EOS SPHERES

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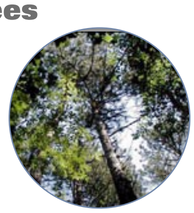

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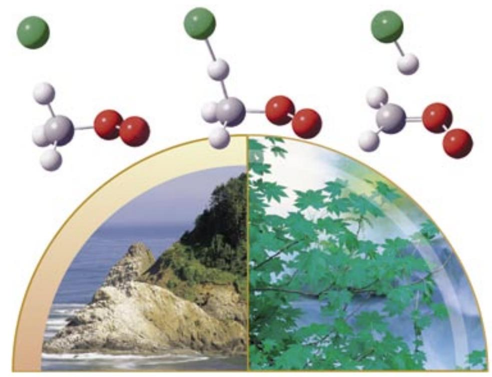
Spring 2005

Vol. 4 Issue 1

Good Chemistry

A "Powerful Alliance" Between EOS and the Department of Chemistry is Building New Bonds

During the first semester of his sabbatical year, Howard Mayne, former chair of the UNH Department of Chemistry, sat in on Rob Griffin's graduate course, Global Atmospheric Chemistry. Mayne is a theoretical chemist and, as such, specializes in a branch of the science that tends to ponder very small systems, posing questions like – Will this atom react with this molecule? For Mayne, Griffin's course was a decidedly different area of inquiry.



When forest air mingles with a sea breeze, interesting and unknown chemistry takes place.

According to Griffin, an atmospheric chemist in the Climate Change Research Center, "I'd imagine it gave Howard a chance to see fundamentals of chemistry being applied to a big, dirty, ugly, real-world scenario."

In fact, for the past year or so, Mayne and others in the Chemistry department have been delving into ugly, real-world chemistry more than usual as they build what Mayne characterizes as "a powerful alliance" with EOS scientists doing cutting-edge atmospheric research.

Several chemistry faculty, graduate and undergraduate students have become involved in various ways with AIRMAP – the joint NOAA/UNH effort to develop a detailed understanding of climate variability and the source of persistent air pollutants in New England.

In addition to Mayne, faculty members Richard Johnson, Glen Miller, and John Dudek have all participated in AIRMAP projects. Dudek, a physical chemist, is developing laser detection devices for important atmospheric trace gases, while organic chemist Miller has worked with AIRMAP scientists by synthesizing molecules needed for atmospheric experiments performed in the Morse Hall atmospheric simulation chamber.

Says Mayne, "I think the power of what we have is that the people in the atmospheric camp know what questions to ask about the data they collect, and those of us in the chemistry camp have an array of tools to help interpret the data."

For example, Mayne, organic chemist Johnson, and EOS atmospheric chemist Barkley Sive have been collaborating on a project looking at how chlorine (from sea salt, for example) reacts with unstable, intermediate molecules in the atmosphere to possibly affect air quality. The chemists are using field data gathered by Sive at UNH's atmospheric observatories located at Thompson Farm in Durham and on Appledore Island at the Isles of Shoals. In addition, doctoral student Carsten Nielsen (see story on page 3) has been doing experimental work with chlorine and hydrocarbons

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Going Deep

The Western Divide Ice Core Project in Antartica

The National Ice Core Laboratory in Denver, Colorado holds 13,000 meters of ice cores and a record of hundreds of thousands of years of the Earth's climate history. And if you're a scientist interested in analyzing a chunk of the stuff to help unravel the past and foretell the future, you'll have to first get the go-ahead from Mark Twickler in the Climate Change Research Center.

Twickler is the director of the NICL's Science Management Office and, as such, serves as the gatekeeper for ice cores collected around the world by U.S. researchers.

"I'm not actually doing the science that helps humanity. What I do is help a wide array of scientists help humanity. And that's why I can sleep at night, that's what I like to do," Twickler says matter-of-factly.

Twickler will soon be helping those involved in a new chapter of ice coring – phase two of the National Science Foundation's deep ice coring project in Western Antarctica. Known as the WAISCORES program, the main goals are to

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Mark Twickler holds an ice core from UNH's collection of temperate ice cores

EOS SPHERES

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From the Director

Remembering Jack Lockwood

WITH THE PASSAGE OF TIME, any organization must weather sadness. As I was writing this column, I learned of the death of Emeritus Professor Jack Lockwood.

Jack's role in the formation of EOS and his extraordinary scientific contributions were one of my themes in this column for the first issue of Spheres. As I have noted on numerous other occasions, Jack built one of the world's first cosmic ray detectors at the Mount Washington Observatory and, in so doing, discovered that the cheapest path to (almost) space was the Mount Washington Auto Road. More importantly, because of Jack's early leadership, when the nation was ready to go to space, the Space Science Center (SSC), then within the UNH Department of Physics, was ready to participate. The SSC contributed significantly to pathfinding work in space with instruments on the Pioneer and Voyager series as well as the Solar Maximum Mission.

