Lat.</th>
<th>Long.</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larsen Ice</td>
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<td>Upgrade software</td>
<td>66.949S</td>
<td>60.887W</td>
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<td>Butler Island</td>
<td>8902</td>
<td>Upgrade software</td>
<td>72.207S</td>
<td>60.160W</td>
<td>91</td>
</tr>
<tr>
<td>Fossil Bluff</td>
<td>8920</td>
<td>Upgrade software</td>
<td>71.333S</td>
<td>68.283W</td>
<td>63</td>
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<tr>
<td>Limbert</td>
<td>8925</td>
<td>Upgrade software</td>
<td>75.422S</td>
<td>59.851W</td>
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<td>Ski-Hi</td>
<td>8917</td>
<td>Upgrade software</td>
<td>74.792S</td>
<td>70.488W</td>
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</table>

G. AWS Fieldwork to be done for LTER/Operations based from Palmer Station.

<table>
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<tr>
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<th>Action</th>
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<th>Long.</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>Bonaparte Point</td>
<td>8921</td>
<td>New AWS</td>
<td>64.778S</td>
<td>64.067W</td>
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<tr>
<td>Santa Claus I</td>
<td>8922</td>
<td>New AWS</td>
<td>64.964S</td>
<td>65.670W</td>
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</table>

H. AWS servicing of Peter I Island AWS

<table>
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<tr>
<th>Location</th>
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<th>Action /New</th>
<th>Lat.</th>
<th>Long.</th>
<th>Code</th>
</tr>
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<tr>
<td>Peter I</td>
<td>8933</td>
<td>Service</td>
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<td>90.670E</td>
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</table>
I. WS Fieldwork in support of GLOBEC AWS.

<table>
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<th>Code</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Quantity</th>
</tr>
</thead>
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<tr>
<td>Kirkwood Island*</td>
<td>8930</td>
<td>88.340oS</td>
<td>69.007oW</td>
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</tr>
<tr>
<td>Dismal Island*</td>
<td>8932</td>
<td>68.087oS</td>
<td>68.825oW</td>
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J. AWS servicing in support of Iceberg Research (IO-190-O)

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<td>C16</td>
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* Not received as of June 15
Appendix A. Images of AWS at WAIS Divide camp

Figure A1. Layout of WAIS Divide Camp and location of AWS Kominko-Slade.
Figure A2. View towards WAIS AWS Kominko Slade (small arrow is near top of tower).
Figure A3. AWS Kominko-Slade at WAIS Divide camp January 2006 including the snow profile sensors.
The National Science Foundation’s Office of Polar Programs funds the placement of automatic weather station (AWS) units in remote areas in Antarctica in support of meteorological research, applications and operations. The basic AWS units measure air temperature, wind speed and direction at a nominal height of 3 meters above the surface. Air pressure is measured at the height of the AWS electronic enclosure. Some units measure relative humidity at 3 meters above the surface and the air temperature difference between .5 and 3 meters above the surface at the time of installation. A small, but increasing number of AWS sites measure snow accumulation. The data are collected by the ARGOS Data Collection System (DCS) on board the National Oceanic and Atmospheric Administration (NOAA) and MetOp (EUMETSAT) series of polar-orbiting satellites.

The AWS units are located in arrays for specific research activities and also used for operational purposes. Any one AWS may support several experiments and all support operational meteorological services - especially support for weather forecasts for aircraft flights.

**Research areas supported over the years include:**

- Barrier wind flow along the Antarctic Peninsula and the Transantarctic Mountains
- Katabatic wind flow down the Byrd and Beardmore Glaciers, the Siple and Adelie Coast
- Mesoscale circulation and sensible and latent heat fluxes on the Ross Ice Shelf
- The Ross Ice Shelf Air Stream.
- Climatology of long operating AWS sites in particular, Byrd and Dome C sites.
- Meteorological support for the West Antarctic Ice Sheet Initiative
- Long Term Ecological Research (LTER) along the Antarctic Peninsula
- Meteorological support for United States Antarctic Program flight operations

**The following are a sampling of historically supported principal investigators funded by NSF-OPP.**

- Dr. Douglas R. MacAyeal: Iceberg Drift in the Near-Shelf Environment, Ross Ice Shelf, Antarctica.
- Dr. Ray Smith, Long Term Ecological Research: Racer Rock, Bonaparte Point, and Santa Claus Island.
• West Antarctic Ice Sheet Initiative: Siple Dome and West Antarctic Divide drilling sites.
• Dr. John Cassano: The Ross Ice Shelf Air Stream
• Aircraft Operation: All AWS sites in Antarctic.
• The Antarctic AWS units support many investigators outside of NSF-OPP.

AMRC collaboration:
• Climatological analysis from the AWS, and other stations (complimenting the activities in the SCAR READER project).
• Continued data collection, archival and distribution of AWS data.
• Continued educational outreach activities (as outlined in the above section and in the following outreach section).
• Utilities developed to generate climatological analyses from AWS observations.

Field work completed for 2008-2009

For the AS 2008-2009 field season, the field team consisted of Matthew Lazzara (O-283, O-202) and Jonathan Thom (O-283), and Shelley Knuth (O-283) all from the University of Wisconsin – Madison and John Cassano (O-283) and Melissa Richards (O-283) from the University of Colorado - Boulder, with assistance from the personnel at McMurdo Station, Ken Borek Twin Otter pilots, and station personnel at WAIS divide field camp. Fieldwork was also done through cooperative programs with personnel from the the French Antarctic program, Institut Polaire Français - Paul Emile Victor (IPEV) and the British Antarctic Survey (BAS). Additional assistance was received from the Mawson's Huts Foundation’s field personnel of Chris Henderson and Pete McCabe.

Mr. Jonathan Thom arrived in Mcmurdo on October 19, 2008 as the only member of O-283 to deploy for the early season part of the 2008/2009 field season. He departed McMurdo on 17 November for return to Madison. George Weidner did not deploy as planned due to a back problem and remotely assisted field personnel in McMurdo from Madison. The remaining field team members deployed at the end December with varied departure dates from late January to early February 2009.

In addition to the normal servicing of AWS sites, we retrieved two AWS set up for testing at the Williams Field AWS site. The first test AWS use an Iridium modem rather than n Argos transmitter for data telemetry. The second test AWS was recording data from various temperature sensors to determine the effect of differing radiation shields and sampling protocols that are being introduced with the new AWS based on Campbell Scientific Inc.’s, (CSI) CR1000 data logger. Jonathan Thom serviced the two test AWS in late October 2008.

For the Iridium test AWS we are using a NAL Research A3LA-D modem to send SBD binary messages from a Campbell-Scientific CR1000 datalogger. The messages were sent to an email address provided by Jonathan Thom to the Iridium network. Anecdotal evidence from other attempts at using Iridium modems in cold climates indicated they did not function a very cold temperatures. We experienced similar results. When the ambient temperature at Williams Field AWS site went below –20C, SBD messages became sporadic. Finally all messages ceased near
the start of the Austral Winter in April. Data was successfully stored on the compact flash cards installed with the CR1000 datalogger.

The AWS us to test the radiation shields was also a CR1000 based AWS using a Telonics ST-20A transmitter for data telemetry. There was also a compact flash card installed with the CR1000. The data was complete on the flash card. We tested our traditional temperature sensor (a PRT fabricated with a WEED Inc. 1000 ohm platinum element) with both our own radiation shield and with a RM Young radiation shield that is now standard with CSI temperature sensors. In addition a RM Young RTD temperature sensors were installed with one sensor ventilated and another not ventilated.

Figure 1. AWS test tower at Williams Field AWS site for 2008/2009.
We had intended to move this test AWS platform to the South Pole for use in comparing data with the South Pole temperature sensors, but we significantly modified the test platform and decided to operate the system at Williams Field for one more year. The new temperature sensor mounting system is shown below in Figure 2. We anticipate that the radiation shields/temperature sensors will have a more uniform exposure to the sun and wind with this platform.

![Mounting platform for radiation shield/temperature sensor testing.](image)

Figure 2. Mounting platform for radiation shield/temperature sensor testing.

With the introduction of the new AWS based on the CR1000, the measurement protocols available compared with the traditional AWS2 version of our automatic weather station will be quite different. The AWS2 model essentially took instantaneous temperature readings every 10 minutes. The CR1000 based AWS can record temperature data for almost varying lengths of time for whatever sampling interval one chooses. As more of our traditional AWS are retired, we wish to document any differences in temperature statistic due to the new radiation shields and various sampling schemes. Many analyses of long-term temperature records imply temperature trends on the order of 0.1°C per decade are important. We wish to insure that the temperature data between the various AWS is rigorously compared and checked for consistency. Final analyses of the temperature data from the test AWS site will be available before the next field season.
The remainder of this report documents the fieldwork accomplished during the 2008/2009 season. The deploy members of the January field team deserve recognition for completing much of the planned work despite limited electronics knowledge due George Weidner’s absence. This work could not have been done without the Internet and digital photography. We have come a long way in 30 years of Antarctic AWS.

George Weidner (May, 2009)

Table 1: AWS for 2009. An ‘@’ in the ‘Altitude’ column indicates a location obtained from UNAVCO GPS. Red print is site service in 2008/2009. Blue print is new site established.

