

CGRER

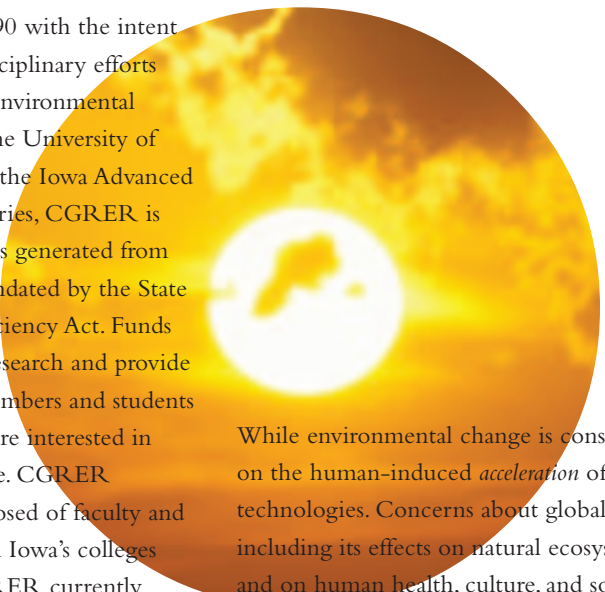
The Center for Global and Regional Environmental Research

2003
ANNUAL REPORT

CGRER

The Center for Global and Regional Environmental Research

The Center for Global and Regional Environmental Research – CGRER – was established in 1990 with the intent of promoting interdisciplinary efforts that focus on global environmental change. Housed on the University of Iowa (UI) campus in the Iowa Advanced Technology Laboratories, CGRER is supported by revenues generated from public utilities, as mandated by the State of Iowa’s Energy Efficiency Act. Funds are used to support research and provide services to faculty members and students across the state who are interested in environmental change. CGRER membership is composed of faculty and professional staff from Iowa’s colleges and universities. CGRER currently is composed of 65 members from 21 departments.



While environmental change is constant and natural, CGRER focuses on the human-induced *acceleration* of such change caused by modern technologies. Concerns about global change encompass multiple issues including its effects on natural ecosystems, environments, and resources, and on human health, culture, and social systems. Because global change promises to touch virtually every aspect of life and require the interpretation of many fields of science and engineering, the humanities, medicine, and law, an understanding of global change requires collaborative efforts among the many disciplines involved. CGRER’s mission is to foster such collaborative interdisciplinary actions in three ways:

by promoting dialogue among specialists and agencies,

by educating students and the general public, and

by fostering and supporting relevant research projects.

This annual report summarizes CGRER’s activities in each of these three areas. Because CGRER’s output is commensurate with that of its many members, a summary of which would require a small book, this annual report includes only a sampling of significant projects and efforts. Yet this sampling provides a vision of CGRER’s multiple efforts to achieve its ultimate goal: assisting Iowa’s agencies, industries, and citizens to assess and prepare for global change and its effects.



EXECUTIVE SUMMARY



Sustainability

Sustainability. That's the concept of meeting the needs of people today while not compromising the ability of future generations to meet their own needs. It means consuming renewable resources at sustainable rates rather than exhaustively extracting non-renewables, and it means not polluting the planet beyond its self-purification capacity. Sustainability, as a goal, is the embodiment of what the Center for Global and Regional Environmental Research seeks to accomplish through its research, education, and service programs, many of which are reported here in our 2003 Annual Report.


Students are leading the charge on sustainability at CGRER. In the past year, they have organized a new group called Engineers for a Sustainable Future. Students have attended conferences sponsored by Engineers Without Frontiers and the U.S. Greenbuilding Council. Their efforts to raise \$100,000 to fund the Society of Hispanic Professional Engineers Midwestern Expo helped sponsor a conference at the UI on the interrelated topics of jobs, networking, and career development in an increasingly diverse workplace. This large multifaceted event also increased awareness of divergent cultures, a key component of successful sustainable projects.

Students

CGRER students are active in monitoring water quality in Iowa rivers, and in designing inexpensive, energy efficient “eco-homes” and better operating composting toilets for developing countries. They are modeling a new air pollution improvement program for the city of Santiago, Chile, as well as the impacts of black carbon particles on global temperatures. One student is using Geographical Information System (GIS) technology to estimate the amount of carbon dioxide that can be sequestered in Iowa and Wisconsin soils and forests, in an attempt to help alleviate global warming.



Faculty





CGRER students have joined ISU students in participating in the program Water for People, initiated by Rotary International, a service project to help bring water and sanitation resources to Xicotepec, Mexico. Together with the Iowa Department of Natural Resources (DNR), students have created a new engineering course, *Sustainable Systems*, to be offered for the first time in spring 2004. Several students with CGRER- member advisors have participated in the Iowa Pollution Prevention Intern Program, operated with local industries through the Iowa DNR, which in the past three years has been credited with conserving 354 million gallons of water, 11 million kilowatts of energy, 16,600 tons of solid waste, 42,380 gallons of hazardous waste, and 192 tons of air pollutants, while saving \$5.4 million for Iowa's industries, an amount that is many times the cost of the program.

CGRER faculty members are contributing as well. Their research projects help create the new knowledge necessary to build the emerging meta-discipline of "sustainability." Dollars garnered by faculty members fund graduate and undergraduate students who are pursuing studies related to sustainability and care of our environment. CGRER members' research articles in peer-reviewed journals help to disseminate relevant knowledge to all corners of the globe. This past year, faculty consulted with university officials about reducing the UI's greenhouse gas emissions. A program to supplement energy production at the UI power plant by burning waste oat

hulls from Quaker Oats (in Cedar Rapids) has been tested and is now being implemented. This program will save annually \$500,000, avoid the burning of 30,000 tons of coal, and reduce the UI's carbon dioxide emissions by 70,000 tons each year. In 2003, CGRER faculty have chaired or served on numerous state, national, and international committees to advise governments on issues of sustainability, environmental policy, global warming, air pollution, preservation of habitat and native species, water quality, and problems associated with concentrated animal feeding operations. Many of these activities are reported in the Dialogue and Education sections of this Annual Report.

We could not have accomplished any of these ends without the support of the investor-owned utilities, the Iowa Commerce Commission, and the Iowa Utilities Board, which generate and provide us with our core level of funding, approximately \$514,000 in 2003. In turn, CGRER faculty members garnered approximately \$7.3 million in new research grants, which leverage precious state funds and help to bolster Iowa's economy. This story of energetic exploration and fruitful effort is told within the following pages of CGRER's 2003 Annual Report.

