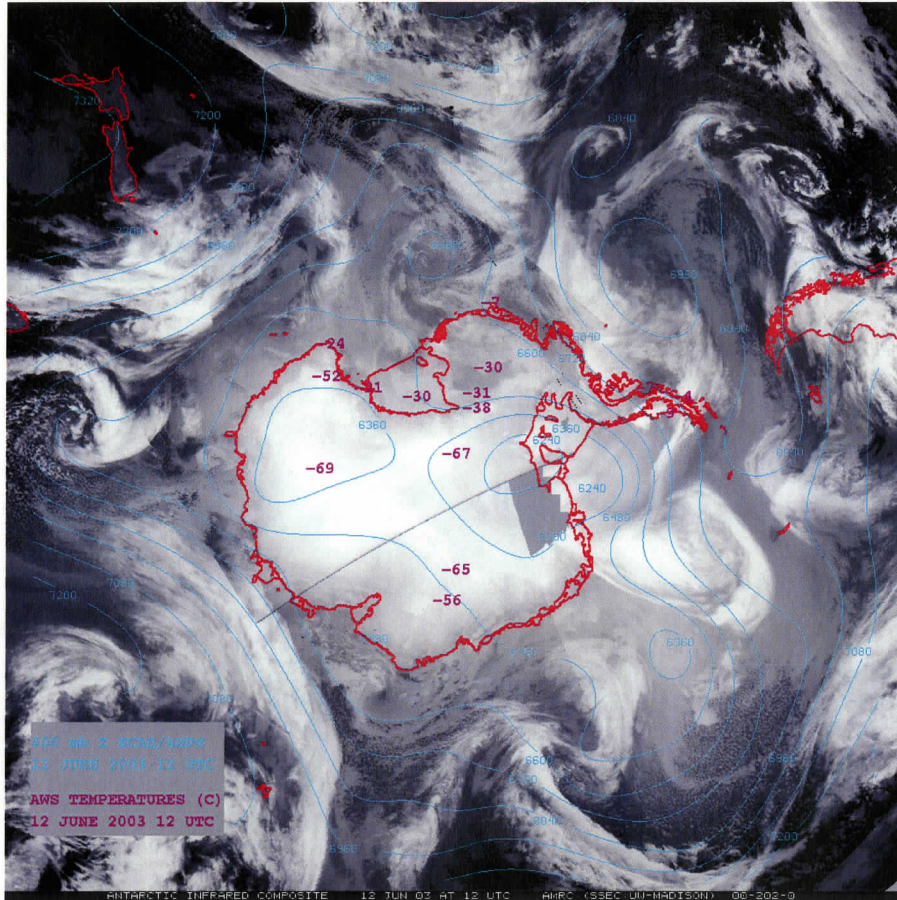


AMRC Annual Project Report: NSF-OPP Grant #0126262, October 1, 2002 to June 30, 2003

Antarctic Meteorological Research Center (AMRC) 2002-2005

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



Professor Charles R. Stearns, Principal Investigator
Matthew A. Lazzara, co-Investigator
Shelley L. Knuth, Meteorologist

Space Science and Engineering Center
University of Wisconsin-Madison

Submitted on July 10, 2003



Annual Report for Period: 10/2002 - 06/2003

Submitted on: 07/10/2003

Principal Investigator: Stearns, Charles R.

Award ID: 0126262

Organization: U of Wisconsin Madison

Title:

Antarctic Meteorological Research Center (AMRC) 2002-2005

Project Participants

Senior Personnel

Name: Stearns, Charles

Worked for more than 160 Hours: No

Contribution to Project:

During the first year of the grant, Dr. Charles R. Stearns has overseen the Antarctic Meteorological Research Center (AMRC) as Principal Investigator.

Name: Lazzara, Matthew

Worked for more than 160 Hours: Yes

Contribution to Project:

Matthew Lazzara, during the first year of the grant, has worked on the day to day activities of the grant including data management, handling data requests and questions, and conducting educational outreach.

Name: Knuth, Shelley

Worked for more than 160 Hours: Yes

Contribution to Project:

Shelley Knuth, during the first year of the grant, has contributed significantly to the day to day activities of the AMRC, including data management, handling data requests and questions, web page redesign, and started case study collections.

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Name: Soundarapandian, Karthik

Worked for more than 160 Hours: No

Contribution to Project:

Karthik Soundarapandian has assisted the AMRC in computer hardware and software maintenance.

Other Participant

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 (SSEC), University of Wisconsin-Madison (UW-Madison) has continued to follow its 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 this mission, the AMRC continues its core activities and begins new initiatives. The core activities the AMRC continues include:

- * Generation of Antarctic composite satellite imagery (both infrared and water vapor)
- * Collection, archival and distribution of meteorological data from the Antarctic and adjacent Southern Ocean including:
 - POES/NOAA Local Area Coverage (LAC) data
 - POES/NOAA High Resolution Picture Transmission (HRPT) data {as backup for AMRC's sister center, the Arctic and Antarctic Research Center at Scripps Institute of Oceanography}
 - GMS and GOES satellite cloud drift and water vapor wind charts over the New Zealand/Ross Sea region
 - Synoptic/Manned station reports (especially from the USAP stations)
 - Meteorological aviation surface hourly report (METAR)
 - Upper-air reports (especially from the USAP stations)
 - Ship and Buoy observations (especially from the USAP research ships)
 - Numerical weather prediction forecasts and analyses from the National Center for Environmental Prediction (Global Forecast System and Wind and Wave Forecast Model), European Centre for Medium Range Forecasts model, and United Kingdom Meteorology Office model
- * Stewardship of the Antarctic Automatic Weather Station (AWS) program and other US AWS data.

