In-Depth

NEWSLETTER OF THE NATIONAL ICE CORE LABORATORY — SCIENCE MANAGEMENT OFFICE

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Message from the Director

As part of its internal strategic planning, the U.S. Geological Survey (USGS) recently evaluated its long-term commitment to operate the National Ice Core Laboratory (NICL). NICL, operated jointly by the National Science Foundation (NSF) and the USGS, was one of a number of facilities, programs, and activities internally reviewed by USGS in an effort to refine its mission and the strategic science directions of USGS and its government parent, the Department of Interior. We are pleased to report (see story of page 7) that the USGS intends to continue the operation of NICL for the foreseeable future. The USGS and NSF are currently in negotiations regarding the future joint operations of NICL.

As a reminder, we are always looking for short articles from the ice core community for publishing in *In-Depth*. Please contact us at nicl.smo@unh.edu if you would like to contribute an article.

-MST ■

Uncovering Denali

by Eric Kelsey and Cameron Wake

Eric Kelsey and Cameron Wake collect snowpit samples from the Upper Yetna Glacier. Photo: Karl Kreutz

While long-term climate variability in central Alaska has been mapped, high-resolution records of Holocene climate variability have been lacking from central Alaska. However, a collaboration of scientists from New England is working to recover valuable information from the ice in Denali National Park (DNP). Denali, meaning "the great one" in native Inuit and better known as Mount McKinley to many Americans, is located in south central Alaska about 300 km north of Anchorage. Researchers Dr. Cameron Wake and PhD student Eric Kelsey (University of New Hampshire), Dr. Karl Kreutz, and Masters students Ben Gross and Seth Campbell (University of Maine), Dr. Erich Osterberg (Dartmouth College), and Mike Waszkiewicz (Canadian ice core driller) recently completed their first reconnaissance expedition to identify suitable locations to drill a deep ice core on the shoulders of the majestic mountain.

Their overarching goal for this research is to obtain a very high

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Masthead photos courtesy of
Lonnie Thompson and Michael Morrison.

Upcoming Meetings

15-19 December 2008
AGU Fall Meeting, The Moscone Center, San Francisco, CA
www.agu.org/meetings/fm08/

19-24 April 2009
EGU General Assembly, Vienna, Austria
http://meetings.copernicus.org/egu2009/

27-31 June 2009
Symposium on Glaciology in the IPY, Northumbria University, Newcastle upon Tyne, UK
www.scar.org/events/IGS_IPY_Symp_Jun09-2ndCirc.pdf

6-7 July 2009
IPICS Science Meeting, Oregon State Universiity, Corvallis, OR
www.pages.unibe.ch/ipics/meetings.html

8-11 July 2009
PAGES Open Science Meeting, Oregon State University, Corvallis, OR
www.pages-osm.org/

14-18 December 2009
AGU Fall Meeting, San Francisco, CA
www.agu.org/meetings/

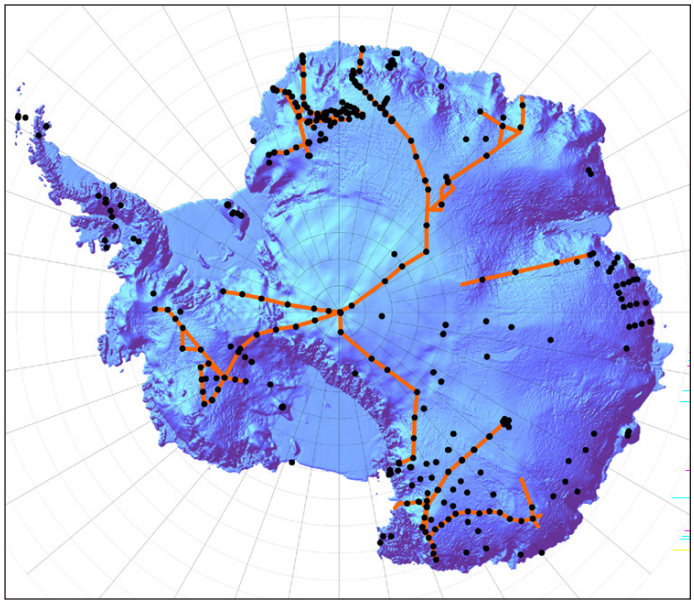
International Trans-Antarctic Scientific Expedition (ITASE) Synthesis Workshop:

Recent Change in the Climate and Atmospheric Chemistry over Antarctica

Castine, Maine, USA, September 2-5, 2008

Changing global climate is forcing scientists to vigorously test the existing paradigms and to find improved evidence of how the climate system really works at various time scales. With polar regions being the pacemakers of climate change, it is imperative to gain critical knowledge on the role and response of the cryosphere system in a warming scenario. However, due to the lack of long-term instrumental climate records in remote places like Antarctica, scientists are focusing on ice core proxy climate records buried in the vast ice sheets of Antarctica that provide valuable information on climate change from interannual to millennial scales. One such multi-national effort to obtain climate archives from Antarctica is the International Trans-Antarctic Scientific Expedition (ITASE). Operating since 1990, twenty-one countries are now involved in ITASE programs to understand the impact of global change on the Antarctic continent and the influence of Antarctica on global change during the last ~200-1000+ years.

At the idyllic coastal Maine village of Castine, Prof. Paul Mayewski and his group from the Climate Change Institute at University of Maine collected 32 glaciologists, geophysicists and climate modelers to discuss and synthesize the results obtained thus far from the ITASE programs. This synthesis workshop generated many fruitful discussions on the data, and also future directions.



The Ice Reader shaded relief map of Antarctica showing ITASE ice core locations (black dots) and GPR transects (orange lines).

By combining available meteorological data from the Antarctic and Southern Ocean with firn/ice core proxies for a variety of climate parameters (e.g., moisture balance, atmospheric circulation and temperature) ITASE is actively working to extend the Antarctic climate and atmospheric chemistry records back at least ~200 years. This offers the temporal perspective needed to assess the multi-decadal variability of natural Antarctic climate.

The main focus for this workshop was to get an updated overview of newly collected firn/ice cores and available data sets. A large effort is planned to make the data available online in order to facilitate a number of synthesis products. In addition, we had a number of presentations from the participants with information both on syntheses of previously collected data and also new developments from the many participating countries. One of the important new results discovered by members of the ITASE group is that the climate of West Antarctica appears to have warmed during the last several decades.

Other interesting aspects discussed were the importance of the Southern Annular Mode (SAM) in Antarctic climate change as well as climate teleconnections

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ITASE Synthesis Workshop *(continued from page 2)*

related to extra-tropical systems like the El Nino Southern Oscillation (ENSO). It was also concluded that firn/ice core records should be interpreted in combination with snow Ground Penetrating Radar (GPR) surveys to ensure continuous chronology and climate data from the cores.

Based on the available data and our current state of knowledge we agreed that the following synthesis products from the ITASE community will be created in the near future:

1. Temporal variability of snow accumulation using well-dated firn/ice cores with reference horizons such as sulphur peak from the eruptions of Tambora 1815 as well as the atomic bomb tests of 1964/65.
2. Sea ice proxy reconstruction using a combination of sea salt and methanesulphonic acid (MSA) records from coastal ice cores around Antarctica.
3. Proxy Atmospheric Reanalysis of AnTarctica (PARAT).
4. Temperature reconstruction during the past 200 years using ice core proxy data.

In addition to the interesting talks and discussions, we also enjoyed an afternoon of sailing in Penobscot Bay on the polar-class schooner Bowdoin, which has sailed many times to Greenland.

Participants at the ITASE Synthesis Workshop, held at the Manor Inn, Castine, Maine from 2-5 September 2008.

ITASE is jointly sponsored by the Scientific Committee on Antarctic Research (SCAR) and the Past Global Changes (PAGES) project of the International Geosphere Biosphere Program (IGBP). The next workshop is planned to take part in connection with the SCAR meeting in Buenos Aires (Argentina) in July 2010.

-- Daniel Dixon (Climate Change Institute, University of Maine)
Massimo Frezzotti (ENEA, Lab. Climate Observations, Rome, Italy)
Elisabeth Isaksson (Norwegian Polar Institute, Tromsø, Norway)
Thamban Meloth (National Centre For Antarctic & Ocean Research, India)

For more information about ITASE, visit: http://www2.umaine.edu/itase/

ITASE Synthesis Workshop
NSF Award Number 0829227
Principal Investigator: Paul Mayewski, University of Maine

Ice Core Working Group

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Desert Research Institute
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Physical Properties

Karl Kreutz
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Stable Isotopes

Ryan Bay
University of California-Berkeley
Borehole Logging

Mark Skidmore
Montana State University
Biogeochemistry

Eric Steig
University of Washington
At Large

Kendrick Taylor
Desert Research Institute
At Large

In 1986, the National Academy of Sciences recommended developing an Ice Core Working Group of representatives from institutions prominent in ice coring activities. Administered by the NICL-SMO, ICWG is organized around scientific disciplines, rather than institutions. Members are elected to a three year term, with the committee chair serving two years.

