

# The Center for Global and Regional Environmental Research

# CGRER

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 (IATL), 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 68 members from 25 departments at six institutions.

While environmental change is constant and natural, CGRER focuses on the human-induced acceleration of such change caused by modern technologies, lifestyles, and population growth. 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 reinterpretation 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 in assessing and preparing for global change and its effects.



IN 2005, WE WERE REMINDED OF THE FEROCITY OF NATURE IN THE AFTERMATH OF THE TSUNAMI IN INDONESIA, FLOODING IN CENTRAL EUROPE, MULTIPLE HURRICANES IN THE UNITED STATES, AND THE EARTHQUAKE IN PAKISTAN. ALL THESE EVENTS CREATED HUMAN TRAGEDIES OF UNFATHOMABLE SCALE.

From our perspective at CGRER, we wonder about the role that humans play in triggering climatic events like floods and hurricanes. The multiple facets of Hurricane Katrina – its causes, consequences, and cures – are strongly linked to the broader mission of CGRER. From the temperature of the seas to the greenhouse gases in the atmosphere, from the erosion of coastal wetlands to the reconstruction of infrastructure for safe drinking water and sanitation, CGRER researchers have considerable expertise related to these subjects.

Yet while CGRER's research portfolio includes projects on extreme weather events and global warming, our research and educational goals are actually much broader. At CGRER, we are dedicated to fostering interdisciplinary research and education focused on the many facets of global change, including regional effects on environmental quality, ecosystems, people, and industries. This charge requires interweaving the natural sciences and engineering, social and behavioral sciences, public policy, and health sciences. This annual report documents activities that addressed this mission in 2005, which

comprised another fascinating year of interdisciplinary research, education, and dialogue for CGRER.

Return to the question, are extreme events like Hurricane Katrina caused by global warming? The answer remains illusive. However, the Third Assessment on Climate Change by the Intergovernmental Panel on Climate Change has concluded that humans have caused a significant portion of the global warming that occurred in the past 100 years (a worldwide average temperature exceeding 1° F).

That brings us to the sobering possibility that hurricanes might be made more powerful by human-caused global warming. Two recent independent studies of global hurricane intensity by Webster et al. (*Science* 309:1844, 2005) and by Keri Emanuel (*Nature* 436:686, 2005) conclude that the number and fraction of storms of the highest intensities (Categories 4 and 5) have increased greatly during the past 35 years, even though the total number of all storms has remained about the same. Emanuel correlated the intensity of the storms (wind speed and duration) to sea surface temperature, which has

warmed significantly in the Atlantic, Pacific, and Indian Oceans, even at depths of several hundred meters. That temperature change can be explained only by human-caused warming (Barnett et al., *Science* 309: 284, 2005). This relationship is, however, complicated by an 80-year natural cycle that is thought to govern ocean water temperatures in the North Atlantic: we are now in the middle of an approximately 20-year warmer period of this cycle.

In conclusion, while at present we lack an irrefutable connection between hurricane force and human-caused global warming, the evidence for this connection is mounting. At some point we must learn the lesson that there is never complete scientific certainty about anything. We must claim the courage and wisdom to make decisions in the face of scientific uncertainty.

What other lessons are to be learned from Hurricane Katrina? In hindsight, we knew the levees in New Orleans might not be strong enough to withstand a slow-moving Category 4 storm like Katrina, yet we lacked the resources or political will to fix them. Many other coastal cities, such as Tampa, Florida, remain at risk to storm surge, a problem shared by low-lying communities throughout the world. Following the great floods of 1953, The Netherlands rebuilt its entire flood wall and protection gates at an enormous cost to protect half the country lying below sea level. A lesson of Katrina is that we must do the same if we want to continue to inhabit cities in low-lying coastal locations.

From Katrina, we also learned that we are vulnerable to many events curtailing oil supply because of our nation's dependence on foreign oil, minimal excess capacity to refine oil and produce gas, and tremendous consumption. Promoting energy conservation and renewable energy resources could effectively supplement our energy supplies and decrease the vulnerability of our ports and refining capacity on the Gulf Coast.

The year 2005 showed us that CGRER's focus on global and regional environmental change is more important than ever. This past year also was a milestone in that CGRER celebrated its fifteenth anniversary. Throughout our history, we have worked to bridge science and policy. Our researchers are not policymakers, but our work can and does dependably inform decision makers. We pledge to continue to offer the state and the nation our expertise whenever we can be of assistance. We are grateful to the State of Iowa and its public utilities for supporting CGRER, and we will endeavor to produce policy-relevant, expert research for the future.

JERALD L. SCHNOOR  
CGRER Co-Director with  
Gregory R. Carmichael

## CGRER Executive Committee

David Bennett  
Geography

Jonathan Carlson  
Law

Gregory Carmichael, Co-Director  
Chemical & Biochemical Engineering

Dennis Dahms  
Physical Geography, UNI

Jeffrey Dorale  
Geoscience

Vicki Grassian  
Chemistry

Paul Greenough  
History and Community &  
Behavioral Health

Steve Hendrix  
Biological Sciences

Diana Horton  
Biological Sciences

Sarah Larsen  
Chemistry

Lou Licht  
Ecolo-Tree, Inc.

Michelle Scherer  
Civil & Environmental Engineering

Jerry Schnoor, Co-Director  
Civil & Environmental Engineering

Peter Thorne  
Occupational & Environmental Health

You-Kuan Zhang  
Geoscience



# Message

## MESSAGE FROM THE ADVISORY BOARD

My reflections begin as my term on the CGRER Advisory Board ends. Because problems facing life on Earth have become increasingly urgent, this is a critical moment in human history. Devastating natural events of unparalleled magnitude, like Hurricane Katrina and the Indian Ocean tsunami, have been increasing in frequency and intensity over the past few decades. Even national borders have become illusionary in today's environmentally interconnected and interdependent world. These changes, combined with an exploding human population, dwindling resources, and a significantly warming climate, afford a harsh glimpse into the future.

After serving on the CGRER Advisory Board since its inception in 1993, I have gone beyond gratification for the expertise I have found there to the belief that the "impossible" can be

attained. CGRER's ability to advance environmental solutions through relevant research projects and work on long-term challenges has helped me grasp the big environmental picture at both the macro and micro levels. First-rate scientific research – addressing issues from atmospheric dust storms in Asia affecting air quality in the Midwest, to PCBs in the Hudson River, to clean water in Iowa – has built my awareness that environmental threats in faraway places have a way of migrating to other lands. CGRER has made important progress in promoting dialogue and educating the public about these and other environmental issues. CGRER's influences are extended through the work of its interdisciplinary faculty, students, and Advisory Board members representing Iowa government, industry, and other educational institutions.

