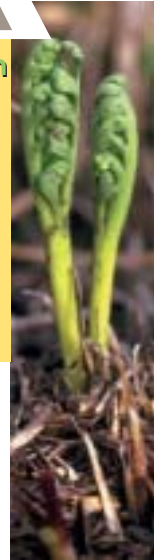
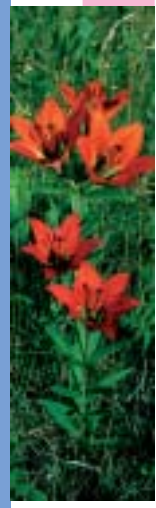


2001

ANNUAL REPORT

# CGREER

The Center for Global and Regional Environmental Research



Graphics in this Annual Report are taken from the University of Iowa Herbarium's new web site (<http://www.cgrer.uiowa.edu/herbarium>), established in part with funding from CGRER. The herbarium is an historically significant repository for over a quarter-million dried and fossil plant specimens, about 70,000 of which are from Iowa. Established in 1869, the herbarium continues to be used regularly for research, education, and scientific documentation of Iowa's plant life.

# 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 66 members from 22 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

In this Annual Report, we relate CGRER's many activities in the areas of research, education, and outreach dialogue. Our primary mission continues to be that of promoting interdisciplinary research with a focus on environmental change at the regional and global scale, research that includes features of natural ecosystems, agro-ecosystems, engineered environments, and the human dimensions of global change.

We sponsor research through the seed grant program, initiate new research proposals for external funding, and collaborate with other universities to forge alliances with multidisciplinary expertise to attract research support.

Eight seed grants were awarded by CGRER in 2001 to researchers at Iowa, Northern Iowa (UNI), and Iowa State (ISU) universities. These seed grants will allow examination of stable geochemical isotopes for inferring ancient climates and hydrology in Iowa and elsewhere; improvements in global climate models at the regional scale; validation of remotely sensed hydrologic information; a new method to measure photolysis products in natural waters and their impact on the global carbon cycle; and the potential for carbon sequestration by grasslands and wetlands. One seed grant seeks to develop better nickel-hydride batteries for electric and hybrid automobiles. Most of these small grants will lead to much larger funding from federal or industrial sources.

CGRER investigators continue high quality research efforts through externally funded grants. Research highlights from the past year were CGRER's active participation in the execution of two major atmospheric chemistry studies: the NASA-funded

Tropospheric Atmospheric Chemistry Experiment in Asia (TRACE-P), and the National Science Foundation (NSF)-funded Aerosol Characterization Experiment in Asia (ACE-Asia). These large field experiments involving multiple aircraft, ships, ground stations, and satellites explored the impact of Asian emissions on global air quality and climate. It turns out that dust storms and particulate matter from industry in Asia can travel all the way across the Pacific Ocean to influence air quality even here in the Midwest!

Geoscientists at the Paul H. Nelson Stable Isotope Laboratory have been particularly successful in the past year at gaining grants and unraveling complicated problems related to past climates. They have developed one of the best facilities in the country for small-sample analyses of oxygen, carbon, hydrogen, and nitrogen isotopes, which they use to infer changes in past and recent climates and hydrologies.

Working with the Chariton Valley Biomass Project, CGRER cooperated in a successful test burn of switchgrass to replace 2.5% of the coal at the 650-megawatt Ottumwa Generating Station. The idea is to see if homegrown biomass can successfully replace coal and decrease pollution and greenhouse gas

emissions, while providing a new commodity crop for Iowa farmers. The burn received extensive national attention through an Associated Press release and coverage in the New York Times.

CGRER is collaborating with IIHR - Hydrosience & Engineering on the use of lidar technology to measure fine particulate matter in ambient air. The research has the potential to revolutionize how we monitor and verify emissions from mobile and fugitive sources.

Dialogue with community leaders takes many forms. At the end of 2001, several CGRER researchers participated in a blue-ribbon panel for Governor Vilsack and the Iowa Department of Natural Resources (DNR), preparing the report *Iowa Concentrated Animal Feeding Operations Air Quality Study*. The Task Force found that changes are needed to protect the public health and safety of workers and neighbors around large animal confinement operations.

Education, service, and outreach are important components of CGRER's mission. We hosted 10 undergraduate students in an NSF-sponsored summer program for undergraduates that incorporated hands-on research projects and individual instruction by faculty members. Projects ranged from

spectroscopic methods to measure chemical reactions on microscopic particle surfaces to modeling greenhouse gases emanating from Iowa soils. CGRER members spoke to the interim sessions of the Iowa Legislature, the Iowa Association of Electric Cooperatives, the Midwest Sierra Club, and many other groups about global and regional environmental change and how we, as citizens, can address such change.

We are pleased to conclude that research activities at CGRER are leading to an enhanced research portfolio in the State of Iowa. More universities and colleges are interested in and collaborating with research related to environmental change than ever before. In calendar year 2001, CGRER researchers accounted for over \$17 million in external funding through the leveraging of \$478,000 (during fiscal year 2001) in state funding. We are grateful for the support of the state, and we pledge to meet our obligations as research leaders in coming years.