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

As critical parts of this grant, the AMRC has embarked on new initiatives including:

- * Improvements to the Antarctic composite satellite imagery (both infrared and water vapor)
- * Began investigating the development of Antarctic composite visible satellite imagery
- * Started to identify case study collections of significant weather events
- * Started to develop the utilities to generate climatological analysis from the AWS, and other stations (in compliment to the activities in the SCAR READER project)

At the time of this report, the AMRC is at different levels of accomplishment on these new activities. The Antarctic composites have already had a significant improvement including higher resolution (now 5 kilometers rather than 10 kilometers nominally), larger size (2048 by 2048 rather than 1024 by 1024), and improved use of polar orbiting data including the initial use of Aqua and Terra MODIS satellite data in the water vapor composites (See Figures 1 and 2). The work with visible Antarctic composites has started, but there are some significant difficulties that have been encountered due to the way satellite operators calibrate visible satellite data differently across different satellites. It

is hoped to overcome this as much as possible in the future. Work on the case study collections has just started, as has the work on climatological analysis.

In the past year, the AMRC has also continued to monitor, nearly daily, the various Ross Sea icebergs, especially the formation and evolution of the C-19 iceberg. (See Figure 3)

Finally, the AMRC has rounded out its activities in this first year to include:

- * Attending national polar meteorology meetings
- * Participated in RIME Science Planning meetings
- * Host annual AMRC meeting in conjunction with the AAWS and AMPS annual meeting
- * Conduct educational outreach activities

During the first year of the grant, the AMRC has been represented at the 7th Conference on Polar Meteorology and Oceanography. In addition, the UW-Madison has been host to the annual Automatic Weather Station meeting joint with the annual AMRC meeting and now joint with the Antarctic Mesoscale Prediction System Users' meeting. Of course, educational outreach activities have been conducted at several locations.

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

The results of the work accomplished to date with this grant include:

- * Continued data collection, archival and distribution
- * 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)
- * Initial work into developing the utilities to generate climatological analyses
- * Initial identification of case collections (See Figure 4).
- * Attended national polar meteorology meetings and hosted annual AMRC meeting

As always, the AMRC aims to benefit a wide audience including operational, research and educational groups. Examples include the use of AMRC data for weather forecasting, use of AMRC Antarctic composites in the classroom for education and application of AMRC data holdings toward research projects by other scientists. An important element the AMRC project demonstrates is the fusion of various data sources (See Figure 5). Finally, as discussed in the Web/Internet site section, Figure 6 depicts AMRC's web and FTP site statistics.

Training and Development:

In the first year of this grant, this project has started to bring new skills and experiences, especially to the new member of the group, in the areas of:

- * Polar/Antarctic and Satellite Meteorology
- * Computer Science
- * Public Speaking

The new member of the group has started to learn more about Antarctic meteorology. For example, the synoptic scale flow patterns in the AMRC composite satellite imagery animations are a constant source of learning and medium for understanding how the Antarctic atmosphere works.

Additionally, the group continues to learn more with regards to satellite meteorology, especially from polar orbiters, which is not always routinely a part of undergraduate education in the atmospheric sciences.

With regards to computer science, skills in using an interactive processing system (McIDAS), and internet skills (such as HTML programming) have been added to the abilities of the members of the project.

As a part of the public outreach efforts, and the participation in scientific meetings, members of the group have worked on public speaking skills. This is critical to offering the best outreach effort as well as to conveying ideas in scientific meeting forums.

Outreach Activities:

The AMRC project continues to put significant effort into its outreach activities. Within the first year of the grant, the following lists AMRC's outreach efforts to date:

General Public:

- * WORT-FM Radio Interview, Madison, WI and live from McMurdo Station, Antarctica
- * SSEC Public Tours, UW-Madison
- * E-mails answering questions or providing data or information to students and the general public

University:

- * Project ASPIRE, UW-Madison (A project aimed at encouraging and introducing higher education possibilities to disadvantaged 10th grade students)

High School:

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

Elementary School:

- * Mendota Elementary School, Madison, WI

It is especially noteworthy that the outreach work at Hopkinton High School was the third year of an on-going project where the C++ class used data from the AMRC/AWS programs as a part of their final class project.

During the past year, the AMRC continues to work on improving its grass-roots educational outreach activities. This initial effort is only the start of more effort planned for the remainder of the grant.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

- <http://amrc.ssec.wisc.edu>
- <http://ice.ssec.wisc.edu>
- <ftp://amrc.ssec.wisc.edu>
- <ftp://ice.ssec.wisc.edu>

Description:

These FTP and web sites are the primary and secondary/backup AMRC sites offering real-time meteorological data over and near the Antarctic, links to AMRC's archived data, and other information. These sites are shared with AMRC's sister project, the Antarctic Automatic Weather Station Program. See Figure 5 in the activities and findings section for a graphic report on the traffic these sites have seen in the last calendar year.

Other Specific Products

Product Type: Data or databases

Product Description:

AMRC Data Collection (Real-Time and Archive)

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

Generated Data/Products

- * Antarctic Composites
 - Infrared & Water Vapor
- * GMS/GOES Satellite Winds
 - IR & Water Vapor (CIMSS)
- * UW & SPAWAR AWS Data

Model Analyses & Forecasts

- * Global Forecast System (GFS) from NCEP (formerly MRF or AVN)
- * Wind and Wave Forecast Model (WWFM) from NCEP
- * UK Met. Office model
- * European Centre for Medium Range Weather Forecasts model
- * To be available soon à AMPS (real-time only)
- * Others à (CIMSS Regional Assimilation System (CRAS))

Satellite Imagery & Data

- * NOAA
 - HRPT (McMurdo only)
 - GAC (Project FROST/by request)
 - LAC (iceberg monitoring)
- * DMSP (real-time only)
 - OLS
 - SSM/I

Observational Data (GTS/NOAAport)

