

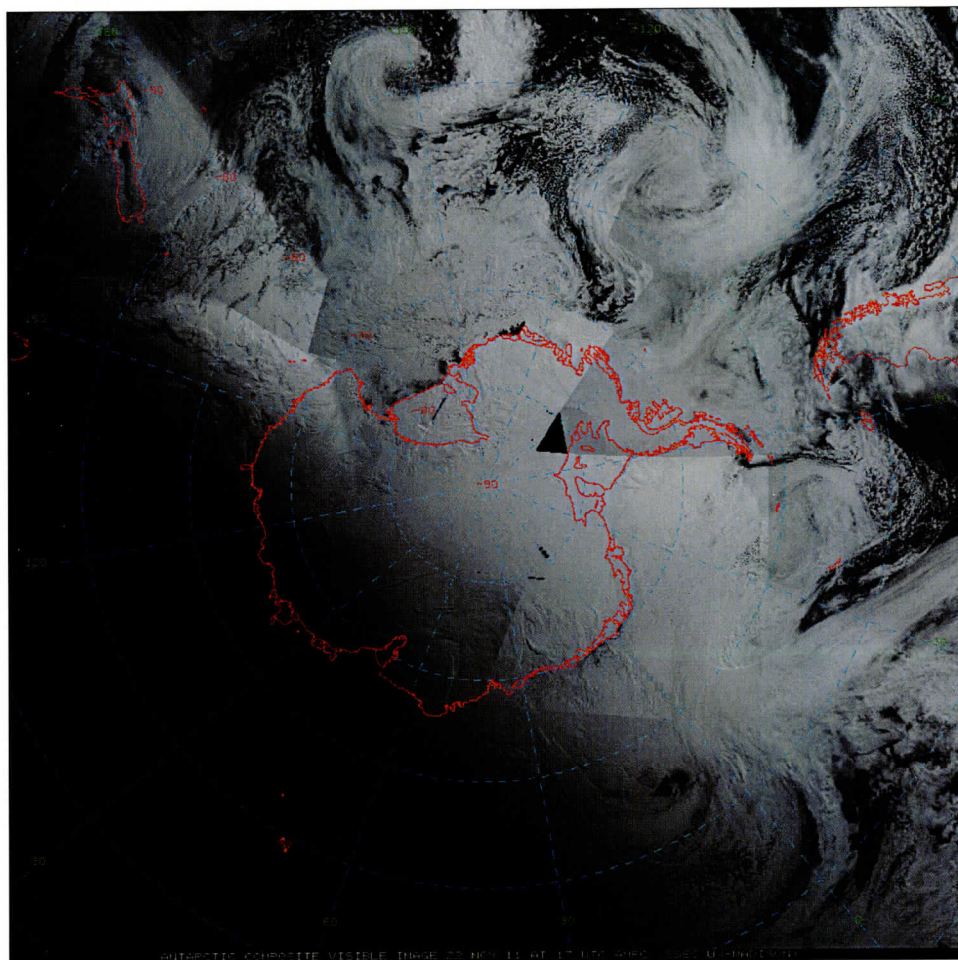
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AMRC Annual Project Report: NSF-OPP Grant #0838834, October 1, 2010 to September 30, 2011

Antarctic Meteorological Research Center (2009-2011)

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



Matthew A. Lazzara, Principal Investigator and Meteorologist
Linda M. Keller, co-Investigator and Meteorologist

Space Science and Engineering Center
University of Wisconsin-Madison

Submitted on November 22, 2011



Annual Report for Period: 10/2010 - 09/2011

Submitted on: 11/23/2011

Principal Investigator: Lazzara, Matthew A.

Award ID: 0838834

Organization: U of Wisconsin Madison

Submitted By:

Lazzara, Matthew - Principal Investigator

Title:

Antarctic Meteorological Research Center (2009-2011)

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Project Participants

Senior Personnel

Name: Lazzara, Matthew

Worked for more than 160 Hours: Yes

Contribution to Project:

Matthew Lazzara, as Principal Investigator, has been directing the activities of the project. He has been overseeing the development of the new AMRC portal/Web site. He has been involved in the re-casting of data products for the new portal. He has directed the purchase and construction of Automatic Weather Stations funded by this project. Educational outreach has also been an activity over the past year. He is also directing the foundational work on the analysis of cloud mass transport systems using the AMRC satellite composites.

Name: Keller, Linda

Worked for more than 160 Hours: Yes

Contribution to Project:

Linda is the co-Investigator for this project, and is the alternate director of the project. She oversees aspects of the effort, including participating in the re-working of the AMRC data portal, and the foundation work for the cloud mass transport study using the Antarctic composites.