Jack was also a driving force behind one of NASA's great astrophysical observatories–the Gamma Ray Observatory. Launched in April 1991, GRO was the largest scientific payload lifted into orbit by shuttle. Extraordinary discoveries flowed from GRO, including a plume of antiparticles gushing from the center of our galaxy that the press dubbed the "fountain of annihilation." When I mentioned this phrase to Jack, I remember his wry smile and words, "I'm not sure I would have used that phrase; it is a rather beautiful object."

Finally, Jack played a special, quiet role in the lives of many; he did so in mine. In 1976, when I decided to turn down a Fulbright Fellowship to continue my work in mathematics and spend an uncertain year shifting professional directions, Jack was central in supporting my decision. He simply said, "You must do what you must do."

We will miss you, Jack Lockwood.
–Berrien Moore III

Good Chemistry

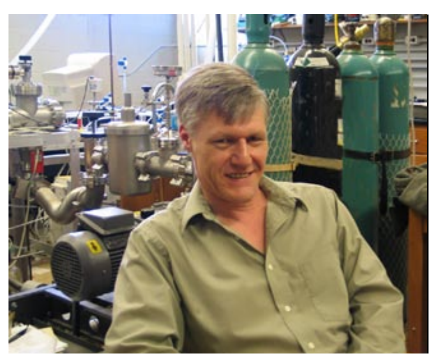
continued from page 1

from a class of compounds known as terpenes (generally emitted from pine trees) in Griffin's NSF-funded simulation chamber. Mayne notes that in addition to Nielsen, two other chemistry students are currently working on AIRMAP-funded projects, with more likely to arrive soon.

The molecular model illustrated on page 1 represents what might happen in one of the possible reactions when sea air mixes with forest air. The green atom is chlorine, and we know from the world's experience with chlorofluorocarbon (CFCs) and the springtime, stratospheric Antarctic ozone hole, that chlorine can have surprising and unexpectedly important roles in the chemistry of the atmosphere. Perhaps it is not surprising then that the chemistry near the ocean has its own surprises. (Notes Sive, "Until we started making measurements at Thompson Farm, we didn't realize how big of an impact marine-related molecules can have on air quality in the seacoast area. The extent and scale of what we're finding was completely unknown.") The bigger molecule represents a hydrocarbon respired by trees and the changes it undergoes by reaction with marine-derived chlorine atoms. The two red atoms are oxygen, which were plucked out of the atmosphere by the hydrocarbon that is now reactive because it has an altered chemical structure.

Explains Mayne, "The molecules involved are much more complicated than what we show here, but by breaking the real-world system down into a series of simpler steps where we look at individual components, modern chemistry can start to unravel the strands of the big, complex picture."

In Mayne and Johnson's case, that unraveling is done using powerful computer programs available to chemists only in the last few years. Referring to the reaction mentioned above, Mayne explains,



Howard Mayne

"Laboratory investigations are very difficult because the unstable species make it hard to do the experiment, which in academic terms means it's very expensive." He adds, "These days theoretical calculations have become very competitive with experimental work in terms of their accuracy."

Mayne cautions that these computational programs have only been viable for four or five years and are not "black boxes" that magically provide answers. "There's a lot of work involved in getting these programs to actually give you the right answers." Moreover, most people are using these computational programs for less reactive species than those involved in atmospheric chemistry.

Adds Richard Johnson, "There is some very complex mechanistic chemistry going on in atmospheric processes, and while there are good models for many of those processes, a lot of things are not well understood." Johnson first got involved in AIRMAP because one such process that Sive was wrestling with–the mechanism by which one atmospheric compound morphs into another–piqued his interest. "You couldn't get there from here," he says of the chemical pathway proposed by Sive. So he used computational chemistry to help define a reasonable pathway for the process. One thing led to another and soon Johnson and Mayne had done the most thorough study ever of this type of radical-radical reaction.

Efforts like this, in combination with a well-funded, focused program (AIRMAP) provide the infrastructure for a viable and growing collaborative effort. Says Sive, "We have state-of-the-art instrumentation, focused campaigns, and field sites with a full spectrum of measurements." Both Sive and Mayne stress that all this a powerful tool for attracting and engaging students.

