

Project Title: Antarctic Meteorological Research Center

PD/PI Name: Matthew A Lazzara, Principal Investigator  
Linda M Keller, Co-Principal Investigator

Recipient Organization: University of Wisconsin-Madison

Project/Grant Period: 09/15/2012 - 08/31/2015

Reporting Period: 09/01/2014 - 08/31/2015

Submitting Official (if other than PD\PI): Matthew A Lazzara, Principal Investigator

Submission Date: 12/03/2015

Federal Agency and Organization Element to Which Report is Submitted: 4900  
Federal Grant or Other Identifying Number Assigned by Agency: 1141908

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## Preview of Award 1141908 - Final Project Report

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### Cover

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Submitting Official (if other than PD\PI):	Matthew A Lazzara Principal Investigator
Submission Date:	12/03/2015
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Matthew A Lazzara

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### Accomplishments

**\* What are the major goals of the project?**

The Antarctic Meteorological Research Center's major goals are the following:

1. Improvements to the Antarctic satellite composites
2. Ongoing Antarctic meteorological data collection, distribution and archiving of a variety of Antarctic meteorological datasets with emphasis on United States Antarctic Program (USAP) main station observations, vessel situation reports, etc.
3. Quality control efforts of Antarctic datasets
4. Educational outreach activities

In this supplemental year, 2 major goals were the primary focus with one on-going activity:

1. The Antarctic satellite composite imagery will be converted to netCDF format for broader community use
2. The Antarctic Automatic Weather Station (AWS) archived observations are placed into a database for better community access as well as seeding an improved usage capabilities into the future for this valuable dataset.

**\* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

1. The Antarctic satellite composites - all spectral channels/bands - have now all been converted to netCDF format. Additionally, all new composites that are generated are also made into netCDF format. The CF-compliant netCDF format has been selected for maximum use by the community. The original format that the composite is created in is McIDAS AREA format, and this format is also archived.
2. A new web interface to a database to the AWS observational archive has been created. The output allows basic queries of AWS observations along with format output options including netCDF. This interface is now available via our AMRC web site. Capabilities here may expand/evolve into the future.
3. Completion of peer review manuscript that is an example of a fusion study of high wind events in the Ross Island region of Antarctica using data from the AMRC data collection. Additionally, work historically completed on under the AMRC on composite atmospheric motion vectors has been published.

Specific Objectives:

1. New Antarctic composite datasets in netCDF have been created from the original archive McIDAS AREA format
  - 1.1 Infrared window
  - 1.2 Water Vapor
  - 1.3 Visible
  - 1.4 Shortwave infrared
  - 1.5 Longwave infrared
2. New database created for AWS observations
  - 1.1 Web interface for selection of output and basic database query capability
  - 1.2 Format output options including netCDF
3. An investigation into the high wind events in the Ross Island region was completed and submitted for publication. High latitude atmospheric motion vectors generated from satellite composites has been published (an application of a version of the satellite composites).

- Significant Results:
1. This supplemental effort has successfully met its goal of converting all of the Antarctic satellite composites into netCDF format. Further, all new composites made are automatically made into netCDF format to ensure the archive collection will continue to have these made available, if new composites are made.
  2. The creation of an AWS database from the supplemental funding seeds the future of improved accessibility of AWS observations to the community. It also offers AWS observations in a netCDF format formally for the first time.
  3. With seed funding from the NSF, the high-latitude atmospheric motion vectors derived from a version of the Antarctic satellite composites now demonstrates the ability to have full coverage of these winds in a region that was historically void of them. The high wind speed event study is an example study of a problem that periodically wreaks havoc in the McMurdo area impacting the ability to perform research due to bad weather, introducing safety hazards for flying, etc. for both staff stations, airfields, and nearby field camps alike (See Figure 1).

Key outcomes or  
Other achievements:

**\* What opportunities for training and professional development has the project provided?**

This effort has been one that led to training several of the participants, specifically the undergraduate student and research intern, on the skills needed to accomplish the project's goals. Specific training on how to create the netCDF files, scripting, batch jobs, and database configuration was central to these efforts. The research intern also acquired some basic skills in project management as well.

**\* How have the results been disseminated to communities of interest?**

This effort has been reported at the annual Antarctic Meteorological Observing, Modeling and Forecasting Workshop (AMOMFW), both initial expectations at the 9th AMOMFW in Charleston, SC with an update at the 10th AMOMFW in Cambridge, UK. This final year will also be reported at the upcoming 11th AMOMFW meeting in Columbus, OH June 2016. Throughout this project, the AMRC has been a participant in the Antarctic and Arctic Data Consortium (A2DC). As the only Antarctic meteorological data curation participant, it has been critical for establishing and exchanging ideas associated with the roles of data and sample archives across the Polar Programs, NSF enterprise.