Post-doc

Graduate Student

Undergraduate Student

Name: Rasmussen, David

Worked for more than 160 Hours: Yes

Contribution to Project:

DJ Rasmussen has participated in educational outreach activities, handled questions AMRC receives via e-mail as well as been a tester for the new AMRC web site portal. DJ left the AMRC in late 2010/early 2011.

Name: Schroeder, Nicole

Worked for more than 160 Hours: No

Contribution to Project:

Nicole has been providing support in documentation and organization of AMRC tasking, updating/correcting AMRC metadata information, and developing a new educational outreach presentation as a resource for AMRC team members. Nicole left the AMRC in July 2010.

Name: Uttech, Zach

Worked for more than 160 Hours: Yes

Contribution to Project:

Zach has played a role in overseeing the new AMRC portal, including aiding in the development of the new dynamic web displays as connected to an underlying database, etc.

He has worked on deploying an initial testing of a RAMADDA services to offer data to the community. Zach left the AMRC in August 2010.

Name: Willmot, Kathleen

Worked for more than 160 Hours: Yes

Contribution to Project:

Elena has worked on the development of the content of the new AMRC portal, along with responding to data requests, and assisting in product development. She has also responded to questions via e-mail from users and the community. Elena has been one of the lead students working with the PI and co-I on the cloud mass transport work.

Name: Gebre, Embibel

Worked for more than 160 Hours: No

Contribution to Project:

Embibel has assisted with the new web page working with Bill Bellon.

Name: Knapp, Sam

Worked for more than 160 Hours: No

Contribution to Project:

Sam has assisted the AMRC with some of the meteorological data holdings. He left the AMRC in May of 2011.

Name: Mikolajczyk, David

Worked for more than 160 Hours: Yes

Contribution to Project:

David has worked on routine data posting activities for the AMRC. He has also participated in AMRC educational outreach activities.

Name: Pasowicz, Daniel

Worked for more than 160 Hours: No

Contribution to Project:

Dan has assisted the AMRC with some minor clerical work.

Name: Snarski, Joey

Worked for more than 160 Hours: Yes

Contribution to Project:

Joey is an undergraduate student working with the PI and co-I on the cloud mass transport events. He also assists with educational outreach activities and data stewardship.

Name: Trevorrow, Scott

Worked for more than 160 Hours: No

Contribution to Project:

Scott has been assisting the AMRC project on the web site and data portal.

Name: Weber, Nicholas

Worked for more than 160 Hours: No

Contribution to Project:

Nick has been working with AMRC data collection and data stewardship.

Technician, Programmer

Name: Lalande, John

Worked for more than 160 Hours: No

Contribution to Project:

John has provided technical computing support to the AMRC project, primarily with regards to data tape backup/archive; and assistance in keeping AMRC computing assets complying with USAP IT regulations.

Name: Batzli, Samuel

Worked for more than 160 Hours: No

Contribution to Project:

Sam has assisted the AMRC project with support in the creation of the new web page and data portal.

Name: Bellon, Willard (Bill)

Worked for more than 160 Hours: No

Contribution to Project:

Bill has led the effort on the new AMRC web page and data portal. Bill is the SSEC Web master.

Name: Dengel, Russ

Worked for more than 160 Hours: No

Contribution to Project:

Russ has worked on the software for displaying AMRC datasets, specifically for the AMRC weather display in Crary Lab.

Name: Hallock, Kevin

Worked for more than 160 Hours: No

Contribution to Project:

Kevin has worked on the installation and configuration of the AMRC RAMADDA data server.

Name: Heinzelman, Jay

Worked for more than 160 Hours: No

Contribution to Project:

Jay has aided the AMRC with training several undergraduates (who work on the AMRC project) on interactive processing software tools that they use while working on the project.

Name: Kohrs, Richard

Worked for more than 160 Hours: No

Contribution to Project:

Rick has worked with the PI on the development of a dramatically improved visible Antarctic composite.

Name: Phillips, Jean

Worked for more than 160 Hours: No

Contribution to Project:

Jean has worked on a portion of the new AMRC web page and data portal.

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Raytheon Polar Services
SPAWAR
Murdo Ground Station/NASA

Activities and Findings

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

This project focus is centered around three major themes:

1. Data Portal Upgrade
2. Cloud Mass Transport Studies
3. Automatic Weather Stations purchase

Beyond this, the AMRC project continues to conduct educational outreach activities

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

Year 1: 2009-2010

The status of our project focal points are:

1. We will be announcing the new web site portal in July 2010. This new foundation will allow us to develop an improved means for providing AMRC's meteorological data collection in a more 'self-service' fashion.
2. Cloud Mass Transport Studies - Training of an undergraduate student who will be participating in the study has been accomplished over the last year.
3. AWS components have been purchased and 3 AWS constructed & awaiting deployment at Byrd Station. Two additional AWS components are being purchased for future AWS deployment.

