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Studying solar flares, the aurora, and dust from shooting stars



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a new GroundWinds facility takes the project one step closer to space



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Spring 2002

Vol. 1 Issue 2

Two EOS scientists have recently been elected as Fellows of the American Geophysical Union (AGU), which promotes the study of Earth and its environment in space. Few receive this honored designation of “a scientist who has attained acknowledged eminence in the geophysical sciences.” We celebrate the induction of Karen Von Damm of Earth Sciences and Joseph Hollweg of Physics as AGU Fellows.

Focus on the Region

Something is in the Air in New England

The National Oceanic and Atmospheric Administration’s largest research vessel will be based in New England this summer, heavily instrumented with atmospheric chemistry and remote sensing equipment. The Research Vessel *Ronald H. Brown* is coming to New England in order to monitor air pollutants and their transport through the region as part of a multi-investigator project coordinated by the Institute. AIRMAP, which stands for Atmospheric Investigation, Regional Modeling, Analysis and Prediction, involves four monitoring sites, \$10 million total in NOAA funding, and the investigation of major scientific questions.



A springtime view of the Mt. Washington Observatory tower, in which all of the AIRMAP instrumentation is located. The project’s sample inlets are in the foreground. *Photo by Kevan Carpenter*

According to Principal Investigator Robert Talbot, Research Professor in EOS and Earth Sciences, the northeastern U.S. is one of the most polluted regions of the country. This news may be surprising to people who associate New England with an abundance of natural beauty and rural character, but air pollutants can travel great distances; this is one of the problems being addressed through AIRMAP.

“We know that the most heavily polluted air comes from the southwest, and that the air coming from the west is also pretty polluted,” says Talbot. “One of the things we are doing is comparing the air quality in New England to what pollution is actually emitted here so that we will know what certain emissions from other regions of the U.S. contribute to New England.”

The *Ronald H. Brown* will be instrumented with lasers for measuring wind and ozone, to help do a better job of modeling the transport of air pollutants and meet other program goals. The ultimate goal of the project is to identify the links between air quality, weather, and climate. The UNH research team working on AIRMAP is one of the few groups in the country trying to examine all these variables and their complex relationship.

Talbot offers as an example, “If you’ve got a certain weather pattern that develops and brings in pollutants from the Midwest, it can include high levels of sulfate particles which can then induce local cloud formation.

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Discovering Something Really Deep

For the first time in 20 years, Professor Karen Von Damm of EOS and Earth Sciences, returned to the site of her dissertation research. This is a big deal when your research site can get up to a temperature of 760 °F and lies under 1.5 miles of ocean water, only accessible with a deep sea submersible. Von Damm’s recent expedition took her to two sites off the coast of Mexico, so remote that the locations have no names other than their latitudes — 2 °N and 9 °N.

Von Damm, one of the first scientists to describe the chemistry of these deep-ocean hydrothermal vent systems, also called “black smokers,” has followed her calling over the course of 20 expeditions. Funded by NOAA, her recent expedition involved 34 days at sea.

“I like working with black smokers because you get to think about extraordinary problems,” she explains, “The chemistry of rivers and lakes are at a low temperature so the reactions are often pretty slow. In my research, the temperatures are very hot and reactions happen fast, so you don’t have to wait geologic time to see some of the changes.”



The Alvin submersible launches early in the morning for an all-day dive. *Photo by Joost Hoek, Portland State University*



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Spheres Newsletter
Institute for the Study of Earth, Oceans, and Space (EOS)

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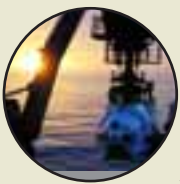
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The geochemist and her crew spent long days on the U.S. academic fleet research vessel *Atlantis* this January in order to try and answer some basic and

important questions about the ocean. The overarching question of this research is that scientists don't really know how these vents, which spurt scalding water into the sea, affect ocean chemistry.

Working with biologists, Von Damm can use vent chemistry to try and explain the appearance of 500 new animal species living off the vents. Through the windows in *Alvin*, a deep-sea submersible, the scientists can witness this relationship with their own eyes.

Says Von Damm, "As you go closer to the vent, you see more animals. We follow the 'animal gradient,' the white spots on the black rock, to a vent. Some have tubeworms up to 3 meters long."

On this latest trip to the East Pacific Rise, the researchers came across some surprises. One was that the vents at 9 °N showed an unexpected take-over by mussels, indicating that the environment has changed in some major way.

