EOS SPHERES

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Taking Core Science Into the Wild

IF A PICTURE is indeed worth a thousand words, next time graduate student Eric Kelsey gives one of his climate change talks to secondary school kids he might be able to say more with less.

Kelsey, a second-year Ph.D. candidate in the Climate Change Research Center spent the month of May digging snowpits and drilling shallow ice cores on glaciers in Alaska's Denali National Park as part of his thesis work. The month-long reconnaissance mission, funded by the National Science Foundation, will identify specific drill sites for surface-to-bedrock ice cores and provide researchers with clear climate records going back some 2,000 years.

Photo: Cameron Wake, UNH-EOS

The Saint Elias Mountains from the window of a Twin Otter aircraft en route to an ice core drill site in May 2002.

The fieldwork, led by CCRC scientist Cameron Wake and University of Maine colleague Karl Kruetz, is part of a decade-long goal to gather ice-core climate records from around the entire Arctic region. Shorter term, the effort will provide Kelsey with plenty of imagery to enliven his student talks, which are also part and parcel of his doctoral duties.

"I've had a number of wonderful opportunities to go to various schools and conferences in the area and give talks about what I do at CCRC, the fundamentals of climate change, and why it's important," says Kelsey, who had to leave behind his wife and 10-week-old daughter to carry out his first hardcore scientific field campaign.

"Most important of all," he adds of his outreach efforts, "I talk about how energy and our lifestyles tie in to climate change and the humbling implications of it all *if* we're really serious about fixing things."

Kelsey earned a bachelor's degree from the University of Missouri and a master's from the University at Albany/SUNY—both in meteorology. But a desire to study

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Mapping the Galactic Frontier

Three years in the making, IBEX, with UNH-built sensors onboard, is poised for "liftoff"

Interstellar Boundary Explorer IBEX

LONG BEFORE NASA's Interstellar Boundary Explorer satellite is secured inside a winged Pegasus rocket and cinched to the belly of an Air Force L-1011 widebody jet, the little spacecraft receives the same treatment your car tires get down at the local garage.

Earlier this spring, IBEX was bolted to a huge spin table at Vandenberg Air Force Base in California and whirled around with various stages of the Pegasus. This spin balancing assures the 28-inch-tall by 38-inch-wide, octagonal satellite won't wobble uncontrollably in space, ruining its seminal mission to map the boundary between our solar system and interstellar space.

A spate of such mundane, pre-launch activities is standard operating procedure for satellite-based science missions and is the reason why UNH principal investigator Eberhard Möbius and his team of Space Science Center scientists, engineers, and students had to deliver their IBEX goods long before the Pegasus blasts off its L-1011 launch pad, which is slated for September as *Spheres* goes to press.

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EOS Spheres

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Morse Hall, Room 309
39 College Road, Durham, NH 03824
Tel: (603) 862-5369
www.eos.unh.edu

Interim Director: Roy Torbert
Associate Director for Finance & Administration: David Bartlett
Associate Director for Research & Academics: Janet Campbell
Editor: David Sims
Graphic Design: Kristi Donahue
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From the Director

A Pathway to the Future

Photo: K.Donahue, UNH-EOS

AS MOST OF OUR READERS know, the institute has moved into a new era with the retirement of Berrien Moore, our longtime director. Despite the implied finality of this milestone, Berrien will continue to be a part of the EOS family for the foreseeable future and will assist us in selecting our next director. Soon, there will be an announcement of festivities to celebrate his extensive contributions to EOS and the university.

Although Berrien can never be replaced, his retirement will launch a broad spectrum of new possibilities. To help us in this transition, a search committee—soon to be established in consultation with the university president and provost—will begin the process of selecting the new EOS director.

As a pathway to the future, the institute has also decided to establish a permanent visiting committee that will meet approximately once a year to advise us on strategic planning issues, opportunities to explore for the future, and future areas of research. This committee will have a rotating membership that serves for a period of three years and will be comprised of distinguished research scientists from around the world who are intimately aware of our strengths (and weaknesses) and who are leaders in the fields of Earth, oceans, and space research. We are grateful to our former colleague, Lennard Fisk, now professor of space science at the University of Michigan, and former chair of the Space Studies Board of the National Academy of Sciences, for agreeing to be the first chair of our visiting committee.

