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EOS SPHERES

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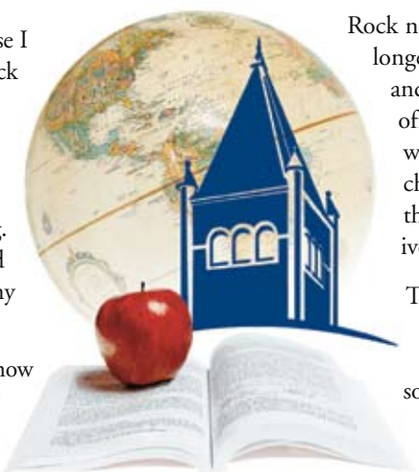
Reaching Out From the Ivory Tower

LONG BEFORE the University of New Hampshire established its innovative, faculty Outreach Scholars Academy, Barry Rock was reaching out and engaging with K-12 students and teachers.

"I've done outreach for years because I thought it was important," says Rock of the Complex Systems Research Center. He adds, "But while I'd get a pat on the back or an 'attaboy' it was never seen as anything central to what I was supposed to be doing. I remember someone saying I could do outreach as long as I did it on my own time."



Times have changed, and UNH is now widely recognized as one of the few places where outreach is, as Rock puts it, "prized and promoted."

Rock is one of a handful of EOS faculty who graduated from the semester-long professional development academy, which was created in 2004 and has grown into a model now being emulated by universities around the nation. Rock was a member of the inaugural class.

At its core, "outreach scholarship" is a process in which university faculty link their scholarly research to the needs of external partners to develop a mutually beneficial relationship.

In Rock's case, the Forest Watch program, which he started in 1991 as a means of getting K-12 students involved in real scientific research, is an example of this two-way, societally relevant approach.

Rock notes that while the program's longevity is testament to its relevance and value in the classroom, getting it off the ground was no small task. "It was a great deal of work and often a challenge getting teachers—who, I think, often see us at the university as ivory-tower egg heads—onboard."

The Forest Watch program (see story on page 7) is a classic case of outreach *enhancing* research—something that Cameron Wake of the Climate Change Research Center asserts is key to outreach scholarship.

"When you address research issues with an external partner you can do so in a much more realistic and integrated way," says Wake who, along with Eleanor Abrams (Education), Sharyn Potter (Sociology) and Lisa Townson (Cooperative Extension), collaborated with UNH Associate Vice President for Research and Outreach Scholarship Julie Williams to define the academy's structure and goals during its start-up phase. Wake now serves as its director. *— continued on page 3*

Space Science Center Balloon Program Gets Pumped

A NASA scientific balloon prepares to lift an experiment. Photo courtesy of NASA.

IT'S BEEN 20 YEARS since researchers in the Space Science Center sent scientific payloads up and away via balloon. We're not talking about projects like BalloonWinds, which investigate our own atmosphere, but high-energy astrophysics experiments aimed at probing the distant reaches of the cosmos.

Now, two recently funded NASA projects have reinflated the balloon program. The Gamma-Ray Polarimeter Experiment or GRAPE received $2 million from NASA with plans for a full scientific payload to be launched by balloon in the fall of 2011. The goal of the mission is to measure x-ray polarization in pulsars, gamma-ray bursts, and solar flares. Mark McConnell is the principal investigator.

And for a mission that will, in a sense, pick up the SSC balloon program where it left off, Jim Ryan will lead a team developing a smaller, improved version of the telescope UNH scientists and engineers created for the Compton Gamma-Ray Observatory (CGRO).

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From the Interim Director

Moving Forward in a Time of Challenge and Opportunity


Photo: K.Donahue, UNH-EOS

ON NOVEMBER 1ST, the search for Berrien Moore's successor as EOS director began in earnest with advertisements in national publications and the appointment of a search committee co-chaired by Janet Campbell, EOS interim associate director, and Taylor Eighmy, UNH interim vice president for research.

Berrien's departure after 20 years at the helm leaves some big shoes to fill, particularly given his stature as an international leader in climate change research and in crafting science policy.

Because he was our founding director and, thus, our only model of leadership, it will be challenging to consider other models; we will need to be open to the possibility of a different type of director. Noting a point made recently by the EOS Visiting Advisory Committee, search committee member and director of the Complex Systems Research Center Steve Frolking has observed, "We need to look towards where we want to be, not where we have been."

Our search comes at a time of great flux—at UNH, in the federal government, in the economy, and in global change science. It is a time of both challenge and opportunity.