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**Ocean Islands**

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**Ross Ice Shelf**

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**Antarctic Peninsula**

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**High Polar Plateau**
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<td>1.025W</td>
<td>2755</td>
<td>Jan-93</td>
<td>89108</td>
</tr>
<tr>
<td>Nico</td>
<td>2B</td>
<td>89.000S</td>
<td>89.669E</td>
<td>2935</td>
<td>Jan-93</td>
<td>89799</td>
</tr>
<tr>
<td>Relay Station</td>
<td>2B</td>
<td>74.017S</td>
<td>43.062E</td>
<td>3353</td>
<td>Feb-95</td>
<td>89744</td>
</tr>
<tr>
<td>Dome Fuji</td>
<td>2B</td>
<td>77.31S</td>
<td>39.70E</td>
<td>3810</td>
<td>Feb-95</td>
<td>89734</td>
</tr>
<tr>
<td>Mizuno</td>
<td>2B</td>
<td>70.70S</td>
<td>44.29E</td>
<td>2260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JARE 2008</td>
<td>2B</td>
<td>77.000S</td>
<td>20.000E</td>
<td>3400</td>
<td>Dec-07</td>
<td></td>
</tr>
<tr>
<td>Megadunes</td>
<td>2B</td>
<td>80.775S</td>
<td>124.526E</td>
<td>2881</td>
<td>Jan-04</td>
<td></td>
</tr>
<tr>
<td>Panda South</td>
<td>2B</td>
<td>82.246S</td>
<td>75.989E</td>
<td>4027</td>
<td>Jan-04</td>
<td></td>
</tr>
<tr>
<td>Baldrick (BAS)</td>
<td>2B</td>
<td>82.774S</td>
<td>13.054W</td>
<td>1968</td>
<td>Jan-04</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. AWS unit not deployed for 2009**

<table>
<thead>
<tr>
<th>AWS not deployed</th>
<th>AWS type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madison</td>
<td>8908 AWS2B</td>
</tr>
<tr>
<td>Madison</td>
<td>8916 AWS2B</td>
</tr>
<tr>
<td>Madison</td>
<td>8919 AWS2B</td>
</tr>
<tr>
<td>Madison</td>
<td>8936 AWS2D</td>
</tr>
<tr>
<td>Madison</td>
<td>21355 AWS2D</td>
</tr>
<tr>
<td>Madison-CR10X</td>
<td>8922 CSI /Seimac</td>
</tr>
<tr>
<td>Madison-CR10X</td>
<td>30423 CSI /Seimac</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8901 CSI/ST-20</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8903 CSI/ST-20</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8927 CSI/ST-20</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8937 CSI/ST-20</td>
</tr>
<tr>
<td>Madison-CR1000</td>
<td>*8987 CSI/ST-20</td>
</tr>
</tbody>
</table>

* Replacement AWS ID’s for 2009

For Telonics ST-20’s with CR1000
Table 3. GPS data for 2008/2009. Horizontal accuracy is +/- 10 cm and vertical accuracy +/- 20 cm. The horizontal position does not refer to the exact AWS location, but rather a position approximately 10 (~meters) paces north of the AWS.

<table>
<thead>
<tr>
<th>Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Start Time (UTC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pegasus S</td>
<td>77.9903768°S</td>
<td>166.5600761°E</td>
<td>4.839</td>
<td>1/7/2009 2:49</td>
</tr>
<tr>
<td>Willy Field</td>
<td>77.8669724°S</td>
<td>166.8655529°E</td>
<td>12.581</td>
<td>1/12/2009 0:43</td>
</tr>
<tr>
<td>Linda</td>
<td>78.4262044°S</td>
<td>168.4178687°E</td>
<td>42.484</td>
<td>1/16/2009 6:50</td>
</tr>
<tr>
<td>Ferrell</td>
<td>77.8459259°S</td>
<td>170.8190210°E</td>
<td>45.06</td>
<td>1/16/2009 8:21</td>
</tr>
<tr>
<td>Carolyn</td>
<td>79.9391445°S</td>
<td>175.88395625°E</td>
<td>52.017</td>
<td>1/22/2009 21:58</td>
</tr>
<tr>
<td>Vito</td>
<td>78.4661465°S</td>
<td>177.78168453°E</td>
<td>49.55</td>
<td>1/23/2009 21:48</td>
</tr>
<tr>
<td>Emelia</td>
<td>78.4736640°S</td>
<td>173.14581275°E</td>
<td>51.494</td>
<td>1/24/2009 0:31</td>
</tr>
<tr>
<td>K-S WAIS</td>
<td>79.4656911°S</td>
<td>112.10623369°W</td>
<td>1801.095</td>
<td>1/26/2009 21:31</td>
</tr>
<tr>
<td>Elaine</td>
<td>83.0972223°S</td>
<td>174.2912160°E</td>
<td>61.587</td>
<td>1/28/2009 1:35</td>
</tr>
<tr>
<td>Sabrina</td>
<td>84.2503706°S</td>
<td>169.98718025°W</td>
<td>88.072</td>
<td>2/2/2009 0:43</td>
</tr>
<tr>
<td>Lettau</td>
<td>82.4805819°S</td>
<td>174.57042869°W</td>
<td>38.804</td>
<td>2/2/2009 4:01</td>
</tr>
<tr>
<td>Minna Bluff</td>
<td>78.5546910°S</td>
<td>166.69081022°E</td>
<td>894.872</td>
<td>10/31/2008 23:32</td>
</tr>
<tr>
<td>Linda</td>
<td>78.4271355°S</td>
<td>168.41696764°E</td>
<td>42.277</td>
<td>11/1/2008 0:09</td>
</tr>
<tr>
<td>Linda</td>
<td>78.4271357°S</td>
<td>168.41696232°E</td>
<td>42.253</td>
<td>11/1/2008 0:09</td>
</tr>
<tr>
<td>Ferrell</td>
<td>77.8473396°S</td>
<td>170.81911836°E</td>
<td>45.536</td>
<td>11/3/2008 21:29</td>
</tr>
<tr>
<td>Ferrell</td>
<td>77.8473389°S</td>
<td>170.81913969°E</td>
<td>45.693</td>
<td>11/3/2008 21:29</td>
</tr>
<tr>
<td>Lorne</td>
<td>78.2394977°S</td>
<td>170.00577011°E</td>
<td>45.262</td>
<td>11/4/2008 22:15</td>
</tr>
<tr>
<td>Margaret (RI)</td>
<td>79.9999052°S</td>
<td>165.00039361°W</td>
<td>67.419</td>
<td>11/12/2008 23:05</td>
</tr>
<tr>
<td>Margaret(RI)</td>
<td>79.9999039°S</td>
<td>165.00040228°W</td>
<td>67.554</td>
<td>11/13/2008 0:00</td>
</tr>
<tr>
<td>Bases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEVI</td>
<td>81.47672111°S</td>
<td>161.9770776°E</td>
<td>114.353</td>
<td>1/21/2009 23:59</td>
</tr>
<tr>
<td>MCMG</td>
<td>77.838349719°S</td>
<td>166.669330152°E</td>
<td>151.452</td>
<td>1/6/2009 23:59</td>
</tr>
<tr>
<td>MIN0</td>
<td>78.6503084°S</td>
<td>167.163793652°E</td>
<td>729.568</td>
<td>1/15/2009 23:59</td>
</tr>
<tr>
<td>RAMG</td>
<td>84.388425444°S</td>
<td>178.047113444°E</td>
<td>1103.681</td>
<td>1/27/2009 23:59</td>
</tr>
<tr>
<td>WAIS</td>
<td>79.467499966°S</td>
<td>112.053987572°W</td>
<td>1802.972</td>
<td>1/25/2009 23:59</td>
</tr>
</tbody>
</table>
New Installation Site: Margaret AWS site near Roosevelt Island

Jonathan Thom with assistance from Ken Borek Twin Otter pilots, and Bill Vandiver (SPAWAR Office of Polar Programs), installed a new AWS site near Roosevelt Island on November 12, 2008.

Installation information:

Sensor Boom height: 514 cm
Top of enclosure: 325 cm
Lower Temperature: 210 cm
ADG height: 215 cm

The boom is about 8 degrees west of North.
Note: this requires a correction for the wind direction of negative 8 degrees (-8 deg)
The station is installed at 80 S and 165 W.
The snow surface there was nice, no sastrugi at all.

Figure 3. Margaret AWS - installed near Roosevelt Island on the eastern Ross Ice Shelf
New Installation Site: Sabrina site at southern end of the Ross Ice Shelf

Sabrina AWS installed on 2/2/2009 1:30 pm (approximate ground time was 2.5 hours). Field Team: Shelley Knuth, Melissa Richards, Kevin Emery (FSTP)
Pilots: Lexi and Rory (Ken Borek):

The UNAVCO GPS was up from 1:30-4 pm.

Heights to surface:

<table>
<thead>
<tr>
<th>Component</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG</td>
<td>066</td>
</tr>
<tr>
<td>Junction box</td>
<td>112</td>
</tr>
<tr>
<td>ADG Temp</td>
<td>116</td>
</tr>
<tr>
<td>Electronics box</td>
<td>146</td>
</tr>
<tr>
<td>Solar Panel</td>
<td>201</td>
</tr>
<tr>
<td>Sensor Boom</td>
<td>288</td>
</tr>
</tbody>
</table>

Field notes: Beautiful day on the field, and a beautiful location with the mountains in the background. Temperature was fairly warm and there was no wind. The area is crevasse free so it's pretty safe. The South Pole traverse was very nearby - we could see their tracks and flags. We stopped at Moody Glacier on the way out and back to refuel. Took about 4.5 hours to get out to Sabrina from McMurdo.

Site was a new install. Put one 5' base and one 7' tower section on top. Then we added a solar panel, temperature/RH sensor, RM Young, junction box, CR1000, ADG, and lower temperature sensor for ADG. Also added white wand antenna. Added two battery boxes measured at 12.7 volts each.

Once the tower was up, we could not get a transmission for about 20 minutes. We began troubleshooting by rebooting the system, unplugging and re-plugging the antenna in, but nothing happened. We had just pulled out the toughbook laptop computer and an extra antenna and suddenly got a transmission. We verified three transmissions before we left.