The unknowns will be keeping Von Damm busy looking for answers until the next expedition sometime next year. —AS

<http://divediscover.sr.unh.edu>

From the Director

Reflection upon the Year

As the academic year draws to a close, I find the refrain, "There is a time for every season, a time for every purpose" particularly relevant. This is the time to say "thank you."

The Institute for the Study of Earth, Oceans, and Space has again enjoyed a remarkable year. The scientific accomplishments of the Institute have been simply extraordinary. Our students continue to challenge and excite us—and make us proud. Faculty searches in oceanography, in atmospheric chemistry, and in space science have attracted internationally recognized applicants, and announcement of the creation of the Peter T. Paul Chair in Space Science has positioned EOS to make another quantum leap in excellence.

And all of this excitement and progress simply would not be possible were it not for the exceptional technical and administrative staff supporting EOS. From the best space science machine shop on the planet to our unmatched engineers and business managers, EOS benefits from the Best of the Best. The Institute simply could not function, let alone excel, without the tireless efforts of the staff of the Institute and our colleagues in the Office of Sponsored Research.

It is time to say thank you!

There are two other thank you's that simply must be shouted from the rooftop of Morse Hall.

Professor Roger Arnoldy, the first Director of EOS, is retiring from the University of New Hampshire this June. Roger has been tireless in his support of the Space Science Center, where he served as Director for more than 20 years. During his exemplary tenure at the Institute, Roger's extraordinary dedication to science, teaching, and service has benefited everyone within his orbit.

Fortunately for us, Roger will remain with EOS as Emeritus.

Finally, President Joan Leitzel will be leaving UNH after a remarkable six years of unmatched service. Her record of pursuit of excellence has set the tone and the agenda for the University. She has challenged us all to greater heights from which we can now see beyond the next horizon.

It is time to say thank you!

— Berrien Moore III



Something is in the Air continued from page 1

These clouds can then affect the weather in New England and might decrease the temperature and increase precipitation."

While it will take several years to isolate some of these issues, the study will have some immediate practical applications. Since weather and air quality are intrinsically linked, the next step in weather forecasting is to add an air quality component. With the data gathered from AIRMAP, the National Weather Service will be able to disseminate regional forecasts for air quality on an hourly basis to the media and the Internet.

Since this study is so all encompassing, it offers a variety of opportunities for students. Six graduate students help run the project and assess data, including Kevan Carpenter, who is working on his Master's degree in geochemical systems part-time while continuing his duties as an AIRMAP technician.

Carpenter, who is using the data he gathers from AIRMAP for his graduate thesis, says "From my job standpoint, it is very exciting

that I get to travel to lots of locations and talk to people about air quality. From the student standpoint, the project offers so many different avenues for doing research, including instrument development, data analysis, and outreach."

The project offers opportunity for undergraduates, as well. Rachel Scudder, an incoming freshman and recipient of the UNH Tyco Scholarship, will be joining the AIRMAP crew this summer. According to Talbot, Scudder was accepted to many top-ranked colleges but had chosen UNH because of her interest in participating in this large-scale study.

This summer, signs of preparation for the RV *Ronald H. Brown's* arrival will be appearing throughout the seacoast. An ozone instrument will be carried on the Isle of Shoals Steamship Company ferry. Drivers on Route 1A near Rye Harbor may spot the trailer holding other ozone sensing instrumentation.

—Amy Seif

<http://airmap.unh.edu>


EOS Innovations

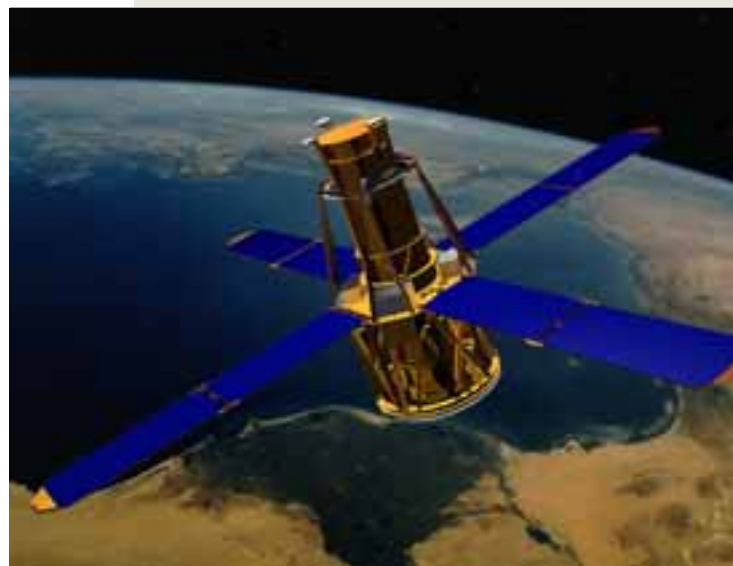
In the Rocket's Red Glare

From the moment when man first walked on the moon, we have been fascinated with rockets going up into space. While it's certainly less rare these days for rocket launches, only the diligent actually get to participate in a launch. EOS Professors Mark McConnell, Roger Arnoldy, and Kristina Lynch have certainly done their homework, winning them a seat on the launch pad.

