

2004 ANNUAL REPORT

CGRER

The Center for Global and Regional Environmental Research





The Floods of 1993
(Spring 1994)

This Annual Report commemorates a decade of publishing CGRER's newsletter *Io Watch*. Original artwork included herein was prepared by Claudia McGehee for those newsletters. A complete listing of the illustrations and the dates published can be found on page 24.

Cover: Rebalancing the Carbon Cycle (1998)



Fall 1994

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 69 members from 21 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.



I write this year's message from my office in the UN's World Meteorological Organization (WMO) headquarters in Geneva, Switzerland, where I am working with the Global Atmospheric Watch program on issues related to atmospheric chemistry and climate. This is an appropriate place to search for the pulse of global and regional environmental trends. WMO is at the front of climate change science: it has primary responsibility for all UN matters related to weather and climate, and the Secretariat of the Intergovernmental Panel on Climate Change (IPCC) is housed here. Every hour of every day, WMO contributes to the welfare of humankind by providing services and

EXECUTIVE SUMMARY

warnings – everything from weather forecasts for commercial aviation, to predictions of hurricanes and tsunamis, to information on the dispersion of locusts in western and central Africa. Longer term forecasts facilitate planning around the globe, shaping matters such as what crops to plant when, and how much heating fuel will be needed next year. WMO simultaneously assesses how humans are changing climate both unintentionally (e.g., through producing greenhouse gases) and intentionally (e.g., through cloud seeding research). In this enlightened environment, I am constantly reminded that the meteorological needs and perspectives of the 190+ member countries vary greatly.

From this perspective, it is clear to see that we are making progress on many scientific and policy fronts. For example after years of effort, the Kyoto Protocol finally came into power on Feb 16, 2005. But climate change remains a difficult topic. Discussions remain tangled with issues such as defining “dangerous human interference with climate.” No official definition of “how much is too much” has been accepted around the globe, although the European Union has proposed a working definition of “too much” as an additional 4.5° F temperature rise. Then there’s the companion question: “How much would greenhouse gas emissions need to be reduced to foster climatic stability?” Suggested answers to such questions contain a high degree of uncertainty because of the difficulties in quantitatively linking specific processes, emissions, and climate change. Some individuals and nations interpret this uncertainty as arbitrariness. They then proceed to reject actions that would reduce greenhouse gas emissions. Meanwhile Earth provides warnings about the consequences of such inaction. For example, in 2004 we had eight named hurricanes in the Caribbean, one more than the previous record of seven set in 1933. Such increases in the frequency and intensity of severe weather events have been predicted by climate change research.

While much scientific progress has been made, we remain faced with a fundamental but all-encompassing question: How do we prod ourselves, and our society, to decide to pollute less? Scientific research, such as that conducted at CGRER, is working toward

reducing the uncertainties surrounding atmospheric pollutants and other global threats. Sound research will make it easier to identify appropriate actions. But while science may win the day at the end, at present, the issue of when and how much to reduce greenhouse gases and pollutant emissions is treated not as a necessity, but rather as a value judgment to be decided each day by Earth’s diverse societies and their elected officials. In the case of climate change, both action and inaction are decisions that are weighted by national priorities, and by choices about whether to avoid “dangerous human interference” or adapt to its consequences as the need arises. From where I sit today, it is clear to me that while each nation must strive to make wise choices, an international perspective is imperative: without global participation, the atmosphere will remain a dumping ground for those who reject efforts to reduce their emissions; everyone will feel the consequences of those actions.

CGRER plays a critical role in conducting first-rate science on environmental change, and also works to educate diverse audiences about the implications of its discoveries. The next step is out of our hands. We can only hope that CGRER’s efforts are valuable to individuals and governments who transform this knowledge into action that leads toward a sustainable environmental future.

Gregory R. Carmichael
*CGRER Co-Director
with Jerald Schnoor.*

CGRER EXECUTIVE COMMITTEE

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The world's most powerful earth quake in more than 40 years struck deep under the Indian Ocean on

December 26, 2004, triggering massive tsunamis causing massive destruction and the death of more than 150,000 people in some dozen countries. As this human drama unfolds, we are reminded of the powerful forces of nature and the inability of humans to control these naturally occurring events. Efforts continue to improve the scientific understanding of tsunamis, as scientists are busy studying tsunamis and running sophisticated computer models. However, despite the scientific understanding of the causes of tsunamis, the best science still doesn't understand how the super-waves behave, or provide the ability to predict when and where they'll strike next.

Yet as chronicled throughout time, these destroyed areas will rebuild and adapt to the inevitable naturally occurring forces. Early warning systems are being proposed for these areas to mitigate the impact of future tsunamis, and efforts as simple as planting mangroves are being discussed to mitigate the destructive forces of future tsunamis as they hit land.

You might wonder how tsunamis relate to the efforts of CGRER. Consider this: In an analogous fashion to a tsunami, the effects of atmospheric chemistry are experienced through



2003

MESSAGE FROM THE ADVISORY BOARD

natural forces that range from events as devastating as tornadoes, to the subtle yet life-sustaining nature of warmth and rain. Like the ocean, the atmosphere is a fluid medium that has fascinated computer modelers for decades. The use of computers in meteorology is now a routine practice, yet it's still hard to reliably forecast the weather more than several days in advance. Similarly, although the scientific understanding of the greenhouse gas effect is known, the best science still doesn't fully understand the complexities of climate variability, nor can it accurately project the impacts of climate variability in the short term, much less in the long term. Increasing our knowledge and understanding in these areas is certainly where we will all benefit from the efforts of CGRER as it strives toward its ultimate goal of assisting in assessment and preparation for global change and its effects.