We anticipate the visiting committee's first meeting to be on October 2-3 of this year. Results of the committee's work will be reported by *Spheres* as appropriate. Please join us in extending thanks in advance to committee members for investing their precious time in an effort to help make EOS a more productive, vibrant, and forward-looking institution. The outstanding legacy of Berrien Moore in making EOS a world-class research organization will thus be continued into the future. – Roy Torbert

Space Science

IBEX

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Says Möbius, "You use the reserve time that's built into every project because you anticipate unanticipated snags, which often happen if you build such challenging new instrumentation as we have with IBEX."

For example, there have been a series of "mission rehearsals" similar to the theatrical variety where any potential flubs can be caught and remedied well before showtime. In a clean room, the satellite was put through the paces of powering-up all systems and communicating with the delicate sensors that will soon be gathering data in an orbit up to 198,000 miles or 50 Earth radii from home (the Moon orbits at a distance of 60 Earth radii).

IBEX is one of NASA's Small Explorer Program missions, which by design are more highly focused and less expensive than bigger satellite missions shot into space from a ground-based rocket. For example, Möbius notes, were IBEX lofted into space with a beefy, 127-foot Delta II rocket, the launch alone would rival the cost of the entire IBEX mission, which is led by the Southwest Research Institute of San Antonio, Texas.

But to properly do its science, which involves capturing atoms barreling towards Earth from the very edge of our solar system, IBEX must get into a highly elliptical Earth orbit that takes the spacecraft relatively close to the Moon. Such an orbit cannot be achieved from the belly of a big jetliner—IBEX needs an extra kick to send it on its way—and such a post-Pegasus kick-start has never been tried before.

"So you push the limits," Möbius says. Mission scientists and engineers came up with a unique delivery system—a little rocket attached to the satellite itself—that will push IBEX into its higher orbit without pushing the budget up.

"This method will be demonstrated for the first time with IBEX and I think there's at least one other mission interested in using the same approach," Möbius says adding, "so we will be opening a new means of achieving a higher Earth orbit."

IBEX's big elliptical orbit around Earth is needed in order for the spacecraft to get far away from the background "noise" of our planet's magnetosphere, which also generates the energetic neutral atoms that are the satellite's quarry.

Specifically, IBEX will be capturing and recording these same atoms from a region in space where the solar wind collides with interstellar gas to form the termination shock—the boundary of the huge, magnetic bubble that surrounds the Sun (and the solar counterpart of our magnetosphere) known as the heliosphere.

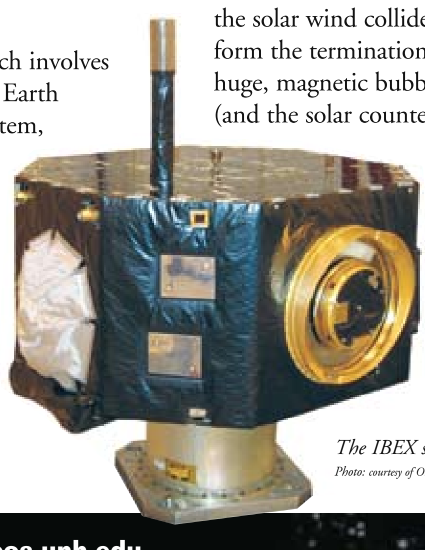
Using two, ultra-high sensitivity cameras containing components built at the Space Science Center, IBEX will, for the first time, produce a full-sky map of this region. The map will, among other things, provide modelers with the real-world constraints needed to better understand how the shock is formed, and how and where these energetic atoms are accelerated.

More broadly, the IBEX data will help scientists understand the underlying physics operating in this same boundary region—the astrosphere—of other stars.

Möbius notes that because the full-sky maps will be created during solar minimum, it is the hope of mission scientists that NASA will let IBEX continue to do its work after two years of successful data gathering (two years is the baseline for these smaller-scale missions).

"As we go into the rising solar maximum, when the solar wind is changing and pushing the termination shock out or bringing it in, we'd like to track those changes," he says.

But first things first. The next step in the mission is a flight to the Kwajalein Atoll in the South Pacific where the L-1011 will wait during a 10-day launch window for the right moment (determined by the Moon's position) to take off and jettison the Pegasus, which will in turn send its cargo on its initial journey to study the "space between the stars." -DS



The IBEX satellite mounted for spin testing at Orbital Sciences Corporation.

Photo: courtesy of Orbital Sciences Corporation.

Taking Core Science Into the Wild

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longer-scale weather and climate variability landed him "right back in my backyard." The Nashua native returned to his home state and found a good match in Wake as an advisor because of Wake's focus on New England climate issues, ice cores, and climate change in general.

