TERI VISIT PROMPTS AWARENESS OF INTERNATIONAL CLIMATE CHANGE ISSUES

by Katie Oberthaler

I had a difficult time imagining a trek into the frigid Himalayas. I had just emerged from 90-degree heat, humidity, and a cloud of car exhaust in New Delhi. I hardly wanted to talk about glacial movements – I wanted bottled water.

However disconnected from my interview I felt, the small plastic bottle I clutched in my hand was the source of the contention I had come to discuss with Dr. Syed Hasnain. Dr. Hasnain is a Senior Fellow at The Energy and Resources Institute (TERI), a government-funded research center that studies the use and impact of natural and man-made resources. Our meeting followed a talk given by Dr. Hasnain at the University of Kansas on May 13th entitled “Global Warming at the Roof of the World: Climate Impacts, Water Resources and the Himalayan Glaciers.”

CHERI HAMILTON SHARES GREENLAND EXPERIENCE WITH STUDENTS

by Ashley Thompson

The airplane’s propellers swirled, creating an impressive noise and forceful winds from the wings of the plane. It had just touched ground near the NEEM (North Greenland Eemian Ice Drilling) camp in Greenland, in the center of what looked like an ocean of white, with only snow visible in all directions.

It was May 30, 2009, and Cheri Hamilton, K-12 Outreach Coordinator at CReSIS, had just begun her week-long stay at NEEM. Awe and anxiety were already setting in.

From the white backdrop appeared a string of sturdy Nansen sleds approaching the skiway to transport the gear and the 27 passengers, which happened to include the Crown Princes of Denmark and Norway, the Crown Princess Victoria of Sweden, and their entourage of 20-plus members of the media.
CRESIS ASSISTS IN OUTREACH EFFORTS AT IGARSS CONFERENCE

by Ashley Thompson

The International Geosciences and Remote Sensing Symposium (IGARSS) convened July 12-17 in Cape Town, South Africa. Six CReSIS students and Dr. Linda Hayden of Elizabeth City State University attended the conference and collaborated in outreach efforts that provided hands-on opportunities to more than 400 high school students from low-income areas in and around Cape Town.

Dr. Hayden played a key role in organizing this year’s outreach activities. These included a GPS workshop, a Remote Sensing art workshop, team math competitions, and a seminar with NOAA’s Education Council member Nina Jackson about the array of fields of earth science. Jerome Mitchell, University of Kansas PhD student, assisted at several sessions and said the students’ enthusiasm was catching.

“It makes you appreciate all the opportunities you’ve had,” Mitchell said. “The sessions really helped introduce these students to all the possibilities that are open to them in the future.”

This year marked the first time that IGARSS was held on the African continent. Compared to previous IGARSS conferences, more than twice as many area students were included in outreach efforts this year.

Along with Mitchell and Hayden, Cameron Lewis, Logan Smith, William Blake (all KU graduate students) Je’aime Powell (ECSU graduate student) and Randy Justin (PSU graduate student) all made the trip to Cape Town and presented posters or oral presentations, thereby contributing to CReSIS partner collaboration.

SCIENTISTS CONTENT WITH ELEMENTS DURING SPRING SURVEY OF GREENLAND GLACIERS

by Katie Oberthaler

M. Night Shyamalan’s new action movie Avatar deals with elemental manipulation: conjuring of waters, creating fire balls, creating earthquakes – the usual hero work. The protagonist awakes from years of entrapment in an iceberg to discover that he is the protagonist in a troubled fantasy world. Sharamalan’s fantastical world might be a far cry from the isolated, frigid world known by glaciologists, yet CReSIS brushed shoulders with Shyamalan this spring.

The filmmaker was on location, of all places, in Ilulissat, Greenland. CReSIS spent significant time in Ilulissat in March and April detecting the bedrock below the surrounding ice masses.

Although CReSIS scientists can’t move the ice to reach the bedrock, they deal with equally severe elemental manipulation. These large, fast-flowing glaciers, called outlet glaciers, have moved at accelerated speeds in recent decades. The glaciers break up at ice fjords buried within the ice sheet. Eventually the ice deposits into the sea as icebergs and contributes to sea level rise. Cameron Lewis, University of Kansas graduate student, said, “The fact that it is so deep and it is moving so fast is what makes it important. That means it has the ability to discharge more ice than other glaciers.” Josh Meisel, a graduate research assistant at CReSIS who assisted with data processing on the expedition, said, “Whenever the locals came up, they would say, ‘Oh, are you with the movie?’ and we would say ‘No, we run radar over the ice’ and they would start talking about the ice. They would say things like, ‘This year the ice has retreated way back’. That year we could get access to the water. Everyone was really interested in our stuff. They all wanted to talk about how they view that the climate has been changing.”