- * METAR
- * PIREP/AIREP
- * Synoptic
- * ABoM Synoptic
- * Radiosonde
- * Ship & Buoy

Text Data

- * METAR (McMurdo Area/South Pole)
- * TAF (McMurdo Area)
- * USAP Ship (SIT-REP)
- * AIREP (New Zealand Region)

USAP Station Data

- * South Pole
- * Palmer
- * McMurdo
- * (+NCDC holdings)

Sharing Information:

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

- * Via the Internet from AMRC's web, 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 Meteorological Society meetings, Wednesday Science Lecture at McMurdo Station, etc.)
- * Word of mouth

Contributions**Contributions within Discipline:**

As noted in previous reports, the AMRC continues to contribute to the field of Antarctic meteorology with its unique products (e.g. Antarctic composite satellite data, AWS data, etc.), and archive of freely available data. Some NSF grantees and others the AMRC has worked with recently include:

- * NCAR/NCEP Reanalysis Roy Jenne (AWS data, etc.)
- * NCAR/AMPS Jordan Powers (AWS data)
- * Meg Smith, U. Alaska (AVHRR imagery)
- * SPAWAR, (Variety of data)
- * Jack Williams (USA Today)(Imagery for books)
- * National Geographic Ruth Musgrave (information)
- * OSU/BPRC, Andy Monaghan (variety of weather data)
- * NOAA/ETL, Bill Neff (South Pole radiosonde data)
- * RPSC (Misc. weather data)
- * Marianna Nardino, NRC/IASC Bologna, Italy
- * Hamish McGowan, U. Queensland, Australia
- * Iloria Fattori, U. Florence, Italy
- * Wolfgang Rack, AWI, Bremerhaven, Germany
- * Miranda Huston, NZ Antarctica, New Zealand
- * Peter Barret, ARC Victoria U. of Wellington, New Zealand
- * Angelika Humbert, Darmstadt University, Germany
- * Christine Elliott, U. Canterbury, New Zealand

The hosting/facilitating of the annual joint AAWS/AMRC/AMPS meetings is becoming an important contribution to the field of Antarctic meteorology in gathering together the active participants for a partial working/scientific exchange meeting. This event provides a medium by which collaborations and future advances build from the foundations of prior work. Other specific contributions are in progress.

Contributions to Other Disciplines:

As in the past, AMRC's data and expertise are used to benefit other non-meteorological disciplines (such as Antarctic glaciology). Some NSF-OPP grantees the AMRC has worked with recently in this role include:

- * U-Chicago: MacAyeal IO-190 (Iceberg/AWS data)
- * Woods Hole: Beardsley GLOBEC OG-231-O (AWS Data)
- * Portland State: Fountain BM-042-F (McMurdo weather)
- * Svarney WO-220-O (Misc. Data/Information)
- * NSBF: Stepp AB-145-O (Imagery/AWS data)
- * NASA WFF, Bob Swift (NOAA LAC data)

* International Whaling Commission, Diederik van Liere, Netherlands

Other contributions are in progress.

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

The AMRC continues to be the polar meteorology center within the University of Wisconsin-Madison/Space Science and Engineering Center (SSEC). This compliments other projects within SSEC, especially bringing a polar meteorology point of view to the significant satellite meteorological studies taking place at SSEC. The AMRC continues to be an educational resource to the students and the 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 following are examples of how the public can and does benefit from this project work:

- * Monitoring of tabular icebergs with a continued public interest
- * Unique and one of kind displays of meteorological data looked at routinely by interested citizens
- * An open-door resource to answering questions and clarifying concepts to the general public as well as other communities (e.g Public tours at SSEC, E-mail questions from the public, public presentations such as the ASPIRE project, etc.)
- * Providing comparative Antarctic weather data to a television weather reporter during a cold snap in the United States.

Work in progress in this grant will improve this role.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners

Any Journal

Any Book

Contributions: To Any Human Resource Development

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



Reply to Attn of: YS

February 12, 2003

Dr. Dennis Peacock
Head, Antarctic Sciences Section
The National Science Foundation
Room 755 S
4201 Wilson Blvd.
Arlington, VA 22230

Dear Dr. Peacock, *Dennis*

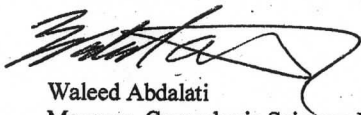
This letter is to recognize and express our sincere appreciation to Matthew Lazzara, Shelley Knight, and the rest of the staff at the Antarctic Meteorological Research Center for weather imagery support during our recent missions flown over Pine Island and Thwaites Glaciers in West Antarctica. The purpose of the flights, staged out of Punta Arenas, Chile, was to acquire baseline measurements of ice surface elevation and thickness over these glaciers. These data will be made available to the scientific community to support investigations aimed at understanding the mechanisms that are driving the thinning and acceleration of these glaciers that has been observed in the past decade. As you are aware, this area was identified by Terry Hughes a number of years ago as the "weak underbelly of the West Antarctic Ice Sheet."

These missions were logistically difficult owing to the long distance of the glaciers from Punta Arenas and the lack of good weather support required for making these measurements from an altitude of ~600 meters above the ice surface. This low altitude operation is a particular challenge because it is so difficult to recognize low clouds and ground fog from infrared AVHRR Local Area Coverage (LAC) images that are routinely available from the AMRC real-time web site. Visible band LAC imagery provides the type of tool required to make "go/nogo" decisions. Several weeks prior to our deployment to Chile we apprised Matthew Lazzara of our project and our need for visible band imagery. Matthew was able to successfully convince NOAA to retain the LAC images of the area which were then downloaded at Wallops Island and routed to AMRC. Matthew and the staff were able to provide supporting processing of the images that enhanced their utility and he was even able to superimpose our intended flight tracks right on the images making them easier to interpret. A sample of this valuable product is enclosed.