We did not have a handheld gps with us. The one we had was packed in our WAIS cargo, and we could not retrieve another one before we left in the morning despite various attempts. While we talked to the pilots and know where true north was so that the boom is facing that direction, the RM Young could easily be off by several degrees, and we had no way of verifying how far off it was.
Figure 4. Sabrina AWS after installation in January 2009.
Table 4. AWS Activities planned this season (2009-2010) by U. Wisconsin field team

<table>
<thead>
<tr>
<th>AWS Site</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Status</th>
<th>Field Season Activity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Tower</td>
<td>78.82°S</td>
<td>173.33°E</td>
<td>Unknown</td>
<td>Not installed – new AWS site</td>
<td>First installation</td>
<td>Site to be renamed, Put-in by traverse and twin otter</td>
</tr>
<tr>
<td>Elaine</td>
<td>83.097°S</td>
<td>174.29°E</td>
<td>62 m</td>
<td>Installed Off air</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Carolyn</td>
<td>79.939°S</td>
<td>175.884°E</td>
<td>52 m</td>
<td>Installed Off air</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Lettau</td>
<td>82.481°S</td>
<td>174.57°E</td>
<td>39 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Gill Byrd</td>
<td>79.922°S</td>
<td>178.586°W</td>
<td>54 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Siple Dome</td>
<td>80.007°S</td>
<td>119.404°W</td>
<td>1530 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter or LC130 to camp</td>
</tr>
<tr>
<td>Kominko-Slade (WAIS Divide)</td>
<td>81.656°S</td>
<td>148.773°W</td>
<td>668 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter or LC130 to camp</td>
</tr>
<tr>
<td>Siple Dome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elizabeth</td>
<td>82.607°S</td>
<td>137.078°W</td>
<td>519 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Harry</td>
<td>83.003°S</td>
<td>121.393°W</td>
<td>945 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>Erin</td>
<td>84.904°S</td>
<td>128.828°W</td>
<td>990 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Twin Otter</td>
</tr>
<tr>
<td>South Pole</td>
<td>-90°S</td>
<td></td>
<td>Unknown</td>
<td>Not installed</td>
<td>Install of test AWS (non-transmitting)</td>
<td>LC130 day trip. One year test - only</td>
</tr>
<tr>
<td>Cape Bird</td>
<td>77.21°S</td>
<td>166.439°E</td>
<td>38 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
<tr>
<td>Ferrell</td>
<td>77.846°S</td>
<td>170.819°E</td>
<td>45 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
<tr>
<td>Laurie II</td>
<td>77.517°S</td>
<td>170.801°E</td>
<td>37 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
<tr>
<td>Linda</td>
<td>78.426°S</td>
<td>168.418°E</td>
<td>43 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
<tr>
<td>Marble Point</td>
<td>77.439°S</td>
<td>163.754°E</td>
<td>108 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
<tr>
<td>Minna Bluff</td>
<td>78.554°S</td>
<td>166.69°E</td>
<td>895 m</td>
<td>Installed</td>
<td>Servicing</td>
<td>Helicopter</td>
</tr>
</tbody>
</table>

1 This list is subject to modification based on any AWS failures that may occur before the start of the field season. Some sites may not be visited due to limited logistics or weather. This list is not in priority order.
Table 5. AWS Activities planned this season (2009-2010) by U. Wisconsin collaborators

<table>
<thead>
<tr>
<th>AWS Site</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Status</th>
<th>Collaborator</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pegasus North</td>
<td>78.952oS</td>
<td>166.5oE</td>
<td>10 m</td>
<td>Installed – needs servicing</td>
<td>John Cassano</td>
<td>USAP - O-400-M</td>
</tr>
<tr>
<td>PIG Helo Camp (Site C)</td>
<td>75.6ºS</td>
<td>99.917ºW</td>
<td>Unknown</td>
<td>Not installed – new AWS site</td>
<td>David Holland field team</td>
<td>USAP - WAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(includes UNAVCO)</td>
<td></td>
</tr>
<tr>
<td>Thurston Island</td>
<td>72.53ºS</td>
<td>97.56ºW</td>
<td>Unknown</td>
<td>Not installed – new AWS site</td>
<td>David Holland field team</td>
<td>USAP - WAP - POLENET</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(includes UNAVCO)</td>
<td></td>
</tr>
<tr>
<td>Bear Peninsula</td>
<td>74.546ºS</td>
<td>111.88ºW</td>
<td>Unknown</td>
<td>Not installed – new AWS site</td>
<td>David Holland field team</td>
<td>USAP - WAP - POLENET</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(includes UNAVCO)</td>
<td></td>
</tr>
<tr>
<td>E-66</td>
<td>68.912ºS</td>
<td>134.655ºE</td>
<td>2485 m</td>
<td>Installed – needs repair</td>
<td>Christophe Genton</td>
<td>France - IPEV</td>
</tr>
<tr>
<td>Port Martin</td>
<td>66.82ºS</td>
<td>141.39ºE</td>
<td>39 m</td>
<td>Installed – needs repair</td>
<td>Christophe Genton</td>
<td>France - IPEV</td>
</tr>
<tr>
<td>Dome Fuji</td>
<td>77.31ºS</td>
<td>39.7ºE</td>
<td>3810 m</td>
<td>Installed – needs repair</td>
<td>Takao Kameda</td>
<td>Japan - JARE</td>
</tr>
<tr>
<td>Relay Station</td>
<td>74.017ºS</td>
<td>43.062ºE</td>
<td>3353 m</td>
<td>Installed – needs repair</td>
<td>Takao Kameda</td>
<td>Japan - JARE</td>
</tr>
<tr>
<td>Cape Denison</td>
<td>67.009ºS</td>
<td>142.664ºE</td>
<td>31 m</td>
<td>Installed – needs servicing</td>
<td>Rob Easther</td>
<td>Mawson’s Huts Foundation</td>
</tr>
<tr>
<td>Panda South</td>
<td>82.325ºS</td>
<td>75.989ºE</td>
<td>4027 m</td>
<td>Installed – needs repair</td>
<td>Bian Ligen, Cunde Xiao</td>
<td>China - CHINARE</td>
</tr>
</tbody>
</table>

This list is not in priority order and is subject modification.
Figure 5. Map of Antarctic automatic weather stations (AWS) for 2009.
Appendix A
Summary of site visits for 2008/2009

Event 1: Minna Bluff and Linda AWS site visits by Jonathan Thom
10/31/2008 9:28 PM
Made it to Minna Bluff and Linda today. Minna bluff had one battery cable that was busted and one that was still good. It was pretty well covered in hoar frost. I have a feeling that this station is going to need to be completely reinstalled next year. It was pretty well stabilized by the chains, but tower base is not being held by anything. I think it will probably last for another year, but next year we should probably install a Rohn base. The tower section had at least one broken cross piece. Other than that it seemed that it was in OK shape.

Linda was another issue. I ended up raising the box, delta T and junction box. I tried multiple attempts to get it rebooted, but I did not have any success. I checked the antenna and power and they were both good. I ended up leaving the box there because were were a bit short on time to take everything down. I also forgot to bring caps for the cables. So, it is still there, but everything is raised up so you will just need to replace the box. The boom is a thermocouple delta-T. We can reprogram to read the thermocouple on the CR1000, if we choose to replace it with a CR1000.

![Image A1: Minna Bluff AWS October 31 2008.](image-url)
Here are the before and after photos of Linda AWS. We raised the box, delta T and junction box. The junction box didn't have much extra battery cable so, we got it up as far as we could. Unfortunately, I couldn't get the station to boot up again. It should be an easy swap when you are down in January. It shouldn't be too difficult to make this a CSI station.

Top of the boom was 350 cm
Top of the box was 224 cm
Top of the delta-T 108 cm
Image A3: Linda AWS before image
Image A4: Linda AWS after field work
Event 2: Ferrell site visit by Jonathan Thom
11/3/2008 4:54 PM
Didn't make it to Lorne today. Conditions were a bit sketchy, with 25 knot winds and -24C. It would have been difficult to get the tower raised. We did stop at Ferrell. I swapped out the memory module and will download the data this afternoon. It looked all right and should be all right for another year. It may need a raise next year. The ADG will definitely need to be raised next year. I'll send the tower measurements with the photos in the next email. I got about 15 minutes of GPS data at Ferrell. Picture from Ferrell AWS. I think I mentioned in the last email, I got about 15 minutes of GPS data. I still need to download the data from the memory module.

Here are the measurements from the site:

Top of boom: 338 cm
top of box: 234 cm
T for ADG: 075 cm
Base of ADG: 090.5 cm
Image A6: Ferrell AWS on November 3, 2008 (after ADG raise).
Event 3: Visit of Lorne AWS by Jonathan Thom
11/4/2008 7:11 PM
Just got back from Lorne. It was a much, much (dare I say much three times) better day. No wind and temps around -20 or so. We got the station raised and I did get one reception at least on the telonics uplink receiver. I ended up swapping out the antenna for an antennex antenna. There teflon sheathing was broken in a spot. We'll see if it keeps transmitting. It would be an easy swap out, like Linda if it does turn off.

Here are the heights:

Before raise:
Boom: 2.38 m
Top of box: 0.72 m

After raise:
Boom: 4.3 m
Top of box: 2.9 m
Top of jnc box was: 2.4 m

Image A7: Lorne AWS before servicing on November 4, 2008
Image A8: Lorne AWS on November 4, 2008 after servicing
Event 4: Iridium AWS servicing at Williams Field AWS sit by Jonathan Thom.
11/7/2008 12:10 PM
I pulled the radiation shield test and the box with the iridium modem yesterday. I downloaded the data from the radiation shield test compact flash card. The data was perfect. There were none of the crazy points I was seeing in the Argos transmission. I'm a little bit concerned about sending this set up to pole as it is. I would kind of like to get it setup on the rack and run in McM at least until January to try and find out if the Argos TX issue can be resolved. If anyone has any other ideas let me know. The iridium station was completely dead. I haven't tried to fire it up in the lab yet, but I'll do that today. I'll let you know what I find out. That's all for now.
Jonathan

Event 5: Installation of Margaret AWS near Roosevelt Island by Jonathan Thom
11/12/2008 11:48 PM
(See more at the beginning of this report)
Boom height: 514 cm
top of box: 325 cm
lower T: 210 cm
ADG height 215 cm

The boom is about 8 degrees west of North.
I'll update the cal file tomorrow with all of the info.
The station is installed at 80 S and 165 W, I think the TO pilot actually tried to get as close to that location as possible.
The snow surface there was nice, no sastrugi at all.
**Event 6: Removal of AWS at Pegasus South by Shelley Knuth and John Cassano**

1/7/2009 1:02 AM

Here are our notes from our trip to Pegasus South:
Shelley and I flew out to Pegasus South AWS this afternoon to remove this site. We retrieved:
- AWS electronics
- Belfort aerovane
- Upper boom attached to lower boom with delta T
- solar panel
- junction box
- 3 battery boxes (2 with 3 batteries and 1 with 2 batteries)
- 2 anchor chains
- 2 anchor boards
- 1 AWS base board
- 2 5' tower sections

We left the following items at the site (as they were encased in ice):
- 2 anchor boards and chains
- 1 battery box (at least we assume one was buried as we had to cut the cables)
- 4 4"x4" wood posts used for anchoring the station

The Unavco GPS was left running at the site from approximately 3:30 to 5:20 PM (Unavco GPS unit 16414)

John

![Image A10: Pegasus South AWS before removal on January 7, 2009](image-url)
Event 7: Removal of Williams Field Iridium test AWS by Shelley Knuth and Melissa Richards
1/8/2009 2:50 AM
Shelley and Melissa visited Willie Field and pulled out the Iridium test AWS only. The radiation shield test AWS is still there, as well as the batteries/tower from the Iridium test AWS.