**Supporting Files**

Filename	Description	Uploaded By	Uploaded On
McMurdo-ExtremeWindEvents.pdf	Fig. 1 b) 500hPa heights c) surface wind speed (shading) & mean sea level pressure (white contours) d) surface wind speed (shading) mean sea level pressure (white contours) & surface wind barbs e) surface wind speed (red contours), mean sea level pressure	Matthew Lazzara	11/30/2015

**Products**

## Books

## Book Chapters

## Inventions

### Journals or Juried Conference Papers

Lazzara, M.A., R. Dworak, D.A. Santek, B.T. Hoover, C.S. Velden, and J.R. Key (2014). High-latitude atmospheric motion vectors from composite satellite data. *Journal of Applied Meteorology and Climatology*. 53 (2), 534. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1175/JAMC-D-13-0160.1

Weber, N.J., M.A. Lazzara, L.M. Keller, D.J. Rasmussen, J.J. Cassano, and J.G. Powers (2015). The Extreme Wind Events in the Ross Island Region of Antarctica. *Weather and Forecasting*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

## Licenses

### Other Conference Presentations / Papers

Costanza C.A. and D.E. Mikolajczyk (2015). *Antarctic Meteorological Research Center's McIDAS Usage and Future Cyber-infrastructure*. 2015 McIDAS Users' Group Meeting. Madison, WI.. Madison, WI. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Lazzara, M.A., D.E. Mikolajczyk, R.A. Kohrs, J.O. Robiadek, D.A. Santek, N. Bearson, and S.L. Knuth (2013). *Antarctic Satellite Composite Imagery: 20 Years of Polar Observations*. 12th Conference on Polar Meteorology and Oceanography. Seattle, WA. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Lazzara, M.A., C.A. Costanza, S. Fons, and L.M. Keller (2015). *Antarctic meteorological cyberinfrastructure sustainability*. 10th Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Cambridge, UK. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Lazzara, M.A., R. Dworak, D.A. Santek, B.T. Hoover, C.S. Velden, and J.R. Key (2014). *Composite satellite Atmospheric Motion Vectors*. 39th Annual Northeastern Storm Conference. Rutland, VT. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Archer, A.B. and M.A. Lazzara (2015). *The future of the USAP Antarctic internet data distribution system*. 10th Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Cambridge, UK. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Lazzara, M.A. (2014). *The uncertain future of the Antarctic Meteorological Research Center data services*. 9th Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Charleston, SC. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

### Other Products

*AMRC's Directory Interchange Format (DIF) Entries*.

The following are the main Directory Interchange Format (DIF) links to several of AMRC's data collections:

[Satellite Navigation data over the Southern Hemisphere \[SSEC-AMRC-NAV\]](#)

[Antarctic/Southern Hemisphere Ship and Buoy Weather Observations \[SSEC-AMRC-SHIP BUOY\]](#)

[Antarctic Local Area Coverage NOAA AVHRR data/imagery \[SSEC-AMRC-NOAA-LAC\]](#)

[Radiosonde Weather Observations over Antarctica/Southern Ocean \[SSEC-AMRC-RAOB\]](#)

[Antarctic Composite Images \[SSEC-AMRC-ANT-COMP\]](#)

[SOPP AWS Observations \[SSEC-AMRC-SOPP\\_AWS\]](#)

[Aircraft meteorological reports over Antarctica \[SSEC-AMRC-AIRCRAFT\]](#)

[Atmospheric Motion Vectors over Antarctica \[SSEC-AMRC-AMV\]](#)

[METOP images over Antarctica \[SSEC-AMRC-METOP\]](#)

[Antarctic/Southern Hemisphere Weather Observations \[SSEC-AMRC-STN\\_OBS\]](#)

[Antarctic/Southern Hemisphere METAR Weather Observations \[SSEC-AMRC-METAR\]](#)

[Antarctic/Southern Hemisphere Weather Observations \[SSEC-AMRC-SYN\]](#)

[UKMET forecasts over/near Antarctica \[SSEC-AMRC-UKMET\]](#)

[NCEP Medium Range Forecast model analyses and forecasts over Antarctica \[SSEC-AMRC-NCEP-MRF\]](#)

[NCEP Wind and Wave Forecast model analyses and forecasts over/near Antarctica \[SSEC-AMRC-NCEP-WWFM\]](#)

[ECMWF forecasts over/near Antarctica \[SSEC-AMRC-ECMWF\]](#)

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## **Other Publications**

## **Patents**

## **Technologies or Techniques**

## **Thesis/Dissertations**

## **Websites**

*AMRC AWS Database Website*

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

This web site offers an interface to the AWS Database created as a part of this project. This site will be used by the public, scientists and educators.

*Antarctic Meteorological Research Center*

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

This is the URL of the main website for the AMRC. This is the umbrella website for a variety of Antarctic projects (AWS, AMRC, etc.). Realtime weather information that is still available and being created is updated routinely on this site including the Antarctic satellite composite imagery, AWS observations, etc. The audience this web site reaches includes the general public, weather forecasters, researchers and educators alike.

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## **Participants/Organizations**

### **What individuals have worked on the project?**

Name	Most Senior Project Role	Nearest Person Month Worked
Lazzara, Matthew	PD/PI	0
Keller, Linda	Co PD/PI	0
Fons, Steven	Undergraduate Student	4
Costanza, Carol	Other	3

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**Full details of individuals who have worked on the project:**
**Matthew A Lazzara**

Email: mattl@ssec.wisc.edu

**Most Senior Project Role:** PD/PI**Nearest Person Month Worked:** 0

**Contribution to the Project:** Matthew Lazzara directs and oversees the AMRC and its projects including this supplemental. In this final supplementary year, he has focused efforts on meeting two key goals: converting the Antarctic satellite composite imagery to netCDF format for broader community use and providing a database interface to the AWS observations also with options for netCDF output. Other science investigations associated with the project have also been a part of this final year.