Perhaps the optimal way to deal with potential climate change is to promote efforts that enhance our understanding, while taking actions that move toward sustainability and mitigate potential future impacts. The addition of sustainable forms of energy in Iowa, such as Mid-American Energy's 310 MW wind farm and the burning of waste oat hulls at the University of Iowa's power plant, are examples of actions that mitigate potential climate impacts. Yet actions as simple as planting a tree, or reducing energy consumption by turning the light off

as you leave the room, all mitigate potential climate impacts. However, as we look to the future, the history of human response to the forces of nature stands as a testament that adaptation is the key to our long-term success.

On behalf of the CGRER Advisory Board, I hope you enjoy this annual report.

Steven C. Guyer
MidAmerican Energy

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

DIALOGUE AFFECTING THE USE OF ENERGY...

From its inception, CGRER has encouraged discussions about the impact of energy use on climate and the natural environment. In 2004, energy-related concerns produced rewarding results close to home, on the University of Iowa campus. Governor Vilsack awarded the University's Power Plant with two Iowa Environmental Excellence awards. These awards, one for air quality and the other for energy efficiency/renewable energy, resulted from the UI's co-burning of discarded oat hulls along with coal. CGRER

encouraged and guided this activity, which creates significant savings both in fuel expenditures and in carbon dioxide emissions.

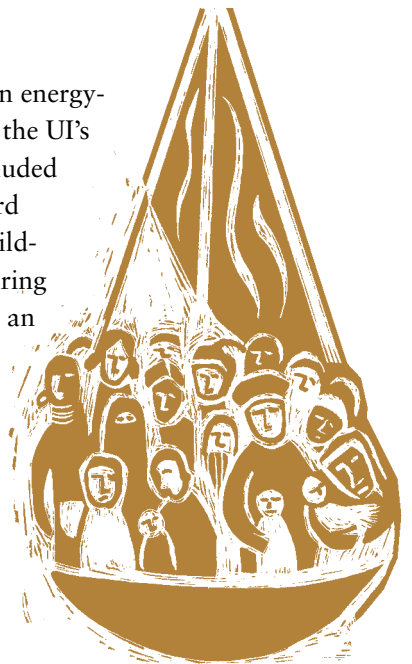
CGRER also encouraged the University's 2004 joining of the Chicago Climate Exchange (CCX), the world's first multinational and multi-sector market for reducing and trading greenhouse gas emissions. This membership legally commits the University, by 2006, to decrease its greenhouse emissions by 4%. If the UI cannot do so, it must purchase credits from the CCX to account for the shortfall; however, the UI is expected to exceed the 4%

reduction, and thus will be able to produce income through selling greenhouse gas credits.

CGRER co-directors Greg Carmichael and Jerry Schnoor, along with CGRER Graduate Research Assistant Marcelo Mena, are members of the University's Energy Conservation Advisory Council, formed in 2004 in response to the UI General Education Fund Task Force recommendations for budget cuts. The council, chaired by Schnoor, will seek ways to reduce UI energy consumption and utilities costs by \$250,000 annually, while increasing campus-wide involvement in energy-related decisions.

STUDENT INITIATIVES...

CGRER graduate students are generating their own energy-related initiatives, in particular through furthering the UI's Green Campus Initiative. Their 2004 activities included the posting of 600 educational light-switch reminders across campus; inviting Stanford professor Gil Masters to campus to speak to individuals and present a seminar on building-related energy use (see "Seminars" below); and successfully promoting the UI's hiring of a "green" architectural firm to design the new UI Recreational Services building in an environmentally friendly manner. In addition, student Forrest Meggers was accepted onto the U.S. Green Building Committee's "Emerging Green Builders National Committee," a selective appointment that pulls him into activities to encourage young professionals to emphasize environmentally-friendly construction efforts, and administers the annual design competition for beginning professionals.



VISITING SCIENTISTS...

In 2004, as in preceding years, CGRER promoted global-change-related dialogue through hosting visiting scientists:

James Hansen (10/26), Director of the NASA Goddard Institute for Space Studies in New York City, came to the UI as a Physics and Astronomy Dept. Distinguished Public Lecturer to speak on “ ‘Dangerous Anthropogenic Interference:’ A Discussion of Humanity’s Faustian Climate Bargain and the Payments Coming Due.” While on campus, he met with CGRER members and planned future collaborative efforts.

Benjamin Jelly (6/11 - 8/15), an undergraduate meteorology student at Texas A&M, was awarded a DOE Global Change Fellowship which provided funds to spend the summer in a laboratory of his choice. He chose CGRER. Carmichael served as his mentor, involving Jelly in the

summertime INTEX mission’s air-quality forecasting activities.

Mizuo Kajino (6/13 – 7/10), a PhD student at Kyoto University’s Center for Disaster Prevention, came to collaborate with Carmichael on the impact of SO₂ emissions from the Miyake-jima volcano on acid deposition and aerosol amounts in Japan.

Yoo Jung Kim (6/28), a PhD student at Konkuk University in Seoul, Korea, visited to learn more about CGRER’s regional air pollution model, which he plans to use in his dissertation studies.

