Antarctic meteorological data – collection, archive, and distribution

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Summary Antarctic geophysical data is important for research and logistical needs including studies of localized weather, operational weather forecasting, climate monitoring, and the movement of ice sheets. The Antarctic Meteorological Research Center (AMRC) houses various types of geophysical data for the Antarctic, and in particular, meteorological data. This database is the premier weather data collection system for the United States Antarctic program. Within this database, satellite imagery, weather station observations, model output, climatological data, and pilot reports are just some of the data available. All data is available to the public and scientific community free of charge, as long as it is used for educational or scientific purposes. The purpose of this presentation is to introduce the full extent of the AMRC collection to the Antarctic community.

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Introduction

The Antarctic Meteorological Research Center (AMRC) at the University of Wisconsin-Madison is one of the foremost data collection operations in place for the Antarctic community. The AMRC has been in operation since 1992, and was initially developed in part as a distribution point for Antarctic automatic weather station (AWS) data, a sister project to the AMRC. It was also a repository for a variety of Antarctic meteorological datasets and a source for AMRC's trademark satellite composite imagery (Bywaters, 1994 and Lazzara, 1995). The AMRC has a large collection of Antarctic weather data from various sources in some cases dating back to the 1950s. The data in this repository includes original collections from the AMRC as well as data from other projects and field campaigns (Knuth, et al., 2003).

The data is acquired from several sources, including various other Antarctic programs outside of the United States. The United States Antarctic Program (USAP) provides station climatological data to the AMRC, while other data, such as some satellite imagery and other generated products, are obtained from the Space Science and Engineering Center (SSEC), also at the University of Wisconsin-Madison. Some data, such as the AWS data or satellite composite imagery, are generated at the AMRC. New uses for these data types are always being sought, but recently several new scientific projects, including the tracking of icebergs, measurements of snow accumulation, and the flow of ice sheets have been undertaken using the AMRC's available data collection.

Available Data

The AMRC has various forms of data available to the public for use. The centerpiece of this data is the Antarctic composite satellite imagery (Figure 1). These satellite composite images are unique to the AMRC and are generated in-house. These images include pieces of satellite data that cross at or near the pole within 50 minutes of the top of the hour, and are generated every three hours (Lazzara et al., 2003). These images include data from polar-orbiting and geostationary satellites from the United States, Europe, China, Japan, and India. Currently available are composites in the infrared, water vapor, and visible spectrums. In addition to the composite imagery, other satellite imagery from these countries is available in unedited format. Infrared images are available from October 1992 to the present, water vapor from May 2001 to the present, and visible imagery only in the last few years as an experimental product.

In addition to satellite data, the AMRC is the host of all USAP AWS data from 1980 to the present. The US AWS program has had over 100 stations placed across the Antarctic in the 27 years of its tenure, with about 65 stations currently in operation. The stations take basic meteorological data – temperature, pressure, wind speed and direction, relative humidity, and on some stations, snow depth change (Figure 2). The AMRC offers all AWS data in the raw 10 minute format, or the quality-controlled data which is available in 3-hourly format. New quality-controlled datasets will soon be added at 10 minute, 1 hour and 3 hour intervals. The AMRC also offers AWS data from other countries, including, but not limited to, Italy, Australia, and the Netherlands.

The AMRC also hosts a variety of other types of data, including model output, synoptic data, and climatological data for each of the three US permanent stations. Additionally, the AMRC hosts observations from ships and buoys from several countries, including the United States, Russia, and Argentina, and pilot observations from United States Air Force pilots. As is the case with all of AMRC's data holdings, all of this

data is available to the scientific community and public free of charge.