Photo: David Sims, UNH-EOS

Eric Kelsey

Moreover, Kelsey notes, he was enthusiastic that Wake, like other faculty at EOS, "encourages students to engage with other external partner organizations to do outreach scholarship, to help educate others, to put their research to work even in circumstances where it's not directly related."

Thus Kelsey's climate change talks to groups around the region, like Coe-Brown Academy in Northwood, both the Oyster River high school and middle school in Durham, the Project WILD International Conference, and the Northeast Organic Farming Association Conference, to name several.

The fieldwork in Denali National Park (home of Denali a.k.a. Mount McKinley, the highest peak in North America at 20,320 feet) is the second leg of a multi-year NSF project.

Two years ago, Wake flew over Denali in an initial effort to identify potential drill sites. This year is the first time scientists have "had boots on the ground."

Wake, Kelsey, UMaine's Kruetz, post-doc Erich Osterberg, second-year M.S. candidate Ben Gross, undergraduate Seth Campbell, and Canadian ice-core driller Mike Waszkiewicz spent the month using a portable, ground-penetrating radar to determine the ice thickness and internal structure on various glaciers. Specifically, they looked for "layer-cake" ice with clear, well-defined annual stratigraphy.

The researchers also collected samples for chemical analysis from 20-foot-deep snowpits and shallow ice cores, and installed automatic weather stations at heights of 7,800 and 14,000 feet. The chemical analyses, which will be carried out at both UNH and UMaine labs, are needed to decipher changes in temperature, atmospheric circulation, and environmental change—such as the phenomenon known as "Arctic haze," which has brought heavily polluted air masses to the region for decades from North America, Europe, and Asia.

A clear record from Denali will help round out the bigger paleoclimate picture by adding critical information gathered from ice cores recovered in the North Pacific, all of which can be compared to a wealth of climate data already gathered in the North Atlantic region.

According to Wake, scientists have long thought that the North Atlantic region drives global climate changes. However, there are now indications that a change in the North Pacific might happen first and be followed by a North Atlantic response. "We need to better understand the relationship in terms of the timing and magnitude of climate change between these two regions," he says.

The Denali ice cores will complement others gathered over the years from around the Arctic as part of an overall effort to get a clearer, fuller picture of climate change. Moreover, complementing the ice core data are analyses done on tree rings, glacial moraine, and marine and lake sediments from the North Pacific region.

Notes Wake, "We have very long ice core records from Greenland that go back 110,000 years and provide us with a wonderfully detailed record. But just as any one meteorological station can't tell you about weather across the entire United States, you need a whole series of ice cores to understand the regional texture of climate variability across the entire Arctic."

Ice cores have been drilled in Penny Ice Cap and Devon Ice Cap—both in the Eastern Canadian Arctic, and at three elevations in the Saint Elias range in the Yukon. One more field season is expected at Denali next year—to download data from the weather stations—and scientists then hope to begin the deep-drilling program in the spring of 2010, should the NSF fund the second phase of the project. The team hopes to recover surface-to-bedrock ice cores from glacial ice that is about 1,000 feet thick. This length of core should provide a detailed record of climate and environmental change extending back several thousand years.

Photo: Cameron Wake, UNH-EOS

Previous ice core expeditions, like this one in the Canadian Yukon, are part of an effort to understand climate variability across the entire Arctic region.

By taking ice cores in distinctly different climatic zones in the Northern Pacific—for example, the Saint Elias range is hard against the Gulf of Alaska while Denali is more interior—the researchers will be able to decipher smaller-scale, local variability with more regional climate variability. This, in turn, will help paint a clearer big picture with respect to the North Pacific and North Altantic.

"With respect to understanding global climate change," explains Wake, "we want to know how these different regions compare to each other, we want to know what the driver is, which one is changing first and which is following. And so developing these high-resolution records that are directly comparable is really important."

> *"...you need a whole series of ice cores to understand the regional texture of climate variability across the entire Arctic."*

In addition to getting some valuable props, i.e., stunning photographs, for his climate change talks, the trip will give Kelsey a chance to further hone his outreach skills. As they set out for Denali National Park, the plan was for the intrepid researchers to give a presentation or two to park employees on what their research was all about and why it is important.

Explains Wake, "Sharing our research plans with the park rangers and local citizens on this trip represents the beginning of a larger engaged outreach effort we are developing with Denali National Park. We hope the results of our research will eventually provide park visitors with a better understanding of how the climate in central Alaska is changing and what it means for the future of the park and the region." -DS

Fisheries Science of the People, by the People, for the People

EVEN AS A YOUNG GIRL growing up near Bogotá, Colombia, Lina Maria Saavedra Díaz felt the only effective way to solve environmental problems was through an integrated, interdisciplinary approach.

