CReSIS CONTRIBUTES TO CLIMATE CHANGE EXHIBITS AT SPENCER MUSEUM OF ART

» by Beth Ruhl

A fusion of art and science will hit the Spencer Museum of Art this spring. It features two new exhibits which center on the issue of climate change. The first is called Climate Change at the Poles, and it will demonstrate how art, science and history have influenced the public’s perception of climate change using scientific data, photographs and cultural items.

It will run from January 24 to May 24. The second exhibit, entitled A Greenland Glacier: The Scale of Climate Change, will feature photographs by Terry Evans taken while she was exploring the Jakobshavn Glacier with scientists and researchers from CReSIS. It will run from February 7 to May 24. Both exhibits run concurrently with the International Polar Year, IPY, which lasts from 2007-2009. “This exhibit deals with an idea taking form on a piece of paper and then developing it. There is something universal in that,” said Kate Meyer, curation assistant for the Spencer Museum of Art. She said technology and modern art were similar because many people don’t understand them and think they are mysterious. Evans said one of the biggest challenges she faced while photographing the Jakobshavn glacier.

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LT. GOVERNOR PROMOTES SCIENTIFIC INNOVATION IN ENERGY ISSUES

Should scientists or politicians spearhead societies’ adjustments to changing climate? Mark Parkinson, Lieutenant Governor of Kansas, stressed the former in a talk entitled “National Policy and Climate Change” on April 2nd.

Addressing a crowd of 200 at the KU campus, Parkinson summarized current policy deficiencies. He also highlighted areas of potential advancements in energy technology. CReSIS, the KU C-Change IGERT Program, and the Dole Institute of Politics sponsored the event.

Parkinson said that guidelines to simply stabilize or reduce greenhouse gas emissions will not assuage the human impact on climate change. Energy demands from future population growth and developing nations’ reliance on cheap, coal-fired and nuclear power sources encumber these strategies.

“‘The only real answer is in science. Politicians can’t solve this problem. Scientists can.’”
— MARK PARKINSON

Instead, he emphasized scientific innovation in renewable energy production, storage, and transportation. Parkinson mentioned cleansing coal technologies, developing long-term nuclear, wind, and solar energy storage capabilities, and encouraging unforeseen breakthroughs in non-emitting energy production as some prospective solutions. Altering the energy source rather than human consumption behavior may most effectively manage human environmental factors. “‘The only real answer is in science,’ Parkinson emphasized repeatedly. ‘Politicians can’t solve this problem. Scientists can.’

Although Parkinson stressed the problem’s immediacy, he remained hopeful for a global shift from policy to science-based outlooks. “‘Climate change is a difficult topic to be optimistic about,’” Parkinson said. “‘There are not easy solutions. Together with a concentrated effort, we can bring our scientists together to provide us a long-term solution.’”

IPCC AUTHOR DISCUSSES JUNCTION OF SCIENCE AND INTERNATIONAL POLICY

What role should scientists play in prescribing climate change solutions? How can the global community share responsibility and take action toward human influence on the climate?

Richard Somerville, coordinating lead author for the IPCC Fourth Assessment Report, addressed these concerns in a lecture entitled “Global Warming: What Should We Know and What Should We Do?” on November 24, 2008 at The University of Kansas. The National Science Foundation C-Change IGERT Program at KU sponsored Somerville’s talk.

Lack of clear communication between scientific conclusions and policy towards human activity may encumber necessary actions toward climate change. Somerville suggested that scientists, rather than dictating statutes themselves, should present concerns to policy-makers through documents like the IPCC Assessment Report and the 2007 Bali Climate Declaration by Scientists.

Then, he said, scientists can provide advice towards potential policies based on their scientific findings. Researchers should express frankness about uncertain research areas, while policy-makers should also consider responsibility for future generations and developing nations.

“What change requires equity, fairness and ethics as well as science.”
— RICHARD SOMERVILLE

Somerville accentuated the importance of ongoing research to provide sound information to policy-makers. On the use ice core drilling for gleaning ancient atmospheric carbon levels he said, “‘Without this technology, there is no other way to know.’