After numerous delays due to problems with the launch vehicle, McConnell finally celebrated the launch of the RHESSI satellite this February from Cape Canaveral. RHESSI is studying solar flares, gigantic explosions in the Sun's atmosphere, and has already produced the first high-fidelity x-ray movie of these striking events. As a guest investigator, McConnell will have access to data that may provide unique clues as to what takes place during a solar flare.

Unlike McConnell, Arnoldy and Lynch typically work with sounding rockets, probes that go up and then quickly come back down. This January, Arnoldy, a co-investigator, watched as the SIERRA rocket left the Earth, bound for an altitude of about 700 km above the Poker Flat Rocket Range in Alaska. His experiment carried detectors to measure the electrons that produce the aurora. A new detector designed to measure very low energy electrons was flown for the first time.

Lynch's experiment was also launched from Poker Flat. In March, the four rockets of Dust-Orion went up to an altitude of about 90 km to study dust from shooting stars. —AS 



NASA image of RHESSI satellite in space. Image courtesy of NASA/Goddard Space Flight Center.

A Partnership that's Out of this World


EOS professors Eberhard Moebius and Toni Galvin are stars, seen daily on the big screen by hundreds. In "Living with a Star," Moebius plays a college professor and Galvin plays a space scientist fascinated with the sun. They were natural in their roles, and continue in these roles with the Christa McAuliffe Planetarium in Concord, NH, where the multi-media production plays. This show is the first example of what will hopefully be a long friendship and collaboration between the Planetarium and EOS scientists.

This budding relationship offers unique educational benefits to both partners. Professor Moebius has been aware of the Planetarium as an education resource for years. Since 1994, he has been taking his undergraduate astronomy class to the Planetarium.

Explains Moebius, "When I talk about the movement of the planets, it is a tough concept for the students to understand. The best way to help them to understand this is to go to the Planetarium and make the Earth move. There, we can take off into orbit around the Earth and dive into the center, an experience which helps

the students to see where the sun is and how it moves in relation to where they are standing."

Jeanne Gerulskis, the Planetarium's Executive Director, says that their friendship with the Institute is "absolutely wonderful" because EOS has the latest scientific information and the Planetarium, which hosts 60,000 visitors each year, can serve as a bridge to get this information out to the public.

The Planetarium and EOS scientists are now brainstorming ideas for the next show, but even more possibility for collaboration exists. The Institute expects to provide expertise and funding for exhibits and workshops to be held at the proposed planetarium addition, the Alan B. Shephard Discovery Center, an air and space museum. Galvin, who was recently appointed as a Planetarium Commissioner, and Moebius testified this year to the N.H. House's Public Works and Highways Committee on the educational opportunities which this expansion will bring to the state. —AS 

<http://www.starhop.com>

Bookmark this

Enter EOS's Data Warehouse

EOS-WEBSTER is an on-line "one-stop data shop," where terrestrial ecosystem researchers, teachers and others worldwide can find rare satellite images, data from climate models, and other hard-to-find nuggets of information. Funded by NASA as an Earth Science Information Partner, EOS-WEBSTER provides timely, free and accessible data, customized for the particular needs of the user. One of young WEBSTER's first tasks was to provide information for the National Assessment of climate change. This "digital library" has since grown as a service both to users and providers of peer-reviewed Earth science data.

<http://eos-webster.sr.unh.edu>



Scientists on the Slopes

The Morse Hall Maniacs know it's not about winning, it's how you play, but that sure doesn't stop them from ripping up the slopes of Gunstock during the annual corporate ski league competition. This year's team consisted of eight stalwart members of EOS's Complex Systems Research Center, but anyone is welcome to join. Contact team captain Andy Mosedale (pictured).



Faculty/Staff News

Earth System Science

Patrick Crill has been hiding north of the Arctic Circle for three months at the Royal Swedish Academy of Sciences' Abisko Naturvetenskapliga Station supported by the Stiftelsen för internationalisering av högre utbildning och forskning - STINT - in a quest (hopeless) to find cheap beer in the Swedish arctic.