Photo: Lina Maria Saavedra Díaz

Lina Maria Saavedra Díaz (right) with Letilina Curvelo de Mejia, who runs a restaurant that depends on her husband's artisanal fishing catch.

Though she might not have said it quite like that at the time, her strong beliefs held fast and, today, Díaz is a Ph.D. candidate in the Natural Resources and Earth Systems Science program at the University of New Hampshire.

"The type of integrated research I'm doing is what the NRESS program is all about," Díaz says. "My focus is both environmental and social so on my Ph.D. committee I have a sociologist, a biologist, and a fisheries manager."

For her doctorate, Díaz, who is a lecturer in marine ecology at the University of Magdalena in Colombia, is working with communities that practice artisanal or small-scale fishing on the Pacific and Atlantic coasts of her native Colombia.

These are hard times for the fishermen and their families whose very lives and way of life depends on what they're able to catch from the sea using traditional, low-tech methods. For her study, Díaz will have to integrate the environmental, social, and economic aspects of these subsistence communities in an effort to, eventually, help them help themselves.

"There are many differences between the two coasts, like species of fish and types of gear used. But basically the fishermen all have the same problems. Their livelihoods are threatened and fisheries are becoming fragile due to overexploitation," Díaz says.

Díaz will spend portions of the next two years living in four fishing villages on the Pacific coast and five on the Atlantic after each community has been carefully evaluated from an environmental, social, and economic standpoint.

The work she is doing is very much nontraditional fisheries science, and is not without its risks. In some cases she will work in communities that are inaccessible by road and live in a tent—an "outsider" working alone.

"It can be tough gaining their trust, and even more so because I am a woman and white–many of the fishermen are of African descent," Díaz says. "They are good people but to build trust will take time. And while I hope it doesn't happen, I'm open to being rejected."

Building trust aside, Díaz stresses that the fate of her research is in the hands of the fishermen and, in fact, they themselves will be doing the research.

Photo: Lina Maria Saavedra Díaz

A fisherman casts a net from the shoreline near Santa Marta on the Colombian Caribbean coast.

"This project will be based on local, traditional knowledge—knowledge that fishermen have built through living and working. They know more than any fisheries expert–they know who is fishing, when to fish, what problems they are facing. They have the knowledge we don't have. We're not going in there to 'save' them," she says.

The ultimate goal of Díaz's research is to help local communities and the appropriate Colombian government agencies adopt a community-based management fisheries plan. This co-management style is not the typical top-down bureaucracy but, rather, involves local fishermen and government agencies as equal management partners. Such an approach has been tried with some success in the Philippines and Vietnam. Díaz's work is in a very real sense setting the stage for this eventual cooperation.

So with a fully vetted survey in hand, Díaz is sitting down with fishermen and community members to assess their situations; what is happening to their local fisheries, what are their methods of fishing, what types of equipment do they use, what problems are they having, and what kinds of solutions might help?

"If you look in the literature there are just a few standout studies on artisanal communities because not too many people work successfully in these places," says Andy Rosenberg, director of EOS's Ocean Process Analysis Laboratory and one of Díaz's advisors.

Rosenberg says that in a traditional fisheries science investigation researchers would go collect a wealth of biological fisheries data and *then* talk to the people involved later.

"What Lina's doing instead is trying to do this with traditional knowledge, and that's just very appealing. You have to be really committed to going back and talking to people, listening to them, trying to figure out what's next, and she can do that because she's deeply attached to her country," Rosenberg adds.

Díaz is also "intensely motivated," according to Rosenberg–so much so that she successfully competed in the 2008 UNESCO-L'ORÉAL Women in Science Fellowship program becoming one of just 15 young women researchers worldwide to be awarded a two-year fellowship.

In a sense, Díaz's work is that of a diplomat as well as scientist; once she has gathered her data, part of her job will be convincing villagers to adopt new practices that might save or restore their depleted fisheries.

For example, her studies might suggest that closing a specific area to fishing for a time could help restore a certain species, or changing the type of fishing gear used might similarly help turn things around. Difficult ideas to sell, of course.

"The people are just trying to survive. I understand that, but the resources are endangered and, ultimately, the fishermen's lifestyles are endangered if we don't do something," Díaz says.

In such an instance, a co-management approach could be the difference between success and failure. If, for example, the villagers agreed to close a certain area to fishing for a time it would require that the government enforce the closure.

