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EOS SPHERES

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For Undergraduates, Opportunity Knocks

Last January, two weeks into his UNH career after transferring from Salem State College, Ty Cook "just wandered into" Cameron Wake's office looking for a job. Five months later Cook found himself digging a snow pit on the St. Elias ice field in the Yukon Territory as part of a snow chemistry-climate change study.

"I guess I walked in at an opportune moment," says Cook, a senior majoring in geology. Wake, who over the years has signed on a host of undergraduates to assist in field research, introduced Cook to UNH's Undergraduate Research Opportunity Program (UROP), helped him write a proposal for funding under the program, and bundled Cook into his own research proposal. Between UROP and Wake's National Science Foundation project, Cook had enough money to take a respite from his usual summer work of house building to fly to the Yukon for two weeks of hands-on scientific research, followed up by eight weeks of laboratory work and data analysis.

Undergraduate Ty Cook stands next to meteorological instruments in the Yukon's St. Elias Mountains. Behind him is Mt. Logan, Canada's highest mountain at 19,550 feet.

Undergraduate research flourishes at EOS and UNH in general because, unlike larger schools with larger graduate student populations, undergraduates here have a host of opportunities to participate in faculty research and are shepherded towards those opportunities both formally and informally. All four EOS centers actively engage undergraduates in research projects.

These students, says Mark McConnell of the Space Science Center (SSC), "get real-life exposure to what research is all about. They get a sense that it can be exciting and also that there can be some routine drudgery involved. They get a real sense of the kind of tools we use, computing tools for example that analyze real spacecraft data." One of McConnell's students, Leila Mizouni, received a UROP research award (funded through NH Space Grant) and has been analyzing a backlog of data on X-ray and gamma-ray emissions from the Cygnus X-1 black hole that was gathered during the latter part of the GRO-Comptel mission. "Her work has added information we didn't have before," McConnell says.

While students who knock on a scientist's door looking for a research opportunity, like Cook, might

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John Aber has assumed his duties as Interim Vice President for Research and Public Service at Thompson Hall.

Payback Time

For sixteen years, UNH has provided John Aber with the time and space to do his work, and he has done so in stellar fashion. Last year Aber was named by the Institute for Scientific Information (ISI) as one of the most cited scientists (11th in a field of 1,975) in ecology and environmental sciences over the last decade. Now, says Aber, as he steps into the role of UNH's InterimVice President for Research and Public Service, it's payback time.

"If I didn't really like what UNH stands for, I wouldn't do this," Aber says. What he likes is the land, sea, and space grant mission UNH fulfills. He likes the way UNH operates with an open, interdisciplinary, lean administrative structure. He says, "It's a place where I've been able to meet all the goals I set for myself in terms of research, and when President Hart asked if I'd do this, it occurred to me that this was a chance to help maintain the quality of the institution, that it was a chance of paying back."

Vice president for research and public service? An odd coupling it would seem but, Aber notes, it's just one more reason to like the place. "UNH has so few vice presidents compared to other universities and people here wear more than one hat." With respect

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For Undergraduates, Opportunity Knocks

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perhaps be atypically motivated, they represent a broad spectrum both in terms of skills they bring and goals they hope to achieve. Says John Macri, who uses many students to help with projects in his SSC lab, "They don't have to bring any particular skills; it's helpful, and I like that, but it's more the motivation, willingness, time, and commitment. To me it's more the attitude than the skills."

In addition to real-world experience in the laboratory and, often, in the field, undergraduates also get the opportunity, for example, to write a formal proposal under the UROP program and write research papers for submission to scientific journals. James Ledoux, who worked with both Macri and McConnell for three years (independent of UROP) and is now off to Cornell to study in a Ph.D program for theoretical physics, co-authored four papers based on his research experience. Not bad for a 22-year-old. Says Ledoux, "I gained a lot of general problem solving skills. I worked independently, troubleshooting problems for something that had to get done as part of grant-funded research."

Cook, a 30-year-old "nontraditional" student, combined his passion and experience in climbing and mountaineering with his interests in geology and environmental issues to formally study alpine and arctic environments. Of his research project he says, "The biggest benefit, aside from my own personal experience in the field, is that I can produce good science, that I can do something useful, not just take but give something back as well."

Wake says the experience Cook and others get involves seeing a project through from start to finish – from the formulation of an idea to planning the field pieces, gathering samples, analyzing and writing the data up for publication in a scientific journal. "And that's just not something we teach undergraduates." -DS

From the Director

Looking Ahead

When the Institute for the Study of Earth, Oceans, and Space (EOS) was established in July 1985, its charge was to become one of the premier academic Earth and Space Science centers in the nation. This goal has been achieved. Growth in numbers and reputation places the Institute in the forefront of academic centers conducting interdisciplinary research in Earth and Space Science. But in addition to our research mission, we have an even more important educational mission.