"We will try to involve additional graduate and undergraduate students and faculty as time goes on," says Mayne. He adds, "This is a fantastic area for them to get involved in. In research, physical and analytical chemists are trained to be problem solvers, and this collaborative effort allows us to bring our skills where they can be used by somebody who has real-world problems that need to be solved." -DS

The STEREO-PLASTIC Team Enters the Home Stretch for Instrument Delivery

MARK POPECKI sits on the floor outside a first-floor high-bay room, back against the wall, legs splayed out in front, a laptop at his fingertips. Inside, STEREO Flight Model #2 is being put through the paces in the big vacuum chamber that simulates space conditions and helps determine just what the instrument if made of. Upstairs in the Flight Assembly Area, Flight Model #1 is scattered hither and yon–dismantled and being modified in the wake of calibration testing conducted at the University of Berne in Switzerland. As the deadline for delivering the two identical STEREO-PLASTIC instruments looms, and as more than three years of intensive work begins to wind down, activity is intense.

STEREO-PLASTIC co-investigator Mark Popecki tests Flight Model #2 in the Morse Hall vacuum chamber.

"We need to get FM#1 out in the next couple of weeks for environmental testing," says Popecki – a co-investigator on the UNH project. "We had planned to have it out by now, but there are always more problems than you expected and you're usually in a mad rush trying to make things work and get it all together and out the door... you never have enough test time." The soft-spoken Popecki says all of this with good humor in part because, he believes, "Unless you're having problems you're not making progress, you're not doing anything new."

There's been plenty new ground broken for the NASA-funded project, and plenty of complications during the building process that needed to be fixed–most notably the inevitable "noise" created by the supporting electronics supplies that can get picked up by the instruments detectors. Says Popecki, "It's always a chronic problem for everybody–where you have your support electronics bothering your detector."

It's easy to see why. When you've got an electronics system that has to ramp the spacecraft's 28 volts of juice up to 25,000 volts to do the science, and you're cramming all the separate components together in close quarters with detectors that have to measure tens of thousands of particles per second, you're going to run into a few challenges.

What's more, inevitably, solving one problem creates another in what can become a discouraging series of inexplicable hurdles through which to jump. Explains Popecki, "The configurations of these instruments is so sensitive that if you make the slightest variation in any component it can upset things. Sometimes you solve something and it works and then you test the very same thing two days later just to make sure, and it doesn't work. It can get very discouraging." He adds, "But because our group is small and individuals have diverse experience and skills, we do help each other out and come up with the inspiration needed to get over some big hurdles." -DS

Student Profile

Carsten Neilsen

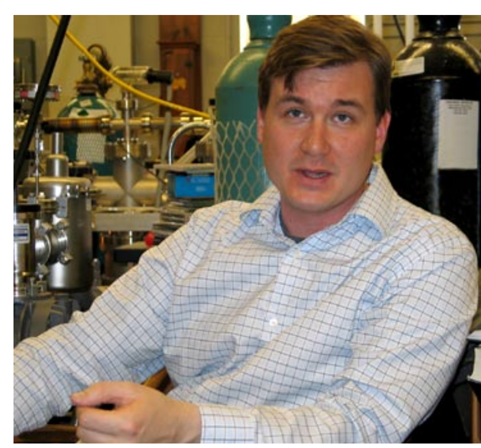
PH.D. STUDENT CARSTEN NIELSEN is involved in the collaborative research being done by EOS and Department of Chemistry scientists (see cover story), and firmly believes the experience has broadened and enriched his education. Of course, he may have had his doubts last summer while marooned on Appledore Island pulling 12-hour shifts collecting air samples during an intense, six-week-long atmospheric field study. Nielsen spent much his time holed up in the concrete, World War II ship spotting tower that looms 63-feet above rock and shrub.

Of the work he did on Appledore with CCRC's Barkley Sive, Nielsen says, "It was important for Barkley to get data that was accurate and complete. Besides analyzing data, once every hour for twelve hours I'd go up to second floor of the tower to fill cans. And we had a problematic gas-chromatograph system at top of the tower, so I climbed up there plenty of times."

Nielsen, who came to UNH from his native Michigan, is an experimental physical chemist and, now, since working with AIRMAP researchers, an atmospheric chemist – two distinctly different areas of chemistry.

"What we, physical chemists, try to do is bridge the gap – try to get a fuller understanding of the big picture by looking at smaller parts of what atmospheric chemists are looking at," he says. The smaller parts include things like the reaction dynamics, kinetics, and thermodynamics of chemical species – the meat and potatoes of experimental physical chemistry.

Nielsen might not have ventured into atmospheric chemistry at all had his UNH career not taken what was at the time an unfortunate turn. When his faculty advisor moved to another job, Nielsen had to make some adjustments and, as luck would have it, the collaborative effort was just gearing up and presented him with new opportunities. In addition to last summer's field study, he has run experiments in Morse Hall's atmospheric simulation chamber and participated in an EPA-funded project headed by CCRC's Huiting Mao looking at biogenic emissions under conditions of enhanced carbon dioxide at Duke Forest in North Carolina.