Search committee co-chair Taylor Eighmy sees the possibility of great opportunity in the change of leadership in tandem with a changing landscape. He expects that federal agencies, foundations, NGOs, and corporations here and abroad will be very coherently focused on climate change implications, global hydrology and ecosystems services, and multi-scale Earth systems observations. "We have a wonderful opportunity to continue to position EOS as a principal player around global policy development and transformational research in these fields," Taylor has said.

To our great advantage, Berrien has left us an outstanding group of talented faculty, students, and staff poised to make significant contributions across the full spectrum of EOS activities—from water resources to gamma-ray astronomy. The original EOS concept of an interdisciplinary approach to global studies of common scientific challenges has turned out to be very prescient. The institute now offers its new director the opportunity to lead us into a future where this interdisciplinary, global approach to science is needed more than ever. -Roy Torbert

Space Science

SSC Balloons

—continued from page 1


Photo courtesy of NASA.

The three-year, half-million-dollar project known as the Fast Compton Telescope (FACTEL) aims to fly an engineering model of the telescope in the fall of 2010.

Notes McConnell, who 25 years ago was a graduate student working with Ed Chupp on balloon-based experiments, "The last balloon flight was in 1988 and then the focus shifted towards CGRO, which was launched in 1991. We never did get back into balloons."

In part, the beauty of a reinvigorated balloon program is that it provides students—both graduate and undergraduate—unique opportunities to work on a mission soup to nuts.

"Students get to design, build, fabricate, fly, and analyze data – everything in the space of a few years. It's not like satellite work, which is typically stretched over many years and involves a large team of engineers and scientists, where everybody specializes and where there's lots of quality control," McConnell says.

There is, of course, quality control for balloon work as well. But McConnell recalls one long-ago mission, dubbed "Gamma-Busters," in which they duct-taped a stuffed teddy bear ("Buster Bear") to the gondola in an effort to conjure up some good luck; two previous launches had ended in balloon failure. The balloon went up and they collected gamma-ray data for 40 hours—a very successful balloon flight.

In 2007, a small engineering prototype of the GRAPE experiment flew on a high-altitude balloon in a successful proof-of-concept flight. Now, with full funding for three years, McConnell and team hope to send a large array of the gamma-ray detectors built at the SSC to further validate the science in a one- to two-day flight. With success, the next step would be a balloon mission launched from Antarctica where balloons can catch the polar winds and circle the Earth for 30 days.

GRAPE is designed first and foremost to study gamma-ray bursts—massive ejections of high-energy particles and photons from dying stars or supernovae. The ejection is thought to take the form of a narrow jet moving outward at nearly the speed of light. If the jet happens to point towards the Earth, the beam of explosive radiation will be seen in the form of a gamma-ray burst. Most of these events are missed, but were GRAPE to orbit the South Pole for 30 days perhaps a dozen gamma-ray bursts could be recorded.

Says McConnell, "We think that the beam is the source of the high-energy radiation, but the structure of that beam and the mechanism by which the high-energy radiation is generated is not entirely clear. There are lots of theories, but to test them we need data like those GRAPE can provide."

The FACTEL mission will build upon the highly successful Imaging Compton Telescope (COMPTEL) that flew on NASA's Gamma-Ray Observatory from 1991-2000. The design will be an upgraded version of the telescope—using the latest technologies, like detectors and electronics—that should make it orders of magnitude more sensitive and produce much sharper imagery.

"COMPTEL looked at a part of the gamma-ray spectrum that is notoriously difficult to view," McConnell says. "FACTEL will be able to see fainter sources and have finer angular resolution allowing us to map out the distribution of radioactive materials in the galaxy much better."-DS

Outreach Scholarship

Reaching Out from the Ivory Tower

—continued from page 1

Says Williams, "Eleanor, Cameron, Sharyn and Lisa have been critically important colleagues who helped develop the academy by contributing invaluable intellectual and practical ideas. Their input and what we also learned from participants make what we now do possible."

At a more fundamental level, George Hurtt, who also graduated from the academy, believes that science done in partnership always achieves better results. "And that's because you bring more expertise to bear on a given problem, you have different perspectives, values, skills—people bring different backgrounds and priorities."

The Carbon Solutions New England project (carbonsolutionsne.org) that he and Wake helped create is a perfect example of this kind of collaborative science producing societally relevant results.

