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Over Antarctica in flight. Antarctica (DCH-6 Twin Otter). Photo courtesy of Cameron Lewis. 2010.
About CReSIS
What is CReSIS?

OUR MOTIVATION

A recent report by the IPCC states that expected sea level rise will be between 18 and 59 cm by 2100. However, it also acknowledges that large uncertainties exist in estimates of contribution from ice sheets. Over 100 million people live within a 1-meter elevation of the present sea level, and in the next few years, 20 of the world’s 30 mega-cities will be on the coast, with many low-lying locations vulnerable to rising sea level. As coastal development expands with a growing population and increased urbanization, a rapid increase of sea level will have a profound impact on society. There is an urgent need to improve our knowledge of ice dynamics and improve ice-sheet models to predict their response in a warming climate.

OUR MISSION

The Center’s mission is to develop technologies, conduct field investigations, and compile data to understand why many outlet glaciers and ice streams are changing rapidly. Our results are used to develop models that explain and predict ice sheet response to climate change. We also use our expertise to educate and train a diverse population of graduate and undergraduate students in Center-related disciplines and to encourage K-12 students to pursue careers in science, technology, engineering and mathematics (STEM).

OUR HISTORY

The Center for Remote Sensing of Ice Sheets (CReSIS) is one of seventeen active Science and Technology Centers established by the National Science Foundation (NSF). CReSIS began operating in 2005 under a five-year cooperative agreement, which was renewed for another five years in 2010. Headquartered at the University of Kansas in Lawrence, Kansas, CReSIS includes six main partners: Elizabeth City State University, The Pennsylvania State University, Indiana University, University of Washington, the Association of Computer and Information Sciences and Engineering Departments at Minority Institutions, and Los Alamos National Laboratory. CReSIS also collaborates with international research centers and universities partners, including the Centre for Ice and Climate at the University of Copenhagen Niels Bohr Institute (Denmark), the Center for Polar Observations & Modeling (United Kingdom), the Indian Institute of Technology Kanpur (India), and the University of Magallanes (Chile). CReSIS also works closely with the NASA Goddard Space Flight Center and various other domestic and international research organizations.

OUR VISION

To understand and predict the role of polar ice sheets in sea level change
# Who is CReSIS?

## Partners, Collaborators & Sponsors

<table>
<thead>
<tr>
<th>Lead Institution</th>
<th>International Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Kansas (KU) Lawrence, Kansas</td>
<td>Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen (CIC) Copenhagen, Denmark</td>
</tr>
<tr>
<td>Elizabeth City State University (ECSU) Elizabeth City, North Carolina</td>
<td>Center for Polar Observations &amp; Modeling (CPOM) Cambridge, United Kingdom</td>
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<tr>
<td>The Pennsylvania State University (PSU) University Park, Pennsylvania</td>
<td>Indian Institute of Technology Kanpur (IITK) Kanpur, India</td>
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<td>Indiana University (IU) Bloomington, Indiana</td>
<td>University of Magallanes (UM) Punta Arenas, Chile</td>
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<tr>
<td>University of Washington (UW) Seattle, Washington</td>
<td>Government and Industry Partners</td>
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<tr>
<td>Association of Computer and Information Sciences and Engineering Departments at Minority Institutions (ADMI)</td>
<td>Kansas City Plant Kansas City, Missouri</td>
</tr>
<tr>
<td>Los Alamos National Laboratory (LANL) Los Alamos, New Mexico</td>
<td>NASA Goddard Space Flight Center Beltway, Maryland</td>
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</table>

## Partner Institutions

- Kansas City Plant
- National Science Foundation
- National Aeronautics and Space Administration
- Kansas Board of Regents

## Government and Industry Partners

- Association of Computer and Information Sciences and Engineering Departments at Minority Institutions (ADMI)
- NASA Goddard Space Flight Center
- Los Alamos National Laboratory (LANL)
- The University of Kansas (KU)
- Elizabeth City State University (ECSU)
- The Pennsylvania State University (PSU)
- Indiana University (IU)
- University of Washington (UW)
- The University of Kansas (KU)
CReSIS Organizational Chart