Jerald L. Schnoor
Gregory R. Carmichael
CGRER Co-Directors





MESSAGE FROM THE ADVISORY BOARD

**CGRER has
a secret.
It has many
of them, actually.
And I'd like
to reveal them
to you.**

First, a little background: More than a dozen years ago, an amazing concept was developed by a group of academics at the University of Iowa. They envisioned a center devoted to the study of the environmental impact of Earth's ever-increasing human population, what that impact may mean for our future, and possible solutions to resulting problems. With amazing vision, these leaders also sought to include the perspective of the "hard sciences," and to expand the interdisciplinary approach to encompass engineering, economics, history, law, and public policy. In recognition of the fact that actions in Iowa can have regional and even global impacts, they named this new entity the Center for Global and Regional Environmental Research (CGRER).

Forward-thinking Iowa lawmakers passed legislation funding the center through a surcharge on the usage of electricity and natural gas by customers of Iowa's utilities.

As a member of the Iowa Utilities Board, the state agency that regulates public utilities in Iowa, I have seen firsthand how economics, business, public policy, and the sciences can be made to work together in solutions that benefit both the environment and economic development in Iowa.

As a member of the CGRER Advisory Board, I have had the opportunity to learn about the creative interdisciplinary research being performed by the students and professors affiliated with CGRER. I continue to be amazed by CGRER's accomplishments.

Studying and addressing problems from one perspective can often produce great results, but may miss other potential solutions. By teaming researchers, academics, and students from varying perspectives, problems can be studied and solutions formed that would never have been

envisioned by a single discipline. That's what's so amazing about CGRER, but it's still not what I meant by the "secrets" I referred to in my opening sentence.

Are you ready to learn about CGRER's "secrets"? At each CGRER Advisory Board meeting, we are treated not only to a summary of current research projects, but also to presentations by undergraduate, graduate, and postgraduate researchers. To say that these students are impressive would be an understatement. They truly have a hands-on role in every aspect of the research projects. They also do amazing things on their own initiative; for example, CGRER students organized an undergraduate class on sustainable systems, and put together a sustainable-job fair to match students interested in environmental matters with employment that expresses their goals for improving the world.

As each year goes by, CGRER impacts the world not only through its well regarded research, but also by sending its "secrets" forth into the world – the students who have gained so much and are so eager to share their knowledge and skill to truly

make a positive impact on Earth's environment. They leave the University of Iowa inspired, full of passion, and with real experiences to help them solve the world's environmental problems. The reason I call them "secrets" is that the work these students will do in their own communities – in Iowa, across the nation, and throughout the world – will positively influence our world, yet we may never realize the far-reaching impacts of the training they received because of their involvement in CGRER.

It has been my pleasure to serve on CGRER's Advisory Board. I hope you enjoy this annual report.

Mark O. Lambert
Iowa Utilities Board Member

CGRER Advisory Board Members

James Christensen
ALLIANT ENERGY

Robert Dvorsky
IOWA SENATE

Mary Lou Freeman
IOWA HOUSE

Steven Guyer
MIDAMERICAN ENERGY
HOLDINGS COMPANY

Mark Lambert
IOWA UTILITIES BOARD

David Osterberg
UI, OCCUPATIONAL &
ENVIRONMENTAL HEALTH

Dorothy Paul
UI, CENTER FOR HUMAN RIGHTS

Sharon Tahtinen
IOWA DEPARTMENT OF NATURAL
RESOURCES

Dialogue

CGRER PROMOTES INTERDISCIPLINARY DIALOGUE TO ADDRESS IOWA'S NEEDS



In 2003, several initiatives identified CGRER as a state and national leader in promoting sustainability issues. From shaping energy production at the University of Iowa, to creating innovative publications, and continuing to sponsor visiting scientists and seminars, CGRER's efforts have stimulated dialogues that focus on this ideal: Throughout our society and around the world, we can work toward a balance between human demands and nature's propensity for self-renewal.

At Home and Across the Country Since 2002, CGRER has been working with Ferman Milster, Manager of the UI Power Plant, and other university administrators as well as Quaker Oats (Cedar Rapids) officials to explore potential benefits of co-burning oat hulls with coal in the UI's power plant. The year 2003 saw one final trial burn of these waste materials, an official permit granted by the Iowa Department of Natural Resources, and the full-scale implementation of this co-burning process. The UI is now burning approximately 30,000 tons of hulls annually, resulting in a yearly decrease of 30,000 tons of burned coal, decreased carbon dioxide emissions of 72,000 tons, and a savings of \$500,000 – a striking example of the coupling of environmental and economic benefits.

Jerry Schnoor, who in 2003 became editor of the American Chemical Society's professional journal *Environmental Science and Technology (ES&T)*, used this position to expand CGRER's sustainability initiative to the national level. He commissioned three special editors to produce an issue of *ES&T* devoted solely to green engineering. The December 2003 issue (Vol. 37, No. 23) – *ES&T*'s first dedicated issue on any subject – brings together the work of approximately 100 authors from numerous engineering disciplines, representing industry, academia, and government, who produced over two dozen feature articles and technical papers that “illustrate the application of green engineering principles to a broad array of real-world engineering challenges to advance the goal of sustainability” (p. 423).

Visiting Scientists In 2003, CGRER hosted the following thirteen researchers from around the world:

DAVEN HENZE, chemical engineering PhD student at California Institute of Technology, visited CGRER from August 4 – 8 to collaborate with Greg Carmichael on data assimilation in atmospheric aerosol studies.

PETER HESS and **DAVE BAKER** (research scientists, National Center for Atmospheric Research, Boulder), **ADRIAN SANDU** (professor, Virginia Polytechnic Institute and State University), and **DACIAN DAESCU** (professor, Portland State University) visited Iowa from May 27 – 30 as part of the NSF Information Technology Research project. They are collaborating to integrate measurement information into global and regional atmospheric chemistry models.

YOO JUNG KIM, a PhD student at Konkuk University, Korea, spent the month of July in residence at CGRER learning new techniques in air quality modeling. He plans to use these skills in his studies of air quality in Korea.

SIJIN (TOM) LEE, from Kyonggi University, Seoul, South Korea, visited CGRER January 23 – July 31. During that time he and Jerry Schnoor worked

on planning for a joint scientific meeting on phytoremediation, which was held at Lee's home institution on October 30 – 31. Schnoor presented three seminars at that meeting. Joint proposals and further collaboration may follow.

NEUZA NEVES, from the environmental consulting firm CETREL S.A. in San Paulo, Brazil, visited Iowa from June 6 to July 2 to establish a collaborative research project on reducing ozone levels in and around an industrial complex in Brazil. Through a new contract, modeling techniques developed at CGRER will be used. This activity will also involve technology transfer from CGRER to CETREL.

