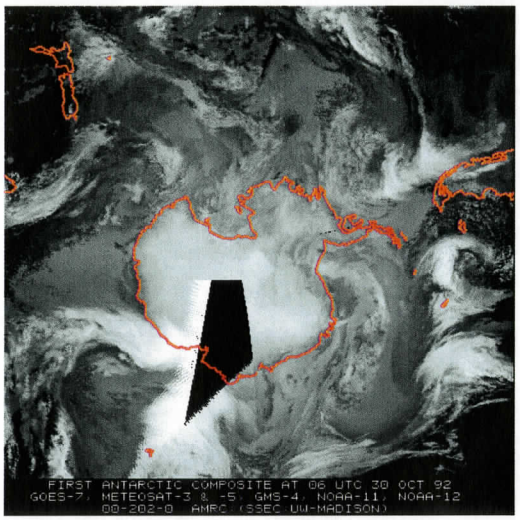
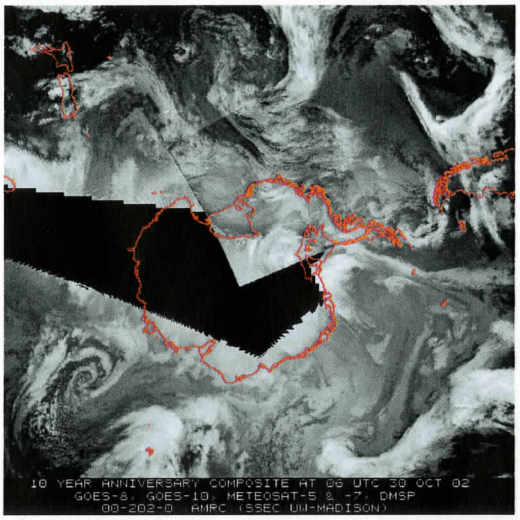
AMRC Final Project Report: NSF-OPP Grant #9908842, October 1, 2000 to March 28, 2003

Antarctic Meteorological Research Center (AMRC): 1999-2003

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

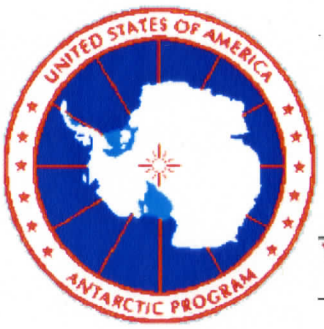


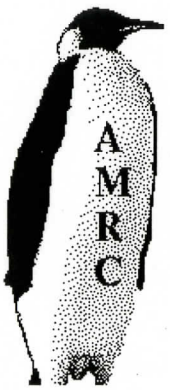


Professor Charles R. Stearns, Principal Investigator
Matthew A. Lazzara, co-Investigator

Space Science and Engineering Center
University of Wisconsin-Madison

Submitted on June 10, 2003





Final Report for Period: 10/2000 - 03/2003
Submitted on: 06/10/2003
Principal Investigator: Stearns, Charles R.
Award ID: 9908842
Organization: U of Wisconsin Madison
Title:
Antarctic Meteorological Research Center (AMRC): 1999-2003

Project Participants

Senior Personnel

Name: Stearns, Charles
Worked for more than 160 Hours: No
Contribution to Project:
During the grant, Dr. Charles R. Stearns, directed the Antarctic Meteorological Research Center as Principal Investigator.

Name: Lazzara, Matthew
Worked for more than 160 Hours: Yes
Contribution to Project:
During the grant, Matthew Lazzara worked on the day to day activities of the AMRC, including all data management, handling data requests and questions, conducting educational outreach, as well as doing the initial fog particle collection work.

Post-doc

Graduate Student

Undergraduate Student

Name: Staude, Jessica
Worked for more than 160 Hours: No
Contribution to Project:
Jessica Staude has worked on the project in two related areas - assisting in the update of the AMRC Antarctic composite video tape and employing that information in a first ever climatological study of cloud mass transport around and over the Antarctic.

Technician, Programmer

Name: Lindstrom, Scott
Worked for more than 160 Hours: No
Contribution to Project:
Scott Lindstrom has worked to create new software/data server capabilities with regards to the use of Level 1b formatted satellite datasets within the AMRC data servers and software systems.

Name: Benson, John
Worked for more than 160 Hours: No
Contribution to Project:
John Benson has provided some key programming and software solutions to assist the AMRC staff with data acquisition and archiving.

Name: Krauss, Robert
Worked for more than 160 Hours: No
Contribution to Project:
Robert Krauss has assisted the AMRC with some minor software to assist other AMRC staff with correctly calibrating a subset of critical satellite data in AMRC's data archive.

Other Participant

Name: Roth, Barry
Worked for more than 160 Hours: No
Contribution to Project:
Barry Roth has assisted the AMRC in assembling some docuementation about the AMRC to be used in outreach activities.

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

N/A

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)
The Antarctic Meteorological Research Center (AMRC) at the Space Science and Engineering Center (AMRC), University of Wisconsin-Madison (UW-Madison) has the following mission:

> Research in observational meteorology and the stewardship of meteorological data along with the ability to provide such data and expert assistance to the Antarctic community in support of research and operations.

In keeping with its mission, the AMRC has accomplished its core activities during this grant. These accomplishments include collecting, archiving, generating, and maintaining meteorological data from the Antarctic and adjacent Southern Ocean. The centerpiece of AMRC's core activities is generating the Antarctica infrared composite satellite imagery (See Figure 1). In addition, this has been expanded to routinely create Antarctic water vapor composite satellite imagery (see Figure 2). The AMRC data collections and holding include:

* Antarctic Composites (Infrared and Water Vapor)
* POES/NOAA Local Area Coverage (LAC) data
* POES/NOAA High Resolution Picture Transmission (HRPT) data {as a backup for AMRC's sister center, the Arctic and Antarctic Research Center at Scripps Institute of Oceanography}
* GMS satellite cloud drift and water vapor wind charts
* Synoptic/Manned station reports (especially from the USAP stations)
* Meteorological aviation surface hourly reports (METAR)
* Upper-air reports (especially from the USAP stations)
* Ship and buoy observations
* Numerical weather prediction forecasts and analyses from National Center for Environmental Prediction Center (Global Forecast System and Wind and Wave Forecast Model), European Center for Medium Range Forecast Center model, and United Kingdom Meteorology Office model.

All of this data is available to the public without charge.