By reconstructing a template of prior weather patterns, climatologists can better project future climate change and provide more confident counsel to legislators. Improved computer models, increased spatial resolution of measurements, and sophisticated remote sensing devices have also improved the accuracy of climate science.

Continuing developments in oceanographic, atmospheric and glacial measuring device precision will hasten transfer of information from science to policy. Somerville said, “‘These are difficult issues, but there is a history of progress in many of them.’”
ALLEY WINS PRESTIGIOUS ENVIRONMENTAL SCIENCE AWARD

by Katie Oberthaler

Dr. Richard Alley, professor of geosciences at Pennsylvania State University and CReSIS member, has won the 2009 Tyler Prize for Environmental Achievement.

The award consists of gold medals and a $200,000 cash prize and is one of the foremost awards for environmental science. Alley will share the award with V. Ramanathan from The University of California-San Diego. The award panel recognizes both men for their work demonstrating the global reach and severity of human impacts on climate. Alley, who is a professor of geosciences at PSU, has evidenced expeditious climate shifts in the past using ice cores from Antarctica and Greenland. He is the author of Two-Mile Time Machine, which explains the climate record of the Greenland ice cores and its pertinence to present climate assessments. He was also one of the lead authors on the IPCC Fourth Assessment Report.

CRESIS HOSTS OPEN HOUSE

by Beth Ruhl

CReSIS hosted its first annual open house on February 12 at Nichols Hall. Students and researchers displayed their work and explained what actually goes on at CReSIS and why their research on climate change is important.

Approximately 70 people attended. Open to the general public, visitors included local journalists, KU faculty, members from the Spencer Museum of Art, and employees of KUCR, as well as the family and friends of CReSIS associates.

CReSIS gave out many informational items such as its newly developed FAQ book on Climate Change, CReSIS magnets and key chains. The “Understanding Global Climate Change” CDs developed by Carol Landis from the Byrd Polar Research Center at Ohio State University were also available.

William Blake explains concepts about Synthetic Aperture Radar (SAR) to attendees of the CReSIS open house. Blake is writing his dissertation SAR research.
AERIAL SURVEY UNCOVERS SUBGLACIAL ANTARCTIC MOUNTAIN RANGE

by Katie Oberthaler

This past winter, Dr. David Braaten spent his holiday season husking off the icy wrapping of one very large gift. Dr. Braaten and KU undergraduate Chris McMinn traveled to Antarctica to study the Gamburtsev Mountains.

The mountain range that extends more than 1,200 km and rises approximately 3,400 km from the bedrock near the South Pole. The mountain range is thought to have been the nucleation point for the East Antarctic Ice Sheet, under which the range is now completely submerged.

From December to late January, Dr. Braaten and McMinn joined scientists from Lamont-Doherty Observatory, the U.S. Geological Survey and the German Federal Institute for Geosciences and Natural Resources (BGR) for an airborne geophysical survey of the mountains. The collaboration, called GAMBIT, marks the first expedition of the mountains since their discovery in 1957. GAMBIT is one project of a larger initiative called AGAP. The modern expedition worked to determine the topography of the mountains, the stability and internal layers of the overlying ice, and the locations of new subglacial lakes in with area.

Lifting the white, frozen sheet draping these “ghost mountains” required an intensive effort. The team contended with the effects of high altitudes, freezing temperatures, and the unpredictable weather of the austral summer on their equipment and health while working around the clock. During calm conditions, the team flew a Ken Borek Twin Otter suited with ice-penetrating radar and four antennas on each wing over an area near Dome A in the East Antarctic Ice Sheet. Using a copy of CReSIS-developed radar custom-built for this project, researchers from Lamont could detect the peaks beneath the 1000 meters of ice. The airplane also contained gravity and magnetic sensors, a GPS system, and a laser altimeter. Two flights teams alternated continuous operations of five-hour flights, completing four flights per day during clear weather conditions. After each flight, Dr. Braaten and McMinn transferred and copied the collected data onto four dual-core laptops. Dr. Braaten then used date processing routines to produce rough echograms of the ice-bed topography. He completed one analysis sequence over the course of eight hours. In all, the team completed 50 flights and surveyed approximately 50,000 kilometers of flight lines.