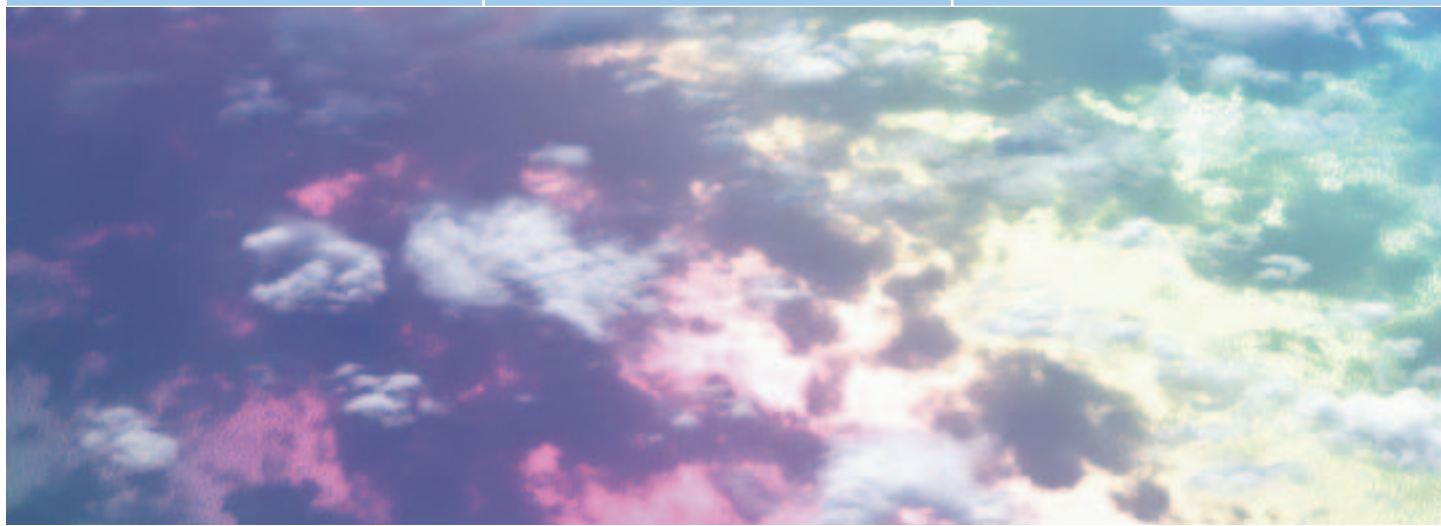
JUAN PEREZ, of the Environmental Software and Modeling Group Computer Science School, Technical University of Madrid (Spain), spent August and September at CGRER working with faculty and staff on new techniques in air quality forecasting. Juan is a doctoral student in Professor Roberto San Jose's laboratory, where they are providing operational forecasts of air quality for Spanish cities including Madrid.

MAHESH PHADNIS, scientist at EarthTech Consulting, Boston, visited CGRER from October 29 to November 2 to discuss air quality modeling and opportunities for joint work.

SHANG SHIM, Korea Institute for Science and Technology (KIST) who earned his doctorate in chemical engineering from the UI, visited Iowa on June 24 – 25 to discuss the establishment of new research collaborations. Dr. Shim and KIST plan to participate in the ABC-Asia project. Collaborations involving measurements of long-range transport of pollutants at the GOSAN measurement site are also planned.

ITSUSHI UNO, professor at Kyushu University in Japan, visited CGRER from October 29 – November 2 as part of a long-standing research collaboration with Greg Carmichael, regarding atmospheric chemistry in East Asia and long range transport of dust.

XUEMEI WANG, Professor of Environmental Sciences of Zhongshan University, China, arrived in mid-October to spend a sabbatical year at CGRER, where she is collaborating with faculty and staff on the analysis of air quality in the Pearl River Delta region of China. This area is a growing rapidly economically and experiencing significant resultant air-quality-management challenges.



Speaker

Richelle Allen-King

Affiliation

Geology Department, Washington State Univ.;
the National Ground Water Association's
2003 Darcy Lecturer

Title

A Hydrogeochemist's Perspective
on Organic Contaminant Transport
in Ground Water

Amita Baviskar	Department of Sociology, Delhi University, India	Toxic Citizenship: The Pursuit of Happiness Through Environmental Activism in Delhi
Terry F. Bidleman	Meteorological Service of Canada, Egbert, Ontario	Chiral Pesticides as Tracers of Biogeochemical Processes
Jonathan Clement	Black & Veatch, The Netherlands	Global Perspectives on New Advancements in Water Treatment and Supply
Barbara Finlayson-Pitts (presented 3 seminars)	Department of Chemistry, University of California, Irvine	1) Atmospheric Chemistry from Air Pollution to Global Climate Change: The Challenges of a New Discipline 2) Reactions at Air-Water Interfaces: The Next Frontier in Atmospheric Chemistry? 3) Heterogeneous Reactions of Oxides of Nitrogen in Thin Films Indoors, Outdoors, and in the Laboratory: Is it Magic?
Louis Guillette	Department of Zoology, University of Florida	Environmental Contaminants as Hormones in Wildlife: Effects from Genes to Populations
Alexander Laskin	Pacific Northwest National Laboratories, Richland, Washington	Application of CCSEM/EDX, ESEM, and TOF-SIMS Techniques for Single Particle Characterization of Aerosols
Steven Manson	Geography Department, University of Minnesota	Complexity Theory and Environmental Science
Mark Pagini	Department of Geology, Yale University	Alkenones and the Evolution of Cenozoic Atmospheric Carbon Dioxide
David Peterson	USDA Forest Service and University of Washington	Climatic Variability and Natural Resources in the Pacific Northwest
Matt Simcik	Environmental & Occupational Health, University of Minnesota	Analytical Challenges of Perfluorochemicals

CGRER also provided supplementary support for Billie Lee Turner II, an Ida Beam Distinguished Visiting Professor at the University of Iowa. Turner, a distinguished professor at Clark University (Worcester, MA) and member of the National Academy of Sciences, presented the following three lectures while on campus:

- Integrated Environmental Science and Land Change in the Southern Yucatan
- Back to Brookfield: Uniting Cultural and Political Ecology
- Vulnerability of the Coupled Human-Environmental Systems in the Southern Yucatan

His lectures highlighted the complex relationships among local and regional economies and climate, soil, and vegetation dynamics. He presented a strong case for land use activities as the pivotal issue fueling global environmental change.



In Addition: CGRER members and their students received numerous awards and signs of recognition in 2003. The following is a sampling of these tokens of successful dialogue with colleagues and the larger professional world:

GARRY BUETTNER (UI, Electronic Spin Resonance Facility) became president-elect of the Society for Free Radical Biology and Medicine.