**Funding Support:** Any work done on this project was supported by this project.

**International Collaboration:** No

**International Travel:** No

**Linda M Keller**

Email: lmkeller@wisc.edu

**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 0

**Contribution to the Project:** Linda has provided advice on the project in this final supplemental year of the AMRC project, specifically with regards to the AWS database efforts. Her role has been limited in this final year with the focus in this year restricted to just a few key activities and assistance with the submission of one peer reviewed publication.

**Funding Support:** Her effort on this project was paid by only this project.

**International Collaboration:** No

**International Travel:** No

**Steven Fons**

Email: sfons@wisc.edu

**Most Senior Project Role:** Undergraduate Student**Nearest Person Month Worked:** 4

**Contribution to the Project:** Steven worked on routine data collection, and archive of USAP meteorological observations from the USAP stations, field camps, ships, etc. on a routine basis. He also worked with other team members on the conversion of the Antarctic satellite composite archive (all 24 years) into netCDF format.

**Funding Support:** Steven's efforts were funded by this project only.

**International Collaboration:** No

**International Travel:** No

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**Carol Costanza**

**Email:** carol.costanza@ssec.wisc.edu

**Most Senior Project Role:** Other

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Carol is a research intern working on this final year of the project. During this supplemental year, she has worked to oversee the conversion of all of the Antarctic satellite composite imagery into netCDF format as well as working with others in our department on providing the AWS observations via a database, etc. She has also overseen the maintenance and archiving of USAP meteorological data (from USAP stations, field camps, ships, etc.) done by the undergraduate students.

**Funding Support:** Her time working on this project was funded by this project alone.

**International Collaboration:** No

**International Travel:** No

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**What other organizations have been involved as partners?**

Nothing to report.

**What other collaborators or contacts have been involved?**

Nothing to report

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## Impacts

**What is the impact on the development of the principal discipline(s) of the project?**

The two focal points of this past year's supplemental funding, the Antarctic satellite composites and the database for the AWS observations, will lead to easier access of these dataset, increasing the value of the investment put into creating and having these unique observations. The improved availability will enable future research to use these datasets.

At the submission of this report, the Antarctic satellite composites are already being actively used in another research project, as well as being considered by others for research projects. The satellite composite investment the NSF has put into the Antarctic may lead to other US agencies (e.g. NOAA) to consider adopting this product for operational use (as well as its archive for future research). This would follow the model of another NSF funded project, centered around Arctic satellite composites that is making this successfully transition from research to operations.

The AWS observational dataset has been utilized by hundreds of peer-reviewed science publications over the life



of the US Antarctic AWS existence (external to the current and prior PIs). Having a database and netCDF format option output will enable this historically successful use to continue into the future.

### **What is the impact on other disciplines?**

The AMRC datasets discussed here are utilized in other science disciplines, especially the AWS observations. This effort of this supplemental funding to encourage a stronger availability opens access to other disciplines even broader than before. This enables the continued use of AWS observations by glaciologists, oceanographers, biologists, etc. to support their current and future efforts.

### **What is the impact on the development of human resources?**

The undergraduate student who worked on this project has learned several key skills, include the use of a commonly available interactive processing system (e.g. McIDAS) combined with a UNIX-based scripting language to convert the Antarctic satellite composite imagery from McIDAS AREA format to netCDF format.

The research intern has expanded knowledge on database and the interface of a database via a webservice, in providing the availability of the AWS observations. Project management was another skill set gained by the research intern.

### **What is the impact on physical resources that form infrastructure?**

Nothing to report.

### **What is the impact on institutional resources that form infrastructure?**

All of the datasets worked on during this project will live beyond this supplemental funding period. Efforts are underway for the next two years to determine that future, with an aim toward a sustainable future. Meantime, what has been produced here will be available to community for future use or yet-to-be-proposed projects.

### **What is the impact on information resources that form infrastructure?**

Nothing to report.

### **What is the impact on technology transfer?**

The products produced by this project are made available via the services offered by the AMRC include Web, FTP, McIDAS ADDE, rsync, etc.

### **What is the impact on society beyond science and technology?**

The two key observational datasets that were the focus of this supplemental year of funding are some of the most public-facing imagery/data of all Antarctic meteorology: composite satellite imagery (actually imagery of storms around/over the Antarctic) and surface weather observations (especially temperature). This will remain the case as long as these observations continue to be collected, assembled, and made available.

With all NSF-funded projects the AMRC has had an outreach component. Here are a sample of some of the outreach events and venues in the past year:

- Emerson Middle School (April 9, 2015)
- Lincoln Middle School (April 10, 2015)
- Madison Eastside Optimists Club (May 27, 2015)
- Middleton Glen Retirement Community (October 20, 2015)
- UW-Madison Open House/Science Expeditions weekend event (April 18, 2015)
- Visitors to UW-Madison (various, multiple dates)

## Changes/Problems

### **Changes in approach and reason for change**

Nothing to report.