Polar Grid, an infrastructure initiative of Indiana State University and Elizabeth City State University, provided the computer configurations for the field data analysis.

The quick speed and reliable power of the system helped the team temper the vacillating interplay of the sensitive radar and the unpredictable ice characteristics. Shortly after arriving at the AGAP-South camp, the team discovered jumbled radar signals in the first few echograms. Within hours, they adjusted the radar settings and corrected the problem. Without quick processing in the field, the noise may have persisted for the expedition’s duration producing poor data. Dr. Braaten emphasized, “When you go to a new area, you never know how the radar signal will interact with the ice. We would have wasted almost one-third of the flights had we not picked this up. It made a huge success.”

At the end of the expedition, Braaten returned with ten terabytes of raw data and three terabytes of processed data. Initial data processing unearthed surprising geological features that suggest the mountain range may have formed over a time scale of only a few hundred million years. Previously, glaciologists speculated the Gamburtsev Range to have originated approximately 800 million years old. However, the first echograms revealed sharp crests and troughs below the ice. “The mountains were really jagged. We were a little surprised. We expected them to be more

The Twin Otter refuels at the camp between flights over the Gamburtsev Mountains in Antarctica.
Climate Pathfinders Project Coordinator Marci Leuschen, who joined the CReSIS team in January, has jumpstarted the Climate Pathfinders program by creating a new project at Robinson Middle School in Topeka. She meets with 10 to 15 students every other Tuesday and covers many topics including climate change, greenhouse gases, the carbon footprint, the carbon cycle and environmental decision making, as well as making an introduction to CReSIS work. “The group of kids is fantastic. They are truly interested in climate change and want to make a difference,” said Leuschen. She said that lately the students have been working on improving their school recycling program and putting up posters that explain how to reduce one’s carbon footprint. “You’ve got to love the enthusiasm and energy of a middle-schooler.” Leuschen is currently planning a field trip for the Climate Pathfinders to the KU Spencer Museum of Art where they will view the exhibit Climate Change at the Poles and an arctic photo exhibit by photographer Terry Evans to learn about the intersection of art and science. The students will learn more about ice and water as the semester progresses. K-12 Outreach Director Cheri Hamilton will also be helping out with Climate Pathfinders toward the end of the semester. //
Glacier was trying to explain the thought process of CReSIS researchers through her photographs. She said that she struggled to understand the depth of the glacier just as the CReSIS researchers did. Her other memories include taking photographs at midnight and struggling with the concept of time because at that time of year they were experiencing 24 hours of daylight in Greenland. Evans’ work has centered on ecological issues in the past, but this is her first time working with climate change.

Items included in the Climate Change at the Poles exhibit contributed by CReSIS include a bright blue echogram showing ice-depth measurements taken by CReSIS researchers in Antarctica and a sculpture collection of objects that can be found on ice penetrating radars. Other items in the exhibit include maps of Antarctica contributed by the National Science Foundation and the American Geographical Association, as well as cultural items such as Inuit hunting gear from Arctic regions. “It is important for those of us that have an affinity for numbers to develop an affinity for other things,” said Stephen Ingalls, the associate director for administration for CReSIS. He said he encourages students to study subjects outside of their normal academic fields to be better rounded people. Climate Change at the Poles was organized by Curatorial Assistant Kate Meyer, Assistant Director Jennifer Talbott, and Associate Collections Manager Angela Watts. Stephen Ingalls, Associate Director for Administration at CReSIS, facilitated collaboration on the exhibits.

GRADUATE STUDENT PIONEERS COLLABORATION WITH INDIAN INSTITUTE

During the past Spring Semester of 2009, calculus and curry have comprised University of Kansas graduate student Kevin Player’s diet. Player has spent the spring semester studying with students and faculty at The Indian Institute of Technology-Kanpur, an international partner institute of CReSIS located in Kanpur, India.