But, Díaz emphasizes, the key to the co-management approach is to empower villagers to use solutions based on their own fishing practices and the social needs of their community–along with some help from modern-day scientific technologies and government assistance.

"The idea is for the people to start making decisions that allow them to use the resources wisely. With co-management, the villagers will continue to do what they've always done, there will just be some agreed-upon rules that will benefit everybody in the long run," says Díaz. -DS

Atmospheric Science

Celebrating Earth's Thawing Polar Regions, Studying Them From On High

THE FOURTH INTERNATIONAL POLAR YEAR was intended to entice the public and stimulate interest in climate change. Unfortunately, the program got quite a bit of help from the poles themselves.

"When IPY was dreamed up five years ago nobody would have expected to see the extent of the melt we saw last summer in the Arctic Ocean or the vastly accelerating discharge of the Greenland ice sheet," says scientist Jack Dibb of the Climate Change Research Center. Antarctica, too, has been the site of some dramatic melting and loss of ice sheets.

As part of a field campaign conducted under the IPY banner, Dibb, along with CCRC colleague Eric Scheuer, spent the better part of April in NASA's DC-8 "flying laboratory" cruising above the Arctic region sniffing for pollutants transported from near and far.

The Arctic Research of the Composition of the Troposphere from Aircraft and Satellites, ARCTAS for short, is the most extensive field campaign ever conducted to investigate the chemistry of the Arctic's lower atmosphere. The mission is poised to help scientists identify how air pollution contributes to climate changes in the Arctic.

Photo: Glenn Shaw, Univ. Alaska Fairbanks

Jack Dibb records aerosol data aboard NASA's DC-8 "flying laboratory."

Explains Dibb, "People are really concerned about the changes happening in the Arctic. There are burning scientific questions about how atmospheric composition might be driving those changes and, in turn, how the changing Arctic might cause feedback and further modify atmospheric composition."

The Arctic is a particularly vulnerable place, subject to dramatic amplification of environmental change with possibly global consequences. Changes have occurred so rapidly that the Arctic has been referred to as the "poster child" of global change. It is where warming has been strongest over the past century, and has accelerated over the past decades. The region is an atmospheric receptor of pollution from the northern mid-latitude continents, as manifested in particular by thick aerosol layers known as "Arctic haze," and by the accumulation of persistent pollutants such as mercury—a toxin being measured by UNH instruments onboard the DC-8 for CCRC's Bob Talbot and Huiting Mao. Dibb and Scheuer are measuring gaseous nitric acid—a byproduct of pollutants emitted by car and truck engines, and particles in the atmosphere known as aerosols.

> *"There are burning scientific questions about how atmospheric composition might be driving changes in the Arctic."*

The Arctic is increasingly beset by emissions from massive forest fires in boreal Eurasia and North America—something the second phase of the campaign will investigate. Changes to the Arctic environment trigger unique regional responses including melting of ice sheets and permafrost, decrease in snow albedo (reflectivity) due to deposition of black carbon (soot), and chemical processes driven by sea salt aerosols deposited to the ice.

Soot has traditionally been thought to play a small role in Arctic climate change, but recently published reports suggest its influence might be greater than suspected. Increased industrialization of Asia and the increasing numbers and extent of boreal wild fires have paralleled the observations of earlier and more extensive melting (of snow, ice, and permafrost) throughout the Arctic. Long-range transport of soot from these sources may reduce the albedo of the Arctic cryosphere and accelerate the melting. Currently, says Dibb, "There's a push to find out if greater amounts of imported soot and melting in the Arctic are really directly linked."

The campaign began during the first week in April in Fairbanks, Alaska. Three NASA aircraft, including the DC-8, served as airborne laboratories for the three weeks.

Of particular interest to scientists is the formation of the springtime Arctic haze. The return of sunlight to the Arctic in the spring fuels chemical reactions of pollutants that have accumulated over the winter after traveling long distances from lower latitudes. For example, before the Soviet Union collapsed, dirty air from heavy industry wafted from Russia into what people assumed was a relatively pristine Arctic region. After a noticeable post-USSR decline in this pollution, the industrialization of Southeast Asia is driving what appears to be a resurgence of the long-range transport of polluted air masses.

Photo: Eric Scheuer, UNH-EOS

The Brooks Range of Alaska from the NASA DC-8

The wealth of data collected will also improve computer models used to study global atmospheric chemistry and climate, and the new aircraft observations will help researchers interpret data from NASA satellites—such as Aura, Terra, and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO)—orbiting over the Arctic. Interpreting satellite data can be difficult in the region because of extensive cloud cover, bright reflective surfaces from snow and ice, and cold surface temperatures.