The bottom line, however, still remains. Our fate, and that of our planet, rest with the ultimate choices we all make to save ourselves from our own actions. Behavioral changes must be made at governmental, industrial, and personal levels. Through my learning experiences as a member of CGRER's Advisory Board, I renewed my resolve to live my own life in a more "sustainable" fashion, and to promote stewardship of Planet Earth for the benefit of future generations. My paradigm is wrapped in the wisdom of a 12-year-old African boy who said, "Do all you can with what you have, in the time that you have, in the place you are."

DOROTHY M. PAUL  
Associate Director for  
Community Affairs  
UI Center for Human Rights

*CGRER bids Dorothy Paul a grateful and heartfelt farewell after her thirteen years of dedicated service on our Advisory Board. We know that her passion for environmental concerns will continue to energize positive efforts in many spheres.*

### CGRER Advisory Board Members

Robert Dvorsky

Mary Lou Freeman

Steven Guyer (Chair)

Jim Klosterbuer

John Norris

David Osterberg

Dorothy Paul

Sharon Tahtinen

Iowa Senate

Iowa House

MidAmerican Energy

Alliant Energy

Iowa Utilities Board

UI, Occupational & Environmental Health

UI, Center for Human Rights

Iowa Department of Natural Resources

# Student Portfolio

## STUDENT PORTFOLIO



Lindsay Eaves-Johnson with a reproduction of a Natufian burial near Haifa, Israel. (Russ Ciochon)



Andy Boyd (center right), UI Global Health Studies team, and public health experts inspecting a well for malaria parasites, post-tsunami Sri Lanka. (Paul Greenough)



Hannah Marsh sifting materials from a 1.4 million-year-old hominid site, Koobi Fora Field School, Kenya. (Russ Ciochon)



Erik Kabela measuring dew during Soil Moisture Experiment 2005 in the Walnut Creek watershed south of Ames. (Brian Hornbuckle)



A scenic view of a beach. The foreground is a stone-paved area with irregular, light-colored stones. The middle ground is a vast expanse of turquoise water meeting a clear blue sky at the horizon. The sky is filled with large, fluffy white clouds. The word "DIALOGUE" is overlaid in the center in a large, white, outlined font.

# DIALOGUE



# INTERDISCIPLINARY DIALOGUE CGRER PROMOTES INTERDISCIPLINARY DIALOGUE TO ADDRESS IOWA'S NEEDS

CGRER continues to engage in regional, national, and international discussions of global change issues. Primary among these was the November 17-18 Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER) workshop held at CGRER and jointly hosted with the University of Minnesota. The workshop, **Environmental Observatory Networks for Analysis of Water Quantity, Quality and Biotic Integrity in the Upper Mississippi River Basin**, was preparatory to submission of a major NSF grant for establishing a regional environmental observatory for the Upper Mississippi River Basin (UMRB). This observatory would use remote sensors, distributed network sites, and continuous computer modeling of data to enhance understanding of human-stressed environmental systems and define remedial efforts for their restoration. Participants from Iowa and surrounding states discussed water quality monitoring; real-time environmental observing stations and cyberinfrastructures currently operating in the UMRB; similar research networks elsewhere; and formation of necessary alliances. They recommended establishing a nonprofit Upper Mississippi Environmental Observatory early in 2006.

ACTIVITIES OF CGRER'S CO-DIRECTORS CONTINUE TO EXEMPLIFY THE CENTER'S FOCUS ON CHANGING ENVIRONMENTAL CONDITIONS. JERRY SCHNOOR FOR EXAMPLE WAS A PEER REVIEWER OF THE EXECUTIVE SUMMARY AND TWO WATER RESOURCES SECTIONS IN THE FORTHCOMING INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) FOURTH ASSESSMENT REPORT, CLIMATE CHANGE 2007. THE IPCC IS THE WORLD'S LEADING ORGANIZATION ASSESSING HUMAN-INDUCED CLIMATE CHANGE.

Greg Carmichael was involved in many climate- and air-quality-focused initiatives. He was:

- named to a committee of NOAA's **Climate Change Science Program**, which reviews, analyzes, coordinates, and integrates scientific research on changes in climate and related systems. Carmichael's committee, which deals with aerosols and climate, authored the paper *Aerosol Direct Radiative Effects over the Northwest Atlantic, Northwest Pacific, and North Indian Oceans: Estimates Based on In-Situ Chemical and Optical Measurements and Chemical Transport Modeling*, now in review.
- an invited member of the **Task Force on Hemispheric Transport of Air Pollution**, formed through the United Nations Economic Commission for Europe. The task force will address growing scientific evidence for global transport of ozone, fine particles, mercury, and other air pollutants in the northern hemisphere, and serve as a bridge between international research and policy communities.
- co-organizer of the **10th Atmospheric Sciences and Air Quality Conference** held in April in San Francisco. Eight UI graduate students and postdoctoral fellows presented papers there, with Sarika Kulkarni (a CGRER graduate research assistant) receiving the Best Poster award for Surface Elemental Composition of Aerosols at Beijing (China), Gosan (Korea), and Tango (Japan) during ACE Asia.
- co-convenor of the **Workshop on Chemical Data Assimilation and Data Needs for Air Quality Forecasting** held in Silver Spring, MD, in June. This workshop developed research and technical recommendations for NOAA's National Weather Service (NWS) regarding its planned air quality forecasting efforts. The NWS, which now provides next-day ozone forecasts for northeastern states, plans to expand them to the entire U.S., lengthen the forecast period, and add fine particulate matter to forecasts within 10 years.
- member of the U.S. air-quality delegation attending the conference, **Strategic Approaches to Regional Air Quality Management**, held Oct. 24-26 in Beijing. Leading experts from the U.S., Europe, and China convened to share best control practices, in an effort to help China more effectively manage its challenging air pollution problems.
- invited participant in the 1.5-day workshop, **Nanoparticle Aerosol Science and Technology: Emerging Trends and Priorities**. He also gave a plenary lecture at the **Asian Aerosol Conference**. Both events were in Mumbai (formerly Bombay), India, in December.





## Visiting Scientists

*In 2005, CGRER promoted change-related dialogue through hosting fourteen visiting scientists:*

Brazilians **Vinicius da Almeyda** and **Rogério Assuncao** visited from February 14-19 to receive training and collaborate on applying the STEM air-quality model to air pollution problems in the Brazilian state of Salvador (see page 15).

**Tad Anderson**, from the University of Washington, came to Iowa City from May 19-25 as part of an NSF grant on data assimilation (grant #11, page 21). Tad presented seminars on the new satellite observations and their promise to better define the effect of aerosols on climate.

**Satoru Chatani** and **Tazuko Morikawa** from Tokyo Central R&D Labs, Inc., Japan, stopped at CGRER on March 8 as part of their larger U.S. research mission to obtain feedback for ongoing studies of air quality in and around Tokyo.

**Emil Constantinescu** and **Philipp Miehe**, doctoral students at Virginia Technological University, visited from May 2-6 to interact with faculty and students, and to work on joint projects that were part of an NSF research project related to data assimilation (grant #11, page 21).