Several educational outreach activities have been conducted, and more are planned.

Year 2: 2010-2011:

The status of our project focal points are:

1. A new data portal has been launched as of mid-October 2010. The creation of AMRC's Antarctic composite imagery carries on as a part of this project (See attached figures). Effort continues on two key features to be made available before the end of 2011 - AMRC's own RAMADDA server and dynamic Automatic Weather Station information pages. Akin to this project, there has been effort put into improving the AMRC On-line Weather Loop (OWL) display in the foyer of Crary Lab at McMurdo Station. This effort was prompted by comment and direction from NSF.
2. An undergraduate student, who was trained in year 1, has been working on adding to the CMT time series, and has since left the research group. A second student has been trained on identifying and characterizing CMT events, and is actively adding to the CMT time series.
3. Collaborative efforts with several researchers has led to manuscripts published, accepted or submitted regarding: a. Antarctic Tropospheric Clouds, b. Antarctic satellite composites and c. how those composites are a view of what could be accomplished from a satellite in an artificial Lagrange orbit.
4. The AWS hardware funded in this project have been built and deployed at a variety of sites around West Antarctica during the 2010-2011 field season.

A more proper visible (~0.65 microns) Antarctic satellite composite imager is now being created, along with shortwave (~3.8 microns) and longwave (~12.0 micron) infrared channels. This brings the total number of spectral channels the Antarctic composite is generated in to 5, along with the infrared (~11.0 micron) and water vapor (~6.7 micron) channels. These are the common spectral channels available among most all geostationary and polar orbiting satellites. In the shortwave infrared, not all satellites share the same peak wavelength as some have 3.7 microns and others have 3.9 microns. The longwave infrared imagery will be suffering in the short run, as the GOES satellite fleet being put into use has replaced the 12 micron channel with a 13.3 micron channel. This will be rectified with the upcoming launch of the GOES-R satellite in 2015. (See attached figures)

A 50 year South Pole climatology project and data stewardship effort is in progress, with a manuscript to be submitted for publication by the end of 2011. This effort has taken longer than expected as the data required more work than expected to be ready for analysis.

7. The PI of the project had an accident earlier this year (hit by a car while crossing the street, while attending the annual Antarctic Meteorological Observing, Modeling and Forecasting Workshop). This has unfortunately impacted the timeliness of completed activities under this project and others. The PI has returned to work, and is striving to catch up.

Training and Development:

One of the key portions of the first year of this project is the training of new undergraduates students who have joined the project. They are learning new skills in computing, meteorology, data types, communications, etc. This effort has continued into the second year of the project, with students playing a major role in the main science activity.

Outreach Activities:

The AMRC has participated in several public outreach and classroom outreach activities, and many of these activities are done in conjunction with outreach activities with the Automatic Weather Station (AWS) project:

- Madison West Rotary Club, Madison, WI
- * SSEC Public Tours, UW-Madison, Madison, WI
- * Deerfield Middle School, Deerfield, WI
- Madison Area Middle School, Lodi, WI
- Hamilton Middle School, Madison, WI
- * Wisconsin State Fair, West Allis, WI
- E-mail contacts with the public and Antarctic community

- Journal Publications

Lazzara, M.A., A. Colletti, and B.L. Diedrich, "The Possibilities of Polar Meteorology, Environmental Remote Sensing, Communications and Space Weather Applications from Artificial Lagrange Orbit", *Advances in Space Research*, p. 1880, vol. 48, (2011). Published, doi:10.1016/j.asr.2011.04.026

Lazzara, M.A. and S.L. Knuth, "Arctic and Antarctic Satellite Composite Imagery", *Polar Research*, p. , vol. , (2011). Submitted,

Tomowich, D.H., J.P. Nicolas, K.M. Hines, J.E. Kay, E.L. Key, M.A. Lazzara, D. Lubin, G.M. McFaruhar, I. Gorodetskaya, D.P. Grosvenor, T. Lachlan-Cope, and N. van Lipzig, "Tropospheric Clouds in Antarctica", *Review of Geophysics*, p. , vol. , (2011). Accepted, doi:10.1029/2011RG000363

Lazzara, M.A., L.M. Keller, and T. Markle, "Fifty-year Amundsen-Scott South Pole Station Climatology", Atmospheric Research, p. , vol. , (2012). In preparation,

Books or Other One-time Publications

Web/Internet Site

URL(s):

<http://amrc.ssec.wisc.edu>

Description:

This is the main web site for the AMRC project. It is co-located with the AWS project. A new web site was released early in year two of the project. Continued improvements to the functionality and data content on the site will be made in the coming year.