Makoto Koike, Professor of Earth and Planetary Science, The University of Tokyo, came to CGRER for a few days in December to establish a collaboration with Carmichael on modeling aerosols in eastern Asia.

O-Yul Kwon (2/04 - 1/05), Visiting Scholar from Seoul University, came to CGRER to work on environmental modeling in Korea with Schnoor.

Tijian Wang (6/24 - 8/31), Professor of Atmospheric Sciences at Nanjing University, China, visited CGRER as a “Global Change System for Analysis Research and Training” (START) fellow, to work with Carmichael on aspects of China’s regional air quality and climate.

Xuemei Wang, Department of Environmental Science, Zhongshan University, China, spent her sabbatical year at CGRER working with Carmichael on air pollution modeling efforts. Specific projects related to China’s Pearl River region (a major economic development zone), and to evaluating the environmental impact of export manufacturing in Southeast China.

Young Sun Woo, Professor of Environmental Engineering, Konkuk University, Seoul, spent his sabbatical year at CGRER, performing research on a variety of Korea’s air pollution problems.



CGRER 2004 SEMINAR SERIES...

SPEAKER	AFFILIATION	TITLE OF SEMINAR
Bill Arnold	Dept. of Civil Engineering University of Minnesota	Development of Reactive Membrane Barriers for Environmental Applications
Thomas Graedel	Dept. of Chemical Engineering Yale University	Sustainability of Industrial Metals
Gil Masters	Dept. of Civil & Environmental Engineering Stanford University	Energy Efficient Buildings: The Key to Our Climate Change
Eric Sumner	Cargill-Dow	Environmental Impact Comparison of Petroleum and Bio-Based Plastic: Life Cycle Assessment of Cargill-Dow Natureworks Polylactide and Conventional Petroleum Derived Plastic

ADDITIONAL CGRER-MEMBER AWARDS AND SIGNS OF RECOGNITION...

Vicki Grassian's student **Hind Al-Abadleh** received the 2004 D.C. Spriestersbach Dissertation Prize for her doctoral dissertation, "Heterogeneous Reactions of Atmospheric Gases on Oxide, Carbonate and Soot Surfaces."

Greg Carmichael was named to the Scientific Advisory Committee of the International Global Atmospheric Chemistry Program's DEBITS project. This project, nested within the IGBP (International Global Biosphere Program), coordinates and designs scientific studies of deposition of pollutants on Earth's surface. Carmichael also became a member of NOAA's Air Quality Forecasting Scientific Advisory Committee, which is guiding the US Weather Bureau's plans to provide routine regional ozone forecasts starting in 2005. And he became a member of the Texas Environmental Research Council's Scientific Advisory Board, which oversees state-funded air quality research.

David Forkenbrock received the National Academy of Science's first-ever William S. Vickrey Award for the Best Paper in Transportation Economics and Finance. The paper, "A Mileage-Based User Charge Concept" (published in *Transportation Research Record* 1864:1-8), discusses assessing road-user charges to encourage environmentally friendly vehicles.

Vicki Grassian received the UI's \$15,000 James Van Allen Natural Sciences Fellowship. She will use the award to design and implement laboratory experiments to better understand links between mineral-dust chemistry and atmospheric processes.

Don Gurnett was elected a member of the American Academy of Arts and Sciences.

Brian Hornbuckle received the "Best Paper and Presentation by a Young Hydrologist" award at the Second International Conference of the British Hydrological Society, for his paper "Radiometric Sensitivity to Dew at 1.4 GHz Relative to Soil Moisture in a Dense Canopy."

Keri Hornbuckle and her students have been receiving abundant press and TV coverage regarding their studies of chemical contaminants in the Great Lakes region. Interest has focused on their findings about contaminants associated with surface protectants (e.g., Teflon, Scotchgard) and synthetic fragrances used in detergents, shampoos, and other consumer products. Five papers were published by her research group in 2004: "A Mass Budget of Perfluorooctane Surfactants in Lake Ontario" (B Boulanger et al, *Environ. Sci. Technol.* Web Release 12/3/04); "Milwaukee, WI as a Source of Atmospheric PCBs to Lake Michi-

gan" (D Wethington et al, *Environ. Sci. Technol.* Web Release 12/3/04); "Detection of Perfluorooctane Surfactants in Great Lakes Water" (B Boulanger et al, *Environ. Sci. Technol.* 38: 4064-4070); "Synthetic Musk Fragrances in Lake Michigan" (A Peck et al, *Environ. Sci. Technol.* 38: 367-372); and "The Magnitude and Origin of Contaminants Resuspended in Southern Lake Michigan" (K Hornbuckle et al, *Geophysical Research-Oceans* 109, #C05017).

Sarah Larsen received a three-year UI Faculty Scholar award. She will use her released time to synthesize and characterize extremely small zeolite crystals, inorganic materials that are widely used in environmental catalysis, separations, and as adsorbents and ion-exchangers.

George Malanson received the 2004 James J. Parsons Distinguished Career Award from the Association of American Geographers Biogeography Specialty Group.

"CGRER graduates" continue to advance their fields in significant manners. For example **David Ufnar**, who received CGRER travel support during his UI graduate studies, was principal author of the 2004 paper, "Evidence for Increased Latent Heat Transport During the Cretaceous (Albian) Greenhouse Warming" (*Geology* 32: 1049-1052), which was featured in the "Editor's Choice" column of *Science* (10 Dec 04).