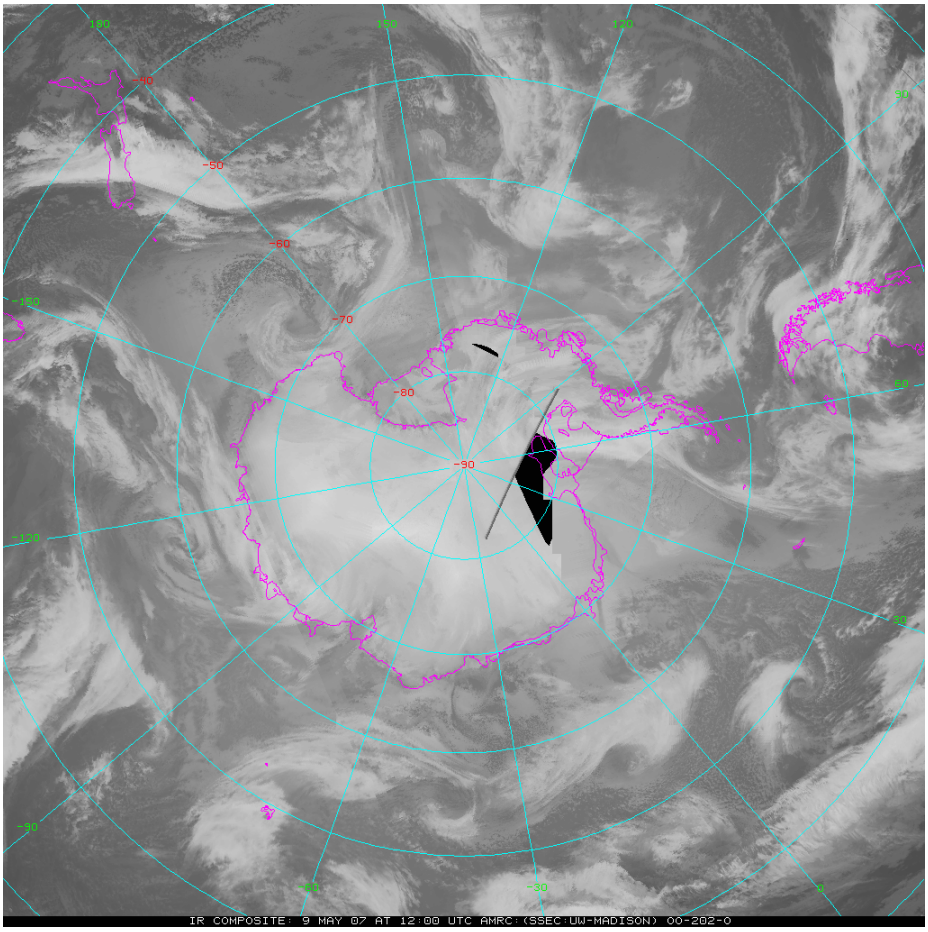

Figure 1. Infrared composite imagery over Antarctica from 9 May 2007. The black areas in the middle of the image are data void regions.

Distribution of Data

The AMRC has several methods of distributing its data holdings to the public (Figure 3). The two oldest and most common methods are through web and ftp. The AMRC has an extensive web site located at http://ice.ssec.wisc.edu which houses real-time data that can be downloaded at any time. In addition, the AMRC has a vast ftp site available at ftp://ice.ssec.wisc.edu. The entire collection of AMRC data can be found on this site, and is available for download. For users of modern meteorological interactive processing software such as McIDAS, VisAD, DV, MatLab and IDL, most of AMRC's realtime collection and a growing portion of the archive collection is available via the Abstract Data Distribution Environment (ADDE also known as OpenADDE).

The easiest and newest method of collection of data is via the Antarctic Internet Data Distribution (IDD) system (Lazzara, et al., 2006). The idea of the Antarctic-IDD system is that multiple groups can place their data in the IDD data stream, which can then be collected by other groups that are also a part of the IDD. This is an extremely efficient and quick way to collect all types of data.

Currently, the AMRC offers most of its data via the Antarctic IDD, including all AWS data, all satellite composite imagery, synoptic, radiosonde, METAR, ship, and pilot observations. Future distribution plans include the offering of AMRC's collection via OpenDAP server (formerly known as DODS). In relation to this, it is hoped to have the AMRC data collect be cataloged and available via a THREDDS server system, and be recognized by the DLESE NSDL effort. At this time, only groups that are members of the Antarctic-IDD system can collect this data, but anyone is welcome to join. Please contact amrc@ssec.wisc.edu to be added to the Antarctic-IDD.

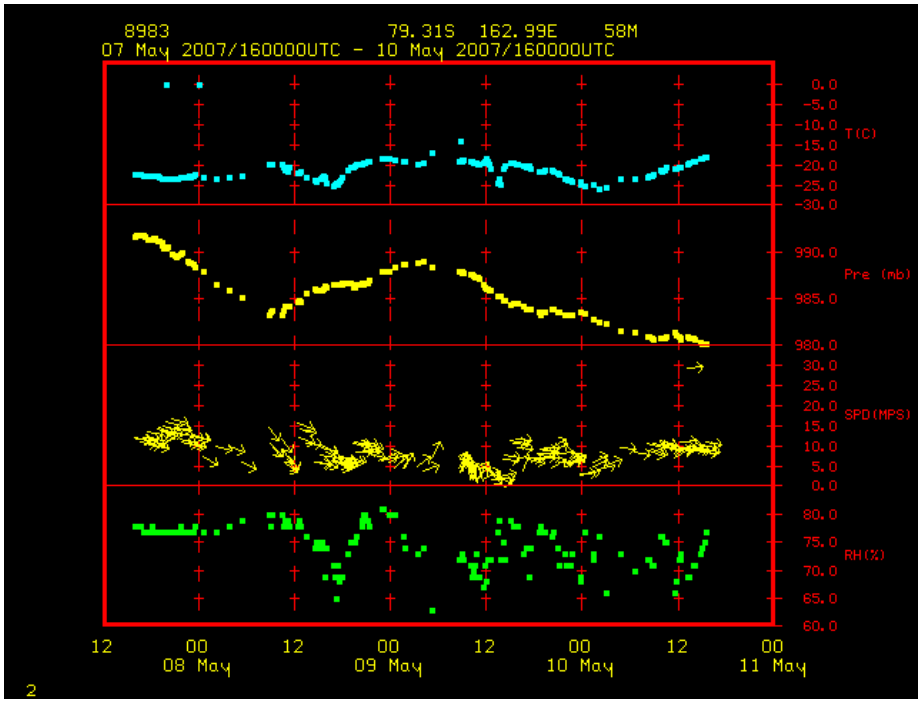

Figure 2. AWS meteogram depicting temperatures, pressures, wind speeds and directions, and relative humidities for Mary site from 8 May to 11 May 2007.