The staff at AMRC supported our project with the visible LAC imagery throughout our 3-week field campaign. These images formed an important component of our logistical

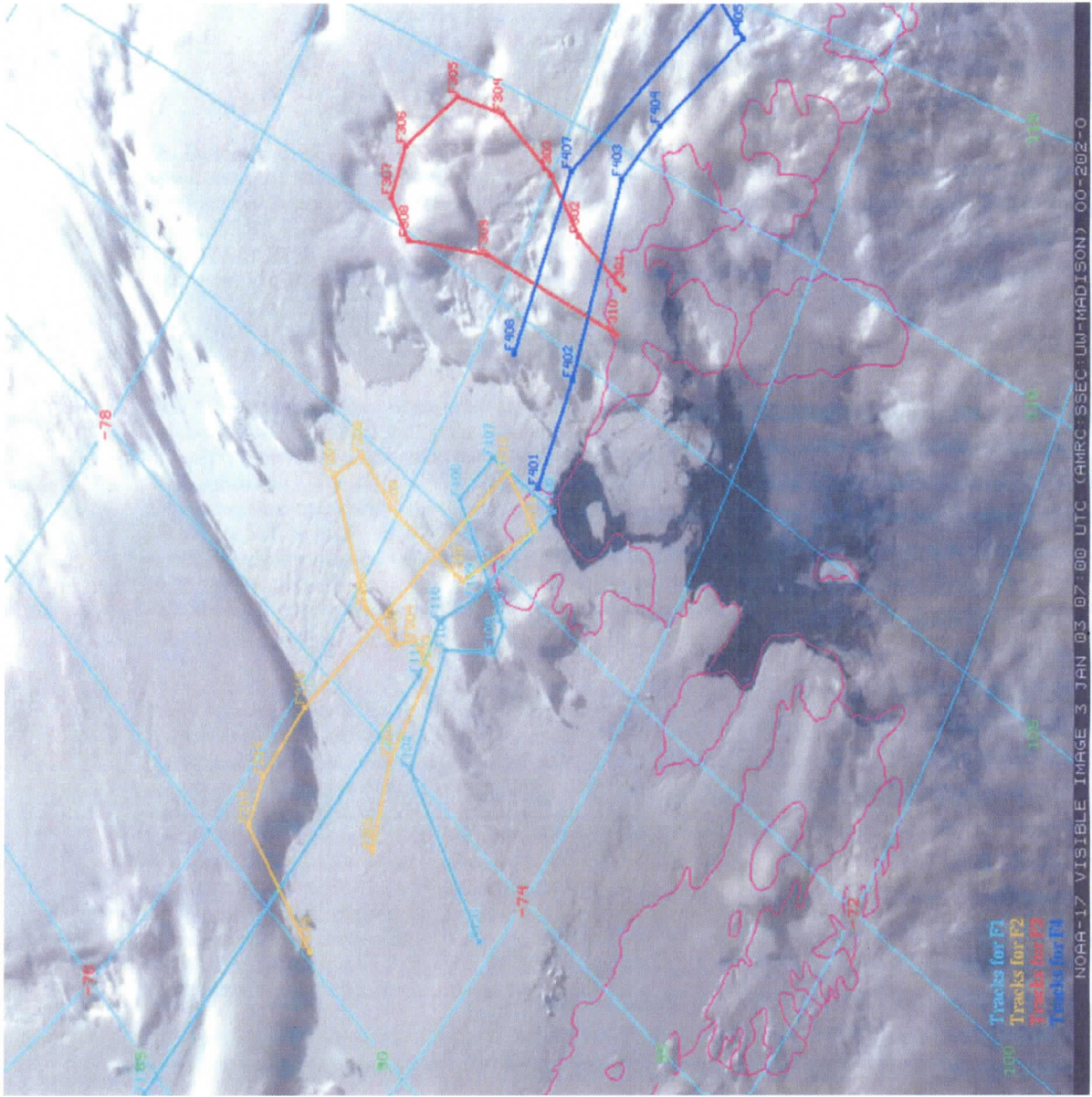
strategy, which resulted in the successful completion of all 4 of our planned missions over these glaciers. Considering that these missions require five hours of transit time each way for two hours of measurements on site, the data they provided was crucial to the success of our campaign.

Sincerely,



Waleed Abdalati
Manager, Cryospheric Sciences Program
Office of Earth Science

Cc: Dr. Bernhard Lettau/National Science Foundation
Mr. Al Sutherland/National Science Foundation
Dr. Hank Revercomb/University of Wisconsin
Dr. Charles Stearns/University of Wisconsin



Tracks for F1
 Tracks for F2
 Tracks for F3
 Tracks for F4

NORA-17 VISIBLE IMAGE 3 JAN 03 07:00 UTC (AMRC_SSEC:UM-MADISON) 00-202-0

Physical Science Laboratory

NATIONAL SCIENTIFIC BALLOON FACILITY
P.O. Box 319
Palestine, Texas 75802-0319
Area (903) 729-0271



19 March 2003

Mr. Hank Revercomb
1011 Atmospheric, Oceanic, and Space Sciences
Space Science and Engineering Center (SSEC)
University of Wisconsin
1225 West Dayton Street
Madison, WI 53706

Dear Mr. Revercomb:

I want to take this opportunity to express my sincere appreciation for the support that was provided to the National Scientific Balloon Facility (NSBF) by your meteorologist, Matthew Lazzara, during the NASA 2002-2003 Antarctic Long Duration Balloon Campaign. The support Matthew provided to us was outstanding in all respects.