Chemistry Ph.D. student Carsten Nielsen

Says Nielsen, "I think we, as physical chemists, are helping AIRMAP researchers to understand some of the discrepancies they may see in their data – things that don't quite make sense, maybe we can shed a little light." -DS

Going Deep *continued from page 1*

investigate the stability of the West Antarctic Ice Sheet and try to decipher the cause of rapid changes in climate. One ice core has already been recovered from the Siple Dome area near the Ross Ice Shelf, and work on a core site located near the Western Divide is set to begin next winter.

The divide – a high-elevation region that demarcates movement of the vast ice sheet in opposite directions – was selected because the high accumulation rate of snow should provide a clear and detailed record of climate history.

Says Twickler, "At other inland places in Antarctica, the accumulation rate is fairly low and, as a result, you can't decipher individual years in the ice core record. You have to use other ice cores and ocean cores to date your core; you can't actually count the annual layers as with the Greenland deep cores where we've counted back 110,000 years."

The Western Divide core, however, will likely have similar time resolution to cores extracted from the Greenland ice sheet and will allow scientists to count annually – like counting tree rings – back at least 40,000 years. Beyond that, in the more highly compressed core, other means of analysis will provide a detailed look at climate in the Antarctic over the past 100,000 years – information which is not currently available in a detailed way. A main purpose of the Western Divide core is to give the deep ice cores in Greenland drilled in early 1990s a southern sister core so that the north-south temporal variability can be deciphered.

"This core will give great insight and answer questions about what drives the climate. Right now we don't know if Antarctica or the Arctic drives the climate," Twickler says.

He notes that other work with shallower cores in this general area have shown that there may be a good record of El Niño events, and it is hoped that this deep core will allow scientists to see how El Niño has changed over time. "They've looked at corals and other proxy records, but they haven't taken it back real far, and we'd like to know when El Niño started. Is it a recent phenomenon?"

The Western Divide core should also provide a detailed carbon dioxide record for the past 100,000 years. Says Twickler, "We've got CO_2 records that go back 800,000 years, but the problem with a lot of those is that your sample is a snapshot of decades because the ice is so compressed. Here we can get a single year of record to see how CO_2 fluctuates in a natural climate system."

Greenland ice cores show a distinctive record of so-called Dansgaard-Oeschger events or rapid changes in circulation patterns. "Some of these events have been seen in other Antarctic ice cores but we cannot decipher the timing." Adds Twickler, "This core should allow us to precisely date the events and tell us if they happen first in the north and get amplified down in the southern hemisphere or do they first happen in south, or do they happen at the same time?

We don't even know what causes these things. There are a lot of theories out there, but we don't know for sure."

The Western Divide core has been a top requirement for the U.S. ice core community since 1989, Twickler notes. It's been held up because of the huge expense and difficult logistics involved with working in Antarctica.

"The area we're going to, there's nothing there but the white ice sheet, and the number of flights it takes just to start getting equipment in, people, fuel, supplies to make the camp is substantial," Twickler says. Beginning next November and running through January, planes will arrive at the Western Divide site to begin building the camp and setting up the drilling structure. Some shallow, sample coring will be done, and then researchers will return in 2007. Drilling will continue, for three months at a time during the Antarctic summer, for at least three years.

Of ice cores in general Twickler says, "This is the best way to look at the climate in the past because it provides a direct connection to the atmosphere. It's one of a few proxies – you have tree rings, coral, ocean and lake sediments – but the glacier is at the atmospheric boundary, it's a direct linkage to what was happening in the atmosphere at the time, and that's what makes it so powerful." -DS

Annual Layers in Ice: The figure above is a digital scan representing 90 centimeters of ice from a depth of 2,114 meters recovered from the summit of the Greenland ice sheet. This section of ice is 31,500 years old. The ice core was drilled by the Greenland Ice Sheet Project 2 (GISP2), a project managed by UNH scientists.

The insert to the right shows the annual layering in the ice core, which is revealed just like annual tree rings. The lighter colored sections represent summer layers and the dark areas represent winter. (Angled layers result from the ice core drill not being exactly vertical.)

Around the Hall . . . EOS News Briefs . . . EOS News Briefs . . . EOS News Briefs . . . EOS News Briefs

In late March, Andrew Revkin, environment reporter for *The New York Times*, and Craig Duff, producer for New York Times Television, spent an afternoon in Morse Hall interviewing scientists involved in Arctic research for a multimedia story on change in the Arctic. The effort is in collaboration with the Canadian Broadcasting Corporation, Times Television, and the Discovery Channel. **Charlie Vörösmarty** and **Mark Fahnestock** were interviewed on camera, and participants in a roundtable discussion included **Steve Frolking**, **Richard Lammers**, **Sasha Shiklomanov**, **Mike Rawlins**, Larry Hamilton of the UNH Department of Sociology, **Vörösmarty**, **Fahnestock**, Ian Joughin of the University of Washington, and **Jonathan Pundsack**, coordinator of the Arctic CHAMP Science Management Office.