Notes Dibb, "The open questions about what's going on in the Arctic with rapid change make a lot of people really want to push the satellites as hard as they can, in terms of getting accurate data." The *in situ* measurements made by the aircraft will be invaluable with respect to corroborating what satellites are "seeing" remotely.

ARCTAS is part of a larger interagency and international IPY effort collectively identified as POLARCAT, which will execute a series of aircraft experiments at different times of the year.

In order to have full and equal coverage of both the Arctic and the Antarctic, IPY 2007-8 covers two full annual cycles from March 2007 to March 2009 and will involve over 200 projects, with thousands of scientists from over 60 nations examining a wide range of physical, biological and social research topics.

For more on the International Polar Year and ARCTAS visit www.ipy.org and www.epo.nasa.gov/arctas, respectively. -DS

Space Science

If We Build it, They Will Come?

Of Petaflops, PlayStations, and Processors

YOU MIGHT SAY, to use an anachronistic analogy, that the National Science Foundation put the cart before the horse as it readied itself to enter the world of "petaflop" computing.

Poised to build the first civilian computer capable of mind-boggling processing powers at the National Center for Supercomputer Applications in Urbana-Champaign, Illinois, the NSF wondered if, in fact, there would be anyone out there ready to take advantage of a computing speed capable of churning through one-million-billion operations per second—the petaflop.

So out went a call to the scientific community saying, in essence, "Get your applications ready" for such a supercomputing beast.

The call was answered by, among others, Joachim "Jimmy" Raeder and colleagues in the Space Science Center. The group's proposal successfully garnered a $1.5 million, four-year contract from the NSF to ready their Open Geospace General Circulation Model–OpenGGCM for short.

OpenGGCM simulates nothing less than the interaction between Earth's magnetic field (the magnetosphere) and the solar wind–a dance that, among other things, creates the aurora and space weather. So complex is this "magnetohydrodynamic" simulation that it is one of the so-called "grand challenges" of modern-day computational science (climate change being another) and, thus, is an application yearning for the power of the petaflop.

As luck would have it, Sony's PlayStation3 game console uses a similar computer brain (a chip co-developed by Sony, IBM, and Toshiba and called the Cell Broadband Engine) that the NSF will likely use in its petaflop machine. And so, Raeder and his group have purchased 40 Sony PlayStation3 consoles and bundled them together into a supercomputing cluster to gain but a fraction of the prized petaflop.

"You need a lot of computing power to do games realistically, to run the graphics," Raeder says of the PS3 computer superchip. He adds, "So we're not the only ones taking this approach, there are lots of projects in which people have used PlayStations to do scientific calculations."

Raeder points out that the cluster of PlayStations won't come even close to petaflop power, which requires tens of thousands of superchips working in unison. "But it does provide us with a platform on which we can test our approaches to make the code very fast," he says. (The Roadrunner Project, a high-performance computer being built at the Los Alamos National Laboratory, uses 13,000 Cell Broadband Engines.)

Jimmy Raeder

The superchip that drives the PlayStation3 runs some 50 times faster than that of a typical processor. Looked at another way, while a "normal" chip, which is about the size of your thumbnail, contains one to two central processing units or "brains," the PS3 chip has seven to nine brains per thumbnail and can perform upwards of 10^{11} operations per second.

> *"…there are lots of projects in which people have used PlayStations to do scientific calculations."*

However, straight out of the box, it's not plug-and-play for Raeder's simulationists; there are several major hurdles to overcome before any science can be done.

First, the PS3 must be "tweaked" to run an open-source Linux operating system, otherwise scientists will only be able to use the console to play Grand Theft Auto IV, Star Wars: The Force Unleashed, Hail to the Chimp and other such mind-expanding activities.

The second and more challenging hurdle concerns the scientific program itself, in this case the OpenGGCM, which must be rewritten to run on the highly specialized superchip. This reprogramming fell to Kai Germaschewski, who spent the better part of two months completing this complex task. (SSC's Germaschewski, and Doug Larson, Daniel Bergeron, and Andrew Foulks, from the Computer Science Department are all part of the PS3 project.)

Photos: K.Donahue, UNH-EOS

Lastly, while the PS3 chip has speed to spare, it has little memory to speak of, which means only little chunks of a monster simulation like OpenGGCM can be run at any one time. But string a bunch of PlayStations together (cluster computing) and the problem is solved.

In this case, 40 PS3s talking to each other will churn through an OpenGGCM simulation and do so, relatively speaking, on the cheap.

