

NewsLetter

Week of November 19, 2007

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Photo by Jeanne Bowles of Communication, Arts, and Services

Polar warnings

Sea ice, ice sheets, and the threat of abrupt climate change

Los Alamos-based computer models project that by 2040 the Arctic Ocean may be ice-free for part of each year, bringing devastation to Arctic inhabitants. What makes this projection believable? And does it portend other abrupt changes in climate?

At a distance, the vast expanses of polar sea ice seem static and sublime, but they are actually in constant slow motion and internal change. Los Alamos researchers Elizabeth Hunke and Bill Lipscomb know that firsthand. Spending weeks onboard an icebreaker will teach you to read the signs. Ice floe extent, floe thickness, snow cover, and ratio of ice to open ocean—all change with location and season, and now with global warming.

Hunke and Lipscomb are members of the Los Alamos effort, begun nearly 20 years ago, to apply the power of supercomputers to the problem of modeling climate change. Both have contributed for more than a decade to accurate computer models of floating sea ice.

Today their models are sought after by worldwide climate modeling groups who are trying to predict how rapid changes in the entire Arctic and parts of the Antarctic will impact Earth's climate.

Sea ice and climate

Sea ice plays a sensitive role in Earth's climate system, because it is white and, therefore, has high albedo, or reflective power. While covering only 4 percent of Earth's surface, it accounts for perhaps 8 percent of the planet's total reflected energy, so it contributes significantly to the delicate balance between the energy delivered to Earth as sunlight and the energy radiated from Earth's surface as heat.

Today, global warming is causing the sea ice to melt and give way to open ocean. This has caused the Arctic's albedo to decrease; the increased absorption by the dark ocean surface causes more warming. Thus, melting begets melting in a feedback loop that amplifies the warming trend.

Additionally, ice frozen in the Arctic Ocean flows into the North Atlantic and melts, diluting the dense, salty water brought northward by the Gulf Stream and possibly disrupting the density-driven movement of global ocean currents.

Understanding the possible strength and ramifications of these events requires a good sea ice model incorporated into a full climate-system model.

Global warming already was a major concern in 1990, when the Department of Energy challenged climate researchers to adapt climate models to new, massively parallel supercomputers.

Called "parallel" because they consist of hundreds of individual processors wired together and working simultaneously, these computers increased computing power by a factor of 10 (now a factor of 1,000s).

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The two main sea ice drift systems in the Arctic Ocean, the Beaufort Gyre and the Transpolar Drift.
 Graphic by Donald Montoya of Communication, Arts, and Services



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Pizza lures first-aid trainees

Free pizza drew nearly 70 Laboratory employees to the Environmental Remediation and Support Services (ERSS) Worker Safety and Security Team (WSST) brown-bag lunch on November 8 at the Pueblo Complex. Attendees who completed standard first-aid training in September, or were current with their certification also were eligible for a drawing to win one of four REI hiker first-aid kits.



Felicia Taw of Inorganic Isotope and Actinide Chemistry gives a safety message during a recent Worker Safety and Security Team brown-bag lunch.

Photos by Allen Hopkins of Communications, Arts, and Services

Standard first-aid training offered by Environmental Programs (ADEP) and ERSS WSST was completed by 55 employees over a two-week period in five classes at the Pueblo Complex, according to Billy Turney, chairman of the ERSS WSST and ADEP representative to the institutional-level WSST.

"Safety is the first and highest priority in ADEP," said Turney. "This WSST first-aid drawing/pizza brown bag is outreach from

the ADEP-ERSS WSST to highlight safety."

First-aid kit winners were Chris Echohawk, John Wilcox, Dwain Farley, and Orval Hart. For more information on the event, contact Billy Turney at turney@lanl.gov.

Training is available through the Virtual Training Center for standard first aid (Course #3574) and cardiopulmonary resuscitation/automated external defibrillator use (Course #43562).

Polar warnings ...

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Los Alamos had the computer power, having acquired a Connection Machine from Thinking Machines Inc., the first modern parallel computer. But the Laboratory was a relative newcomer to climate modeling.

Bob Malone of Theoretical (T) Division knew that the Lab's strength in fluid-flow modeling could make a big difference to ocean models. The challenge, according to Malone, was to improve the physics and make the models run efficiently on the new parallel machine.

By 1993, Malone and colleagues had developed the Parallel Ocean Program, or POP, the first model to accurately represent the path of the Gulf Stream. POP also set a new standard in computational efficiency and soon was chosen as the ocean component of one of the world's leading climate models, now known as the U.S. Community Climate System Model.