These unpredictable conditions are exactly what CReSIS aims to understand. CReSIS has traveled to Greenland multiple times to map the bedrock and internal ice layers using an array of systems mounted on a Kenn Boreck Twin Otter plane. The 2009 expedition built on the data from previous trips. This year the team consisted of Dr. Prasad Gogineni, Dr. Fernando Rodriguez-Morales, graduate students Lewis, Meisel, Blake, and Indiana University Polar Grid staff member Keith Lehigh.

In the past, CReSIS has collaborated with NASA for GPS and light-beam radar (lidar) systems. However, this year, just the CReSIS team and the Kenn Boreck Twin Otter pilots flew over the glaciers. As a result, the team could test further developments in their remote sensing technologies. CReSIS employed their own new GPS and accumulation radar systems in addition to the Multi-Channel Radar Depth Sounder (MCRDS) used in past expeditions. These stacked technologies each decipher a different section of the thick ice. MCRDS, CReSIS’ most time-tested radar system, detects layering...
down to three kilometers. The accumulation radar, which Lewis is working on, surveys recently deposited ice on the glacier’s surface between three centimeters and 200 meters. The accumulation radar provides a finer resolution than the MCRDS system. Lastly, a device called an altimeter reaches from the plane down to ten meters into the ice and gives a very accurate return signal detecting the surface snow and ice.

In addition to these systems, the team also tested their own lidar device for the first time. Dr. Ron Hui and Dr. Christopher Allen of The University of Kansas developed the lidar system to precisely measure the distance between the aircraft and the snow surface. The system is unique in that it uses a process called “pulse compression” that allows the use of smaller, lower power lasers. Scientists have used normal lidar systems for decades, but none have applied pulse-compressed lidar to glacial studies.

“This is the first that we know of pulse-compressed lidar. What we know of, nothing has been flown or tested before, especially in the Arctic.”

— LEWIS

The team did not use the lidar to formally collect data during these initial test runs.

Overall, the systems produced high resolution results. In future expeditions, CReSIS will work to miniaturize and optimize the settings of the GPS, the accumulation radar, and the lidar. “We’ll be bringing those other systems up to the level of the Depth Sounder in terms of robustness and operation,” Lewis said.

The team significantly expanded its geographical range in Greenland this year. In past expeditions, the team has stationed solely in the town of Ilulissat and sent individuals to other places with NASA. This time, the entire team moved between locations. They began by surveying the Jakobshavn glacier in Western Greenland near Ilulissat for two weeks. The team then moved to Kulusuk to collect data on the Helheim and Kangerdlugssuaq glaciers in Eastern Greenland. Lastly, they were stationed in the town of Kangerlussuaq and gathered more data on the glacier of the same name.

The glaciers’ composition challenged the team to adapt to their environments. In Eastern Greenland, the team worked with thinner, smoother ice. This allowed for more fine-tuning and less rigid flight paths. In contrast, crevasses, broken pieces of ice, and deeper ice characterize Western Greenland. These characteristics diminished the accuracy of the returning radar signal. Lewis said, “Jakobshavn is very deep and it has a high clutter surface. That makes it hard to get a nice, consistent radar signal. We also get returns from spots we didn’t expect.” To avoid problems with radar signal attenuation, the team visited the glaciers earlier in the year before the summer melting created pools of water on the ice surface.

Storms also disrupted the team’s flight schedule, more so in their assessment of the western glaciers than in the eastern portion of the country. When the team did fly, conditions inside the Twin Otter could be uncomfortable. Lewis said, “Sometimes the MCRDS would heat up and we would have to turn the cabin heat off. That wasn’t a problem for Fernando because he was in the front of the cabin. I am next to the leaky back door.” Leaky back door or not, the team successfully collected data on all of the glaciers.