"It's outreach scholarship at a high level because the central question—how can we effectively reduce our regional carbon emissions?—is itself co-driven by scientists in collaboration with a wide range of stakeholders, and analysis is done by scientists with constant feedback from stakeholders," says Hurtt.

To build outreach from the ground up, so to speak, and get these concepts into the classroom, Hurtt and colleagues were awarded a UNH grant through the Outreach Scholars Academy program to develop and deliver a new undergraduate inquiry course to engage freshmen in the process of outreach scholarship.

"We brought students and community partners together in teams to define and address real scientific issues in the community, and in the process influenced for the better how young students see the very relationship between science and society, Hurtt says."

Like Rock, most faculty have engaged in some form of outreach for many years as part of the "service" faculty are expected to do—along with teaching and research. But outreach scholarship takes things a step further by instilling the two-way communication and real collaboration with external partners so that both the faculty and the partner can benefit.

Wake, Rock and others note that any discussion about successful outreach scholarship by EOS faculty would be incomplete without a tip of the hat to former EOS director Berrien Moore.

Moore's own extensive outreach scholarship throughout his career—from helping lead the International Geosphere-Biosphere Programme to chairing and co-chairing numerous national scientific committees—provided clear examples for institute faculty to build upon.

"In a sense we've all been building upon the example set by Berrien who for over 20 years engaged in outreach scholarship with external partners," Wake says.

And Rock notes that Moore was always fully supportive of his efforts even when outreach was very much a behind-the-scenes activity. Now, with the creation of the Outreach Scholarship Academy, the engaged outreach that has been occurring at EOS and UNH for years is, in a sense, formalized.

> *"It was satisfying to be able to take the research I do and literature I'm familiar with and help the EPA do a better job of evaluating the Clean Air Act…"*

"Lots of us do outreach but much of it has fallen under the nebulous cloud of unmeasured service," notes academy graduate Scott Ollinger of CSRC. He adds, "Historically, the collective work done by faculty across campus has made enormous contributions, but I think much of it has gone unrecognized. Having a formal means of structuring and documenting our efforts helps show the world that UNH scholars are doing work that has real relevance to the needs of society."

Ollinger notes that work he did several years ago, as part of an U.S. Environmental Protection Agency subcommittee evaluating the effectiveness of the Clean Air Act, hammered home both the importance of engaged outreach and the satisfaction that comes from applying personal research to a broader-than-usual sphere.

"It was satisfying to be able to take the knowledge or expertise of the research I do and literature I'm familiar with and help the EPA do a better job of evaluating the Clean Air Act, which is an immensely important law."

Academy graduate Ruth Varner was "honored" to be nominated for and participate in the outreach program. Varner's work in the Climate Change Research Center focuses on methane emissions from small-scale terrestrial systems. She often works with local science teachers in an effort to provide them with some scientific tools with which to educate their students on issues of climate change and the carbon cycle. To accomplish this, Varner essentially involves students in a scaled-down version of her field research and data analysis.

Photo: UNH Photo Services

Julie Williams

"A lot of teachers are interested in the topic but they don't necessarily have the background for it. So I've been trying to engage them in the idea that students could collect data and learn about the carbon cycle and climate change," Varner says.

She adds, "The idea with the outreach scholarship program is to make efforts like this more intentional, to build up relationships with community partners and schools or businesses outside of UNH and, by doing so, provide faculty with more tools to effectively move their own scholarship forward."

Williams says a particular strength of the academy is that it attracts faculty from all across campus allowing participants to interact with colleagues they might otherwise rarely encounter. As a result, ideas about how to collaborate become much more interdisciplinary.

"We are now in the process of recruiting our fifth class, which will mean nearly 75 faculty participants. And I'm pleased to say among the 75 are a few stars from EOS," Williams says.

In addition to those mentioned in this story, EOS Outreach Scholars Academy graduates include, Annette Schloss, Pingguo He, Antoinette Galvin, Ru Morrison, Joe Salisbury, and former EOS faculty members Jeffrey Runge and Vania Jordanova. -DS

Visit the Outreach Scholars Academy website at www.unh.edu/outreach-scholars

Faculty Profile

Old School, New Chair

Doing physics the old-fashioned way, Marty Lee is honored for decades of excellence

AT A SCIENTIFIC MEETING two years ago, while the 60 other space physicists clicked through their PowerPoint presentations, Marty Lee rolled out an overhead projector and plunked down hand-drawn viewgraph transparencies. His colleagues took great delight in gently poking fun and calling him a "dinosaur."