Several other internet dissemination techniques that are utilized including:

- FTP server
- rsync server
- Antarctic-IDD/LDM services
- RAMADDA server (In development - version 1 will be released before the end of 2011)
- E-mail service
- McIDAS ADDE server

Other Specific Products

Product Type:

Data or databases

Product Description:

AMRC created and collected data sets:

Created Datasets:

Antarctic Satellite Composites

- * Infrared
- * Water Vapor
- * Experimental Visible
- * Formal visible composites
- * Longwave infrared
- * Shortwave infrared
- * Pseudo-color

Composite Atmospheric Motion Vectors

Antarctic Automatic Weather Station Observations (shared with AWS project)

Collected Datasets:

NOAA LAC satellite imagery

Field Camp Observations

USAP research vessel meteorological observations

USAP station observational datasets

Antarctic and Adjacent Southern Ocean area Observations:

- * METAR observations

- Synoptic observations
- Ship and Buoy observations
- * Radiosonde (Mandatory and Significant level) observations
- Aircraft observations
- ext/Coded observations/forecasts:
 - * Coded METAR from USAP airfields
 - * TAF from USAP airfields
 - Coded AIREPs from the McMurdo and Auckland Airspace
- Numerical Model output:
 - * GFS
 - ECMFW
 - UKMET
 - * WWFM
- Gridded analysis:
 - Sea Surface Temperature Analysis
 - Sea Ice Concentration Analysis
- Meteorological Satellite Navigation
 - Two Line Element
 - McIDAS System Navigation

Sharing Information:

The AMRC project shares its created and collected data with the community via the following means:

- Method:
 - Web Site/Portal
 - FTP Server
 - RAMADDA Server
 - Antarctic-IDD/LDM Service
 - Sync Server
 - Email distribution (upon request)

The project will continue to make sure the metadata filed on the Antarctic Master Directory (AMDD)/Global Change Master Directory (GCMD) are kept updated for AMRC datasets.

Contributions

Contributions within Discipline:

The AMRC collection provides an important contribution to the meteorological and atmospheric sciences with its data set offerings. The updated AMRC portal aims to improve this contribution.

The AWS hardware purchased on this project will improve the observing base in the Antarctic benefiting the entire Antarctic and global meteorological community by providing observations in locations that have never been routinely observed (deep West Antarctica, Pine Island Glacier region, etc.)

Contributions to Other Disciplines:

The AMRC is a hub for other disciplines to find or use Antarctic meteorological data in support of their research, teaching or outreach. Recently, an Antarctic researcher outside atmospheric sciences denoted: '...AMRC site, where everyone goes to find Antarctic weather data!'

Contributions to Human Resource Development:

Currently, undergraduate students who are participating in the project are gaining experiences on this project. They are developing new skills and expanding existing skills and combining skill sets to help accomplish the goals of the project. Examples of this include:

- Satellite image display and manipulation
- Addressing science questions posed by the general public
- Developing clear writing, speaking, and people skills with tour groups
- Exploring new computer resources (e.g. RAMADDA, LDM, McIDAS, Web design, etc.)

Contributions to Resources for Research and Education:

The AMRC is the central polar meteorology center and complements other projects within the Space Science and Engineering (SSEC) Center, University of Wisconsin-Madison. The AMRC is an asset beyond the University as it is a information resource to the Antarctic meteorological and United States Antarctic Program community.

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:

Organizational Partners

Any Book

Contributions: To Any Beyond Science and Engineering

Any Conference

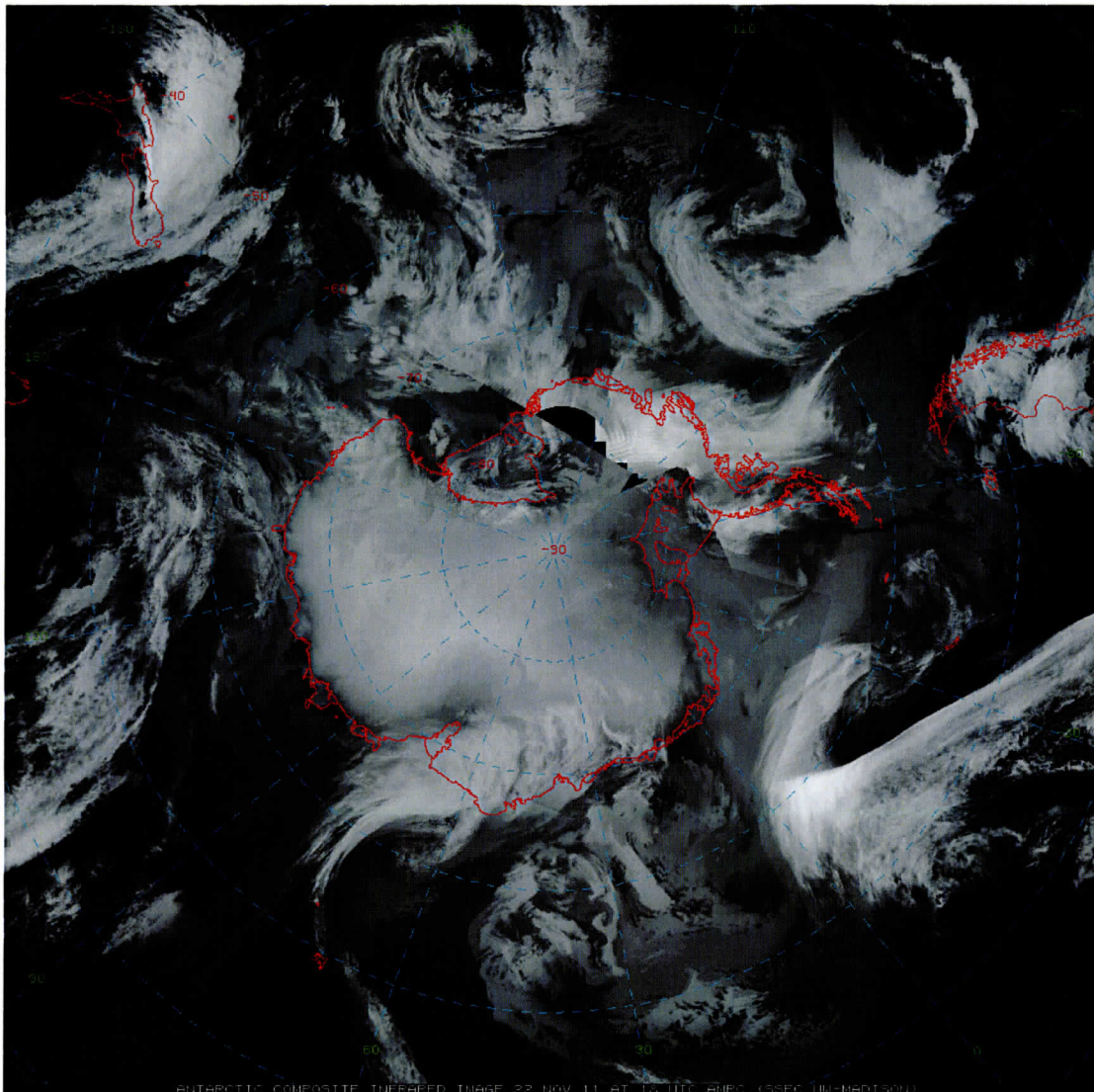


Figure 1. An Antarctic infrared satellite composite image is available on an hourly basis. This image from 22 November 2011 at 18 UTC is comprised of observations from geostationary and polar orbiting satellites with the common ~11.0-micron infrared window channel. Only a small region of missing data (in black) can be seen in West Antarctica.