GREG CARMICHAEL (UI, Chemical and Biochemical Engineering) delivered the 2003 Priestly Lecture for the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. He is Chair of the World Meteorological Society's Scientific Advisory Group for the Urban Research and Meteorology and Environment Project, and steering committee member of NSF's Cyberinfrastructure for Research and Development in the Atmospheric Sciences committee.

RHAWN DENNISTON is Chair of the Environmental Studies Department at Cornell College.

BILL EICHINGER (UI, Civil and Environmental Engineering) was awarded the M.L. Huit Faculty Award for teaching excellence.

JEFF DORALE was appointed Director of the Paul H. Nelson Stable Isotope Laboratory in the UI's Geoscience Department. He also received the DISCCRS (Dissertations Initiative for the Advancement of Climate Change Research) award, which brought Dorale together with other recent PhD recipients, who together honed their teambuilding and communication skills in hopes of fostering future interdisciplinary climate-related research.

Witold F. Krajewski's Ph.D. student

MEKONNEN GEBREMICHAEL received a NASA Earth System Science Fellowship.

KERI HORNBUCKLE (UI, Civil and Environmental Engineering) is vice president of the International Association for Great Lakes Research (IAGLR), and will assume the presidency in 2004.

WITOLD F. KRAJEWSKI (UI, Civil and Environmental Engineering) was elected Fellow of the American Geophysical Union. He also received the Outstanding Water Resources Researcher Award from the Iowa State Water Resources Research Institute.

SARAH LARSEN (UI, Chemistry) received the PROGRESS Speaker Award for Women from the American Chemical Society. This award took her to Washington University in St Louis to present the invited seminar, *Zeolite Nanoarchitectures for Applications in Environmental Catalysis*.

GREG LUDVIGSON (UI, Geoscience) was elected president of the Great Lakes Section, Society for Sedimentary Geology, and also was elected to the Board of Directors, Iowa Academy of Science.

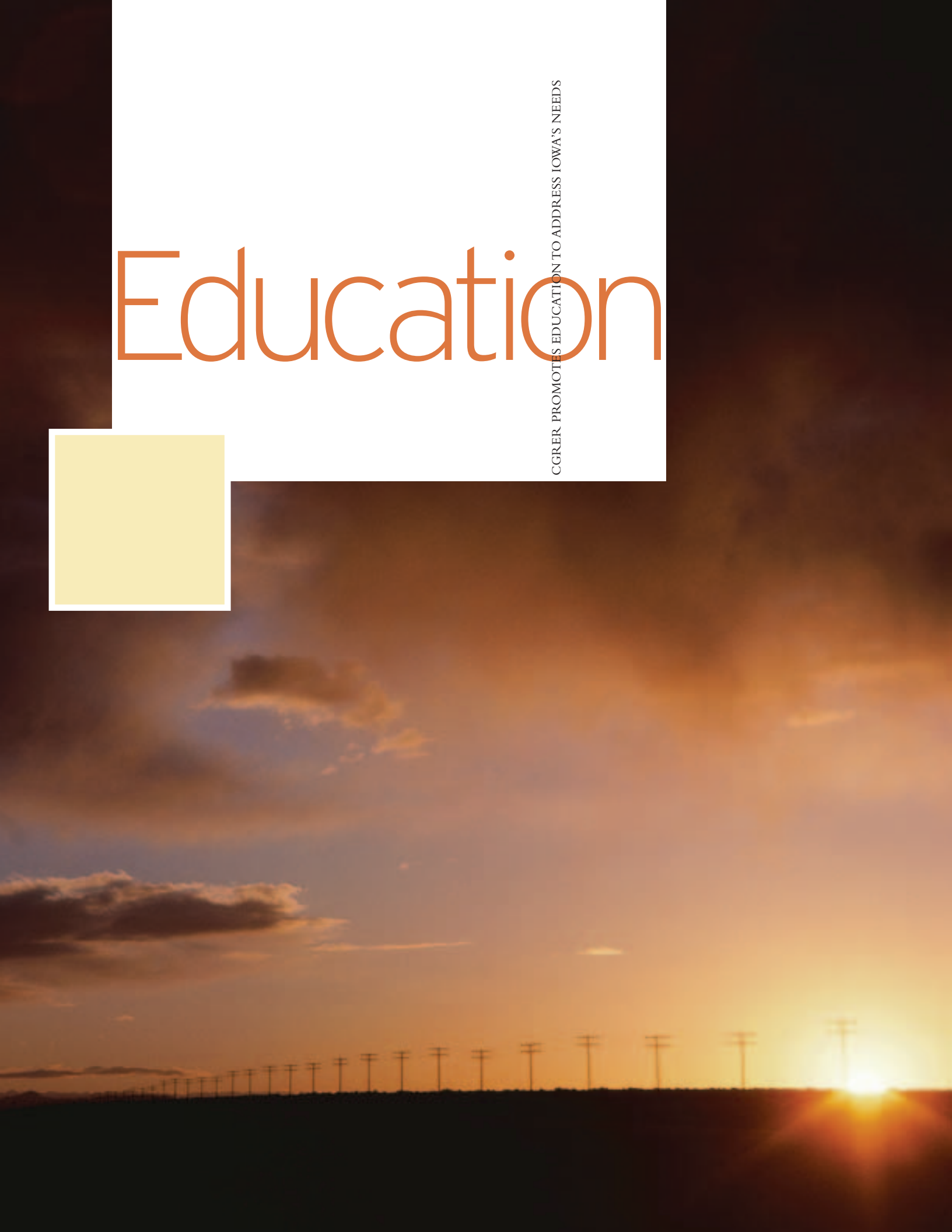
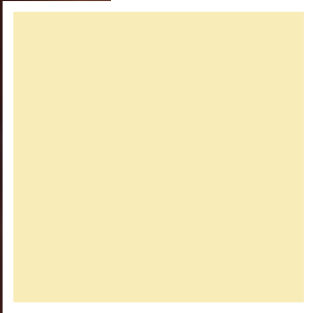
GEORGE MALANSON was named Coleman-Miller Professor in the UI Geography Department. He also was elected Fellow in the American Association for the Advancement of Science.

JERRY SCHNOOR (UI, Civil and Environmental Engineering) assumed the Editor-in-Chief position of the American Chemical Society's journal, *Environmental Science and Technology*. He also received the Peace Award from the United Nations Association – Iowa Division, for his work in environmental affairs.



Education

CGRER PROMOTES EDUCATION TO ADDRESS IOWA'S NEEDS



The year **2003** saw a proliferation of CGRER-fostered workshops and student-driven initiatives that centered on the concept of sustainability. Through them, shared ideals mixed with creative thought and a goodly share of energy, and led to exciting educational products.