It is time now to renew and expand our commitment and resources to the vital challenge of educating graduate students capable of advancing our understanding of the Earth and its setting in the universe. In addressing this mission, we need to recognize an added responsibility to better incorporate undergraduates in our enterprise by expanding their opportunities to participate actively in research (see cover story *For Undergraduates, Opportunity Knocks*).

EOS has much to be proud of for its contribution to undergraduate and graduate education, but we can do even more in providing a unique educational experience to the younger student. During this next year, we should focus more on the student and the quality of our academic program, and on improving the curriculum and spreading its excitement.

Several specific goals come to mind. We must:

- Capitalize on our already close relationship with the Marine Program and particularly with the Center for Coastal and Ocean Mapping;
- Strengthen the university-wide, newly created combined graduate program in Natural Resources and Earth Systems Science that resides in the Graduate School;
- Seek and realize the establishment of a graduate program at the college or university level in Atmospheric Sciences;
- Enhance the space science curriculum by leveraging the extraordinary growth in faculty during this past year;
- Increase our effectiveness in outreach, by expanding our commitment to and collaboration with the Space, Sea, and Land Grant Programs, and finally, and *most importantly;*
- Increase our presence in and support of the intellectual life of the UNH undergraduate through several avenues including new courses, expanded research opportunities, and creative special projects.

– Berrien Moore III

Payback Time

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to his new job, what this represents is that the university sees research as an integral part of its overall academic mission. "There is a real dedication on the part of the administration and faculty that research should be entwined very closely with education, teaching, and service," Aber says.

Part of this dedication shows up in the university's commitment to undergraduate research. "When we support undergraduate research opportunities, at EOS and departments campus-wide, it's not just window dressing," Aber says. In like fashion, having faculty engaged with undergraduates in the classroom, in the laboratory, and in the field represents the best of both worlds: a blending of a small, liberal arts college and a larger research institution, the latter where graduate students play a more dominant role in both research opportunities and classroom teaching.

This, he notes, is part of a larger national trend of integrating undergraduate education with research for more "experiential" learning. With respect to that trend, UNH is ahead of the curve. "We're already there," Aber says with pride. - DS

UNH Receives Top Tier Status as a Sea Grant College

"This is a wonderful day in the 35 years of the history of New Hampshire Sea Grant," said NH Sea Grant Director Ann Bucklin at an August 20 ceremony in Dimond Library. During the event, National Oceanic and Atmospheric Administration (NOAA) Administrator and Undersecretary of Commerce for Oceans and Atmosphere Vice Admiral Conrad Lautenbacher Jr. presented UNH President Ann Weaver Hart with a plaque commemorating the university's renewed status as a top tier Sea Grant College.

Sea Grant College status is the top level of programs within the National Sea Grant College Program, a federal-university partnership whose mission, as mandated by Congress, is to foster the sustainable development of the nation's coastal resources through research, education, and outreach.

"This top status signifies that NOAA recognizes the breadth of our marine research, education, and outreach activities, and it also recognizes the quality of both our people and our facilities," said outgoing UNH Vice President for Research and Public Service Donald Sundberg during the ceremony.

Also speaking were National Sea Grant Review Panel Chair Peter Bell, Seacoast Science Center President Wendy Lull, and National Sea Grant Director Ronald Baird. Nancy Ragland Perkins, Legislative Assistant for Oceans and Environment for U.S. Senator Judd Gregg (R-N.H.), read a letter from the Senator.

UNH has received Sea Grant funding since 1968, but for most of that period it was part of a joint program with the University of Maine. In 2000, the institutions created two fully distinct programs. The newly independent NH Sea Grant has been able to focus its efforts on the needs of the Granite State, but the separation also required UNH to reapply for top tier status as a Sea Grant College. In March, a panel of marine experts visited UNH to review its application and gave a "glowing recommendation" that it should become a Sea Grant College, according to Bell, who assembled the panel. Maine has submitted its application but a site visit has not yet been scheduled.

Prior to the Sea Grant ceremony, Admiral Lautenbacher spent the morning touring campus and learning more about UNH – NOAA collaborations, eight in all. NOAA is the largest contributor of federal funds to UNH marine centers and institutes.

