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1. INTRODUCTION

The generation of Antarctic composite infrared images started on October 30, 1992 and has continued to the present time. The images are constructed at 3-hour intervals from geostationary and polar satellite images available at the Space Science and Engineering Center (SSEC), University of Wisconsin-Madison. The initial inspiration for the composite images was an image prepared from polar orbiting satellites over Antarctica by the National Snow and Ice Data Center. These composites are unique and are valuable for weather forecasting, for both meteorological and non-meteorological research as well as for teaching and educational purposes.

2. COMPOSITE CONSTRUCTION

The images are updated every three hours using data that is plus or minus 50 minutes from the top of the synoptic hour. The geostationary satellite data is entered into the composite image first and then overlain with the polar orbiting satellites using a conditional minimum method that also alleviates any possible problems with limb darkening. The images extend from the South Pole to 34°S at the corners with New Zealand in the upper left-hand corner and to 48°S at the edges nearest to the poles (See Figure 1 and 2). The image resolution is a nominal 10 kilometers making the final image size approximately one megabyte in raw format. The composites are assembled using the McIDAS software (Lazzara et al., 1999).

As opposed to the standard orientation of Antarctic displays with the prime meridian to the top of the display, the orientation for the composites was chosen so that the flight paths between Christchurch, New Zealand and McMurdo Station, Antarctica and ship routes between Punta Arenas, Chile and the Antarctica Peninsula are at the top and sides. The two paths are the main paths for aircraft and ships in the United States Antarctic Program (USAP) which is managed by the National Science Foundation (NSF), Office of Polar Programs (OPP). The composite is made using the common infrared band of approximately 11 microns, which is available on most weather satellites. This

channel also ensures that the images are available throughout the year, regardless of sun angle.

As a part of the process of making the images, raw satellite data does have bad lines of data cleaned up and bad buffer flakes removed to improve the composite image, without overly massaging the data. Additional satellite counts from space are also removed. The raw data also does contain infrared temperature information, in addition to brightness counts, although the accuracy of this information is likely to be on the order of a degree or so Kelvin.

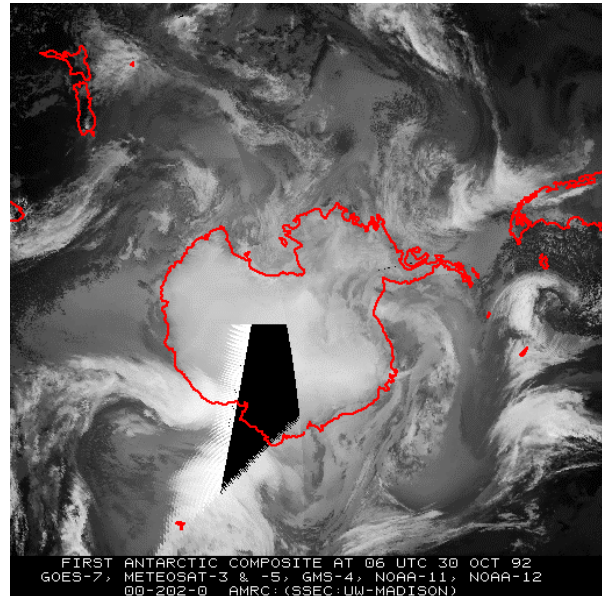


Figure 1. A display of the first Antarctic composite infrared image taken at 6 UTC on 30 October 1992. The black portion of the image is an area that was not covered by satellite imagery that meet the minimum criteria for inclusion into the composite.

The final composite image is navigated in a polar stereographic image centered at the South Pole, with standard latitude of 60 degrees South and standard longitude of 140 degrees West. The process for generating the composites is completely automated and

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experiences only a few failures often due to computer problems, human error, etc.