**Zhanna Duiseneyeva**, a Fulbright Scholar from Kazakh National Medical University, Kazakhstan, was at CGRER from November 2004 to June 2005 while she performed research at several laboratories relating environmental exposure to health outcomes.

**Sarath Guttikunda** from the World Bank came from April 14-19 to lecture in the UI's Sustainable Systems course and discuss new research initiatives related to air quality in Latin America and Asia.

**Amanda Hopkins**, a doctoral student from the Dept. of Meteorology, Florida State University, visited from March 7-11 to learn about CGRER's STEM air quality model, which she will apply to Asia as part of her thesis research.

**Jung-Yoon Kang**, a PhD student at Seoul National University, Korea, visited for a year (2/14/05 - 2/13/06) to learn more about air quality and aerosol models used at CGRER, and to develop analysis plans for aerosol and radiation data collected in Korea as part of the Asian Brown Cloud project (grant #9, page 21). Seoul National University and CGRER are collaborating on this project.

**Hyun-Dong Lee** was a visiting professor from the Department of Construction and Environmental Engineering, Korea Institute of Construction Technology, Gyeonggi-Do, South Korea. He came to CGRER January 10 to December 22 to work on water quality research, and while here wrote two papers on land-use characteristics that influence nonpoint source loadings of pollutants to Korean streams and rivers.

**Hitoshi Matsui**, a graduate student at the University of Tokyo, Japan, visited CGRER from May 10 to July 15 to study CGRER aerosol models, which he plans to use in his studies of aerosol formation and transport in Tokyo.

**Chandra Venkataraman**, professor of chemical engineering at India Institute of Technology, Bombay, spent her six-month (June 1 - December 6) sabbatical at CGRER. She collaborated on research focused on the effects of aerosols on air quality and climate in South Asia.

## **CGRER 2005 Seminar Series**

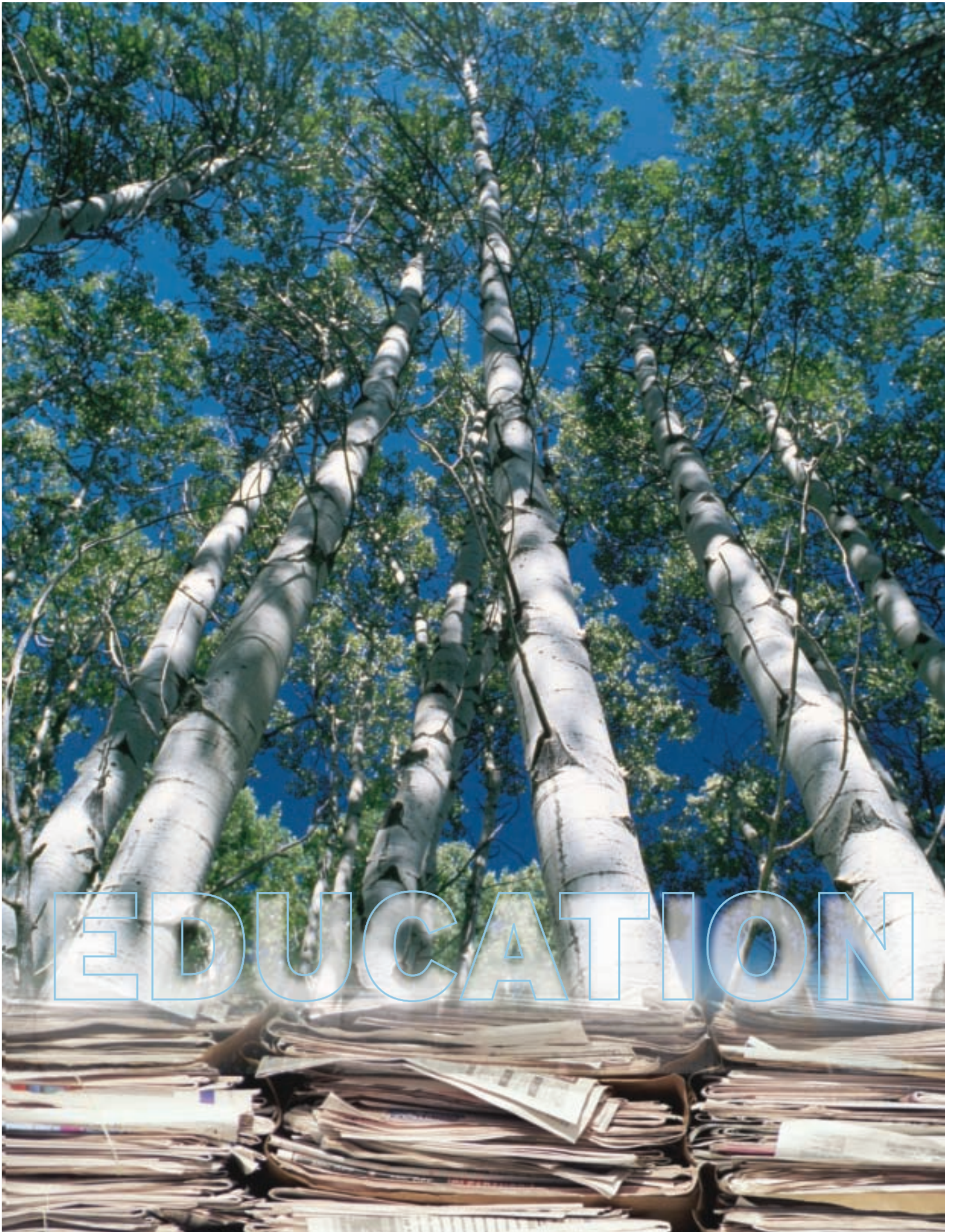
<b>SPEAKER</b>	<b>AFFILIATION</b>	<b>TITLE OF SEMINAR</b>
Ian Baker	Atmospheric Science Department, Colorado State University	Simple Biosphere Model (SiB) in a Nutshell: Evolution, Model Scheme and Diagnostics
Allen Chu	MODIS Aerosol Team, NASA	Monitoring Air Pollution from Satellite Imageries
Jacek Koziel	Agricultural & Biosystems Engineering, Iowa State University	Characterization of VOCs and Odorants Associated with Swine Barn Particulate Matter using SPME and Gas Chromatography – Mass Spectrometry- Olfactometry
Aarne Vesilind	Civil & Environmental Engineering, Bucknell University	William Dibdin and the Birth of Biological Treatment
Mark Weisner	Environmental & Energy Systems Institute, Rice University	Nanomaterials, Sustainability, and Environmental Engineering
Yang Zhang	Marine, Earth & Atmospheric Sciences, North Carolina State University-Raleigh	Modeling Atmospheric Aerosols: Current Challenges and Future Directions