Clockwise from top: UNH President Ann Weaver Hart and NOAA Administrator Vice Admiral Conrad Lautenbacher Jr.; Ellen Goethel of the Northeast Seafood Coalition (right) and Nancy Ragland Perkins, Legislative Assistant for Oceans and Environment for U.S. Senator Judd Gregg; NH Sea Grant Director Ann Bucklin (right) with President Hart.
Photo courtesy of UNH Instructional Services.

"The University of New Hampshire is an extremely impressive organization that is a leader in partnerships," said Admiral Lautenbacher. He added, "The problems and challenges that we face are significant, and we have reached the stage where they are not just single disciplinary problems. They are issues that require us to bring together a full understanding of the coupling of Earth systems and Earth sciences, and the University of New Hampshire is at the forefront of bringing together multidisciplinary teams to help solve some of these difficult issues." – Kathy Schmitt

UNH as a Land, Space and Sea Grant Institution

The Sea Grant celebration also marked the day that UNH became one of only nine universities in the nation to hold top tier status as a land, sea, and space grant institution. With this status, UNH receives federal funding for research, education, and outreach through three national programs established by Congress: the Cooperative State Research, Education, and Extension Service (funded by USDA), the National Space Grant College and Fellowship Program (funded by NASA), and the National Sea Grant College Program (funded by NOAA).

The term "Sea Grant" was chosen to emphasize the parallel between this new program focusing on the nation's marine resources and the land grant program that had been established a century earlier to develop agricultural resources. In 1989, another university-based program, the National Space Grant and Fellowship Program, was formed within NASA, with UNH designation following in 1991 and top tier status in 1999.

Says John Aber, UNH Interim Vice President for Research and Public Service, "It is rare to find the land, sea, and space grant designations all in one university, especially in a mid-sized institution with such a strong commitment to undergraduate education. This epitomizes the close partnership between research and teaching that is at the heart of the UNH mission." – Kathy Schmitt

The Morse Hall atrium was the site of the Sea Grant College reception where a host of displays on scientific research being conducted at UNH/EOS was on display. *Photo courtesy of UNH Instructional Services.*

Committed to Big Science

Space and plasma science endeavors are in the category of "big science," Amitava Bhattacharjee says, and UNH struck it big indeed when the Peter Paul Chair in Space Science was created and infused EOS, the Space Science Center (SSC) and the Department of Physics with new faculty and researchers. Bhattacharjee, who arrived in July from the University of Iowa to fill the newly endowed chair, deflects the spotlight and says in a soft-spoken voice, "The very fact that the Paul Chair was created at UNH demonstrates a strong and unequivocal commitment on the part of the university to space and plasma science at a time when such commitments have not always been forthcoming at some leading institutions around the country."

Adds former UCLA geophysicist Joachim "Jimmy" Raeder, who joined ranks with six other scientists at SSC this summer, "UNH really stands out in the U.S. in that it does support space physics and even expands it. I know very few places where that's the case."

Historically, UNH has been very strong in space physics and Bhattacharjee and others see the recent additions as both prudent and visionary. Says SSC director Roy Torbert, "The Paul Chair gave us the opportunity to highlight the strength of the Space Science Center and establish it as a premier institution in the U.S. in this area of science." Torbert asserts that, with respect to its faculty in the field of space and plasma science, UNH is now in the top tier of institutions, alongside schools such as UCLA and UC Berkeley. "And that's a nice group to be among."

Bhattacharjee believes he and the others will fulfill this commitment by adding a new dimension to the existing work at SSC/EOS, "primarily in plasma theory and computation, which cuts across disciplinary lines in that it combines expertise in magnetospheric, solar, astrophysical, and laboratory plasma science," he says.

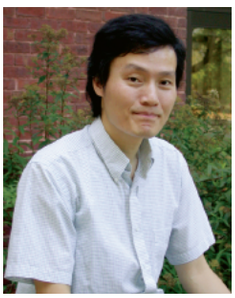
Adds Raeder, "What we bring is computational physics, which means that we use whatever computer power we can get our hands on to solve problems, to build models." The Bhattacharjee team, for example, brought with them a supercomputing cluster that, while modest in size (involving 32 processors), uses fast connectors between the processors, which enables them to talk to each other and carry out computing tasks in parallel. This is ideal for solving the equations of plasma physics and fluid dynamics.

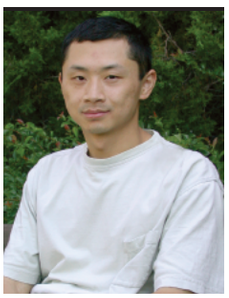
Amitava Bhattacharjee

This computational approach, which takes advantage of new developments in applied math and computer science, says Bhattacharjee, "enables us to make a natural bridge with observers and experimentalists at EOS and SSC, as well as the physics department. It also provides possible tools for the Solar Terrestrial Theory Group to test out some of their analytical models."

