In-Depth

NEWSLETTER OF THE NATIONAL ICE CORE LABORATORY — SCIENCE MANAGEMENT OFFICE

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Dr. Lindsay Powers hired as NICL's Technical Director

DR. LINDSAY POWERS IS THE NEW TECHNICAL DIRECTOR of the National Ice Core Laboratory (NICL). Lindsay has a diverse and complimentary background in research, science support, and business management. She is trained as an interdisciplinary scientist, and her Ph.D. work was focused on the development and application of an organic geochemical tool for continental paleoclimate reconstruction.

Lindsay is familiar with the ice core community through her work with the U.S. Antarctic Program as the Manager of Science Support for Raytheon Polar Services. Lindsay's team provided all of the logistical support planning for US funded research in Antarctica. Most recently her work has been focused on facilitating data interoperability in the Earth Sciences in her roles with the National Ecological Observatory Network (NEON) and The HDF Group. She participates in many community-based organizations working toward improving data access and understanding (e.g. EarthCube, Federation of Earth Science Information Partners, Research Data Alliance and Belmont Forum).

Lindsay holds a Ph.D. from the University of Minnesota in Water Resources Science, a M.S. in Evolutionary Biology and Ecology from the University of Montana, and a B.A. in Biology from Macalester College.

Ice flow and ice cores in the St. Elias Mountains

Karl Kreutz and Seth Campbell, University of Maine

The researchers' ice drilling tent on the Eclipse Icefield, with Mt. Logan in the distant background. –Credit: Dorota Medrzycka, University of Ottowa

HOME TO MT. LOGAN, the tallest peak in Canada (5959 meters), the St. Elias Mountains straddle the U.S. (Alaska)/Canada (Yukon Territories) border on the west coast of North America. The mountains are essentially a wall sitting next to the Pacific Ocean – starting at sea level, they rise over 18,000 feet within 20 miles of the coast, and are the highest coastal mountain range on Earth. This extreme elevation change means that the mountains are very effective at removing precipitation from the atmosphere as storms move from the Pacific Ocean and go inland. And because of the high precipitation rates, the St. Elias Mountains contain one of the largest concentrations of non-polar glacier ice in the world. Understanding climate variability and glacier change in this region is essential for predicting how these glaciers will contribute to future sea level rise.

Ice coring in the St. Elias dates back to 1980, when the Geological Survey of Canada (GSC) recovered a 180-meter long ice core from near the summit of Mt. Logan. Then in 2002, an international collaborative group recovered a second ice core from Mt. Logan (GSC), a core from King Col (on the flank of Mt. Logan; National Institute of Polar Research, Japan), and a core from the Eclipse Icefield (~30km to the northeast of Mt. Logan; University of New Hampshire and the University of Maine). Since that time, there have been significant advances in geophysical methods that can help us better understand the ice core records. For example, ground penetrating radar (GPR) can be used to image the interior structure of a glacier, and also determine the bed surface below a glacier. By incorporating this information into models of ice flow, we can get a much better idea of how old the ice is at any depth in the glacier – a critical piece of information when trying to use ice cores to reconstruct past climate change.

With funding from the National Science Foundation Paleo Perspectives on Climate Change (P2C2) program, we returned to the Eclipse Icefield in May 2016 to collect a variety of geophysical data. Our group included the principal investigators (K. Kreutz and S. Campbell, UMaine), a research scientist (D. Dixon, UMaine), three PhD students (S. Bernsen, UMaine; D. Winski, Dartmouth; D. Medrzycka, University of Ottawa), and two undergraduate students (J. Leavitt, UMaine; P. Saylor, Dartmouth). We worked with staff at the Kluane Lake Research Station (operated by the Arctic Institute of North America) and Icefield Discovery to move us and all of our gear with a ski-equipped Helio Courier plane from Kluane Lake to Eclipse Icefield. This is probably the most spectacular 40-minute flight anywhere! After setting up camp, we started skiing lines on the icefield, collecting GPR and Global Positioning System (GPS) data. The GPR data gives a look inside the icefield itself – we can see internal layers (for example, the 1912 Katmai eruption) and the bedrock surface below the glacier. Then, by using all of the GPR and GPS data together, we can make maps of the surface elevation of the icefield, as well as the elevation of the bed surface below the glacier. Finally, three dimensional ice flow models will