Player is the first KU Engineering student to study at IIT-K. At the Institute, Player has been working under the direction of Dr. A.R. Harish, professor of electrical engineering. Player’s collaboration intends to improve linear power amplifiers for CReSIS radars and design more efficient antenna arrays for the radars. Player is learning how to correct mutual coupling effects for a 150 MHz, 6-element folded-dipole antenna array. He is applying this knowledge to create a 12 to 18 GHz stacked-patch antenna. Ideally, these antenna arrangements could assist in gathering snow accumulation data in future field work over ice sheets and glaciers. Such tasks diversified Player’s solid background in RF power amplifier design at CReSIS.

“I have not had much experience working with antennas or antenna simulation software so this has been a good learning experience for me. I can’t think of any other place I could learn what I have learned here.”

— KEVIN PLAYER

Player also expanded his approaches to learning within his projects’ framework. He usually employs a hands-on technique in engineering. While abroad he has supplemented this method with more theoretical reasoning: “Most of the mathematics involved in engineering I understand at a surface level, just barely enough to get by, but the Indians here comprehend it on a much deeper level and know how to use it for problem solving.”

His foreign colleagues have augmented his understanding of the “math behind the magic.” Both CReSIS and IIT-K aspire to strengthen the connection between the institutions. Player chose to study in India and study antennas under Dr. Harish’s direction in order to work with top engineers and discover alternate problem-solving procedures.

Player explained, “I knew it would be a win-win-win situation for CReSIS, me, and IIT-K because the knowledge I obtained would be useful for CReSIS, me, and IIT-K. Hopefully, it will open the door to others to engage in a more active foreign exchange program in the future.”

Outside of the lab, Player continues his experimentation by embracing a foreign lifestyle. Adjusting to piquant cuisine and congested traffic prove to be as enriching as his research opportunities. Player emphasized, “In India, almost every day is something new and exciting.”
NEW TECHNOLOGIES BOLSTER GREENLAND AERIAL SURVEY

by Katie Oberthaler

As the Antarctic summer wanes, a team of CReSIS scientists have migrated north to Greenland to continue researching fast-moving glaciers.

The team, comprised of Dr. Prasad Gogineni, Dr. Fernando Rodriguez-Morales, KU graduate students Cameron Lewis, William Blake, Josh Meisell, and Indiana State University Polar Grid staff member Keith Lehigh are conducting an aerial survey over the Jakobshavn and Kangerlussuaq glaciers using a Kenn Boreck Twin Otter aircraft in March and April of 2009. Using a radar system called the Multi-Channel Depth Sounder, they are mapping the bedrock topography and the ice thickness of these fast-moving glaciers.

The expedition follows a similar CReSIS airborne survey of the Jakobshavn glacier in June and July of 2008. Although the team gathered beneficial data, water on the ice’s surface obscured some of the radar signals. The team returns earlier in the year during colder temperatures to avoid the summer melting season.

The team will install and the test the equipment in Calgary, Canada and then relocate to Ilulissat in western Greenland for the survey.

In Ilulissat, they will measure the Jakobshavn Ice Fjord, an area replete with calving glaciers and rapidly-moving ice. The team then plans to relocate the aerial survey to Kangerlussuaq in eastern Greenland. The ice in both locations requires sensitive equipment to detect its supple dynamics, and the team has compiled a new equipment package to improve data quality.

Among the updates from the last trip are multi-frequency dipole antennas. Previously, scientists outfitted the Twin Otter with six antennas on each of aircraft’s wings operating at one limited frequency. Dual frequency antennas allow the transmitters to serve more than one instrument at a time. “Now we are able to use them for two radars that could potentially operate simultaneously,” emphasized Dr. Rodriguez.