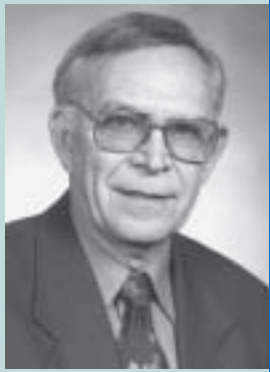
*Jerald L. Schnoor and  
Gregory R. Carmichael, Co-Directors*



This year, both CGRER co-directors received endowed chairs in the UI's College of Engineering. Jerald Schnoor is now Allen S. Henry Chair Professor of Civil and Environmental Engineering, and Gregory Carmichael is now Karl Kammermeyer Professor of Chemical Engineering. Carmichael also was appointed as the college's Associate Dean for Research and Graduate Studies on January 1, 2002.

# MESSAGE FROM THE

# Advisory Board



**By Representative  
Clyde Bradley**

Legislators in the Iowa Senate and the House of Representatives are the policy makers for Iowa's environmental law. Their decisions, or procrastination in making decisions, significantly impact the quality of life for all Iowans. This responsibility at the state level has taken on greater significance in view of the environmental management changes that are taking place in the United States: Today, the states are the leaders.

The environmental vision of the 1970s and the 1980s was crisis-driven with management and policy centered within the federal government. It distrusted markets and the private sector, in some cases rightfully so. Punishment rather than cooperation was the method for obtaining environmental progress. This vision assumed that environmental problems and conditions were similar everywhere, and consequently resulted in "one-size-fits-all" regulations mandating acceptable technologies and corrective methodologies. The prevailing thought process in Washington, D.C. was that the

states lacked the capacity and the will to regulate effectively. The reasoning was that individual states, in their competitive zeal to improve economic growth, would compromise environmental standards in order to attract business and industry.

The larger, crisis-type environmental threats have been addressed and still are being addressed. The remaining problems we face are more complex and subtle, and they vary from location to location; the costs and inadequacies of inflexible, prescriptive, and confrontational policies have become apparent. Achieving future environmental goals will require cooperation, innovation, flexibility, and decentralization, especially as we recognize that many of our environmental problems are global in nature.

Our new environmental approach stresses problem solving instead of fundamentally relying on punishment for failure to follow the "one-size-fits-all" approach. It strives to balance competing economic and environmental values. As we deal with these issues on a global basis, it is imperative that we seek flexibility in compliance methods, so that industry as well as countries can choose the lowest-cost methodology to achieve a given level of environmental quality. We are

looking toward bringing decision making to the lowest possible level and holding that entity responsible for the result, rather than relying on prescribed solutions.

During my tenure as vice-chair of the Environmental Committee in the Iowa House of Representatives, I have come to rely more and more on works, studies, analyses, and conclusions of the Center for Global and Regional Environmental Research. CGRER has been a very reliable source of the impartial objective data that is absolutely critical to informed legislative policy decisions. The Center has provided exceptional contributions to our scientific knowledge of health, ecosystems, and water and air quality, both regional and worldwide.

It is imperative that local problems have local solutions; state problems have state solutions; federal problems have federal solutions; and that we correctly place in perspective those problems that are human-induced changes, caused by modern technologies, with global consequences.

We are living in exciting times. One of our greatest challenges is to ensure that human-induced environmental changes do not compromise our quality of life.

CGRER bids a fond farewell to Larry Bean, who chaired the CGRER Advisory Board since its formation in 1994. On January 3, 2002, Mr. Bean retired from his position as administrator of the Iowa Department of Natural Resources' Energy and Geological Resources Division, simultaneously stepping down from his CGRER board directorship. In his over 20 years with Iowa's state government, he helped direct energy-related efforts relating to efficiency, policy, emergency preparedness, renewable sources, GIS, and the like. Mr. Bean provided leadership on the national as well as state level, and his innovative efforts were rewarded by numerous awards to him and to the state. CGRER will miss Larry's apt guidance. We express heartfelt thanks for his years of service, as well as warm wishes for his retirement years.



#### **CGRER Advisory Board Members**

**Larry Bean**

Iowa Department of Natural Resources  
Energy Bureau

**Representative Clyde Bradley**

Vice Chair, Environmental Protection Committee  
Iowa House of Representatives

**James Christensen**

Manager, Research and Technology  
Alliant Energy

**Senator Robert Dvorsky**

Appropriations and Education Committees  
Iowa Senate

**Senator William Fink**

Ranking Member, Natural Resources and  
Environment Committee  
Iowa Senate

**Mark Lamberts**

Iowa Utilities Board

**David Osterberg**

Clinical Assistant Professor  
UI Department of Occupational and  
Environmental Health

**Dorothy Paul**

Associate Director  
UI Center for Human Rights



# Dialogue

**CGRER Promotes Interdisciplinary Dialogue to Address Iowa's Needs**



CGRER continues to foster creative interdisciplinary discourse among the many groups concerned with global change issues. In 2001, major efforts included compilation of information on livestock confinement air quality issues, and sharing software and training to help Chinese scientists control sulfur-based air pollution. CGRER also encouraged dialoguing through its traditional seminar series, hosting of visiting scientists, web page, and newsletter publications.

## **Iowa Concentrated Animal Feeding Operations Air Quality Study**

Several CGRER members made major contributions to a detailed report, titled above, on the effects of animal confinement units on air quality. This study, carried out in the last half of 2001, was initiated under a charge from Governor Vilsack and the Iowa DNR to ISU's College of Agriculture and the UI's College of Public Health. The report is intended to provide the scientific basis for the Iowa legislature's upcoming dialogue concerning the need for, and feasibility of, DNR regulations of odor and air contaminant emissions from animal confinement operations.

