BYU Center for Remote Sensing

CERS Observer

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"However exciting CERS' past may be, we are even more enthusiastic about its future."

Remote Sensing Director Notes

Perry J. Hardin, Associate Director

Welcome to another edition of the *CERS Observer*. Writing this newsletter gives us a periodic chance to pause and review the CERS activites of the past few months and see what we've accomplished. A few of those accomplishments are detailed in this edition. However exciting this past may be, we are even more enthusiastic about the future.

Let me tell you about our summer. We have conferences both in Toulouse, France and Anchorage, Alaska where several papers are going to be presented. The topics of these papers cover such issues as microwave hardware design, measurement of grassland biomass and evaluation of the urban heat island.

Along with the fun of conferences, there is also work to do. We have planned extensive fieldwork in Tanzania designed to investigate conservation methods around Mt. Kilimanjaro. This project utilizes Landsat and MODIS imagery to study landcover change. While some of the staff is in Africa, others will be in Texas doing fieldwork for two other projects. In one study being conducted with Southwest Texas State and Georgia Tech, we are measuring above-ground biomass of woodland and shrubland using microwave methods from various platforms. In another project, we are acquiring archaeological imagery of several historical sites using small unmanned aerial vehicles. In both these projects we hope to gather some high quality data that we can analyze for several months when we return home in September.

So, as you read about our recent past in this edition, we look forward to sharing our exciting future with you.

SeaWinds Sensor Used in Monitoring Icebergs in Antartica

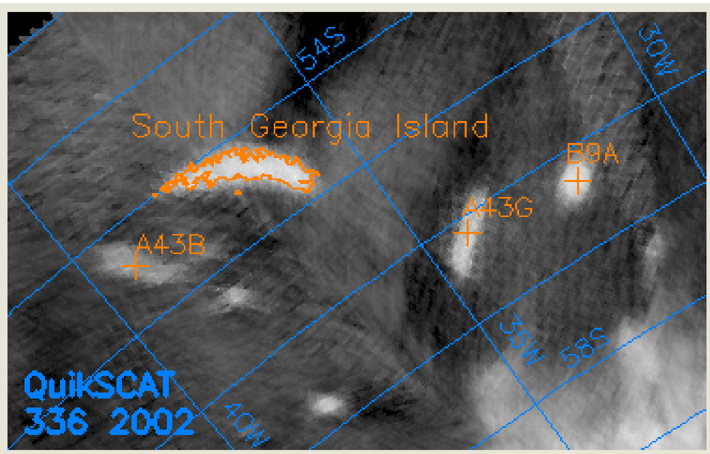
During a recent biweekly iceberg tracking session, researchers in the MERS lab encountered a rather unusual configuration of very large icebergs around a large island in the South Atlantic. One of the latest biweekly images of icebergs collected by the QuikSCAT sensor reveals that the remote South Georgia Island near Antarctica is nearly surrounded by massive icebergs almost as large as the island itself. Since this island is 170 km (106 miles) long and 32 km (22 miles) wide, this is significant coverage. The uninhabited South Georgia Island is located in the South Atlantic approximately 1400 km (870 miles) east of the Falkland Islands at 54 degrees south latitude.

While originally designed to measure winds over the ocean, the SeaWinds sensor aboard the QuikSCAT satellite has proven to be very effective in tracking large icebergs. This effectiveness is due to its ability to actively acquire imagery both day and night regardless of cloud cover. This capability is important since poor solar illumination and extensive cloudiness predominate in the South Atlantic during the Antarctic winter.

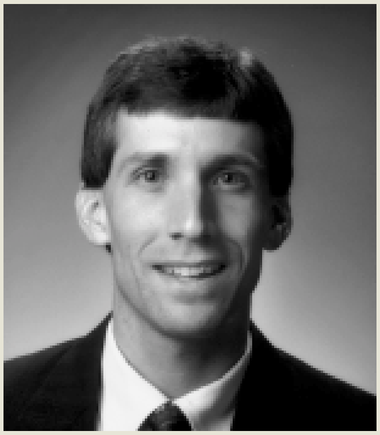
Using advanced computer processing techniques, daily global images of Antarctica are made to map the extent of sea ice and track icebergs. In the image below, the ocean appears black while icebergs and islands are white. The white patch on the lower right is sea ice. Identifiers used by the National Ice Center to track large icebergs are also shown in the image. The other white patches without

continued on next page ...