With the Research & Discover Program starting this summer, **George Hurtt** has been busy spreading the word. In the February 5 issue of the Proceedings of the National Academy of Sciences, he projected the future of the US carbon sink. In March, Hurtt lectured at the USGS National Center on the uses of high resolution IKONOS imagery, and in February he gave the Bronfman Family Foundation Lecture at the University of Vermont.

New England's Changeable Weather and Climate, a new book by **Barry Keim** and the Maine State Climatologist Greg Zielinski, was recently accepted for publication by the University Press of New England. Keim has presented talks on New England weather at the Mt. Washington Hotel, the Seacoast Science Center, and the Stratham Historical Society. With the NH Drought Management Team, Keim issued drought emergencies for the state.

Sponsored by the Lowell Institute, **Mary Martin** and **Scott Ollinger** shared their research with the public at the Museum of Science this March. They participated in a series of presentations on "New England's Forests in a Changing Environment." Ollinger talked about the effect of global change on the Northern Forest and Martin discussed studying forests from space.

In February, **Cheryl Moore** joined the Institute as the Assistant Director of OPAL. Moore previously worked in a human resources capacity with TyCom, Manchester Housing & Redevelopment Authority and with the Automotive Technology Center at Textron. She has a B.S. in Business Administration and was recently certified as a Professional in Human Resources. Welcome Cheryl!

Scott Ollinger was awarded a 3-year grant from the National Institute for Global Environmental Change to study the effects of multiple environmental stressors on forest carbon uptake. The award is for \$232,000 and the project will involve Fluxnet sites at Howland, Maine and Harvard Forest.

New Faces



Charles Farrugia (left), formerly an EOS research scientist, has moved into a new position as a Research Associate Professor in the Space Science Center. The Northeast Consortium welcomes their new Executive Director, Troy Hartley (right).

Michael Prentice received funding from NSF to work up the ice cores recently collected in Papua New Guinea. At the Spring AGU meeting, Prentice presented some of his findings on glacier recession and implied global warming.

Still on sabbatical in the Czech Republic, **Barry Rock** wrote an article this spring on the lessons learned from the New England Regional Assessment for the April 15 issue of the Czech national science magazine, *Ziva*. The article has been translated into Czech and offers suggestions for how the Czech people can take action to reduce potential climate change impacts.

National Geographic will feature key maps and analysis from the Water Systems Analysis Group, directed by **Charles Vörösmarty**, in its September 2002 edition focusing on global freshwater issues. Vörösmarty, **Pamela Green**, and **Alex Proussevitch** participated in an expert review meeting held in Cairo, Egypt this April to demonstrate the Data Synthesis System for Pan-African Water Resources.

Cameron Wake left on May 10 for an ice coring expedition to the northwestern North American Arctic to recover detailed depositional histories of a wide variety of pollutants over the last 200 years. This expedition is funded by NSF and takes place on the Eclipse Icefield in the St. Elias Mountains in the Canadian Yukon.

Space Science

Antoinette Galvin presented an invited paper at the STEREO Workshop in Paris this March, and recently returned from a meeting of the NASA Sun-Earth Connection Advisory Subcommittee. On the personal front, she has been elected as Treasurer and member of the board of the Friends of the Portsmouth Harbor Lighthouse and is working to preserve the lighthouse near Fort Constitution.

Four scientists from the Experimental Space Plasma Group attended the XXVII General Assembly of the European Geophysical Society in Nice, France this April: **Vania Jordanova**, **Charles Farrugia**, **Harald Kucharek**, and **Jack Quinn**.

They presented measurements from instruments on the joint ESA-NASA mission Cluster II, as well as model simulations of magnetospheric regions.

Kristina Lynch will soon be leaving EOS to take a faculty position as Assistant Professor in the Department of Physics and Astronomy at Dartmouth College. We will miss her and wish her well; Lynch has been at the Space Science Center since 1988, originally as a student and then later joining the faculty in 1992.

Over the past two years, **Eberhard Moebius** has been Chair for a science team at the International Space Science Institute in Bern, Switzerland. They are trying to nail down the density, temperature and flow velocity for helium in interstellar gas. Moebius is co-convenor for a special session on the Heliosphere and its surrounding medium at the Spring AGU Meeting, and he is giving a keynote talk for the opening of Science Day at the Gymnasium Kreuzgass in Koeln, Germany, in June.