CGRER Promotes **EDUCATION** to Address Iowa's Needs

TEACHER AT SEA...

CGRER continues to foster education concerning global change in a diversity of manners. In 2004, for example, CGRER partially sponsored a “Teacher At Sea” internship for Kevin McMahon, a Brooklyn, NY, high-school science teacher and former practicing engineer. The NOAA-administered program encourages integration of cutting-edge science into the school curriculum. McMahon spent four weeks working side by side with researchers working on the INTEX mission, a massive international study that

traced large-scale movement and transformation of air pollutants. (CGRER was one of the participating institutions; see page 15.) McMahon spent one week in the mission’s flight control center and three weeks on a research ship in the Atlantic. He then wrote lesson plans to bring his new knowledge back into the inner-city Brooklyn, NY, high school where he teaches. He described his “exciting adventure” as “wonderful, something I could never replicate,” and the researchers as “amazing in their camaraderie, dedication, and sense of mission.”



STUDENT INITIATIVES...

CGRER graduate students have been stretching their own educational parameters. Graduate research assistant Marcelo Mena joined an international group of around 30 at a one-week NCAR Climate and Health Symposium in Boulder. There he heard lectures on a broad spectrum of climate-related research projects and our changing climate’s link to health and global economics. In addition, Mena and four other CGRER-associated graduate students traveled to Stanford University to attend its Solutions for a Shrink-

ing Planet conference, presented by the local Engineers for a Sustainable World (ESW) chapter.

This national organization now claims a newly formed UI chapter. Student members (many of whom are CGRER-affiliated) have been drawing attention across campus for their proactive efforts to educate others about global change issues. In the past year, they have organized a UI Progressive Career Fair, which exposed the 250-plus attendees to numerous NGOs and socially responsible careers. Three of the ESW students traveled to

Xicotepec, Mexico, to lecture to local college students about water issues and treatment. The CGRER students helped found the UI Sustainability Coalition (UISC), which brings together eight student groups concerned with environmental and social justice issues. And they created an interactive website (www.uisc.org) to encourage dialogue and consolidate efforts of UISC members.

GRANTS TO STUDENTS...

The Graduate Student Travel Grant program awarded ten grants-in-aid, ranging from \$357 to \$800 and totaling \$7,000, to support student travel to field research sites:

NAME	DEPARTMENT	TITLE OF PROJECT	DESTINATION
Young Jin Chun	Dept of Ecology, Evolution & Organismal Biology, ISU	Comparative Study on Invasiveness of Purple Loosestrife (<i>Lythrum salicaria</i> L.) in Native and Non-Native Populations	Michigan and Iowa
Francis Dube	History, UI	The Impact of Changes in Land-Use Regimes on the Epidemiology of Cattle Diseases in Southern Africa with Particular Reference to Mozambique and Zimbabwe	Mozambique and Zimbabwe
Chris Gienapp	Biological Sciences, UI	Are Spatial and Temporal Differences in Prairie Fragments Related to Pollinator Species Richness?	Hayden Prairie, Howard County, Iowa
A.E. Haj	Geoscience, UI	Bioclimatic Changes Recorded in Alluvial Sediments within the Prairie-Forest Ecotone of Southwestern Missouri and Eastern Kansas	Sites in Missouri and Kansas
Chiara Hemsley	Biological Sciences, UI	Distribution, Abundance, and Diversity of Solitary Bees in Fragmented Tallgrass Prairie Landscapes	Sites in Iowa
Amber Hill	Biological Sciences, UI	Local and Landscape Variation in Floral Resources for Pollinators at Prairie Preserves and Remnants	Northwest Iowa
Richard Mtisi	History, UI	Wildlife Conservation and the Dispossession of Rural Communities in Mozambique and Zimbabwe	Mozambique and Zimbabwe
Abiodun Oluyomi	Occupational & Environmental Health, UI	Water-Related Diseases and Water Handling Practices: An Evaluation of Trachoma Prevalence and Water Hygiene in The Gambia	The Gambia
Sara Sheeley	Biological Sciences, UI	The Molecular Basis of Gall Induction by <i>Eurosta Solidaginis</i> (gall-fly) on <i>Solidago altissima</i> (tall goldenrod)	Cone Marsh, Iowa
Yu Zeng	Geography, UI	Land Use and Land Cover Change (LULCC) in Ecuadorian Amazon Through Field Work and Simulation Study	Ecuadorian Amazon

In addition graduate student **Wenwu Tang** received partial summer support (\$2500) from CGRER to numerically model migratory behavior of Yellowstone Park's northern range elk herd, an effort that contributed to **David Bennett's** NSF project, "Complexity Across Boundaries - Coupled Human and Natural Systems in the Yellowstone Northern Elk Winter Range."

IN ADDITION...

CGRER continued to publish its newsletter *Io Watch*, which in 2004 focused on atmospheric field studies and modeling. And CGRER maintained a website which, in 2004, received about 3.9 million hits, down from the 2003 figure of 4.7 million hits.

CGRER continues to provide the Iowa Weather Forecasting System as a community service. This system combines use of CGRER's and the National Weather Service's atmospheric modeling tools, producing Midwestern weather predictions that are higher in resolution than they otherwise would be. In 2004, 3-day predictions were extended to cover five days (see <http://www.cgrer.uiowa.edu/iowaforecasting/mid-region_index.swf>)

ADDITIONAL EDUCATION-RELATED EFFORTS OF CGRER MEMBERS...