CGRER affiliates were lead authors for three of the report's 11 chapters: Jerry Schnoor for the chapter "Environmental Fate of Air Pollutants," and Advisory Board member David Osterberg for the chapter "Relevant Laws, Regulations, and Decisions." Peter Thorne was lead author for "Air Quality Data," as well



as co-chair of the entire project. All of these authors also contributed to other report chapters, as did Keri Hornbuckle.

### China Sulfur Mitigation Project

Sulfur is one of the major air pollutants in the People's Republic of China (PRC), a result of the country's burning of soft coal for energy and heat. In 2000, CGRER research assistant and Ph.D. candidate Sarath Guttikunda joined a team of scientists visiting the PRC for on-site consultation on sulfur-related problems. This World Bank project proposed integrated assessment of a two-zone control policy, which established a "sulfur dioxide control zone" in northern China and an "acid rain control zone" in southern China.

For two weeks in late autumn 2001, CGRER hosted 11 PRC research scientists and laboratory directors who are involved in these sulfur-control efforts. The 2001 visit allowed CGRER to provide the PRC scientists with relevant software and to train them in the use of computer models for evaluating current and proposed sulfur control measures. More specifically, CGRER's models and training are allowing CGRER's Chinese visitors to perform integrated environmental assessment and cost-benefit analysis, applying these techniques to various sulfur control technologies for two specific PRC cities (one in each of the two control zones). CGRER will continue to provide technical assistance to Chinese scientists who are employing these computer models.

### Visiting Scientists

In addition to the Chinese Sulfur Mitigation Project scientists and a variety of seminar and colloquium speakers, the following 13 international and U.S. scientists visited CGRER in 2001:

- **Giuseppe Calori** visited CGRER for several days in February to continue research initiatives related to air quality and to establish new research collaborations between CGRER and his newly founded company Arianet, located in Milano, Italy.
- **Jim Cowin**, from the U.S. Department of Energy's (DOE's) Battelle Pacific Northwest Laboratories (PNL), visited CGRER for one day in June to discuss research collaborations between CGRER and PNL in the area of heterogeneous chemistry, and to demonstrate his new method for passively sampling particles. This technique can be used in variety of chemistry and public health applications. As a follow-up to his visit, Professor Grassian and her students have established a formal collaboration that will include visits between the laboratories.
- **Ms. Qingyan Fu** and **Mr. Chen**, visitors from the Shanghai Academy of Environmental Sciences (SAES), came to CGRER for a week in April to receive training in using atmospheric models and integrated assessment techniques focusing on human health and environmental benefit analysis of urban development policies. They will apply these to the Municipality of Shanghai, China. Their visit was part of an ongoing Shanghai Integrated Environmental Assessment Program funded by the U.S. Environmental Protection Agency's National Renewable Energy Laboratories (NREL), Washington, D.C.
- **Vlasta Hladikova** and **Iveta Carikova**, both from the Institute for Public Health in Bratislava, Slovakia, visited CGRER for three weeks in April. These environmental scientists and public health specialists are working with Jerry Schnoor on a seed grant from the UI's Environmental Health Sciences Research Center. They came to Iowa for training in the use of GIS, and to write a paper on potential human health effects of lead and cadmium contamination from smelters in Slovakia.
- **Ram Khadka**, Dean of the School of Environmental Management and Sustainable Development in Kathmandu, Nepal, spent a week in Iowa participating in CGRER's ongoing initiative to foster

cooperative educational and research activities in engineering and global change issues with Nepal. Khadka participated in discussions and activities with CGRER's directors, Global Health Studies personnel, and the director of Study Abroad, and gave two lectures as part of CGRER's new Global Environmental Politics Seminar Series.

- **Gakuji Kurata**, a research associate with the Department of Ecological Engineering, Toyohashi University of Technology, Aichi, Japan, is spending his sabbatical year (May 2001 to May 2002) at CGRER working with Greg Carmichael and his research group on the analysis of data collected during the Asian field experiments ACE-Asia and TRACE-P.
- In June, CGRER hosted the first post-mission workshop of the ACE-Asia and TRACE-P research team. At that time, **Itsushi Uno**, **David Streets**, **James Yienger**, **Chuang Liu**, and **Daewon Byun** (who joined CGRER's UI researchers to form a collaborative team from Kyushu University, Japan; Argonne National Laboratory; Academy Seneca, China; and the University of Houston) assembled in Iowa City for five days to review and analyze data from these two large field experiments.

### CGRER Seminar Series

In 2001, CGRER hosted 11 global change researchers from around the world, who came to Iowa City to present seminars on their varied areas of expertise. Three additional seminars were presented as part of the Global Environmental Politics Colloquium - Seminar Series (see page 11). Seminar speakers and their topics are listed to the right.