Uncovering Denali

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resolution, 500-year or longer ice core record in 2010 from which to reconstruct climate and environmental variability in the Alaska-Arctic-North Pacific region. "Relative to the North Atlantic basin, for example, we still have much to learn about the climate of the Arctic and North Pacific region and how it behaves with the rest of the climate system," Kelsey explains. The core they plan to drill should provide a continental and Arctic climate signal, due to its inland location, that will complement the maritime climate signal already obtained from ice cores drilled in the St. Elias range in Yukon Territory. Developing this new information will add another important piece to the building Earth climate system puzzle and how the climate of different parts of the globe varies and interacts with the rest.

Eric Kelsey and Mike Waszkiewicz drilling ice core from the bottom of a four meter snowpit on the Kahiltna Glacier using a hand auger. Photo: Cameron Wake

Their three-week long tour of the glaciers in DNP in May 2008 began with a pair of reconnaissance flights to survey the Alaska Range for possible drill locations. The flights revealed interesting high-elevation saddle sites at Mt. Spurr and Mt. Hayes. And on the southeast corner on the edge of DNP, a large icefield near Mt. Russell looked promising enough to merit a modification in plans to become a focus for the 2008 field season.

"Our reconnaissance field season helped us identify several potential sites to recover a suite of surface-to-bottom ice cores," says Cameron Wake. "Now we just need to study our geophysical and glaciochemical records to pick the spot for our deep coring program".

The team took completed geophysical surveys and collected snowpit/firn core samples at two locations in DNP. At about 9700 feet, Kahiltna Pass marks the western margin of the large Kahiltna Glacier and is just off the popular West Buttress climbing route that leads to the peak of Denali. The second site, northeast of Mt. Russell on the Upper Yetna Glacier and 20 miles southwest of Denali, is approximately 8700 feet in elevation and rarely visited by climbers. At both sites, the team sampled snow from four-meter snowpits and then manually drilled firn core down to a depth of ~20 meters.

A ground-penetrating radar was towed across a detailed grid at each site to obtain data on sub-surface glacier stratigraphy. In addition, GPS measurements were taken on the grid to determine surface flow rates. From these snow and firn samples and geophysical records, which currently are undergoing analysis, the researchers will determine how much snow typically falls each year, the types of storms that produce significant snowfall in the region, the types and sources of pollution that are transported into DNP, and whether or not either location has undisturbed, horizontal layering of the snow.

Thus far, preliminary analysis of the occurrence of small melt layers shows that both sites likely exhibit very high annual accumulation rates – more than two meters water equivalent. The scientists are now preparing a second proposal to the National Science Foundation to fund the deep drilling program.

A weather station was installed at Kahiltna Base Camp (7200 feet) where most climbers begin their mountaineering expeditions. The weather information logged will inform the team on how various storms impact this part of DNP.

Ben Gross and Seth Campbell collecting ground profiling radar data on a grid on the Mt. Russell Plateau/Upper Yetna Glacier. Photo: Cameron Wake

Plans are underway for a second reconnaissance expedition in May 2009. Weather station observations will be retrieved and will be reconciled with snow samples to be taken then and used as an analog for the calibration of the samples taken in May 2008. If everything goes well, a high-resolution ice core will soon shed light on the mysterious climate of Denali.

-- Eric Kelsey and Cameron Wake
University of New Hampshire

Collaborative Research: Drillsite Reconnaissance and Snow Chemistry Survey in Denali National Park
NSF Award Number 0713974
Principal Investigator: Karl Kreutz, University of Maine

NSF Award Number 0714004
Principal Investigator: Cameron Wake, University of New Hampshire

Girls on Ice: Using "Immersion" to Teach "Fluency" in Science

Each year, a new *Girls on Ice* team spends eight days exploring glaciated Mt. Baker in Washington State guided by myself, mountaineer Cecelia Mortonson, and a third (rotating) instructor. The nine teenage girls on the team learn not only about alpine geology, glaciology, and mountaineering, but they also challenge themselves and gain self-confidence in their physical, intellectual, and social abilities. Girls on Ice is the science version of a "language immersion" experience – where we connect science with all aspects of daily life with the goal of creating lifelong advocates for Earth science, specifically, and the scientific process as a whole, regardless of whether or not they decide to specialize in science in college.