Working directly with Bhattacharjee in his theoretical plasma physics group are assistant research professor Chung-Sang Ng, and research scientists Ping Zhu, Kai Germaschewski, and Naoki Bessho (not pictured). Raeder, who joins SSC/EOS and the physics faculty as an associate professor, was appointed in conjunction with the Paul Chair (Bhattacharjee requested the appointment) but leads an independent research effort in computational models of the Sun-Earth system.

Charles Smith, of the Bartol Research Institute at the University of Delaware joins SSC/EOS and the physics department as a research professor and is also independent of Bhattacharjee's group. However, his work in analyzing magnetic field data will mesh with the work being done by Bhattacharjee et al. In addition, Smith's work in cosmic ray and interplanetary energetic particles will dovetail with that of his new Morse Hall neighbors, Bruce McKibben, Jim Connell, and Cliff Lopate, who arrived last year from the University of Chicago (see the cover story in the Spring '03 issue of Spheres). -DS





Top right: Jimmy Raeder.
Bottom from left to right: Charles "Chuck" Smith, Chung-Sang Ng, Kai Germaschewski, and Ping Zhu.

Faculty/Staff News

Space Science

Mark McConnell presented some of the first results from his study of X-ray polarization from solar flares at the June meeting of the Solar Physics Divsion of the American Astronomical Society. The study uses data from the Ramaty High Energy Solar Spectroscopic Imager (RHESSI), a satellite mission that was recently rated highly by a NASA review panel and whose mission will therefore by extended for at least another two years.

In May, **Charlie Farrugia** addressed an audience at the Argentinian Academy of Sciences of Buenos Aires. His lecture, "The magnetic connectivity of interplanetary magnetic clouds to the Sun," will be published later this year in a special journal of the Academy.

Eberhard Möbius served as guest editor for a special issue of the Journal of Geophysical Research (JGR) entitled, "Interaction of the Heliosphere with the Local Interstellar Medium and the Boundary Regions." The issue brings together results from the fleet of heliospheric spacecraft, such as the Voyagers, Ulysses, ACE, SOHO and Wind.

Earth System Science

Huiting Mao's paper, "Global and Seasonal Variations of O3 and NO2 Photodissociation Rate Coefficients," recently appeared in the *Journal of Geophysical Research – Atmospheres.* Her work identified the mechanisms controlling the geographical and seasonal variations in rate coefficients through sensitivity experiments of temperature, surface albedo, aerosols, ozone column, and clouds.

Karen Von Damm will be exploring "black smokers" in the East Pacific Rise (EPR) during the month of November aboard the RV *Atlantis.*

Jack Dibb, **Eric Scheuer** and **Garry Seid** participated in NASA's DC-8 Inlet Characterization Experiment (DICE) in May and June. The UNH airborne aerosol sampling system proved scientists can efficiently sample particles as large as 8 microns in diameter from jet aircraft moving over 200 meters per second.

Ann Bucklin reports that visitors to OPAL included Ho-Young Soh, a researcher from Yosu National University, Korea. A taxonomic expert for copepods (a group of marine zooplankton), Ho-Young is working with Bucklin on the ZooGene project (http://www.ZooGene.org). Bucklin also notes that OPAL is growing rapidly, with new faculty, a postdoctoral fellow, staff, and students.

George Hurtt was invited to speak at a National Academy of Sciences Workshop entitled, "Direct and Indirect Human Contributions to Terrestrial Greenhouse Gas Fluxes," held in Washington, D.C. Sept 23-25. The title of the talk was "Consideration for Differing Spatial and Time Scales."

Vania Jordanova was promoted to Research Associate Professor in SSC.

Ruth Varner was promoted to Research Assistant Professor in CSRC.

Cameron Wake was promoted to Research Associate Professor in CCRC.

Championing the Pan-Arctic Region

Jonathan Pundsack is up to his neck in Arctic water systems. Only a few weeks into the job, Pundsack is charged with coordinating the efforts of 22 scientific research projects currently being done as part of the National Science Foundation's (NSF) Arctic Community-wide Hydrologic Analysis and Monitoring Program, or Arctic CHAMP. The NSF mandated that the disparate groups from around the country doing this research synthesize their efforts, and Pundsack has been given the task as the newly appointed coordinator of the Arctic CHAMP Science Management Office. The establishment of the office at UNH/EOS was due to the fact that Charles Vörösmarty's Water Systems Analysis Group has been very active in Arctic hydrology research, and Vörösmarty took a lead role in the establishment of Arctic CHAMP.