The NSBF completed the campaign in late January with two successful launches from Williams Field. The first flight (ATIC/LSU) made a transit around the continent in 474 hours and was successfully terminated on the plateau west of Terra Nova Station, Antarctica. Our second flight remained aloft for 358 hours before being terminated south of Dome Fuji Automatic Weather Station (AWS) on the Valkyrie Plateau. The second flight was exceptionally successful with data being returned from detectors operating at unheard of sensitivity. When published, the results from both these flights are expected to gain worldwide scientific attention.

We are especially grateful for the timely satellite imagery and AWS reports that Matthew provided to us during the planning and execution of both of these payload termination and recovery evolutions. His data were extremely valuable and materially aided my staff in their decision-making. The real-time AWS data from Dome Fuji was a critical element in our decision to successfully terminate that flight in this very remote area of the Antarctic.


During the campaign there were some informal, and very preliminary discussions with Matthew regarding the possibility of establishing an "on-continent" WEB site. As envisioned, this site would contain data that could be very valuable to the NSBF meteorologist at Williams Field. We would look forward to having this capability.

We expect to return to Antarctica later this year for another flight season and look forward to renewing our relationship with Matthew once again.

Sincerely,



Danny Ball, Site Manager
National Scientific Balloon Facility

cc: Dr. Karl Erb
Dr. Bernard Lettau
Mr. Al Sutherland

Ms. Terri Gregory



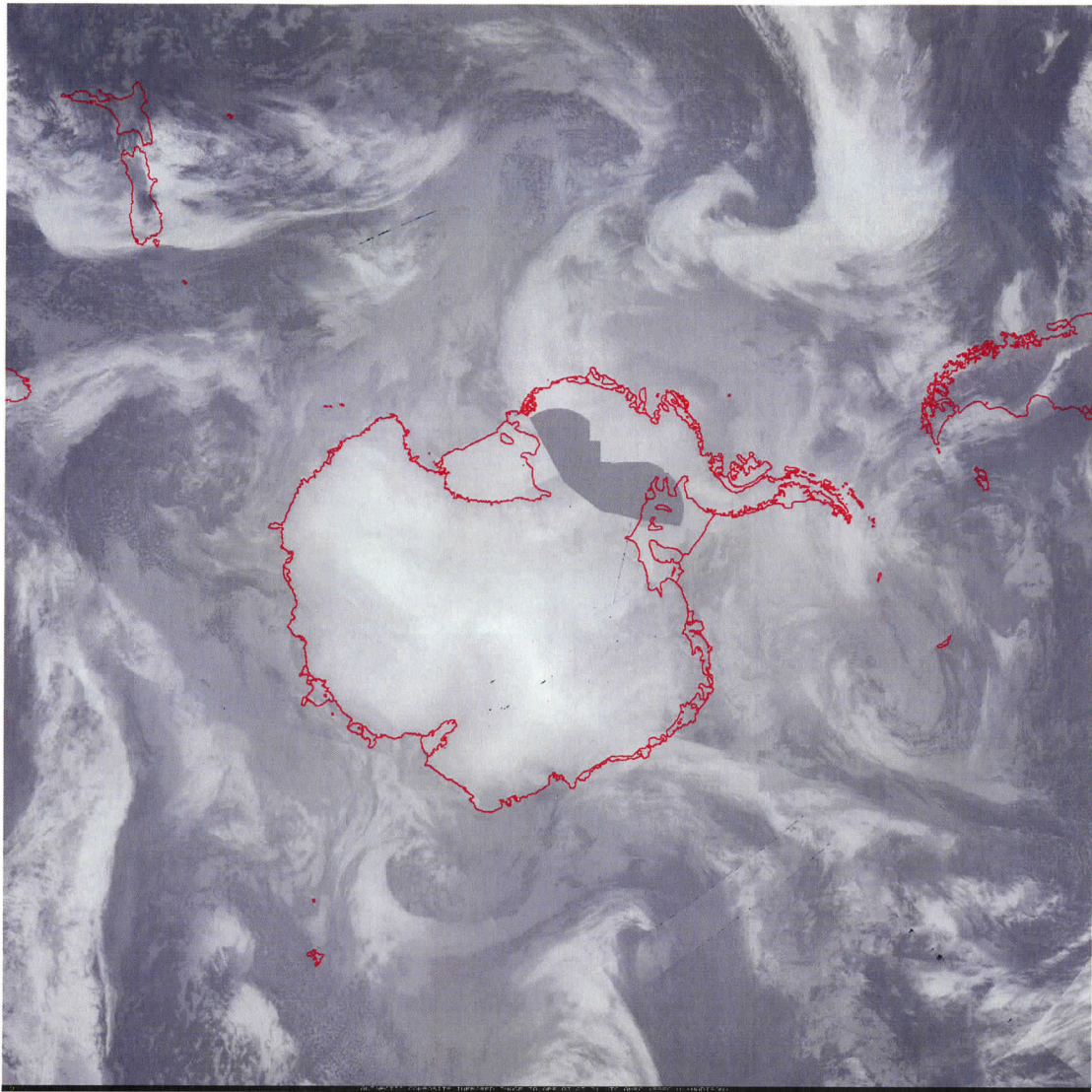


Figure 1. This is an example infrared Antarctic composite satellite image with the improvements of higher resolution and improved polar orbiter coverage over the Antarctic continent interior. The gray area in West Antarctica is missing data in this example.