Speaker	Affiliation	Title of Seminar
Ricardo Alvarado	Dean of Chemical Engineering National University of Nicaragua	Challenges of Green Science and Technology in Developing Countries: The Case of Nicaragua
James Anderson	Harvard University	1) The Halogen Story: Chlorine, Bromine and Global Ozone 2) Radical-Molecule Reactivity: A New Theoretical Framework 3) Climate and Chemistry: An Intimate Link
Joseph DePinto	Limno-Tech, Inc., Ann Arbor MI	Insights Gained from Development of an Aquatic Ecosystem Model for Saginaw Bay, Lake Huron
Henry Fricke	Department of Geology Colorado College	Unveiling Warm Climate Periods of the Past Using the Stable Isotope Biogeo-chemistry of Fossil Tooth Enamel
James S. Gardner	University of Manitoba Canada	1) Accelerated Mountain Tourism Growth and its Social, Economic, and Environment Impacts in Kullu, India 2) An Analysis of Land Use History and Risk from Natural Hazards in Kullu, Indian Himalaya
Ronald Gehr	Department of Civil Engineering & Applied Mechanics McGill University, Canada	New Directions in Disinfection of Water and Wastewater
Wolfgang Hoeschele	Truman State University	Geographic Information Engineering and Social Ground Truth in Attappadi, Kerala State, India
Greg Ludvigson	Dept. of Geoscience University of Iowa	Explorations of Iowa's Rock Record of the Late Ordovician Greenhouse-Icehouse Transition
Bedrich Moldan	Charles University Prague, Czech Republic	Environmental Challenges to Central and Eastern European Economics In Transition
Leo Saldanha	Environment Support Group Bangalore University, India	Globalization, Environment, and Freedom: An Indian Perspective
Paul G. Tratnyek	Oregon Graduate Institute of Science and Technology	Redox Properties of Natural Organic Matter (NOM), Fractions of NOM, and Model Biogeochemical Electron Shuttles





### Other Outreach Efforts

CGRER continues to publish the newsletter *IoWatch*, which this year focused on the Center's many research efforts that deal with the small particles commonly called "dust."

In 2001 CGRER's web page ([www.cgrer.uiowa.edu](http://www.cgrer.uiowa.edu)) was upgraded, giving the Center a greatly improved web presence. A major addition was the Iowa Weather Forecasting System, brought online in April. This site provides general 72-hour weather forecasts (including still and animated weather maps) for 12 Midwestern states and more specific 72-hour forecasts for 37 Midwestern cities, as well as connections to national weather resources. This system employs Regional Atmospheric Modeling System (RAMS) to analyze forecasts. Future plans for this site include adding more tightly focused local information and instability indexes for severe weather forecasts.



### Additional Successes

The many appointments and honors awarded to CGRER members and their students demonstrate the success with which they have expressed their messages, both to the professional community and to the larger world. Following is a sampling of such appointments, honors, and awards received in 2001:

- Richard Baker (UI, Geoscience), awarded Distinguished Scientist Award, Iowa Academy of Sciences
- Rhawn Denniston (Cornell College, Geology), appointed Board of Directors - Geological Society of Iowa
- G. Edgar Folk (UI, Physiology and Biophysics), received Annual Presentation of the American Physiological Society (the Daggs Award) for Distinguished Service
- Keri Hornbuckle (UI, Civil and Environmental Engineering), appointed Director, Environmental Assessment Facility of the UI's Environmental Health Sciences Research Center
- Witold Krajewski (UI, Civil and Environmental Engineering and IHR-Hydrosiences & Engineering) received UI College of Engineering's Research Award
- George Malanson (UI, Geography), appointed to National Academy of Sciences / National Research Council Committee on Research Priorities in Geography at the U.S. Geological Survey
- Sondra Miller (student of Keri Hornbuckle), received Selected Professions Engineering Dissertation Fellowship from the American Association of University Women Educational Foundation, and International Institute for Applied Systems Analysis Young Scientists Summer Program funding research in Vienna, Austria
- Benjamin Miriovsky (student of Witold Krajewski and Allen Bradley), received American Meteorological Society Graduate Fellowship
- Peter Thorne (UI, Occupational and Environmental Health) appointed Director, UI's Environmental Health Sciences Research Center
- Dave Wethington (student of Keri Hornbuckle), received Kersten Fellowship
- Dale Zimmerman (UI, Statistics and Actuarial Science), named Fellow of the American Statistical Association



# Education

**CGRER Provides Education to Address Iowa's Needs**

CGRER continues its efforts to encourage sound, well-founded thought processes among those dealing with global change issues. Relevant efforts in 2001 ranged from facilitating discussions on environmental politics to promoting the development of educational materials. CGRER also continued to host an undergraduate research program and award research travel grants to graduate students.





	Speaker	Affiliation	Title of Colloquium and Seminar
<p><b>Global Environmental Politics Colloquium - Seminar Series</b></p> <p>In Fall, 2001, CGRER created a new colloquium - seminar series to establish an academic forum for interdisciplinary discussions of the politics of environmentalism and the environment. Three speakers (listed to the right) led a lunchtime colloquium for CGRER members and later presented a seminar to the university community as a whole.</p>	Amita Baviskar	Department of Sociology Delhi University, India	<p><i>Colloquium:</i> The Politics of Environmental Management: The Case of the Watershed Mission in Central India</p> <p><i>Seminar:</i> Red in Tooth and Claw: Looking for Class in Struggles over Nature in India</p>
<p>This lecture series is yet another of CGRER's attempts to promote interdisciplinary dialogue among members of the many disciplines concerned with environmental problems. Because CGRER's membership base includes physical, biological, and social scientists, the Center is seen as an ideal instigator of such a series.</p>	Charles Zerner	Head, Environmental Studies Unit Sarah Lawrence College, NY	<p><i>Colloquium:</i> Justice and Conservation in Southeast Asia</p> <p><i>Seminar:</i> The Viral Forest in Motion: Ebola, African Forests, and the New Cartographies of Environmental Danger</p>
<p>The Global Environmental Politics Colloquium - Seminar Series will continue in Spring 2002. During the 2002-2003 academic year, CGRER and the UI's Global Health Studies Program will collaborate in presenting a similar lecture series that focuses on Global Environment and Health.</p>	Ram Khadka	Dean, School of Environmental Management and Sustainable Development Kathmandu, Nepal	<p><i>Colloquium:</i> Case Study of Water Supply Dilemmas in a Country with Too Much Water: Upland Nepal</p> <p><i>Seminar:</i> An Overview of Water Hazard and Management Issues in Katmandu Valley, Nepal</p>



**Research Experience for Undergraduates Program**

In 2001, CGRER hosted 10 students in an eight-week summer research program for undergraduate students. This was the second year of a three-year, NSF-funded program directed by CGRER member Vicki Grassian. The program is designed to heighten student involvement in research by involving them in actual ongoing research efforts, and thus to help students to make informed decisions about future science studies and careers. Students, sponsors, and their projects are listed to the right.