A Historic Moment for Biogeochemistry



Professor Changsheng Li of EOS and Natural Resources has an extraordinary story to tell. Li's tale starts in a remote Chinese village, when he was a young boy in the 1950's. In the village lived people with strange deformities. When Li asked about the cause of their illness, his father told him that the soil and water were no good.


What was remarkable about this theory was that it was made before the world had come to understand the connection between public health and the environment. Even more remarkable, is that a similar deduction, made by the young scientist himself a decade later, led to saving thousands from dying of a rare heart condition called "Keshan Disease."

For three decades, medical scientists had studied the disease, which was spread across 13 provinces in China, and had found no answer. Motivated by a public challenge issued by the government, Li, having just completed college, organized a team of eight young scientists (among pictured) to study the disease from an entirely new angle.

Li recalls, "One day in college there was a seminar given by a young professor who told us about a new inter-disciplinary science called 'biogeochemistry.' He told us about livestock with strange diseases caused by too little or too many trace elements."

Shortly thereafter, Li set off, as one of the first Chinese biogeochemists, to solve the seemingly unsolvable problem of Keshan Disease. For two years, while carrying their supplies on their backs, Li and his team walked from village to village along the remote Wuyur River in the Heilongjiang Province.

"The disease was only found in rural areas bonded to soil and water," explains Li. "We found a big difference in drinking water. Healthy villages had water with lots of minerals, but the water of affected villages had few minerals."

The young team's findings were at first greeted with skepticism. However, five years later, with the help of about 150 scientists, Li identified selenium to be the missing mineral causing the disease. -AS 

Student Profile

Heading in the “Right” Direction

There’s no doubt that Scott Kraus is into his research, since he’s only been studying right whales for, oh, 20 years. Kraus is not trying to break the world’s record for time spent working on a Ph.D., he has actually only been at UNH for four years but his interest in the conflict between humans and wildlife in the marine environment has been the impetus of his life’s work. Currently the Director of Research at Edgerton Research Laboratory at the New England Aquarium, the marine biologist works full-time while pursuing his degree in Zoology.

For his dissertation, Kraus is looking at the natural history and human effects on conservation of right whales utilizing a database that he has compiled over time. His research shows that right whale reproduction has slowed to half of what it was 20 years ago, but he is yet unaware as to why this is occurring.

The scientist finds great academic challenges in his subject, explaining “it’s hard to study something that lives longer than you do.” Yet, putting the purely scientific pursuit aside, he

obviously cares for the fate of the right whale, a baleen whale of 55-60 ft, which was so named because it was the “right whale” to kill.

He explains, “Right whales are in desperate straits, there’s only 300 left. This is a dramatic case of conflict between what they do in the ocean versus what we do. Many are dead because of human activities.”

While he may be the only EOS student studying whales, Kraus says, “I was attracted to UNH because of its unique resources. I use satellite imagery a lot in my work, so Professor Janet Campbell is a great resource. My specialty eats copepods, which is what my advisor, Ann Bucklin, studies.”

Professor Bucklin, of EOS and Zoology, comments, “I’m impressed by Scott’s ability to simultaneously examine both individual behaviors and the open ocean ‘system’ as a whole. The dual focus of his research will be a significant contribution to the field and will provide new information that will help save this unfortunate species.” –AS 🌍

www.neaq.org/scilearn/research/old/index.html



Scott Kraus, doctoral candidate and Director of Research at Edgerton Research Laboratory, pictured in the field.

Student Recruitment

Undergraduates to Improve Health of NH Lakes

While EOS primarily serves graduate students, several exciting undergraduate opportunities have surfaced this year. This summer marks the beginning of both the Research and Discover internship program (see Issue 1, Spheres), and Project Lake Watch, a two-year pilot program to introduce UNH juniors and seniors to lake monitoring and satellite image analysis. With funding from the National Science Foundation, COLSA, CEPS, and EOS, the Lake Watch program is just in the infancy of what promises to be a very fruitful educational experience.

For 22 years, citizen volunteers have been collecting water samples from lakes throughout New Hampshire in a partnership with university limnologists called the “Lakes Lay Monitoring Program.” Lake Watch will build upon this existing partnership by involving students as outreach teachers for the lay public. Richard Blakemore, Professor of Microbiology, developed the original idea to bring the Lakes Lay Monitoring Program together with satellite remote sensing and GIS, utilizing students as the bridge. Janet Campbell, of EOS and Earth Sciences, and Alan Baker, one of the originators of the Monitoring Program, enthusiastically jumped aboard as co-investigators. Other collaborators include Jeff Schloss, Shane Bradt, and Jim Haney.