CReSIS Leadership

Dr. S. Prasad Gogineni  
KU  
Director

Dr. Carl Leuschen  
KU  
Deputy Director

Dr. David Braaten  
KU  
Associate Director: Science

Dr. Rick Hale  
KU  
Associate Director: Technology

Dr. Swapan Chakrabarti  
KU  
Associate Director: Knowledge Transfer

Dr. Linda Hayden  
ECSU  
Associate Director: Education & ECSU Operations

Dr. Sridhar Anandakrishnan  
PSU  
Associate Director: PSU Operations

Dr. Geoffrey Fox  
IU  
Associate Director: IU Operations

Dr. Ian Joughin  
UW  
Associate Director: UW Operations

Dr. Andrea Lawrence  
ADMI  
Associate Director: ADMI Operations

Dr. Stephen Price  
LANL  
Associate Director: LANL Operations

Media Contact

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2335 Irving Hill Road  
Lawrence, Kansas 66045

www.cresis.ku.edu
CReSIS research is divided into six focus areas, which together offer a comprehensive view of our ongoing research activities:

1. Sensors and Signal Processing
2. Uninhabited Aerial System
3. Field Activities
4. Satellite Measurements
5. Analysis and Modeling
6. Cyberinfrastructure
Sensors & Signal Processing

SENSORS
The University of Kansas (KU) has a long record of radar development and deployment for measuring ice thickness and mapping internal layers and bed topography of the polar ice sheets. Radar-depth sounders developed at KU have been used in conjunction with a laser altimeter developed by NASA in nearly all survey flights across Greenland and Antarctica over the past 18 years. At CReSIS, we have successfully applied our sensor innovations and techniques to sound three major glaciers in Greenland. We have produced the first and only bed topography maps for these glaciers.

CReSIS research activities in sensors and signal processing are currently aimed at refining and optimizing radars to reduce surface clutter and collect data required to sound fast-flowing glaciers and ice-sheet margins. Additional ongoing research activities in sensors and signal processing include imaging the ice-bed interface, developing algorithms to estimate bed conditions processing data collected during the 2009 to 2011 field seasons, and generating data products both for our own use and for distribution to our collaborators, partners, and ultimately the broader science community.

As CReSIS expands and develops its remote sensing technologies and instrumentation, we increase our collective and collaborative capabilities for a wide range of polar research, including measurements over sea ice and permafrost, and measurements of soil moisture, vegetation, and snow thickness over land.

SIGNAL AND DATA PROCESSING:
Our signal and data processing activities are focused on executing two major tasks: (1) developing structured code to process data from all our radars, and (2) generating first-ever fine-resolution gridded bed elevation products.

To learn more about the CReSIS radar suite, please visit our website:
https://cms.cresis.ku.edu/research/sensors-development/radar

**CRESIS RADAR SUITE**

| Multichannel Coherent Radar Depth Sounder / Imager (MCoRDS/I) |
| UAS Radar |
| Accumulation Radar |
| Snow Radar |
| Ku-Band Radar Altimeter |

The first high-resolution 3-D bed map of Jakobshavn Isbræ in Greenland, created by Joel Plummer, a CReSIS graduate student in the Geography Department at the University of Kansas.

https://cms.cresis.ku.edu/research/sensors-development
Uninhabited Aerial System

ABOUT

The Meridian Uninhabited Aerial System (UAS) is designed to provide an aerial platform for radars developed at CReSIS. Construction of the Uninhabited Aerial Vehicle (UAV) began at the University of Kansas in 2006 under the direction KU faculty members and with the support of KU students and former graduates. The UAV weighs in at 1,100 pounds, features a 26-foot wingspan, and is capable of carrying the in-house and custom-built radars, magnetometers, and cameras.

FLIGHT TESTS AND DEPLOYMENTS

The first Meridian-class UAV was completed in December 2008 and underwent initial flight testing at Fort Riley Army Base, Kansas in 2009.

The Meridian completed additional field testing at McMurdo Station, Antarctica, in December 2009 to test its compatibility with polar conditions and verify radar system functionality.