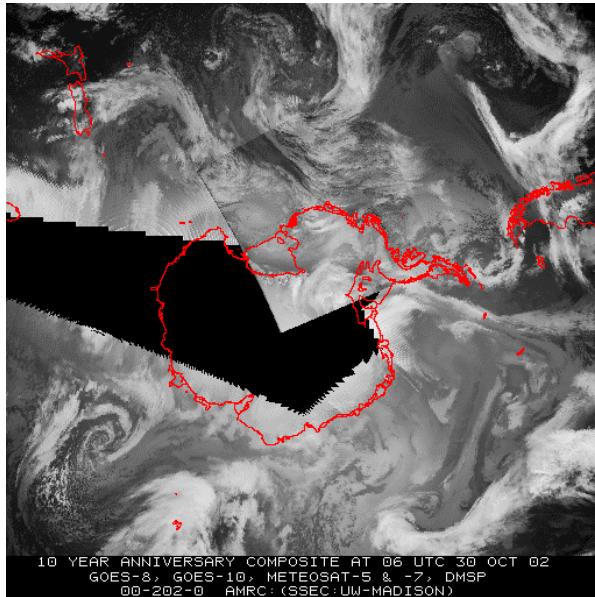


Figure 2. The 10-year anniversary Antarctic composite infrared image at 6 UTC on 30 October 2002.

3. APPLICATIONS

One of the first uses of the images was the explanation for the transport of dust from Argentina to Vostok Station in Antarctica. The cloud systems would go over the Andes Mountains in Argentina then around Antarctica over the ocean then into Antarctica in the vicinity of Dumont D'Urville toward Vostok Station:

"Assuming that the clouds that one sees circling Antarctica in this video track the air masses that might be transporting dust, one sees that clouds traversing Patagonia spiral into East Antarctica in less than one-half revolution of the continent." (Biscayne, Pierre, pers. comm., 1994)

Forecasting has been the longest running and most logical application of these composite images. In one of its first forecasting tasks, the images have been used by forecasters for the United States Antarctic Program (USAP) research vessels and icebreakers operating in the oceans around Antarctica. The forecasters were able to provide improved forecasts in the data sparse region because the forecast models did not reproduce all of the details about the storm systems around Antarctica including the correct locations. The model forecasts were usually 12 to 24 hours earlier and did not give the accurate positions of the systems (Keller, pers. comm., 1999). The USAP has also employed the composites for aviation forecasting during the active field season in the Antarctic and continues to

do so today. In fact, several nations and national Antarctic programs utilize the composites operationally including Australia, Brazil, and perhaps others (Lazzara et al., 2003).

Traditional and even non-traditional meteorological research has also been an active area for composite use. A recent example of classic study use of the imagery is in the review of the weather that impacted the rescue of Dr. Shemenski from South Pole Station in April of 2001 (Monaghan, et al., 2003). Other applications that have included the composite imagery do so in support of their larger research, including air chemistry work, shallow ice coring analysis, etc.

Another critical area where the composites have seen wide application is with education and outreach activities. In K-12 classrooms, university and college lecture halls, as well as for the general public, the Antarctic composites demonstrate some classic characteristics of the atmosphere, such as the westerly winds associated with the general circulation, from a unique point of view.

4. DISTRIBUTION

In the first years of generating the composites, several days of the composite images were programmed into computers to track the movement of the cloud systems around Antarctica. This was done as an aid to forecasting so that the speed of the motion could be determined. This led to putting the images onto VHS tape for viewing the image motion for a longer period of time. Putting the images on tape resulted in a decrease in the resolution to about 20-kilometer but did reveal the details of the circulation of the cloud systems around Antarctica. The composite images are timed and dated so they provide a catalogue of the available images for possible users. The nearly ten years of images are available for viewing at this conference. One quickly learns that the circulation around Antarctica is very porous when viewing this long animation sequence.

Over the years, the distribution of the composites has taken several available routes, including:

- McIDAS-MVS mainframe to mainframe computer communications (Lazzara et al., 1999)
- Gopher
- File Transmission Protocol (FTP)
- World Wide Web (WWW)
- Unidata Internet Data Distribution (IDD)
- Abstract Data Distribution Environment (ADDE)
- Various computer media
- Printed form or hard copy

Currently, real-time composites can be viewed on the web servers as still images and animations.

5. FUTURE DIRECTIONS

With regards to the future, Antarctic composite imagery has new horizons yet to be fulfilled. Only within the last few years have water vapor composites been routinely constructed and made available (See Figure 3). During the austral summer, visible composites are also a future possibility, despite some inter-satellite calibration challenges that must be overcome.