Art Bettis became editor of the journal *Geoarchaeology*.

Jon Carlson developed and taught a new undergraduate course entitled "International Trade, the WTO and Environmental Protection: The Shrimp – Turtle Controversy." He produced a 130-page packet of text and materials for the course, which is part of the "Introduction to International Studies" course.

Greg Carmichael was highlighted in an eight-minute segment of NPTV's "The News Hour with Jim Lehrer," describing his modeling of atmospheric gas and aerosol movement for the 2004 INTEX study, the largest air quality study ever performed (see Grant #3, page 16). He also was an invited speaker at the Beijing Environmental Forum, a meeting preparatory to the 2008 Beijing Olympics, and has been assisting with planning air-quality forecasting events for those Olympics. In addition, Carmichael presented the invited lecture, "Quantifying Health and Climate Benefits of Curbing Air Pollution in Megacities," at the Dubai International Conference on Atmospheric Pollution in the United Arab Emirates.

Mike Chibnik coauthored "The Life and Times of *Bursera glabrifolia* (H.B.K.) Engl. in Mexico: A Par-

able for Ethnobotany" (*Economic Botany* 57:431-441). The cover-feature article describes the ecology and use of this tree, which is threatened because of its use for artistic wood carvings made in southern Mexico, but is sold widely in the US.

Chibnik's coauthored chapter "Figuras de Madera de *Bursera* en Oaxaca, Mexico" was published by the Center for International Forestry Research in the book *Productos Forestales, Medios de Subsistencia y Conservación: Estudios de Caso Sobre Diversos Sistemas de PFSM*. This chapter is part of a comparative study of non-timber forest products around the world.

Brian Hornbuckle and **Raymond Arritt** used the Personal Response System (PRS) in their teaching of ISU's 300-student "Introduction to Meteorology" course. This electronic system allows instructors and students to obtain immediate feedback to their questions and responses, which guides the direction of further class discussions.

The new UI course "Sustainable Systems" was taught for the first time by **Keri Hornbuckle**, **Jerry Schnoor**, and **Mike Valde**, assisted by CGRER graduate student **Anna Forkan**.

Diana Horton taught for the second time her new course, "Ecosystems

of North America," which examines boreal forest and arctic tundra as analogues for deciduous forest and prairie. This month-long summer field course takes students from Iowa Lakeside Lab (in northwest Iowa), up through Manitoba, to Churchill, Canada, on the west shore of Hudson Bay.

Horton's undergraduate student **Tom Madsen** received 2003 and 2004 Iowa Research Experiences for Undergraduates grants to study the vegetation of remnant natural communities in eastern Iowa. His rare-plant discoveries have led to formal discussions with the Iowa State Preserves Board about establishing a State Preserve to protect plants that Tom discovered, and also may reshape a highway slated to skirt the Rock Island State Preserve in Cedar Rapids.

Jerry Schnoor presented the following three honorary lectures: "Phytoremediation: From the Molecular to Field Scale," Honorary Lecture at the Soil Science Society of America's national meeting, Seattle; "Environmental Grand Challenges," Walter J. Weber, Jr. Distinguished Lecture at the University of Michigan, Ann Arbor; and "Plants and Sustainability," Keynote Address at the 150th Anniversary Celebration of Washington University.

Mark Young taught the new course "Atmospheric and Environmental Chemistry" for the second time.



Spring 1996

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

ATMOSPHERIC FIELD RESEARCH...

Several field studies were carried out at CGRER in 2004. The INTEX mission (Grant #3 below) pulled CGRER into the first coordinated international attempt to establish benchmark atmospheric readings. These complicated studies, described in detail in the last *Io Watch*, utilized CGRER's models to predict the speed and course of air pollutants, and thus guided data collection from aircraft. Other field studies related to the Asian Brown Cloud initiative. Grant #8 below established a permanent observatory in the Maldives, which performed its first field experiments on Indian Ocean radiative forcing in October. CGRER also provided forecasts for the design and execution of the Cloud Indirect Forcing Experiment.

PLANNING CYBERINFRASTRUCTURE...

A new grant to CGRER (Grant #1 below) has been bringing together key researchers and agencies to plan one of the nation's first environmental analysis networks based on real-time remote sensing of data and continuous computer modeling. This planning grant is preparatory to submission of a major interdisciplinary, inter-institutional proposal to NSF's CLEANER program. The proposal will focus broadly on the Upper Mississippi River Basin's water quality and environmental sustainability, and will apply high performance tools such as embedded sensing networks to broaden understanding of environmental changes. CGRER hosted a workshop in February, 2004, preliminary to this planning grant, and will host two workshops in 2005 preparatory to the major proposal.

EFFORTS TO SPREAD THE WORD...

Two new CGRER grants addressed the synthesis and spread of information. Greg Carmichael is helping complete a major worldwide review, based on original data and current studies, of radiative forcing due to aerosols, a project funded by NOAA and NASA for the U.S. Climate Change Program (Grant #2 below). And the Ozone Modeling Project (Grant #4 below) recruited CGRER graduate research assistants Narisara Thongboonchoo and Marcelo Mena to develop an air pollution emissions inventory and numerical pollution models specific to the Bahia region of Northeast Brazil. Future efforts will pull them into training Brazilians to use models to assess the Bahia petrochemical industrial complex's contribution to regional air quality.