Event 8: Servicing of Pegasus North AWS by Shelley Knuth and John Cassano
1/11/2009 8:29 PM
Shelley and I visited Pegasus North yesterday. We checked all of the cables, and they appeared to be fine. We unplugged the AWS electronics and then plugged the power back in. The station then began transmitting (we received two transmissions with the Teloniks before removing the power again). We removed the following from this site for redeployment:

AWS electronics
Junction box
Lower delta T boom
Instrument boom
RM Young aerovane

We left the following at the site:
Tower
2 battery boxes
solar panel

John

Event 9: Removal of the AWS2B version of our AWS from Williams Field site by Matthew Lazzara and Melissa Richards
As of 00:30 UTC today, 12 Jan 2009, Wisconsin's Williams Field AWS has been taken off the air. As a note, the Argos ID 21364 will be redeployed to another field location later in this field season. You may want to change processing on the MetApps system so that data will not be mis-filed as Williams Field data, when it may indeed be installed at a new location soon.

Here is the information from Melissa and my visit to Willie Field AWS:
Removed 21364 at 00:30 UTC
Height to the boom from the snow surface: 174.5 inches or 443.25 centimeters
Height to bottom of the electronics box from the snow surface: 78.25 inches or 198.75 centimeters
Height to the bottom of the delta-T from the snow surface: 18 inches or 45.75 centimeters
We removed the aerovane (in case that is needed at all) - and capped the based on the boom.
We removed the electronics enclosure.
All loose plugs capped, etc.
We did take UNAVCO GPS measurements.
Image A11 Williams Field Test Site before removal of the Wisconsin AWS IIB. (radiation test site still installed on right).
Event 10: Servicing of Linda AWS and Ferrell AWS by John Cassano
1/16/2009 2:43 PM

- First attempt to get to Linda (new electronics) and Ferrell (ADG fix) didn't work out due to fog. They are flying now - night shift - to try again today....they *just* took off as I write this.

Here is my field report from our visit to Linda and Ferrell, to add

Linda
Field team: Shelley, Melissa, John
Replaced AWS electronics with AWS 21355
Unable to confirm transmission with Telonics
One horizontal prong on the antenna is broken off
Dug snow pit (3 years)
Placed UNAVCO GPS at site for approx. 1h (GPS 16414)

Height to bottom of:
Junction box: 23"
Lower delta T boom: 42"
AWS enclosure: 65"
Solar panel: 99"
Upper boom: 137"

Ferrell
Field team: Shelley, Melissa, John
Replaced ADG and confirmed correct operation
Dug snow pit (2 years)
Placed UNAVCO GPS at site for approx. 40 min (GPS 16414)

Height to bottom of:
Junction box: 35"
ADG: 37.5"
AWS enclosure: 74"
Solar panel: 104"
Upper boom: 131"
ADG solar panel: 51"
Campbell enclosure: 28"

GPS coordinates from helo:
77 deg 50.77 min
170 deg 49.15 min

John
Image A12: Linda AWS after servicing on January 16, 2009

Image A13: Image of damaged antenna at Linda AWS
Event 11: Servicing of Linda AWS by John Cassano and Shelley Knuth
1/21/2009 10:50 PM
Shelley and I visited Linda AWS today and all appears to be working.
Here are my notes for the trip:
Field team: Shelley and John
Reboot existing AWS (21355) at Linda site: No transmission
Check voltage at junction box plug going into AWS: 13.4V
Disconnect solar panel
Note: all of the following voltage measurements were made with power connected to the AWS
Check voltage at jct box: 13.4 V
Disconnect 1 battery box check voltage in jct box from green to black: 0.008 V
Reconnect battery box and disconnect second battery box, check voltage in jct box from green to black: 0.034 V
Check voltage of battery boxes at plugs going into jct box:
Battery box 1: 13.2 V
Battery box 2: 13.3 V
Replace antenna and cable
Replace AWS 21355 with AWS 21362 (original Linda AWS)
Confirmed transmission with Telonics in field
We also see current data on local computer ([http://herbie.usap.gov/~amrc/21362.txt](http://herbie.usap.gov/~amrc/21362.txt))
The GPS coordinates from the helo were:
78 deg 25.57 min S
168 deg 25.03 min E
and differ from those we had for the site (78 deg 27.06 min S, 168 deg 23.64 min E)
Shelley and I cannot remember if 21355 transmitted with the new antenna and cable (actually we do remember, but not the same thing).

John

Event 12: Kominko – Slade AWS (WAIS Divide) by Shelley Knuth and Melissa Richards
1/25/2009 7:22 PM
Shelley’s report from WAIS.

So as you know we serviced K-S site on Tuesday, and revisited on Wednesday to check to make sure everything was working ok.

Event 13: Servicing Marilyn AWS by John Cassano
1/23/2009 4:30 PM
Marilyn site was visited on 1/23/09 by John Cassano and 3 RPSC personnel on a morale trip (Kris, Marty, and Joel).

The Twin Otter had difficulty locating this site. After circling for approximately 15 minutes we landed at the given lat/long and scanned the horizon for the AWS. We were unable to spot the AWS and then taxied approximately due east until we spotted the AWS. The Twin Otter GPS coordinates at the site were 79 deg 55.551 min S and 165 deg 29.511 min E.

UNAVCO GPS (#16414) deployed at site from 2:30 to 5:00PM

Upon arrival the height to bottom of:

- Lower T boom: buried
- Junction box: buried
- Solar panel: 38"
- AWS enclosure: mostly buried (top 7" exposed)
- Upper boom: 58"

A new 7' tower section was added to this site. New height to bottom of:

- Lower T boom: Not retrieved (had not been connected when we arrived)
- Junction box: 76"
- Solar panel: 128"
- AWS enclosure: 92"
- Upper boom: 150"

After reinstalling all equipment transmission from the station was confirmed with Telonics. I’ve attached a before and after photo.
Image A18: Marilyn AWS January 2009 (before raising the tower)
Image A19: Marilyn AWS January 2009 after raising the tower
Event 14: Servicing Carolyn AWS site by John Cassano
Carolyn site was visited on 1/23/09 by John Cassano and 3 RPSC personnel on a morale trip (Kris, Marty, and Joel).

The Twin Otter had difficulty locating this site, and the Twin Otter GPS coordinates at the site were 79 deg 56.368 min S and 175 deg 53.049 min E.

UNAVCO GPS (#16414) deployed at site from 11AM to 12:15PM

ADG data downloaded to Toughbook laptop computer, but data from late 2008 through present was retrieved.

Height to bottom of:

Lower T boom: at snow surface
Junction box: 28"
Solar panel: 65"
AWS enclosure: 12"
Upper boom: 99"
ADG: 25"
ADG temperature: 47"
CR10 enclosure: 40"

Decision was made to not add an additional tower section, but all equipment was repositioned on the tower.

New height to bottom of:

Lower T boom: 25"
Junction box: 53"
Solar panel: 84"
AWS enclosure: 28"
Upper boom: 99"
ADG: 56"
ADG temperature: 74"
CR10 enclosure: 54"

After reinstalling all equipment transmission from the station was confirmed with Telonics.

I've attached a before and after photo.
Image A20: Carolyn AWS site before servicing in January 2009
Image A21: Carolyn AWS site after servicing in January 2009
Event 15: Servicing Vito AWS site by Shelley Knuth and Melissa Richards

Visited Vito AWS on 1/24/2009 at 10:30 am (approximate ground time was 2 hours)

Team: Shelley, Melissa, Jason (RPSC), and LaVonne (RPSC)
Pilots: Josh and Randy

Had a bit of trouble spotting Vito. Site had moved about a half a mile since last visited. Upon arrival, all instruments including junction box were above snow. Measurements to surface were as follows:

- Junction box: 13 cm
- Electronics box: 22 cm
- Solar panel: 34 cm
- Boom: 2.3 m

Unfortunately we forgot to get new heights before we left so this is the only information we have.

Noted that tower put on from previous year was simply held on by a cargo strap and was not bolted on (was a base section). Did not rectify because tower seemed solid and cargo strap would soon be buried in snow. Could still see guy lines above surface.

RM Young shaft was loose (ie, it would turn). Was tightened.

Removed all instruments, added a 7 foot tower section on top, then re-mounted all instruments. Station did not come back online at first. Had to reboot, and then was fine. Got two, possibly three transmissions. A battery was not added as it was determined that there was more than enough battery power. Next time visited will definitely need battery extension cables.

Battery voltages were as follows:

- Battery #1: 13.14
- Battery #2: 13.15

UNAVCO GPS was put out from approximately 10:30 am - 12:30 pm.

New GPS coordinates from pilots:
78 27.973’S  177 46.854’E

Shelley
Image A22: Vito AWs before raising the tower in January 2009
Image A23: Vito AWS after raising the tower in January 2009
Event 16: Servicing Emilia AWS by Shelley Knuth and Melissa Richards
Visited Emilia AWS on 1/24/2009 at 1:30 pm (approximate ground time was 1.5 hours)

Team: Shelley, Melissa, Jason (RPSC), and LaVonne (RPSC)
Pilots: Josh and Randy

Actually had no trouble spotting Emilia, even though the pilots said it was nearly 2.5 miles from last known coordinates. Upon arrival, all instruments including junction box were above snow. Measurements to surface were as follows:

- Junction box: 21 cm
- Electronics box: 53 cm
- Solar panel: 1.32 m
- Boom: 2.05 m

New measurements after raise:
- Junction box: 97 cm
- Electronics box: 240 cm
- Solar panel: 320 cm
- Boom: 430 cm

The tower on this station was also not bolted on, even though there were holes in the section to bolt it with. Added bolts in the section to secure.

