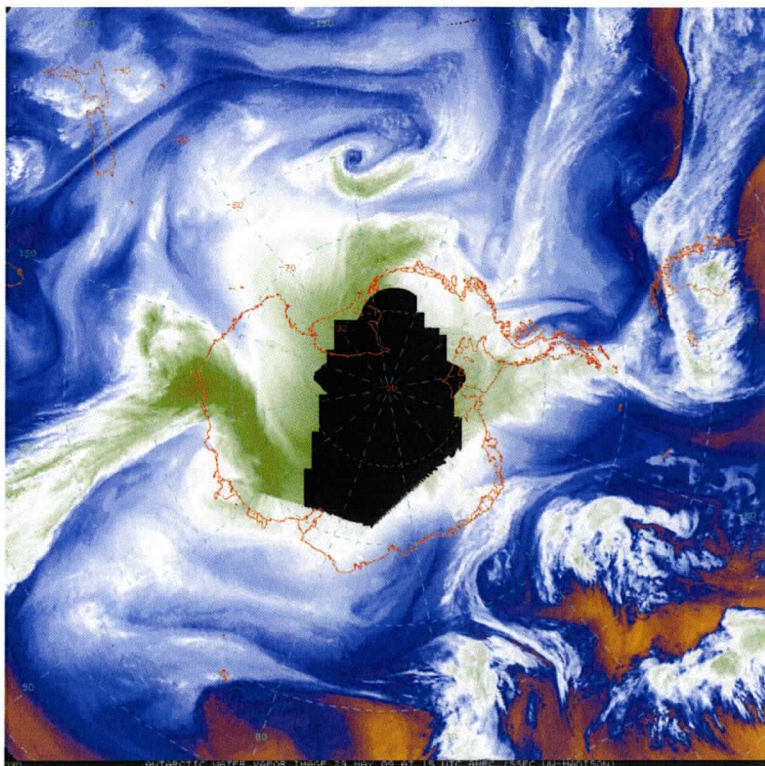


Annual Project Report: NSF-GEO-DPP Grant #ANT-1244924, March 1, 2013 to February 28, 2014

Collaborative Research: Synoptic and Mesoscale Storms in the Southern Ocean and their Impact on Cryosphere

*An Annual Report to
The Division of Polar Programs, Geoscience Directorate, National Science Foundation*



Dr. Maria Tsukernik, Principal Investigator
Dr. Matthew A. Lazzara, co-Principal Investigator

Environmental Change Initiative
Department of Geological Sciences
Brown University

Antarctic Meteorological Research Center
Space Science and Engineering Center
University of Wisconsin-Madison

Submitted on January 25, 2014



BROWN



Preview of Award 1244924 - Annual Project Report

Cover

Federal Agency and Organization Element to Which Report is Submitted: 4900

Federal Grant or Other Identifying Number Assigned by Agency: 1244924

Project Title: Collaborative Research: Synoptic and Mesoscale Storms in the Southern Ocean and their Impact on Cryosphere

PD/PI Name: Matthew A Lazzara, Principal Investigator

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

Submission Date: 01/24/2014

Recipient Organization: University of Wisconsin-Madison

Project/Grant Period: 03/15/2013 - 02/29/2016

Reporting Period: 03/15/2013 - 02/28/2014

Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions) Matthew A Lazzara

Accomplishments

What are the major goals of the project?

This project aims to investigate the mechanisms that control the synoptic and, where possible, mesoscale drivers of cryospheric variability in Antarctica and the Southern Ocean. The project will employ satellite products, ground observations, new generation gridded reanalyses and a state of the art regional climate model to elucidate these high frequency interactions. The primary aim of the research is to advance the understanding of atmospheric processes responsible for the characteristics of Southern Ocean synoptic and mesoscale cyclones that most influence the evolution of the cryosphere. In particular, the research will focus on the dynamic processes that drive sea ice changes and will better quantify the poleward moisture transport critical for the maintenance of the Antarctic ice sheet mass balance.

Specific University of Wisconsin-Madison activities to meet these goals include:

- Extend Cloud Mass Transport (CMT) efforts that reveal regions of increased transport of cloud systems, and hence moisture into the Antarctic.
- Case study construction of cyclone and transport events, supported via satellite and ground based observations.
- Development of Water Vapor Transport (WVT) analysis to aid in understanding the poleward transport of moisture over the Antarctica.

These activities compliment and support the analysis and modeling activities being conducted at Brown University.