8

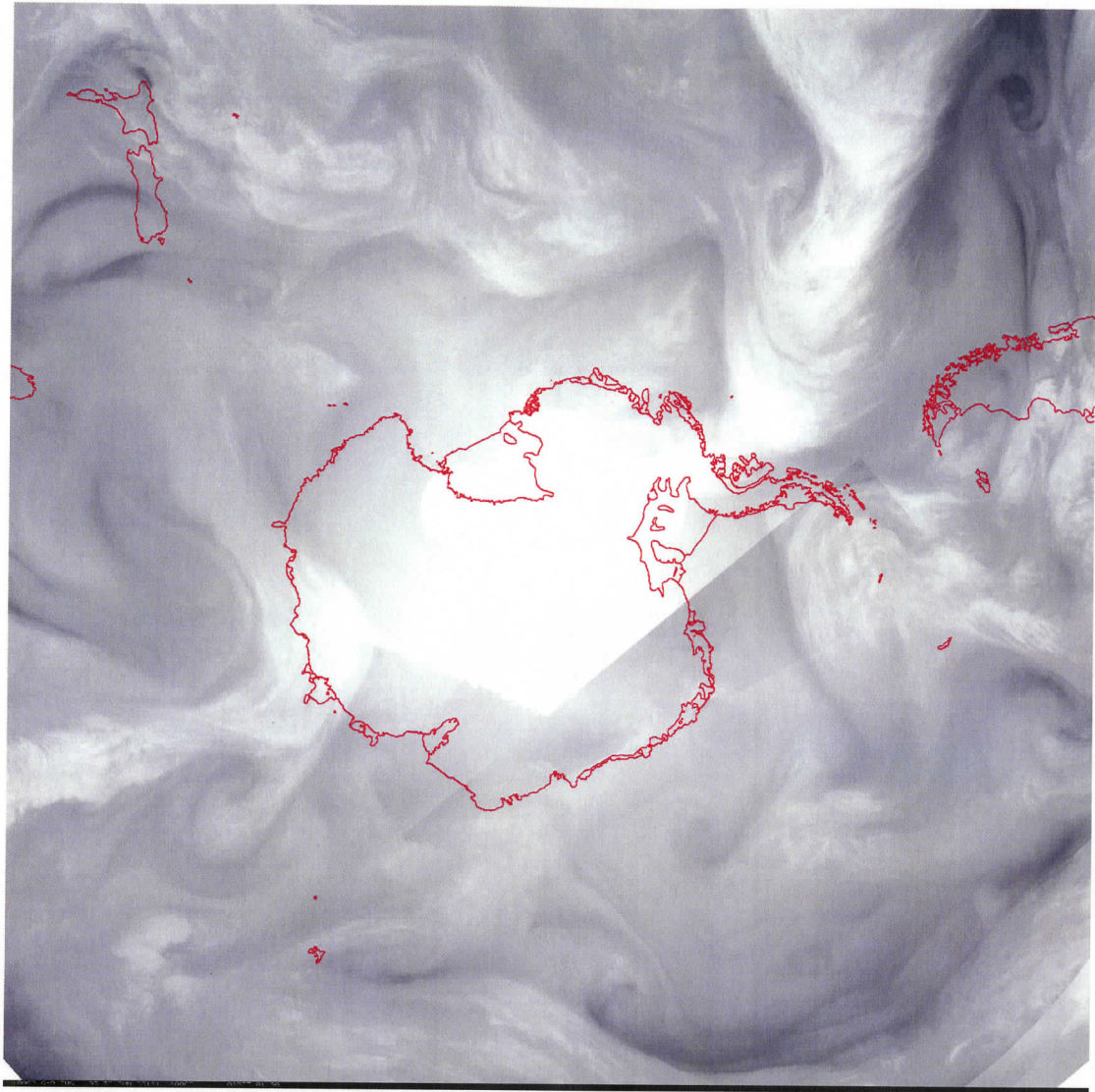


Figure 2. This is a sample Antarctic water vapor satellite composite image with MODIS data added over Queen Maud Land.

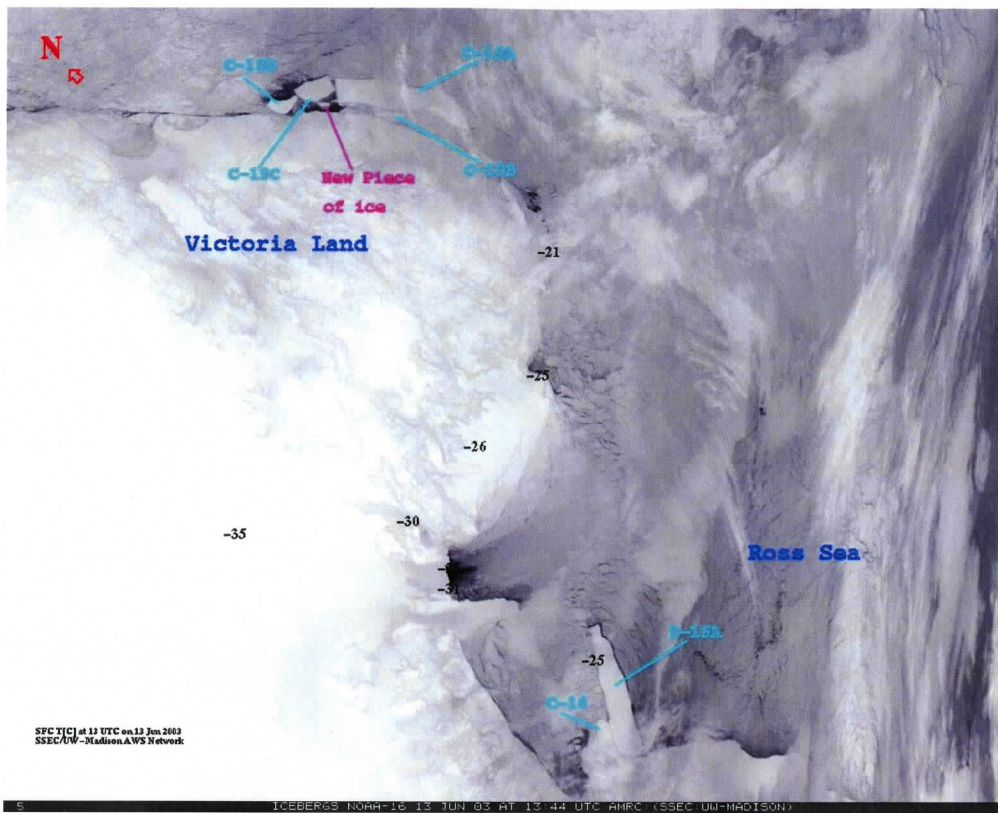


Figure 3. A sample NOAA-16 infrared image used to monitor and depict the location of tabular icebergs in the Ross Sea and Victoria Land region.