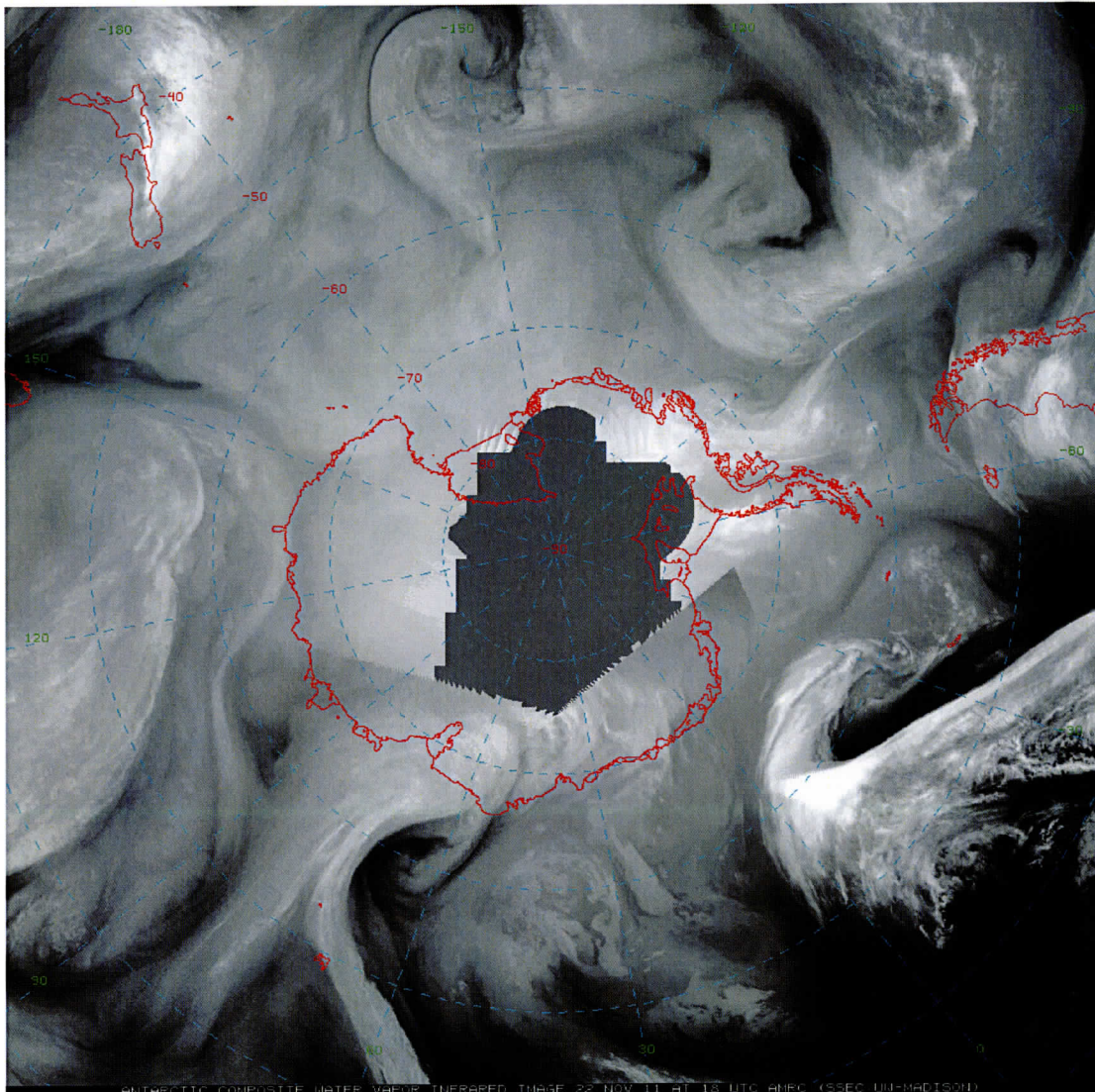


Figure 2. An Antarctic water vapor (~6.7-micron) infrared composite satellite image from 22 November 2011 at 18 UTC shows mid-tropospheric moisture. The slightly darker imagery in the lower right corner is due to the contribution of the Meteosat Second Generation (MSG) satellite series that has water vapor measurements in the 7.3-micron band.