CReSIS also sent the first Haskell University student to Greenland this summer. Josh Meisel, 2009 graduate in environmental science, assisted with mapping flight lines and data processing on the expedition. Meisel is currently working as a graduate research assistant for CReSIS. The bed maps Meisel has generated with CReSIS data include data from 1999 to 2008. Previous bed maps had only reflected data collected between 1993 and 1999. A new Synthetic Aperture Radar (SAR) processor has allowed Josh to process all the data beginning in 1993 with higher fidelity.

“Since we got back last summer there has been a lot of interest in these fast-flowing glaciers, and we must make bed maps,” he noted. So much interest has been generated in fact that Meisel’s bed maps will be featured in a forthcoming National Geographic article. The piece will highlight CReSIS’ efforts in Greenland. “I get to have my name in National Geographic. For a geographer, that’s huge,” Meisel emphasized. Meisel said he enjoyed his time in Greenland. “It was great. I recommend it to anybody.”

The team has finished processing the data from the Greenland trip. The optimization of the antennas and radar during the trip prepared the team for its deployment to Antarctica this winter. In Antarctica, they will use an identical setup on the Twin Otter. “We’ve learned quite a bit, especially about the secondary and tertiary systems that we’re going to upgrade for Antarctica,” said Lewis. Although the scientists still can’t move the ice with either thought or force, preliminary processing shows that the fined-tuned systems have improved the comprehensive picture of these glaciers. Lewis said, “We can get a nearly complete depth-map of Jakobshavn. We’re able to sound the very deepest parts. We’ve got very complete pictures of Helheim and Kanger, which we’ve not had in the past.”

Being associated with Hollywood wasn’t without it perks, however. In stores and restaurants in Ilulissat, Meisel said, “We would get discounts.”

Cameron Lewis, KU graduate student, and Dr. Fernando Rodriguez-Morales monitor radar systems inside of the Twin Otter.
On June 6, a field team from The Pennsylvania’s State University’s Ice and Climate Exploration (PSICE) group returned from a summer field expedition to the Greenland Ice Sheet (GIS). The team, consisting of members Donald Voigt, Randy Justin, and Knut Christianson set out to acquire seismic and GPS data from one of many supraglacial lakes that fill and drain each summer in the vicinity of the Jakobshavn Isbrae.

Unlike their Antarctic subglacial counterparts, supraglacial lakes form on the surface of glaciers, and can be many kilometers in diameter and reach tens of meters in depth. Despite their large size, supraglacial lakes typically drain in a period of hours with a flow rate rivaling that of Niagara Falls. Previous studies by glaciologist Ian Joughin (University of Washington) and Sarah Das (Woods Hole Oceanographic Institute) suggest that basal lubrication from these drainages could partially explain the summer speedups of outlet glaciers such as the Jakobshavn Isbrae. The Jakobshavn Isbrae is currently the world’s fastest-flowing outlet glacier and has roughly doubled its speed in the last decade. Summer surface melt often obstructs GPS surveys of these outlet glaciers. Team PSICE hopes that monitoring the activities associated with a supraglacial lake’s drainage event will offer insight into dynamics governing the accelerated ice flow of Jakobshavn Isbrae and the net summer speedup of the western margin of the GIS. The mechanisms and pathways through which surface melt water propagates to the surface bed through thick, cold ice are not yet well understood. This study will advance the understanding of this by providing a more complete dataset on these occurrences than has previously been available.

Poor weather foiled the team’s first deployment on the ice and crevassing near the lake increased landing hazards for the aircraft during the second attempt. As a result, the team returned to PSU for a brief rest and revamped their approach. Upon returning to Greenland, the team worked from Ilulissat and enlisted helicopter support, making transit to and from the lake site more convenient, precise, and less problematic. In spite of weather delays and logistical issues, the team accomplished all of their objectives.

To sufficiently record the drainage activity in the area, the team installed four stations proximal to the supraglacial lake just north (North lake) of the lake previously studied by Joughin and Das (South lake). Each station consisted of a broadband seismometer, high-frequency 3-component geophone, and a differential GPS instrument. The team also deployed a new generation of GPS, active and passive seismic instruments christened “Geopebbles,” which were configured for continuous passive seismic data acquisition. Three of the stations were installed around the lake in a roughly triangular arrangement. A fourth station was installed on land approximately 20 kilometers from the lake to serve as a local seismic and differential GPS base station.