The new management office joins ranks with an impressive list of similar offices at EOS that oversee national scientific research efforts, among them, NASA's Large-Scale Biosphere-Atmosphere Experiment (in Amazonia) Ecology Project Science Office, the National Ice Core Lab, the Northeast Consortium, the Center of Excellence for Coastal Ocean Observation and Analysis (COOA), two International Geosphere-Biosphere Programme offices (GAIM and IGAC), AIRMAP, and the newly relocated Center for Magnetic Reconnection headed by Amitava Bhattacharjee.

Jonathatn Pundsack

Why this intense focus on the hydrology of the far north? "The Arctic has been identified as a key region to study because, it is theorized, climate change – increases in temperature, changes in precipitation and stream flow – will have far-reaching consequences outside the region," Pundsack says. For example, there is growing evidence or an increasing number of hypotheses that the thermohaline circulation of the world's oceans is greatly influenced by the input of freshwater from the pan-arctic region.

This circulation system, also referred to as the ocean "conveyor belt," is fueled by the vast amount of cold surface water that empties into the Arctic Ocean and, eventually, descends to the bottom of the North Atlantic and gets redistributed to the other oceans of the world. The conveyor belt is responsible for taking heat from the south Atlantic and moving it northward into the higher latitudes (via the Gulf Stream, for example), which brings heat and moisture up the North Atlantic and it helps keep places such as Europe fairly warm. Thus, it is believed to be the driver for large-scale climate patterns. Evidence suggests that the circulation system may have shut down in the past as part of the last glacial cycle.

"One of the CHAMP project's specific goals was to have all the funded parties (which includes over ten universities and research institutes) communicate and cooperate with each other right from the get-go," says Richard Lammers, a research scientist in the Water Systems Analysis Group. According to Lammers, smaller projects have not required this kind of cooperative approach, "but with this, we are looking at all the watersheds for a very large region – essentially the top quarter of the globe – and no one group can do that on their own."

The watershed area covered by the 22 Arctic CHAMP research projects being coordinated by Jonathan Pundsack (left) stretches some 24 million square kilometers of tundra and boreal-taiga forest in North America and Eurasia, Russian grasslands, and Canadian prairies.

There is a perception that the high latitude region, what is referred to as the pan-arctic, is a cold, barren wasteland. Hardly. From a hydrological point of view, if defined by the river basins that flow north, it's a 22 to 24 million square kilometer land area that includes tundra, boreal-taiga forest in North America and Eurasia, Russian grasslands, and Canadian prairies.

Says Lammers, "In some ways CHAMP can be viewed as a natural progression. We've been trying to do a lot of this on our own for quite a while so it's very natural for us to look at the entire pan-arctic. We've been very fortunate that our way of looking at the Arctic from a large-scale freshwater perspective has effectively been adopted by the NSF as a really important way of doing it." - DS

http://www.arcticchamp.sr.unh.edu

Bookmark this

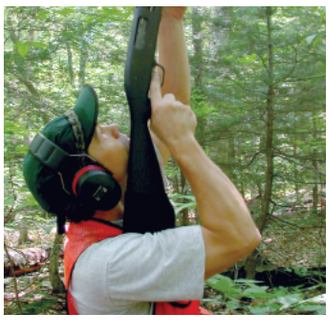
Facelift for EOS-Webster

EOS-WEBSTER, the UNH-based Earth Science data distribution system, celebrated its fifth birthday with a facelift. According to Denise Blaha, User Support Coordinator, the upgrade makes the site "far more intuitive and much more flexible to users as far as how they select and retrieve the data." The site provides terrestrial ecosystem data sets free of charge to scientists, teachers, students, and the general public. To date, EOS-WEBSTER has distributed over 640 gigabytes of data to about 20,000 users worldwide. There are currently 95,000 data holdings.

The site contains satellite data (e.g., MODIS and Landsat images), agricultural statistics, climatological data, demographic, land use, and soils data, to name just a few. "Data can be downloaded or ordered on a customized CD," says Blaha adding, "typically, an order gets placed and processed within a few minutes." Give EOS-WEBSTER a whirl at **http://eos webster.sr.unh.edu.**

The Sound of Science

We are tromping through the woods in the White Mountains on Plot 32-P of the 2,600 acre Bartlett Experimental Forest. In the distance, intermittent blasts of shotguns echo while, right here on 32-P, the air reeks of gunpowder as Scott Ollinger again locks and loads, looks skyward, takes aim, and blasts 12-gauge steel birdshot at his quarry, *Acer rubrum.* Down through a haze of blue-gray smoke, small branches and individual leaves flutter and whirl from the crown of the red maple tree Ollinger has just nailed. The leaves, peppered with holes, are placed in a brown paper lunch bag by Ollinger and his fellow hunter-gatherer, Marie-Louise "M.L." Smith of the USDA Forest Service. They move on, GPS (global positioning satellite) monitor in hand, to bag their next trophy, *Betula alleghaniensis,* a 100-foot high yellow birch. By late afternoon, there will be boxes of spent shells, labeled bags full of leaves from a "dog's breakfast" of trees (a large variety of species), and half a dozen tired scientists/sharpshooters satisfied with another day of fieldwork doing cutting-edge science.