According to Pundsack, the impetus for the UNH-Morse Hall visit was research for a story on changes in Arctic sea ice. Revkin and company first gathered information from researchers at the UNH Center for Coastal and Ocean Mapping on work done in the Arctic.

Says Pundsack, "Andy was interested in talking with people in the group (Complex Systems/Water Systems Analysis) because he knows there's a lot of Arctic-related research going on in individual projects and also the CHAMP office is helping to coordinate the Freshwater Initiative – projects looking at the whole hydrological cycle in the Arctic."

Noting that the U.S. Arctic Research Commission chose to hold it's 73rd session in Morse Hall last fall, Pundsack says, "What both of these meetings illustrated is that there is a pretty impressive breadth of Arctic research going on here." That would include work done by CCRC's **Cameron Wake**, **Jack Dibb**, and **Mark Twickler**.

Staff Profile

Alison Magill: Killing Trees with Kindness

Top: The Harvard Forest red pine control plot that received no supplemental nitrogen; bottom: the high-nitrogen plot after years of heavy fertilization.

POISED TO BEGIN her 17th field season the day after she returns from maternity leave, Alison Magill is a long-termer at the Long Term Ecological Research site at Harvard Forest in central Massachusetts. She's been at it so long in fact that, even without a Ph.D. at the end of her name, she is UNH's *de facto* principal investigator for the project.

Alison Magill of the Complex Systems Research Center

"I have basically taken over management of our plots at Harvard Forest, I've published papers with others about the research, and these are all things that I've been able to do because John Aber gave me total support and encouragement."

Aber, who is now UNH Vice President for Research and Public Service, hired Magill in 1989 as a technician for the Forest Ecosystem Research Group (commonly referred to as "the Aber group") where she eventually became supervisor of the group's laboratory (informally known as "the dirt lab").

"I started working as a technician and over time became guardian of the Harvard Forest plots and contact for anyone interested in using data or initiating other studies on the plots.

What Magill and others in the group have been doing all these years is applying fertilizer to several 30x30-foot plots of red pine and hardwood forest in what is termed the Chronic Nitrogen Amendment Study. Since 1988, the plots have received varying amounts of the nutrient in an attempt to push the system to its extreme or, as Magill recalls Aber saying, "kill the trees with kindness."

Nitrogen is normally a limiting nutrient in a natural system, meaning that it is an essential component for plant growth and is often in short supply; therefore additional inputs are better, up to a point. "What we've been doing is emulating the effects of nitrogen deposition from acid rain and seeing how that affects forest health," Magill explains.

The plots consist of a control where no additional nitrogen is added, a plot where 50 kilograms per hectare per year of nitrogen are added, and, finally, a plot that gets loaded down with 150 kilograms per hectare per year. According to Magill, this level of nutrient loading isn't a realistic reflection of the natural world but, rather, is an attempt to saturate the plots and push them to some sort of end point.

Says Magill, "The study method is called 'dose for time substitution.' We don't have time to put on 12 kilograms per year and wait 60 years to see the results because this type of research is, hopefully, oriented toward getting results that can be used to bring about changes in environmental policy. "

Although the Harvard Forest researchers, which include scientists from nearly a dozen institutions, found that the forest soils have a remarkable ability to retain extra nitrogen, too much of a good thing finally did catch up with the trees.

"Between 1999 and 2002, in the highest treated plot, most of the trees died. You'd walk into the plot and there were dead branches everywhere. It looked like a war zone," Magill says. She adds, "There are about 100 trees per plot; today, only 10 red pines have live foliage."

Magill notes that after she and Aber organized and edited a series of 12 papers covering the first 15 years of research at Harvard Forest, "Someone asked why the trees had died. I could name off all the things that had happened, like the roots starting to die off and needles dropping off due to higher, nitrogen-induced photosynthetic rates, but I couldn't say they died because of X or Y – it's a combination of things."

Scientists postulate that, in such an anthropogenically altered situation, the trees get stressed to the point where an extreme, natural or man-made event pushes things over the edge – like a bitterly cold winter with little snow cover or a drought early in the spring. But good science takes time and patience and hard-and-fast answers can be elusive. Asserts Magill, "If you look at the response to the treatments, with no trees dying until year 11 or 12, it shows you why it's so important to support these long-term studies."

Harvard Forest is one of a network of 26 U.S. Long Term Ecological Research sites, which are funded by NSF. For more information on the LTER sites, go to http://www.lternet.edu/sites/ -DS

Student News

CCRC students **Emily Fischer** and **Rachel Russo** successfully defended their master's theses in mid-April and will graduate in May. Both are part of AIRMAP and work in the area of atmospheric chemistry and transport. **Lukas Saul** and **Wil Wollheim** successfully defended their Ph.D. dissertations in late April and will graduate this spring.