## A Sampling of Additional CGRER-Member Publications

- Boulanger B.O., A.M. Peck, J.L. Schnoor, K.C. Hornbuckle. "A Mass Budget of Perfluorooctane Surfactants in Lake Ontario." *Environmental Science and Technology* 39(1): 74-79. 2005.
- Chibnik M., S. Purata, B. Brosi, A. María López Gómez. "Bursera Wood Carving in Oaxaca, Mexico." In A. Cunningham et al. (eds), *Carving Out a Future: Forests, Livelihoods, and the International Woodcarving Trade*. University of British Columbia Press, Vancouver, Canada. In press.
- Chibnik M., S. Purata, B. Brosi. "Alebríjes: Mexico's Flight of Fancy Carved in Copal Wood." In C. López, P. Shanley, A. Celso Fantini (eds), *Riches of the Forest: Fruits, Remedies, and Handicrafts in Latin America*. Center for International Forestry Research (CIFOR), Bogor, Indonesia. 2005.
- Daly S., R. Ettema. "Monitoring for Frazil Ice Accumulation on Water Intakes in the Nearshore Zone." *Proceedings of "Ports and Ocean Engineering under Arctic Conditions" Conference*, Potsdam, New York. August 2005.
- Ettema R. "Information Needs When Estimating Ice-jam Floods." *Proceedings of NATO Advanced Research Workshop on Extreme Hydrologic Events*, Novosibirsk, Russia. July 2005.
- Grassian V. (ed). *Environmental Catalysis*. CRC Press, Boca Raton, Florida, 2005. (Includes chapters by CGRER members Vicki Grassian, Sarah Larsen, and Gene Parkin.)
- Greenough P. "Introduction" to India section. In J. Bauer (ed), *Forging Environmentalism: Explorations in Justice, Livelihood, and Contested Environments in Four Countries*. M.E. Sharpe, Armonk, N.Y. In press.
- Hines H., S.D. Hendrix. "Bumble Bee (Hymenoptera: Apidae) Diversity and Abundance in Tallgrass Prairie Patches: The Effects of Local and Landscape Features." *Environmental Entomology* 34(6): 1477-1484. 2005.
- Laskin A., T.W. Wietsma, B.J. Krueger, V.H. Grassian. "Heterogeneous Chemistry of Individual Mineral Dust Particles with Nitric Acid. A Combined CCSEM/EDX, ESEM and ICP-MS Study." *Journal of Geophysical Research* 110, D10208, doi:10.1029/2004JD005206, 1-15. 2005.
- Li G., C.A. Jones, V.H. Grassian, S.C. Larsen. "Selective Catalytic Reduction of NO<sub>2</sub> with Urea in Nanocrystalline NaY Zeolite." *Journal of Catalysis* 234: 401-413. 2005.
- Li G., S.C. Larsen, V.H. Grassian. "An FT-IR Study of NO<sub>2</sub> Reduction in Nanocrystalline NaY Zeolite: Effect of Zeolite Crystal Size and Adsorbed Water." *Catalysis Letters* 103: 23-32. 2005.
- Li G., S.C. Larsen, V.H. Grassian. "Catalytic Reduction of NO<sub>2</sub> in Nanocrystalline NaY Zeolite." *Journal of Molecular Catalysis* 227: 25-35. 2005.
- Peck A.M., K.C. Hornbuckle. "Gas-Phase Concentrations of Current-use Pesticides in Iowa." *Environmental Science and Technology* 39(9): 2952-2959. 2005.
- Schnoor J. "Global Warming: A Consequence of Human Activities Rivaling Earth's Biogeochemical Processes." *Human and Ecological Risk Assessment* 11(6): 1105-1110. 2005.
- St. Pierre M., S.D. Hendrix, C.K. Lewis. "Dispersal Ability and Host Plant Characteristics Influence Spatial Population Structure of Monophagous Beetles." *Ecological Entomology* 30:105-115. 2005.
- Ufnar D.F., L.A. González, G.A. Ludvigson, et al. "Reconstructing a Mid-Cretaceous Landscape from Paleosols in Western Canada." *Journal of Sedimentary Research* 75(6): 984-996. 2005.
- White T.S., B.J. Witzke, G.A. Ludvigson, R.L. Brenner. "Distinguishing Base-level Change and Climate Signals in a Cretaceous Alluvial Sequence." *Geology* 33(1): 13-16. 2005.
- Williams D., L. Jackson, D. Smith. "Effects of Frequent Mowing on Survival and Persistence of Forbs Seeded into a Species-poor Grassland." *Restoration Ecology*. In press.





EDUCATION





# PROMOTES EDUCATION

## CGRER PROMOTES EDUCATION TO ADDRESS IOWA'S NEEDS

CGRER continues to attract and educate students who are destined to become tomorrow's global change experts. Over the years, dozens have received CGRER research assistantships or been housed at CGRER. Hundreds more have been mentored by CGRER members. CGRER-affiliated graduate and undergraduate students benefit from amenities such as office space, computational facilities and assistance, research assistantships, and stipends crucial to their efforts. Students also benefit from CGRER-organized courses and programs.

CGRER's support of educational efforts extends beyond the university. In February, two professionals from CETREL, a major environmental consulting company in Salvador da Bahia, Brazil, traveled to CGRER to be trained in using STEM, a CGRER air-quality numerical model that had been adapted for application specifically to northeastern Brazil. For five days, they learned→

how to use STEM to analyze regional air pollution problems, and also to analyze ozone-formation episodes, particularly as these related to Bahia's petrochemical complex. In May, CGRER graduate assistant Marcelo Mena traveled to Brazil to conduct on-site training.

In May, CGRER hosted the final session of a training program to enhance high school education by incorporating GPS and GIS technology into science course work. This day-long session brought 43 students and 19 teachers and educational administrators to CGRER's headquarters. They heard research talks presented by CGRER graduate students, toured CGRER, and applied GIS and GPS skills to water-quality data they collected on the adjacent Iowa River. The training program was organized by the Grant Wood Area Education Agency.

CGRER continues to support sustainability efforts across campus, both through the Center's initiatives and through the activities of CGRER graduate students who are members of Engineers for a Sustainable World (ESW). In 2005, CGRER students initiated an educational radio program, "Environment at Iowa," broadcast weekly on the student-run station KRUI. CGRER's ESW members successfully applied for an EPA grant that, in 2006, will bring two students from Mexico and Chile to Iowa City for 12 weeks of training in pollution prevention. The training will be carried out by the Iowa Department of Natural Resources and UI Facilities Management personnel, with technical support from CGRER.

CGRER was an active participant in the October 6 UI Energy Expo, where several talks and displays were hosted by CGRER students and members. CGRER students, faculty

members, and others are active on the UI's Energy Conservation Advisory Council (chaired by Jerry Schnoor) and Campus Planning Committee. These two advisory groups strive to conserve energy and incorporate sustainability practices into decision-making processes across campus. CGRER was instrumental in the UI's 2005 signing of an official agreement to join the federal EnergyStar partnership program, which pledges the UI to follow EnergyStar protocols and purchase EnergyStar products that conserve energy, save money, and reduce greenhouse gas emissions.