"Only very recently was I embarrassed into getting up to date," he says somewhat sheepishly. With a nod in the direction of an open laptop sitting on his office desk he adds, "So I bought this thing two years ago and I'm making progress, despite the fact that I never learned to type." Dragged "kicking and screaming a little bit," Lee is one-finger typing his way into the computer age.

"To be honest, the computer revolution kind of went by me—I think probably because I always enjoyed the analytical stuff. I love the close tie of physics to mathematical analysis," Lee says.

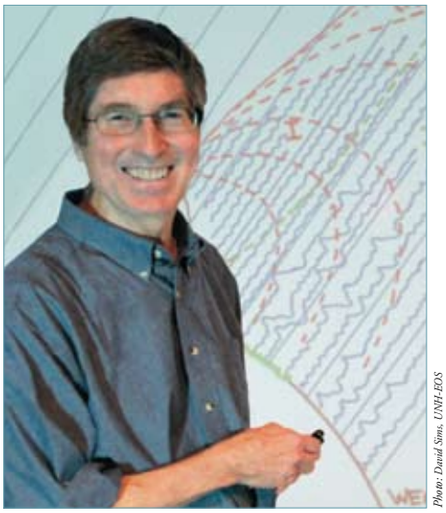

Photo: David Sims, UNH-EOS

Marty Lee

It is the "tidiness" of mathematical analysis that drew Lee into the field years ago and it has kept him there, a sharpened pencil in hand, ever since.

But as the frontiers of knowledge get pushed further out—and problems become more complex—physicists increasingly rely on numerical simulations to forge ahead. For pencil-and-paper guys like Lee, this means funds for analysis-based projects are harder to secure.

Serving on a NASA review panel for a heliospheric theory and modeling competition several years ago, Lee recalls that 85 percent of the proposals were for numerical, computer-based calculations or simulations. "That's not like it was 30 years ago, so there's certainly been an evolution of the field."

While he stood on the sidelines as the computer age swept the planet, Lee, too, evolved over 30 years since landing at UNH in 1979 as a young, inexperienced research scientist.

> *"I am so often impressed and humbled by my colleagues at UNH and I know the achievements of so many of them could be and should be celebrated."*

As he recounted at the late-September reception honoring his appointment as a UNH Presidential Chair, "I found a home at UNH after failing to get tenure at another institution, which at the time seemed like a death knell. But it turned out to be propitious, for that failure led me to a place where I found mentors and colleagues who provided support and the environment I needed to find my way and figure out how to become a good scientist."

Indeed. In accepting the honor from UNH President Mark Huddleston with colleagues gathered round (including three others being honored), Lee credited his personal achievements to a much larger sphere of influence.

"I am so often impressed and humbled by my colleagues at UNH and I know the achievements of so many of them could be and should be celebrated. In recognizing individual achievements today we are actually celebrating the strength of the institution," Lee said with characteristic modesty.

The newly created awards of Presidential Chair and Presidential Professor, Huddleston noted, represent the highest level of excellence at UNH. "The commitment of these faculty members to research, teaching, and engagement not only benefits students but enhances the reputation of the colleges and the university as a whole."

Lee's work in theoretical space physics, astrophysics, and plasma physics as a founding member of the Space Science Center's Solar-Terrestrial Theory Group "has contributed to and has had ongoing influence on NASA experiments and programs for over 20 years," Huddleston added.

As Lee noted upon receiving the honor, that he is *still* contributing is due entirely to the skill of students and faculty of the Department of Kinesiology who, six years ago, helped save his life after he went into cardiac arrest at the UNH Field House.

Lee's area of expertise through the decades has been in energetic particle processes—a field he became interested in as a physics graduate student at the University of Chicago. He arrived at Chicago with a fellowship in hand, which freed him from having to take on teaching assistant duties, a love of and gift for mathematics, and no particular interest in space physics.

"I was never one of these amateur astronomy types as a kid. "I ended up in this field because one of the professors on my qualifying exam committee was in space science and he convinced me to come work with him."

Lee's focus has been the behavior of energetic ions throughout the heliosphere—the vast cavity "blown" into the interstellar medium by the solar wind and extending beyond the planets.

He believes analytical work he did on data from the International Sun-Earth Explorer mission was probably the biggest accomplishment of his career.

ISSE was a three-satellite mission launched in 1977-78 to study the relationship between Earth and the Sun, the solar wind, and cosmic rays. (Lee's SSC colleague Eberhard Möbius was a co-investigator on the mission.) In November 1978 there was a very big, very well observed shock wave that provided a rich data set, including the first good look at the orientation and structure of the shock wave and its associated energetic particles and magnetic waves.