The UAS successfully deployed to Greenland in July 2011 with an NSF mission to the NEEM station. Initial results demonstrate that the UAS is capable of sounding and imaging ice, which marks a major milestone in efforts to develop technology capable of sounding and imaging ice sheets in areas highly susceptible to rapid change. CReSIS plans to deploy the UAS to Antarctica in December 2011. Through additional flight testing and continued improvements, the CReSIS UAS team aims to eventually bring the system into operational use.

A video documenting the first flight is available at the following YouTube link: http://www.youtube.com/watch?v=v-3pcvfkGU

The video also includes an interview with team leader, Associate Professor Rick Hale, and voice-overs by the chief designer, doctoral candidate Bill Donovan.
Field Programs

WHERE DO WE GO?

CReSIS has participated in extensive airborne and surface surveys of targeted areas in Greenland and Antarctica since 2007. These campaigns involve domestic and international partner universities, and faculty, staff, and students spend weeks preparing for deployments that usually last over a month. The overriding purpose of our fieldwork is two-fold. First, we seek to collect data sets in areas currently undergoing or expected to undergo rapid changes. Second, fieldwork allows us to test and optimize sensors and platforms at established field stations. In planning and executing these field activities, participants from our six research focus areas interact extensively.

UPCOMING CAMPAIGNS

Antarctica
• October – November 2011 (NASA)
• November 2011 - January 2012 (NSF)
• December 2011 - January 2012 (NSF)
• November 2013 - January 2014 (NSF)
• December 2013 - January 2014 (NSF)

Greenland
• March 2011 – May 2012 (NASA)
• July 2012 (NSF)
• July 2013 (NSF)

Data from these field programs are available at our website: https://cms.cresis.ku.edu/data

GREENLAND ICE SHEET
• Helheim Glacier
• Kangerdlugssuaq Glacier
• Petermann Glacier
• Jakobshavn Glacier

ANTARCTIC ICE SHEET
• Thwaites Glacier
• Smith Glacier
• Kholer Glacier
• Pine Island Glacier
• Getz Glacier
• Abbot Ice Shelf
• Peninsula
• 86th Degree Arc

https://cms.cresis.ku.edu/research/field-programs
Satellite Measurements

Satellite data products are critical for CReSIS activities, as large-scale changes typically observed over an entire year can occur in periods as short as 11 days. This is contrary to the earlier conventional wisdom that ice streams and outlet glaciers respond on century-to-millennial time scales.

To respond to the need for satellite data products, a CReSIS researcher at the University of Washington (UW) has produced comprehensive maps of ice flow velocity for Greenland for the winters of 2000-2001 and 2005-2006 and is extending these measurements for additional years. This was accomplished using satellite data to produce velocity in all ice sheet locations, except where limited by satellite coverage and poor interferometric correlation. Recently, a great deal of effort has gone into improving the speckle tracking to maximize the coverage on fast-moving glaciers.

Additionally, the Center for Remote Sensing Education and Research (CERSER) Lab at Elizabeth City State University (ECSU) is focused on developing innovative and relevant research collaborations concentrating on coastal, ocean, and marine research. The CERSER Lab utilizes a TeraScan® High Resolution Picture Transmission (HRPT) System which includes a Polar Orbiting Tracking 1.5m Antenna, Global Positioning System (GPS) Antenna/Receiver, Telemetry Receiver, and the TeraScan® software suite.

Analysis & Modeling

Integrated model development and modeling studies are being conducted by CReSIS at the University of Kansas (KU), the Pennsylvania State University (PSU), the University of Washington (UW) and Los Alamos National Laboratory (LANL). These complimentary modeling efforts provide critical inputs to CReSIS technology development and data processing efforts to help optimize collected data.