1999



GRANTS RECEIVED BY CGRER

CGRER administered a dozen grants in 2004, four (#1-4 below) of which were initiated that year. Most of these grants are described on the CGRER web site.

1. *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
PIs: Prasad Kasibhatla (Duke University), Greg Carmichael (UI), Louis Giglio (SSAI)
2. *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
3. *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
4. *Ozone Modeling Project*, 2/1/04 - 9/30/04, CETREL SA, \$25,000; PI: G Carmichael
5. *Quantifying Anthropogenic Sources of Trace Gases and Aerosols: An Integrated Approach*, 12/1/03 - 11/03/06, NASA, ACMAP program, \$242,395; PI: V Ramanathan (Scripps), with G Carmichael as co-PI
6. *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
7. *Quantifying Carbon Storage In and Beneath Wisconsin Forestlands*, 5/15/03 - 6/30/04, Energy Center of Wisconsin, \$70,561; PI: J Schnoor
8. *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
9. *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
10. *Retrospective Analysis of Near-shore Marine Communities (Exxon Valdez Oil Spill Project #02656)*, 8/15/02 - 9/30/04, U.S. Geological Survey - Anchorage, \$44,562; PI: Scott Carpenter
11. *Modeling and Emissions Analyses in Support of the Spring 2002 ITCT Field Experiment in the Eastern Pacific and Western U.S.*, 4/1/02 - 3/31/05, NOAA, \$310,902; PI: G Carmichael, UI, David Streets, Argonne National Laboratory, and Hiram Levy II, Geophysical Fluid Dynamics Laboratory, Princeton University
12. *The Role of Heterogeneous Chemistry in the Photochemical Oxidant Cycle: A Modeling and Laboratory Study*, 3/15/98 - 3/14/05, DOE, \$1,113,864; PI: G Carmichael and Vicki Grassian

SEED GRANTS AND OTHER FUNDING AWARDED BY CGRER...

In 2004, CGRER awarded a total of \$100,000 in seed grants to develop and improve instrumentation, reconstruct past climate regimes, and trace changes in genetic variability. The five funded proposals will attempt to garner preliminary data prerequisite to submission of more comprehensive grant proposals to outside funders.

PROJECT DIRECTOR	AMOUNT AWARDED	TITLE OF PROJECT
Jeff Dorale, Greg Ludvigson, Dick Baker Geoscience, UI	\$20,000	Capturing Iowa's Industrial Age Record of Global Change
Jiasong Fang Geological & Atmospheric Science, ISU	\$20,000	Stable Carbon Isotope Fractionation in Fatty Acid Biosynthesis of Piezophilic Bacteria and Implications to Paleo-environmental Reconstruction
Brian Hornbuckle, Thomas Sauer, Elwynn Taylor Agronomy, ISU	\$20,000	How Accurately Can I Remotely Sense Surface Temperature? Practical Options for Investigators
Paul Kleiber (Physics & Astronomy), Vicki Grassian (Chemistry), UI	\$20,000	Development and Implementation of an Aerosol Flow System for Laboratory Studies of the Impact of Atmospheric Aging on the Optical Properties of Mineral Dust Aerosol
John Nason Ecology, Evolution, and Organismal Biology, ISU	\$20,000	Historical Controls on the Evolution of Continental Plant and Insect Herbivore Biotas



Additional CGRER funding included the second of two payments of \$41,195 to **Vicki Grassian** to hire a two-year postdoctoral associate, who will join her staff in 2005.

CGRER also allocated \$2,600 to **Umran Dogan** to support his preparation of an NIH grant entitled "Pathogenesis of Mesothelioma," which intends to test the feasibility of using optical microscopy for characterizing zeolite-group minerals that may be causing fatal mesotheliomas in genetically predisposed individuals.

CGRER granted \$3,200 to **Greg Ludvigson** to travel to Liaoning Province, China, in September, for visits to the Yixian Formation fossil beds, renowned for their feathered dinosaurs and birds. Ludvigson's field collection of terrestrial carbonates from these Cretaceous deposits will allow him to assess the potential for future Asian paleo-climatic studies, similar to those he has undertaken for North America.

CGRER AIDS TO RESEARCHERS AND THE UI COMMUNITY...

As in past years, CGRER supported additional research on the UI campus through its logistical support. CGRER continues to offer use of state-of-the-art computing, visualization, and resource materials to members and their students. As part of this effort, in 2004 CGRER purchased a third Linux cluster for large computations. This 17-node cluster, which greatly increased researchers' environmental modeling abilities, has been used primarily for atmospheric models such as STEM and MM5. CGRER also implemented

the use of a 4-node mini-cluster, used to train Linux cluster users as well as run relatively small models.

CGRER collaborated with the UI's Information Technology Services by allowing its four clusters to be monitored for CPU speed and viability, in conjunction with the UI's "Grid Research and Education" (GROW) project. Participating in such a project allows CGRER students and collaborators to walk the cutting edge of grid computing on the UI campus. CGRER also has been involved in the UI's monthly

cyberinfrastructure meetings.

CGRER continues to utilize its web server to host student, faculty, and class (e.g., "Green Engineering") web pages. Additional class sites are being created in-house by CGRER students. These sites allow students to access class materials electronically, post their work, and share ideas and documents.