The sea ice component, however, remained a stumbling block, and Malone suggested that John Dukowicz, a POP developer, team up with Hunke to develop a fresh approach. "Dukowicz and Hunke were as immune as the rest of us to the 'this is the way we've always done it' mindset. They completely rethought the traditional methods for calculating sea ice dynamics," Malone said.

Hunke and Dukowicz broke through the computational barrier by introducing a clever numerical scheme. "When a portion of the material begins slowing down, the energy of its forward motion is converted to elastic waves that, like sound waves in a tuning fork, cause the material to effectively 'vibrate' in place without deforming, while the neighboring ice floes move past," Dukowicz explained.

The new elastic viscous-plastic scheme mimics the real behavior of the ice, affecting only the local region that encounters the barrier. And it is fast and efficient on modern parallel supercomputers.

Similarly, Lipscomb worked to model thermal processes more realistically. He improved the model representation of how brine pockets affect heat flow, melting, and freezing within each computational cell.

In 1998, Lipscomb traveled to the Arctic as part of the international Surface Heat Budget of the Arctic (SHEBA) project. There he learned that sea ice in the central Arctic had thinned from about 10 feet to 6 feet or less in the 20 years since the previous such project. Anomalies associated with strong winds were part of the explanation, but a year later, newly released submarine sonar measurements showed that overall Arctic sea ice thickness had decreased about 40 percent from the 1970s to the 1990s.

Since sea ice thinning must affect heat flow between ocean and atmosphere, Lipscomb added to the thermal model the ability to represent variable sea ice thickness within a computational cell. The improved thermal model fit smoothly with the Hunke-Dukowicz dynamics model, and together they became known as CICE (pronounced "sea ice"). CICE can be downloaded from the Web.

"Our users send us questions when they get funky or suspicious results, and sometimes that leads to improvements in the model. Also, because many people have applied it to different problems, the program is quite trustworthy. I hate to call it 'bug-free,' but 'almost' is OK," said Hunke.

Is CICE a crystal ball?

CICE's accuracy has been assessed by comparing simulations of past sea ice changes with observations. When CICE is used along with POP in the U.S. Community Climate System Model, it accurately reproduces satellite observations of ice pack movements over the cycle of seasons in both the Arctic and Antarctic.

In addition, when major components of CICE are used in both the Community Climate System Model and the United Kingdom's Hadley Centre Climate Model, those two come much closer than other models to reproducing the dramatic decline in summer Arctic sea ice from 1957 to the present.

In view of its successes, some researchers believe CICE might well be a crystal ball for predicting the Arctic's future.

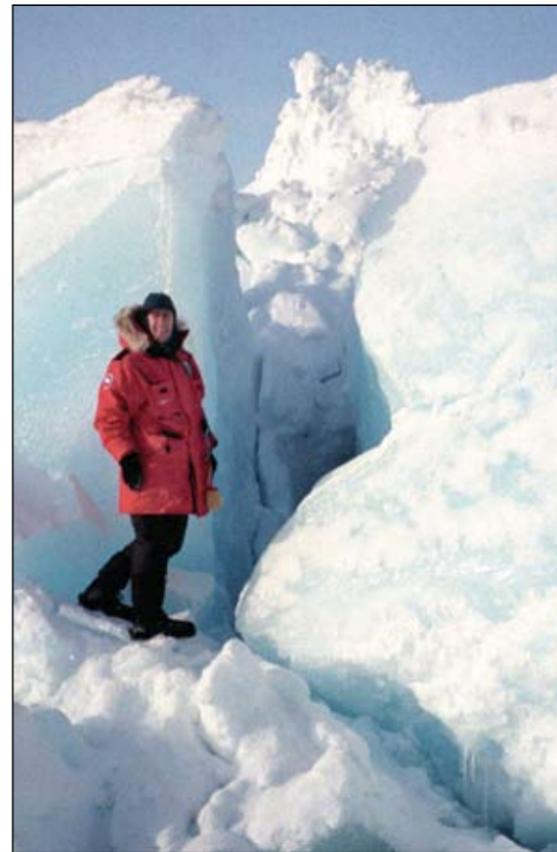
For a scenario in which greenhouse gas emissions follow a middle-of-the-road projection, the Community Climate System Model, with CICE and POP components, forecasts that Arctic summer ice could decline precipitously in coming decades and almost disappear by 2040.

When the initial conditions of a computer run are varied to represent natural climate variation, the pattern of sea ice decline shows one or two brief periods of abrupt change (30 percent or more), flanked by slower changes. Interestingly, these abrupt events were triggered by unanticipated influxes of warm water from neighboring oceans into the Arctic Ocean.

The complete disappearance of Arctic sea ice for part of the year would destroy the habitat of polar bears and other species dependent on floating ice. In addition, the associated Arctic warming could trigger the onset of other major changes, including accelerated melting of the mile-thick ice sheet covering Greenland. The melting of so much ice from a land mass would cause a rapid rise in sea level. (Sea ice already displaces its weight in water and does not raise the sea level when it melts.)