The objective of the Modeling Team is to identify processes responsible for rapid changes observed on outlet glaciers and ice streams and to incorporate these processes into numerical models simulating the response of individual drainage basins and the entire ice sheets of Greenland and Antarctica to climate forcing, or climate change. Each institution uses its existing strengths and expertise to explore answers to these critical questions.
CReSIS partner Indiana University (IU) provides world-class expertise in Cyberinfrastructure and high-performance computing; addresses challenges in data management, processing, distribution, and archiving; and contributes to high-performance modeling requirements. The Center’s current cyberinfrastructure activities include support of field expeditions, as well as off-line data analysis. We have made progress in preliminary Matlab processing, visualization and presentation of data products from CReSIS and related activities to support the interpretation of radar data. Cloud computing and advanced visualization technology is being exploited in this work. Field cyberinfrastructure consists of field servers to process data in real-time and drives to back up data collected during each mission.

CReSIS cyberinfrastructure is also part of PolarGrid, which is an NSF MRI-funded partnership between Indiana University and Elizabeth City State University to acquire and deploy the computing infrastructure needed to investigate the urgent problems in glacial melting. The infrastructure developed through the NSF MRI is also significantly contributing to the NASA Operation Ice Bridge (OIB) program. PolarGrid has produced a significant amount of high-resolution geo-spatial data best analyzed with 3-D visualization techniques. As such, the CReSIS Cyberinfrastructure team is currently working to develop a visualization service based on cloud computing techniques, which will support displays ranging from extremely high-resolution display walls to much lower-resolution mobile devices, such as tablets and smart phones. For more information on PolarGrid, please visit http://polargrid.org.

IU’s high-resolution display wall is one example of a user case. Each panel has a resolution of 1600x1200 pixels, with over 23 million pixels on the wall. Shown here is a 3-D structure of Greenland’s ice bed.
The CReSIS education vision is to inspire, educate, and train the next generation of scientists and engineers for the nation in Center-related disciplines. We engage in extensive K-12 outreach by conducting interactive science lessons at underserved schools near the University of Kansas (KU), providing teacher training opportunities to elementary and middle school science teachers, and hosting middle school and high school summer workshops at Elizabeth City State University (ECSU). CReSIS education outreach at the post-secondary level enables both undergraduate and graduate students who study geology, geography, engineering, computer science, and other related science, technology, engineering and math (STEM) fields to be involved in CReSIS activities. CReSIS URAs and GRAs engage in hands-on research, collaborate with faculty in their disciplines, and have the unique opportunity to participate in polar fieldwork and attend national and international workshops, conferences and presentations by important scientists in polar research.

CReSIS is also committed to including underrepresented populations across the science and engineering fields in our research and education programs. Our partnership with the Association of Computer and Information Sciences and Engineering Departments at Minority Institutions (ADMI) and Elizabeth City State University (ECSU) highlight our commitment to increasing the number of underrepresented students in the STEM disciplines.
CReSIS has developed multiple interactive education outreach programs that target traditionally underserved K-12 schools near KU. Our K-12 Education Coordinator travels to targeted schools each month to share hands-on science lessons focused on polar science with the goal of increasing students’ interest in science and science-based inquiry. As of June 2011, our K-12 Education Outreach Team has reached more than 8,600 students, teachers and families. We are currently expanding our grades 9-12 outreach through the development of online polar science lesson plans and hands-on activities.

K-12 students near Elizabeth City State University (ECSU) have the opportunity to learn more about the STEM fields and CReSIS research by participating in the CReSIS Middle School Program and the CReSIS High School Program. Participating students in both programs work with a team mentor on projects that involve learning the fundamentals of earth science. In particular, students participating in the Middle School Program learn about remote sensing and satellite imagery, take scientific measurements in the fields of atmosphere and hydrology, learn about polar regions, publish their research projects, and collaborate with scientists and faculty. Students in the High School Program learn about analysis and robot prototyping, testing and optimization of robot design, and Vehicle Radio Communications (VRC) Gateway game rules.

Our K-12 Education Outreach Team also provides professional development opportunities for science teachers through workshops, webinars, and lesson plans shared via the Online Data Portal on our website.

K-12 OUTREACH PROGRAM OBJECTIVES:

- Enhance relevant science content taught in K-12 classrooms
- Increase underrepresented K-12 students’ exposure to Center-related studies
- Motivate students to pursue careers in STEM fields
- Reinforce necessary foundational skills and promote inquiry-based learning
- Produce online resources and content for teacher and classroom use
- Improve teacher knowledge of climate science via teacher workshop in-service days
- Offer free and informal educational activities to our communities through family science nights, museum presentations, and conferences

Middle school students conducting an experiment at ECSU, Elizabeth City, North Carolina. Photo courtesy of Cheri Hamilton. 2011.