In accomplishing the core objectives of the project, AMRC has offices at SSEC/UW-Madison, as well as Crary Science and Engineering Center (CSEC), McMurdo Station, Antarctica. During this grant, only one deployment was made to the AMRC/CSEC at McMurdo in January and February of 2003. During this deployment the following activies were accomplished:

* Upgraded software and operating system on AMRC computers with help from RPSC support staff.
* Created a web page to display meteorological data on-station for multiple uses including weather forecasting, supporting special science projects, and general use. This effort also saves deployed personnel from having to look for weather information off station, clogging up the already stressed outgoing internet connection in McMurdo.
* Trained RPSC personnel on the care of the AMRC equipment.
* Held discussions with Mac Weather/SPAWAR/ATS and RSPC meteorology staff regarding data acquisition and transfer
* Assisted with the meteorological display needs for the Long Duration Balloon Project

* Gave tours to distinguished visitors
* Worked on acquiring more McMurdo area meteorological data for the AMRC collection from Black Island, Building 71, Arrival Heights and Crary Lab.
* Initial work has been started on reviewing the nearly ten and half year archive of the Antarctic composite imagery for climatological characteristic analysis.

In addition, during this deployment and at the end of this grant, initial ground work on studying local fog events in the McMurdo Station/Ross Island region was started.

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

The results of the work accomplished as a part of this project include the following:

1. Continued generation of Antarctic infrared composite imagery, up through its 10th anniversary image and beyond

2. Began the generation of Antarctic water vapor composite imagery.

3. Continued data collecting, archiving, and distributing Antarctic meteorological data.

4. Improved web and FTP sites for offering data, both archived and real-time. A primary and secondary or backup capability is now available for the AMRC web and FTP sites:

http://amrc.ssec.wisc.edu
http://ice.ssec.wisc.edu
ftp://amrc.ssec.wisc.edu
ftp://ice.ssec.wisc.edu

5. Collected and observed the first fog droplets in the Ross Island Region/McMurdo Station, Antarctic which lays the foundation for future studies on Antarctic fog. (See Figure 3)

6. Began the analysis of AMRC's Antarctic infrared composite satellite images for cloud mass transport events that seem to occur in preferred sectors of the Antarctic (See Figure 4)

Throughout the project, other groups in the operational, research and educational sectors have benefited from AMRC. Some examples include use of Antarctic composites for forecasting, use of AMRC datasets for research, or AMRC staff answering school children's questions about the Antarctic and Antarctic meteorology.

Training and Development:

This project has brought a variety of new skills and experience in the following subject areas to the grant participants:

Computer science
Polar Meteorology
Cloud Physics

Specific skills include constant learning in the area of computing. The AMRC project is staffed by meteorologists who must make use of computer systems. Hence, the grant participants are exposed to new developments with regards to hardware and software. Although these experiences are informal, they are a valuable part of training and development of the grant participants.

In the remaining sub-disciplines of meteorology, this project has given the participants a front row view of how observational data is critical to our own research and the research of others. The AMRC plays a key role in facilitating polar meteorological research activities for other researchers and scientists in the Antarctic/polar meteorology arena.

One unique example is in the arena of clouds physics. The methods to collect and observe fog droplets are more like those of a traditional microbiologist rather than meteorologist (e.g. collecting samples, observing the samples under a microscope, etc). Yet, these skills will be an important foundation for the participants to build on for future research projects.

Outreach Activities:

The AMRC project has placed outreach on equal footing with its central mission. In doing so, AMRC participants over the term of the project

have visited local and non-local schools, used e-mail communication with students while deployed to Antarctica, given on-site demonstrations at both SSEC/UW-Madison and CSEC/McMurdo Station, worked in conjunction with the Teachers Experiencing Antarctica program, and responded to over 1000 e-mails answering questions and providing data or information to students and the public. This grass-roots educational outreach has involved multiple levels of the United States educational system. Some of the groups the AMRC has outreached to are outlined below:

General Public:

* Norwood Hospital Auxillary, Norwood, MA
* Charles River Lodge Masons, Medway, MA
* WORT-FM Radio Interview, Madison, WI

University:

* Wisconsin Space Grant Consortium at UW-Madison
* Project ASPIRE at UW-Madison

High School:

* Hopkinton High School, Hopkinton, MA
* King Philip Regional High School, Wrentham, MA

Middle School:

* Lodi Middle School, Lodi, WI

Elemenary:

* Mendota Elemenary School, Madison, WI
* Luther and Purdy Elemenary Schools, Ft. Atkinson, WI

Journal Publications

Lazzara, M.A., L.M. Keller, C.R. Stearns, J.E. Thom, and G.A. Wiedner, "Antarctic Satellite Meteorology: Applications for Weather Forecasting", Monthly Weather Review, p. 371, vol. 131, (2003). Published

Monaghan, A.J., A.J., D.H. Bromwich, H. Wei, A.M. Cayette, J.G. Powers, Y.H. Kuo, and M.A. Lazzara, "Performance of weather forecast models in the rescue of Dr. Ronald Shemenski from South Pole in April 2001", Weather and Forecasting, p. 142, vol. 18, (2003). Published

Books or Other One-time Publications

Web/Internet Site

URL(s):

1. http://amrc.ssec.wisc.edu
2. http://ice.ssec.wisc.edu
3. ftp://amrc.ssec.wisc.edu
4. ftp://ice.ssec.wisc.edu

Description:

These web and FTP sites are the primary and secondary AMRC web sites and FTP locations offering real-time meteorological data, links to AMRC's archival data and other Antarctic meteorological data, observations and information. These sites are shared with AMRC's sister project, the Antarctic Automatic Weather Station Project.

On average, the AMRC web sites see 8 to 10 Gigabytes of data downloads per month while the AMRC ftp sites see a more variable 1 to 6

Gigabytes per month, depending on specific data requests from interested parties. Typically several hundred hosts connect to the web and ftp sites on a monthly basis.