Student	Home Institution	Faculty Sponsor	Project
Matthew Barron	University of Michigan Ann Arbor, MI	Jerry Schnoor	Modeling Greenhouse Gases, and their Sequestration into Forests and Soils by Trees and Prairie Grasses
Kari Brown	Hollins University Roanoke, VA	Michelle Scherer	Transformations of Organic Pollutants in the Presence of Green Rusts
Adam Christensen	University of Iowa Iowa City, IA	Vicki Grassian and Mark Young	Heterogeneous Atmospheric Chemistry of Trace Gases on Oxide Particles and Mineral Dust
Brian Connolly	University of Iowa Iowa City, IA	Keri Hornbuckle	The Fate and Transport of Semi-Volatile Organics in Environmental Systems
Brett Darrow	University of Iowa Iowa City, IA	Len MacGillivray	Green Chemistry in the Solid State
Cory Gerdts	Greenville College Greenville, Illinois	Sarah Larsen	Spectroscopic Investigations of NOX Catalysts
Nathan Lien	Wartburg College Waverly, IA	Jason Telford	A Novel Approach to Environmental Remediation: Development of Outer-Sphere Ligands for Uranyl Carbonate
Kristy Reeves	West Chester University of Pennsylvania West Chester, PA	Greg Ludvigson and Luis Gonzalez	Cretaceous Paleoclimatology
Elizabeth Smith	University of Massachusetts Amherst, MA	Greg Ludvigson and Luis Gonzalez	Cretaceous Paleoclimatology
David Weingeist	Washington University St Louis, MO	Greg Carmichael	Tropospheric Trace Gas Cycles in East Asia

### Public Education Projects

CGRER funded two special projects in 2001, both of which promise to heighten the general public's awareness of human-induced environmental changes. The first, a \$7,918 grant to Diana Horton (UI, Biological Sciences), supplemented the Fragile Flora Database seed grant she had received the previous year. The new grant further aided Horton in establishing a web site for the UI's herbarium. The web site will

enable Iowa's amateur and professional botanists to track changes in the numbers and locations of Iowa's endangered flora, and to compare changes in their official listings through time.

CGRER also awarded a \$28,326, two-year grant to Cornelia Mutel (UI, IIHR - Hydroscience & Engineering) to fund her work on a book manuscript with the working title, *The Nature of Ecological Change: The Changing Natural History of Johnson*

*County, Iowa*. This book will trace, in lay language, the natural and human-induced changes in the native ecosystems of Eastern Iowa (focusing on Johnson County), from ancient prehistory to the present. Intended both as a text and as a guide for amateur naturalists and policy makers, the book should be useful in reshaping the change process to benefit Iowa's native species, ecosystems, and citizens.

### CGRER Graduate Student Travel Awards

For the second year, CGRER provided grants to graduate students to help pay for travel to research sites. A total of \$9,819 was awarded to nine UI students, who were required to demonstrate that they received additional funding from sources other than CGRER. Students along with their travel destinations and projects are listed to the right.

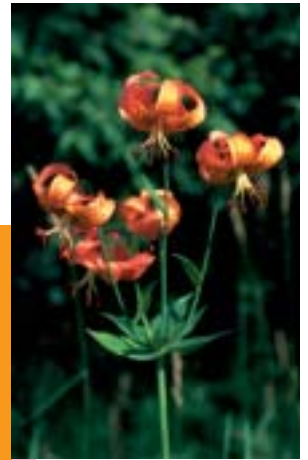
Student	Destination	Project
Barbara L. Davidson	Doi Pooley, Thailand	TB Treatment of Hmong Villagers: Intersections of Public Health, Hmong Identity, and Thai Nation Building
Jennifer DeWoody	Illinois River floodplain	Genetic Analysis of Population Parameters in <i>Boltonia decurrens</i> , a Threatened Floodplain Plant
Chris Gienapp	Various sites in Iowa	Are Spatial and Temporal Differences in Prairie Fragments Related to Pollinator Species Richness?
Roger Gomez	Dominican Republic; Valencia, Venezuela; Jackson Bay Caves, Jamaica	Holocene Precipitation and Vegetational History from the Caribbean Tropics Recorded in Speleothems
Kathleen O'Reilly	Rajasthan, India	Constructing Development in India's Thar Desert: NGOs as Sites of Contestation
Julie Seehawer	Cone Marsh, Iowa	Sympatric Speciation in <i>Gnorimoschema</i>
Matthew J. St. Pierre	Dickinson County, Iowa	What Role does Dispersal Play in Structuring the Population Dynamics of a Monophagous Prairie Insect?
Dave Wethington	Milwaukee, Wisconsin	Polychlorinated Biphenyl Concentrations in the Atmosphere at Milwaukee, Wisconsin, along the Lake Michigan Shoreline
Frederick Williams	Ames, Iowa	Role of Host-Plant Specialization in Driving Genetic Differentiation in a Goldenrod Gallmaker

### Additional Educational Activities

CGRER members perform numerous activities that contribute, broadly speaking, to the spread of knowledge about global change problems and their solutions.