Ryan Huntley and Barry Rock returned from Mexico in late April as part of a continuing field campaign being conducted as part of Huntley's master's program. The fieldwork included some additional collaboration with faculty from UC Riverside, The University of North Carolina - Wilmington, UNAM (the Autonomous University of Mexico), and the Akumal Ecological Center (CEA). The effort also involved a distance learning Web-cast (via UNH's Learnlinc system) from Mexico, involving Huntley, Rock, other participating faculty, and high school students from both Concord High and Somersworth High.

Robert DiFabio, who has been working on ACE data with Mark Popecki and Eberhard Möbius, finished an honors thesis on charge states in impulsive flares.

The 2005 Research & Discover first-year summer interns have been selected and include **Cassie Ann Stearns** of Smith College (advisor Mark Fahnestock, CSRC), **Andrea Crosby** of Duke University (advisor Rob Griffin, CCRC), **Jeremy Ott** from Northland College (advisor Huiting Mao, CCRC), **Brian Cook** of UC Berkeley (advisor Rob Griffin, CCRC), and **Katheryn Berger** from UMASS Amherst (advisor Barry Rock, CSRC).

Staff Profile

Joe Salisbury

JOE SALISBURY might be talking about carbon sequestration, about fluxes of carbon, sediments, and nutrients in the coastal ocean, but leaking through the rigorous science talk is the distinctive patois of a Maine lobsterman. Before he became a remote sensing oceanographer several years ago, Salisbury spent a decade and a half piloting a lobster boat around his native Cape Elizabeth.

"I supported the family by lobstering and in winter I'd work on bigger fishing boats that were always icing up or taking on water, and after a while I'm thinking to myself, 'There's got to be something else I can do with my life,'" Salisbury says.

That something, it turned out, was teaching at the South Portland High School–chemistry, earth science, environmental science, and physics –for another 14 years. And although he enjoyed the work and the students, there was still that lingering desire to do "something else" with his life. A chance meeting with OPAL's Janet Campbell through a school-related program pushed him in that new direction. "That was exciting because Janet was a leader in a field I had been thinking about for years. I had gotten a Master's while I was teaching high school and she invited me to come here for a Ph.D. if I could ever find the time and money." In 1997, that's just what he did.

While pursuing his Ph.D., Salisbury's primary research interest has been the recycling of land constituents – fluxes of carbon, sediments, and nutrients – in coastal oceans. Says Salisbury, "I'm a remote sensing oceanographer so the thing I'm most interested in is understanding these processes and looking to see if they have an optical expression" that can be gauged using satellite instruments. Salisbury adds that this type of coastal ocean observation is relatively new compared to open ocean satellite monitoring, and more challenging optically because of the influence of land-based constituents. "When you have sediments and tea-colored, organic substances, they seriously complicate your satellite signal."

Although Salisbury is a research scientist in OPAL, he works in the Water Systems Analysis Group (WSAG) and he navigates between the two water groups.

"People ask me all the time, 'What are you?' I'm definitely not a hydrologist, like most of the people here are. I'm in the water systems group but I'm really a coastal oceanographer. And so part of my job is to try to bring the groups together and work on issues and research they have in common. We all join forces and have slightly different interests. It's very much an interdisciplinary approach, and I love working with both groups," Salisbury explains.

With WSAG, Salisbury is doing global scale, satellite-based work detecting regions of freshwater influence in the coastal ocean, and with OPAL's Center for Coastal Ocean Observing and Analysis he and others are focused on trying to understand carbon cycling and the fate of terrestrial constituents like nitrogen and carbon in half a dozen estuarine areas of the Gulf of Maine.

"We have 130 cruise dates over a 36-month period and deploy an instrument package that measures some 40 different parameters," including gases that give insight into ecological processes and air-sea exchanges.

OPAL research scientist Joe Salisbury

Says Salisbury, "One of the big questions is, what happens to the carbon that comes off the land? Does it end up in the atmosphere contributing to global warming, or is it somehow carried offshore to deeper water to get sequestered at time scales of 500 to 3,000 years. It's a really important question because there's about three quarters of a gigaton per year – a considerable amount that comes in that we can't account for, we don't have the budget." In raw weight, that's roughly the equivalent of 296 million elephants flowing downstream per year – a lot of carbon, but relative peanuts compared to, say, the amount that gets cycled through North American forests. "It is a much smaller number, but it's on par with the *net* air-sea exchange for the entire globe. We've only begun to do more focused research into what gets into the water from off the land." He adds, "What is really exciting is that working across centers in EOS, we are beginning to unravel this mystery." -DS

Faculty/Staff News

Amitava Bhattacharjee reports that the Department of Energy will fund UNH to become part of the National Science Foundation Physics Frontier Center known as the "Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas." Magnetic "self-organization" is the process by which a plasma gets rid of excess free energy by rearranging (self-organizing) its large-scale structure. The UNH group will focus on magnetic reconnection as a mechanism for self-organization. Understanding this process in plasmas is crucial to unraveling puzzles in astrophysical and laboratory plasma behavior, and the center unites laboratory plasma physicists with plasma astrophysicists for this purpose. Other academic institutions in the center are the University of Wisconsin (lead institution), Chicago, Princeton, Swarthmore, and the University of Rome. To learn more about the center, visit http://www.cmso.info/.

