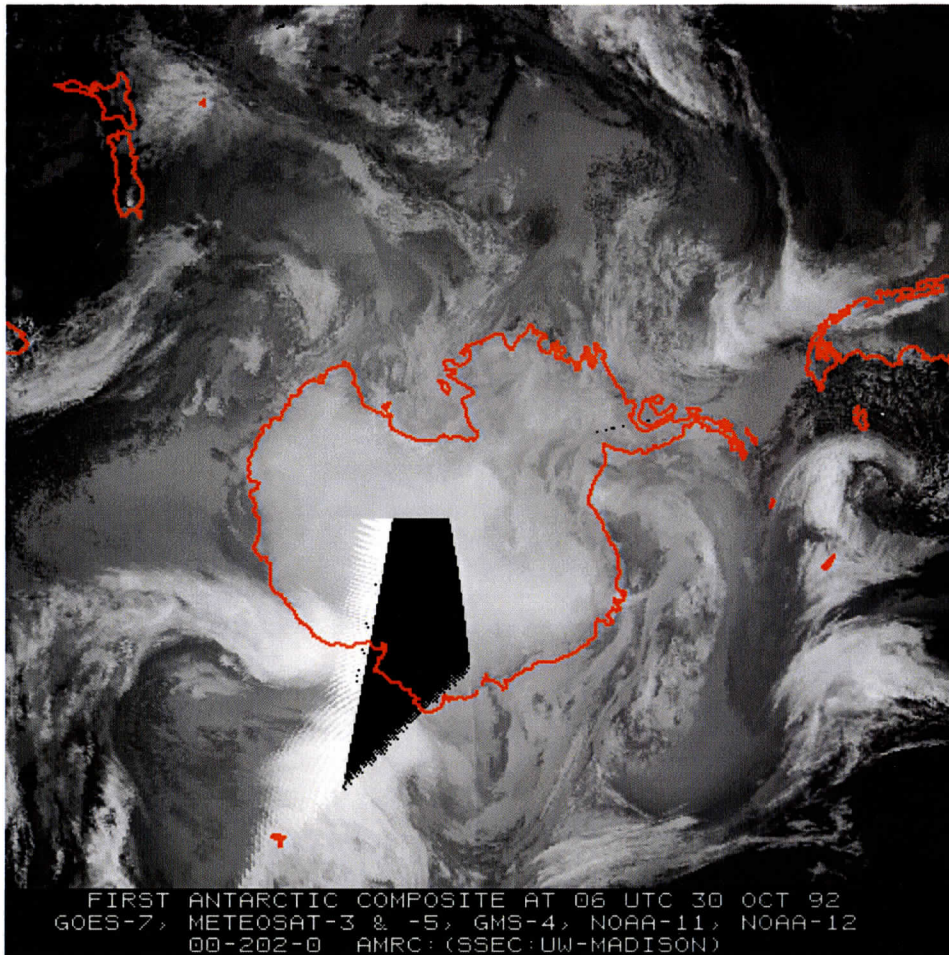


*AMRC Final Project Report: NSF-OPP Grant #9527603, February 1, 1997 to July 31, 1998*

## **Antarctic Meteorological Research Center: 1996-2000**

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



Professor Charles R. Stearns, Principal Investigator  
John T. Young, co-Investigator  
David A. Santek, Program Manager/Programmer  
Matthew A. Lazzara, Meteorologist

Space Science and Engineering Center  
University of Wisconsin-Madison

Submitted on April 13, 2000



Final Report for Period: 02/1997 - 07/1998

Submitted on: 04/13/2000

Principal Investigator: Stearns, Charles R.

Award ID: 9527603

Organization: U of Wisconsin Madison

Antarctic Meteorological Research Center: 1996-2000

Project Participants

## Senior Personnel

Name: Stearns, Charles

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Young, John

Worked for more than 160 Hours: No

Contribution to Project:

Co-Investigator

Name: Lazzara, Matthew

Worked for more than 160 Hours: Yes

Contribution to Project:

Matthew A. Lazzara during this grant was Antarctic Meteorological Research Center's Site Coordinator.