"By establishing the orientation using three satellites we could look into the energetic particles in great detail, and I came up with an analytical theory that unified the waves and energetic particles."

Lee hopes to collaborate with Möbius by analyzing data from the Interstellar Boundary Explorer mission, which was launched this past October 19 to map the edge of our solar system for the first time. Möbius is lead UNH scientist on the mission.

"Through an analytical approach, I'd like to be able to help Eberhard derive a little more scientific pleasure from the mission, not just by interpreting the data but by helping to shed more light on the physical processes that occur out in these distance reaches of the heliosphere," Lee says.

It is this type of exploration into unknown frontiers that always generates rich new information and keeps the pencil-and-paper guys busy.

"Whenever there's a new mission, new measurements that have not been made before, people jump on every little twist and turn in the data and all the basic, simpler things get addressed again," Lee says.

With IBEX now poised to provide the first glimpse beyond the solar system and into the galactic frontier, Lee, pencil in hand, will be ready to have at the data. -DS

Graduate Student Profile

Essential, Unknown: Calcium in the Forest Ecosystem

WHEN CLAIRE HOFF WAS LOOKING at graduate schools after finishing up at Cornell University she was steadfast.

"Basically, I wanted to do research *I* wanted to do – not something a professor had sitting on the sidelines," says the Ph.D. student in the Natural Resources and Earth Systems Science interdisciplinary program.

After making the rounds at other potential graduate schools, Hoff found her seminal research project upon visiting UNH and meeting with professors Julie Bryce of the Department of Earth Sciences and Erik Hobbie of the Complex Systems Research Center and Department of Natural Resources and the Environment.

In a nutshell, Hoff is trying to piece together the complex puzzle of the calcium cycle in terrestrial ecosystems. It's important to solve because calcium is a critical nutrient for trees and has been largely depleted from forest soils by acid precipitation over vast areas of North America and Europe.

For example, Hoff notes, sugar maples—so key to the character and economy of New England—are in decline and scientists suspect a lack of calcium might be the culprit.

But the cause-effect link is hard to show scientifically because, among other things, it's unknown how tree roots, and the fungi that have a symbiotic relationship with them, actually take up calcium and make it available to the rest of the plant.

> *"Basically, I wanted to do research I wanted to do—not something a professor had sitting on the sidelines."*

Moreover, while the ultimate source of calcium is bedrock, scientists don't know how long it takes to replenish the soil pool after calcium ions get displaced from soil particles and are, ultimately, washed downstream.

One key aspect of her project is trying to determine if mycorrhizal (meaning "fungus root") fungi have the ability to extract calcium directly from bedrock and give it to trees. If this is indeed occurring, it would mean that trees don't have to wait for the time-consuming weathering process to make calcium available once again. (It is also unknown if tree roots themselves have the ability to get calcium directly from bedrock.)

The only means of deciphering these complex and circuitous microscopic processes is to use chemical "tracers" and follow them on their journey through the terrestrial ecosystem.

Hoff's first step in her research was to show that the previously accepted tracer technique (using strontium) did not truthfully replicate calcium's behavior throughout natural processes and that, instead, using different isotopes of calcium as a means of tracking calcium's fate might solve the riddle.

Mirroring the path she took as an undergraduate, Hoff's Ph.D. work is decidedly interdisciplinary. At Cornell, she took a degree in Science of Earth Systems, which involved course work out of three colleges and a variety of disciplines.

"I always knew I wanted to do interdisciplinary work," she says. After getting a strong foundation in science and mathematics she concentrated her upper level coursework in ecology and courses that were oriented towards systems- and conceptual-thinking but also had a hard science component that is usually left out in more traditional subject divisions.

> *"I always knew I wanted to do interdisciplinary work…"*

With funding from a National Science Foundation Critical Zone Exploration Network grant, this past summer Hoff conducted an experiment in Belgium under the guidance of professor Jan Colpaert, a noted expert on mycorrhizal fungi and a colleague of Hoff's co-advisor Erik Hobbie. Central Europe has had severe problems with acid rain and soil calcium depletion in forest ecosystems.

Claire Hoff

Hoff grew seedlings of Scotch pine and sugar maple in syringes under carefully controlled conditions. She is now in the process of analyzing her samples using an EOS state-of-the-art mass spectrometer that will provide elemental concentrations and, thus, help map out the calcium cycle. The numbers from this little, closed-system experiment can then be extrapolated to a terrestrial ecosystem.