### Additional Educational Outreach

CGRER continues to publish its newsletter *IoWatch*, which in 2005 presented a summary of the Center's history and accomplishments since its inception 15 years ago. CGRER's website has steadily increased in quality, although in 2005 its use fell slightly, to about 3.8 million hits. CGRER continues to post the Iowa Weather Forecasting System as a community service. And in 2005, CGRER teamed with the Optical Science and Technology Center, located on the first floor of IATL, to install three digital signage displays. These wall-mounted computer screens, which are readily visible to visitors and passersby, will increase CGRER's visibility and educate viewers about its activities. The screens, capable of showing a multitude of software packages and animations, will display continuous, looping videos about environmental change and research performed at IATL. One of CGRER's first postings is a NASA animation of the 2005 hurricane season, correlating sea surface temperatures with generation of the year's named hurricanes.

### A Sampling of Additional CGRER-Member Teaching Efforts and Workshops

**Allen Bradley** offered a new course, *Contemporary Topics in Civil & Environmental Engineering, Land Development & Low-Impact Design Practices* (53:195). The course examined land development practices that seek to minimize harmful environmental impacts by maintaining or replicating the predevelopment hydrologic regime.

In August, **Diane Debinski** participated in an ISU symposium titled *After Kyoto: Ethics and Global Climate Change*, hosted by ISU's Bioethics and Bioethics Outreach programs.

**Robert Ettema** co-organized and participated in a NATO *Advanced Research Workshop on Extreme Hydrologic Events* held in Novosibirsk, Russia, in July. The workshop focused on floods and droughts and discussed how global climate change might affect such events.

In September, Emeritus Professor **G. Edgar Folk** presented a plenary talk titled "A 50 Year History of Biometeorology" at the 17<sup>th</sup> *International Congress of Biometeorology*, Garmisch, Germany.

**Paul Greenough** taught a new course, *Disease, Politics and Health in South Asia* (16W:140), which has a large urban environmental component. In June, he led a second faculty-student tour to Durban, South Africa, and Mumbai (Bombay), India, to explore the continuing effects of racism and the caste system on the politics of those cities.



## Travel Grants for Graduate Students

In 2005, CGRER awarded \$10,000 for student research-related travel, with grants ranging from \$530 to \$1,910. These small grants can produce major benefits, as was the case with a year 2000-recipient, geologist David Ufnar. He used his travel grant to collect scientific specimens that he then leveraged into a dissertation and string of high-profile publications. Ufnar's research led him into a tenure-track faculty position at the University of Southern Mississippi, where in three years he has garnered more than a million dollars of external research funding.

NAME	DEPARTMENT	TITLE OF PROJECT	DESTINATION
K. Lindsay Eaves-Johnson	Anthropology, UI	Thoracic Form and Adaptation in Later Hominid Evolution	University of Wittersrand, Johannesburg, South Africa
Lindsay James	Geoscience, UI	Soil Carbon Assessment of a Reconstructed Tallgrass Prairie	Jasper County, Iowa
Alicia Kalafut	Chemical & Biochemical Engineering, UI	Vertical Structure of Continental Boundary Layer Nucleation	Bondville, Illinois
Zhongwei Li	Geoscience, UI	Dynamic Sediment Model of Walnut Creek Responding to Land Restoration in Walnut Creek Watershed at Jasper County, Iowa	Jasper County, Iowa
Grant McCall	Anthropology, UI	Nhomadom Archaeological Research Project Investigating Middle Pleistocene Lithic Assemblages	Windhoek, Namibia
Matthew Murphy	Occupational & Environmental Health, UI	Evaluating Pesticide Use, Knowledge, and Exposure Health Risks in The Gambia and the Role of Changing Climatic Conditions on Increased Pesticide Use	The Gambia
Ernesto Ortiz	Epidemiology, UI	Occupational Risk of Avian Influenza Infection among Peruvian Poultry Workers	Huacho, Peru
Mahesh Sahu	Civil, Construction & Environmental Engineering, ISU	Applications of the Soil and Water Assessment Tool Model to Riparian Buffer Strips	Blackland Research Center, Texas A & M University, Temple, Texas

**Steve Hendrix** has been inserting new information on global change and global ecological issues into the UI's *Ecology 2:134* course. He also was invited to join the faculty of the UI's interdisciplinary PhD program in Applied Mathematical and Computational Sciences, which fosters the use of mathematics in applied problems, including conservation of biodiversity.

**Keri Hornbuckle** was an invited speaker at a workshop to develop an internationally recognized system for sampling persistent atmospheric organic pollutants. The December workshop, sponsored by the European Commission, was held in Brno, Czech Republic.

**Greg Ludvigson** convened the session, *Developing Approaches to Terrestrial Paleoclimatology*, at the North-Central

Section meeting, Geological Society of America, Minneapolis, in May.

**George Malanson** co-organized a September *Alpine Treeline Workshop* in Glacier National Park, Montana. The USGS-funded workshop focused on the importance of establishment and early seedling survival on the potential for alpine treelines to respond to, and be an indicator of, climate change.



# RESEARCH



# GLOBAL CHANGE RESEARCH CGRER FOSTERS GLOBAL CHANGE RESEARCH TO ADDRESS IOWA'S NEEDS

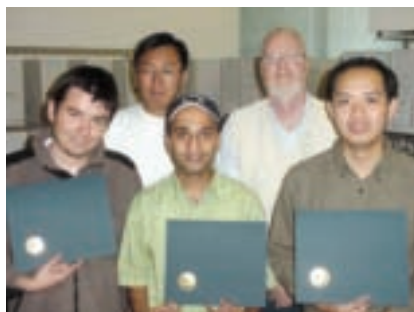
Grants received by CGRER members continue to break new ground. Proposals are regularly stimulated by the interdisciplinary connections formed through CGRER alliances. This was the case with a major \$1.4 million NSF grant received by Michelle Scherer and colleagues, which will fund studies of the behavior of nanoscale iron oxides in the environment. The grant will be completed by an interdisciplinary team including Vicki Grassian, whose cross-departmental association with Scherer was nurtured by CGRER.

This and other grants received by CGRER members in 2005 are listed on page 21. In addition, four new grants were facilitated by CGRER, joining the nine ongoing CGRER grants.