Jagadeesh Yeluripati Babu, a post-doc from Central Rice Research Institute in India, has been working with **Steve Frolking** and **Changsheng Li** on mapping rice cropping in India and assessing greenhouse gas emissions using an agro-ecosystem biogeochemical cycling model developed by Li and others.

Charles Vörösmarty and **Pamela Green** of the Water Systems Analysis Group published a paper in the April 15 issue of *Science* entitled, "Impact of Humans on the Flux of Terrestrial Sediment to the Global Coastal Ocean."

Jimmy Raeder's proposal to couple three magnetosphere ring current models, including **Vania Jordanova**'s, with his Geospace General Circulation Model was selected to receive $361,000 in funding from NASA's SR&T program. His NSF/GEM proposal, in collaboration with Marit Oieroset (UC Berkeley) to study the entry of plasma into the magnetosphere was selected to receive $250,000 in funding.

The Spring 2005 issue of the Natural Resources Defense Council's *OnEarth* magazine featured the story "Europe's Black Triangle Turns Green," which focuses on the work **Barry Rock**, professor Jana Albrechtova, and scores of EOS and Czech undergraduates, graduate students, and research staff have conducted over the last decade in an area of the very heavy deposition of soot, severe air pollution loads, and acid rain in eastern Germany, Poland, and Czechoslovakia – the Black Triangle. To read the story, visit http://www.nrdc.org/onearth/05spr/triangle1.asp

SSC's **Marc Lessard** reports he has received NASA funding for a rocket project and a Canadian satellite project. UNH will lead and build two auroral imagers and an electron instrument for the Rocket Observation of Pulsating Aurora project (ROPA), and calibrate auroral imagers for the Canadian EPOP satellite.

Sea Grant's Changing Tide

SPARE TIME is something that zoology professor Ann Bucklin keeps in very short supply. This summer she'll devote it to packing, boxing up her life and lab to head for new opportunities at the University of Connecticut. She'll be leaving behind more than a few pairs of empty shoes around campus; at NH Sea Grant, where Bucklin has served as director for more than 12 years, they won't be easy ones to fill. Fortunately, Jon Pennock, director of the UNH Marine Program since 2002, has feet that are up for the challenge. Pennock will take over as director of NH Sea Grant when Bucklin leaves to become head of the marine sciences department and director of the Marine Sciences and Technology Center at UConn's Avery Point campus.

When Bucklin became Sea Grant director in 1993, the program was run jointly with Maine. "When I came in, New Hampshire was the smaller partner of a big program," Bucklin said. "I felt that Sea Grant didn't get the attention it deserved on campus." She began actively recruiting proposals and working hard to bring more Sea Grant resources to UNH. But tipping the balance may have led to the breakup of the joint program.

In 2000, the Maine/NH Sea Grant Program separated, forcing each university to re-earn its "Sea Grant College status" designation. When UNH officially did so in 2003, the celebration that followed was a high point, Bucklin remembered. "It was a culmination of an enormous amount of work," she said, "and we relished our moment in the sun."

Under Bucklin's leadership, Sea Grant has become an even more important presence among the many marine-related programs at UNH. "We bring stability, a national network, our national reputation, a strong NOAA link," she said. "Sea Grant is in my view still the best among many." The program has served as an "incubator," she said, providing the early funding and support to get a variety of major projects off the ground. Both the Northeast Consortium (a program that encourages research partnerships between scientists and fishermen) and UNH's Open Ocean Aquaculture program are spin-offs of Sea Grant projects, she said.

Ann Bucklin and Jon Pennock
Photo: Steve Adams, Sea Grant

Bucklin is also proud of the extension program, which is "always called out as one of the best in the country," she said. She attributes the strength of Sea Grant's research and extension projects to a team-based management approach. "We have a wonderful team," she said. "The bedrock is that we all want Sea Grant to be wonderful. With a goal like that, it becomes a lot of fun."

Fun, but also effective, as the program has earned national respect. "Ann Bucklin has done a tremendous job in leading this program to national stature," noted John Aber, UNH Vice President for Research and Public Service. With the program in good shape and the Sea Grant network poised to become even more significant on a national level, Bucklin said, now is the time to hand over the reins. "It's a great opportunity for the program to have new leadership, a new vision, a new philosophy," she said.