### **Actual or Anticipated problems or delays and actions or plans to resolve them**

Nothing to report.

### **Changes that have a significant impact on expenditures**

Nothing to report.

### **Significant changes in use or care of human subjects**

Nothing to report.

### **Significant changes in use or care of vertebrate animals**

Nothing to report.

### **Significant changes in use or care of biohazards**

Nothing to report.

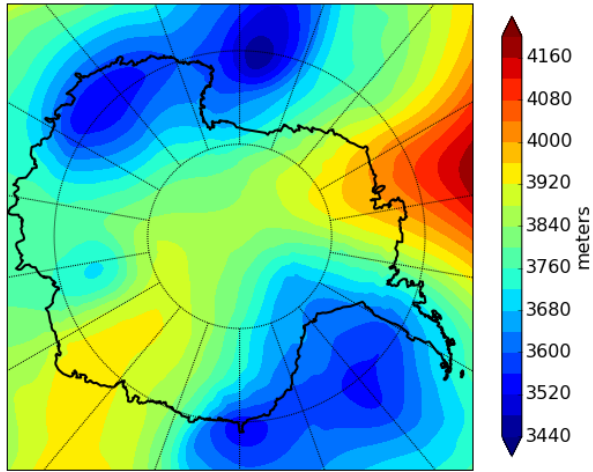
## Real-Time and Archive

- **Automatic Weather Stations** (Meteorograms, Weather Maps, Raw Data)
- **Staffed Stations** (Meteorograms, Weather Maps, Raw Data)
- **Ship and Buoy Data**
- **Flight** (Aireps and TAFs)
- **Antarctic Composites** (Infrared, Psuedo-Color, Longwave, Shortwave, Visible, Water Vapor, Google Earth KMZ)
- **METOP A** (Centered over McMurdo)
- **Suomi-NPP** (CrIS, ATM and VIIRS (coming soon))
- **NOAA** (LAC, GAC, HRPT)
- **Satellite Navigation**
- **Atmospheric Motion Vectors**
- **Models** (AMPS (real-time only), GFS, ECMWF, UKMET)
- **Analysis** (ICE, SST)
- **Upper-Air** (Hodographs and Skew-T)
- **Forecast HySPLIT AMPS Back Trajectories** (at AWS in McMurdo area)

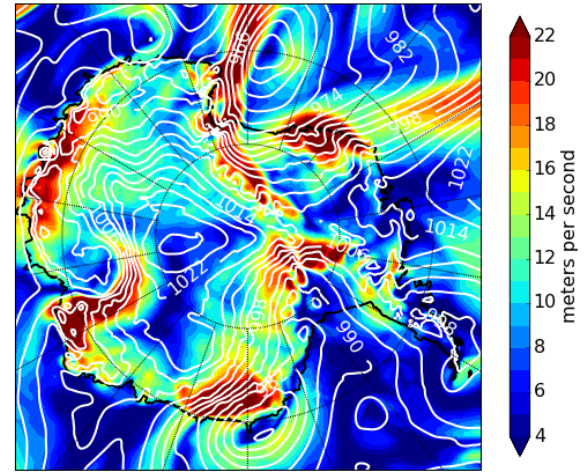
## Non-Real-Time/Archive

- **Automatic Weather Stations** (Quality Controlled 10 minute, hourly, 3-hourly, CLIMAT Messages, Monthly Summaries)
- **Field Camps**
- **McMurdo** (Barocharts, Surface and Upper Air CLIMAT Messages, Climatology Sheets, Pegasus Runway, Radiosonde, Arrival Heights, Building 189, Building 69, Building 71, SPAWAR AWS, BIF, White Island, Black Island, MWS)
- **Neumayer** (Radiosonde)
- **Palmer** (Surface CLIMAT Messages, Climatology Sheets, Station Observations)
- **South Pole** (Surface and Upper Air CLIMAT Messages, Local Climatology Data, Climatology Sheets, South Pole Runway, One Minute Observations, Radiosonde, Synoptic Observations)