## National Environmental Observatory

A number of CGRER members are actively involved in a \$450,000 NSF planning grant, received through IIHR-Hydroscience & Engineering, to prepare a major proposal for establishing a multi-institutional, multidisciplinary National Environmental Observatory (#2, page 21). Project co-director Jerry Schnoor, along with co-directors at the University of Illinois and Drexel University, are establishing a Project Office that will bring together the environmental engineering and hydrological sciences communities nationwide. The Project Office will work with the Consortium of Universities for the Advancement of Hydrologic Sciences (CUAHSI) to develop a \$300 million NSF proposal that will lay out a strategic plan for developing a “Collaborative Large-scale Engineering Analysis Network for Environmental Research” (CLEANER) environmental observatory. The observatory, slated for construction in 2011, would work to sense, analyze, model, visualize, and forecast diverse environmental problems. (Note that this national CLEANER observatory differs from the



In June, Greg Carmichael and his research team, along with collaborators from other institutions, were honored with the prestigious NASA Group Achievement Award for their contribution to the 2004 INTEX-NA studies and outstanding contributions to the NASA mission. UI awardees include, from left to right: Tianfeng Chai, Greg Carmichael (back row); Marcelo Mena, Bhupesh Adhikary, Youhua Tang (front row).

proposed regional CLEANER observatory – grant #5, page 21 – which would focus specifically on the Upper Mississippi River Basin.)

## Monitoring Greenhouse Gases

The National Oceanic and Atmospheric Administration (NOAA) is establishing a nationwide “tall tower network” that will continuously monitor CO<sub>2</sub> and other greenhouse gases from instrumented tall towers (such as television towers). This network will constitute a key component of an observational system for quantifying the net flux of greenhouse gases across North America. CGRER will assist NOAA in establishing and operating the eastern Iowa tower and in analysis of its data. Supplementary CGRER studies will include boundary layer measurements using aerosol lidar. This grant (#1, page 21) will fund CGRER’s research and seal the CGRER-NOAA tall tower partnership.

## Observing and Analyzing Atmospheric Pollutant Movement

In the summer of 2004, Greg Carmichael and several CGRER students were involved in the “Intercontinental Chemical Transport Experiment (INTEX) – North America,” one of the largest and most comprehensive environmental studies ever performed. INTEX used NASA spacecraft, aircraft, and surface sensors to observe transport and transformation of atmospheric gases and aerosols across North America to Europe.

In 2005 Carmichael received a second NASA grant (#3, page 21), to analyze the 2004 INTEX data using (in part) a new chemical data assimilation

component of CGRER’s STEM numerical model.

This same grant also will fund CGRER’s participation in two new INTEX field experiments. The first, in March 2006, will study movement of the mammoth atmospheric pollution plume produced by Mexico City. The second, in April and May, will observe pollutant transport from Asia to North America. Both will employ techniques and goals similar to those of the 2004 experiment. Carmichael and students will again be using the STEM model to forecast pollutant movement and guide aircraft that are collecting field data.

The March observations will be carried out simultaneously and cooperatively with an NSF-initiated field experiment that assembles researchers from around the world to study Mexico City’s air pollutants. CGRER members Bill Eichinger and Charles Stanier, and their students, will participate in that study. Eichinger will use his lidar equipment to identify and trace particulate and gas pollutants from the ground. Stanier will be measuring the water content of aerosols, which is thought to govern the aerosols’ catalytic activity and chemical transformation.

Carmichael received a second grant in 2005 (#4, page 21). The project will fund his research team to explore new techniques for assimilating observational data from large atmospheric field experiments into air quality models. This project supports NOAA’s long-range goal of integrating reliable air-pollution predictions into the National Weather Service’s routine weather forecasts.

## **CGRER Grants Active in 2005**

In 2005, CGRER administered or facilitated 13 grants. Numbers 1 through 4 were initiated that year.

1. *Sampling Support and Data Analysis of NOAA Tall Tower and Aircraft Measurements in Iowa*, 9/1/2005 - 8/1/2006, NOAA, \$75,000; PIs: C Stanier, G Carmichael, W Eichinger
2. *Collaborative Large-scale Engineering Analysis Network for Environmental Research*, 9/1/05 - 8/31/07, NSF, \$450,000; PI: J Schnoor
3. *Regional Scale Analysis of Gas and Aerosol Distributions in Support of the INTEX A and B Missions*, 3/1/05 - 2/28/08, NASA, \$545,430; PI: G Carmichael
4. *A Chemical Data Assimilation Test Bed for the Interpretation and Analysis of the 2004 NEAQS/ITCI Observations*, 2/1/05 - 1/31/07, NOAA, \$290,237; PIs: G Carmichael and A Sandu (Virginia Technology University)
5. *A Large-Scale Environmental Research and Analysis Network of the Upper Mississippi River Basin (UMRB): Hydrology, Sediments, Nutrients, and Emerging Chemical Contaminants – A Planning Grant Proposal*, 9/1/04 - 8/31/06, NSF, \$68,906; PI: J Schnoor
6. *Analyze the Results of Chemical Transport Models to Connect Emissions with Radiative Forcing Using the Chemical Composition Optical Properties Derived as Part of the CCSP Review*, 9/1/04 - 8/31/05, NOAA, \$15,000; PI: G Carmichael
7. *Regional Scale Forecasting of Gas and Aerosol Distributions in Support of the INTEX Mission*, 5/1/04 - 4/30/05, NASA, \$91,367; PI: G Carmichael
8. *Quantifying Anthropogenic Sources of Trace Gases and Aerosols: An Integrated Approach*, 12/1/03 - 11/03/06, NASA, ACMAP program, \$242,395; PIs: P Kasibhatla (Duke University), G Carmichael (UI), L Giglio (SSAI)
9. *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
10. *Regional Aerosol-Chemistry-Climate Observatories for the Indo-Asia-Pacific Region*, 5/1/03 - 6/30/06, NOAA, \$110,168; PI: V Ramanathan (Scripps), with G Carmichael (UI) and others as co-PIs
11. *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: G Carmichael
12. *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; PIs: G Carmichael (UI), D Streets (Argonne National Laboratory), H Levy II (Geophysical Fluid Dynamics Laboratory, Princeton University)
13. *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; PIs: G Carmichael, V Grassian

## Seed Grants and Other Funding Awarded by CGRER

In 2005, CGRER awarded four Seed Grants for a total of \$99,386. Seed grants such as these have resulted in numerous scientific publications and major success stories. For example the year-2000 seed grant to study incipient speciation among a gall-moth that feeds on goldenrod plants, awarded to ecologists Stephen Heard and John Nason, led to a 2001 NSF award of \$455,000 to the same researchers to further this study. Again, a 2004 Seed Grant to Nason for studying the long-term effects of changing climate on genetic variability fed into \$350,000 of NSF funding to Nason and a colleague, initiated in 2006.

PROJECT DIRECTOR	AMOUNT AWARDED	TITLE OF PROJECT
E. Arthur Bettis, Scott Carpenter (Geoscience, UI) Russell Ciochon (Anthropology, UI)	\$25,000	Climate Change and Human Evolution in Java
Thanos Papanicolaou, Jerald Schnoor (Civil & Environmental Engineering, UI)	\$ 25,000	Development of a Biogeochemical Fingerprinting Method for Sediment Source Identifications: Application in a Predominately Rural Catchment in Eastern Iowa
Charles Stanier (Chemical & Biochemical Engineering, UI)	\$25,000	Modeling of Biogenic and Anthropogenic CO <sub>2</sub> in the Upper Midwest with Application to NOAA Tall Tower Observations
You-Kuan Zhang (Geoscience, UI), Kung-Sik Chan (Statistics and Actuarial Sciences, UI), Keith Shilling (Iowa Geological Survey)	\$24,386	Increasing Streamflow and Baseflow in the Mississippi River Basin since 1940s: Effect of Climate or Land Use Change?