Name: Santek, David

Worked for more than 160 Hours: Yes

Contribution to Project:

Program Manager/Programmer

Post-doc

Graduate Student

Undergraduate Student

The Schwerdtfeger Library  
University of Wisconsin-Madison  
1225 W Dayton Street  
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Organizational PartnersOther Collaborators or ContactsActivities and Findings**Project Activities and Findings:**

The AMRC collects, archives, generates and maintains meteorological data related to the southern polar region, primarily Antarctica, which are available to others without charge. The AMRC operates two centers, one at the University of Wisconsin-Madison (UW-AMRC) in the Space Science and Engineering Center (SSEC) and a second at McMurdo Station, Antarctica (MCM-AMRC) in the Crary Science and Engineering Center (CSEC). The UW-AMRC serves as the primary data center that collects, processes, and distributes data to others. The MCM-AMRC collects data from the McMurdo weather office and the UW-AMRC for use by scientists at McMurdo to assist in their field operations. Occasionally, data are provided for aircraft flights to remote areas of Antarctica, other stations (including Palmer Station), or for ships participating in the United States Antarctic Program (USAP).

Matthew Lazzara was at the MCM-AMRC during November 1997. During that time he:

- À Restarted a failed computer
- À Updated the automatic weather station data processing
- À Added weather displays to the McMurdo Station Local Area Network
- À Installed new hardware to capture the raw signal of National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) and Defense Meteorological Satellite Program (DMSP) satellite data transmissions
- À Trained Antarctic Support Associates (ASA) and Spawar NISE-East personnel on the availability of meteorological data from UW-AMRC
- À Provided McIDAS demonstrations to distinguished visitors.

### **Project Training and Development:**

AMRC data has been valuable for research activities of NSF-OPP funded and other scientists as well as for operational applications, especially at McMurdo Station Weather. The Antarctic composites infrared images (ACII) that are uniquely generated at the AMRC have been an important part of research projects such as Project FROST and its follow-up research. The composites have also been a key component in Antarctic weather forecasting operations for USAP flight operations between New Zealand and Antarctica and USAP research vessel operations.

A yearlong experiment in forecasting for USAP research vessels showed that ACII were a valuable addition to numerical model forecasts. The composite showed features which were not predicted by the models and allowed better forecasts to be made, enhancing the efficiency and safety of the research activities.

### **Research Training:**

Within the AMRC team, we have continued to learn more about the needs and demands of the science, operational and educational communities with regards to Antarctic meteorological data. During this grant, the AMRC has applied improved methods for data distribution, especially between the UW-AMRC and the MCM-AMRC.

The forecasting experiment for the USAP research vessels acquainted research crews with the operational value of the ACII and allowed them crew to utilize the products on their own with appropriate meteorological training.

### **Outreach Activities:**

#### Automatic Data Transfers

These transfers represent requests by people and organizations for certain types of data to be transferred to them on a regular basis (usually daily). 'On demand' means that the data are put into a special file so that the user can access the data at their convenience.

Unidata Project ACIIs (Antarctic Composite Infrared Image) every 3 hours to approximately 160 educational institutions throughout the United States.

Research vessels ACIIs every 3 hours and Medium Range Forecast (MRF) model analyses and forecasts every 12 hours on demand.

McMurdo Station ACIIs every 3 hours, MRF analyses and forecasts every 12 hours, water vapor and cloud drift winds every 12 hours for the Meteorology Office on demand.

Palmer Station MRF analyses and forecasts every 12 hours on demand.

Project GLACIER- Rice University Observations from Automatic Weather Stations sites transferred daily.

British Antarctic Survey (BAS) One ACII daily

Australian Bureau of Meteorology (AboM) ACIIs daily

#### Data Requests

The AMRC Web site (<http://uwamrc.ssec.wisc.edu>) has unrestricted access; therefore many of the hits will be from those not active in Antarctic meteorology. This kind of public outreach provides valuable service to the general public: to see a movie of the clouds rotating around

Antarctica or a space-eye view of the iceberg off the Ronne Ice Shelf. Each host is unique and each item accessed counts as one hit. The AMRC web site is used by Antarctic forecasters to view the ACII and MRF forecasts. The AMRC File Transfer Protocol (FTP) sites (<ftp://uwamrc.ssec.wisc.edu> and <ftp://uwaaws.ssec.wisc.edu>) are used by researchers active in Antarctic meteorology to transfer requested archived or product data from the AMRC.

Site	Total Hits	Number of Hosts	Megabytes Transferred
uwamrc Web	363,549	42,090	9,804
uwamrc FTP	18,706	589	5,866
uwaaws FTP	72,025	724	3,215

#### Custom Data Requests

Several data requests are often received daily at the AMRC. Some specific requests that required several hours to days to fulfill are:

À AWS support for Environmental Research Institute of Michigan (ERIM) International's Cape Roberts project.