I created Girls on Ice simply because I wanted to share the excitement of field science – the excitement of being surrounded by the natural processes I am studying. For myself (along with many other scientists), fieldwork is a primary inspiration for the research, and I wanted to share this inspiration with younger women who are at a transitional point in their lives. Girls on Ice has grown far beyond my original ideas, however, and has been successful mostly because of the people and organizations that have helped along the way. In particular, the support of the scientific community as a whole has played a role in the program's success.

Girls on Ice today is a result of a close collaboration with the North Cascades Institute (an educational partner to North Cascades National Park). We designed the program with three underlying philosophies in mind: that teaching the *whole process* gives them ownership of the science; that teaching to the *whole student* puts the science in context; and that *diversity* inspires new ideas, new approaches, and better science in the end.

The Whole Process. In school, students often learn the scientific method as a linear process of moving from observation to question to experiment to conclusion. Those of us in science know there is rarely linearity in "real" science: the original question and hypothesis may lead to data, which cause us to rewrite the question and redesign the experiment. If a student is lucky, he or she will have a teacher who will explain the nonlinearity of the scientific process and allow the students to experience it, but this is difficult in the classroom where observations are often limited.

We approach teaching the scientific process in Girls on Ice through encouraging the girls to interact with and explore the alpine setting first, before we tell them the ideas and theories of other scientists (one of the biggest challenges in both teaching and learning science is getting the students to let go of preconceived ideas of what the answer is). As we teach them the basics of glacier travel and safety, we guide them through various activities aimed at getting them to use all of their senses to interact with the environment. For example, this year our rotating instructor was an "expeditionary artist" who taught the girls to see the glacier as various shadings of color and shadows, shapes and boundaries, and textures rather than as a "glacier". The eye of an artist is not that different than the eye of a scientist: both need to be open to seeing something new and different.

Their observations of the landscape lead to questions and discussions and finally to the design of experiments. Every year the experiments are different. In 2008, we had a group of girls study the behavior of ice worms, a group measured the slow glacier change through mass balance techniques, and a group measuring fast glacier changes through time-lapse photography. The girls define hypotheses, collect data, and discuss ideas and conclusions. After coming down off the mountains, they write a description of their project for themselves to take with them and for future Girls on Ice teams.

Instructor Sarah (Girls on Ice 2006) examines a single ice crystal. Photo: Erin Pettit

The Whole Student. It is sometimes too easy to judge an outreach or education program on the number of students it reaches, rather than the impact it has on each student's life. Girls on Ice is intended to be a high-impact program focused on a few students, with the goal of creating life-long science learners and teachers. By showing them how science is integrated into everything they do – from how to pack their backpack to carry weight efficiently to how to interpret the clouds for signs of coming weather - the girls will begin to see science as a part of their life. The integration of art techniques into their learning is an example of teaching to the whole student, especially for those for whom science is still *(continued on page 6)*

Girls on Ice *(continued from page 5)*

intimidating. We also challenge the girls' thoughts and ideas through evening discussions of the philosophy of science, the role of science in society, how media portrays science, and other questions. Ultimately our goal is to offer girls a tangible connection to both the scientific process and to the natural processes that create the world around us in hopes that in the future they will pass on their experience to others through stories and actions.

Diversity in Science. The creative side of science – how and what questions are asked – benefits from a diversity of viewpoints: the more variety of questions asked, the higher the chance of finding the right questions that will lead to major new discoveries. For this and other reasons, we choose a team of girls (from among 100 or more applicants) who are diverse in all aspects of their personalities. Currently, the program is tuition-free (primarily through private donations) to ensure that girls from all walks of life can participate. The all-girls format (although technically a limitation on our philosophy of diversity) is intended to provide the young girls with a comfortable environment to challenge themselves and discover their own abilities and self-confidence.

Since 1999, over 60 girls have participated in Girls on Ice, many have graduated from college (in fields such as geology, mechanical engineering, environmental science, and many other science fields), and at least one is now pursuing a PhD (in microbiology). Depending on continued (and increased) funding and support, we are considering ways to expand the program.