Other Specific Products

Product Type: Data or databases

Product Description:

AMRC Data Collection (Real-time and Archive)

The AMRC has acquired, archived and created a significant collection of Antarctic meteorological data. The following summarizes the collection:

Satellite Data

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* Antarctic composite (infrared and water vapor)
* GMS satellite derived wind charts (cloud drift and water vapor)
* NOAA POES data (HRPT from McMurdo, GAC (Project FROST), LAC)
* DMSP data (real-time RTD only)

Observational Data

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* METAR Surface aviation observations **
* Pilot report/Air report observations
* Synoptic/Manned Station observations **
* Radiosonde/Upper Air observations **
* Ship and Buoy observations

**Special emphasis on USAP station data

Forecasts and Analyses

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* Terminal Aerodrone Forecasts
* Global Forecast System (aka Medium Range Forecast Model) from NCEP
* Wind and Wave Forecast Model from NCEP
* UK Met Office model
* European Center for Medium Range Weather Prediction model

Sharing Information:

This collection is shared with researchers, operational forecasters, educators and the general public via the following means:

* AMRC's Web and FTP and McIDAS ADDE servers
* Filing of AMRC data information using data interchange format (DIF) metadata with the Antarctic Master Directory at the National Snow and Ice Data Center/NASA Global Change Master Directory
* AMRC's infrared composite data distributed via NSF funded Unidata program's Internet Data Distribution (IDD) system
* AMRC to be a future participant in the NSF funded Unidata THREDDS program.
* "Advertised" via talks/presentations at meetings and lectures (such as American Meteorologicial Society Meetings, Wednesday Science Lectures at McMurdo Station, etc.)
* Word of mouth

Contributions

Contributions within Discipline:

The AMRC project has and continues to make a significant contribution to Antarctic meteorology in multiple ways. First, the generation of the

one-of-a-kind Antarctic composite reached a ten year milestone during this grant. The composite has been used extensively over the years by many, including forecasters, researchers, educators, and book publishers. The image collection is nearing a significant climatological sample of satellite observations over and around the Antarctic. The second contribution the AMRC project has to offer to Antarctic meteorology is a significant data collection. This collection has been, is and will be the basis for research and educational activities. Finally, the AMRC project has worked to bring the importance of studying Antarctic meteorology to the educational community and general public.

Contributions to Other Disciplines:

As in the past, the AMRC project has aided disciplines outside Antarctic Meteorology by offering data and expertise to non-meteorological scientists and researchers (including Antarctic glaciology, etc.).

Contributions to Human Resource Development:

During the later half of this grant, this project started a contribution to the development of an undergraduate student and her research interest in Antarctic meteorology. Clearly, AMRC's educational and outreach activities may have future human resource impacts in science, engineering and technology. It is hoped that these efforts will lead to some taking an interest in science, engineering, or technology as a career.

Contributions to Resources for Research and Education:

Within the University of Wisconsin/Space Science and Engineering Center (SSEC), the AMRC is the polar meteorology center. This compliments other projects within SSEC, especially in bringing a polar meteorology point of view to the significant satellite meteorological studies taking place at SSEC. With regards to education, the AMRC is and will continue to be an educational resource to the students and university community hosting materials, information, expertise, and data about the Antarctic.

Contributions Beyond Science and Engineering:

This project offers to the general public its Antarctic meteorological data collection, along with its expertise, free of charge. The AMRC monitoring of the tabular icebergs (with a continued moderate public interest), unique and one of a kind displays of meteorological data (looked at routinely by interested citizens), an open-door resource to answering questions and clarifying conceptions (to the general public as well as other communities) are some examples of how the public can and do benefit from this project.

Categories for which nothing is reported:

Organizational Partners

Any Book

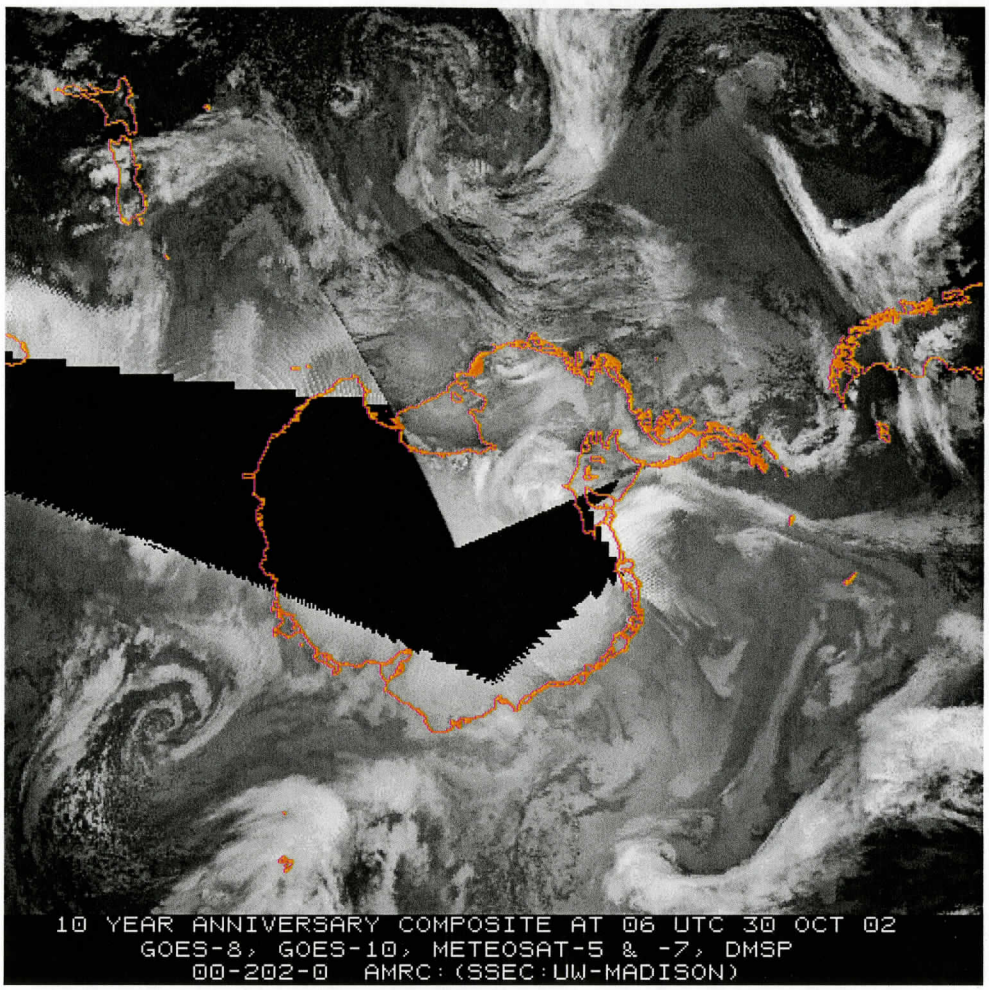


Figure 1. An infrared composite satellite image is shown here. This particular image marks the tenth anniversary that the AMRC has been generating these unique composites.