À Extensive AWS data to Project GLACIER (Stephanie Shipp, Rice University and Besse Dawson, Pearland, Texas, Teachers Experiencing Antarctica) and others to a lesser degree for use by elementary and secondary schools.

À Extensive ACII requests from Ted Scambos (NSIDC), Gareth Marshall (BAS), Russ Ladkin (BAS), Chris Peters (NCEP), David Noone (U. of Melbourne), Lt. Chester Clogston (Naval Postgraduate School), Michael Lieder (U. of Bonn), Stephan Leonard (BAS), and Teodoro Georgiadis (Italy).

À Jennifer Radtke (UW-Oshkosh, S-216C) requested more than four months of NOAA AVHRR data processed through a cloud/no-cloud algorithm that selected cloud free pixels. Three months of computer time were required. The request was terminated before completion because the project changed scope.

This last request is an example of a unique capability provided by the AMRC. The computers, programming, and data are here with the scientific expertise for help. Some of these processes can be automated.

#### Video Tape

The three hourly ACII were added to AMRC's videotape, which now covers the period 1 November 1992 to 31 March 1998. The videotape provides a visual record of the quality and availability of the images since each image is time stamped. The videotape shows the behavior of the cloud systems south of 40oS. Twenty videotapes have been provided to interested individuals and organizations.

### Journal Publications

### Books or Other One-time Publications

### Web/Internet Sites

#### URL(s):

The AMRC operates the following Internet sites:

Web: <http://uwamrc.ssec.wisc.edu>

FTP: <ftp://uwamrc.ssec.wisc.edu>  
<ftp://ice.ssec.wisc.edu>

Gopher: <gopher://ssec.wisc.edu> (no longer in operation)

**Description:****Other Specific Products****Product Type:** Data or databases**Product Description:**

Data Inventory and Archive

The AMRC signature product is the Antarctic Composite Infrared Images (ACII) that are constructed from infrared images from four geostationary and two to three polar orbiting satellites. The ACII is constructed every three hours using data within 50 minutes of a nominal image time.

The AMRC has collected, archived and provided a large collection of meteorological data. The data collected by the AMRC are:

Composite satellite data: ACIIs (Antarctic Composite Infrared Image) at 3 hourly intervals 30 October 1992 to the present  
Polar orbiter satellite data NOAA satellite data 12 December 1992 to the present. There are some gaps in the data.

Model analyses and forecasts: Medium Range Forecast (MRF) from the National Center for Environmental Prediction (NCEP) from 2 July 1993 to the present with forecasts added in late 1994

Synoptic observations: Synoptic observations south of 40oS from 1 January 1997.

Radiosonde observations: Mandatory/significant Antarctic radiosonde levels from 1 November 1996 to present. McMurdo 1956 through 1979, Antarctic region 1980 through 1993, McMurdo and South Pole 1994 to the present (Late 1996 to present all available data south of 35oS have been added).

Water vapor winds: Wind vectors based on water vapor movement from the Geostationary Meteorological Satellite (GMS) satellite, 130oE to 180o, 40oS to 70oS, 27 October 1997 to the present

Cloud drift winds: Wind vectors based on infrared image cloud movement from GMS satellite, 130oE to 180o, 40oS to 70oS, 10 June 1998 to the present.

Research vessel observations: Meteorological observations from the research vessels, April 1996 to present.

AWS observations: Antarctic automatic weather station (AWS) data February 1980 to the present, as 3 hourly or 10 minute data.

AGO observations: Automatic Geophysical Observatory (AGO) ten minute meteorological data December 1992 through December 1997.

Antarctic peninsula observations: Six hourly meteorological data from the British Antarctic Survey (BAS) 1957 through 1993 for Faraday, Halley, Rothera, and Signy Island Stations.

Monthly means: Monthly means of air temperature and air pressure 1957 through 1996 for all available Antarctic manned stations

Monthly summaries: Monthly summaries for Palmer Station from September 1992 to September 1993 and April 1998 to present. Amundsen-Scott Station (South Pole) January 1996 to present.