Removed all instruments, added a 7 foot tower section on top, then re-mounted all instruments. Station came back online right away. Next time visited will definitely need battery extension cables.

We cut the delta T cable which was taped to the tower but wasn't plugged into the electronics box so didn't think was hooked up. Dug down 3 feet but never saw the lower boom.

Battery voltages were as follows:

- Battery #1: 12.8
- Battery #2: 12.9

UNAVCO GPS was put out from approximately 1:30 pm - 3:00 pm.

New GPS coordinates from pilots:
78 28.37'S 173 08.81'E

Shelley
Image A24: Emilia AWs before raising the tower in January 2009
Image A25: Emilia AWS after raising the tower in January 2009
**Event 17: Servicing Elaine AWS site by John Cassano**
Elaine site was visited on 1/28/09 by John Cassano, 3 RPSC personnel on a morale trip (Scott, Tanya, and Kat), and 2 Twin Otter pilots (Josh and Randy).

The Twin Otter had difficulty locating this site.

The Twin Otter GPS coordinates at the site were 83 deg 05.84 min S and 174 deg 17.38 min E.

UNAVCO GPS (#16414) deployed at site from 14:35 to 16:50 local time

Upon arrival the height to bottom of:

- Lower delta T boom: buried
- Junction box: buried
- Solar panel: 28"
- AWS enclosure: buried to top of enclosure
- Upper boom: 61"

Work completed:
- A new 7’ tower section was added to this site
- AWS 8987 was replaced with AWS 21357
- Belfort aerovane was replaced with RM Young aerovane

New height to bottom of:

- Lower delta T boom: 34"
- Junction box: 55"
- Solar panel: 117"
- AWS enclosure: 89"
- Upper boom: 148"

Voltage at AWS power plug: 14.0V (without solar panel)

The next time this site is raised we will need two battery extension cables as there is no more slack left in the existing battery cables.

After reinstalling all equipment transmission from the station was confirmed with Telonics.

I did not remember to take a before photo, but have attached two after photos.
Image A26: Elaine AWS after servicing in January 2009
Event 18: Installation of Sabrina AWS site in southern area of Ross Ice Shelf by Shelley Knuth and Melissa Richards

Installed Sabrina on 2/2/2009 1:30 pm (approximate ground time was 2.5 hours).

Team: Shelley, Melissa, Kevin Emery (FSTP)
Pilots: Lexi and Rory

Beautiful day on the field, and a beautiful location with the mountains in the background. Temperature was fairly warm and there was no wind. The area is crevasse free so it's pretty safe. The South Pole traverse was very nearby - we could see their tracks and flags. We stopped at Moody Glacier on the way out and back to refuel. Took about 4.5 hours to get out to Sabrina from McMurdo.

Site was a new install. Put one 5' base and 1 7' tower section on top. Added solar panel, temperature/RH sensor, RM Young, junction box, CR1000, ADG, and lower temperature sensor for ADG. Also added white wand antenna. Added 2 battery boxes measured at 12.7 volts each.

Once the tower was up, we could not get a transmission for about 20 minutes. We began troubleshooting by rebooting the system, unplugging and re-plugging the antenna in, but nothing happened. We had just pulled out the toughbook and an extra antenna and suddenly got a transmission. We verified 3 transmissions before we left.

One very important note.

We did not have a handheld gps with us. The one we had was packed in our WAIS cargo, and we could not retrieve another one before we left in the morning despite various attempts. While we talked to the pilots and know where true north was so that the boom is facing that direction, the RM Young could easily be off by several degrees, and we had no way of verifying how far off it was.

The UNAVCO GPS was up from 1:30-4 pm.

Heights to surface:

ADG: 66 cm
Junction box: 112 cm
ADG Temp: 116 cm
Electronics box: 146 cm
Solar Panel: 201 cm
Boom: 288 cm

I've attached photos.

Shelley

P.S. The before picture is just us being funny...the pilots were circling several times and we didn't know what they were doing (they didn't give us a headset) and finally they yelled that they couldn't
find the site. So we informed them it wasn't there. Also, the pilots were a HUGE help with installing the site too, as was Kevin.

Image A27: Area before installation of Sabrina AWS
Event 19: Servicing of Lettau AWS by Shelley Knuth and Melissa Richards

Visited Lettau on 2/2/2009 at 5 pm. Approximate ground time was 45 minutes.
Team: Shelley, Melissa, Kevin Emery (FSTP)
Pilots: Lexi and Rory

Upon arrival all sensors were above the surface, including the delta T (although barely). Site was off air so we rebooted the electronics box, and it came back online right away. We checked the antenna and antenna cable and everything appeared fine. We moved the electronics box and delta T further up the tower to avoid being buried. We also replaced a battery at the site, although the 2 batteries on site appeared ok (we replaced the battery registering the smallest voltage). We cut off the plug from the battery that was left there. After moving the instruments up the tower we plugged everything back in and got a transmission immediately. Verified with three transmissions.

Heights to surface upon arrival:
Delta T: 22 cm
Electronics box: 55 cm
Junction box: 94 cm
Solar panel: 198 cm
Boom: 258 cm
Heights after raising instruments:
Delta T: 57 cm
Electronics box: 137 cm

Voltages of batteries on site: 13.08 and 12.79
Voltage of power cable coming out of junction box: 13.23

Image A28: Lettau AWS before servicing in February 2009
**Event 20a,b,c: Servicing of Pegasus North AWS by John Cassano and Melissa Richards**

Here are my field notes for the re-deployment of Pegasus North:

Field team: Melissa and John

Install:
AWS 21355
Junction box
Boom and lower delta T boom

Height to bottom of:
Lower delta T boom: 33"
Junction box: 44"
Solar panel: 86"
AWS enclosure: 61"
Upper boom: 130"

Voltage at:
Battery box 1: 12.8V
Battery box 2: 12.9V
AWS power plug: 12.9V

Confirmed transmission with Telonics. I've attached a photo of the station.
John
Pegasus North site was visited again on 2/5/09 by Melissa Richards and Dan Steinhoff
Work completed:
Removed electronics box 21355
Installed electronics box 8923
Installed lower temperature sensor below the current lower delta-T

Height to lower temperature sensor: 20"
Height to the remaining instruments are the same as the last field report

Received 3 successful transmissions.
Melissa

**Event 21: Installation of new AWS at Williams Field AWS site by Melissa Richards**

Willie site was visited on 2/5/09 by Melissa Richards and Dan Steinhoff

Work completed:
Installed electronics box 30477
Installed RMY aerovane with Belfort base
Installed Antennax antennae
Removed ADG, ADG radiation shield and ADG enclosure
Installed new ADG to attach to the 30477 electronics box

New height to bottom of:

Lower temperature sensor: 20"
Junction box: 41"
ADG: 43"
Solar panel: 49"
Electronics box: 77"
Solar panel: 154"
Antennae: 164"
Boom: 175"

Received 3 successful transmissions.

A few notes:
* The old style antennae was left on the boom with the electronics box end of the cable taped off
* The Antennax antennae was attached directly to the tower as done at Sabrina. This caused close clearance with the aerovane, but it was verified multiple times that there is sufficient clearance.
* The old ADG enclosure had a battery cable hard wired inside. In order to remove the enclosure, this cable needed to be cut. Dan and I did not have a shovel to try to dig up the battery box. The cut end of the battery cable has been covered with tape and taped to the tower.
* The cable to the lower solar panel followed the tower down into the snow. Does this go to the battery box that powered the ADG enclosure? If so, is there a problem that this is still connected and the battery box cable has been cut?

I think that is it. Dan, do you have anything to add?

Melissa

The following pictures are of the completed site, the cut battery cable taped to the tower and of the close clearance of the antennae and aerovane.

On Feb 5, 2009, at 9:14 PM, George Weidner wrote:

Melissa,

The Experiment wins one. Evidently my supposition that the problem was with the 10V line to the WS interface and Humidity probe proved incorrect. After you fine work, we still have no WS or Humidity... it is a harsh continent.
Thanks to you and Dan for attempting to correct the problem as assumed..
We will provide a new AWS for John when he is there early next season...
either the RM Young board itself is the issue or there are subtle issues with the A to D circuit...

Thanks again to you and Dan for your efforts and for your work in the field ..
Image A31: New AWS 30477 after installation at Williams Field site in February 2009
Event 22: Installation of new AWS on Hugo Island
Field team headed by
W. Kevin Pedigo
Sr. Marine Computer and Instrument Specialist
ARSV Laurence M. Gould
United States Antarctic Program

Image A32: AWS for Hugo Island under test in Punta Arenas
 Gospel 2009

Remarks: Done and done as they say. Today we installed the second GPS station for C-515-L and the AWS (automatic weather station) for the University of Wisconsin. None of this could have happened in weather other than what we experienced today. Nor could any of this have happened without the very spirited help of all who went ashore including three personnel from Palmer Station who logged a very physical day hauling gear up and down some very rocky inclines. We also hauled out the old AWS, including all rigging and batteries and loaded them aboard the ship. Some feisty fur seals stood guard as well as colonies of gentoo and chinstrap penguins to whom we gave a wide berth. Despite the ideal weather conditions, Zodiac landing sites require a great deal of caution due to the breakers on the rocks with even a minimal swell.

Once again we very much appreciate the incredibly accurate weather forecasts that we are receiving and the help of ECO working the back deck and holding station with the ship. We are now enroute to the final GPS site at Duthier's Point near Paradise Harbor, ETA tomorrow morning early.

I have a lat/lon for Hugo Island, from Kevin on the LMG:

64 57.70 S, 64 40.12 W
Image A33: W. Kevin Pedigo
(Sr. Marine Computer and Instrument Specialist)
on the ARSV Laurence M. Gould
installing AWS at Hugo Island
Appendix B
Summary of collaborative site visits for 2008/2009

Event 1: Aerovane servicing at Manuela AWS on Inexpressible Island by PNRA personnel.
November 27, 2008 3:23:02 AM CST
I would like to inform you that we have replaced the Aerovane on the Manuela AWS, as you asked us. Now the AWS is working properly. I would excuse me for the delay of this message, but in the last two weeks we have been very busy. I would appreciate if you can write me the name and the address of the person to whom we can send back the old sensor. In attachment you will find a picture of the repaired Manuela AWS.