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Ice flow and ice cores in the St. Elias Mountains

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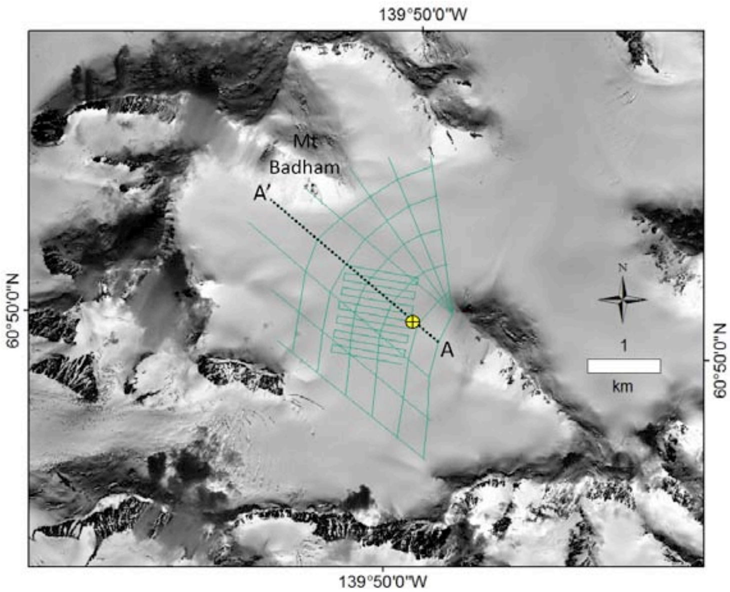
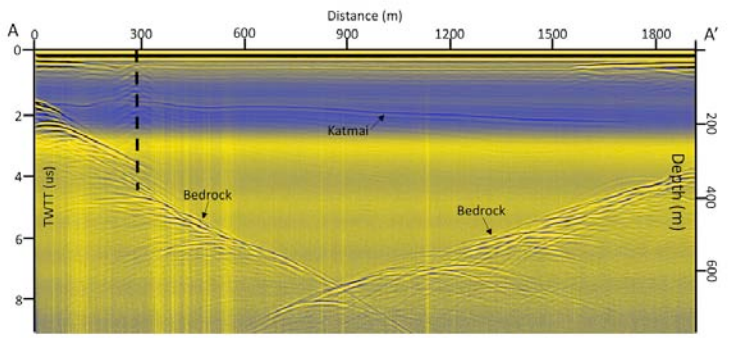


Quickbird satellite image of Eclipse Icefield showing the location of all ice-penetrating radar transects (green lines) collected to measure glacier thickness relative to the ice core site in 2002 and 2016 (yellow bullseye). Also note, the transect from A-A' (black dashed line) is the ice-penetrating radar profile shown below. –Credit: Seth Campbell, University of Maine



5 MHz ice-penetrating radar profile collected across Eclipse Icefield showing nice internal glacier stratigraphy and a strong bedrock reflection with maximum ice thicknesses reaching over 650 meters. We interpret one stratigraphic horizon as the Katmai volcanic eruption from 1912. Also note the vertical black dashed line was the location for ice coring activities in 2002 and 2016. –Credit: Seth Campbell, University of Maine

be used to accurately determine the age of ice at any particular depth, and to correct for the ice thinning that occurs deep in the glacier as the pressure from ice above increases.

We also drilled a 65-meter long ice core, and built a science trench in the snow to cut individual samples from the ice core. Once all of the samples are analyzed, we will use the data to update the ice core collected in 2002 – essentially bringing the ice core record all the way up to the 2016 surface. One of the key findings from this season is that the mean annual temperature on the Eclipse Icefield has increased by ~4°C from 2002 to 2016, based on

Ice core processing on the Eclipse Icefield, 2016. Dom Winski measures and records the physical properties (e.g., density and melt features) of each ice core section in a covered science trench. –Credit: Dorota Medrzycka, University of Ottowa

temperature measurements in the borehole – a rather substantial warming. Another key finding is that the ice is quite deep in the middle of the Eclipse Icefield (~700 meters). Based on what we know from the 2002 core, and from preliminary modeling of the ice flow, we believe that the ice near the bottom in the middle of the icefield should be 10,000 years old or more. And because the snow accumulation rate on Eclipse Icefield is quite high (around 4.5 meters of snow per year), the layers of annual snowfall are probably still preserved down near the bed. Our challenge now, in collaboration with the U.S. community of ice core scientists and engineers, is to figure out the technology needed to recover a 700-meter ice core from this site.