Following is a sampling of such activities performed in 2001:

- Marc Armstrong (UI, Geography) is on editorial boards for the publications *Geoinformatica*, *Geographical and Environmental Modeling*, *Cartography and Geographic Information Science*, and the *International Journal of Geographical Information Science*. He also serves on the NSF's Senior Panel for the Geography and Regional Science Program.
- Richard Baker (UI, Geoscience) was invited by the Union of Concerned Scientists to visit with legislators in Washington D.C. about global warming issues.
- Greg Carmichael and Jerry Schnoor (UI, CGRER co-directors) gave an overview of CGRER activities to Iowa's Joint Legislative Oversight Committee. Schnoor also described CGRER at an Iowa Association of Electric Cooperatives workshop on the environment, and spoke on "Coupled Human and Natural Systems" at a congressional briefing in Washington D.C. (as well as presenting similar global change-related presentations at universities across the country).
- G. Edgar Folk is serving on the Program Committee of the International Society for Biometeorology for the 16th Congress on Biometeorology (meeting October 2002).
- Vicki Grassian (UI, Chemistry) served as co-organizer of two 2001 symposia: "Current Understanding of Tropospheric Aerosols: Advances in Field and Laboratory Studies" (AGU meeting, San Francisco), and "The Physical Chemistry of Gas-Particle Interactions" (National American Chemical Society meeting, Chicago).
- Steve Heard (UI, Biological Sciences) serves on the Belqum Grove Management Committee for the Johnson County Heritage Trust.
- Keri Hornbuckle (UI, Civil and Environmental Engineering) is a member of the Lake Michigan Atmospheric Deposition of Toxics Task Force and an associate editor of the *Journal for Great Lakes Research*. This last year, she also served on review committees for NSF's CAREER Awards, CS Mott / IAGLR Dissertation Fellowship Awards, and CH2M & Parsons PhD Dissertation Awards.
- James Raich (ISU, Botany) is a university delegate to the Organization for Tropical Studies, and reviews manuscripts for several journals including *Biogeochemistry*, *Ecology*, and *Global Change Biology*. He also is a member of the Leopold Center for Sustainable Agriculture's Agroecology Issue Team.







# Research

**CGRER Fosters Global Change Research  
to Address Iowa's Needs**



CGRER continues to foster innovative concepts through procuring and awarding research grants related to global change issues. A total of nine CGRER projects funded by external sources were underway in 2001. In addition, CGRER supported the initiation of projects through seed grant funding, and continued to foster additional research by providing state-of-the-art research facilities and computer equipment to members and their students. These initiatives and incentives have shaped environmental research and policy agendas around the globe.

## **Grants and Contracts Awarded to CGRER**

CGRER received the following three major new grants in 2001:

*The Role of Heterogeneous Chemistry in the Photochemical Oxidant Cycle: A Modeling and Laboratory Study* (Greg Carmichael and Vicki Grassian, \$640,824, four years, from DOE):

Particulates (such as soot and soil particles) and trace gases (for example nitrous oxides) have long been known to modify the atmosphere's chemical properties. However only in the last few years have researchers realized that *interactions* between particulates and trace gases may be significant in altering the troposphere's chemical balances - that mineral dusts actually catalyze reactions among trace gases that adhere to the particles. Some of the very first studies in this new field of "heterogeneous atmospheric chemistry" were performed under a 1998 DOE grant to CGRER. Resulting research was successful in producing 14 journal papers and nine presentations, in training seven students and

post-docs, and in initiating major new program funding from NSF and DOE.

In 2001, CGRER received another four years of funding to continue its heterogeneous atmospheric research. Renewed efforts will be made to evaluate the extent to which these particle-gas interactions affect the photochemical oxidant cycle, and laboratory studies will examine heterogeneous reactions involving nitrous oxides and volatile organic compounds. These studies will be unusual in their multidisciplinary approach, and in the combined use of modeling and laboratory efforts, each guiding the other.

*Conduct Carbon and Oxygen Isotope Analyses on Alaskan Weathervane Scallop Shells* (Scott Carpenter, \$95,600, two years, from Alaska Department of Fish and Game):

Identification of modern human-induced climate change depends in part on our ability to date past natural climate changes. For this reason, CGRER helped establish the Paul H. Nelson Stable Isotope Laboratory (PHNSIL) in the UI's Department of Geoscience. Here the measurement of stable isotopes in many types of Earth materials can be used to help characterize paleoclimates.

This new contract will use the PHNSIL in another manner: to age weathervane scallops. These abundant scallops are harvested along Alaska's coastline, but their numbers and age distribution need to be monitored to avoid commercial depletion. Aging is traditionally performed by counting visible growth rings on the scallop's outer shell. Using carbon and oxygen isotope analyses, the PHNSIL will prepare a reference collection of scallop shells for the Alaska Department of Fish and Game. This collection can then be used to age

living scallops with greater accuracy, a process that will greatly improve understanding of scallop population dynamics and commercial management of the species. The project also will allow compilation of an oxygen isotope time series from shells, enabling the reconstruction of the timing and magnitude of El Nino-related temperature changes in this economically important part of the Pacific Ocean.