Another aspect of her doctoral work is investigating the role magnesium plays as it cycles through the terrestrial ecosystem. As calcium goes in forest soils so goes magnesium—downstream in the wake of acid rain. And, in some systems, magnesium could be *the* limiting nutrient, not calcium.

Explains Hoff, "Magnesium is, in fact, an essential component of chlorophyll, and I'll be looking at whether it's both calcium and magnesium together or separately that's causing the problem of declining health in forest ecosystems." (Acidic soils also end up releasing aluminum ions, which can damage root cells thereby compounding the problem of limited nutrients.)

She notes that a look back in the scientific literature shows calcium and magnesium were once considered partners in the puzzle, "but then magnesium disappeared from the equation for no apparent reason and everyone jumped on the calcium bandwagon."

But the bandwagon of research has yet to provide good answers on just how calcium moves through the system to build healthy trees; Hoff hopes to solve the calcium-magnesium riddle. -DS

From Complex Systems to Communicating Complexity

Former EOS director Berrien Moore comes full circle with move to Climate Central

Berrien Moore III

EARLY IN OCTOBER, EOS bade farewell to founding director Berrien Moore, who has assumed duties as founding executive director and senior research scientist of Climate Central—a nonprofit, non-partisan think-tank created to provide objective and understandable information about climate change and potential solutions.

Moore, a mathematician by training, created the Complex Systems Research Center at UNH back in 1978, and from that seed sprang the four-center, interdisciplinary Institute for the Study of Earth, Oceans, and Space in 1987.

At the reception and dinner held in Moore's honor, colleagues past and present praised him for almost four decades of visionary leadership and for his tireless efforts, in both scientific and political spheres, helping to propel the discipline of Earth system science into the vanguard of societal priorities.

Charlie Vörösmarty, Moore's first graduate student and eventual director of the Water Systems Analysis Group, noted, "Those early days at Complex Systems were filled with heady discussions and ideas that were completely 'out there' at the time." Ideas like creating a "geography" of the global carbon cycle, evolving it through time and plugging it into what would become known as an Earth system model.

"This was totally crazy at the time and, in fact, we were told so whenever we tried to get funding. Reviewers said it could not be done. Now it's just par for the course, and Berrien was absolutely instrumental in creating this new branch of science," Vörösmarty said.

Also in attendance for the festivities was Lennard Fisk, former UNH vice president for research and financial affairs and, as such, a key figure in the foundation of EOS.

Said Fisk, who became a senior official at NASA shortly after EOS was founded, "Under Berrien's leadership, and with the existing faculty who were dedicated to realizing the dream of EOS and the outstanding new faculty who came to UNH *because* of EOS, you have created just what we envisioned: an institute of importance to our society, an institute capable of studying great problems of how the Sun and Earth system work and, most importantly, what we as humans are doing to the Earth."

What we have apparently done to our home planet would have seemed more science fiction than hard science 30 years ago when CSRC was founded. For example, recent data suggests that, in some places, the Arctic Ocean is losing sea ice 30 years ahead of current Intergovernmental Panel on Climate Change predictions. Summer sea ice is now forecasted to completely disappear in the summer months sometime between 2013 and 2040—something that hasn't occurred for over a million years.

Moore and others believe we now know enough to see that we are tending ever closer to some climate tipping points and that, past these, strong feedback loops could amplify the effects we have already seen and move them beyond the scope of our influence.

"We must aim to understand and anticipate these loops, to understand their causes, consequences, and prevention as quickly as possible in order to improve our chances of avoiding their most disruptive results," Moore says.

So Moore comes full circle with his departure to Climate Central and with his desire, as he noted at his farewell dinner, "to connect what I've done in science with clear communication so that we, together, can meet this challenge as effectively has possible." -DS

Faculty/Student News

Scott Ollinger, **Andrew Richardson**, **Mary Martin**, **Dave Hollinger**, **Steve Frolking**, and others published a paper in the *Proceedings of the National Academy of Sciences.* Their study found that forests with high levels of foliar nitrogen have a two-fold effect on climate by simultaneously reflecting more solar radiation and absorbing more CO_2 than their low-nitrogen counterparts. Also, Richardson, Ollinger, and **Rob Braswell** recently had a proposal funded by the Department of Energy's National Institute for Climatic Change Research.