While we were working on the Eclipse Icefield this year, Mt. Logan was always looming in the background – a beautiful and impressive sight when the weather was clear. In 2017 we plan to collect the same type of GPR, GPS, and shallow ice core information from the ice core sites on Mt. Logan, and update those records and interpretations.

We would like to sincerely thank NSF, AINA and Kluane Lake staff (S. Williams, L. Goodwin, T. Bradley), and our collaborators at the University of Ottawa (L. Copland) for a wonderful and productive season.

This research is supported by the National Science Foundation Paleo Perspectives on Climate Change (P2C2) program (award number 1502783).

Ancient ice reveals vital clues about Earth's past climate

By Dan Elliot, Associated Press

LAKEWOOD, Colo. (AP) — Inside a huge walk-in freezer in suburban Denver, a college student in a thick parka shoots a jolt of electricity through a yard-long column of ice extracted from Antarctica.

Just outside the freezer, in a much warmer room, a computer wired to the ice registers a sudden spike in a jagged red line crawling across the screen.

"Hey, we got a volcano," says T.J. Fudge, a University of Washington researcher. The electric current has detected a thin layer of volcanic residue in the ice, deposited by an eruption about 8,000 years ago.

This is the National Ice Core Laboratory in Lakewood, where ice pulled from the depths of Antarctica and Greenland is sliced up, photographed and tested. Most of it is shipped to other labs, where researchers do more experiments looking for clues about Earth's past and future.

In this Aug. 8, 2016 photo, Geoffrey Hargreaves, curator of the National Ice Core Laboratory, carries an arctic ice core inside the minus-33 degree Fahrenheit environment of the lab's archive warehouse, in Lakewood, Colo. Using a wide range of data, from ice cores to trace gas analysis and other methods, scientists are attempting to measure the past and present so they can better model the near and distant future of our planet. –Credit: AP Photo/Brennan Linsley

Smooth and milky white, the 4- to 5-inch-diameter pieces – called ice cores – provide scientists with a wealth of historical information, from air temperature to greenhouse gases to evidence of cosmic events. The record reaches as far back as 800,000 years.

The ice is the remnant of centuries of snowfall, compressed by the weight of successive years of accumulation.

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Upcoming Meetings

2016 AGU Fall Meeting
12-16 December 2016
San Francisco, California, USA
http://fallmeeting.agu.org/2016/

Scientific Drilling in the Polar Regions Town Hall Meeting
13 December 2016
San Francisco, California, USA
https://agu.confex.com/agu/fm16/meetingapp.cgi/Session/14227

International Symposium on the Cryosphere in a Changing Climate
12-17 February 2017
Wellington, New Zealand
http://www.igsoc.org/symposia/2017/newzealand/

EGU General Assembly 2017
23-28 April 2017
Vienna, Austria
http://www.egu2017.eu/

FRISP Workshop 2017
19-22 June 2017
Bergen, Norway
http://folk.uib.no/ngfso/FRISP/news.html

International Symposium on Cryosphere and Biosphere
14-19 March 2018
Kyoto, Japan
https://www.igsoc.org/symposia/2018/kyoto/

SCAR/IASC Open Science Conference
15-27 June 2018
Davos, Switzerland
http://www.polar2018.org/