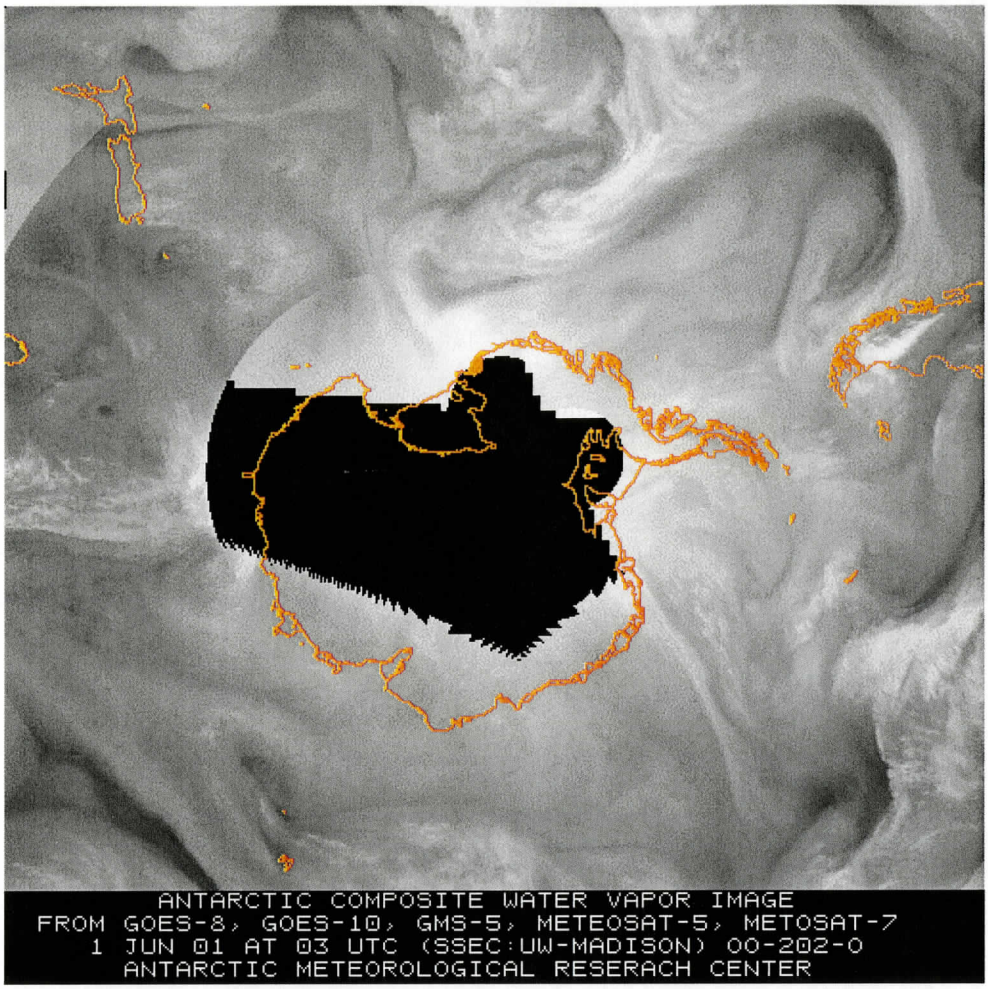


Figure 2. This is a sample Antarctic water vapor image made from a composite of geostationary satellite imagery.

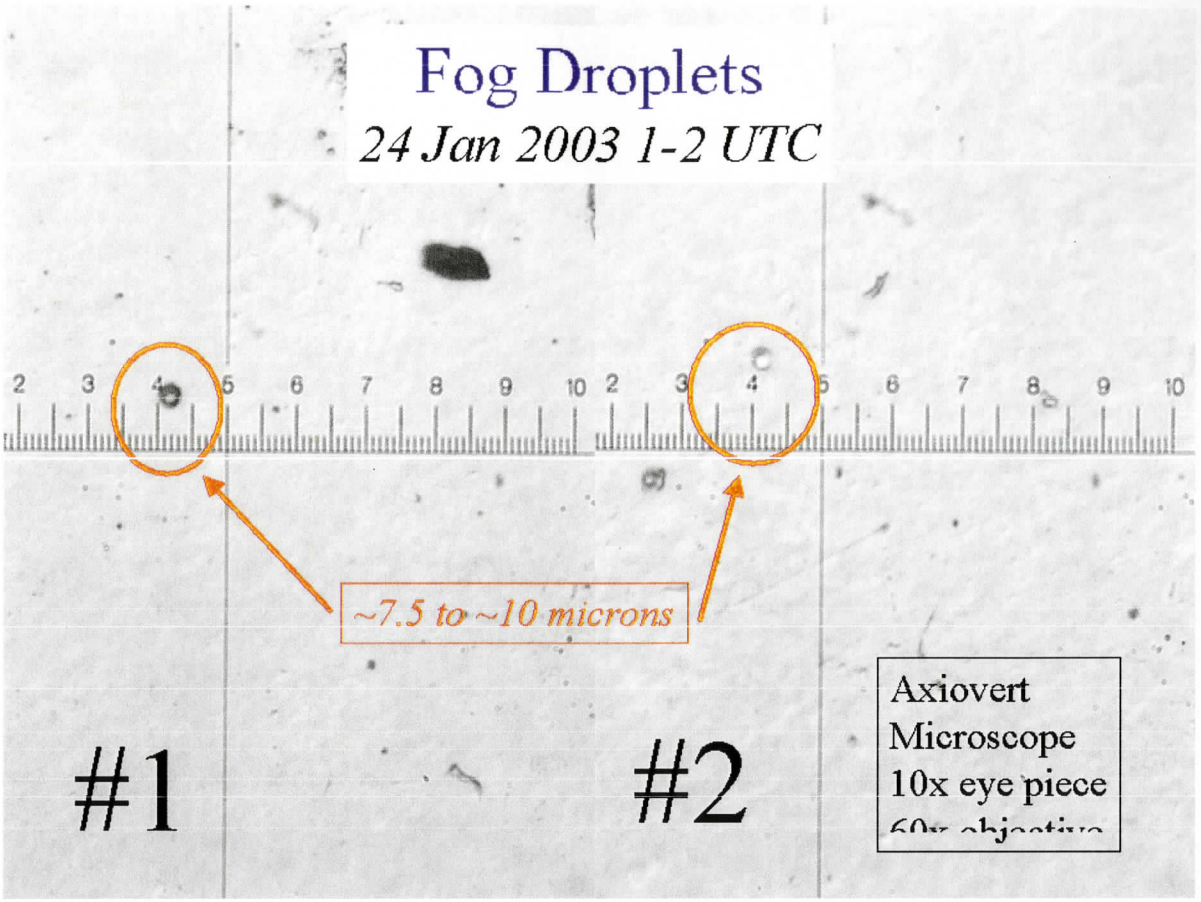
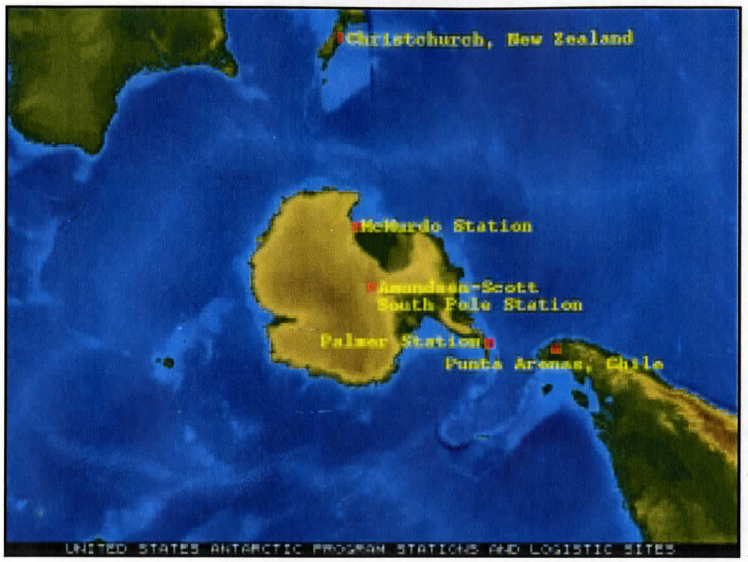