George Hurtt was named to the executive committee of the Vegetation Structure Working Group supporting the development of NASA's Deformation, Ecosystem Structure and Dynamics of Ice (DESDyni) satellite mission. Hurtt also reports that a record number of Research & Discover students–12 compared to 8 in 2007–will present research findings at this year's AGU annual meeting.

On October 19, the Interstellar Boundary Explorer (IBEX) roared into space via a Pegasus rocket dropped from the belly of an Air Force wide-body jet. **Eberhard Möbius**, UNH principal investigator for the mission, reports that commissioning of the satellite's sensors began in mid-November, with first neutral atom data expected by early December.

Huiting Mao, **Bob Talbot**, and **Julie Bryce** received funding from the National Science Foundation for a proposal entitled "Mercury Cycling in the Marine Environment." The three-year, $530,000 proposal is the largest ever granted by the NSF Atmospheric Chemistry Division for a mercury study.

In In late October, staff researcher **Liz Burakowski** published research results in the *Journal of Geophysical Research.* Burakowski conducted a detailed analysis of weather station data from across the Northeast U.S. from 1965 to 2005 as part of her master's thesis (completed in December 2007). Her results show that regional winter temperatures are increasing at a rate of 0.42 to 0.46C per decade with accompanying reduction of snow-covered days.

Karen Von Damm 1955-2008

At the September 25th memorial service for Complex Systems Research Center professor Karen Von Damm, who passed away in mid-August, she was remembered for her strength and confidence, for leadership in her field of chemical oceanography, for outreach work she did over the years with primary school students, and for her role as a strong advocate for women in science.

Said former EOS director, Berrien Moore, "Karen was a positive and strong spirit, a free and noble spirit, a fine and genuinely kind spirit." Also paying tribute to Von Damm's legacy were friends and colleagues Marv Lilley from the University of Washington, Julie Bryce of the UNH Department of Earth Sciences, and Ruth Varner of the Climate Change Research Center who said, "Karen was always a strong advocate for those who did not have a voice." Donations in memory of Von Damm can be made to the Karen L. Von Damm Memorial Scholarship Fund, Department of Earth Sciences, James Hall, UNH, Durham, NH 03824.

Seeing the Forest for the Trees

THE SEEDS OF FOREST WATCH were sown back in the late 1980s when Barry Rock would travel to secondary schools, show some clips from the Public Broadcasting Service's "Mission to Planet Earth" series in which he was featured, and get standing ovations and requests for autographs from the kids.

"It was silly stuff, really," Rock recalls. Silly perhaps, but it sure got the students fired up and laid the foundation for what would become a central part of Rock's scientific research—engaged outreach.

Barry Rock with Forest Watch students. Photo: K.Donahue, UNH-EOS

Forest Watch has been going strong now for 17 years. The program is a unique way of conducting science with the help of primary and secondary school students who collect and process data relating to air pollution damage in forest stands in New England. Over 350 schools have participated in the program, with some 50 to 100 actively engaged in monitoring white pines, a bio-indicator species for ground-level ozone (smog), in any given year.

Over the course of 17 years, Forest Watch has demonstrated that students can collect valuable data for ongoing scientific research and learn science and mathematics by doing research in their local area. Student data have clearly shown how responsive white pines are to year-to-year variations in ground-level ozone exposure.

"The access to student data, when properly collected, has been invaluable in terms of doing our science. The good news is that as the result of student data, we've learned that trees across New England have become healthier during the late 1990s and on into the 2000s compared to the early 1990s," says Rock.

The National Science Foundation has funded Forest Watch as part of its Science, Technology, Engineering, and Mathematics Program, which seeks to increase student interest in the sciences.

Rock notes that one measure of the program's success is the fact that as he walks across the UNH campus he is often greeted by students who are complete strangers but know him through video tapes they saw in the their Forest Watch programs in middle or high school.

Key also to the program's success has been the funding support provided by NASA's Space Grant program. Rock credits David Bartlett, director of the New Hampshire Space Grant Consortium, with "stepping up" and providing additional funds to bolster Forest Watch. "Space Grant has been very instrumental and has made significant contributions almost since the beginning," he says.

"Forest Watch was the very first outreach program that NH Space Grant funded, starting in 1991," says Bartlett. "It's gratifying that we have been able to support this program continuously ever since, and have expanded to help support other programs like Watershed Watch and Project SMART as well. Through Forest Watch and his other projects, Barry has created a model for engaging young students in science that has become nationally and internationally known."