Ancient ice reveals vital clues about Earth's past climate

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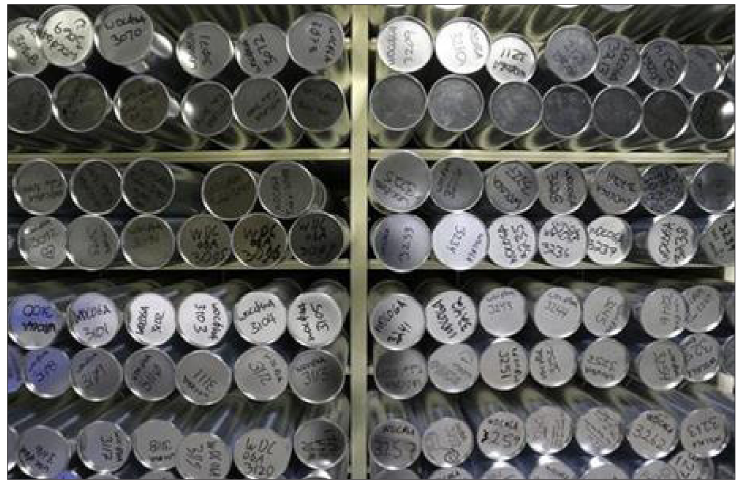
This Aug. 8, 2016 photo shows some of the thousands of frozen ice cores stored in canisters inside the minus-33 degree Fahrenheit environment of the archive warehouse at the National Ice Core Laboratory, in Lakewood, Colo. At this facility, ice pulled from the depths of Antarctica and Greenland is sliced up, photographed and tested. –Credit: AP Photo/Brennan Linsley



This Aug. 8, 2016 photo shows some of the thousands of frozen ice cores stored in canisters inside the minus-33 degree environment of the archive warehouse at the National Ice Core Laboratory, in Lakewood, Colo. Ice cores have led scientists to significant conclusions about climate, including that CO2 levels in the atmosphere today are higher than at any other time recorded in the ice. –Credit: AP Photo/Brennan Linsley

"You can drill into it, and it's much like looking at tree rings," Fudge said. "It's just year after year after year of climate information that's preserved out in the ice sheet."

Specialized drilling rigs pull the cores from as deep as 9,800 feet below the surface of the ice sheets. Crews then tuck them into protective tubes, pack them in chilled containers and ship them to the U.S. Refrigerated trucks haul them to Colorado lab, which is funded by the National Science Foundation.

In a bustling, white-walled workroom in the Lakewood freezer – kept at about minus 11 Fahrenheit – workers push the cores through a series of saws on metal frame benches, divvying up the ice according to a prearranged pattern for different experiments.

Part of every ice core is archived in another, larger room at about minus 33 degrees, so future researchers can verify old results or try new tests. The archive contains nearly 56,000 feet of ice.

Scientists tease data from the ice in various ways. Differences in the weight of molecules in the frozen water hold clues about the air temperature at the time the snow fell.

Air trapped in bubbles can be analyzed to measure how much carbon dioxide and other gases were in the atmosphere when the ice formed.

A solar flare or other cosmic events can leave distinctive radioactive atoms on the snow. Dust blown in from distant continents offers clues about atmospheric circulation.

"The ice sheets are in direct contact with the atmosphere," said Mark Twickler, the lab's science director. "Everything that's in the atmosphere we capture as time goes by, and it gets buried in snow."

The depth of the core and evidence of volcanoes help determine how old the ice is.

Scientists already know when major eruptions occurred, so a layer of volcanic residue indicates the year the adjacent ice formed. That becomes a reference point for annual layers above and below.

The record is remarkably precise, even reflecting seasonal changes, scientists say.

"It's as if we're standing on the ice sheet writing down the temperature for the last 800,000 years," said Bruce Vaughn, a University of Colorado-Boulder lab manager who works with the ice. "It's that good."

Without a record of its depth and age, the ice has little research value, said Geoffrey Hargreaves, curator of the Lakewood lab.

"An ice core without any depth references – I shouldn't say this – it's good for margaritas," he said, poker-faced.

No, Hargreaves said, scientists don't actually do that.

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Ancient ice reveals vital clues about Earth's past climate

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In this Aug. 8, 2016 photo, Geoffrey Hargreaves, curator of the National Ice Core Laboratory, gently places an arctic ice core on a table inside the deep freeze work area at the lab, in Lakewood, Colo. A solar flare or other cosmic events can leave distinctive radioactive atoms on the snow. Dust blown in from distant continents offers clues about atmospheric circulation. –Credit: AP Photo/Brennan Linsley

In this Aug. 8, 2016 photo, Geoffrey Hargreaves, curator of the National Ice Core Laboratory, walks from one area to another inside the deep freeze work area at the lab, in Lakewood, Colo. Using a wide range of data, from ice cores to trace gas analysis and other methods, scientists are attempting to measure the past and present so they can better model the near and distant future of our planet. –Credit: AP Photo/Brennan Linsley

In this Aug. 8, 2016 photo, Geoffrey Hargreaves, center, curator of the National Ice Core Laboratory, talks with engineering students visiting the deep freeze work area at the lab, in Lakewood, Colo. A solar flare or other cosmic events can leave distinctive radioactive atoms on the snow. Dust blown in from distant continents offers clues about atmospheric circulation. –Credit: AP Photo/Brennan Linsley

"There's drill fluids in these things that you really don't want to drink," he said.