Best regards
Lorenzo De Silvestri
Meteo-Climatological Observatory
ITALIAN ANTARCTIC RESEARCH PROGRAMME
Mario Zucchelli Station
E-MAIL: lorenzo.desilvestri_s@mzs.it


Event 2: Servicing of AWS at Cape Denison by Mawson’s Hut Foundation personnel
1/11/2009 11:44 PM
I replaced the anemometer today without any problem. The cables all looked in good condition, but the rubber sleeves on the 3 data cables' entry into the small metal box were perishing so I taped them up. I will sent you pictures when I get back.

Regards
B2: AWS at Cape Denison

Event 3: Servicing AWS D-47, E-66, & D-85 along traverse line from Dumont D’Urville to Dome Concordia by IPEV collaborators

D47 and D85 working; E66 no longer received as of January 19, 2009.

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08914 NO LOCATION Not deployed (spare unit)
Update on IPEC traverse AWS sites as of 2300 UTC 04 February 2009

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</table>

08912  E66  035/2255Z-  08986  D85  035/2215Z-  035/2251Z-  ( 1)  
| ( 1)   | 25  42  5E  00 |
|        | AA  21  FF  94 |
|        | 30  69  31  67 |
|        | FD  00  FE  FF |
|        | 37  67  36  64 |
|        | 00  02  01  A2 |
|        | 34  67  24  A3 |
|        | 00  FF  DF  7B  |

<table>
<thead>
<tr>
<th>08986</th>
<th>D85</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 1)</td>
<td>23  22  5E  00</td>
</tr>
<tr>
<td></td>
<td>A5  51  FF  38</td>
</tr>
<tr>
<td></td>
<td>1F  6E  20  6E</td>
</tr>
<tr>
<td></td>
<td>FE  FE  FF  FF</td>
</tr>
<tr>
<td></td>
<td>1A  6D  1E  71</td>
</tr>
<tr>
<td></td>
<td>00  01  00  37</td>
</tr>
<tr>
<td></td>
<td>1B  6E  92  37</td>
</tr>
<tr>
<td></td>
<td>00  00  DE  28</td>
</tr>
</tbody>
</table>
Event 4: Servicing and correcting wiring error for humidity of AWS at D10.
Collaborators: Christophe Genthon, Philippe Dorhain, and Vincent Favier
January 8-10, 2009

From Christophe:
We did raise D10 one mast length today. Philippe Dordhain had an essential contribution here. Vincent Favier also helped. Operation was done at ~15:00 local time. The SR50 height above surface was 96 cm before, is 310 cm after.

From George Weidner:
We have found the source of the error with the humidity data with D10. The input channel on the CR10X for humidity should be 8 and NOT 7. Channel 7 was the temperature sensor in the HMP45 rather than the humidity sensor. The yellow wire should be moved to channel 8 (fourth from the left). Other AWS that use this CR10X program used the temperature data from the HMP45... The good news is that the data is stored as temperature data in the storage module and can be recomputed as humidity when we get the storage module back after this year. There is enough memory for two years of data and will not need to be replaced until next season. After the wire is moved, the humidity will be stored in its correct field in the storage module, and this should solve the humidity issue for the transmitted data ...

Added sentence in instructions:
"only requires a small slot screwdriver to change the yellow wire channel connection"
Hi George,

Hope you are well, just to let you know that we will not be able to service the Dismal Island AWS this season, we had planned to do it from the Endurance but it nearly sank in December see http://www.visitandlearn.co.uk/TrackHMSEndurance/CaptainsBlog/tabid/64/EntryID/21/Default.aspx

The next plan was to do if from one of our own ships on its way into Rothera but it has not been possible to do that due to bad weather and changes in the ships itinerary. We plan to leave the equipment at Rothera for the winter and then it has been added to the task list for next season so fingers crossed for more success then.

Bye
Steve
Appendix C
SPAWAR Office Of Polar Programs
Automatic Weather Station Locations for 2008/2009

AWS Locations 2008-2009
(circle radii are approximately 10, 20, 30, and 40 statute miles)
Arrow indicates direction of webcam. VIS indicates visibility sensor.
Star indicates landman visible on webcam image.
Tan box indicates year-round site with different summer/winter-over configurations (preferred).

<table>
<thead>
<tr>
<th>Station</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>79°05'00&quot;S</td>
<td>166°40'00&quot;E</td>
<td>40&quot;</td>
</tr>
<tr>
<td>101</td>
<td>77°41'00&quot;S</td>
<td>166°22'00&quot;E</td>
<td>443&quot;</td>
</tr>
<tr>
<td>103</td>
<td>77°45'15&quot;S</td>
<td>166°53'15&quot;E</td>
<td>823&quot;</td>
</tr>
<tr>
<td>104</td>
<td>77°51'25&quot;S</td>
<td>168°07'25&quot;E</td>
<td>74&quot;</td>
</tr>
<tr>
<td>105</td>
<td>77°52'35&quot;S</td>
<td>163°56'35&quot;E</td>
<td>800&quot;</td>
</tr>
<tr>
<td>106</td>
<td>77°52'05&quot;S</td>
<td>166°55'05&quot;E</td>
<td>359&quot;</td>
</tr>
<tr>
<td>108</td>
<td>77°54'40&quot;S</td>
<td>169°55'40&quot;E</td>
<td>130&quot;</td>
</tr>
<tr>
<td>109</td>
<td>78°07'20&quot;S</td>
<td>168°18'20&quot;E</td>
<td>79&quot;</td>
</tr>
<tr>
<td>110</td>
<td>77°50'00&quot;S</td>
<td>167°08'00&quot;E</td>
<td>51&quot;</td>
</tr>
<tr>
<td>111</td>
<td>77°50'00&quot;S</td>
<td>167°31'31&quot;E</td>
<td>82&quot;</td>
</tr>
<tr>
<td>112</td>
<td>77°50'00&quot;S</td>
<td>165°17'45&quot;E</td>
<td>352&quot;</td>
</tr>
<tr>
<td>116</td>
<td>77°31'00&quot;S</td>
<td>164°08'19&quot;E</td>
<td>800&quot;</td>
</tr>
</tbody>
</table>

OPERA
SIO/UC San Diego
Co-PI: Dr. David Halsband
The National Science Foundation’s Office of Polar Programs funds the placement of automatic weather station (AWS) units in remote areas in Antarctica in support of meteorological research, applications and operations. The basic AWS units measure air temperature, wind speed and direction at a nominal height of 3 meters above the surface. Air pressure is measured at the height of the AWS electronic enclosure. Some units measure relative humidity at 3 meters above the surface and the air temperature difference between .5 and 3 meters above the surface at the time of installation. A small, but increasing number of AWS sites measure snow accumulation. The data are collected by the ARGOS Data Collection System (DCS) on board the National Oceanic and Atmospheric Administration (NOAA) and MetOp (EUMETSAT) series of polar-orbiting satellites. The AWS units are located in arrays for specific research activities and also used for operational purposes. Any one AWS may support several experiments and all support operational meteorological services - especially support for weather forecasts for aircraft flights.

Research areas supported in the past include:

- Barrier wind flow along the Antarctic Peninsula and the Transantarctic Mountains
- Katabatic wind flow down the Byrd and Beardmore Glaciers, the Siple and Adelie Coast
- Mesoscale circulation and sensible and latent heat fluxes on the Ross Ice Shelf
- The Ross Ice Shelf Air Stream.
- Climatology of long operating AWS sites in particular, Byrd and Dome C sites.
- Meteorological support for the West Antarctic Ice Sheet Initiative
- Long Term Ecological Research (LTER) along the Antarctic Peninsula
- Meteorological support for United States Antarctic Program flight operations

A sampling of historically supported principal investigators funded by NSF-OPP:

- Dr. Douglas R. MacAyeal: Iceberg Drift in the Near-Shelf Environment, Ross Ice Shelf, Antarctica
- Drs. Tom Parish and John Cassano: The Ross Ice Shelf Air Stream
- Dr. Ray Smith, Long Term Ecological Research: Racer Rock, Bonaparte Point, and Santa Claus Island.
- West Antarctic Ice Sheet Initiative: Siple Dome and West Antarctic Divide drilling sites
- Aircraft Operation: All AWS sites in Antarctic.
- The Antarctic AWS units support many investigators outside of NSF-OPP.
AMRC collaboration:
• Climatological analysis from the AWS, and other stations (complimenting the activities in the SCAR READER project).
• Continued data collection, archival and distribution of AWS data.
• Continued educational outreach activities (as outlined in the above section and in the following outreach section).
• Utilities developed to generate climatological analyses from AWS observations.

Current research efforts include:
• Composite analysis of the surface effects of El Nino/Southern Oscillation and La Nina teleconnections on Antarctica
• Ross Ice Shelf wind flow studies (with collaborator, Dr. John Cassano)
• Snow accumulation studies
• State of the Antarctic climate

Fieldwork completed for 2009-2010

The 2009-2010 field team included Matthew Lazzara (O-283), Lee Welhouse (O-283), and Nicole Schroeder (O-283). Ms. Nicole Schroeder arrived in McMurdo 31 December 2009 and redeployed on 26 January 2010. Mr. Lee Welhouse and Dr. Matthew Lazzara deployed to McMurdo Station on 9 January 2010, and redeployed on 8 February 2010. Fieldwork was also done through cooperative programs with personnel from the Japanese Antarctic program (JARE), the French Antarctic program Institut Polaire Français - Paul Emile Victor (IPEV), the Mawson’s Hut Foundation, and the British Antarctic Survey (BAS). A total of 15 AWS were visited this field season.

Several AWS sites were not able to be serviced due to the reduced field deployment and the weather. Sites that had been expected to visit included Siple Dome and Minna Bluff AWS. New sites that did not get installed included the Tall Tower AWS site and three new AWS in the Pine Island Glacier area of West Antarctica: Thurston Island, Bear Peninsula and Pig Helo Camp Site C/Meyers Nunatak – to be installed by Dr. David Holland. These will be attempted again in the 2010-2011 field season.