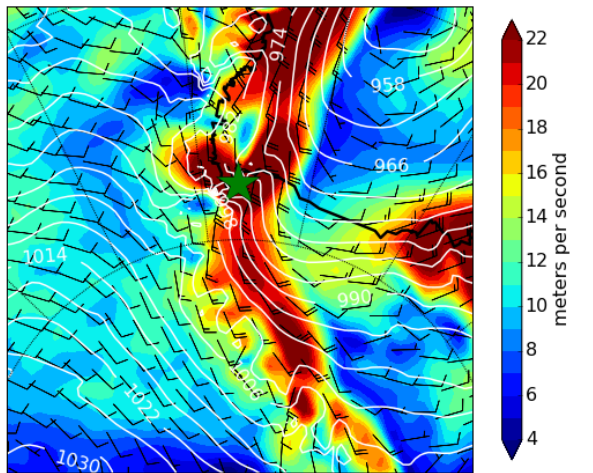
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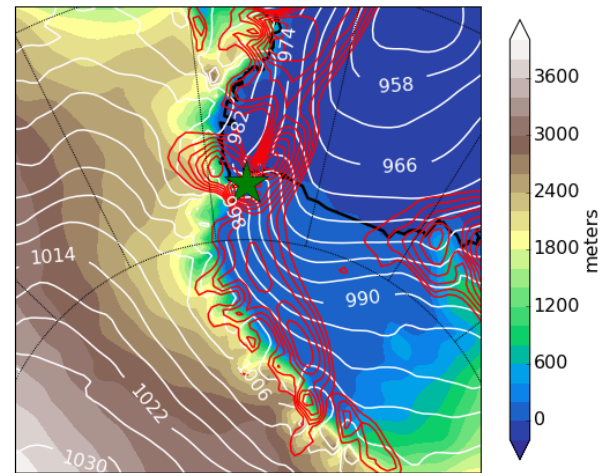
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