Engineers for Sustainable Futures While CGRER can't claim responsibility for the new UI student association *Engineers for Sustainable Futures* (ESF), it can proudly declare that nearly all founding members are CGRER research assistants or advisees. The group's title speaks its purpose: to provide engineers-to-be a platform for developing and voicing professional values tied to environmental sustainability and social justice. Encouraged by CGRER members, their ideas, and minor stipends, this dynamic group of energetic idealists has already accomplished major results. Aided by CGRER travel funds, nine ESF members attended the national conference of Engineers Without Frontiers in Ithaca, New York, in September; in November, two journeyed to Pittsburgh, Pennsylvania, for the U.S. Greenbuilding Council conference.

In 2003, they also initiated and planned for two major activities early in 2004: an inter-college UI career fair focusing on value-driven employment, and a new UI undergraduate Engineering College class titled *Sustainable Systems*. This class was conceived, initiated, and planned by graduate student Anna Forkan, who also received a grant from the Iowa Department of Natural Resources to carry it out. It will be taught for the first time in spring 2004, with Keri Hornbuckle, Jerry Schnoor, and UI Environmental Compliance Manager Mike Valde serving officially as course professors.

CGRER-Sponsored Workshops In October, Greg Carmichael and his advisee Marcello Mena (supported by CGRER funds) traveled to a four-day *World Meteorological Organization Workshop* in Santiago, Chile, which focused on increasing the capacity to forecast air quality in Latin America. Carmichael was a primary facilitator for the workshop. CGRER has been involved with this broad effort in multiple additional ways. Carmichael chairs the responsible scientific advisory group (GURME), which works with agencies interested in improving Latin American air quality. CGRER provides logistical support for GURME and for Carmichael's efforts. Mena's PhD dissertation will involve applying air quality models to Santiago, as part of a pilot program to build better Latin American forecasting infrastructure.

CGRER cosponsored *The Green Awakening: Redefining Prosperity*, held February 27. This one-day UI symposium for engineering students and the general public brought national speakers to campus to talk on sustainable housing, development, energy, and business practices.

CGRER helped support the 26th *Annual Midwestern Environmental Chemistry Workshop*, held at the UI in October. CGRER members also were major participants: Michelle Scherer and Keri Hornbuckle planned the conference, and Jerry Schnoor and Vicki Grassian provided keynote addresses.

CGRER co-sponsored Alliant Energy's conference, *Energy Policy and Global Climate Change: A Path Forward*, at which Jerry Schnoor lectured on energy/climate interactions.

Student

Destination

Project

Student Travel Grants

In 2003, CGRER awarded a total of \$7,000 through its Graduate Student Travel Grant program. Each of the following eight students received between \$500 and \$1,600 to complete travel associated with degree-related research projects:

Kristen Bernhard	Panama	Reconstructing the Phylogeny of a Keystone Resource: A Multi-locus Analysis of Co-speciation in Panamanian Strangler Figs and Their Pollinators
Chris Gienapp	East-central Iowa, University of Illinois, University of Kansas	Are Spatial and Temporal Differences in Prairie Fragments Related to Pollinator Species Richness?
Chiara Hemsley	Northwest Iowa	Distribution, Abundance, and Diversity of Solitary Bees in Fragmented Tallgrass Prairie Landscapes
Amber Hill	Northwest Iowa	Pollen Arrival to Stigmas and Its Relation to the Floral Resources of Iowa Prairie Preserves and Remnants
Richard Mtisi	Mozambique	People-Environment Relationships in the Save River Valley of Zimbabwe and Mozambique
Abiodun Oluyomi	The Gambia, Africa	Water-Handling Practices and Water-Related Diseases: An Evaluation of Trachoma Prevalence and Water Hygiene in Gunjur, The Gambia
Melinda Slagle	Northwest Iowa, Southwest Minnesota	Effects of Habitat Fragmentation on the Fruit Set and Bee Diversity of <i>Amorpha canescens</i> Pursh. (Fabaceae)
Jessica White	Burke Museum of Natural History, Seattle, WA	Effects of Ecological Change on the Diversity of Tertiary Fossil Primates (65-1.8 million years ago)

And also...

Sustainable Futures for Iowa was published in 2003 by the Iowa United Nations Association. This booklet, which contains essays and student thoughts concerning sustainable development in Iowa, is an outgrowth of a student-centered project held in conjunction with the U.N.'s 2002 *World Summit on Sustainable Development*. CGRER was a planning and contributing sponsor for both the 2002 student project and this publication.

CGRER also continues to publish its newsletter *IoWatch*, which in 2003 focused on innovative field research techniques. CGRER's upgraded website received approximately 4.7 million hits in 2003, about the same as in 2002.



In Addition: CGRER members continued to share information about global change issues with their students, colleagues, and the larger world in 2003, thus providing the education so necessary for future planning and efforts. The following is a token of their innovative activities:

MARC ARMSTRONG and **DAVID BENNETT** (UI, Department of Geography) received funds (see page 22) to investigate the utility of wireless geographic information technology in higher education. They will take students from the classroom into the field and provide them access to knowledge repositories (e.g., the Internet, professors,

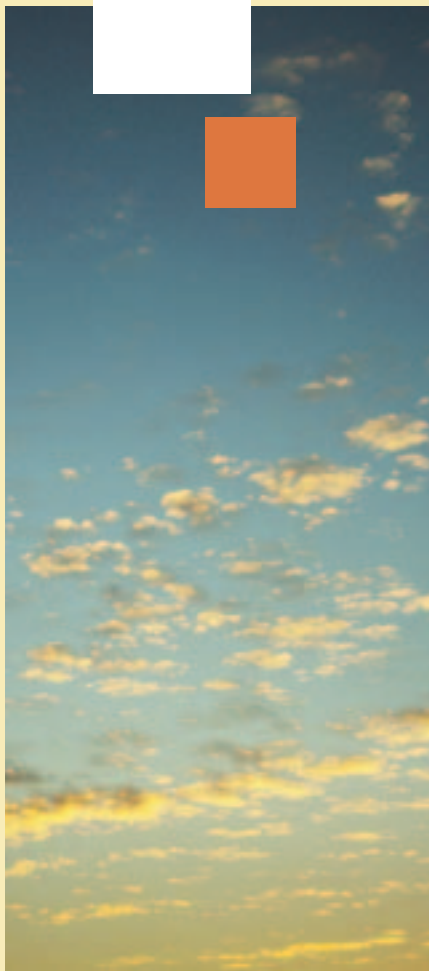
peers) via the World Wide Web. They expect this will provide greater understanding of complex geographical processes and will better prepare students for professions in a rapidly changing and increasingly technological workplace.