Ten sophomores from all UNH colleges are now being recruited to take part in the project. Participants will spend two summers in the program; each summer will involve taking courses and working as technicians, getting paid hourly wages. Participants enroll in a one-hour weekly seminar class during the academic year between the two summers. As an added bonus, the students will be supported to attend a national science conference.

While this program will certainly enhance the current volunteer lake monitoring in the state, the participants will be developing new skills, learning the science of limnology, and gaining 14 academic credits. The program is open to both science and non-science majors, and may be especially suited to students interested in becoming teachers. –AS 🌍

Lake.Watch@unh.edu

Student News

Manoel Cardoso, a Ph.D. candidate, reports that he has passed his Qualifying Exam and gave a presentation on projecting future fire activity in Amazonia during the first LBA Student Congress in Belem, Brazil.

In February, **Elizabeth Macdonald**, a Ph.D. candidate, went back to Alaska for a month with her adviser, Kristina Lynch, to launch four rockets to study meteoric dust. Macdonald received a NASA Graduate Student Research Program fellowship, which will fund her research to analyze data from the auroral rocket, SIERRA.

Brian Pellerin, a Ph.D. candidate, had a paper published in *Water, Air, and Soil Pollution* on near-stream soil chemistry. He presented his current research on water flowpaths and storm runoff in urbanizing watershed at the spring AGU meeting in Washington, D.C.

Lukas Saul, a Ph.D. candidate, also received a NASA Graduate Student Research Program fellowship to fund his work with interstellar pick-up ions. This prestigious fellowship offers full tuition and a stipend for three years.

Doug Vandemark, a Ph.D. candidate, has worked with researchers at IFREMER in France to develop a new ocean wind speed inversion model for satellite altimeters. A paper documenting this work will appear in the *Journal of Atmospheric and Oceanic Technology*. In August, Doug will be involved in an air-sea interaction field experiment off Cape Cod.

Marguerite White, an MS candidate, was recently awarded an NSF Graduate Student Research Fellowship. White is studying the emission of methyl bromide from freshwater peatlands. She will be participating in a course in Stable Isotope Ecology at the University of Utah this summer.

Catching The Wind in Hawaii

Perched up at 11,500 feet upon Mauna Loa, an active volcano and enormous mountain on the island of Hawaii, sits the newest GroundWinds marvel, a facility for measuring wind velocity over land and water. The laser technology being tested represents another big step in weather forecasting towards being able to identify wind velocity from space. The first step, a completed facility in Bartlett, NH, is already in operation.

EOS Director Berrien Moore III summarizes the effort saying, "The range of science and technology achievements is unusually wide, including the demonstration of potential space-based technologies to measure winds using lasers, new insights into atmospheric turbulence and motion, and expanded understanding of the planet's weather systems."

Jim Ryan, who is co-Principal Investigator with Moore, explains that weather forecasting skill degrades dramatically when trying to predict three or more days out, partly because forecasters do not accurately know the winds over the ocean. According to Ryan, "No one lives out there, unless you're a fish, so there is very little data to speak of."

GroundWinds, if successful, will change that situation. The eventual goal of the project is to launch a low-Earth orbiting spacecraft with a laser that can obtain wind data from all over the globe. According to Ryan, just one laser in a pole-to-pole orbit would provide for wind measurement globally at the same density as currently provided from weather balloons; but unlike balloons, this instrumentation can get data from over the oceans.

At Mauna Loa, the atmosphere is probed with ultraviolet laser light instead of the green light used at the Bartlett facility. While green light

works fine for sensing aerosols in the wind, it is less successful in the clean, non-aerosol laden air over the ocean. Ultraviolet light, which scatters off air molecules, simply provides better wind data in clean air. The Mauna Loa instrumentation has also been made more compact, as would be necessary for space travel.

Perhaps the most obvious difference between facilities to a visitor is the fact that the Mauna Loa site is more remote, and the facility operates unmanned. According to Ryan, a visitor to the site almost feels like GroundWinds has already arrived in space, "The mountain is a moonscape of lava fields. When you drive up the road to the site, it is like driving your lunar vehicle over the surface of the moon."

The Mauna Loa facility tests this technology without the high costs of making a blindfolded leap into space. With the completion of the facility in April, testing has begun, and GroundWinds Hawaii will be officially up and running after a demonstration to senior NOAA administrators in May.