**Web Specific Products Generated**

The products generated for the UW-AMRC Web site include:

- À A movie loop of eight ACIIs
- À MRF grids for forecasts of 12 to 120 hours, including movie loop of 12 to 60 hours
- À NOAA AVHRR images of the Ronne Ice Shelf iceberg
- À Plots of radiosonde data

- À ACII overlain with the selected AWS and synoptic observations
- À Meteorograms (time series) of AWS station air pressure, air temperature, wind speed and direction, and relative humidity
- À NOAA AVHRR browse images

**Sharing Information:**

This data and database is shared with other researchers via on-line archives available on the Internet, or via requesting any off-line data to be placed on our Internet sites.

**Contributions**

**Contributions within Discipline:**

The AMRC has made and still makes significant contributions to the Antarctic atmospheric sciences. The data holdings that are freely available without charge are substantial, especially with some of the unique data (e.g. AWS and ACII) that is available only from the AMRC. This is an important foundation from which educational outreach activities and future Antarctic atmospheric research activities can develop.

**Contributions to Other Disciplines:**

One of the express purposes of the AMRC is to aid and assist non-meteorological science and engineering research activity that are in need of meteorological data and consulting. During the duration of this grant, the AMRC has continued and significantly expanded this role with its outreach activities in the research community.

**Contributions to Human Resource Development:**

The AMRC has begun to expand its outreach activities in the educational community. The AMRC infrastructure that is in place will naturally lead towards more educational and other outreach activities, allowing the AMRC to be a bridge between the science research communities and the educational communities. During this grant, the AMRC has worked closely with Project Glacier at Rice University in this area.

**Contributions to Science and Technology Infrastructure:**

Within the University of Wisconsin's Space Science and Engineering Center, the AMRC compliments the Center's expertise in satellite meteorology, and polar meteorology.

**Beyond Science and Engineering:**

With the meteorological data collections available to anyone free of charge, the AMRC is a beneficial resource to the public at large.

**Categories for which nothing is reported:**

Organizational Partners  
Any Journal  
Any Book

### 3. Publications And Products

#### a. Publications

Data from the AMRC was used in the following publications during this time:

#### Papers using AMRC/AWS data

- Bromwich, D. and Z. Liu, An observational study of the katabatic wind confluence zone near Siple Coast, West Antarctica, *Monthly Weather Review*, 124, 462-477, 1996
- Carrasco, J., D. Bromwich, and Z. Liu, Mesoscale cyclone activity over Antarctica during 1991, *JGR*, 102, D12, 13,923-13,954, 1997.
- Cullather, R., D. Bromwich, Validation of operational numerical analyses in Antarctic latitudes, *JGR*, 102, D12, 13,761-13,784, 1997.
- Foster, T., Abyssal water mass formation off the eastern Wilkes-Land coast of Antarctica, *Deep-Sea Research Part I-Oceanographic Research Papers*, 42, 501-522, 1995.
- Gallee, H., Mesoscale atmospheric circulations over the southwestern Ross Sea sector, Antarctica, *J. Applied Meteorology*, 35, 1129-1141, 1996.
- Hines, K., D. Bromwich, and Zhong Liu, Combined global climate model and mesoscale model simulations of Antarctic climate, *JGR*, 102, D12, 13,747-13,760, 1997.
- Hogan, A., A synthesis of warm air advection to the South Polar Plateau, *JGR*, 102, D12, 14,009-14,020, 1997.
- Jeffries, M., Early winter ice and snow thickness distribution, ice structure and development of the western Ross Sea pack ice between the ice edge and the Ross Ice Shelf, *Antarctic Science*, 9, 188-200, 1997.
- Jin, Y., W. Rossow, and D. Wylie, The comparison of the climatologies of high-level clouds from HIRS and ISCCP, *J. Climate*, 9, 2850-2879, 1996.
- Krinner, G., C. Genthon, L. Zhao-Xin, and P. Le Van, Studies of the Antarctic climate with a stretched-grid general circulation model, *JGR*, 102, D12, 13,731-13,745, 1997.
- Leonard S., J. Turner, and A. Van der Wal. Submitted. An assessment of three automatic depression tracking schemes. *Meteorological Applications*.
- Lubin, D., D. Bromwich, W. Lee, and K. Hines, The impact of Antarctic cloud radiative properties on a GCM climate simulation, *J. Climate*, 11, 447-462, 1998.
- Liu, Z., and D. Bromwich, Dynamics of the Katabatic Wind Confluence Zone near Siple Coast, West Antarctica, *J. Applied Meteorology*, 36, 97-118, 1997.
- Marshall, G.J. Submitted. An examination of the precipitation regime at Thurston Island, Antarctica, using ECMWF Re-Analysis data. *International Journal of Climatology*.