ALLEN BRADLEY and **WILFRID NIXON** (UI, Civil and Environmental Engineering) joined civil engineering faculty from across the nation to participate in an intensive week-long ASCE course titled *Excellence in Civil Engineering Education (EXCEED)*. Nixon also served as one of the course's small-group mentors. Recommended teaching techniques have already been implemented in several courses.

GARRY BUETTNER (UI, Electronic Spin Resonance Facility) presented a workshop at the annual meeting of the Society for Free Radical Biology and Medicine on *Scientific Communication*.

GREG CARMICHAEL (UI, Chemical and Biochemical Engineering) helped plan and execute the *Advanced Institute on Urbanization, Emissions, and the Global Carbon Cycle*, an interdisciplinary NCAR (Boulder, CO) gathering held in August that examined variables related to long-term control of urban emissions.

SCOTT CARPENTER (UI, Geoscience) was lead author of the article *Migration of a Late Cretaceous Fish*, published in the journal *Nature* (423: 70-74).



RUSSELL CIOCHON (UI, Anthropology) announced the publication of his new book, *Dragon Bone Hill: An Ice Age Saga of Homo erectus* (coauthored with Noel T. Boaz, Oxford University Press, New York). This book is based on research completed at Zhoukoudian, the Chinese site where “Peking Man” was first found.

RUSSELL CIOCHON, along with CGRER members **ART BETTIS** and **SCOTT CARPENTER** (UI, Geoscience) and others, participated in an interdisciplinary paleoanthropological-geological field expedition to Java, with the intent of determining central Java’s paleoenvironment when *Homo erectus* first reached this area. A CGRER seed grant helped fund earlier fieldwork at this site.

DIANE DEBINSKI (ISU, Ecology, Evolution, and Organismal Biology) participated in the National Park Service’s *Vital Signs Monitoring Workshop* to determine long-term monitoring indicators for our national parks.

RHAWN DENNISTON (Cornell College, Geology) spent two weeks teaching geomorphology at a wilderness field station in northern Minnesota during Cornell College’s Wilderness Field Term. Climate change issues occupied evening discussions. He will be leading a field geology class in New Zealand’s South Island early in 2004.

VICKI GRASSIAN (UI, Chemistry) was a participant and discussion leader for the workshop, *Nanotechnology Grand Challenges in the Environment*, held in Arlington, VA, from May 8 – 10, which was organized by the EPA, NSF, and other federal agencies.

SARAH LARSEN (UI, Chemistry) also participated in the *Nanotechnology Grand Challenges in the Environment* research planning workshop. In addition she developed and (for the first time) taught a seminar for first-year liberal arts students titled *Explorations in Nanoscience and Nanotechnology*.

LOU LICHT (UI, Civil and Environmental Engineering and EcoloTree Inc.) received significant press coverage that has been helping to spread the word about phytoremediation. His planting of hybrid poplars promises to clean up sludge in inactive hog waste lagoons at half the cost of conventional practices. With over 1,700 lagoons awaiting treatment in North Carolina alone, Licht’s “ECaps” are likely to become a commonly applied green technology in coming years.

GREG LUDVIGSON (UI, Geoscience) presented a number of invited lectures on the significance of global climate change and Cretaceous paleoclimatology, both in Iowa and in other states.

GERALD RUSHTON (UI, Geography) taught Eastern European students and faculty about GIS and health at a workshop in Slovakia.

DONNA SURGE and **GERMÁN MORA** (ISU, Geological and Atmospheric Sciences) team-taught a new upper-level undergraduate/graduate course in paleoclimatology.



CGRER FOSTERS GLOBAL CHANGE RESEARCH TO ADDRESS IOWA'S NEEDS

Research



Through grants received and awarded, CGRER continues to foster research on multiple sustainability and change-related topics. Four major new grants were awarded to CGRER in 2003, supplementing the ten continuing grants that were funded in earlier years. CGRER members additionally received dozens of grants awarded to their home departments.

In 2003, CGRER awarded seven Seed Grants to fund budding research initiatives throughout Iowa. Research also was supported through the logistical support CGRER offers its members and their students.

New CGRER Grants: Atmospheric Brown Cloud Initiative

Since CGRER's inception, many of its larger research grants have focused on the production and transport of aerosols, dust particles, greenhouse gasses, and related air pollutants, and on their impact on climate. Various projects have identified and recorded the source of air pollutants, quantified their regional impacts, related them to climate change, modeled their flow, and fed into diverse governmental policies aimed at reducing their harmful effects.

These CGRER research efforts played a key role in the 2003 launching of a major international research initiative. The *ABC (Atmospheric Brown Cloud) Initiative*, instigated by the United Nations Environment Program, will bring an international team of diverse scientists together to create a holistic view of air pollution, one that integrates the science of pollution and climate change with aspects of human health and governmental policy. Under this initiative, the new tools and methodologies developed for studies in Asia and the Pacific region will be fed into similar studies to Africa and the Americas.

In 2003, CGRER received three new grants that will contribute to this ABC initiative:

- *Regional Aerosol-Chemistry-Climate Observatories for the Indo-Asia-Pacific Region*, 5/1/03 – 9/30/04, NOAA, \$110,168 to the UI for this phase (funding expected to continue 8 more years); PI: V. Ramanathan (Scripps), with G. Carmichael (UI) and others as co-PIs
- *Quantifying Anthropogenic Sources of Trace Gases and Aerosols: An Integrated Approach*, 12/1/03 – 11/03/06, NASA, ACPMAP program, \$242,395; PIs: Prasad Kasibhatla (Duke University), Greg Carmichael (UI), Louis Giglio (SSAI)
- *Linking Air Pollution to Regional and Global Climate Change: The Absorbing Asian Brown Cloud (ABC) as a Test Case*, 11/1/03 – 10/31/06, NASA, \$490,000, \$150,000 to CGRER; PI: V. Ramanathan (Scripps), with G. Carmichael as co-PI.

Each grant addresses a different aspect of the complex pathway from initial pollutant detection to control. The first grant listed will fund the establishment of additional Asian observatories for collecting field data. The second grant will integrate observational data and numerical models, with the intent of improving quantitative estimates of varied air pollution emissions. And the third grant, a numerical modeling effort, will address the assimilation of aerosol and chemical data into climate models, so that regional impacts of air pollutants can be properly analyzed. All three projects work together to develop air pollution forecasting tools that are sufficiently accurate to shape responsive governmental policies that limit the pollutants' harmful health, agricultural, and other effects.

All of these grants incorporate regional capacity-building efforts to develop native infrastructure (e.g., measuring sites, computer systems) and trained scientists that will ensure the initiative's healthy continuation well into the future.