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

Major Activities: Two of the three specific goals have been worked on during the first year of the project. With the hiring of an undergraduate student to work on the project, the following

activities have been accomplished:

- Hire and training of undergraduate student
- Running test case for Water Vapor Transport for October 2009
- Case study support for the PI at Brown University

Specific Objectives: In the first year of the project, effort has been focused on the Water Vapor Transport (WVT), an analog to the Cloud Mass Transport (CMT) work, which is based on the infrared Antarctic satellite composite observation imagery (a paper on the CMT effort is in preparation).

Significant Results: No results are yet available at this stage of the analysis.

Key outcomes or Other achievements: No specific achievements or key outcomes yet to report at this stage of the project.

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

In the first year of the project, the training of an undergraduate student at the University of Wisconsin has been a focus. Joe Nettesheim has been working to learn the weather software used to analyze the Antarctic water vapor satellite composite imagery that will be used in the project. He has been testing a sample month of imagery and supporting any case study efforts requested by the PI, Dr. Maria Tsukernik at Brown University.

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

Nothing to report.

*** What do you plan to do during the next reporting period to accomplish the goals?**

In the coming year, efforts on the project will take place on multiple levels. First, the Water Vapor Transport (WVT) effort will be expanded beyond the test month to cover at least one test year, and comparisons to the infrared satellite Cloud Mass Transport will be conducted. Efforts will turn toward beginning to work on WVT over a decade time period. Additional work on extending the CMT beyond the 20 year study will be started. Case study support also be a part of the upcoming activities in the second year of the project.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Figures-NSF-AnnualReport-SynopticTransport.pdf	Figure 1. A sample Antarctic satellite composite water vapor observation from 18 UTC on 12 October 2009 depicts transport of cloud/moisture from the South Pacific into Marie Byrd Land (highlighted by the red arrow). The white and green shades in the image	Matthew Lazzara	01/20/2014
FigureX-NSF-AnnualReport-SynopticTransport.pdf	Figure 2. A sample Antarctic satellite composite water vapor observation set from 29 May 2009 at 3 UTC on through 29 May 2009 at 21 UTC depicts the sequence of a transport event of cloud/moisture from the Southern Ocean onto Wilkes Land (as highlighted b	Matthew Lazzara	01/20/2014

Products

Journals

Lazzara, M.A., L.M. Keller, J. Snarski, K.E. Willmot, J.A. Braun, and M. Tsukernik (). Cloud Mass Transport Observations from Composite Satellite Imagery. *Monthly Weather Review*.

Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Books

Book Chapters

Thesis/Dissertations

Conference Papers and Presentations

Other Publications

Technologies or Techniques

Nothing to report.

Patents

Nothing to report.

Inventions

Nothing to report.

Licenses

Nothing to report.

Websites

Title: Antarctic Meteorological Research Center

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

Description: The Antarctic Meteorological Research Center (AMRC) Website hosts real-time displays of the Antarctic satellite composite observational imagery along with other Antarctic meteorological data and information from AMRC's sister project, the Antarctic Automatic Weather Station (AWS) Project.

Other Products

Product Type: Databases

Description: **Antarctic water vapor satellite composite imagery**: This set of satellite observations, created by the Antarctic Meteorological Research Center (AMRC), will be used to assess the moisture transport over the Southern Ocean onto the Antarctic continent. This data is already provided by the AMRC via a variety of means including FTP server, RAMADDA service and in real-time via web server, ADDE service and Antarctic-IDD/LDM service.

Other:

Participants

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Joseph Nettesheim	Undergraduate Student	1
Matthew A Lazzara	PD/PI	1

What other organizations have been involved as partners?

Name	Location
Brown University	Providence, RI

Have other collaborators or contacts been involved? N**Impacts****What is the impact on the development of the principal discipline(s) of the project?**

Nothing to report.

What is the impact on other disciplines?

Nothing to report.

What is the impact on the development of human resources?

Nothing to report.

What is the impact on physical resources that form infrastructure?

Nothing to report.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Nothing to report.

Changes**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.

Preview of Award 1246178 - Annual Project Report

Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1246178
Project Title:	Collaborative Research: Synoptic and Mesoscale Storms in the Southern Ocean and their Impact on Cryosphere
PD/PI Name:	Maria Tsukernik, Principal Investigator Amanda Lynch, Co-Principal Investigator
Submitting Official (if other than PD/PI):	N/A
Submission Date:	N/A
Recipient Organization:	Brown University
Project/Grant Period:	03/15/2013 - 02/29/2016
Reporting Period:	03/15/2013 - 02/28/2014
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	N/A

Accomplishments

* What are the major goals of the project?