Cheri Hamilton and students participating in Ice Ice Baby activities at Lowman Hill Elementary School, Topeka, Kansas. Photo courtesy of Cheri Hamilton. 2010.
Education: Undergraduate

UNDERGRADUATE

CReSIS provides an undergraduate program that incorporates Center research activities into research and training opportunities. To meet these goals, CReSIS provides internships in science and technology for undergraduates at partner institutions, hires undergraduates to work as research assistants, offers opportunities to collaborate on interdisciplinary projects, and teaches senior engineering design courses and directs senior thesis projects.

RESEARCH EXPERIENCE FOR UNDERGRADUATES (REU) PROGRAM:

CReSIS annually hosts several visiting undergraduate students during the summer months as part of our Research Experience for Undergraduates (REU) program at KU, ECSU, and IU. The REU program has a national impact and an international reach; past participants have included students ranging geographically from Puerto Rico to Ghana. In 2011, 33 students participated in the REU program at IU, KU and ECSU. Of the 33 students, 79% were students of color and 58% were women, both traditionally underrepresented groups in STEM fields.
GRADUATE

Graduate students at CReSIS examine a broad range of scientific and technical topics related to climate change research in various disciplines and most use this research when writing their theses and dissertations. Many graduate students also routinely participate in fieldwork and research in Greenland and Antarctica that exposes them to working and making instrumentation work in extreme environments.

CRESIS GRADUATE RESEARCH PROJECTS INCLUDE

RADAR DEVELOPMENT

Several graduate research projects involve the continued development of our state-of-the-art suite of remote sensors, which includes the MCoRDS/I, UAS, Accumulation Radar, Snow Radar, and Ku-Band Radar Altimeter.

PLATFORM DEVELOPMENT

Graduate students at the University of Kansas have been involved in the development of the Meridian Uninhabited Aerial Vehicle (UAV) since its construction began in 2006. Our graduate students continue participate in the ground-breaking development and testing of the Uninhabited Aerial System (UAS). Finally, CReSIS graduate students participate in the design and development of new and more efficient ground-based platforms for obtaining seismic and in situ data.

EDUCATION

CReSIS also employs graduate students to evaluate the CReSIS Education Program at the K-12 level, including our professional development opportunities for teachers and the Research Experience for Undergraduates. A current CReSIS graduate student in Educational Technology is developing web applications to create online and interactive lesson plans.
Knowledge Transfer
WEBSITE
The CReSIS website, [www.cresis.ku.edu](http://www.cresis.ku.edu), was updated in 2010, and now includes a database-driven search function. Many of our more popular documents, including our newsletter, The Icebreaker, and the Climate Change FAQ book are available for download. You can also discover more about CReSIS through our social media pages on Facebook, Twitter, and YouTube.

For those interested in using data available through our website, please contact [cresis_data@cresis.ku.edu](mailto:cresis_data@cresis.ku.edu).

ICEBREAKER
The Knowledge Transfer Team at CReSIS produces a quarterly newsletter, the Icebreaker, to highlight Center activities and accomplishments. The newsletter is written by two students in the school of journalism and designed by a student in the school of graphic design. A PDF of the Icebreaker is available on our website.

[https://www.cresis.ku.edu/news/icebreaker](https://www.cresis.ku.edu/news/icebreaker)

CLIMATE CHANGE FAQ
The CReSIS Knowledge Transfer Team, in conjunction with the CReSIS Education Team, developed a Frequently Asked Questions (FAQ) booklet to address common questions relating to climate change. Data cited in the booklet draws heavily on Intergovernmental Panel on Climate Change (IPCC) materials and other, related FAQ lists. The booklet was reproduced in December 2008 and has been in distribution since that time.