*Chariton Valley Biomass Project: Benefit-Cost Analysis - Switchgrass versus Coal for Iowa Electric Generation* (Jerry Schnoor, \$69,093, one year, from Chariton Valley Resource Conservation & Development, Inc.):

Since 1994, CGRER has been evaluating Iowa's greenhouse gas emissions. That year, Jerry Schnoor started to compile the Iowa Greenhouse Gas Action Plan, an effort to evaluate specific techniques to lower the state's carbon dioxide emissions. CGRER has continued intensive work on the Greenhouse Gas Action Plan ever since, finally completing the last phase in 2001 with publication of *Final Report: Greenhouse Gas Phase III - Carbon Storage Quantification and Methodology Demonstration* for the project's funder, the Iowa DNR.

The Greenhouse Gas Action Plan suggested use of "green fuels" among other things. By replacing fossil fuels with biomass fuels that remove carbon dioxide from the atmosphere while growing, the state's carbon dioxide emissions could be reduced. The Chariton Valley Biomass Project, which commenced in 1998, grew out of this suggestion. Since then, CGRER has been examining the possible burning of switchgrass as a partial coal substitute in Alliant Energy's Ottumwa Generating Station. In 2001, the first test burn of switchgrass successfully demonstrated that use of this fuel substitute both is

technologically feasible and significantly decreases carbon dioxide (as well as the air pollutants sulfur dioxide and particulate matter). Now, with this new grant, CGRER will be examining the potential economic viability of using such a fuel substitute for electricity generation: Switchgrass's production costs and "environmental externalities" (e.g. financial benefits of increased wildlife habitat and improved water quality) will be compared to those of coal, to determine the true cost of each fuel's use.

CGRER members also continued to work on the following six 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, PI: Greg Carmichael
- *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, PI: 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, 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, PIs: Vicki Grassian and Greg Carmichael
- *A Study of Organic Contaminants in Air and Water in Conjunction with Episodic Events*, 2/4/99 - 2/29/02, U.S. Environmental Protection Agency, PI: Keri Hornbuckle
- *Dynamics of Gas-Phase Persistent Organic Chemicals*, 8/4/98 - 8/31/02, NSF, PI: Keri Hornbuckle



**Seed Grants Awarded by CGRER**

In 2001, CGRER awarded \$149,874 of grant funds to eight projects at Iowa's Regents institutions. These projects, listed to the right, were funded with the expectation that once initiated, they would bring in additional external funding.

Name	Amount	Title
Scott Carpenter, Geoscience, UI	\$ 20,000	High Resolution Stable Isotope Analysis of the Last Deglaciation as Found in the Sediments of Glovers Pond, New Jersey
Mohammad Iqbal, Earth Science, UNI	\$ 14,320	Use of Environmental Isotopes to Determine the Predominant Sources of Moisture that Drive the Precipitation Events in Northeast Iowa
Witold Krajewski, William Eichinger, Keri Hornbuckle, Civil & Environmental Engineering and IIHR-Hydrosience & Engineering, UI	\$ 20,000	Conceptual Network Design Studies for Iowa Hydrologic and Environmental Validation Site
Johna Leddy, Chemistry, UI	\$ 20,000	Magnetically Modified Nickel-Metal Hydride Batteries for Reduced Environmental Emissions
James Raich, Botany, ISU	\$ 16,104	Grass-Type Controls over Carbon Fluxes from Grasslands
Jerald Schnoor, Richard Ney, Civil & Environmental Engineering, UI	\$ 20,000	Measuring Net Greenhouse Gas Emissions from Wetlands
Eugene Takle, Atmospheric Sciences, and Zaitao Pan, Agronomy, ISU	\$ 19,500	Basin Scale Water Quality Change and Uncertainty Under Global Climate Change
Mark Young, Chemistry, UI	\$19,950	Mass Spectrometric Probes of Photochemistry in Natural and Model Water Samples

### CGRER Aids for Researchers

CGRER continues to reside in the Iowa Advanced Technology Laboratories on the UI campus. In 2001, CGRER started readying for an early-2002 move to the fourth floor of the building. This move, although not providing more space for the Center, will consolidate all CGRER office, meeting, and laboratory space on a single floor. The acquisition of dedicated space is expected to increase interactions among CGRER members and students.

CGRER renewed its membership in the University Corporation for Atmospheric Research (UCAR) in

autumn, 2001. This renewal enables CGRER members and their students to continue to utilize multiple UCAR resources: instructional programs, computing assistance, fellowship and post-doctoral support, research equipment, and the like.

CGRER continues to offer use of state-of-the-art computing, visualization, and global positioning system (GPS) equipment to members and their students. CGRER also continues to function as one of four departments on the UI campus to support and distribute geographical information system (GIS) software through its license with ESRI. In addition to standard purchases and

upgrades of personal computers, laptops, and operating systems, in 2001 CGRER added a Linux Cluster to its array of equipment. This cluster consists of 16 computing nodes, each containing 512 MB of RAM and a 1 GHz processor, and a single master node with 1 GB of RAM and a 2 GHz processor. The Cluster, functioning as a super-computer, rapidly evaluates large volumes of environmental data, an asset that has improved the efficiency of data visualization and computing. The CGRER Linux Cluster was the first operational cluster on the UI campus in the summer of 2001.