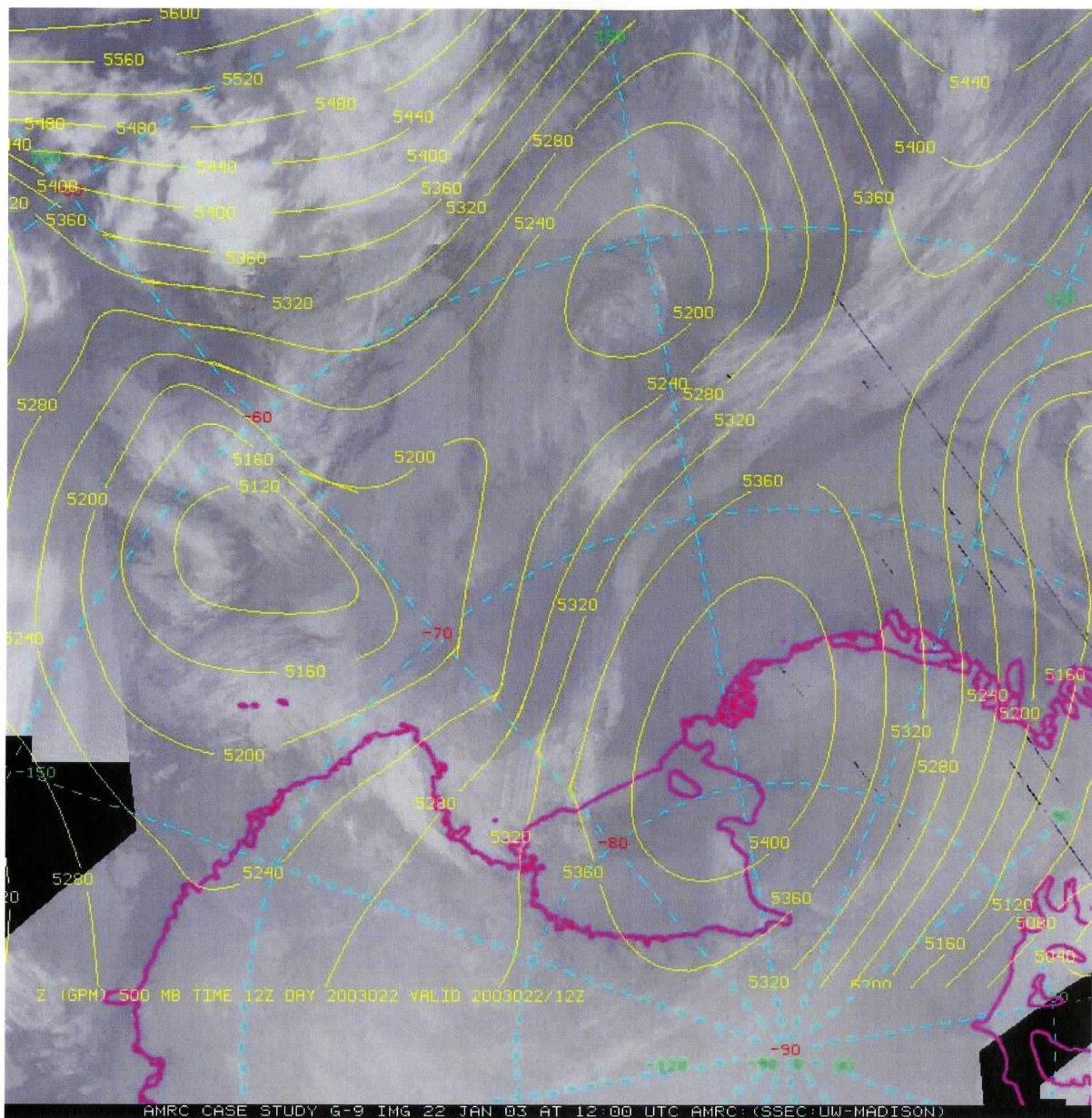
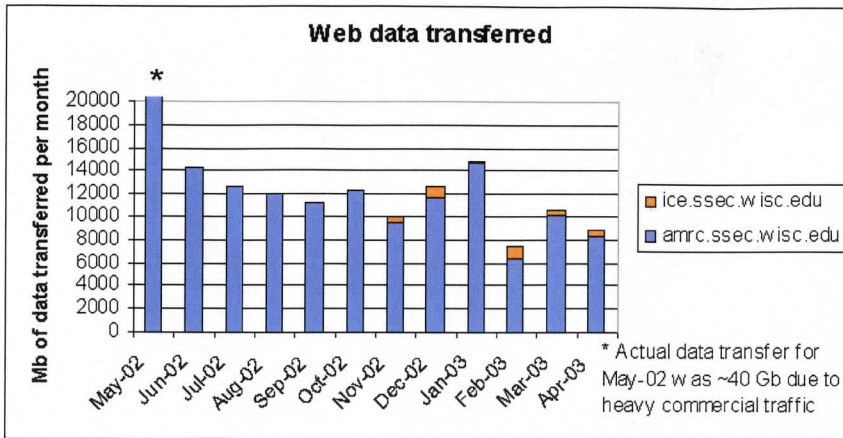


Figure 4. An Antarctic infrared composite satellite image with matching 500 hPa ECMWF model analysis heights from 12 UTC on 22 January 2003. This view shows a significant storm impacting McMurdo Station, Antarctica on Ross Island.