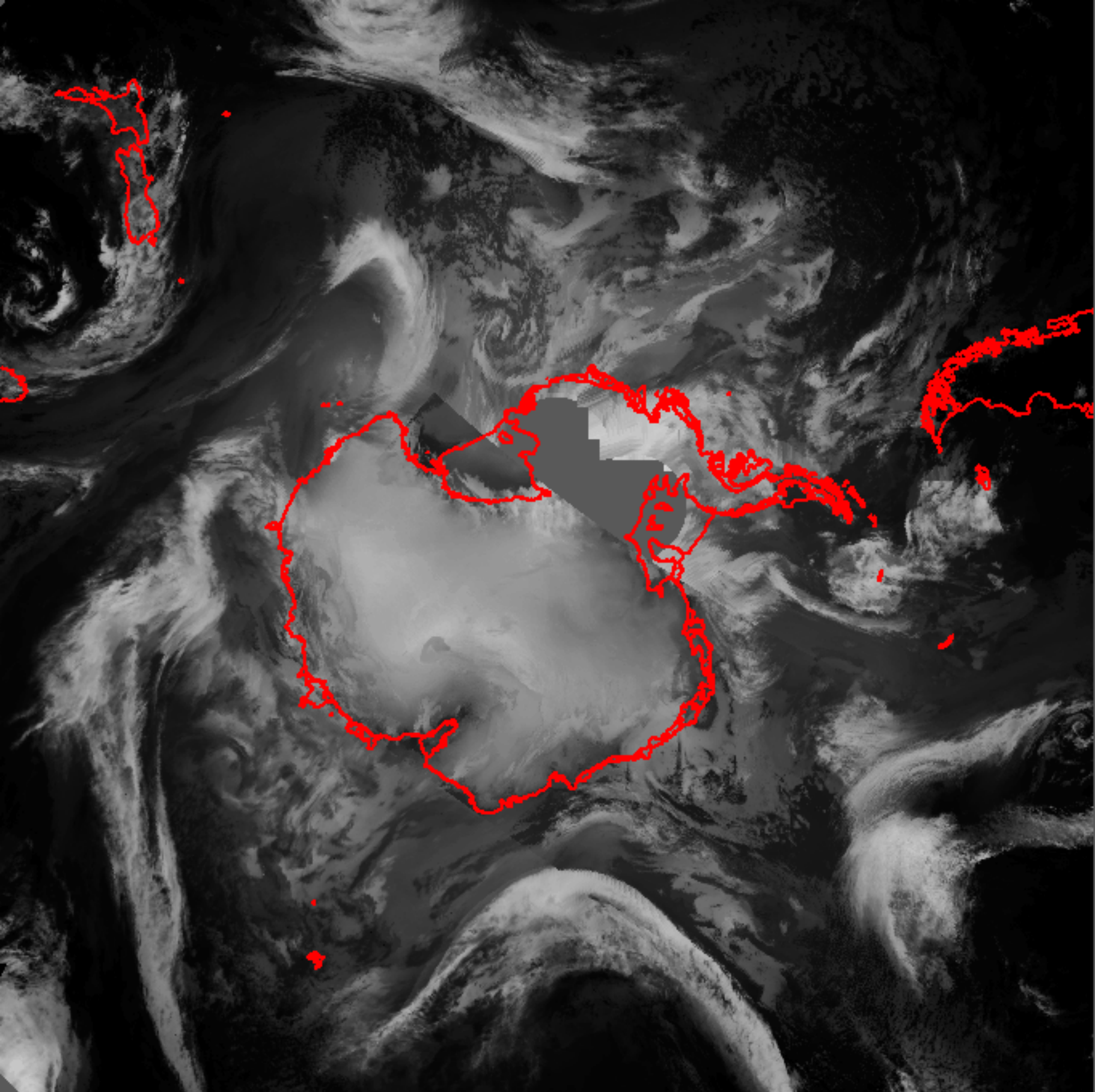
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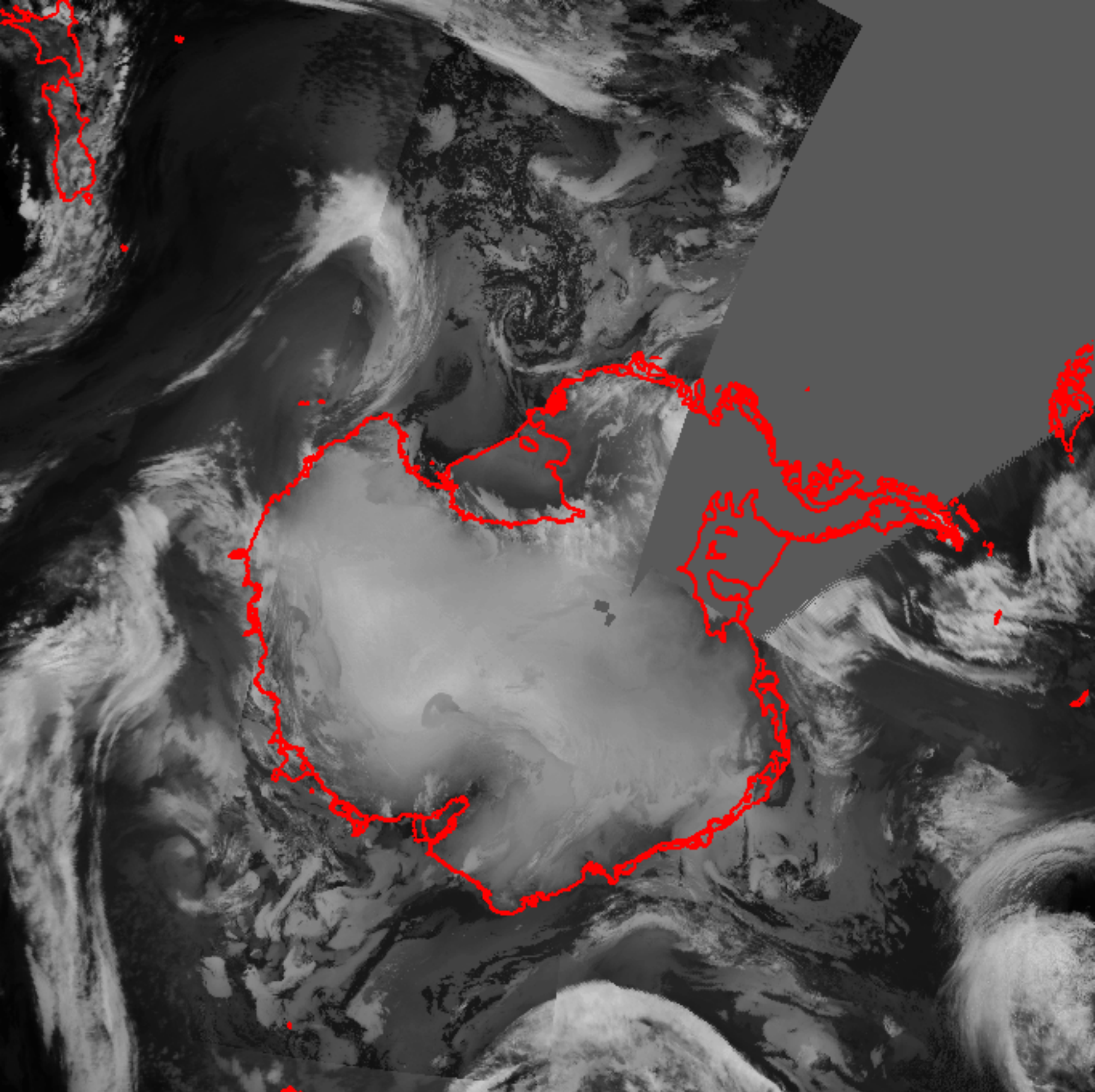
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