This QuikSCAT image shows icebergs in the extreme South Atlantic near South Georgia Island and the Falklands. As demonstrated by this image, the SeaWinds sensor has been effective in monitoring icebergs like the ones shown here. Being an active sensor, SeaWinds' imaging capabilities are not degraded by the extensive cloud cover and poor solar illumination typical of Antarctic Winters.



CERS Researcher Spotlight: Michael A. Jensen



Michael A. Jensen received his B.S. (summa cum laude) and M.S. degrees in Electrical Engineering from Brigham Young University in 1990 and 1991 respectively. He received his Ph.D. in Electrical Engineering from the University of California at Los Angeles in 1994. He also received a National Science Foundation Graduate Fellowship in 1990. While working as an M.S. student, Dr. Jensen worked in BYU's Lasers and Optics Laboratory. While pursuing a Ph.D., he worked at the UCLA antenna farm. Since graduating in 1994, he has been a member of the BYU Department of Electrical and Computer Engineering where he is currently an Associate Professor. His main research interests include antennas and propagation for personal communications, microwave circuit design, radar remote sensing, numerical electromagnetics, and optical fiber communications. Dr. Jensen currently serves on the Joint Meetings Committee for the IEEE Antennas and Propagation Society, and served as the Technical Program Chair for the 2000 IEEE International Symposium on Antennas and Propagation. He was awarded the best paper award at the 1994 IEEE International Symposium on Antennas and Propagation.

SeaWinds continued...

labels are other large icebergs.

Icebergs A43B and A43G have traveled northwards for hundreds of kilometers from where they calved off the Ronne Ice Shelf in May, 2000. B9A broke off from the Ross Ice Shelf on the other side of the continent in 1999 and has traveled for thousands of kilometers. Currently, A43B is 14 km (9 miles) x 40 km (25 miles), A43G is 9 km (6 miles) x 51 km (32 miles), and B9A is 15 km (9 miles) x 22 km (14 miles). All of these icebergs are estimated to be about 300 m (1000 feet) thick. They are now expected to drift northward and eventually melt, probably within the next year. Since they are near shipping lanes, they are being watched carefully by the National Ice Center who will continue to report their positions with the aid of BYU researchers and QuikSCAT data.

CERS Faculty Research

Michael Jensen, a CERS faculty member, has been researching the potential of multiple-input multiple-output (MIMO) systems in wireless communications. Traditional wireless communications systems utilize a single antenna at the transmitter and receiver, and use processing of the information in time and frequency to maximize the amount of information communicated for a given bandwidth. This maximization is important, since the purchase of spectrum from regulatory agencies such as the Federal Communications Commission (FCC) is extremely costly.

Remarkable new research has demonstrated that in many wireless communications systems, the information transfer rate can be dramatically increased without a corresponding increase in bandwidth by utilizing multiple antennas at the transmitter and receiver. Specifically, Dr. Jensen's work has focused on exploring the performance bounds of using this technology in realistic environments, such as wireless local area networking in buildings like those found on university campuses.

To accomplish this work, students in the Wireless Communications Group and the Microwave Earth Remote Sensing Laboratory have constructed a communications system that is capable of transmitting different information from 16 separate antennas, and receiving information on 16 different receiving antennas. The system has been deployed in a variety of locations on campus, and the collected data is used to assess the performance gains possible for such a system when compared to a similar system using only one transmitting and one receiving antenna.

Dr. Jensen's research group also focuses on theoretical studies relating to the performance and implementation of this multi-antenna technology. Recently, they have formulated new theoretical performance bounds for the technique, and have developed models that allow testing of the approach under realistic communication conditions. Recently, for example, they formulated a way to overcome transmission outages caused by airplane maneuvering on air-to-ground communications links. The Air Force is now investigating the development of this technology for operational communications use.

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