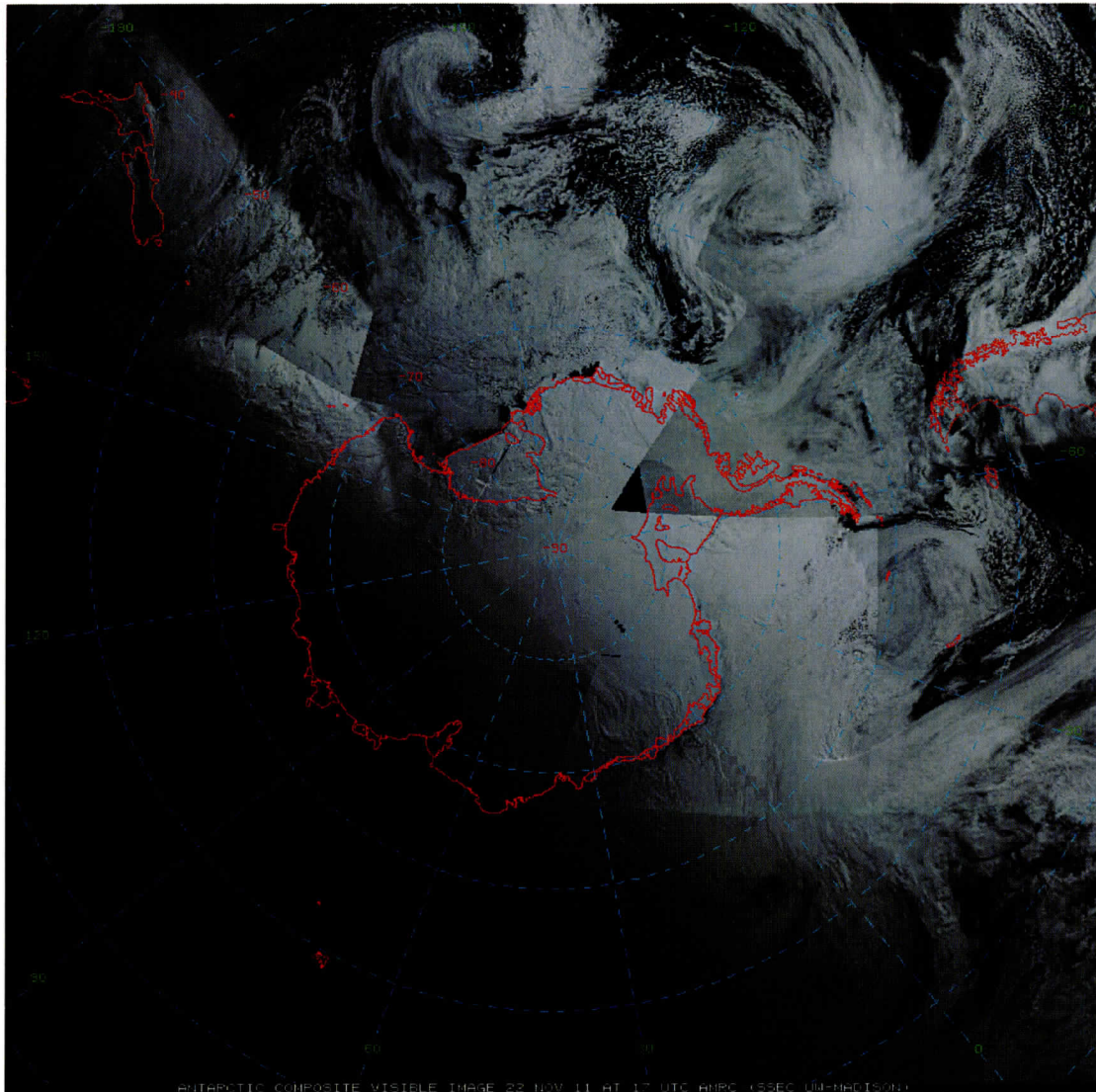


Figure 3. The Antarctic visible (~0.65-micron) composite utilizes a different combination method than the infrared imagery. Overlapping co-located pixels (from different satellites) with the lowest parallax error are used to compute a weighted average to come up with the final combined composite. These images are also created hourly.