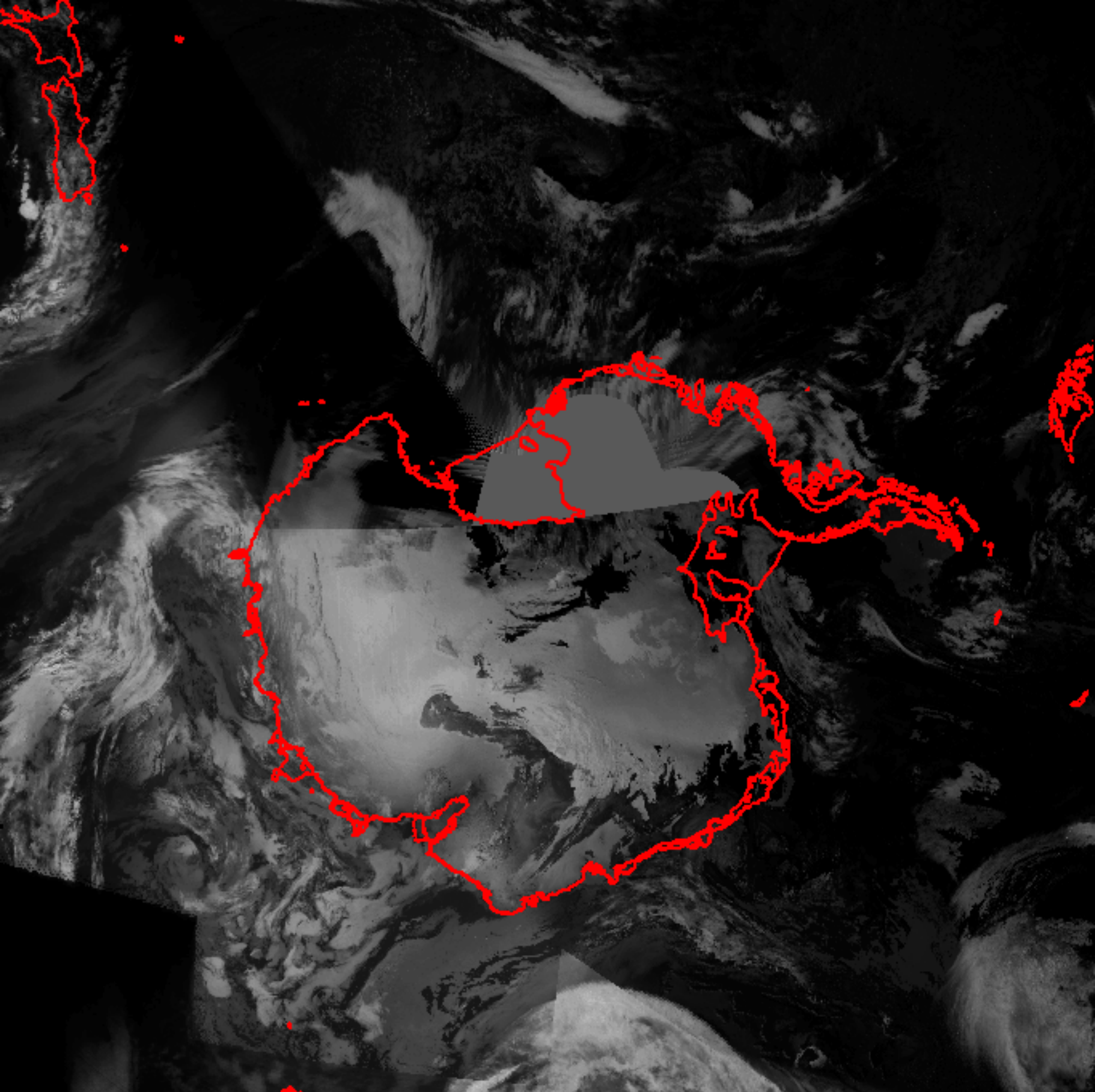
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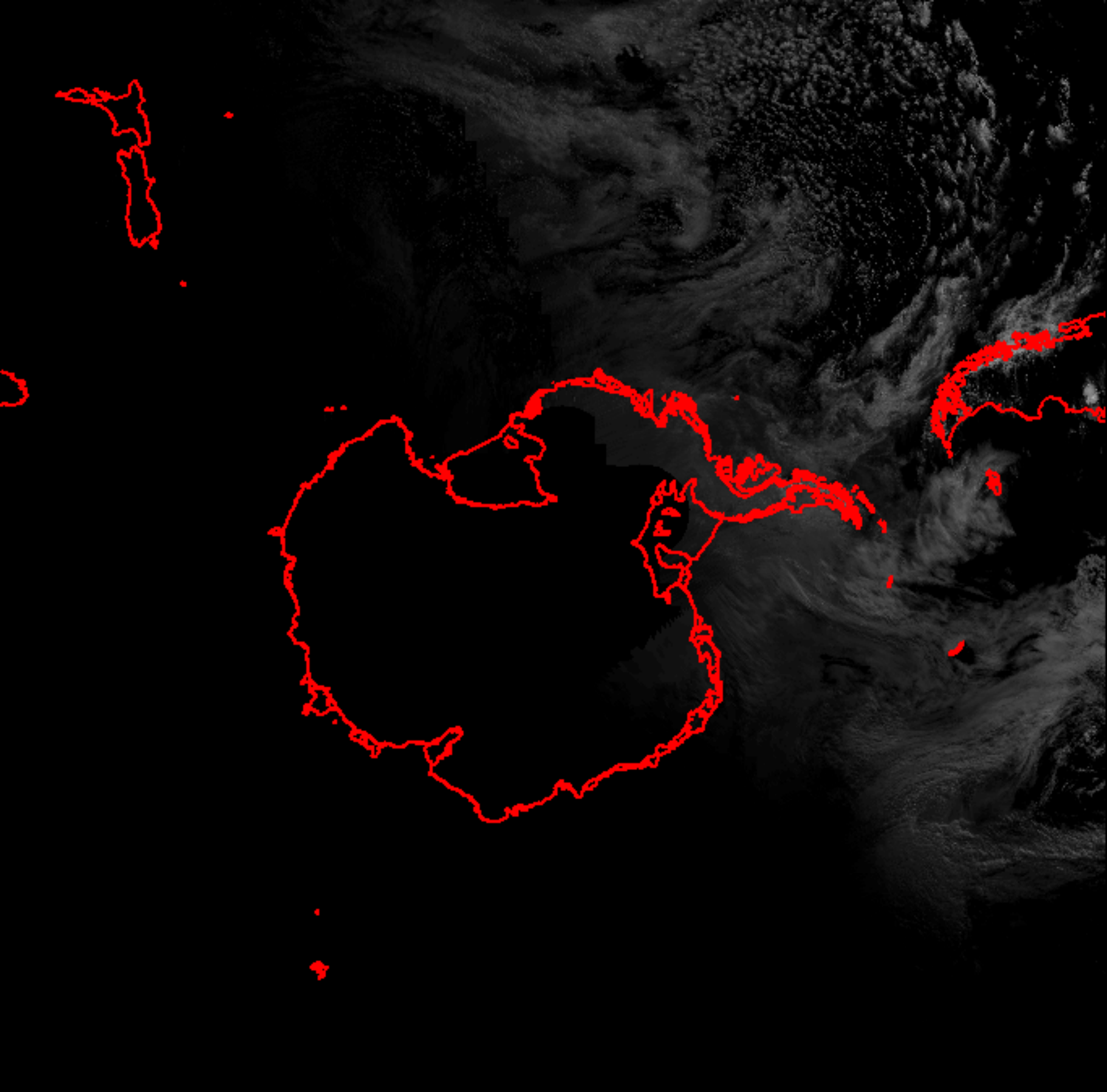
ANTARCTIC COMPOSITE INFRARED 30 JAN 15 AT 18 UTC AMRC