Figure 3 Digital images of fog droplets collect at Observation Hill at McMurdo Station, Antarctica.

The Antarctic Meteorological Research Center



Major stations and logistic sites in the United States Antarctic research program

Forecasts for a Forbidding Continent

Of all airline flights throughout the world, arguably none rely more on weather forecasting than the hundreds each year to and from McMurdo Station, Antarctica. These flights transport many of the 2,500 American scientists, researchers, support staff and their equipment around the harsh and unforgiving continent and its surrounding seas. Flights supporting the United States Antarctic Program (USAP) operate to or from Christchurch, New Zealand and other stations or field camps on the Antarctic continent.

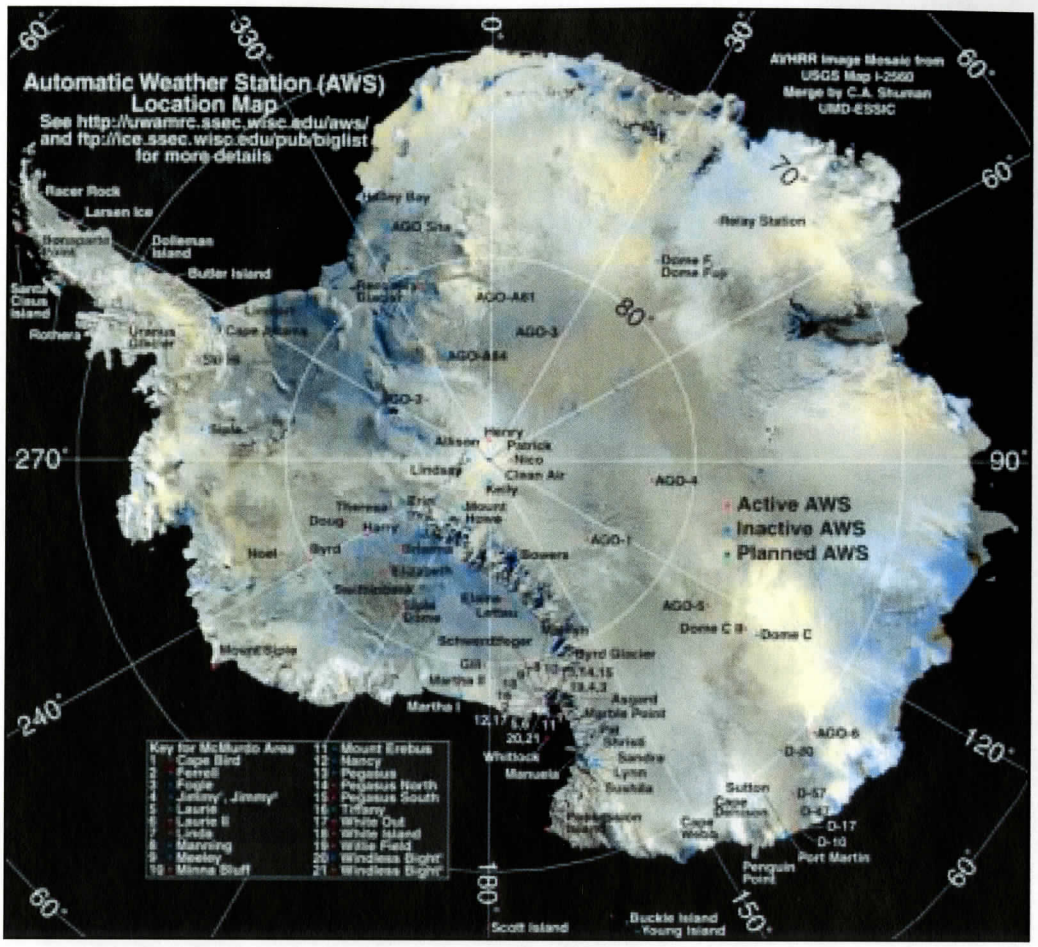
Most flights occur in the Antarctic summer, October to February, using the 109th New York Air National Guard and U.S. Air Force cargo planes. The flights are not only lengthy (more than 2,300 miles from McMurdo to Christchurch, and more than 800 miles from McMurdo to South Pole Station), but are also subject to some of the most dangerous and rapidly changing weather conditions in the world. Sudden hazardous changes in aviation weather, such as fog and blowing snow at the landing sites, account for most aborted flights, which typically number a dozen or more out of nearly 700 flights annually. Given a high concern for passenger safety, it is important that preflight weather forecasting be as accurate as possible. The typical cost of an aborted flight is $25,000 to $80,000, making it cost effective to prevent flights where weather conditions are poor at the landing site. The U.S. Space and Naval Warfare (SPAWAR) group is responsible for forecasting weather for these flights.

Accurate forecasting in a region as expansive and remote as Antarctica requires large amounts of informative and timely meteorological data. The Antarctic Meteorological Research Center (AMRC) at the University of Wisconsin–Madison's (UW–Madison) Space Science and Engineering Center (SSEC) supports advances in Antarctic meteorological research by making the necessary data readily available.