While the facility is really just a test site for the last big step, Hawaiian astronomers are very excited for the trial run. They are hoping that the wind readings from Mauna Loa will help them gain up-to-the minute weather information for their experiments operating on nearby Mauna Kea, the other dominant mountain on the island.

Says Moore, "We owe thanks to the vision of Senator Judd Gregg who championed this far-reaching initiative and the leadership in NOAA who have supported us from the beginning."

—AS 

<http://groundwinds.sr.unh.edu>



The new GroundWinds facility at 11,500 feet on Mauna Loa. Mauna Kea is viewed from the research site. Photo by Linda Tibbets, EOS.



In Hawaii, locals place white coral on top of the dark lava rocks as graffiti. GroundWinds has left its mark on the island.


Space Grant News

Each year, Space Grant awards graduate fellowships, funded by NASA, to support studies in space-related disciplines at UNH. Fellows are chosen by evidence of unusual academic promise and by relevance of the applicant's interests, background, and graduate program to NASA programs. This past year, four students received a full stipend and tuition from the Space Grant Graduate Fellowship Program.

Jeanne Anderson, an EOS student in the Natural Resources Ph.D. Program, received the fellowship to support her interest in applying remote sensing technologies to landscape-scale questions in ecology. Professor Tom Lee in Plant Biology and Assistant Research Professor Mary Martin in EOS and Natural Resources are her co-advisors.

Another EOS student, Mickel McClish, received the fellowship to support his Master's degree research with his advisor, Associate Professor Jim Ryan of EOS and Physics, in high energy astrophysics. McClish is concentrating on energetic astrophysical phenomena and the methods by which those processes can be studied.

Brogan Morton, who is working towards his Master's in Mechanical Engineering as the advisee of Assistant Professor May-Win Thein, is another fellowship recipient. He is studying Attitude Determination and Control Systems of small satellites.

Using his skills as a geographer, Peter Tardie is using remote sensing and GIS to foster learning about the environment, and hopes to help planning agencies gain insight into important environmental issues. The fellowship will assist Tardie in his Master's program through the Department of Natural Resources; his advisor is Professor Russell Congalton. —AS 

<http://www.nhsgc.unh.edu>

This year's Space Grant Graduate Fellowship recipients include Susan Campbell (MS in Forestry), Carolyn Girod (MS in Natural Resources/EOS), Katharine Reeves (Ph.D. in Physics/EOS), and Ned Eldredge (MS in Natural Resources/EOS). Watch for information on their research projects in the Spring '03 issue of Spheres.

A Remarkable Legacy



As Professor Roger Arnoldy prepares to retire this June, a page in the Institute's history is turned. An integral participant in the genesis of EOS, he watched as the first brick was laid for Morse Hall. He is the only person in the University's history to hold the titles of Director of EOS, Director of the Space Science Center, and Chairman of

the Physics Department (albeit for a short time) simultaneously. As a professor and administrator, Arnoldy was instrumental; he provided the foundation for what is now a leading scientific research institute.

As the first Director of EOS from 1985 to 1988, Arnoldy courageously took on the challenge of carving a niche at the University for a new, unprecedented institute.

"We had to try to make the Institute workable on campus and figure out what our role was going to be," says Arnoldy.

In the 35 years of his space science career, Arnoldy was involved in nine satellite experiments. His distinguished career began with his doctoral research on NASA's first satellite, EXPLORER 6, and later, with a research position at Honeywell Research Labs. His recent experiments have involved sounding rockets, such as SIERRA.

Arnoldy, whose dedication to education is admirable, explains, "I turned to sounding rockets primarily because I saw that they were better for training students than satellites."

Professor Kristina Lynch, a former doctoral student of Arnoldy's, reflects upon his teaching style, "I always told people he was more of a partner than a teacher because he expected that students could work independently." Now a colleague, Lynch has grown to know Arnoldy from a different perspective. She explains, "Roger is always fun to work with because he enjoys what he is doing. Roger is EOS, he is why many of the space scientists are here."

Throughout his 27 years with UNH, Arnoldy has been a model and teacher for students and faculty alike. As he takes off his teaching hat and enters retirement, the Professor Emeritus still plans on doing research. However, he will celebrate his retirement by spending more time with his six children and traveling. —AS 🌍

EOS Courses

Spotlight on EOS 405: Global Environmental Change

Every fall, staff and faculty come around the table to negotiate an agreement on reducing UNH's greenhouse gas emissions. This year, they reached an agreement on a matter that has world leaders scratching their heads in only three meetings. The secret to their success may be the fact that the people sitting at the table are not really University employees; they are undergraduate students playing their roles, getting a unique glimpse into the real world of consensus-building and environmental policymaking.