Although CGRER's 2002 move to the fourth floor of the Iowa Advanced Technology Laboratories building was intended to provide room to grow, CGRER is bursting at the seams with nearly all office and laboratory space now filled.

ADDITIONAL RESEARCH PERFORMED BY CGRER MEMBERS...

CGRER members participated in dozens of diverse projects, typically funded by grants awarded through their home departments. Perhaps the most unusual effort encompassed the impromptu activities of historian **Paul Greenough**, who was thrust into a novel research situation while traveling in Sri Lanka on December 26, the day of the great Asian tsunami. His small UI study group immediately left the uplands and traveled to affected coastal areas, with group members offering their help as they continued their original research effort: assessing the health system's functionality during the country's Civil War.

Allen Bradley and **Anton Kruger** received a three-year, \$321,972 grant, "Diagnostic Verification of 6-90 Day Ensemble Streamflow Predictions for AHPS," from the National Weather



Trincomalee harbor, Sri Lanka, December 28. The clock tower, which rose only yards beyond reach of the highest wave, remained unaffected by the tsunami. (Photo by P. Greenough)

Service. This grant will assess the accuracy of long-range, probabilistic river forecasts.

Rhawn Denniston and his students have begun speleothem-based paleoclimate research on the impacts of Late Pleistocene climatic and vegeta-

tion change on human subsistence and settlement in Western Portugal.

Denniston also received a \$35,000, two-year grant from the Petroleum Research Fund entitled "Dominican Republic Corals as High-Resolution Records of Shallow Marine Paleoenvironmental Conditions Prior to the Closure of the Panamanian Seaway." He will be using fossil corals to investigate the impact of the closure of the Central American isthmus on marine environments, and on the faunal extinction and speciation that occurred about that time.

Robert Ettema and colleagues continued research efforts on two 3-year grants totaling \$600,000 from the National Cooperative Highway Research Program, both dealing with channel scour around bridge abutments, while commencing efforts on a new \$80,000 grant from the Iowa Highway Research Board to develop a guide for monitoring small water-

ways at bridges. He also received grants to compose a monograph on river channels in wintertime, and to study frazil ice formation in Lake Michigan.

PI **Vicki Grassian**, with co-PIs **Patrick O'Shaughnessy** and **Peter Thorne**, received a three-year, \$335,000 grant from the EPA entitled "Impacts of Manufactured Nanomaterials on Human Health and the Environment—A Focus on Nanoparticulate Aerosol and Atmospherically Processed Nanoparticulate Aerosol." In addition to physically characterizing these newly created aerosols, the researchers will compare their potential health effects to those of other ultrafine particles.

Keri Hornbuckle received two grants for purchasing instrumentation to help detect trace levels of environmental contaminants: "Acquisition of Automated and High Sensitivity Instrumentation for the Analysis of Organic Compounds in Complex Matrices" (NSF with UI matching funds, \$347,700, 2 years), and "Development of a Passive Air Sampler for Measuring PCBs in Air" (UI Center for Health Effects of Environmental Contamination, \$23,700, one year).

Witold Krajewski, **Allan Bradley**, **Anton Kruger**, and colleagues received a four-year grant totaling nearly \$2 million from the ATM Division of Atmospheric Sciences, GEO Directorate for Geosciences, entitled "A Comprehensive Framework for Use of the Next Generation Weather Radar (NEXRAD) Data in Hydro-meteorology and Hydrology." He, Kruger, and colleagues also received a \$251,011, three-year grant from

NSF for "Small-Scale Variability of Rainfall: Experimental Studies with Implications for Rainfall Estimation."

Greg Ludvigson received a one-year, \$70,278 mapping grant, "Geologic Mapping of the Upper Iowa Watershed: Phase 1: Decorah 7.5' Quadrangle," from the USGS, to be completed with co-PIs R. Anderson, B. Witzke, B. Bunker, and S. Tassier-Surine. He also received a one-year, \$12,317 grant, "Paleoclimatologic Field Studies in Colorado, New Mexico, Oklahoma, and Texas in the Conduct of NSF Grant EAR-0125285," from the University of Kansas. The latter study, with co-PIs B. Witzke and R. Brenner, will allow him to collect appropriate rock samples to complete ongoing mid-Cretaceous climate studies.

George Malanson received two new grants: "Western Mountain Initiative Task 2A," \$79,000 for Year 1, from USGS, 5 years; and "Feedbacks among Patterns and Processes of Land Use and Land Cover Dynamics in the Northern Ecuadorian Amazon," \$120,000 from NSF's Biocomplexity – Coupled Human and Natural Systems program, 3 years.

He and **Jerry Schnoor** received the grant "Virtual Watershed – Agricultural Landscape Evolution in an Adaptive Management Framework," \$130,000 from NSF's Biocomplexity – Coupled Human and Natural Systems program, 3 years.

Jim Raich and **German Mora** received a \$400,000 NSF grant entitled "Distinguishing Root from Soil Contributions to Soil Respiration: Exploration of a New Approach." This three-year grant, which will attempt to independently investigate



Fall 1996

the CO₂-related underground processes of root growth and organic matter decomposition, grew out of a 2001 CGRER seed grant.

Mark Young, **Vicki Grassian**, and **Paul Kleiber** received a \$488,188 NSF grant titled "Toward a Greater Understanding of Direct Radiative Forcing: Laboratory Studies of the Impact of Physicochemical Processing on the Optical Properties of Mineral Dust Aerosol." A 2004 CGRER seed grant kick-started the three-year grant, which will allow the PIs to study optical properties of atmospheric aerosols to better understand radiative forcing and their link to global climate.