The aim of the project is to investigate mechanisms that control the synoptic and mesoscale drivers of cryospheric variability in Antarctica, and to quantify the contribution of water vapor transport and precipitation to the variability of the Antarctic sea ice and ice sheet mass balance. To reach this goal we are using a combination of best available satellite and ground observational data, reanalysis and modeling. We receive tremendous support from the Antarctic Meteorological REsearch Center at the University of Wisconsin, who are our collaborators on this project.

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

Major Activities: During the first year of the projects we have evaluated the cyclonic activity in the Southern Ocean, paying close attention to the meridional tracking of the storm. Upon completing this assesment we were able to identify:

1. Key regions of meridional synoptic activity. This tightly align with key regions of the meridional moisture transport. We will evaluate this regions through the case study analysis in the following year.
2. Identify an interesting case study, which occurred in the atypical location and thus had a large impact on accumulation rates in the East Antarctica.

Specific Objectives: In the first year of the project we focused on evaluating the moisture transport from several perspective. We used the ERAI Reanalysis data for the moisture flux and combined this with ground observations in the Dronning Maud Land.

Parallel to this effort and in collaboration with our University of Wisconsin colleagues we are working on developing an independent method to evaluate the moisture transport from the Water Vapor Transport composite imagery.

Another effort has been put to assessing the sea ice data availability in the Southern Ocean. All the buoy data available to the date has been collected and will be taken into consideration for the sea ice case study selection.

Initial WRF simulations has been performed.

The dynamics of the storm development is being assessed with a quasi-geostrophic algorithm (Lynch et al., 2003), that is now adapted to evaluate data from the WRF simulations.

Significant Results:

Key outcomes or
Other achievements:

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

An undergraduate student at Brown University, Maya Wei, has completed her training under the framework of this project. Maya Wei has worked over the Spring and Summer 2013 to adapt the quasi-geostrophic algorithm, which is our key tool to evaluate the dynamics of a particular storm. Maya has now accepted a graduate student position at the University of Texas-Austin, and although she has left the project, she will continue to contribute to the field of atmospheric dynamics.

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

Pi Maria Tsukernik gave a presentation at the AGU Fall meeting on the case study in the Dronning Maud Land. The results from this analysis are now being submitted for a publication.

*** What do you plan to do during the next reporting period to accomplish the goals?**

We will expand our WRF simulations to other cases of interest. Amundsen/Ross Sea region has been identified as the key region for both meridional transport of moisture and eastward propagation of the cyclones. It has also been independently identified as a region of significant cloud mass transport (CMT) using the CMT composites. Several cases from this region will be evaluated.

The sea ice cases will be selected based on buoy data availability to evaluate the development of storms in the vicinity of the buoy and their impact on the sea ice cover. Meteorological data from sea ice buoys will help the storm evaluation.

Products

Journals

Books

Book Chapters

Thesis/Dissertations

Maya Wei. *Preliminary Analysis of an Atmospheric River Related Cyclonic Event off Dronning Maud Land, May 2009..* (2013). Brown University.

Acknowledgment of Federal Support = No

Conference Papers and Presentations

Tsukernik, Maria; Gorodetskaya Irina; van Lipzig, Nicole; Lynch, Amanda (2013). *Atmospheric Rivers in Antarctica?*. American Geophysical Union Fall meeting 2013. San Francisco, CA.

Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Other Publications

Technologies or Techniques

Nothing to report.

Patents

Nothing to report.

Inventions

Nothing to report.

Licenses

Nothing to report.

Websites

Title: Antarctic water vapor composites and other data

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

Description: This set of satellite observations, created by the Antarctic Meteorological Research Center (AMRC), will be used to assess the moisture transport over the Southern Ocean onto the Antarctic continent. This data is already provided by the AMRC via a variety of means including

FTP server, RAMADDA service and in real-time via web server, ADDE service and Antarctic-IDD/LDM service.

Other Products

Nothing to report.

Participants

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Maya Wei	Undergraduate Student	2
Amanda Lynch	Co PD/PI	1
Maria Tsukernik	PD/PI	2

What other organizations have been involved as partners?

Name	Location
Finnish Meteorological Institute	Helsinki, Finland
Katholieke Universiteit Leuven	Leuven, Belgium

Have other collaborators or contacts been involved? Y

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

An atmospheric river case study that has been discovered and described in the Dronning Maud Land region has made a significant contribution to the accumulation in the region for that particular year. We are evaluating the dynamics of this case to a greater depth to better understand mechanism behind the accumulation processes in the East Antarctica. This is a relatively new discovery as synoptic-scale precipitation has not been thought of as an important contributor to the East Antarctic accumulation.