In the tradition of Forest Watch, Rock, Subhash Minosha, and others also spearheaded the creation of Project SMART—a summer institute at UNH for talented high school students in science and mathematics, and Watershed Watch, also a summertime, hands-on science course that allows students to use a wide range of scientific methods to study both the aquatic and terrestrial parts of a watershed.

Watershed Watch, an NSF-funded program, is aimed at increasing the number of undergraduates receiving associate or baccalaureate degrees in established or emerging fields within science, technology, engineering, and mathematics.

Run by the Joan and James Leitzel Center at UNH, Watershed Watch involves a partnership between UNH and Elizabeth City State University in North Carolina—a historically black university in North Carolina. Also participating are two-year colleges the New Hampshire Community Technical College and North Carolina's College of the Albemarle.

The program has had an approximately 60 percent success rate—based on the number of participants who have declared either a major or a minor in some area of science.

Rock, along with Linda Hayden of ECSU, headed up the outreach efforts for last summer's IEEE International Geoscience & Remote Sensing Symposium (IGARSS) held in Boston. The theme of the 2008 symposium was "The Next Generation" and defined the event's overarching focus on outreach and budding scientists.

The participation of four seventh-grade students from the K-8 Gilmanton School in Gilmanton, N.H. was clear evidence of how successful programs like Forest Watch are at engaging young people in real science and providing them with unparalleled opportunities.

The four girls from Gilmanton presented research findings from their Forest Watch remote sensing work to Earth scientists from over 50 countries during a poster session. The experience, noted their teacher Mary Fougere, opened their minds and doors to the future in ways that no other experience could. The girls may have the opportunity to travel to South Africa in 2009 for the next annual IGARSS symposium.

The fact that the Gilmanton students were girls was not lost on the scientists participating in the IGARSS meetings. Says Rock, "I don't know what surprised participants more, the fact that the students were so young or that they were all girls. They were the hit of the poster session." -DS

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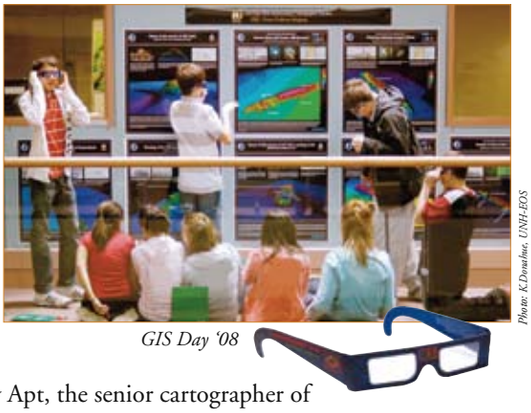
A Decade of GIS Days

THIS YEAR marked the 10th anniversary of the Geo-Information Science (GIS) Day Conference and College Fair, and ten years of effort by Michael Routhier of the Complex Systems Research Center. Routhier, who organizes the event each year, was lauded for the work he has done to bring GIS Day from its beginnings as a small, one-floor poster session to a professional venue.



GIS Day '08

Photo: K.Donahue, UNH-EOS

"Among other things, GIS Day provides a unique opportunity for high school students to learn about the geospatial sciences and the technology, and it's also an opportunity for them to see what research is going on at the university," Routhier says.

GIS Day is focused on educating professionals, students and the public about geo-spatial science technologies—such as computerized mapping and remote sensing of the Earth's surface with satellite imagery—and promoting career and educational opportunities within the field.

Routhier notes that among this year's 650 attendees were more than 200 students from high schools around New England. There was even one student from New York State whose mother drove five hours to and fro to allow her son to take advantage of the unique daylong event.

From humble beginnings GIS Day has grown to the point where it can attract collaborators like NASA, the National Oceanic and Atmospheric Administration, the National Geographic Society, the Library of Congress and others.

For example, Routhier says, keynote speakers have included NASA astronaut Jay Apt, the senior cartographer of the U.S. National Park Service Tom Patterson, and the National Geographic Society's chief cartographer Allen Carroll. Major exhibits through the years have included 90 years of mapmaking at the National Geographic Society, an ocean mapping and exploration cartographic exhibition from NOAA, and historic New Hampshire maps from the Library of Congress.

Although Routhier received special recognition for his efforts, he notes that it requires a great deal of work and expertise on the part of many EOS and university volunteer staff to successfully execute GIS Day. Likewise, he says, major funding provided by NASA's New Hampshire Space Grant Consortium from the very beginning has fueled the event's success. -DS