That's where Pennock comes in. He is optimistic that a closer link between the marine program and Sea Grant will strengthen both. "It's New Hampshire Sea Grant, and it needs to be a program for the whole state," he pointed out. "But more connectivity will also have a positive benefit for marine science at UNH." Still, Pennock doesn't plan to rock the boat too much. "What Ann and the Sea Grant staff have accomplished has set a very high bar," he said. "I want to work with the staff to ensure that Sea Grant continues to do the things it does very well. Along the way, I hope to be able to help the program develop additional opportunities to better serve those with a stake in New Hampshire's coastal resources." –Kirsten Weir

It's a Buoy

AS THE POPULATION living near U.S. coastal regions continues to grow, understanding and monitoring the effects of human activities on the surrounding estuarine and coastal ecosystems will be crucial to protecting these natural resources.

To that end, and as part of OPAL's increasing activities in coastal ocean observing, Ru Morrison deployed a state-of-the-art buoy in Great Bay late in April.

According to Morrison, a bio-optical oceanographer, the buoy deployment is an attempt to unite the monitoring efforts in coastal seas with that being done in estuaries. "A lot of work has been done in coastal oceans and estuaries in developing buoys and other means of monitoring, but the two have not come together all that well so far."

A state-of-the-art coastal ocean observing buoy being assembled in an EOS high-bay area prior to deployment in Great Bay.

Brought about by a collaborative partnership between research scientists at UNH, resource managers at the Great Bay National Estuarine Research Reserve, and commercial system providers at WETSAT, the effort is designed to provide an end-to-end water quality monitoring information system spanning from observations through data management, modeling and product delivery. The core of this effort is a high-tech buoy system. In situ measurements include nitrate, phosphate, chlorophyll, colored dissolved organic matter, dissolved oxygen, turbidity, spectral irradiance, temperature, salinity, current profiles, and meteorological parameters. -DS

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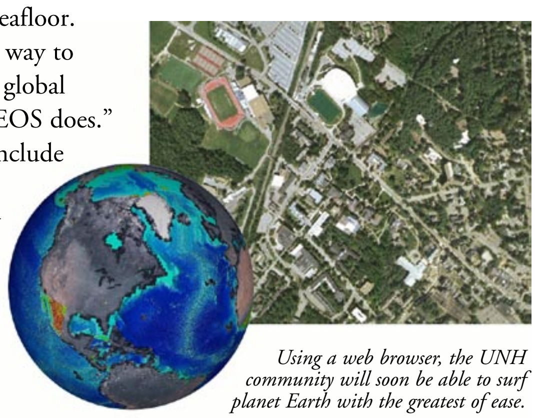
EOS Brings You the Globe

WE'VE GOT THE WHOLE WORLD IN OUR HANDS – thanks to an open source software project called osgPlanet. EOS glaciologist Mark Fahnestock has taken the lead role in working with osgPlanet developer Norman Vine of Woods Hole, Massachusetts to "wrap" huge datasets onto a globe so that, using a web browser, people can view Earth from the height of an astronaut to a crop duster.

"You can 'paint' the globe with anything you want in terms of datasets and seamlessly switch data layers from, say, Landsat imagery to radar data," Fahnestock says. "We eventually hope to populate it with datasets of the work people do here – from Antarctica to the Amazon to the seafloor. It will be a great way to demonstrate the global impact of what EOS does." Eventual plans include a kiosk at the Dimond Library where people can cruise the planet as they see fit. -DS



Using a web browser, the UNH community will soon be able to surf planet Earth with the greatest of ease.

Fall 2005 EOS Courses

EOS 895 – Bio-Optics and Primary Production
Examines factors affecting distribution of light in the oceans and lakes and how this interacts with life, specifically phytoplankton. (Morrison)

EOS 895 – Earth System Science
Does biodiversity matter? Why is El Niño important for forecasting climate months in advance? How did the growth of the Himalayan mountain belt change sea level? These and many more questions in Earth system science will be addressed. (Wake and Hurtt)

EOS 815 – Global Atmospheric Chemistry
Introduction to the principles of atmospheric chemistry and their relationship to biogeochemical cycles, climate, and global change. (Varner and Talbot)

EOS 988 – High Energy Astrophysics
One-semester course on the physical principles underpinning the field of high-energy astrophysics. (McKibben)

EOS 895 – Measurement Techniques in Atmospheric Chemistry
Provides an overview of contemporary instrumental methods used in atmospheric chemistry and biogeochemical research. (Sive)

Syllabi for these fall semester classes are available at:
http://www.eos.unh.edu/Grads/Courses