What is the impact on other disciplines?

Nothing to report.

What is the impact on the development of human resources?

Nothing to report.

What is the impact on physical resources that form infrastructure?

The next set of case studies we will investigate are from the McMurdo region. Understanding the dynamics of storms in this region is important for operations on the US and several other Antarctic bases.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Nothing to report.

Changes**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.

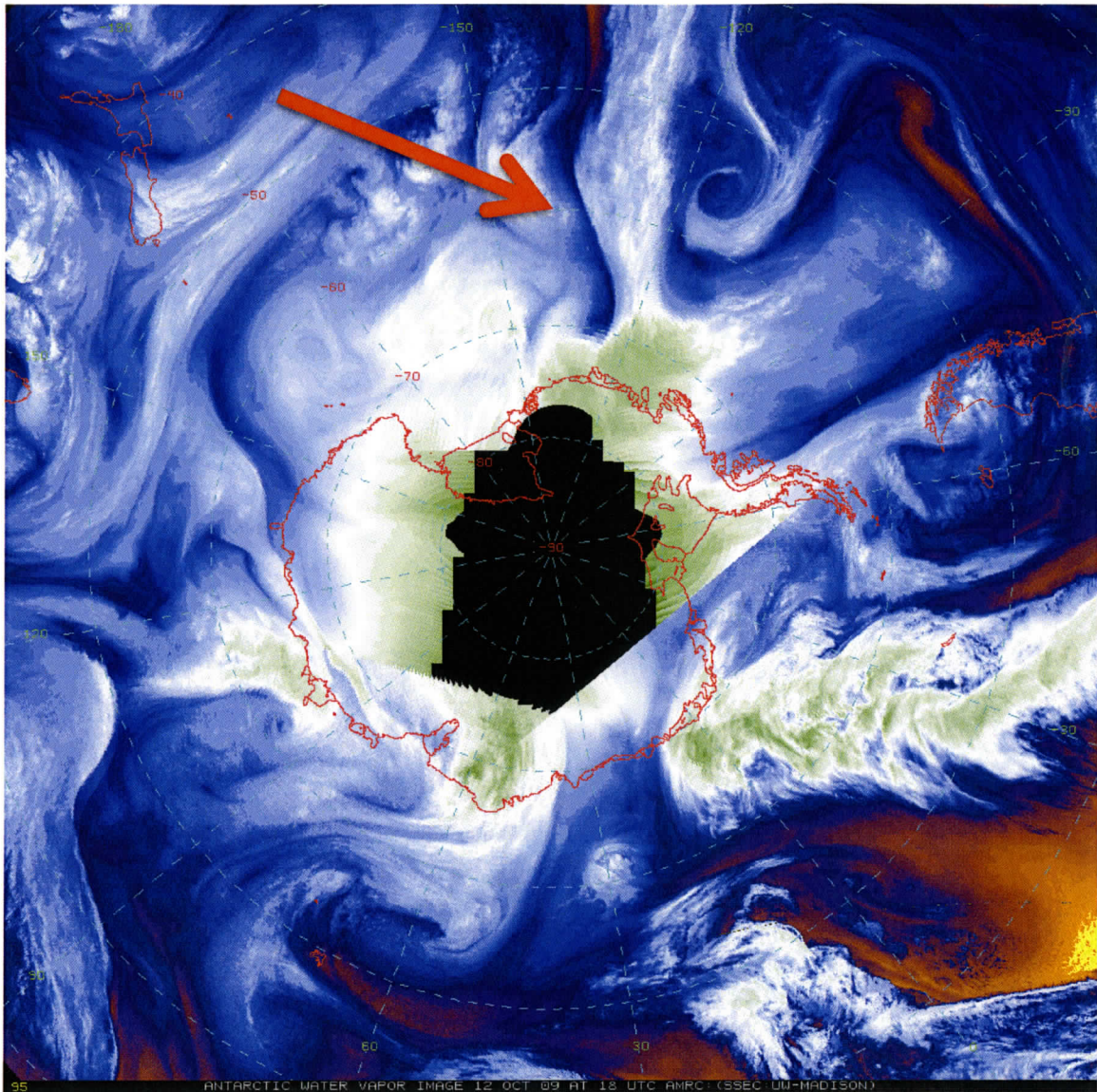


Figure 1. A sample Antarctic satellite composite water vapor observation from 18 UTC on 12 October 2009 depicts transport of cloud/moisture from the South Pacific into Marie Byrd Land (highlighted by the red arrow). The white and green shades in the imagery depict atmospheric water vapor and/or clouds. Blues and tan shades are indicative of lower water vapor content.