ANTARCTIC COMPOSITE LONGWAVE\_IR 30 JAN 15 AT 18 UTC AMRC

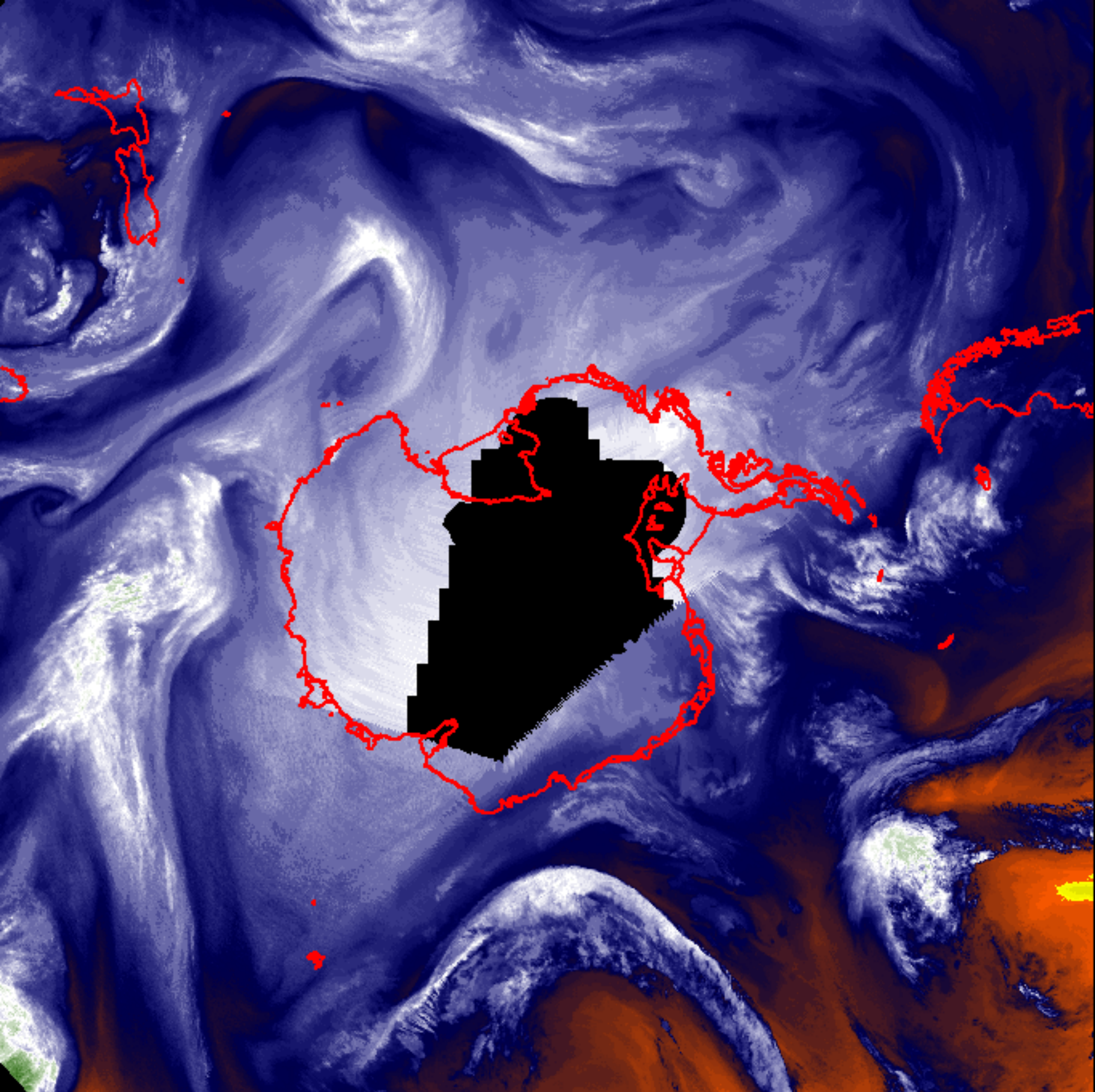


ANTARCTIC COMPOSITE SHORTWAVE\_IR 30 JAN 15 AT 18 UTC AMRC



ANTARCTIC COMPOSITE VISIBLE 30 JAN 15 AT 18 UTC AMRC





ANTARCTIC COMPOSITE WATER\_VAPOR 30 JAN 15 AT 18 UTC AMRC