Summary fieldwork follows:

A. McMurdo based operations (USAP/Wisconsin)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrell</td>
<td>8929</td>
<td>Retrieve ADG data, Replaced memory module, raised lower sensors</td>
</tr>
<tr>
<td>Willie Field</td>
<td>21364</td>
<td>Raised lower temperature probe</td>
</tr>
<tr>
<td>Windless Bight</td>
<td>8982</td>
<td>AWS raised; replaced ADG arm</td>
</tr>
<tr>
<td>Lettau</td>
<td>8928</td>
<td>Replaced Batteries</td>
</tr>
<tr>
<td>Pegasus North</td>
<td>8937</td>
<td>Fixed wind sensor mounting</td>
</tr>
<tr>
<td>Elaine</td>
<td>21375</td>
<td>Replaced AWS: new ADG and solar radiation sensors</td>
</tr>
<tr>
<td>Eric</td>
<td>8697</td>
<td>Raised AWS; recovered/replaced batteries</td>
</tr>
</tbody>
</table>
B. West Antarctic based operation (USAP/Wisconsin)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kominko-Slade (WAIS)</td>
<td>8936</td>
<td>AWS raised; electronics added to snow temperature string; Added battery</td>
</tr>
<tr>
<td>Byrd</td>
<td>8903</td>
<td>AWS raised – new tower and sensor boom -by Dr David Holland, Joe Petit, Susha Dore</td>
</tr>
</tbody>
</table>

C. South Pole (USAP/Wisconsin)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Pole</td>
<td>n/a</td>
<td>Test radiation shield AWS installed.</td>
</tr>
</tbody>
</table>

D. Palmer Station/Peninsula (USAP/Wisconsin)

No AWS serviced in the Palmer Station/Peninsula region

E. Field work in Adelie Land (France –IPEV)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-47</td>
<td>8916</td>
<td>Replaced AWS 8947 with AWS 8916</td>
</tr>
<tr>
<td>E-66</td>
<td>8947</td>
<td>Removed AWS 8912 with AWS 8947</td>
</tr>
</tbody>
</table>

See appendix for excerpts from report from IPEV

F. Field work in Adelie Land (Mawson’s Hut Foundation)

No AWS servicing due to cargo problems

G. Field work in Enderby Land (Japan – JARE)

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dome Fuji</td>
<td>8904</td>
<td>Replaced AWS with a new AWS</td>
</tr>
<tr>
<td>Relay Station</td>
<td>8918</td>
<td>Replaced AWS with a new AWS</td>
</tr>
</tbody>
</table>

H. Field work in Peninsula (United Kingdom – BAS) & AWS maintained cooperatively with the British Antarctic Survey

<table>
<thead>
<tr>
<th>Site</th>
<th>ARGOS ID</th>
<th>Service performed at site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismal Island</td>
<td>8932</td>
<td>Replaced AWS with a new AWS</td>
</tr>
</tbody>
</table>

See appendix for photos from BAS
Figure 1. A draft map of Antarctica showing the locations of the University of Wisconsin’s automatic weather stations (and other nations) for 2010. Identification of the sites is by the site name.
Servicing of Dismal Island AWS by British Antarctic Survey
(Photos Courtesy of Tasmin Gray, BAS)
Adelie Land AWS report

Nov 2009 / Jan 2010

Alain PIERRE
IPEV
Nov 2009 / Jan 2010
2) Cape Denison : ID8988

Type : independent anemometer and wind direction sensor (Same as Port Martin)
Electronic : AWS2D
Current Status: HWS is not working
Location : 67°0’5 / 142°39’E

This AWS is maintained by Mawson’s Hut expeditionners.

NB : For Cape Denison AWS, boxes has to be received at Hobart before end of Nov.

3) Port Martin : ID8909

Type : High wind system anemometer and wind direction sensor (Taylor Scientific)
Electronic : AWS2D with Telonics ST-5
Current status: Not working, Has to be replaced as soon as possible. (scheduled for Nov 2010)

Location : 66°49’S / 141°23’E

Actually Port Martin AWS can only be repaired during Nov, while Astrolabe vessel with 2 helicopters on board are not very far from Port Martin.

This year (Nov 2009) we went at Port Martin but unfortunately it was too windy to do any maintenance on it (80/km/h and higher wind with gusts).

The only parts which are in good conditions are :
- The mast
- Anchor points with steel chain and steel cable.

All others parts have to be replaced.
NB: Last summer season, AWS Port Martin box was not complete. One junction box was missing and terminations wire was not adapted at usual junction box plugs. However, replacement could still be done with some electrical adaptations and also because one spare junction box was available at Cap Prudhomme.

For others scientific reasons we have to go to Port Martin in Nov 2010 and we will try to install a new AWS station if AWS boxes are received at Hobart.

**NB:** Port Martin AWS boxes has to be received at Hobart before 10th of October.

### 4) D10: ID 30374

**Type:** RM Young mounted on Bendix base on sensor boom.
**Electronic:** Campbell CR10X  
**Current status:** Working ok  
**Location:** 66°42'S / 139°50'E

![D10 AWS (Feb 2010)](image1) ![D10 AWS: Electronic box](image2)

**Maintenance schedule:**
- Due to annual snow, we will probably add a section mast during 2010-2011 summer season.

### 5) D47: ID8916

(installed in Feb 2010)  
**Type:** RM Young mounted on Pipe all sensors independent mounts to tower  
**Electronic:** AWSCR1000 with Telonics ST-20 PTT ID 8916  
**Current Status:** Transmitting need to check data but would assume is OK  
**Location:** 67°23'S 138°43,4'E

**NB:** Actual section mast used is smaller (IPEV mast) than AMRC section mast size. Keep in mind for next time when maintenance will be done.

![D47. (Janv 2010)](image3)
6) **E66 : ID8947**

installed in Jan 2005 at D47 and removed in Jan 2010 for E66  
**Type**: Bendix on sensor boom  
**Electronic**: AWS2B with Telonics ST-5 PTT  
**Current status**: Working OK  
**Location**: XXXXX / XXXXX  

Maintenance schedule:  
- Due to annual snow, we will probably add a section mast during 2010-2011 summer season.

![E66 AWS (Feb 2010)](image)

7) **D85 : ID8986**

**Type**: RM Young on Bendix base on sensor boom  
**Electronic**: AWS2B Telonics ST-5 PTT  
**Current Status**: Working OK  
**Location**: 70°25.6'S 134°08.8'E  

Photos ?
COMPOSITE ANALYSIS OF THE SURFACE EFFECTS OF EL NINO SOUTHERN OSCILLATION TELECONNECTIONS ON ANTARCTICA

Welhouse, L.J.\textsuperscript{1*}, Lazzara, M.A.\textsuperscript{2}, Tripoli, G.J.\textsuperscript{1}, Keller, L.M.\textsuperscript{1}

\textsuperscript{1}Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison
\textsuperscript{2}Antarctic Meteorological Research Center, Space Science and Engineering, University of Wisconsin-Madison

1. Introduction

Significant work has been done on identifying and understanding upper level height anomalies associated with El Nino Southern Oscillation (ENSO) events in the Amundsen and Bellingshausen Sea regions. (Turner 2004) This work focuses on the effect these teleconnections have on the Antarctic continent and adjacent Southern Ocean. Composites of ERA-40 (European Centre for Medium-Range Weather Forecasting Re-analysis) data from 1979-2002 of ENSO events, as determined by the Multivariate ENSO Index (MEI), illustrate how these events affect the surface variables (e.g. pressure, temperature, etc.). These composites consist of monthly averaged data compiled into three month seasons, with emphasis on December, January, and February as this is generally the period of maximum ENSO intensity. To ensure the accuracy of these findings regions with values exceeding the confidence intervals are compared with ground based Automatic Weather Stations (AWS) from the University of Wisconsin-Madison that have not been used in the reanalysis. Though the values vary considerably, during the strongest ENSO periods, we note significant warming (cooling) over much of the continent primarily focused in the East Antarctic during El Nino (La Nina) events. Significant high pressure anomalies are found during El Nino events focused in the Amundsen-Bellingshausen Sea regions, and extending to the Ross Ice Shelf and the Antarctic Peninsula. During La Nina events low pressure anomalies are evident throughout the continent.

2. Data

Throughout this study we have used the ERA-40 data set for surface temperature, pressure, wind, and humidity values due to it having higher correlations with observations (Bromwich 2004) during the post satellite era (1980-2002). We have also used the AWS dataset as a means to check the accuracy of the reanalysis during times when AWS stations weren't assimilated.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{aws_network.png}
\caption{A map of the current AWS Network}
\end{figure}

For our composite analyses we have created two different sets of composites, for both El Nino and La Nina events. The first of these composites consist of using all months during all events, as determined by the MEI, to determine the overall affect these events have on the Antarctic continent. The second set of composites involves using three-month seasonal time sets. The timeframe of three months was chosen as it matches with the time frame used to calculate the ENSO indices used. These composites allow us to observe differences in the anomaly patterns between typically weaker seasons (April, May, June) and typically stronger seasons (December, January, February). In all composites the events are compared against the average values.

b. AWS Network

Throughout this process the reanalysis is compared with the observational network (Figure 1) during times we are certain the weather station data has not been assimilated. As the reanalysis discontinued using AWS station data in 1998, a period of 44 months remains available in the ERA-40 dataset that we are able to compare with. We have also checked prior to this time for stations that have gone unused to ensure consistency between the Re-analysis and the observations. To compare between the grid points of
the reanalysis and observation network the weighted average of the nearest four points in the reanalysis was used. Initial findings indicate there is a strong correlation, on the order of .95, between the two datasets.

c. MEI

In this study we have chosen to use the Multivariate ENSO Index as our metric for determining ENSO events. This index utilizes the first principal component of the weighted average of sea surface temperatures, sea level pressures, surface wind speeds, cloudiness, and precipitation. (Wolter, K. 1993) It seems to be a more accurate representation of ENSO events than the more commonly used Southern Oscillation index. Similar compositing techniques were used with SOI as a metric, and while they showed similar results they showed a less robust signal in general.