Ultimately, I hope that this "science immersion" program will continue to influence girls' lives and create life-long advocates for the value of earth science in our society and for minimizing human impact on the earth.

For more information about the Girls on Ice program, contact:

- Erin Pettit, Girls on Ice Instructor, at pettit@gi.alaska.edu,
- Megan McGinty, Girls on Ice Program Coordinator, at megan_mcginty@ncascades.org or (360) 856-5700 ext. 202 ,
- Or visit the Girls on Ice website at: http://www.ncascades.org/programs/youth/girls_on_ice/

Girls on Ice 2008 Team climbing through a crevasse field on their way to the summit. Photo: Maria Coryell-Martin

-- Erin Pettit, University of Alaska

USGS to Continue to Operate NICL

U.S. Geological Survey (USGS) Director Mark Myers has informed NSF's Office of Polar Programs that USGS intends to continue to operate the National Ice Core Laboratory (NICL) for the foreseeable future. An advisory committee consisting of Richard Alley (Penn State University), Tammy Dickinson (USGS), Dan Fagre (USGS), Marty Goldhaber (USGS), Randy Schumann (USGS), and Woody Wise (Florida State University) recommended that USGS continue to operate NICL in a written report and in a briefing given to Director Myers by committee chair Randy Schumann on September 30. Director Myers agreed that NICL is an important asset to USGS and the scientific community and that USGS should continue its long-term partnership with NSF in operating the NICL. USGS will also explore integrating more cryospheric research into its Global Change Research Program, hopefully resulting in more direct USGS participation in NICL-supported research. USGS will name an interim Technical Director by the end of the year, and will begin a search for a permanent NICL Director, who would oversee both NICL and the USGS rock Core Research Center (CRC), as soon as possible. USGS will form a selection committee to evaluate prospective candidates for the NICL/CRC Director position, and welcomes input from the ice-core science community in this process. Many thanks to the committee members for their time and participation, and to the NICL user community for your support and input.

-- Randy Schumann, USGS

National Science Foundation Projects Related to Ice Cores or Ice Core Data

The table below shows projects related to ice core research that have been funded by the National Science Foundation (NSF) since the last issue of *In-Depth* was published. To learn more about any of the projects listed below, go to the NSF Award Search page (http://www.nsf.gov/awardsearch/) and type in the NSF Award Number. If you have a newly-funded NSF project that was omitted from this listing, please let us know and we will add it to the next issue of *In-Depth*.

Title of the Funded Project	Investigator	Award Number
Climatology, Meteorology, and Microbial Metabolism in Ice with Dust Loggers and Fluorimetry	Price, P. Buford	0738658
Collaborative Research in IPY: Abrupt Environmental Change in the Larsen Ice Shelf System, a Multidisciplinary Approach -- Cryosphere and Oceans	Gordon, Arnold Mosley-Thompson, Ellen Pettit, Erin Scambos, Ted Truffer, Martin	0732655 0732738 0855265 0732921 0732651
Collaborative Research: Asian Ice Core Array (AICA)--Reconstruction of Past Physical and Chemical Climate over Asia	Aizen, Vladimir Mayewski, Paul	0754479 0754644
Collaborative Research: Methane Isotopes, Hydrocarbons, and other Trace Gases in South Pole Firn Air	Aydin, Murat Sowers, Todd	0739598 0739491
Collaborative Research: The NEEM Deep Ice Core	Baker, Ian Brook, Edward Severinghaus, Jeffrey Sowers, Todd White, James	0806339 0806414 0806377 0806407 0806387
Dust Logging at Dome C for Abrupt Climate Changes, Large Volcanic Eruptions and Bolide Impacts	Bay, Ryan	0739743
IPY: Stability of Larsen C Ice Shelf in a Warming Climate	Steffen, Konrad	0732946
MRI: Acquisition of a Cold-Room Equipped Micro CT	Baker, Ian	0821056
MRI: Acquisition of an Inductively Coupled-sector Field Mass Spectrometer to Extract Atmospheric Trace Element Histories from Ice Cores and Assess Contemporary Water Quality	Mosley-Thompson, Ellen	0820779
P2C2: Northern Annular Mode (NAM) Variability during the Little Ice Age and Medieval Warm Period in a Cave Ice Core Record from Northwestern Romania	Onac, Bogdan	0823253

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