Satellite imagery from recent summers had shown that the North Lake generally fills around early July and drains near mid-July. However, when the team returned to the ice in late July for station retrieval, they found, surprisingly, that the North lake had not yet drained. This finding indicates that a more complex drainage system may exist than was previously thought. Preliminary analysis of the seismic and GPS data shows that the team was still successful in capturing the drainage event of the South lake. Hopefully, data acquired from this study will accomplish several objectives: 1) provide the first observations of a drainage event from multiple sites, 2) offer supplementary evidence that could help to establish if a complex interconnected drainage system between North and South lake exist, and 3) further clarify the effect of multi-lake drainages on the observed regional net summer ice flow along the Western Greenland margin.
Nine CReSIS Summer 2009 REU students concluded their program by presenting their research on Monday, July 27, 2009.

Using the Polycom System, Penn State students Michelle R. Simon and Sarah E. Brungardt presented their research entitled: Mapping Snow-Firn Interface and Firn Water Table on Holte-dahlfonna, Svalbard, Using Ground Penetrating Radar. Their talk was followed by seven undergraduate students presenting at KU their research results. These presentations were:

Gladys Finyom, Michael Jefferson, and MyAsia Reid: Automatic Ice Thickness Estimation from Polar Subsurface Radar Imagery. Finyom is a junior at Arizona State University studying computer science. Jefferson is a junior at Elizabeth City North Carolina in engineering. Reid is a junior in computer science at Elizabeth City State University.

Theresa Stumpf: A Detailed Study of the Ability of a Porous Flexible Metallic Fabric Material to Isolate Sensitive Radar Components Against Spurious Electromagnetic Radiation in the 130-220 MHz Frequency Band. Stumpf is a senior at The University of Missouri-St. Louis studying electrical engineering.

Annaria Nardone: Use of Geophysical Software to Interpret the 2008 Jakobshavn Radar Grid. Nardone is a senior at Washington and Lee University in physics and engineering.


Felix Lee: Dynamic Analysis of the Meridian UAV Using Sensitivity Analysis Techniques. Lee is a senior at The University of California–Los Angeles in mechanical engineering.

Cat Coquillette started working with CReSIS this summer as a graphic designer. She is a junior at the University of Kansas, double-majoring in graphic design and illustration. Cat's involvement with CReSIS began in May 2008 when her glacier poster design was selected in a class competition and reprinted by CReSIS. In the spirit of the multi-disciplinary focus of CReSIS, Cat joined CReSIS as a full-time designer and has become an integral part of the education and knowledge transfer components of CReSIS. Her designs primarily consist of website redesign and creating educational materials which are being used in K-12 education outreach, The IceBreaker, and beyond. Cat said, "I’m really enjoying working for the Center. It’s fulfilling to know that my work here can absolutely make a difference. I’ve especially gotten into working on education-related projects."
Each year Dr. Hasnain and his team climb to the Kolarhoo Glacier in Kashmir and the Rathong Glacier in Sikkam. Using differential GPS sensors, they monitor the vertical variability, mass change, correlation area, and density of the snow in these areas. The rapid movement and depletion of these glaciers in the Himalayan region will directly affect the populations of India, Nepal, China, and other surrounding communities that depend on glacial runoff as their water source.

In recent years, these glaciers have seen an increase of glacial lake outburst floods. As glaciers retreat due to melting, they leave large amounts of water behind which pool into lakes. Increased pressure of such volumes eventually breaks the natural glacial dams around these lakes, and a large flood ensues. These deluges lead to the destruction of soil fertility and can ruin farmland in areas heavily invested in agricultural means of subsistence. While these floods increase water availability temporarily, their continuance will accelerate the exhaustion of such resources. “This is a direct climate signal,” said Dr. Hasnain.

Additionally, the glaciers have distinct, delicate personalities that compose their melting and refreezing cycles. The yearly monsoon storm systems account for both the snow accumulation and the melting output in the mountain range. Dr. Hasnain noted, “A slight change in temperature will reverse the process. That is what is happening now. We are not having much snow during this time. When the monsoon is weak, where is the snow appearing? Nowhere. That is what is making this glacier melt at a staggering rate.”

Dr. Hasnain and his team must consider the causes of these recent changes. The ubiquitous exhaust of diesel petroleum from large vehicles, the use of biomass for cooking, and the emissions from coal-fired plants contribute heavily to carbon and black carbon emission in the atmosphere. Increased carbon emissions destabilize the monsoon rains, which both mountain and man alike depend on for sustenance.