Some experiments are done only on ice from the core's interior, away from the fluids.

Ice cores have led scientists to significant conclusions about climate, including that CO_2 levels in the atmosphere today are higher than at any other time recorded in the ice.

"The only reason we can make that statement is because we have the ice core air archived," said Murat Aydin, a researcher at the University of California-Irvine.

Ice cores also help refine computer models used to make climate predictions.

"If we run them backwards with the parameters that we measure in the ice core and we get it right, that gives us a lot more confidence in the climate models going forward," Vaughn said.

As technology improves, researchers find new ways to analyze the ice. A technique called continuous flow analysis lets them slowly melt a one-yard stick of ice and analyze it drop-by-drop, instead of cutting it into small pieces, melting them one-by-one and averaging the results. The new technique gives scientists up to 2,400 measurements per yard instead of 20, Vaughn said.

"There'll be science for dozens of years with researchers who are maybe only now getting their degrees or learning about this," Vaughn said. "It's exciting. How could you not be excited about it?"

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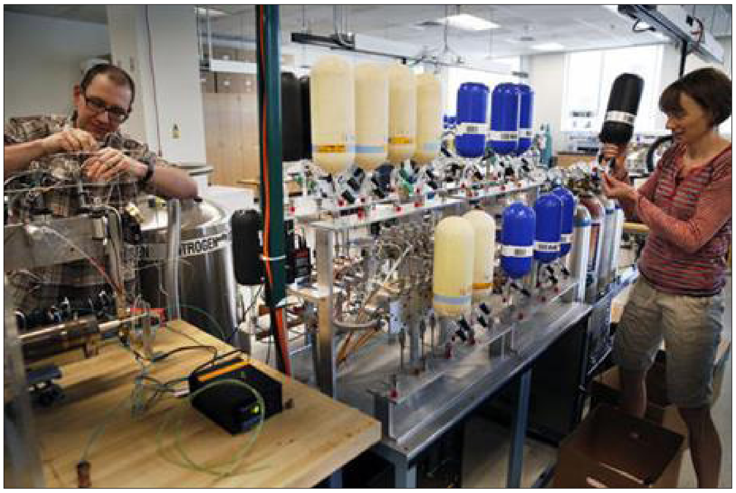
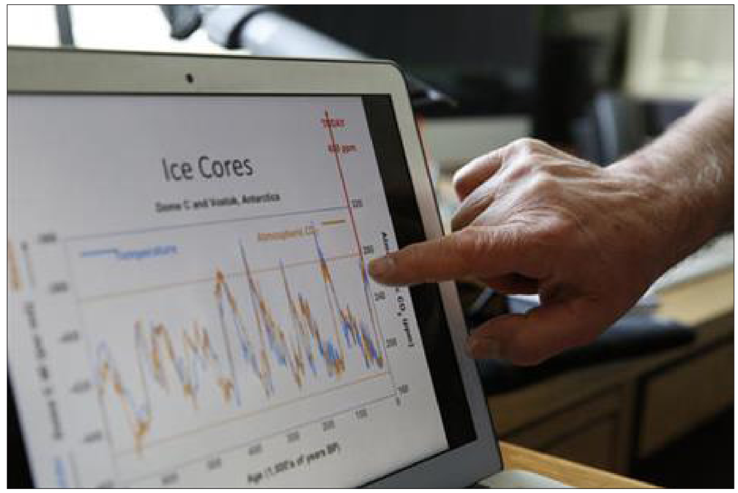
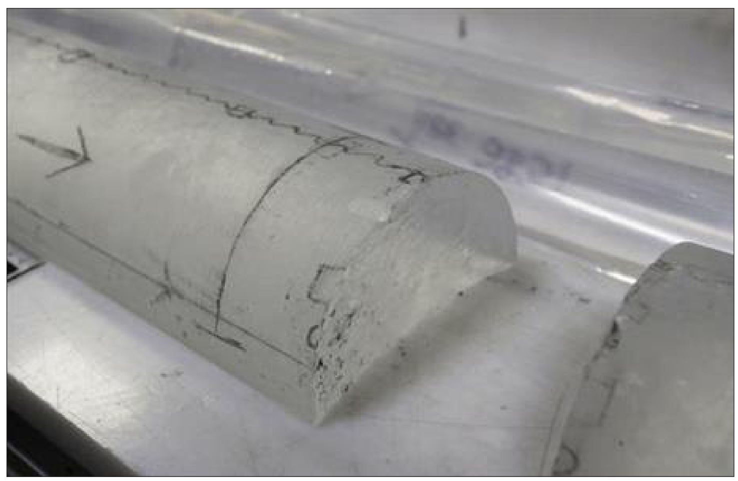