Back in the classroom, after the negotiations have come to a close, Professor Cameron Wake of EOS and Earth Sciences gives a heartfelt speech to his students, proclaiming that "this is one of the greatest days in the life of a professor."

He explains, "So often what we teach students is theoretical. These negotiations allow me to bring the theory of global environmental change down to a scale that is applicable to people's lives and behaviors. This is a classic example of thinking globally, but acting locally."

Class facilitators from EOS and the Office of Sustainability Programs (OSP) work with members of the university community to introduce the students to the kind of challenges they might face in their roles. Each lab of ten students meets with a real stakeholder.

Says OSP's Julie Newman, "As facilitator of the process, you watch the students evolve into the role of the person they interviewed. That is the educational metamorphosis."

In the negotiation room, students sit in a circle with cards in front of them identifying each of their roles. The mood is surprisingly collaborative, yet serious. Facilitators walk between the six circles, quietly observing the process. A brief stop at Table #6 reveals this "metamorphosis."

"About changing the heating system in the dorms, I have facts. If the dorms get renovated, we would save money. In Hamilton Smith Hall, we saved \$70,000 on lighting since upgrades were made and avoided 1/2 million pounds of carbon dioxide," says the student identified as the Energy Manager.



Last year's EOS 405 negotiations in full swing at the MUB.
Photo by Doug Prince, UNH Instructional Services.

Table #6 has found a way to reduce emissions within the first day of negotiations. Their plan involves switching to natural gas buses in 8 years, replacing showerheads with low flow devices, retrofitting light fixtures, proposing a car pool section in the parking lot, and implementing a "green fee."

Earlier in the semester, the class studied Earth systems to learn the science of climate change. Armed with a copy of the Kyoto Protocol and a challenge card explaining what they need to do, the students are just about as prepared as anyone can be going into these types of negotiations.

Following the negotiations and back in the classroom, Darren LaCroix from Table #6 stands in front of a room full of 60 of his peers, scratching equations on the blackboard and explaining his group's vision for a green fee.


The class is engaged. The students enjoy the process of learning, and they are experiencing life in the real world. Perhaps this is indeed one of the greatest days in the life of a professor. —AS 🌍

A Foray into Science Writing

Science has been let loose in the public realm; look no further than your television set or local newspaper. Words like “genome” and “El Niño” unabashedly appear in print and on the nightly news next to reports on Enron and the Middle East.

Whether through the media or personal interactions, scientists from all disciplines are now being thrust into the public sphere. So, as scientists, where do we begin?

To explore this question, EOS and Natural Resources Professor John Aber has guided an EOS graduate seminar this past spring titled “Scientists Who Write.” Each week, students read and discussed popular writing by accomplished scientists, including Carl Sagan, Lewis Thomas, and E.O. Wilson. Issues such as style, audience, and credibility were addressed weekly, and interesting discussions on the scientific content of the material resulted. Several guests joined the seminar, including EOS Communication Coordinator Amy Seif, Professor of Rhetoric Larry Prelli, NSF Fellow Ann Stork, NH Public Radio’s Doug MacPherson and Beth Daley from the *Boston Globe*. Finally, the highlight of the seminar was a visit from the renowned evolutionary biologist and author Stephen Jay Gould, who offered insights into his approach to writing and communicating science with a broad audience.

- Brian Pellerin '04 



Stephen J. Gould

EOS Events


The Spheres Concert Series

At 12:15 p.m. on the third Thursday of each month of the academic year, Morse Hall is magically transformed into a concert hall of staggering acoustical beauty, with a startling variety of music performed by talented musicians. The unusual concert space, unlike traditional performance venues, has no seating, no tickets, and no reservations.

Musicians arrange themselves on the jutting second balcony, and the audience stands leaning on the balcony railings or sits on the floor.

Some munch lunch, some bring their children, and listeners come and go as they wish. Informality reigns, but attention is profound.

It is the intention of Lynda Copeland, artistic director of the EOS Spheres concert series, to provide an eclectic assortment of performers ranging from jazz musicians to bagpipers to brass and woodwind ensembles. The opening event next September will feature the well-known group, The Virtual Consort.

This spring’s performances included a baroque chamber orchestra, a bluegrass band, a concert violinist, and the popular singer Robert Thompson, who was featured in a program of music by African-American composers in the final concert of the term. All are welcome! –Lynda Copeland 

<http://www.eos.sr.unh.edu/About/Events>



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