"If our calculations are right, we will be able to run our program on 40 of these at $400 piece, plus a few bucks for a rack, network switch, and cables," Raeder says. In contrast, simulations are currently run on a supercomputing cluster (named "Zaphod" in honor of a character from the science fiction story *The Hitchhiker's Guide to the Galaxy*) that is an 8,000-pound, $750,000 collection of 320 processors.

The thrust of the simulation work Raeder's group does is connected with a NASA mission known as THEMIS for Time History of Events and Macroscale Interactions during Substorms. The mission aims to resolve one of the oldest mysteries in space physics–what physical process in near-Earth space initiates the violent eruptions of the aurora that occur during substorms in the Earth's magnetosphere. The two-year mission consists of five identical probes that will study the violent, colorful eruptions of auroras.

Says Raeder, who is a co-investigator on the mission, "Our role is to help people understand the data they're getting from the spacecraft with our simulations. The magnetosphere is huge, so even with five probes it's kind of like having five thermometers in the U.S. and trying to figure out what the weather is going to be. Running these simulations helps us to better understand what's going on in the real world." -DS

Earth System Science

Karen Von Damm Honored as Geochemistry Fellow


Karen VonDamm

IN EARLY APRIL, chemical oceanographer Karen Von Damm of the Complex Systems Research Center (CSRC) was elected a Geochemistry Fellow by the Geochemical Society and the European Association for Geochemistry. The societies bestow the honor upon outstanding scientists who, over the years, have made a major contribution to the field of geochemistry. Von Damm, according to the citation for Geochemical Society fellowship, is "without peer" among scientists investigating the geochemistry of submarine hydrothermal systems.

Submarine venting represents a major source of chemical input to the world's oceans, comparable to rivers, and plays a significant role in buffering both solid Earth and whole-ocean compositions on timescales that are not only geologically short but potentially relevant even to climate change.

Von Damm has been studying deep-sea hydrothermal systems since their discovery at mid-ocean ridges 31 years ago when she was doing her Ph.D. thesis. These underwater cracks ring the globe and are areas where Mother Earth "burps up a new skin" in a cloud of acidic black smoke, where temperatures rise to more than 700 degrees Fahrenheit, and where giant tube worms and clams form colonies. Von Damm's work has concentrated in the region of the East Pacific Rise at 9-10 degrees north latitude (referred to simply as "9 North") off the coast of Central America.

Since the first discovery of submarine hydrothermal venting, the citation noted, Von Damm has maintained a position at the very forefront of this fast-moving international field and has developed expertise in both the sampling and analysis of these challenging environmental fluids and in the theoretical treatment of the data obtained from those analyses.

"Along the way she has opened up entirely new lines of inquiry for others (certainly more than any one individual, no matter how many students they advise, could pursue) and willingly encouraged other non-hydrothermal geochemists into novel and rewarding collaborations with her group," the citation reads.

Von Damn has both challenged the understanding of what controls vent-fluid compositions, geologically, and led field campaigns to different parts of the world ocean to validate those hypotheses. "There is no single scientist active today whose name is more synonymous with the study of hydrothermal vent geochemistry."

The Geochemistry Society fellowship is the latest in a long list of accolades and past leadership experiences accumulated by Von Damm through her career, including many stints as chief scientist on cruises to the East Pacific Rise, election as a fellow of the American Geophysical Union, service as the assistant director of the CSRC, service on the Advisory Committee for the Geosciences Directorate at the National Science Foundation (NSF), and past chair of the national steering committee for Ridge Inter-Disciplinary Global Experiments. The latter is a NSF initiative supporting multidisciplinary research investigating mechanisms of how crust is created at mid-oceanic ridges, and how seawater chemistry and biological communities are influenced by these processes.

Von Damm, along with the handful of other newly elected society fellows, will be presented with her certificate of fellowship at the Goldschmidt Conference in Vancouver, Canada in July. -DS

EOS *SPHERES* Earns Award of Distinction

In February, EOS *Spheres* garnered the highest award given by The Society for Technical Communication-Boston/Northern New England. The institute's newsletter won an Award of Distinction for editorial content and graphic design at the 2008 STC Technical Achievement In Communicating Information (STACIEs) awards banquet in Boston.

Faculty/Staff News

In July, **Eberhard Möbius** will become chair of the UNH Physics Department–a three-year appointment.