In 2005, CGRER funded a high-school student who worked with Dave Bennett to produce special databases for the Clear Creek watershed in Johnson County, IA. CGRER also cosponsored the UI's Energy Expo in October and the *Atmospheric Sciences and Applications to Air Quality* meeting held in April in San Francisco.

## Aids to Researchers and the UI Community

As in past years, CGRER offered technical and logistical support to its visitors, members, and their students. In addition to state-of-the-art computing and resource materials, CGRER provides dynamic visualization capabilities as one of four departments on the UI campus that support and distribute GIS software through a license with ESRI.

Computing resource needs continue to evolve. Although CPU cycles, power, and speed remain important, massive amounts of additional storage

are now required because of increasingly complex model outputs. In 2005 CGRER added two large RAIDs (Redundant Arrays of Independent Disks). These provide an additional 10 terrabytes of fully redundant storage. Hurricane Katrina pointed to the value of off-site storage. CGRER will work closely with the College of Engineering to establish a dedicated fiber-optic link between IATL and Seamans Center, which will provide CGRER's researchers with additional off-site storage without compromising access speed.



Chris Mutel displaying his wind energy research at the UI's Energy Expo. (Jerry Schnoor)



## A Sampling of Additional CGRER-Member Grants

*Quantifying Early Indicators of Global Climate Change.* 2005-2006. NSF. \$60,000. PI: D. Debinski

*Elastic Lidar Measurements in MIRAGE-Mex.* 2005-2008. NSF. \$314,725. PI: W. Eichinger

*Symposium on “The Culture of Innovation in Science and Technology in India: Opportunities Seized and Opportunities Lost.”* 2005-2006. Indo-US Science and Technology Forum. \$30,000. PI: P. Greenough

*Chemical Reactions of Environmental and Atmospheric Relevance on Carbonate Surfaces.* 2005-2009. NSF. \$612,500. PI: V. Grassian

*Enhanced Activity of Nanocrystalline Zeolites for Selective Catalytic Reduction of NO<sub>x</sub>.* 2005-2006. DOE. \$59,000. PIs: S. Larsen, V. Grassian

*In-Situ Atomic Force Microscopy Studies of Surface Reactions under Ambient Conditions.* 2005-2007. American Chemical Society – Petroleum Research Fund. \$80,000. PI: V. Grassian

*Nanoparticle Fe as a Reactive Component of Air, Water and Soil.* 2005-2009. NSF. \$1,400,000. PI: M. Scherer, Co-PIs: V. Grassian, T. Coates, C. Johnson, M. St. Clair

*Adding Wildflower Diversity to Species-Poor Grasslands: Requirements of Conservative Species.* 2005-2007. Iowa Department of Transportation, Living Roadway Trust Fund. \$23,976. PI: L. Jackson

## Other Awards and Achievements

**Dick Baker** received the American Quaternary Association’s Distinguished Career Award for 2005.

**Diane Debinski**’s ecological restoration research on reintroducing the Regal Fritillary to tallgrass prairies is described in the new children’s book *The Prairie Builders: Reconstructing America’s Lost Grasslands*, written by Sneed B. Collard III and published by Houghton Mifflin Co. as part of its “Scientists in the Field” series.

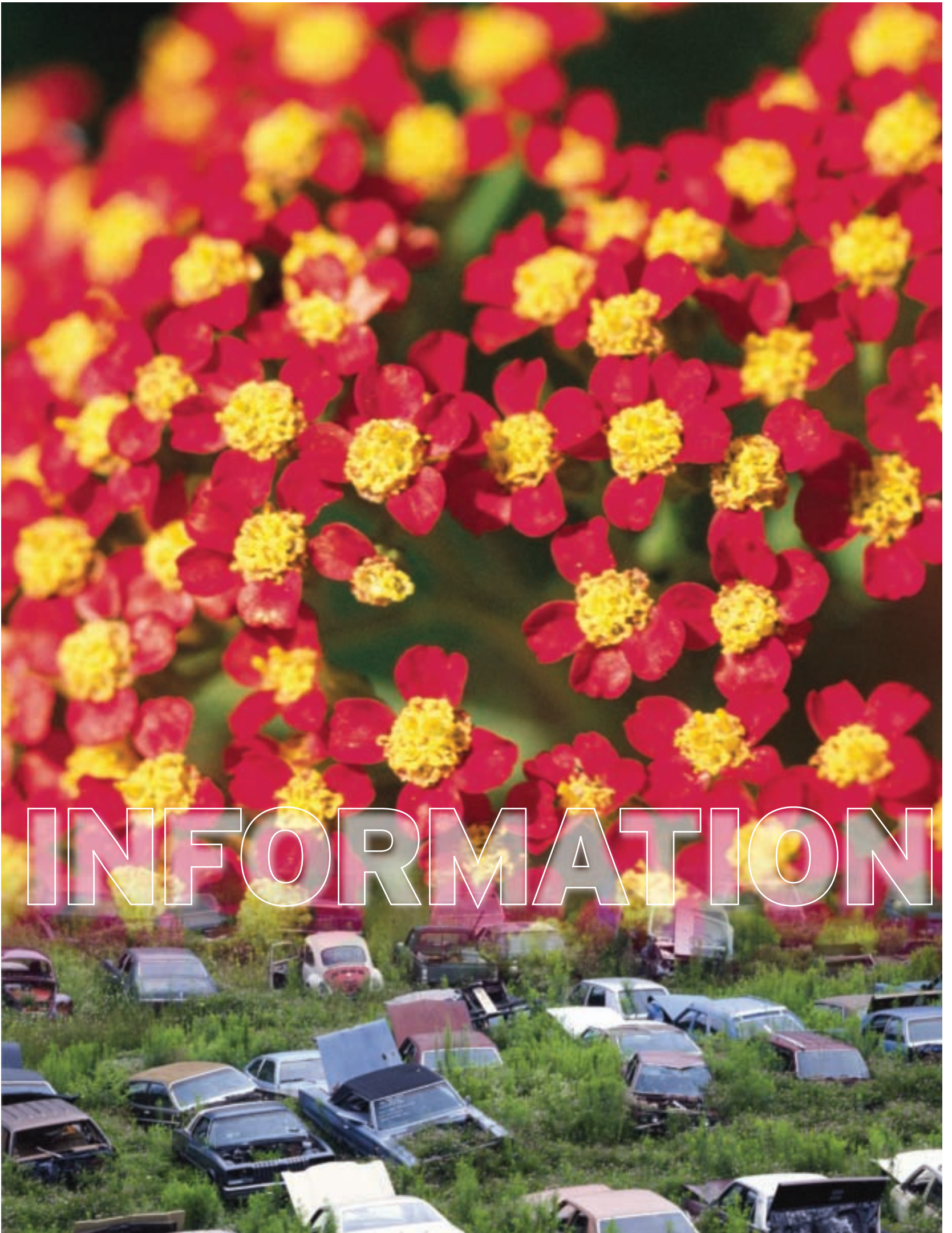
**Vicki Grassian** was elected Fellow of the American Association of the Advancement of Science.