Scott Ollinger shoots leaves from the canopy of trees in the Bartlett Experimental Forest in the White Mountains. Leaf chemistry is analyzed and combined with "hyperspectral" remotely sensed images to provide an accurate gauge of forest productivity.

What would appear to be the scientific method of John James Audubon or Charles Darwin is, in fact, state-of-the-art when combined with the modern technology of remote sensing and other ground-based instruments. The leaf samples Ollinger and company (including Mary Martin, Lucie Plourde and Colin Pinney of the Complex System Research Center, and Smith of the Forest Service) shoot down from the crowns of trees will also be "shot" from 70,000 feet up, at the very edge of the Earth's atmosphere, by an instrument called AVIRIS, for Airborne Visible-Infrared Imaging Spectrometer. The "hyperspectral" instrument is flown aboard a NASA ER-2, which is a modified version of the U2 spy plane. Even from that height, the images AVIRIS collects are so detailed that scientists can correlate precise measurements of canopy nutrient concentrations with the reflectance spectra from an AVIRIS pixel. This is because the spectrometer takes images using 242 spectral bands of light (both visible and infrared) compared to, for example, the Landsat satellite, which uses only seven spectral bands.

Ollinger offers this analogy: "Imagine trying to play a Mozart concerto on a piano that has just seven keys as opposed to one that has nearly a hundred."

Since leaves absorb and reflect light according to their chemical makeup, the spectral images taken by AVIRIS will be correlated with the field samples to determine precise levels of leaf nitrogen, lignin, and cellulose. These data will provide the scientists with a clear picture of forest productivity and related information on carbon uptake and nitrogen cycling. Says Ollinger, "Leaf chemistry is a good index of ecosystem biogeochemical processes. We'll use the spectrometer images and lab leaf samples to get the percentage of nitrogen in the canopy and extrapolate this to the whole image" and, thus, the larger forest beyond this one plot. Nitrogen, Ollinger points out, is *the* limiting nutrient with respect to plant growth; just look at the ingredients on a bag of standard fertilizer – it's mostly nitrogen.

For a broad area of forest, the remote sensing and field sampling data will determine where high and low concentrations of nitrogen are, which in turn will correspond to soil type and land use history (fire, clear cutting, and agricultural usage can have large and long-lasting effects on nitrogen levels). Says Ollinger, "To better understand the patterns and rates of forest growth, which translates into carbon uptake, being able to map out the concentration of nitrogen in plant canopies is extremely useful." Understanding nitrogen levels in the forest canopy will also aid scientists in better understanding nitrogen levels in soils and surface waters, which when elevated can lead to loss of other soil nutrients and acidification of streams.

Back in the woods, the sound of science continues as Ollinger and Smith stalk their targets yelling out "another maple" and "hemlock" much the way a pool player announces the intention of putting the 8-ball in the side pocket.

Ollinger aims, shoots, and scores. - DS

Faculty Profile

Working Globally, Thinking Locally

Steve Frolking, like many people at EOS, works in the broad arena of biogeochemical research, investigating aspects of the big, complex, interrelated systems that drive global processes - like the carbon cycle.

"Of course," he says with a grin, "my background includes virtually no biology, no geology, and no chemistry, so I'm well suited for this." He adds, "But I think it's the nature of interdisciplinary science — you come in from some angle and broaden to a much wider focus."

Frolking, research associate professor in Complex Systems, has indeed widened his focus since transferring to UNH as a math major and getting his undergraduate degree in physics in 1980. While completing his masters in nuclear physics, he heard Berrien Moore give a talk on carbon cycling and global climate change and was "intrigued" enough to change course and get his Ph.D. in Earth Sciences at UNH.

While Frolking researches issues with a global reach (for example, projects on greenhouse gas emissions in Asian rice paddies, and carbon cycling in northern peatland areas), he's keenly aware of the need to think smaller and more locally.