Climate modeling may be coming of age in the nick of time, allowing humanity to project into the future the consequences of its actions and to develop and evaluate strategies for both adapting to and mitigating the changes that are already in motion.

Editor's note: This article by Nikki Cooper of the Science and Technology Based Program Office (STBPO-PO) is excerpted from an article that appeared in the August 2007 edition of 1663, the Laboratory's science and technology magazine.



Bill Lipscomb's height relative to an Arctic sea ice ridge. *Courtesy photo*

Los Alamos National Laboratory NewsLetter

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Los Alamos enhances national security by ensuring the safety and reliability of the U.S. nuclear stockpile, developing technologies to reduce threats from weapons of mass destruction, and solving problems related to energy, environment, infrastructure, health and global security concerns.



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Berryhill new dean of Northern's College of Education

Cathy Berryhill is the new dean of the College of Education at Northern New Mexico College in Española.

Berryhill is one of three master teachers for the Laboratory's Math and Science Academy teacher professional development program in the Education and Postdoc Office (STB-EPDO). Berryhill will be on a leave of absence from the Laboratory.

Berryhill holds a doctoral degree in education from New Mexico State University and has been one of three master teachers involved in the planning and implementation of the Laboratory's Northern New Mexico Math and Science Academy. Since its inception, more than 200 kindergarten through 12th grade teachers in Northern New Mexico have completed the Math and Science Academy program.

Berryhill also assisted in the development and implementation a new Master of Arts



Cathy Berryhill

in Teaching of Math and Science degree program co-sponsored by MSA and New Mexico State University in which 70 MSA teachers currently are enrolled.

She joined Los Alamos as a contract employee in 2001 and became a Laboratory employee in 2004. She received a small team Distinguished Performance Award in 2005 for her exceptional contributions to the MSA program.

Hengartner selected an ASA Fellow

Nick Hengartner of Information Sciences (CCS-3) is a new Fellow of the American Statistical Association.

Recognition as a Fellow establishes Hengartner's reputation as someone who has made outstanding contributions in some aspect of statistical work.

He has been recognized for his wide-ranging research contributions in nonparametric function estimation and inverse problems. His mentoring and statistical leadership as well as his innovative general methodology incorporating statistics into the solution of scientific problems also were recognized.

This award is given annually to no more than one third of one percent of the ASA membership. Hengartner was officially received as an ASA Fellow earlier this summer at the Joint Statistical Meetings in Salt Lake City, Utah.

Hengartner was nominated by his peers to be an ASA Fellow.



November service anniversaries

35 years

David Honaberger, HX-6
Dean Peterson, MPA-STC
William Porch, EES-2

30 years

Rebecca Baca, CTN-3
John Fitzpatrick, C-IIAC
Victor Gavron, LANSCE-DO
Raymond Jermance, IAT-DO
Carlos Martinez, HX-3
Timothy Merrigan, CTN-5
Michael Oothoudt, AOT-IC

25 years

Carla Brewer, CGA-GAO
Amy Martinez, PMT-3
Dale Talbott, W-5
Michael Trujillo, IHS-IP
Cynthia Wallace, IRM-CAS

20 years

Lawrence Earley, ISR-6
Patricia Montoya, TT-DO
Linda Nonno, ERSS-RS
Steven Rae, ENV-RCRA
David Romero, WCM-1
Bill Zwick, CT-DO

15 years

Tanmoy Bhattacharya, T-8
Michael Clevenger, ERSS-RS
Kathryn Creek, P-21
Mark Dunham, ISR-DO
Hans Frauenfelder, T-10

Gilbert Gonzales, ENV-EAQ
Toby Lucero, ASM-PUR
Neomi Salazar, WS-FWS
Michael Smith, W-7
Philip Tubesing, PF-MS
Bernice Williams, LANSCE-LC

10 years

Orlando Archuleta, MSS-EWMFO
William Averill, AET-2
C. S. Randa Brown, RP-2
Claudette Chavez, MST-16
Audra Espinoza, AOT-RFE
Louis Fernandez, AOT-RFE
Reiner Friedel, ISR-1
Dayna Gallegos, T-DO
Deborah Griego, IRM-DCS
Rita Henins, CAO-IM
John Kaszuba, EES-6
Erika Leibrecht, IAT-1
Leonard Maez, MSS-IFCS
David Martinez, C-CSE
John Mitchell, AET-6
Donna Osborn, DE-DO
Jaeyoung Park, P-24
Elaine Rodriguez, WT-DO
Sandra Turner, CTN-5
Peter Walstrom, AOT-ABS
Stephen Watkins, CTN-1
Allen Wood, IHS-OS