Research and resulting 2005 publications, primarily by **Keri Hornbuckle**, **Jerry Schnoor**, and Hornbuckle’s student **Brian Boulanger**, demonstrated the persistence in the water system of certain perfluorooctane surfactants with suspected health risks. Based on these and other studies, in January 2006, the EPA asked DuPont and seven other chemical companies to eliminate residual traces of these compounds from their products, including those with Teflon coatings.

**Greg Ludvigson** left the UI in October when he was appointed Associate Scientist at the Kansas Geological Survey, The University of Kansas.

The *Environmental Science & Technology* paper, “Evaluation of Perfluorooctane Surfactants in a Wastewater Treatment System and in a Commercial Surface Protection Product,” by **Brian Boulanger**, **John Vargo**, **Jerry Schnoor**, and **Keri Hornbuckle**, was cited as one of the journal’s most frequently electronically downloaded articles in 2005. (*ES&T* 39: 5524-5530)

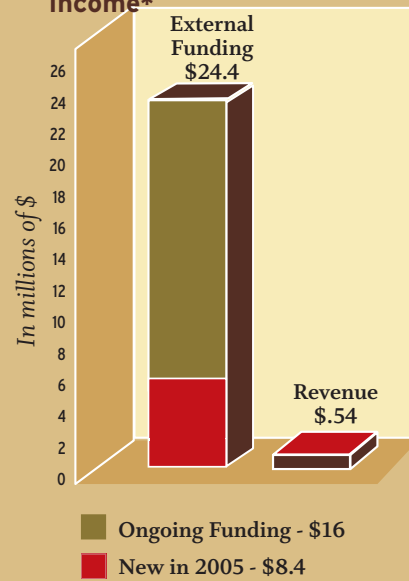
**Michelle Sherer** was appointed to the Editorial Board of *Geochemical Transactions*.



INFORMATION



Figure 1  
Leveraging of CGRER's Income\*

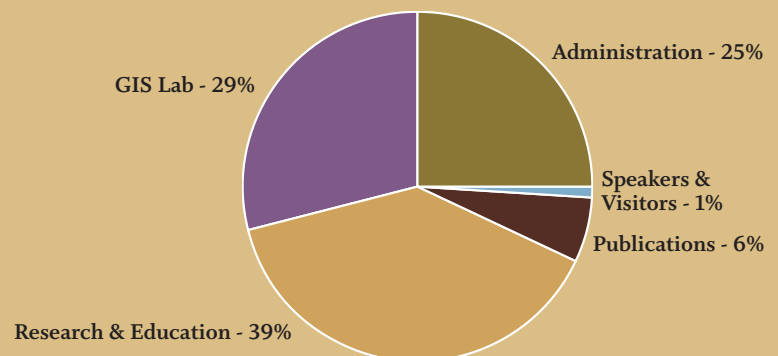


### Budget

In fiscal year 2005 (July 1, 2004 – June 30, 2005), 75% of CGRER's \$539,750 of funding was spent on research, education, and outreach directed toward global change issues (Figure 2). 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 1). In calendar year 2005, CGRER members were performing research that brought in a total of \$24.4 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, \$8.4 million was new funding that was initiated in 2005, while the remaining \$16 million came from ongoing projects.

Figure 2  
CGRER's Expenses\*





## 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 13 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 7 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.

### CGRER Members

#### UNIVERSITY OF IOWA

##### *Anthropology*

Michael S. Chibnik  
Russell L. Ciochon

##### *Biological Sciences*

Stephen D. Hendrix  
Diana G. Horton

##### *Chemical and Biochemical Engineering*

Gregory R. Carmichael  
Charles O. Stanier

##### *Chemistry*

Vicki H. Grassian  
Sarah C. Larsen  
Mark Young

##### *Civil & Environmental Engineering*

A. Allen Bradley  
William E. Eichinger  
Robert Ettema  
Keri C. Hornbuckle  
Witold F. Krajewski  
Lou Licht  
Timothy E. Mattes  
Wilfrid A. Nixon  
A. Jacob Odgaard  
A.N. Thanos Papanicolaou  
Gene F. Parkin  
Michelle Scherer  
Jerald L. Schnoor  
Richard L. Valentine

##### *Economics*

Thomas F. Pogue  
John L. Solow

##### *Electron Spin Resonance Facility*

Garry R. Buettner

##### *Geography*

Marc P. Armstrong  
David Bennett  
George P. Malanson

Michael L. McNulty, Emeritus

R. Rajagopal  
Gerard Rushton

##### *Geoscience*

Richard G. Baker, Emeritus  
E. Arthur Bettis  
Robert S. Carmichael  
Scott Carpenter  
Jeffrey Dorale  
Lon D. Drake  
Mark K. Reagan  
Holmes A. Semken, Jr., Emeritus  
Frank H. Weirich  
You-Kuan Zhang

##### *History and Community & Behavioral Health*

Paul R. Greenough

##### *Law*

Jonathan Carlson  
Burns H. Weston

##### *Physics & Astronomy*

Louis A. Frank  
Donald A. Gurnett  
Steven R. Spangler

##### *Physiology & Biophysics*

G. Edgar Folk, Emeritus

##### *Occupational & Environmental Health*

William R. Field  
Peter S. Thorne

##### *Public Policy Center*

David J. Forkenbrock

##### *Statistics & Actuarial Science*

Dale L. Zimmerman

#### IOWA STATE UNIVERSITY

##### *Agronomy*

Raymond W. Arritt  
Brian K. Hornbuckle

##### *Ecology, Evolution, and Organismal Biology*

Diane M. Debinski  
John Nason  
James W. Raich

##### *Geological & Atmospheric Sciences*

William J. Gutowski  
Germán Mora  
Eugene S. Takle

##### *Natural Resource Ecology and Management*

Jan Thompson

#### UNIVERSITY OF NORTHERN IOWA

##### *Biology*

Laura Jackson

##### *Physical Geography*

Dennis E. Dahms  
Ramanathan Sugumaran

#### CORNELL COLLEGE

##### *Geology*

Rhawn Denniston

#### HYDROLOGIC RESEARCH CENTER, SAN DIEGO, CA

Konstantine P. Georgakakos

#### RICE UNIVERSITY

##### *Civil & Environmental Engineering*

Pedro Alvarez





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# CGREER

The Center for  
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## 2005 ANNUAL REPORT



THE UNIVERSITY OF IOWA