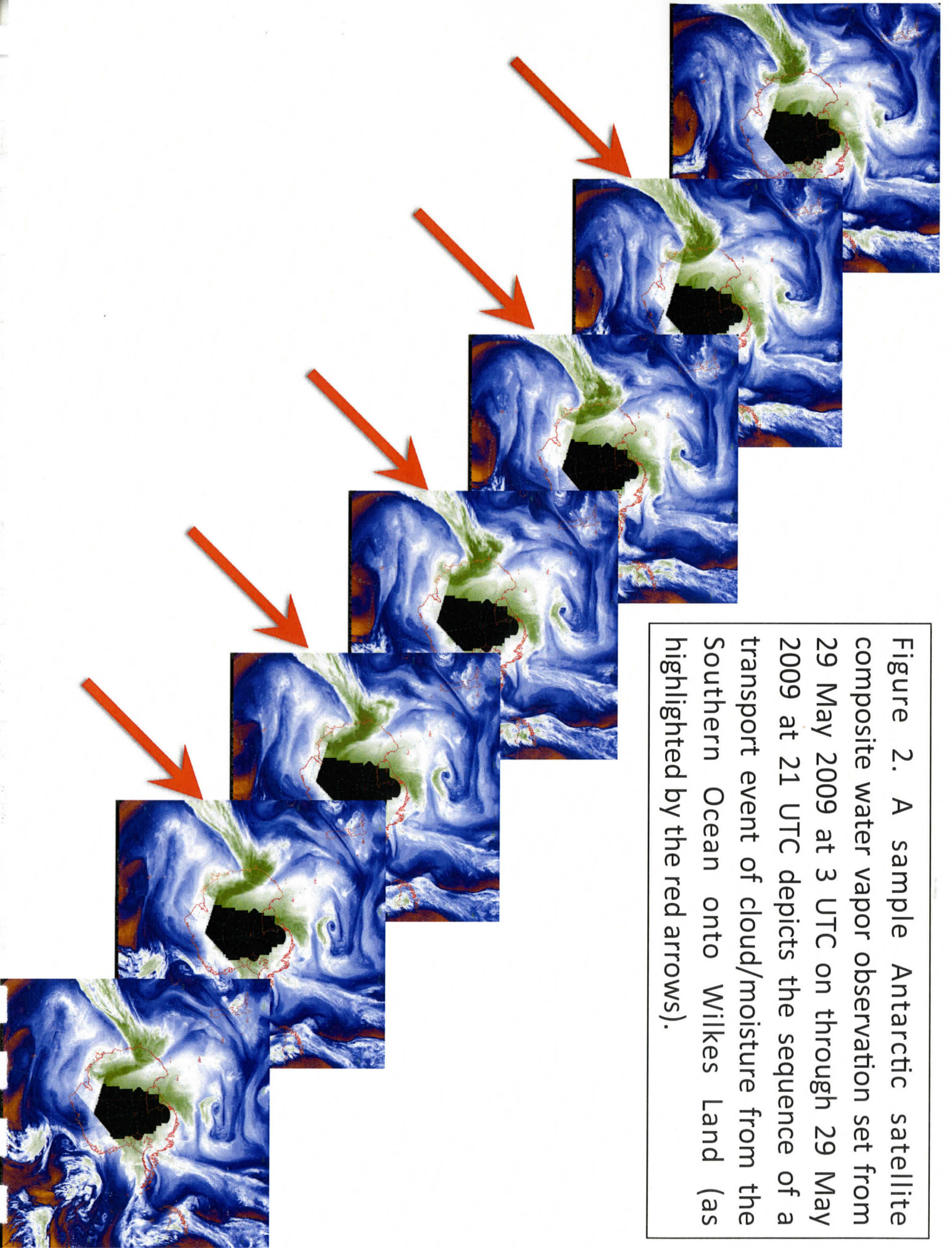


Figure 2. A sample Antarctic satellite composite water vapor observation set from 29 May 2009 at 3 UTC on through 29 May 2009 at 21 UTC depicts the sequence of a transport event of cloud/moisture from the Southern Ocean onto Wilkes Land (as highlighted by the red arrows).