"We've made enormous changes in the nitrogen, sulfur, and carbon cycles but I look out my window and I can't tell the difference from one day to the next, or one year to the next." He adds, "We try, but I don't think people are inherently good at thinking globally in every day life. It's both difficult and a luxury, and we're all caught up in the day to day details of life."

One exercise Frolking uses to help bring matters home is to imagine driving one mile to and from the store to buy, say, a quart of milk. If the one billion people in the world with comfortable living standards did likewise once per week for a year, about three billion gallons of gas would be burned. That's enough fuel, as oil, to heat all homes in New Hampshire for five years. And that's enough to make you think twice, locally. - DS

Student News

New OPAL graduate students in Ann Bucklin's lab are, **Brian Ortman** (a recipient of a UNH Marine Science Fellowship linked to COOA who enters with a M.S. from the University of Southern Mississippi), and **Ebru Unal Yigiterhan** (entering with a M.S. from Middle East Technical University, Turkey.)

Also in OPAL, **Seung-Hyun Son**, a Ph.D. student in oceanography, worked on ocean primary production modeling at the Bedford Institute of Oceanography, Halifax, Canada as a visiting scholar with the IOCCG fellowship. In August, he was awarded a travel fellowship for the PICES meeting and the workshop of the Yellow and East China Sea, which was held October 9-18, in Seoul, Korea.

The 2003 NASA Earth System Science Graduate Student Fellowship Awardees from UNH are, **Jeanne Anderson**, **Amy Frappier**, and **Qingyuan Zhang**. In all, 55 students were selected out of 219 applicants from 38 states. The fellowship program is designed to train a pool of scientists to support NASA's central mission of understanding and protecting the Earth.

The 2003 Research & Discover summer interns, **Erin Atkinson**, **Erica Darken**, **Lorraine Beane**, and **Sarah Silverberg**, presented their projects at both EOS and at NASA'S Goddard Space Flight Center in mid-August. Reports George Hurtt, the program's faculty coordinator, "After just the second year, students in the program have already given talks at national and international meetings, completed theses, and submitted papers for publication in major research journals." Hurtt notes that the program's second-year interns, Bill Sacks, Tom Daigle, Catherine Denoncourt, and Heather Bain, completed their projects at NASA-GSFC and also presented their work.

Student Profile

Working at EOS: more than just a job, an adventure

Kevan Carpenter maintains AIRMAP's Thompson Farm air monitoring station.

Five days traveling by car on "washboard" dirt roads in the Himalayas, peering out the window and down 1,000 feet at crumpled vehicles that had failed to negotiate the curves, Kevan Carpenter wondered whether his decision to leave the private environmental consulting business to join the Glacier Research Group (later to become the Climate Change Research Center) was such a wise career move. But his doubts ended with the hair-raising ride and, today, three years since descending 20,000 feet from Mt. Everest where he tested an ice coring drill (which failed to work), the AIRMAP research scientist and master's degree candidate never looks back.

"It was great, but I don't know if I could go back there again right now, not with two small kids at home," he says. He will, instead, be content to manage AIRMAP's four New Hampshire air quality monitoring stations – at Thompson Farm in Durham, atop Mount Washington, at the Isles of Shoals, and in Castle Springs – and finish up his Earth Sciences degree in geochemical systems with an emphasis on atmospheric chemistry.

It's not Everest or Greenland or the Antarctic (where he's also been lucky enough to do CCRC research), but the four NH sites do get him into the field and out of the office on a regular basis. Which works well for a guy who, by age six, had already climbed all the 4,000-footers in the White Mountains.

Carpenter, along with research technician Pieter Beckman, is charged with maintaining the AIRMAP facilities and their instruments – some 50 precision pieces of air monitoring equipment. Well over half of the off-the-shelf instruments have been significantly modified to enhance or lower their detection limits and to improve their stability and precision. Says Carpenter, "With AIRMAP's focus on trying to develop a more detailed understanding of air quality in the region and the transport of air in and out of the region, we need to look at the whole spectrum of pollutants – from trace levels to elevated levels – and this requires instrument modifications."

Carpenter and Beckman routinely visit each site on a bi-weekly basis (the Isles of Shoals site currently operates seasonally). "I spend about 40 percent of my time troubleshooting the instruments at the four sites," Carpenter says adding, "Pieter came on board two years ago and he's been a life saver." And this has helped Carpenter devote a bit more time to completing his M.S., which will end up taking the full-time research scientist five and a half years. Coursework done, thesis to go. - DS

Waiting to INHALE

The monitoring station went up, the kids did their part, and Cameron Wake's project INHALE got well under way this summer. But because there were only a handful of bad air days in the region, getting more data correlating poor air quality and pulmonary function will have to wait until this autumn.