### Additional Research Grants

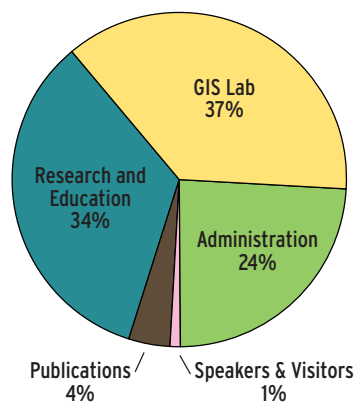
In addition to research funding awarded directly to the Center, CGRER members and their colleagues continue to bring in a variety of grants and contracts that allow investigation of numerous global change topics. The following is a sampling of such grants awarded in 2001:

- Pedro Alvarez (UI, Civil and Environmental Engineering): *Environmental Impacts of Ethanol in Gasoline: A Planning Trip to Brazil* (\$12,915, from NSF); *Effect of Ethanol in BTEX Plume Length* (\$38,994, from American Petroleum Institute)
- Pedro Alvarez, Gene Parkin, Michelle Scherer, Richard Valentine (UI, Civil and Environmental Engineering): *Fe(0)-Based Bioremediation of RDX Contaminated Groundwater* (\$260,000, from SERDP)
- Mark Young, Gregory Carmichael, Vicki Grassian, Paul Kleiber, Mark Arnold (UI, multidepartmental): *Acquisition of a Tunable Solid State Laser System for Applications in Atmospheric Chemistry, Aerosol Analysis, Process Monitoring and Reaction Dynamics* (\$270,670, NSF)
- Rhawn Denniston (Cornell College, Geology): *Acquisition of an Alpha Spectrometry System for Research and Undergraduate Training in Geology and Environmental Science* (\$97,826, NSF)
- Vicki Grassian, Mark Arnold, Tom Boggess, Tom Hasenberg (UI, multidepartmental): *Real Time Monitoring of CO* (\$30,000, Honda Corporation)
- Steve Heard (UI, Biological Sciences) and John Nason (ISU, Botany): *Collaborative Research: Host-Associated Genetic Differentiation in the Goldenrod Elliptical-Gall Moth - Parallel Host-Race Formation?* (\$470,000, NSF)
- Dale Zimmerman (UI, Statistics and Actuarial Science): *Statistical Models and Methods to Analyze Telemetry Data* (\$96,000, Alaska Department of Fish and Game)

GENERAL

# Information

**Figure 1**  
CGRER'S Expenses\*



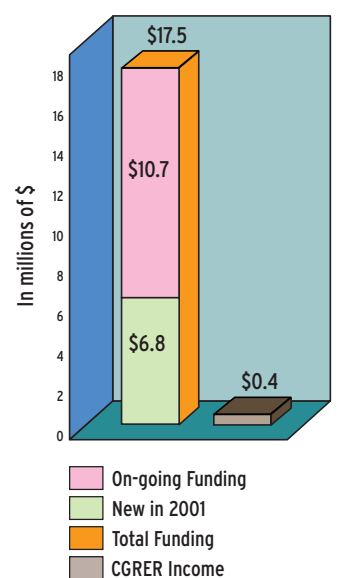
\* Applies to Fiscal Year 2001

## Budget

In fiscal year 2001 (July 1, 2000 - June 30, 2001), three-fourths of CGRER's \$478,389 of funding was spent on research, education, and outreach directed toward global change issues (Figure 1). The remaining quarter 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 2001, CGRER members were performing research that brought in a total of \$17.5 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, \$6.8 million was new funding that was initiated in 2001, while the remaining \$10.7 million came from ongoing projects.

**Figure 2**  
2001 Leveraging of CGRER'S Income\*



\* Applies to Calendar Year 2001

## CGRER Members

### Administration and Membership

CGRER is directed by University of Iowa professors Gregory Carmichael (Department of Chemical and Biochemical Engineering) and Jerald Schnoor (Department of Civil and Environmental Engineering). Center activities are guided by an elected Executive Committee that consists of 11 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 full-time 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, Dr. David Skorton.

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#### Anthropology

Michael S. Chibnik  
Russell L. Ciochon

#### Biological Sciences

Stephen B. Heard  
\* Stephen D. Hendrix  
\* Diana G. Horton

#### Chemical and Biochemical Engineering

\* Gregory R. Carmichael

#### Chemistry

\* Vicki H. Grassian  
\* Sarah C. Larsen

#### Civil & Environmental Engineering

Pedro J. Alvarez  
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\* Keri C. Hornbuckle  
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\* Luis Gonzalez  
\* Gregory A. Ludvigson  
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Holmes A. Semken, Jr.  
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You-Kuan Zhang

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\* Paul R. Greenough

#### Law

Jonathan Carlson  
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#### Mechanical Engineering

V.C. Patel  
Theodore F. Smith

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Donald A. Gurnett  
John S. Neff  
Steven R. Spangler

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G. Edgar Folk

#### Occupational & Environmental Health

Peter S. Thorne

#### Public Policy Center

David J. Forkenbrock

#### Statistics & Actuarial Science

Dale L. Zimmerman

### Iowa State University

#### Agronomy

Raymond W. Arritt

#### Animal Ecology

Diane M. Debinski

#### Botany

John Nason  
James W. Raich

#### Geological & Atmospheric Sciences

William J. Gutowski  
Eugene S. Takle

#### Hydrologic Research Center, San Diego, CA

Konstantine P. Georgakakos

#### Cornell College

#### Department of Geology

Rhawn Denniston

\* Executive Committee Member



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