“Sulfate and aerosols are also affecting the monsoon activity. This is very important for the agriculture. India is basically an agriculture economy.” – DR. HASNAIN

Function often takes precedence over sustainability. India’s population totals 1.17 billion citizens. Mass consumption of cheap energy sources such as diesel and biomass amplifies their effects on the climate. “The situation is really worse in this part of the world,” Dr. Hasnain emphasized. “All of this is having a big impact on the monsoon. The monsoon is weakening and shifting.”

Although the monsoon originates in India, it affects the Himalayas across borders. Glacial lake outbursts are occurring all over the region. The geographic scope of the Himalayas also accounts for decreased domestic action to stop glacial melting. Foreign science collaboration between countries impacted by the melting is often stunted by political or social disagreements. Dr. Hasnain hopes that by creating a database on the mass balance and movements of glaciers, their rapid melting and bursting will be better understood and easily communicated between nations. He hopes to employ an airborne remote sensing technique, like CReSIS has developed, over the glaciers someday. He said, “If we flew over by plane in the region, I think that is cutting-edge kind of research. The small aircraft with lesser payload can run over the lower Himalayas.” Because these glaciers change drastically from year to year depending on the monsoon’s intensity, finer calculations would help glaciologists and climate experts assess the situation with the urgency it requires.

A poster of a Himalayan peak from the Indian Mountaineering Foundation hangs in Dr. Hasnain’s office. When all the snow has gone, what will we call the Himalaya? As I exited the sprawling TERI complex, sweltering smog hit me again as did something Dr. Hasnain said to me: “Everyone on this planet Earth will be affected.” Climate change isn’t endemic to India. As I left, I thought, can we call ourselves aware citizens if we don’t attempt to understand climate change beyond our own borders? //
in Kansas to solve. She wrote about the importance of weather balloons, and even donned a penguin suit as she posed for photos on a sled, skidoo, and Piston Bully. Her prolific Polar students know, of course, that you can’t find penguins in the Arctic.

Since returning from Greenland on June 6, Hamilton has given two talks to students about her experiences. The most common questions she heard from students revolved around the food (rich in musk ox), the bathroom (less than ideal but manageable), and the sleeping situation (beware of leaking bottles of boiled water intended to warm your feet, Hamilton warned).

Having gained an understanding of the logistics of setting up a camp on ice, Hamilton said she feels better equipped in the classroom. She noted that, by humanizing the science and the scientists, students are more engaged. Similarly, Hamilton herself gained more of an appreciation for the science she teaches and the scientists who make it happen.

“What I didn’t fully realize is that the scientists do everything there. They shovel the snow, they build the trenches. It’s not only the science they have to think about.”

MUSEUM FIELD TRIP ENGAGES ELEMENTARY STUDENTS

by Katie Oberthaler

Like many polar scientists, a year of hard work culminated with a field trip for the students at Lundgren Elementary. Instead of traversing Antarctica, however, 53 third- and fifth-graders from Topeka, Kansas, spent an afternoon in May at the Spencer Museum of Art at the University of Kansas.

The students received a special tour of the “Climate Change at the Poles” and “A Greenland Glacier: The Scale of Climate Change” exhibitions. Both exhibitions displayed polar science in unexpected fashions. They featured scientific data graphics, including echograms, radar systems, and flight lines developed by CReSIS scientists, as well as photos of CReSIS facilities and field activities in Greenland taken by artist Terry Evans.

The field trip provided a capstone to monthly interactive science classroom activities led throughout the school year by Cheri Hamilton, CReSIS Education Outreach Coordinator. The “Ice, Ice, Baby” curriculum prepared the students to ask probing questions about the art. The students applied their knowledge from the program to their tour and educated the tour guides in return. “They told the docent that the graph was radar from a sled and it represented how much snow had fallen using snow accumulation radar,” said Hamilton.

The “Ice, Ice, Baby” curriculum and the field trip allowed students to consider climate science above and beyond their textbooks. At the Spencer, the students viewed the fur coat worn by 19th-century Arctic explorer Lewis Lindsay Dyche during his expeditions to Greenland. They also viewed early maps predating the discovery of Antarctica. By helping students interface with climate research models, engineering projects, and artistic representations of science and exploration, the CReSIS education team hopes to excite and encourage children’s interest in future scientific careers.