Doug Vandemark assumed duties as the new director of the Center of Excellence for Coastal Ocean Observation Analysis (COOA) with **Ru Morrison** serving as associate director. Vandemark also reports work on three new NASA proposals involving satellite altimeter research and applications, with **Hui Feng** collaborator.

Marc Lessard was funded for the Rocket Experiment for Neutral Upwelling (RENU) project in which a sounding rocket will explore a connection between the ionosphere and the thermosphere–the very high-altitude atmosphere.

George Hurtt reports his Earth-system modeling research group released a beta version of global land-use history maps and conversions for use in the IPCC Fifth Assessment global climate change modeling and assessment activities.

In late April **Toni Galvin**, **Mark Popecki**, **Kristin Simunac**, and **Katherine Singer** attended the STEREO Science Working Group and Science Workshop held in France and presented papers on the STEREO-PLASTIC investigation.

Mark McConnell recently served on NASA's Astrophysics Senior Review Panel, which made recommendations regarding the operation of spacecraft missions in the Astrophysics Division.

Annette Schloss reports that, in July, EOS/UNH will host the 10th annual meeting of the Federation of Earth Science Information Partners–an organization formed by NASA with Berrien Moore and Schloss as founding members with EOS-WEBSTER.

Student News

The 2008-09 Space Grant Fellows are **Monica Bobra** (Space Science) **Jennifer Hegarty** (Climate Change), **Bradford Larsen** (Computer Science), **Marla Striped Face-Collins** (Complex Systems), and **Amanda Plagge** (OPAL).

The 2008-10 Research & Discover Graduate Fellows are **Clair Treat**, **Jordan Goodrich**, and **Haley Wicklein**, and students selected for R&D 2008 summer internships at NASA Goddard Space Flight Center are **Emily Glick**, **Andrew Maher**, **Jennifer Wurtsel**, Goodrich, and Wicklein.

OPAL's **Tim Moore** received his Ph.D. degree in May.

Ph.D. student **Sarah Jones** of the SSC was awarded a NASA Graduate Student Fellowship for her proposal, "Space-based measurements of pulsating aurora".

Emily Klein of OPAL received a four-year fellowship from NOAA's Dr. Nancy Foster Scholarship Program to begin pursuing her doctorate.

Master's student **Will Kessler** of CSRC published an article on photovoltaics in the Association for the Advancement of Sustainability in Higher Education's Best Practice Series and will make a presentation related to this at the UNH Energy Conference in June. (See www.ece.unh.edu/energy_conference).

UNIVERSITY of NEW HAMPSHIRE

Institute for the Study of Earth, Oceans, and Space
Morse Hall
39 College Road
Durham, New Hampshire, USA 03824-3525

800280

Big Things From Small Packages

AMONG A PLENITUDE of work presented by EOS Ocean Process Analysis Laboratory researchers at the 2008 Ocean Sciences Meeting held in Orlando, Florida, last March was a poster about an ongoing "expeditionary learning" collaboration between OPAL's Coastal Ocean Observing Center and the King Middle School in Portland, Maine.

The collaboration, headed up by OPAL research scientist Tim Moore and education and outreach coordinator Amy Holt Cline, provided a large group of seventh-graders with a year-long, hands-on, multidisciplinary course focused on understanding phytoplankton and their role in global climate change. In addition to a comprehensive field study component of the program, the connection between phytoplankton and ocean color satellite imagery and the Earth system at large was emphasized for students.

"Most of them had never heard of phytoplankton before. The students learned about the phytoplankton-ocean relationship and that these tiny creatures have a big impact not only on what goes on in the ocean but also the atmosphere as well," says Moore, who just completed his doctoral work on various aspects of the little-studied phytoplankton community in the Gulf of Maine.

Since phytoplankton depend upon certain conditions for growth, they are a good indicator of change in their environment. For these reasons, and because they also exert a global-scale influence on climate, phytoplankton are of primary interest to oceanographers and Earth scientists around the world.

Photo: Mitchell Sogin, Marine Biological Laboratory

The dinoflagellate Ceratium longipies, *a commpn phytoplankton in the Gulf of Maine.*

The King Middle School students, who also had to finalize their projects with poster presentations at year's end, report the expeditionary learning experience helped them not only in conducting fieldwork, identifying species of phytoplankton, and interpreting satellite images, but also to "connect the marine environment to the changing climate, make changes in our own house to reduce carbon emissions, become better writers, and gain a better understanding of how scientists study the environment."

Adds Moore, "That this microscopic world of phytoplankton is doing so much—affecting the rest of the food chain, which has global consequences—and that we can detect them from satellites and observe their change over time, that's really quite remarkable." -DS