In this June 3, 2016 photo, lab scientists work with air samples from around the world for climate change research, at the INSTAAR Stable Isotope lab, at the University of Colorado, in Boulder, Colo. Using a wide range of data, from ice cores to trace gas analysis and other methods, scientists are attempting to measure the past and present so they can better model the near and distant future of our planet. –Credit: AP Photo/Brennan Linsley



In this June 3, 2016 photo, Bruce Vaughn, who manages the INSTAAR Stable Isotope lab, refers to his laptop while discussing his data collection and analysis for climate change research, at the University of Colorado, in Boulder, Colo. Vaughn, who is one of many researchers who relies on ice core data, says of the ice cores: "It's as if we're standing on the ice sheet writing down the temperature for the last 800,000 years. It's that good." –Credit: AP Photo/Brennan Linsley

In this June 3, 2016 photo, Bruce Vaughn, who manages the INSTAAR Stable Isotope lab, looks over some equipment in his lab, where climate change research with ice and trace gas samples is completed, at the University of Colorado, in Boulder, Colo. Vaughn, who is one of many researchers who relies on ice core data, says of the ice cores: "It's as if we're standing on the ice sheet writing down the temperature for the last 800,000 years. It's that good." –Credit: AP Photo/Brennan Linsley



This Aug. 8, 2016 photo shows an arctic ice core on a table inside the deep freeze work area at the lab, in Lakewood, Colo. A solar flare or other cosmic events can leave distinctive radioactive atoms on the snow. Dust blown in from distant continents offers clues about atmospheric circulation. –Credit: AP Photo/Brennan Linsley

This article originally appeared at
http://bigstory.ap.org/article/af064b07a4fb452a81da48575f4663a0/ancient-ice-reveals-vital-clues-about-earths-past-climate

Leading UMaine researcher perishes in accident in Antarctica

By UMaine News, University of Maine

Gordon Hamilton with an automated laser scanning system installed to monitor Helheim Glacier, in Southeast Greenland. –Credit: Adam LeWinter / US Army Cold Regions Research and Engineering Laboratory

Gordon Hamilton, a University of Maine professor in the School of Earth and Climate Sciences, and a researcher with the Climate Change Institute, died in a field accident Oct. 22 while conducting research in Antarctica. He was 50.

Hamilton, a physical glaciologist, was working on White Island in the Ross Archipelago in Antarctica, an area where he has conducted research for several seasons, when the snowmobile he was riding hit a crevasse. He was killed in the 100-foot fall, according to the National Science Foundation. Hamilton was conducting NSF-funded research at the time of the accident.

"The University of Maine has lost one of its leading scientists," says UMaine President Susan J. Hunter. "Gordon's glaciology research around the world — from Antarctica to Greenland — was second to none. He leaves a legacy as an outstanding scientist, and a caring mentor and well-known teacher to undergraduate and graduate students. He was an engaged, gregarious and beloved member of the UMaine and Orono communities that now mourn his loss. Our heart-felt thoughts and prayers go to his wife, Fiona, and their two children, Martin and Calum, and his friends and colleagues around the world."

Hamilton joined UMaine's Climate Change Institute in 2000 as an assistant research professor. Prior to coming to Maine, he was at the Byrd Polar and Climate Research Center at Ohio State University and the Norwegian Polar Institute in Oslo.

Hamilton studied the behavior of modern ice sheets and their role in the climate system. His research focused on understanding ice sheet mass balance — how much mass is coming in and going out, and the processes responsible — and involved satellite remote sensing. His current research projects included ice-ocean interaction in Greenland and ice shelf stability in Antarctica.