AMRC Mission

AMRC was founded in October 1992 when Professor Charles R. Stearns of the University of Wisconsin–Madison's Department of Atmospheric and Oceanic Sciences was inspired to combine multiple polar-orbiting and geostationary satellite images of Antarctica into a single composite image. These AMRC Composites are still generated today at SSEC using its McIDAS (Man computer Interactive Data Access System) software package. The composites present a view of all weather systems and their motion over the entire Antarctic continent and southern oceans (from the South Pole to about 40°S latitude). Stearns demonstrated their value while providing weather forecasts for research ships operating in the Antarctic region, and recognized their potential value in forecasting for Antarctic air travel, too.

With strong support from the director of the National Science Foundation's Office of Polar Programs, Dr. Peter Wilkniss, the AMRC's original mission



Automatic Weather Stations in Antarctica, 2000

was to collect, distribute and archive all meteorological data for the meteorological community. The goal is "one-stop shopping" for meteorological data for the Antarctic. The AMRC mission has expanded to include educational outreach.

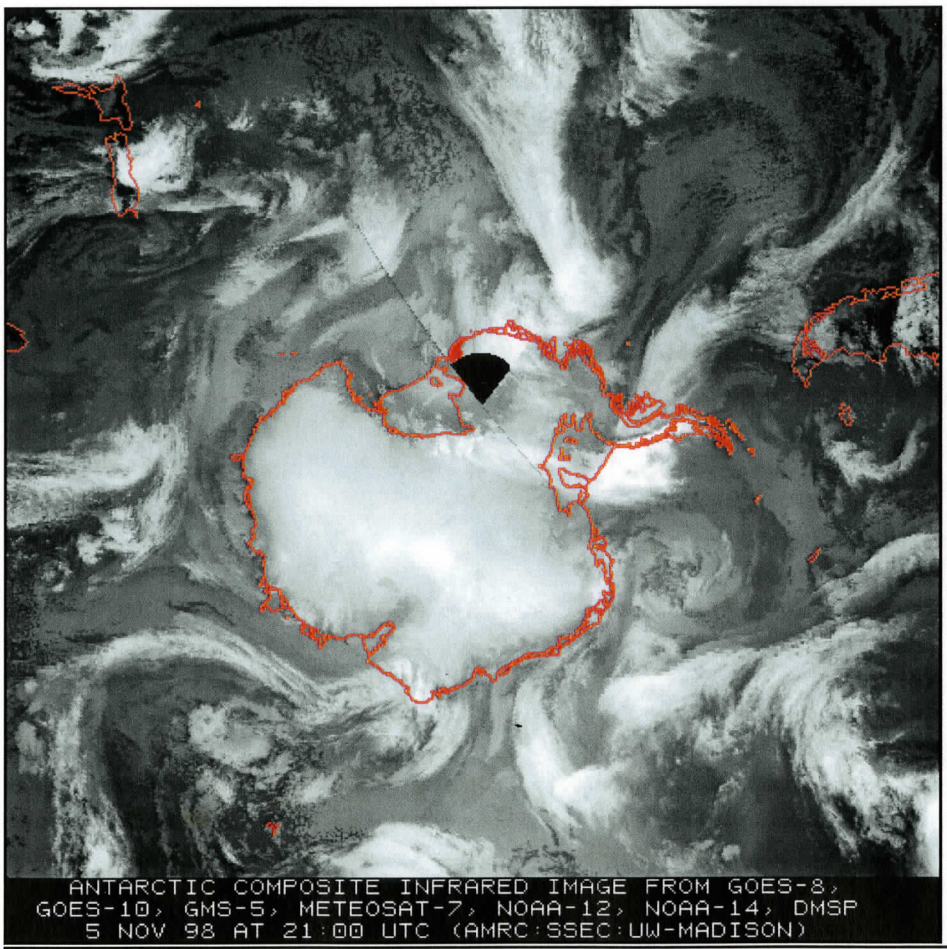
The AMRC is based in the Atmospheric, Oceanic and Space Sciences building at UW–Madison, but also has offices at the Crary Science and Engineering Center at McMurdo Station, Antarctica. AMRC is funded solely by the National Science Foundation's Office of Polar Programs. Related centers include the Scripps Institute Arctic and Antarctic Research Center (AARC) and the National Snow and Ice Data Center (NSIDC).

The Antarctic Automatic Weather Stations (AWS) project is collocated with the AMRC at SSEC. The AWS project designs, assembles, places and maintains automated weather station units in remote areas of Antarctica to support meteorological research and operations. About 56 UW AWS units are operating currently across the Antarctic continent. In collaboration with the United Kingdom, Japan and France, UW AWS units are installed in areas not easily reached by the U.S. Antarctic Program. The AWS data are collected by the ARGOS Data Collection System on board the National Oceanic and Atmospheric Administration (NOAA) series of polar-orbiting satellites. The AWS data form the basis of AMRC data holdings.

AMRC Data and Products

AMRC's signature product is the Antarctic Composite. These composites, which cover the region from the South Pole to about 40° S latitude, are produced every three hours, from 0 UTC. The AMRC archive contains all composites ever created, since October 1992.

Multiple geostationary and polar-orbiting satellite images are combined in each composite. Geostationary satellite data are provided by U.S. Geostationary Operational Environmental Satellites (GOES), European Meteosat satellites and Japan's Geostationary Meteorological Satellite (GMS). Polar-orbiting satellites used are U.S. Polar Orbiting Environmental Satellites (POES) and



Infrared AMRC Composite satellite image for 21 UTC, 5 November 1998.

Defense Meteorological Satellite Program (DMSP) satellites. Images are included in the composite if they have been taken within 50 minutes before the hour to 50 minutes after the hour; most are taken within 15 minutes of the hour. The calibration of all images selected for the composite is standardized so that temperature or color tones are similar throughout the composite. If a particular geographic region is not covered by any satellite, it is left blank. Thus the composites contain only real and timely satellite data. No older data or manipulation techniques are used to fill data-void regions.