5 years

James Angelo, OS-DO
Darwin Apodaca, CTN-2

Robbie Aulwes, HPC-4
Mindy Blandford, C-CSE
Ricardo Cambise, CTN-4
Edwin Chacon-Golcher, AOT-ABS
Susan Chastain, CT-PPI
David Chavez, PE-DO
Sharon Dufur, SAFE-S3
Stephan Eidenbenz, CCS-3
Max Evans, PMT-4
Marianne Francois, CCS-2
Jason Gans, B-7
Eduardo Garcia, AOT-OPS
Catherine Gebin, HR-ER
Tracy Gonzales, WCM-3
Janice Gorman, AET-6
Hugh Greenberg, CCS-1
Todd Heinrichs, IRM-CAS
Kent Kramer, PMT-5
Joseph Liberty, STBPO-RL
Michael McGee, N-1
Alexander Mueller, C-IIAC
Lai Nelson, ES-SE
Diane Ortiz, ASM-PM
Philip Pacheco, CTN-4
Krystal Quintana-Garcia, AET-1
Francisca Rein, C-PCS
Gary Sandine, T-DO
Stephen Schultz, LDRD-PO
Clifford Stroud, EES-12
Felicia Taw, C-IIAC
Guillermo Terrones, X-4-SS
Monica Trujillo, EES-DO
Melissa Valerio, CFO-2
Julia Whitworth, NN



Q: Have you been to the Bradbury Science Museum in the past year? What do you like most about it and what would you like to see added or changed?



Kim Baldwin of Payroll (CFO-PRBEN)

No, but I love to take my family to visit when they are in town, as they are of the World War II era and appreciate the history of the Manhattan Project.



Ryan Chute of the Research Library (STB-RL)

Yes, the Bradbury is a wonderful way to introduce visitors to the various ways the Lab contributes to the nation. Regarding additions, perhaps they could incorporate some of the more recent research and development efforts.



Jay Schecker of Science and Technology Base Program Office (STBPO-PO)

I haven't spent time there recently, but I always enjoy going to the museum. I think their presentations are first rate. The last time I was there, I was looking at the nuclear weapons display, and I thought the information was well communicated, especially for a general audience given that it is a difficult subject to present.

Editor's note: The Bradbury Science Museum is open Tuesday through Saturday from 10 a.m. to 5 p.m. and on Sunday and Monday from 1 to 5 p.m. It is closed on Thanksgiving, Christmas, and New Year's Day.

In Memoriam

Marjorie Devaney

Laboratory retiree Marjorie Devaney died September 20. She was 76.

Devaney joined the Laboratory in 1951 as a computer programmer in the Computing Division where she was one of the principal designers of the Central Filing System. She retired from the Laboratory in 1991.

Devaney received a bachelor's degree in math from the University of Denver and a master's degree in electrical engineering and computer science from the University of New Mexico.

She is survived by her daughter Kathleen, brother Lawrence, and sister Lois.

Joseph Devaney

Laboratory retiree Joseph Devaney died in September soon after his wife's death. He was 83.

Devaney joined the Laboratory in 1950 as a staff member in the Theoretical (T) Division. He retired from the Laboratory in 1987 while working in the Applied Theoretical Physics (X) Division and continued part time as a Lab associate until 1995.

Devaney served in the Army and the Coast Guard during World War II. He received bachelor's and doctorate degrees in physics from the Massachusetts Institute of Technology.

He is survived by his daughter Kathleen.



Open enrollment continues through November 30

Los Alamos National Security, LLC, active employees can make changes to their health-care coverage for 2008 during Open Enrollment, which continues through November 30. For more information, go to <http://int.lanl.gov/worklife/benefits/open/index.shtml> online.





Lab honors nation's veterans



The nation's veterans were remembered—and honored—by the Laboratory at a series of events on November 8. Tod Caldwell of Condensed Matter and Thermal Physics, second photo right, spoke at the annual veterans breakfast in the Otowi Building cafeteria, followed by a flag raising ceremony by members of Los Alamos High School's Naval ROTC program (top right) and a 21-gun salute by members of the Protection Technology Los Alamos honor guard (top photo). Caldwell later spoke in the Physics Building Auditorium about his experiences while deployed in Iraq. Activities culminated with the annual fun run and walk, which drew hundreds of employees to Los Alamos Canyon. At right, Daniel Abeyta of Weapons Product Definition and Sharon Dominguez of Weapons Test Design Drafting signed up runners and walkers. The Veterans' Interest Group and the Office of Equal Opportunity and Diversity sponsored the events. Photos by Richard Robinson, Records Management/Media Services and Operations