3. Analysis

This section will focus on understanding the effects ENSO has on Antarctic near surface temperature anomalies. Though our analysis extends to pressure, and will extend to wind speed and direction as well as relative humidity for this section we are focusing on temperature as seen in the yearly and seasonal composites.

a. Full Year

1. El Nino

This composite shows a general effect that remains consistent with prior understanding of the teleconnection in the Amundsen-Bellinghausen Sea with a few new, potentially important additions. In the case of the El Nino (Figure 2) event we note a relatively strong warming in the Amundsen-Bellinghausen sea region with the statistically significant warming extending somewhat into the Ross Ice Shelf. We also note a cooling just off the Antarctic Peninsula near the Weddell Sea. These two features make physical sense when you consider the teleconnection is generally expressed as an upper level height anomaly, and the associated flow can account for these temperature changes. Analysis of the pressure field indicates this as a likely cause. On the other hand the region of cooling in the Amery Ice Shelf seems disconnected from the upper level height anomalies, and because it is statistically significant it warrants further exploration.

2. La Nina

This composite is also consistent with prior work on the subject, with weaker warming being centered more closely to the Antarctic Peninsula and a region of cooling located north of the Ross Sea. These features seem to be linked to the upper level teleconnection in the same general area. We also see that much of East Antarctica has moderate cooling occurring. Much like the Amery Ice Shelf cooling this region warrants more study as to why this is occurring.

Figure 2: A composite of Full Year temperature anomalies during El Nino events with black lines indicating the 95% confidence interval.

b. Seasonal

1. El Nino

Throughout this section we will focus on two particular seasons, July-September and November-January. These two seasons are quite different. First we note July-September (Figure 4) is generally a season where the event is still growing in intensity. In this composite we note the expected features associated with the teleconnection, but also a region of weak warming on the Queen Maud Land coast that isn’t associated with the upper level flow. This seems to be associated with a strong negative surface pressure anomaly. November-January (Figure 5) is moving toward months where we see the strongest ENSO activity. During this period we note relatively strong, significant, warming throughout much of the continent, with the only regions...
lacking this warming being the Ross Ice Shelf and the Antarctic Peninsula. Much of this seems to be disconnected from the Amundsen Bellingshausen Sea teleconnection, which shows up quite strongly in the surface pressure composites.

Antarctic generally running along the Transantarctic Mountains

![Figure 4: A composite of the July-September temperature anomalies during El Nino events with black lines indicating the 95% confidence interval.](image)

![Figure 6: A composite of the July-September temperature anomalies during La Nina events with black lines indicating the 95% confidence interval.](image)

![Figure 5: A composite of the November-January temperature anomalies during El Nino events with black lines indicating the 95% confidence interval.](image)

![Figure 7: A composite of the November-January temperature anomalies during La Nina events with black lines indicating the 95% confidence interval.](image)

2. La Nina

Again we focus on the July-September and November-January time periods. In July-September (Figure 6) we note two areas of interest, the first being strong warming throughout much of the West Antarctic, specifically focused in Marie Byrd Land and Ellsworth Land. This feature seems connected with the teleconnection. On the other hand there is a region of cooling in Wilkes Land that requires more study. Moving on to the November-January (Figure 7) season much has changed. There is little to no signal in the regions associated with the teleconnection in the West Antarctic, but the cooling in East Antarctic remains strong but has grown to cover most of the East

4. Future Work

With the recent release of newer long-term Re-analysis products that extend through 2009 we hope to expand this study to capture more events. Also expanding the analysis to view humidity as well as wind speed an direction is a necessary step toward understanding the full effects these events have. Also, recent research has shown that the Southern Annular Mode has a strong effect on the variability of the high latitude teleconnections associated with ENSO events. (Fogt R.L. 2006) As such we hope to determine the effect including SAM events has on our findings.
5. Acknowledgements

The National Science Foundation Office of Polar Programs Grant # ANT-0636873 supported this research.

6. References


Annual Report for Period: 09/2009 - 08/2010

Principal Investigator: Cassano, John J.
Organization: U of Colorado Boulder

Submitted By:
Cassano, John - Principal Investigator

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: Nigro, Melissa
Worked for more than 160 Hours: Yes
Contribution to Project:
Melissa Nigro (maiden name: Richards) has worked on this project as a graduate research assistant since fall 2009. Her research is focused on the dynamics of high wind events over the Ross Ice Shelf.

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

July 2009 to August 2010

The primary research activity at the University of Colorado during the past year has been an analysis of high wind events over the southern Ross Ice Shelf using data from the recently installed Sabrina AWS (installed Feb 2009). CU grad student Nigro (formerly Richards) has identified several high wind events at Sabrina AWS and is using a combination of AWS observations and output from AMPS to analyze the dynamics of these high wind events.

A manuscript detailing a synoptic climatology based method for evaluation of numerical weather prediction forecasts using in-situ observational data has been submitted for publication in Weather and Forecasting. This manuscript uses AWS data to evaluate AMPS forecasts in the Ross Sea sector under a variety of different synoptic weather regimes. CU grad student Nigro is the lead author on this manuscript. This manuscript also served as the basis for Nigro's comprehensive exam for her Ph.D.

Conferences attended / presentations

Cassano attended the Antarctic Meteorological Observation, Modeling, and Forecasting workshop in Charleston, SC (July 2009).


Nigro attended the Polar Technology meeting in Boulder, CO (March 2010)

Nigro attended the Antarctic Meteorological Observation, Modeling, and Forecasting workshop in Columbus, OH (July 2010).

Richards (Nigro), M.A. and J.J. Cassano, 2010: An analysis of the low-level wind field over the Ross Ice Shelf, Antarctica. Antarctic Meteorological Observation, Modeling, and Forecasting workshop, Columbus, OH, July 2010 (oral).


Cassano attended the Scientific Committee on Antarctic Research Open Science Conference, Buenos Aires, Argentina (August 2010).

June 2008 to June 2009

coi-PI Cassano and grad student Richards took part in the 08/09 AWS field season at McMurdo station, servicing stations on the Ross Ice Shelf and in West Antarctica.

A new station (Sabrina AWS) was installed at 84.25S, 170W to observe the low-level wind field over the southern Ross Ice Shelf, adjacent to the Transantarctic Mountains.

Grad student Richards continues to assist with QCing AWS data from sites on and near the Ross Ice Shelf.

Grad student Richards is continuing an AWS based evaluation of Antarctic Mesoscale Prediction System forecasts. A manuscript describing this work is currently in preparation and this work will serve as a significant portion of Richards oral Ph.D. comprehensive exam.

Richards is also contributing to an observational and model based synoptic and mesoscale cyclone climatology in the Ross Sea sector.

A climatology of Southern Ocean cyclones (Uotila et al., 2009) is currently in press in JGR. co-PI Cassano was a co-author on this paper.

Conferences attended / presentations

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


Iowa State University, Department of Geologic and Atmospheric Sciences, September 2008


American Geophysical Union Fall Meeting, San Francisco, CA, Dec 2008


McMurdo Station, January 2009


9th Malaysian International Seminar on Antarctica, Kuala Lumpur, Malaysia, April 2009


40th Conference on Polar Meteorology and Oceanography, Madison, WI, May 2009


Other presentations given at conferences not attend by University of Colorado project participants:


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:
July 2009 - August 2010

Two extreme high wind events were identified at Sabrina AWS during August and September 2009. The wind speed during these events exceeded 15 m/s for more than 48 h. The peak wind speed observed was 24 m/s.

June 2008 - June 2009

The location of the newly installed Sabrina AWS site was selected based on simulations from the Antarctic Mesoscale Prediction System (AMPS). This location has the strongest simulated winds over the Ross Ice Shelf in the Antarctic Mesoscale Prediction System (AMPS). Observations from Sabrina AWS from February through April indicate a mean wind speed of 5.4 m/s, which is substantially slower than that indicated by AMPS (12.5 m/s). Work is on-going to understand the source of this discrepancy between the observed and modeled winds at this location. The dynamics of the strong winds in AMPS is still in debate in the literature (Seefeldt et al. suggested this is a tip jet while Steinhoff et al. suggest that this feature is a knob jet), and we are hoping that the new observations from Sabrina AWS will help resolve this issue.

The AWS based evaluation of AMPS has indicated variable skill in the AMPS forecasts, dependent on the variable and location considered. Further, some simulated variables show variable skill as a function of varying synoptic weather patterns, while other variables show little change in skill as synoptic weather patterns vary.

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 Nigro (maiden name Richards) is a fourth year graduate student in the Department of Atmospheric and Oceanic Sciences at the University of Colorado, and has been supported as a graduate research assistant on this project since fall 2009. Ms. Nigro's research will focus on the dynamics of high wind events over the Ross Ice Shelf. A secondary research focus has been on evaluating Antarctic Mesoscale Prediction System (AMPS) forecasts. Ms. Nigro gained Antarctic field experience from her participation in the 2008/09 AWS field season and will participate in the 2010/11 AWS field season.

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.

Grad student Richards gave a presentation at a Saratoga, NY K12 school prior to her Antarctic deployment (Dec 2008) to discuss Antarctic
science and field work.

- PI Cassano gave three invited talks during the period June 2008 - June 2009 which were based, in part, on Antarctic research funded by this award. One of the invited talks was given as part of an undergraduate seminar series in the Department of Geologic and Atmospheric Sciences at Iowa State University. The other two invited talks were given at the 4th Malaysian International Seminar on Antarctica.

**Journal Publications**


**Books or Other One-time Publications**


  Editor(s): David W. H. Walton

  Collection: Antarctica - Global Science From a Frozen Continent

  Bibliography: Cambridge University Press

**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:**
Our analysis of Antarctic cyclones and high wind events and evaluation of Antarctic numerical weather prediction models will allow for improved operational weather forecasting in the Antarctic, which benefits all Antarctic field related activities.
Contributions to Human Resource Development:
Funds from this project are being used to support a PhD student (Melissa Nigro, maiden name Richards) in the Department of Atmospheric and Oceanic Sciences at the University of Colorado. Ms. Nigro 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 serves as the University of Colorado node on the Antarctic LDM network and also provides computational resources for project participants at the University of Colorado.

Contributions Beyond Science and Engineering:

Conference Proceedings

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 Beyond Science and Engineering
Any Conference