AMRC Data Inventory

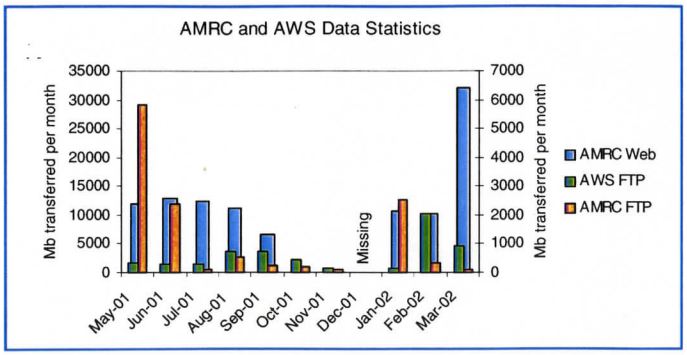
Data Type	Description	Dates
Satellite Imagery	1km resolution POES High Resolution Picture Transmission data from McMurdo Station region	Late 1992 to present
	1km resolution POES Local Area Coverage data	October 1998 to present
	3x5 km resolution POES Global Area Coverage data	12 July 1994–3 March 1996
	CIMSS GMS satellite water vapor and cloud drift wind plots/images	Plots, 10 June 1998 to present; images, 27 October 1997 to present
Observational	Synoptic reports (includes observations from USAP Stations)	1 January 1997 to present
	Meteorological Aviation Reports (McMurdo)	2 December 1998 to present
	Upper-Air reports (Including observations from USAP Stations)	Some data from 1957 to present, others 1 November 1996 to present
	Ship reports	Some from 23 Aug 1993 to present
Forecast Model	MRF/AVN analyses and forecasts	Analyses from 2 July 1993 to present; forecasts from 14 April 1994 to present
	WWFM analyses and forecasts	4 December 1998 to present
	UKMET analyses and forecasts	January 2000 to present
	ECMWF analyses and forecasts	5 December 1998 to present

From October 1992 through May 2001, only infrared composites (10.7–11.5 mm) were created and archived. Since then, both infrared and water vapor (6.5–6.9 mm) composites have been created and archived.

Besides its satellite composites, AMRC collects, generates and archives a vast array of Antarctic geophysical data. Data types include AMRC-generated products, satellite imagery, observational data and forecast model data. Many of these products and data are also disseminated in near-real time to U.S. Antarctic Program research and operations groups, including forecasters in Antarctica (the Navy's SPAWAR group).

Products and data are available from AMRC upon request and are free as long as they are used for a scientific or educational purpose. The products and data are available in many formats, including raw text, JPEG, GIF, netCDF, Flat (text or binary), and McIDAS (area, MD file, grid file, etc.). Products can also be tailored to individual requests. For example, a sequence of AMRC Composites with overlaid Synoptic and AWS reports and/or MRF forecast data could be created and saved as a series of GIF or JPEG images. Additionally, most AMRC data are available in real time on the Web site including composite still images and animation, current AWS data observations, plots of ship and buoy observation, weather balloon observations, and more. See "AMRC Future," p.6, for data types we hope to add.

Researchers, forecasters, and the general public actively use AMRC's Web and file transfer protocol (FTP) sites to view Antarctic meteorological data. Many thousands of megabytes of data are downloaded from AMRC's Web and FTP sites each month.

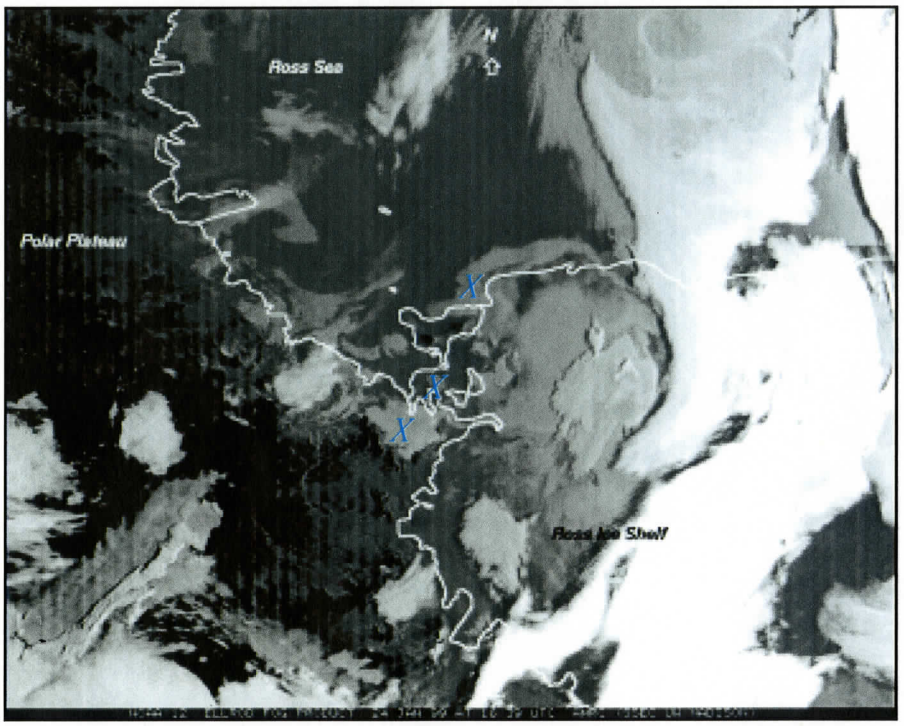


These statistics for May 2001 through March 2002 show the amount of data downloaded from AMRC's Web site and anonymous FTP sites. Some data are missing from October 2001 through January 2002 because of a change in computing systems. Use varies widely from month to month. Scale at the left refers to AMRC Web statistics; right scale applies to AWS and AMRC FTP statistics.

AMRC Research

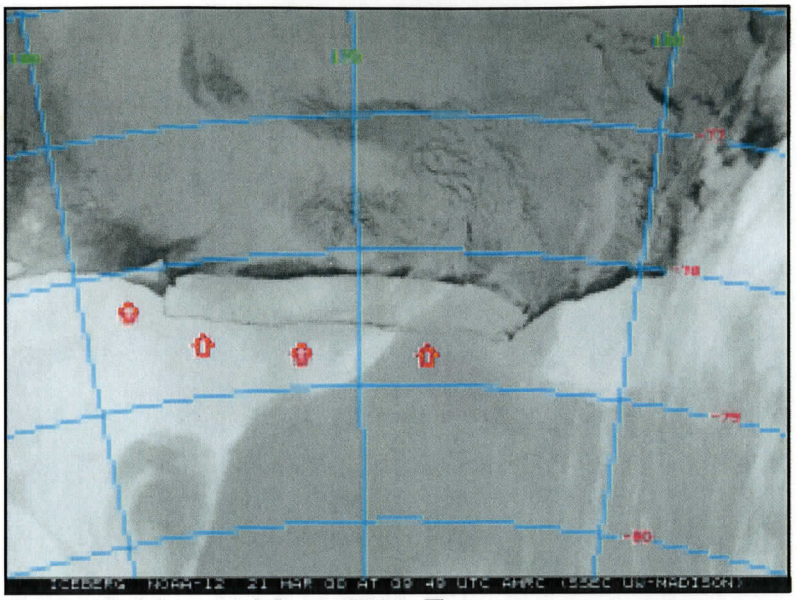
Extending its mission, AMRC conducts research using its data and products. For example, AMRC has embarked on fog-detection research around Ross Island. AMRC has presented studies on tabular iceberg monitoring, and maintains an up-to-date gallery of iceberg imagery on the Web site.