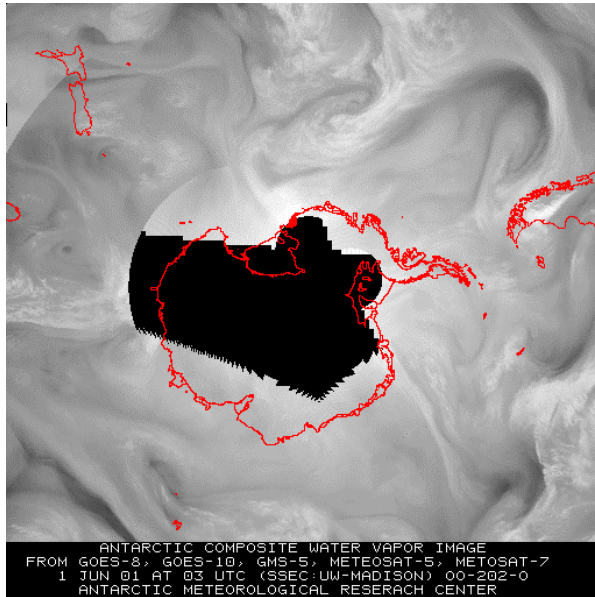


Figure 3. A sample water vapor channel composite image over the Antarctic.

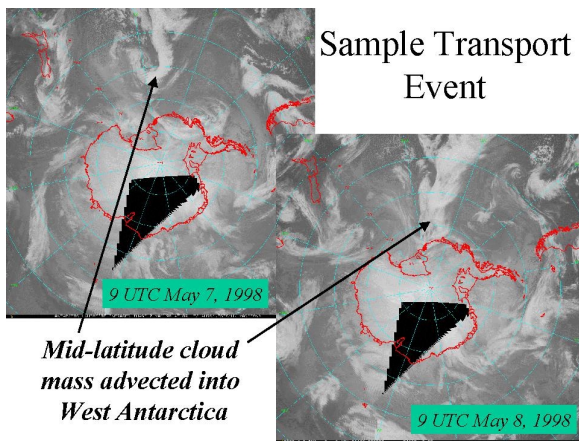


Figure 4. A meridional transport of cloud mass into West Antarctica as captured by Antarctic composite infrared images.

A new role for these composites, with now a moderately large collection at hand, is analysis on a climatological scale. Initial work in this arena has begun

with the investigation of cloud mass transport events (See Figure 4) from over the Southern Ocean onto the Antarctic continent (Staude et al., 2003)

In marking ten years of composites, a critical improvement has been made. With the availability of high-resolution satellite data, the composites are now made at a nominal 5 kilometers resolution and in effect making the resultant raw format image four times larger (approximately 4 megabytes). An additional goal is to improve the composite coverage, to minimize the lack of data or "hole" found in most composite images (See Figure 5).

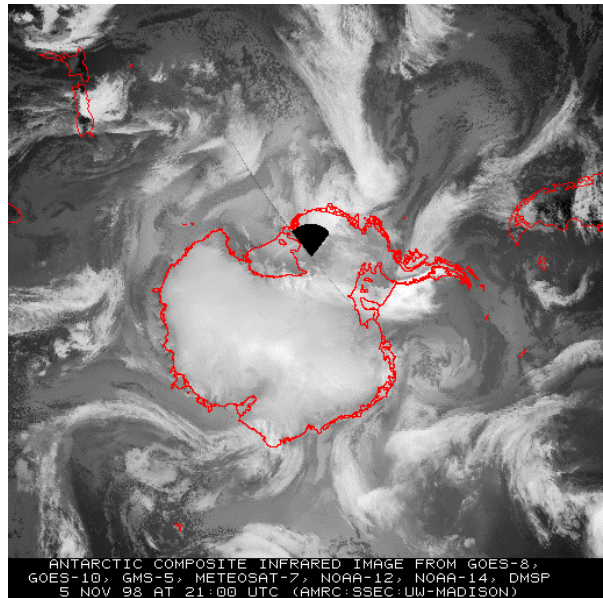


Figure 5. An example Antarctic composite image with a minimized "hole" in satellite coverage.

6. ACKNOWLEDGEMENTS

The authors wish to thank the Office of Polar Programs at the National Science Foundation for its commitment over the years to fund this effort, specifically grants OPP-0126262, OPP-9908842, OPP-9725398, OPP-9527603, and DPP-9208864. The authors also wish to thank all of the users of the Antarctic composite for their interest in and support of the project as well as unique applications of the Antarctic composite images.

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