Web & FTP Statistics



Averages

Web: ~10 Gb/month

FTP: ~2 Gb/month

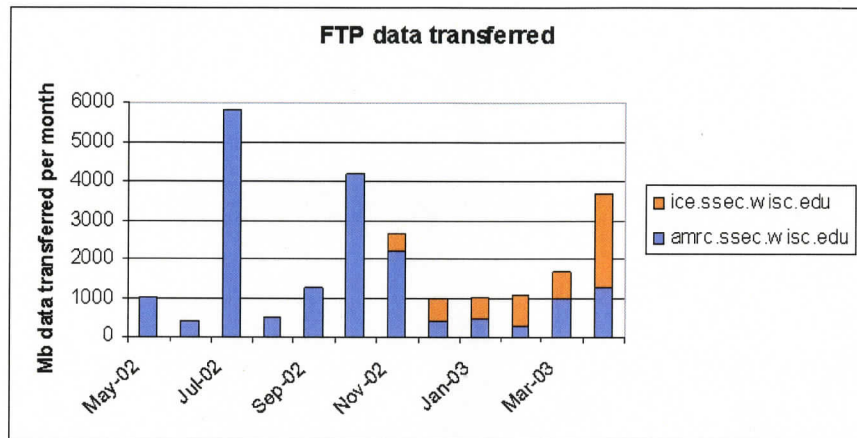


Figure 5. This display of AMRC Web and FTP Internet site statistics depicts the activity of these sites. The variable usage of the FTP is due to variable sized data requests posted to this site at the request of interested users.

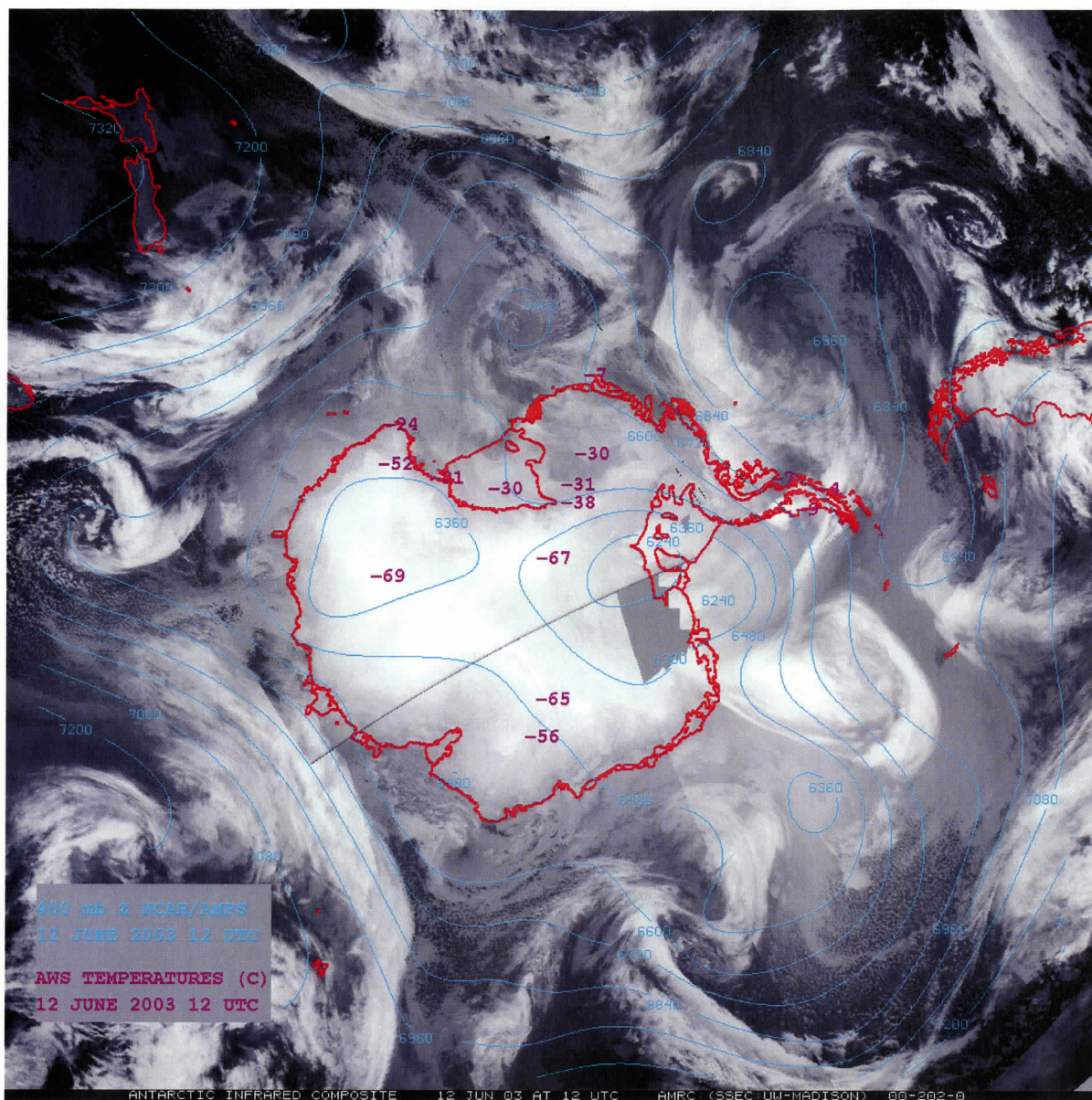


Figure 6. This display shows an example of data fusion by contouring Antarctic Mesoscale Prediction System 400 hPa heights and plotting temperatures from Automatic Weather Stations on top of an infrared Antarctic composite satellite image from 12 June 2003 at 12 UTC.