[https://www.cresis.ku.edu/sites/default/files/faqBook/CReSIS_FAQ.pdf](https://www.cresis.ku.edu/sites/default/files/faqBook/CReSIS_FAQ.pdf)
### Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Term</th>
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<tbody>
<tr>
<td>AAAS</td>
<td>American Association for the Advancement of Science</td>
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<tr>
<td>ACE</td>
<td>Antarctic Climate and Ecosystems Cooperative Research Centre</td>
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<td>ADMI</td>
<td>Association of Departments of Computer and Information Science and Engineering at Minority Institutions</td>
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<tr>
<td>AGU</td>
<td>American Geophysical Union</td>
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<td>ANDRILL</td>
<td>Antarctic Geological Drilling Consortium</td>
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<tr>
<td>CERSER</td>
<td>Center of Excellence in Remote Sensing Education and Research</td>
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<td>CLM</td>
<td>Community Land Mode</td>
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<td>CPOM</td>
<td>Centre for Polar Observations &amp; Modeling</td>
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<td>CReSIS</td>
<td>Center for Remote Sensing of Ice Sheets</td>
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<td>East Antarctic Ice Sheet</td>
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<td>ECSU</td>
<td>Elizabeth City State University</td>
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<td>EGU</td>
<td>European Geosciences Union</td>
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<td>EMI</td>
<td>Electro Magnetic Interference</td>
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<td>EnviSat</td>
<td>Environmental Satellite</td>
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<td>EPSCoR</td>
<td>Experimental Program to Stimulate Competitive Research</td>
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<td>ERC</td>
<td>Engineering Research Center</td>
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<td>Global Climate Models</td>
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<td>Geographic Information Systems Management Office</td>
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<td>GRA</td>
<td>Graduate Research Assistant</td>
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<td>GRACE</td>
<td>Gravity Recovery and Climate Experiment</td>
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<td>GRSS</td>
<td>Geosciences and Remote Sensing Society</td>
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<td>GSFC</td>
<td>Goddard Space Flight Center</td>
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<tr>
<td>ICESat</td>
<td>Ice, Cloud, and land Elevation Satellite</td>
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<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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<td>IGARSS</td>
<td>International Geosciences and Remote Sensing Symposium</td>
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<td>Acronym</td>
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<tr>
<td>IGERT</td>
<td>Integrative Graduate Education and Research Traineeship</td>
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<td>IIP</td>
<td>Industrial Innovations and Partnership</td>
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<td>InSAR</td>
<td>Interferometric Synthetic Aperture Radar</td>
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<td>Intergovernmental Panel on Climate Change</td>
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<td>International Research and Education Program</td>
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<td>Indiana University</td>
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<td>JPL</td>
<td>[NASA] Jet Propulsion Laboratory</td>
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<td>KTEC</td>
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<td>MRI</td>
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<td>MSI</td>
<td>Minority Serving Institution</td>
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<td>National Science Foundation</td>
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<td>NSIDC</td>
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<td>OPP</td>
<td>Office of Polar Programs</td>
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<td>PRISM</td>
<td>Polar Radar for Ice Sheet Measurement</td>
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<td>The Pennsylvania State University</td>
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<td>QuickSCAT</td>
<td>Quick Scatterometer</td>
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<td>RADARSAT</td>
<td>Radar Satellite</td>
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<td>Radarsat Antarctic Mapping Project</td>
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<td>REU</td>
<td>Research Experience for Undergraduates</td>
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<td>RPSC</td>
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<td>SAR</td>
<td>Synthetic Aperture Radar</td>
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<td>STC</td>
<td>Science and Technology Center</td>
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<td>STEM</td>
<td>Science, Technology, Engineering, and Mathematics</td>
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<td>UAS</td>
<td>Unmanned Aerial System</td>
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<td>UAV</td>
<td>Unmanned Aerial Vehicle</td>
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<td>Undergraduate Research Assistant</td>
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<td>UW</td>
<td>The University of Washington</td>
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<tr>
<td>WAIS</td>
<td>West Antarctic Ice Sheet</td>
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Writers: Jenna Collins and Sorcha Hyland
Design and Layout: Erin Zingré

THE CENTER FOR REMOTE SENSING OF ICE SHEETS
MEDIA KIT: SEPTEMBER 2011