New snow accumulation radar developed by CReSIS will also be put into effect. The radar maps the upper layers of the ice in a finer resolution than the lower-frequency Multi Channel Depth Sounder, but has a limited depth range “In one hand, you have a lower frequency, the MHZ system, which can penetrate all the way to the bedrock. The resolution is sufficient but not very high. With the accumulation radar, because of the higher frequency and wider bandwidth, you can measure the internal layers near the surface with a resolution of centimeters. Between the two, they’re providing complementary data,” Dr. Rodriguez explained.

Additionally, the team will integrate new GPS and INS systems developed by KU doctoral student Chris Gifford, as well as test the concept of light radar (lidar) constructed by Dr. Ron Hui and Dr. Christopher Allen of KU.

The lidar employs a beam of light instead of a radio signal to measure the distance between the plane and the snow surface. Although the lidar will not contribute data collection and analysis, the trip allows the team to operate the laboratory developments in the field.

Because numerous systems operate in the constricted Twin Otter cabin, reducing electromagnetic inference between equipment is critical to maintaining high data quality. The team will again shield all the equipment with metallic fabric enclosures called EMI socks. They will also rearrange the equipment within the cabin.

“This time we found that improving the way they are attached to the rack itself, the metal contact between the enclosure and the rack, the more shielding and efficiency you get.”

— DR. RODRIGUEZ

Keith Lehigh of Polar Grid said that cutting-edge radar developments and the addition of snow accumulation and lidar systems challenged him to develop faster algorithms to process this increase in data while in the field. “It’s a constantly evolving project. Preparation is difficult,” he noted.

The updated radar equipment and data management software will help the team analyze glacier movement and compare it to past data sets. Detecting and analyzing high-resolution data at these two Greenland locations will help scientists compare current ice behavior and movement patterns within the Greenland ice sheet. Dr. Rodriguez said, “Following fast-moving glaciers is the key to understanding the thinning of the ice sheets.”
team gathered information to understand the dynamics driving this thinning glacier’s brisk movement. From November 2008 to January 2009, Sridhar Anandakrishnan, Don Voigt, Huw Horgan, Leo Peters, and Joe MacGregor of the Pennsylvania State University, University of Kansas graduate student Anthony Hoch, Don Kirkpatrick of Raytheon Polar Services (RPS), and Mike Jayred and Robin Bolsey of the Ice Core and Drilling Services Group (ICDS) conducted this research at the WAIS Divide camp. The trip was the second installment in a three-year project. “We were trying to find what has caused it to change speed and how much ice was there in the first place,” said Mr. Hoch.

For the seismic survey, the team penetrated the ice using a Rapid Air Movement drill developed by ICDS. The drill used high-pressure air blown through a hose to incise the ice with holes 50 meters deep. Small cylinders of explosives were lowered into the holes. After snow or an inflatable bladder covered the opening, the team detonated the explosives. The explosions released vibrations down to the bedrock, which then traveled back through the ice to the surface. The team placed small microphone-like devices called geophones to detect these returning echoes.

“We would spend our day setting off shots, digging holes to put geophones into, then digging them back out again so we could go to a new place and do it all over again.”

— DR. ANANDAKRISHNAN

A digitizer translated the echoes gathered in the geophones into computer data. Researchers at PSU are currently working to integrate these data into echograms. Echograms will represent properties of the ice sheet both at the surface and at its underside. Subsurface dynamics will help scientists understand just how subglacial activity may be affecting or affected by rapid ice flow.

The radar survey used a ground-based INSAR system pulled behind a Tucker Sno-Cat vehicle to emit radio signals. The reflected signals helped the scientists determine the roughness of the bed and the amount of water at the ice-bed interface. They also provided a picture of the layers within the ice sheet. These features may be contributing to the glacier’s alacritous movement. The radar showed the glacier to be approximately 2.7 km thick in the area surveyed. Further conclusions will come as the team now processes the data from both seismic and radar surveys using sophisticated techniques.

Besides the typical vacillating weather conditions of the Antarctic, the team experienced few problems and collected an immense quantity of data. “We stayed healthy and happy and everybody got along really well. In other words, it was a successful season,” Dr. Anandakrishnan added. //

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