Fog is the most common reason for aborted flights to Antarctica. This underscores the importance of accurately detecting and forecasting fog. Research into fog detection and prediction is based upon AWS and manned observations complemented by MODIS (Moderate-Resolution Imaging Spectroradiometer) data from the EOS (Earth Observing System) polar-orbiting satellites Terra and Aqua.



Fog product image from the NOAA polar orbiting satellite. Fog (marked in bright blue) occurs near McMurdo Station's skiways and air strips. The product is inherently grainy.

AMRC began monitoring icebergs in October 1998. The AMRC gallery of iceberg photos contains polar-orbiting satellite data remapped to a common projection so that images from different times and days can be used to monitor iceberg calving and motion.



Iceberg B-15 on 21 March 2000. This image was captured by the NOAA-12 satellite at 9:49 UTC (or GMT) shortly after it calved and the AMRC began to monitor it.

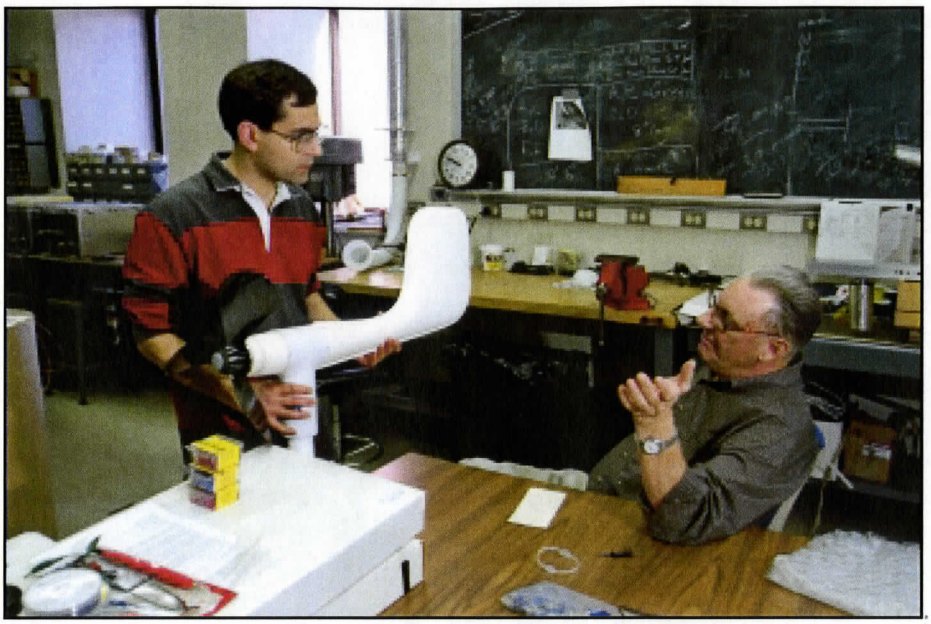
AMRC Future

AMRC looks forward to conducting case studies of significant Antarctic weather events. AMRC plans to offer 5 km resolution Antarctic Composites (currently available only at 10 km resolution). AMRC also hopes to upgrade animations produced in the past to newer media formats and to include recent composite images. This animation will give an unprecedented view of nearly ten years of weather system formation and movement in the Antarctic region. Additionally, AMRC will continue to monitor icebergs, continue fog-detection research, and maintain long-term meteorological data records. AMRC also plans to expand its outreach to include more public presentations.

AMRC hopes to play a central role in the upcoming Ross Island Meteorological Experiment (RIME). AMRC will be a RIME data center, and will work actively with participants. Data from the AMRC will be available to both forecasters and researchers in the field; intensive observing periods will be critical to the success of RIME. Similarly, weather observations from the AMRC database will be delivered to RIME numerical weather prediction modelers. These efforts will employ the data to better characterize the initial conditions in models, ultimately reaching the goal of improved weather forecast products.

AMRC People and Outreach

Emeritus Professor Charles R. Stearns, principal investigator, and Matthew A. Lazzara, co-investigator, lead the AMRC. Lazzara and the AMRC staff perform most day-to-day operations; they monitor data reception and product generation, add or adjust products, and respond to data requests and questions.



Matthew Lazzara and Emeritus Professor Charles Stearns discuss applications of Antarctic weather observations, in the Automatic Weather Station Laboratory. (Photo by Michael Forster Rothbart, UW–Madison University Communications)

AMRC receives roughly 900 e-mails each year from around the world—grade school through college students studying the Antarctic region, scientists and researchers, operational weather forecasters, broadcast and print media, weather enthusiasts—children and adults from many backgrounds and professions. Some e-mails request data, while many others ask about Antarctic weather or other physical and biological phenomena (everything from penguins to descriptions of living and working in Antarctica).

AMRC works to bring the excitement of Antarctic meteorology to students and the general public. AMRC staff members give about a dozen public presentations each year to schools and public groups. Also, AMRC aims to provide scientifically correct facts about Antarctica to its outreach audiences.

Contact Information

To contact the AMRC, send email to amrc@ssec.wisc.edu, call (608) 265-4816, fax (608) 263-6738 or send a letter to the address below.

Antarctic Meteorological Research Center
Atmospheric, Oceanic, and Space Sciences Building
1225 West Dayton Street
Madison, Wisconsin, USA 53706

Web Resources

You are also encouraged to visit the AMRC Web site and related Web sites at the University of Wisconsin.

AMRC Project	http://amrc.ssec.wisc.edu/
AWS Project	http://amrc.ssec.wisc.edu/aws/
AOS Department	http://www.aos.wisc.edu/
SSEC	http://www.ssec.wisc.edu/

The Web sites for AMRC's sister centers are listed below.

AARC	http://arcane.ucsd.edu/
NSIDC	http://www-nsidc.colorado.edu/

Collaborators are listed on the AMRC Web site.

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