Hamilton also taught UMaine undergraduate and graduate courses, and was involved in statewide STEM initiatives for grades 9-12.

"Gordon was the quintessential scientist and educator," says Jeffrey Hecker, UMaine executive vice president for academic affairs and provost. "His research informed his teaching and his community outreach — from schoolchildren to lawmakers and the media. He knew the importance of hands-on learning, and often took students into the field on his research expeditions. Students appreciated his depth of knowledge as a pioneering researcher, his dedication to being involved in student success and his style as an approachable, effective educator. He touched — and changed — many lives. Our thoughts are with his students — past and present — his family, and his many friends and colleagues."

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Leading UMaine researcher perishes in accident in Antarctica

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This August 29, 2009 photo shows Gordon Hamilton conducting research on the Kangerlussuaq Glacier in southeast Greenland. Kangerlussuaq Glacier is the largest glacier on the east coast of the Greenland ice sheet. It flows into the head of the Kangerlussuaq Fjord, the second largest fjord in East Greenland. –Credit: Leigh Stearns

In a statement released Oct. 23, Climate Change Institute Director Paul Mayewski noted that the entire glaciology community held Hamilton in the absolute highest esteem.

"His experience and devotion to understanding glacier dynamics and their role in our evolving climate system, notably with respect to sea level rise, were Gordon's scientific passions," Mayewski said in the statement. "He led many polar expeditions in the course of his research, trained many graduate students, lectured far and wide, and was a well-known science spokesman in many media outlets.

"Those of us who shared time in the field with Gordon know how important he was not only as a fellow team member and scientist, but also how wonderful and how much fun it was to be with him. We send our deepest sympathy to his family and want them to know how much we appreciate the opportunity to have known him and how important his legacy is to our Institute and the scientific community," said Mayewski.

This article was originally published at https://umaine.edu/news/blog/2016/10/23/leading-umaine-researcher-perishes-accident-antarctica/

Editor's Notes:
Gordon Hamilton served on the U.S. Ice Core Working Group from 1998 to 2000.

A memorial fund in Gordon's name has been established in the University of Maine Foundation. Friends of the family have also established a fund to assist with educational expenses for Gordon's children.

For more information, please see:
https://umaine.edu/news/blog/2016/10/28/private-memorial-service-gordon-hamilton-set-nov-3/

Gordon's obituary is online at:
http://obituaries.bangordailynews.com/story/gordon-hamilton-843813442

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
Collaborative Research: Arctic Land Fast Sea Ice Formation in the Presence of Fresh Water Input	Obbard, Rachel Rigor, Ignatius	1603683 1602533
Collaborative Research: P2C2--Ultra-High-Resolution Investigation of High Andean Snow and Ice Chemistry to Improve Paleoclimatic Reconstruction and Enhance Climate Prediction	Mayewski, Paul Seimon, Anton	1600018 1566450
Dynamic Observations of the Evolution of Firn	Baker, Ian	1603239
MRI: Acquisition of an Inductively Coupled Plasma Optical Emission Spectrometer at Central Washington University	Gazis, Carey	1626484
NSFGEO-NERC: Paleoclimate Signatures of the Climate Response to West Antarctic Ice Sheet Collapse	Steig, Eric	1602435

The U.S. National Ice Core Laboratory (NICL) is a facility for storing, curating, and studying meteoric ice cores recovered from the glaciated regions of the world. It provides scientists with the capability to conduct examinations and measurements on ice cores, and it preserves the integrity of these ice cores in a long-term repository for current and future investigations. NICL is funded by the National Science Foundation Division of Polar Programs and operated by the U.S. Geological Survey. Scientific management is provided by the University of New Hampshire.

In-Depth is published semi-annually by the **National Ice Core Laboratory - Science Management Office (NICL-SMO)**. We are interested in project stories and news from the ice coring community. Please contact us if you are interested in submitting a story or news item to *In-Depth*.

Please review the '*NICL Use and Ice Core Sample Allocation Policy*' located at http://icecores.org/use/policy.shtml if you intend to use the facility.

***In-Depth* Newsletter**
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Masthead photos courtesy of Lonnie Thompson and Michael Morrison