New CGRER Grant: Forest Sequestration of Carbon Dioxide

CGRER researchers have also been concerned with how to recapture and hold a meaningful portion of atmospheric carbon dioxide, the greenhouse gas with rising concentrations fed by the burning of fossil fuels. Carbon dioxide can be sequestered in trees and agricultural soils, the latter being effective particularly if no-till practices are utilized.

Forested land has been increasing in Wisconsin since the early 1900s. No one has yet determined whether or not these lands are already sequestering a significant portion of Wisconsin's greenhouse gas emissions. CGRER has received the following new grant to address this question:

- *Quantifying Carbon Storage In and Beneath Wisconsin Forestlands*, 5/15/03 – 6/30/04, Energy Center of Wisconsin, \$70,561; PI: Jerry Schnoor

This grant will attempt to quantify the carbon sequestered in Wisconsin's currently forested land, and also to measure the annual change in this amount. Resulting data will not only reveal how Wisconsin is faring in terms of its greenhouse gas sequestration. They also will help solidify valid methodologies for measuring and monitoring forests' effects on changing carbon dioxide levels, information that will be necessary if state governments are to barter carbon credits commercially as trade items in the future.

Continuing CGRER Grants In 2003, CGRER members continued to work on the following ten externally funded Center projects that were initiated in previous years:

- *Impact of Mineral and Other Aerosols and Asian Emissions on the Chemistry of the Troposphere*, 4/1/97 – 3/31/03, NASA, \$838,976; PI: Greg Carmichael
- *The Role of Heterogeneous Chemistry in the Photochemical Oxidant Cycle: A Modeling and Laboratory Study*, 3/15/98 – 3/14/05, DOE, \$1,113,864; PI: Greg Carmichael and Vicki Grassian
- *Regional Scale Forecasting and Experiment-Specific Emission Estimates of Gas and Aerosol Distributions in Support of the TRACE-P Experiment*, 7/1/00 – 6/30/03, NASA, \$263,099; PI: Greg Carmichael
- *REU Site in Environmental Systems at the University of Iowa's Center for Global and Regional Environmental Research*, 7/1/00 – 6/30/03, NSF, \$181,732; PI: Vicki Grassian and Greg Carmichael
- *Three-Dimensional, Regional-Scale Modeling of the Processes Affecting Aerosol and Chemical Distribution in East Asia and Support of ACE-Asia*, 8/15/00 – 7/31/03, NSF, \$228,310; PI: Greg Carmichael
- *Conduct Carbon and Oxygen Isotope Analyses on Alaskan Weathervane Scallop Shells*, 8/31/01 – 6/30/03, Alaska Dept. of Fish and Game, \$95,600; PI: Scott Carpenter
- *Modeling and Emissions Analyses in Support of the Spring 2002 ITCT Field Experiment in the Eastern Pacific and Western U.S.*, 4/1/02 – 3/31/05, NOAA, \$310,902; PI: Greg Carmichael, UI, David Streets, Argonne National Laboratory, and Hiram Levy II, Geophysical Fluid Dynamics Laboratory, Princeton University.
- *Retrospective Analysis of Nearshore Marine Communities (Exxon Valdez Oil Spill Project #02656)*, 8/15/02 – 9/30/04, U.S. Geological Survey – Anchorage, \$44,562; PI: Scott Carpenter
- *ITR/AP & IM Development of a General Computational Framework for the Optimal Integration of Atmospheric Chemical Transport Models and Measurements Using Adjoints*, 9/1/02 – 8/31/07, NSF, \$2,300,000; PI: Greg Carmichael
- *Workshop on Mathematical Models for Water Quality*, 11/1/02 – 10/31/03, NSF, \$41,225; PI: Jerry Schnoor

Project Director

Amount Awarded

Title of Project

Seed Grants Awarded by CGRER

In 2003, CGRER awarded \$127,993 to the following seven seed grant proposals. Each project intends to gather preliminary data in preparation for submitting larger, more comprehensive grant proposals to outside funding sources.

Bryan Boulanger,
Keri Hornbuckle,
Jerald Schnoor
Civil & Environmental
Engineering, UI

\$20,000

Synthetic Musk Fragrances in Great Lakes Sediments

Gregory Carmichael
Chemical & Biochemical
Engineering, UI

\$20,000

Quantifying the Health and Climate Benefits of Curbing Air
Pollution in Megacities: Comparing Shanghai and Santiago

Meredith Gooding
CGRER, UI

\$14,000

Applicability of Aquatic Life Cycle Testing to the Assessment
of Ecological Health Impacts of Emerging Contaminants

Vicki Grassian
Chemistry, UI,
and Patrick O'Shaughnessy,
Occupational and
Environmental Health, UI

\$20,000

Characterization of Particulates and Their Role in
Environmental Health

Elizabeth Lynch
Biology, Luther College

\$19,993

Responses of Vegetation and Fire to Little Ice Age Climate
Change across a Wisconsin Sand Plain

Germán Mora
Geological and Atmospheric
Sciences, ISU

\$14,000

Environmental Effects on Stable Isotopes and Carbon Cycle
Processes in Agricultural Settings of Iowa

Donna Surge
Geological and Atmospheric
Sciences, ISU, and
Scott Carpenter,
Geoscience, UI

\$20,000

A Geochemical Survey of Iowa's Freshwater Mussels:
Understanding Their Historical Decline

CGRER Aids to Researchers

In 2003, CGRER's website went through a major upgrade, following the purchase of a new web server in 2002. Take a look at the new site at <www.cgrer.uiowa.edu>

CGRER continues to offer use of state-of-the-art computing, visualization, and resource materials to members and their students. CGRER also functions as one of four departments on the UI campus to support and distribute geographical information system (GIS) software through its license with ESRI.

The year 2003 brought the addition of a 20-node Linux cluster. This new cluster sits next to the cluster purchased earlier (see photograph) and gives CGRER greater parallel computing power. CGRER also joined the High Performance Computing Special Interest group on campus. This group meets during the year to discuss high performance computing issues as they relate to CGRER and the UI campus.



The new Linux cluster (on right) sits next to the older cluster (on left) purchased in 2001. The large screen on the far left is CGRER's Immersadesk, which continues to be used extensively for displaying numerical model outputs.

In Addition:

The following is a sampling of the many grants that CGRER members continued to receive through their home departments:

MARC ARMSTRONG and **DAVID BENNETT** (UI, Geography) received an \$8,900 ATAC-Innovations in Instructional Computing grant, *Geography Unfettered: Wireless Technologies in the Geographic Information Science Curriculum*.

JEFF DORALE (UI, Geoscience) received \$137,434 for two years of funding from NSF for his proposal, *The Ocean-Atmosphere Carbon Cycle and Climate Change: Constraints from Radiocarbon and Climate History*.