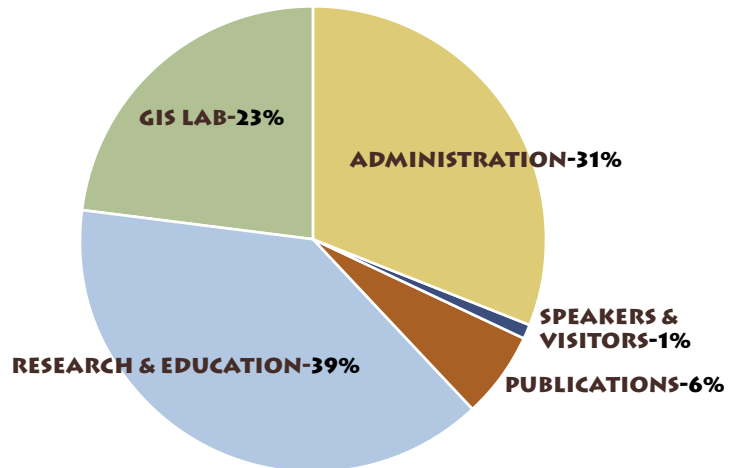
General **INFORMATION**

BUDGET...

In fiscal year 2004 (July 1, 2003 – June 30, 2004), 69% of CGRER's \$490,577 of funding was spent on research, education, and outreach directed toward global change issues (Figure 1). The remaining 31% of the budget was dedicated to administration.

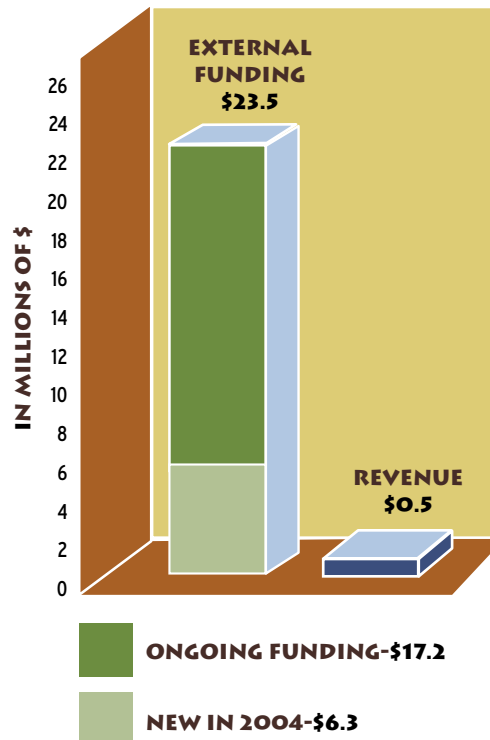
This funding, received in total from an assessment on Iowa's gas and electric utilities through the State Department of Commerce, was magnified many times in the millions of dollars of external grants and contracts awarded to CGRER members (Figure 2). In calendar year 2004, CGRER members were performing research that brought in a total of \$23.5 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, \$6.3 million was new funding that was initiated in 2004, while the remaining \$17.2 million came from ongoing projects.

FIGURE 1
CGRER's Expenses*



*Applies to Fiscal Year 2004

FIGURE 2
Leveraging of CGRER's Income*



*Applies to Calendar Year 2004



2004

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 (see page 3). The Executive Committee meets monthly to plan initiatives and chart CGRER's course. An Advisory Board of nine members from outside the academic community meets annually to lend oversight to CGRER's activities (see page 5 for Advisory Board members).

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

CGRER MEMBERS**UNIVERSITY OF IOWA****Anthropology**

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
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Wilfrid A. Nixon
A. Jacob Odgaard
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

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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
Gregory A. Ludvigson
Mark K. Reagan
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You-Kuan Zhang

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Law

Jonathan Carlson
Burns H. Weston

Microbiology

Lacy Daniels

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

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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



Fall 1995

ILLUSTRATION KEY

Cover	Rebalancing the Carbon Cycle (1998)
Inside cover	Floods of 1993 (Spring 1994)
Page 1	Global Change: Curse or Blessing? (Fall 1994)
Page 2	Sustainably Yours (Environmental Sustainability, 2002)
Page 4	Outside the Laboratory (Innovative Research Instrumentation, 2003)
Page 6	Dust Motes (Minute Particles and Changing Environments, 2001)
Page 9	Songs of a Miner's Canary (Biological Signs of Climate Change, Spring 1995)
Page 10	Visualizing Reality (Computer Visualizations of Changing Environments, 2000)
Page 14	From Grasslands to Glaciers and Back Further Still (Iowa's Past Environments, Spring 1996)
Page 15	Water Connections – Nepal (Education about Global Change, 1999)
Page 19	Eco-logic (Our Environmental Future, Fall 1996)
Page 20	Global Warming and Human Health (1997)
Page 22	Blowing in the Wind (Numerical Models of Atmospheric Flows, 2004)
Page 24	Biking Toward the Solution (Nontraditional Environmental Education, Fall 1995)



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The Center for Global and Regional Environmental Research

The University of Iowa
424 IATL

Iowa City, IA 52242
319-335-3333

FAX 319-335-3337

<http://www.cgrer.uiowa.edu/>