- Marshall, G.J. and J. Turner. 1997. Katabatic wind propagation over the western Ross Sea observed using ERS-1 scatterometer data. *Antarctic Science*, 9(2), 221-226.
- Marshall, G.J. and J. Turner. 1998. ERS scatterometer observations of katabatic winds over a polynya. 3rd ERS symposium: space at the service of our environment, held at Florence, Italy, 14-21 March 1997. Proceedings, 3, 1591-1596.
- Noone, D., J. Turner and R. Mulvaney. Submitted. Atmospheric signals and characteristics of accumulation at Dronning Maud Land, Antarctica. *Journal of Geophysical Research*.
- Parish, P., and D. Bromwich, On the forcing of seasonal changes in surface pressure over Antarctica, *JGR*, 102, D12, 13,785-13,792, 1997.
- Parish, T., Y. Wang, and D. Bromwich, Forcing of the austral autumn surface pressure change over the Antarctic continent, *J. Atmospheric Sciences*, 54, 1410-1422, 1997.
- Parish, T., D. Bromwich, A case study of Antarctic katabatic wind interaction with large-scale forcing, *Mon. Weather Rev.*, 126, 199-209, 1998.
- Rogers, J., R. Hellstrom, E. Mosley-Thompson, and C. Wang, An abrupt air temperature rise over the Greenland ice cap, *JGR*, 102, D12, 13,793-13,800, 1997.
- Stearns, C., G. Weidner, and L. Keller, Atmospheric circulation around the Greenland Crest, *JGR*, 102, D12, 13,801-13,812, 1997.
- Turner, J. et al. 1996. The Antarctic First Regional Observing Study of the Troposphere (FROST) project. *Bulletin of the American Meteorological Society*. 77(9), 2007-2032.
- van den Broeke, M, R. van de Wal, and M. Wild, Representation of Antarctic katabatic winds in high-resolution GCM and a note on their climate sensitivity, *J. Climate*, 10, 3111-3130, 1997.

Papers using AMRC data that have been submitted/accepted to the Weather and Forecasting Special Issue on First Regional Observing Study of the Troposphere (FROST):

- Bromwich, D.H., R.I. Cullather, and R.W. Grumbine: An assessment of the NCEP operational global model forecasts and analyses during FROST.
- Colwell, S. and J. Turner: Antarctic data on the GTS during the FROST project.
- Hines, K. M., R. W. Grumbine, D.H. Bromwich and R. I. Cullather: Surface energy balance of the NCEP MRF and NCEP/NCAR reanalysis in Antarctic latitudes during FROST
- Hutchinson, H., S. Dixon, N. Adams, K. Jacka, S. Pendlebury, L. Marsh, L. Cowled, H. Phillipot, M. Pook, and J. Turner : Report on the re-analysis exercise of weather data for Antarctica and the Southern Oceans during the FROST project
- Lieder, M. and G. Heinemann: A summertime Antarctic mesocyclone event over the Southern Pacific during FROST SOP3: A meso-scale analysis using AVHRR, SSM/I, ERS and numerical model



data.

- Marshall, G. and J. Turner: Synoptic-scale weather systems observed during the FROST project via scatterometer winds.
- Pook, M. and L. Cowled: Detection of weather systems over the Antarctic interior in the FROST analyses.
- Simmonds, I. and R. Murray: Southern extratropical cyclone behavior in ECMWF analyses during the FROST special observing periods.
- Turner, J., S. Leonard, M. Pook, L. Cowled, R. Jardine, S. Pendlebury, and N. Adams: An assessment of operational Antarctic analyses based on data from the FROST project.

Papers using AMRC data that have been submitted/accepted to the Australian Meteorological Magazine Special Issue on FROST:

- Adams, N., H. Hutchinson, and T.Hart: An analysis of TOVS data during the FROST special observing periods.
- Jacka, K.: An impact study involving ERS-1 scatterometer wind data- implications for the FROST project.
- Pook, M. and T.Gibson: Atmospheric blocking and storm tracks during SOP-1 of the FROST project. (in review).
- Simmonds, I., R. Murray, and Leighton: A refinement of cyclone tracking methods with data from FROST.
- Turner, J.: An overview of the Antarctic FROST project.
- Turner, J. S. Colwell, and S.Leonard: Data collected during the FROST project.

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