The National Science Foundation has been funding the research of **VICKI GRASSIAN** (UI Chemistry) continuously since 1991. In that period, she has been a PI on nine NSF grants totaling over \$2.1 million. In 2003, NSF awarded her a two-year \$275,000 *Extension for Special Creativity*. Given in recognition of her recent creative accomplishments, this prestigious award is intended to increase her opportunity to attack adventurous, high-risk problems.

WILFRID NIXON received a 1.5-year, \$90,000 grant titled *Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing/Anti-Icing (IceCal)* from the Iowa Highway Research Board. This agency also awarded him a two-year, \$100,000 grant, *Development of Winter Performance Measures for Highway Winter Maintenance Operations*.

JAMES RAICH (ISU, Ecology, Evolution, and Organismal Biology) and collaborators received \$500,000 from NSF for the project, *Collaborative Research: Tree Species Effects on Ecosystem Processes in Lowland Costa Rica*, to be completed between March 2003 and February 2006.

JAMES RAICH (ISU, Ecology, Evolution, and Organismal Biology) and **GERMÁN MORA** (ISU, Geological & Atmospheric Sciences) received \$400,000 funding for their proposal, *Distinguishing Root from Soil Contributions to Soil Respiration: Exploration of a New Approach*, from NSF, for the period March 2004 to February 2007. This grant is derived directly from an earlier CGRER seed grant awarded to Raich.

JERRY SCHNOOR and **PEDRO ALVAREZ** (UI, Civil and Environmental Engineering), with others, received a \$750,000, two-year grant (1/2003 – 12/2004) from the Keck Foundation for their proposal entitled *Catabolic Enzymes and Metabolic Pathways in Phytoremediation*.

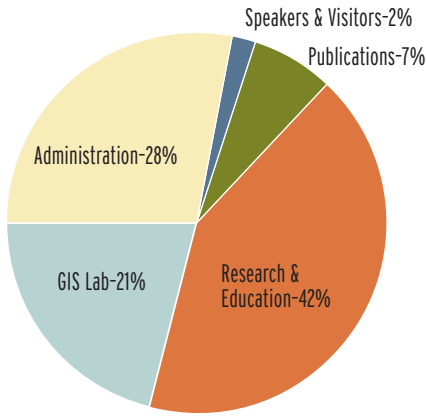
DONNA SURGE (ISU, Geological and Atmospheric Sciences) is the lead PI for an NSF \$357,975 Earth System History project to be completed jointly with the Florida Museum of Natural History (Gainesville). The project, *Collaborative Research: Calibration of Sr:Ca and d¹⁸O Proxies of the Southern Quahog, Mercenaria campechiensis, to Reconstruct Late Holocene Climate, SW Florida*, will be completed between August 1, 2003 and July 31, 2006.

General Information

Budget In fiscal year 2003 (July 1, 2002 – June 30, 2003), seven-tenths of CGRER’s \$514,388 of funding was spent on research, education, and outreach directed toward global change issues (Figure 1). The remaining three-tenths of the budget was dedicated to administration.

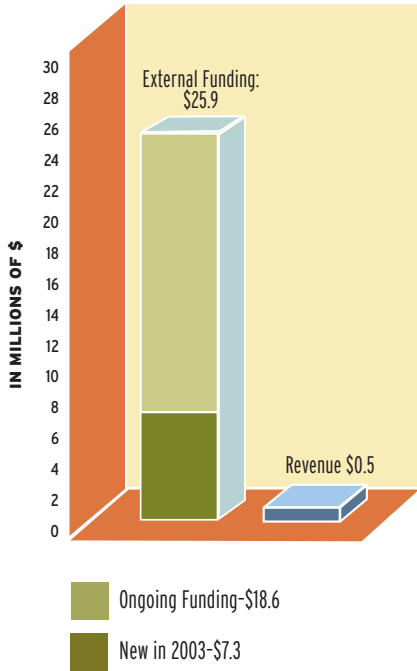
This funding, received in total from an assessment on Iowa’s gas and electric utilities through the State Department of Commerce, was magnified many times in the millions of dollars of external grants and contracts awarded to CGRER members (Figure 2). In calendar year 2003, CGRER members were performing research that brought in a total of \$25.9 million in external funds. This included both those grants awarded to CGRER directly and other grants awarded to CGRER members through their respective departments. Of this amount, \$7.3 million was new funding that was initiated in 2003, while the remaining \$18.6 million came from ongoing projects.

Figure 1
CGRER’s Expenses*

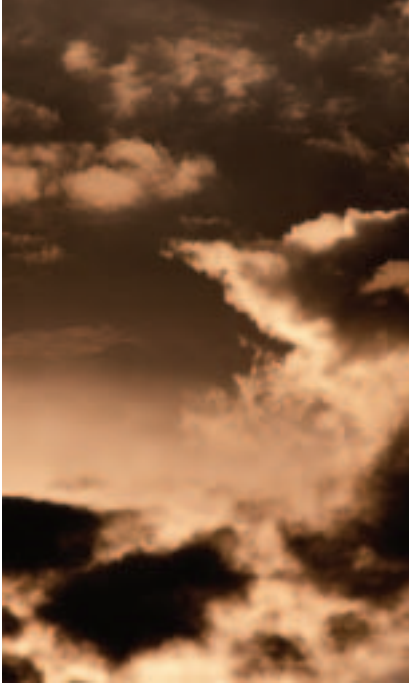


*Applies to Fiscal Year 2003

Figure 2
Leveraging of CGRER’s Income*



*Applies to Calendar Year 2003



Administration and Membership

CGRER is directed by University of Iowa professors Gregory Carmichael (Dept. of Chemical and Biochemical Engineering) and Jerald Schnoor (Dept. of Civil and Environmental Engineering). Center activities are guided by an elected Executive Committee that consists of eleven members plus the two co-directors. The Executive Committee meets monthly to plan initiatives and chart CGRER's course. An Advisory Board of eight members from outside the academic community meets annually to lend oversight to CGRER's activities (see page 5 for Advisory Board members).

Since 1992, CGRER has employed two fulltime staff members. Administrative assistant Jane Frank oversees office operations. Jeremie Moen manages CGRER's computer facilities with the aid of services contracted from the Iowa Computer-Aided Engineering Network. CGRER reports directly to the UI's Vice President for Research.

CGRER Members

UNIVERSITY OF IOWA

Anthropology

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Russell L. Ciochon

Biological Sciences

Stephen D. Hendrix
Diana G. Horton

Chemical and Biochemical Engineering

Gregory R. Carmichael

Chemistry

Vicki H. Grassian
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