Wake, research associate professor in the Climate Change Research Center (CCRC), conducted a pilot project at Bear Brook State Park in Allenstown, NH with a group of campers age 6 to 14 years old. The study is part of the Integrated Human Health and Air Quality Research (INHALE) project for which Wake is the principal investigator. UNH professor of Health Management & Policy and epidemiologist Jeff Salloway, and Tom Kelly, director of the UNH Office of Sustainability Programs, are co-investigators.

For the project, a pre-selected set of campers (10 with asthma, 10 suspected of having asthma, and 20 kids with no history of respiratory problems) blew into spirometers (pictured) three times each morning and evening over the course of eight weeks. The instruments measure a child's forced expiratory volume (FEV1), which provides a measure of lung capacity. This measurement, correlated with air quality information gathered at the site, will, it is hypothesized, give a clear indication of how polluted air affects respiratory function/health.

Says Wake, "We did get some great data and learned a lot about how to do spirometry measurements. We discovered that using the FEV1 measurements we can easily identify children who are asthmatics. But in terms of relating the spirometry measurements to air quality, we're going to have to wait to have a detailed look at the data."

What the pilot study does, Wake says, is lay the foundation to answer some key questions about the asthma-air quality link. "If we can export this methodology to gather data from a broader population, we may be able to actually discern the key pollutants that cause problems and determine if air pollution episodes have a cumulative effect with respect to asthma attacks."

Wake notes that most studies linking air quality to human health deal with emergency room visits or deaths, which represents the smallest portion of people who actually suffer negative health effects. It is estimated that just one tenth of one percent of people who suffer from a bad air quality day are accounted for in the majority of studies.

Of his study Wake says, "We're actually looking at the human health perspective of global climate change, of air quality events, and I think this is critical for scientists to do." Wake and his colleagues will continue the effort, and in a bigger way, as part of next summer's large-scale AIRMAP air quality campaign. - DS

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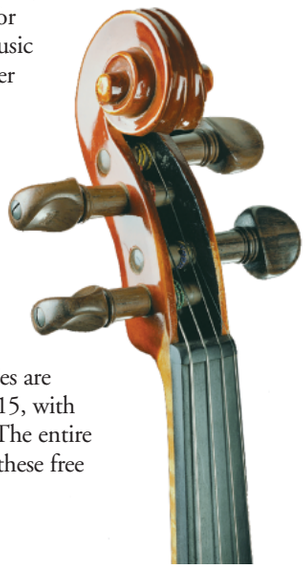
Fall Spheres Concert Series

Music a la Carte

The EOS Spheres Fall Concert Series is underway with a brand new season of music for the enjoyment and enrichment of the entire campus community. The New England Bluegrass Band kicked off the season September 18. Joining the band for the performance were national mandolin champion, John McGann, and seacoast fiddle and songwriting sensation and UNH alumnus, Joyce Anderson.

The second concert in the Fall Series, Thursday, October 16th, features UNH Music Department Faculty members, Arlene and Christopher Kies, who will perform music for piano four-hands. Their program will include music by Igor Stravinsky, George Gershwin, Christopher Kies and others.



Thursday, November 20th, The Amazing Mambo Combo, a 6-piece Latin dance and jazz ensemble, wraps up the season with their unique sound steeped in the Afro-Cuban musical tradition, combined with Latin arrangements of American pop and R&B tunes rounding out their amazing repertoire.

All concerts in the EOS SPHERES Concert Series are held in the Morse Hall Atrium, from 12:15 – 1:15, with complimentary seasonal refreshments provided. The entire campus community is warmly invited to attend these free musical events.

http://eos.sr.unh.edu/About/Events

Fellowship Secured From Homeland Security

Carolyn Girod received a graduate fellowship from the U.S. Department of Homeland Security. Girod, who has been working on her M.S. under a fellowship from the NASA-funded New Hampshire Space Grant Consortium (NHSGC) and will defer those funds for now, is looking at the connection between forest fire risk and carbon storage. In securing her fellowship, Girod argued that these issues are crucial to homeland security since fires endanger people and property, and carbon storage slows the pace of climate change.

There is also an inherent "tension" in the coupled dynamics of carbon and fire. "They are linked by the fact that fire suppression results in carbon storage through the buildup of woody vegetation, and stored carbon is fuel for fires." Of her research Girod adds, "I plan to simulate current forest management strategies and evaluate the results in the context of our national priorities." - DS

Cary Girod was granted a fellowship from the U.S. Department of Homeland Security to study the tension between fire risk management and carbon storage.