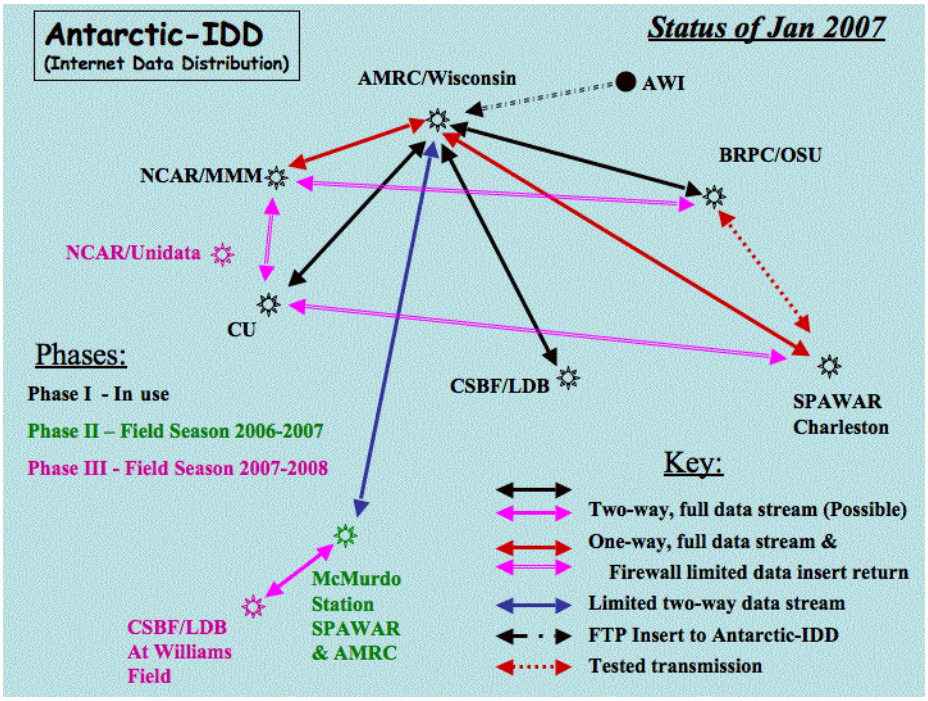

Figure 3. The status of the Antarctic Internet Data Distribution system which shows the connectivity and sharing of meteorological data in real-time among the research and operational communities.

Science and Data

In the past few years, new datasets have been generated by the AMRC and accompanying AWS project that have led to new scientific applications. Perhaps the most significant project as of late has been work with the large tabular icebergs that have recently broken off in the Ross and Weddell Seas (Lazzara, et al., 1999). AWS have been placed on board these icebergs, and have tracked iceberg movement and snow accumulation on the icebergs. This data, in addition to the standard measurements of the AWS, have provided unique information and led to a deeper understanding of iceberg movements and calvings.

In addition to the movements of the large tabular icebergs in the region, snow accumulation data has been tracked as of late at various locations across the Ross Ice Shelf (Knuth, 2007). Acoustic depth gauges, or ADGs, have been used to measure accumulation or ablation at a particular AWS location. Not only is this data useful for determining the mass balance of ice sheets, but it is also important for the detection of precipitation processes. While there has yet to be a system developed to extrapolate precipitation data from ADG data, it is a first step in that direction.

A third important scientific project that has been undertaken using AMRC's data holdings has been the tracking of ice sheets using the GPS on board AWS. By recording the movement of the AWS stations on the Ross Ice Shelf further north along with the growth of the ice sheet, a systematic overview of the growth of the ice shelf can be undertaken.

Summary

The AMRC has an extensive data collection dating, in some cases, back to the 1950s. The AMRC itself has been in existence since 1992, and its satellite composite imagery, the flagship of the organization, has been available since that time. The AMRC offers a variety of data, including satellite imagery, AWS data, synoptic data, METAR reports, ship and air reports, and model output. This data is available via web, ftp, and Antarctic-IDD access, and is free of charge to the scientific community and general public. Recently, several important scientific projects have been undertaken utilizing the AMRC's data holdings, including the monitoring of icebergs, snow accumulation, and the growth of ice sheets.

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