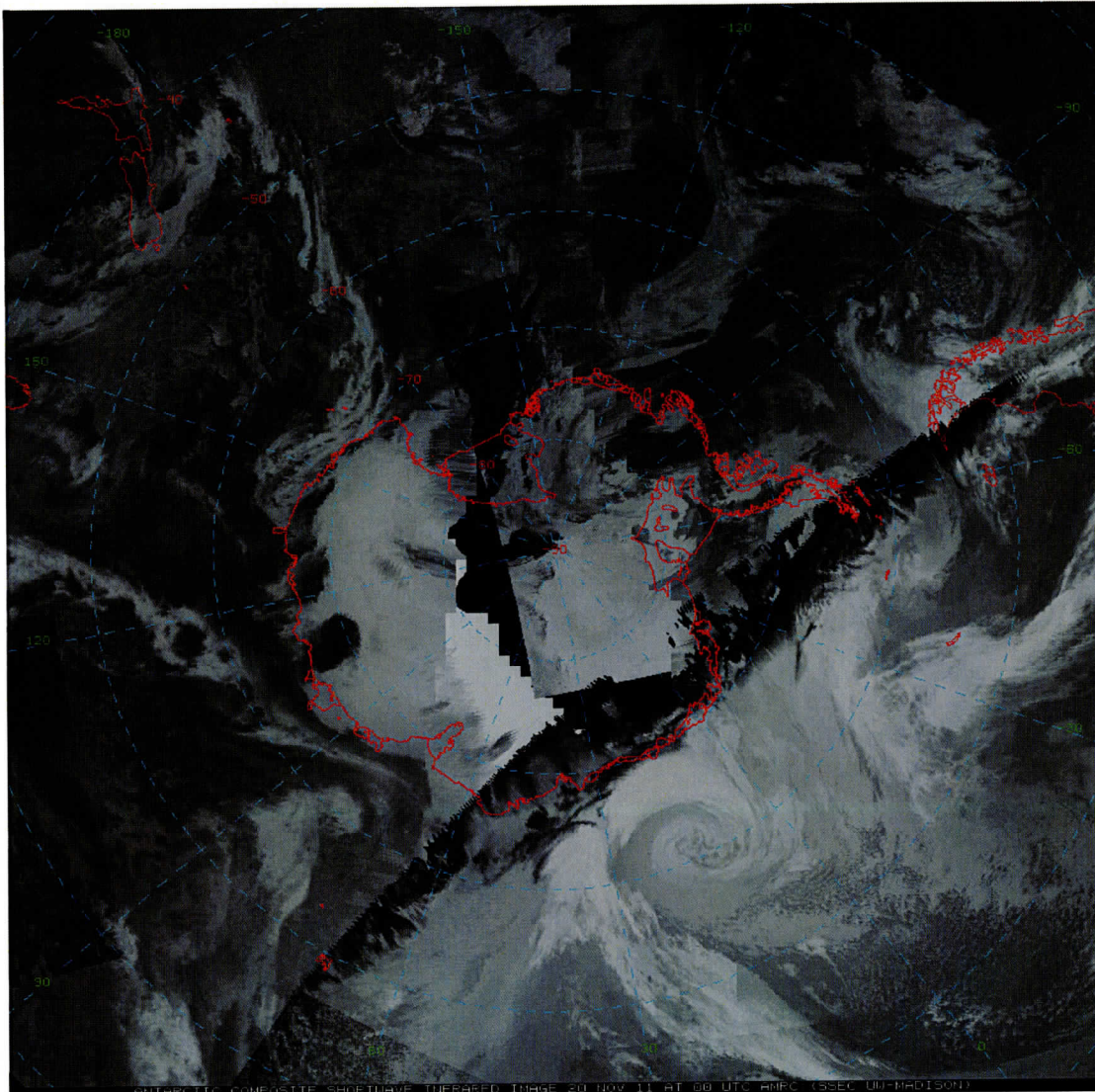


Figure 4. The Antarctic shortwave (~3.8-micron) satellite composite combines shortwave imagery from satellites that carry 3.7- or 3.9-micron imagery. The slight difference in the central wavelength input imagery impacts the resulting display, as seen in some sectors. Also the contribution of sunlight to this spectral channel also impacts the results as seen here in the darker imagery that cuts across the scene.



Figure 5. An Antarctic longwave (12.0-micron) satellite composite image created at 18 UTC on 22 Nov 2011. The more recent GOES satellites used in the composite have replaced the 12.0-micron spectral band with a 13.3-micron channel. As a result, there may be more sectors in the western hemisphere not covered until the next GOES series (GOES-R) is launch in 2015 when the 12.0-micron channel returns to the satellite series.

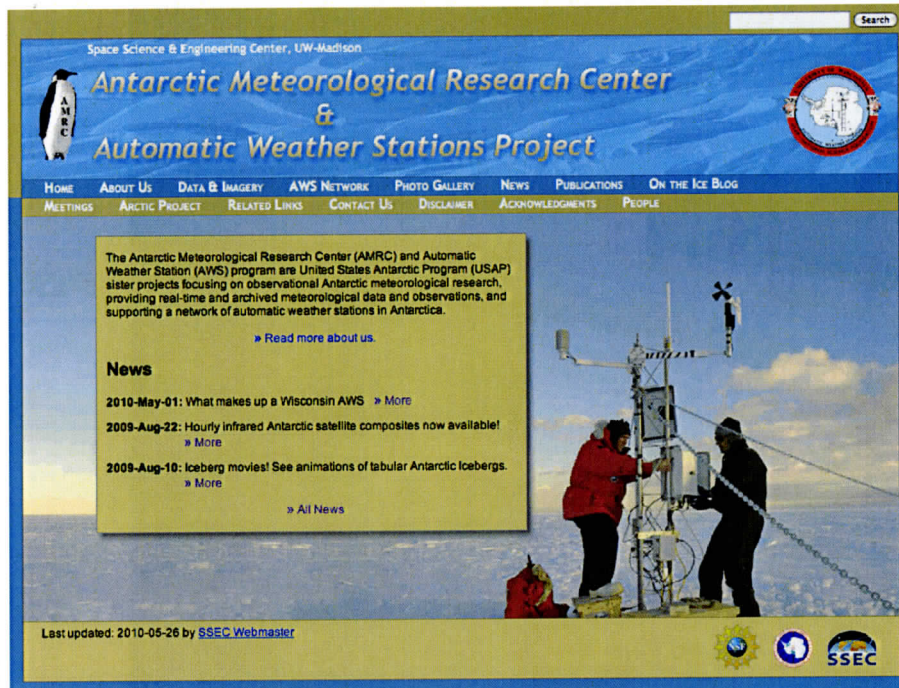
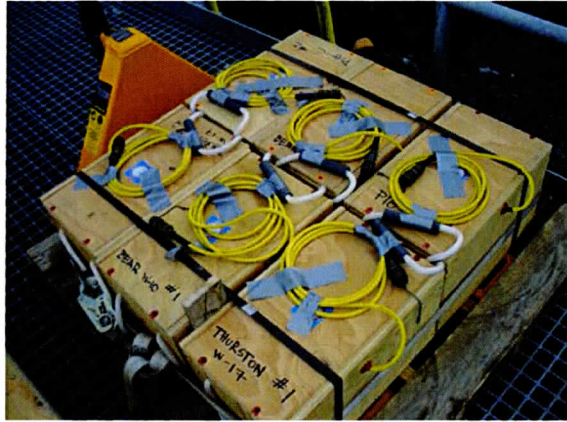


Figure 1. The new AMRC web portal provides a modern look with new functionality (which is continuing to be developed).



Figure 2. The availability of real-time and archival data will all be provided through the new web portal.



a. b.

Figure 3. The some of Automatic Weather Station (AWS) purchased as a part of this project prepared for shipment to West Antarctica including (a) packaged electronics/sensors and (b) batteries.