IOWATCH

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

SPRING 1994

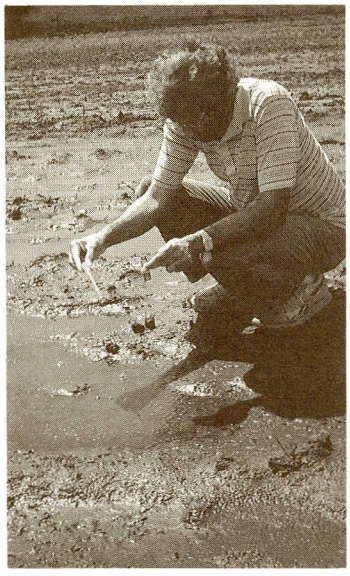
The Floods of 1993

Long before Iowa's flooding rivers reached their crest, several CGRER members were designing research to evaluate the floods' effects and to link flooding to events past and future. The researchers' readiness to do so was not unusual: concern with global change invariably involves climate, and the pulse of the earth's water constitutes a major element of the climatic regime. So when the heavens, as if in gift, released their bounty this past summer at the doorsteps of CGRER's researchers, they willingly stepped out and into the flow.

Rivers carry much more than water. Last summer, they moved refrigerators, fledging birds, pigs, and oil tanks, among other things. And always they move sediment—small particles of soil and rock, sometimes with adsorbed pesticides or other toxic chemicals. Geographer Rajagopal, a University of Iowa water resources specialist, collected and analyzed over 200 eastern Iowa water samples during the height of flood- ing this past July and August. He questioned the conventional assump- tion that copious flood waters would dilute the usual concentrations of water-borne pesticides. And indeed he found that the herbicides atrazine and alachlor were at annual maximum concentra- tions during the peak-flow period.

During those 30 to 40 days, Raj extrapo- lated that the total load of agrochemicals from Iowa fields into the Missis- sippi was as high as the normal annual load of other years. In drier years, agricultural chemicals re- main in place in the upper few feet of soil. But water flowing over and through last summer's satu- rated soils was pushing pesticides directly into the rivers. This led to as much as 1,000 pounds of alachlor and 7,500 pounds of atrazine washing down the Iowa River through Iowa City during the 40-day peak flow—and an estimated total of 20 metric tons of alachlor and 175 metric tons of atrazine (amounts exceeding the normal annual levels) flowing down the Mississippi and into the Gulf of Mexico. The ecological implications of such short-term shock releases of toxic chemi- cals remain unknown. Following the peak floods, herbicide levels in water samples decreased rapidly.

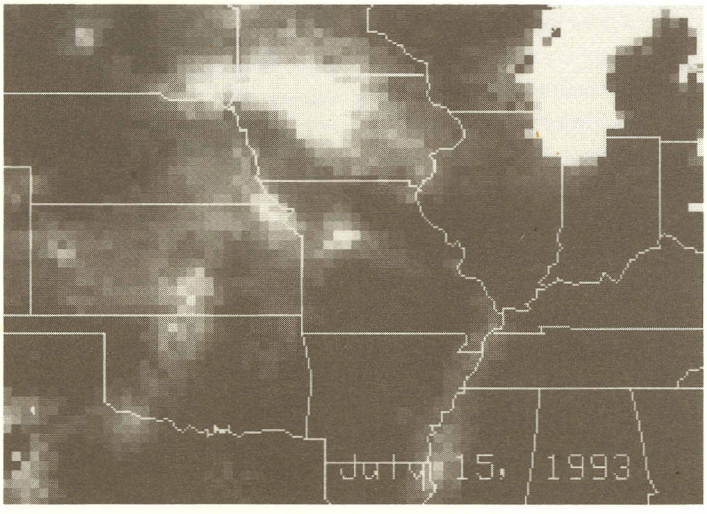
Now that flood waters have receded, University of Iowa geomorphologist Frank Weirich is examining the sediments they left behind. He has been repeating pre-flood studies that outlined the sediment deposits at the bottom of the Coralville Reservoir as well as those on the Cedar and Iowa River floodplains. By comparing pre- and post-flood deposition patterns, he will be able to quantify the amount of sediment moved by the 1993 floods and explain how the floods scoured sediment from some areas and left it elsewhere, information critical to managing Iowa's rivers and reservoirs. Ultimately, he also hopes to predict the sediment deposition patterns of future floods. Such predictions will contribute to efforts for conserving Iowa's topsoil, maintaining the water-holding capacity of reservoirs, and managing river-associated features such as levees, sediment-free navigation channels, and wetland wildlife habitat—features important to sustaining Iowa's river systems economically and environmentally.



Rajagopal collecting a puddle sample in a farm field after a rain storm during the Great Midwestern Flood of 1993.

Frank's readiness to analyze the 1993 midwestern floods springs from his decade of designing and observing "controlled floods" in various types of "outdoor laboratories" in southern California and elsewhere around the world. After collecting preliminary data in a river valley, he releases specific quantities of sediment-laden water from an upstream reservoir, in effect simulating a natural flood. Frank then can return to the surveyed valley to record the depth and pattern of sediment deposits and to study how they have been influenced by floodplain vegetation, river channel shape, and the like. He emphasizes that the new technologies available through computer-based Geographical Information Systems (GIS) have multiplied the power of his field studies. GIS computer simulations transform linear data sets into three-dimensional maps of river basins and lake bottoms, which can be extended forward in time to predict how rivers and reservoirs will function in the future.

Although the 1993 floods were the greatest in historic record, similar large-scale climatic events have defined the landscape's past. CGRER member Luis Gonzalez, along with fellow geologist Mark Reagan, obtained a CGRER seed grant in 1992 to test whether stalagmites could be used to identify and date major climatic events in the Midwest. His research confirmed that analysis of the growth rates and atomic composition of these cave structures could indeed provide a detailed record (accurate to the decade, perhaps even to the year) of precipitation, temperature, and vegetation over the past 7,000 to 10,000 years.



This image from the passive microwave imaging sensor (SSM/I) carried on USAF Defense Meteorological Satellite Program (DMSP) satellites illustrates the degree of relative surface soil moisture saturation across the Midwest on July 15, 1993. The temporary "Great Lake" of Iowa shows up with the same brightness as Lake Michigan. (Produced by the NOAA/ NESDIS Office of Research and Applications)

That seed grant provided the documentation needed for the researchers to receive large grants from the National Science Foundation and National Oceanic and Atmospheric Administration, to develop further their definitions of prehistoric midwestern climates and ecosystems by using stalagmites. (CGRER geologist Richard Baker is also involved in the newly-funded studies.) The results of these new studies will prove interesting not only to academics. The validation of complex climatic models being developed to describe future global warming requires information about prehistoric climates, and other techniques for developing this information are far less detailed and accurate. Also, the floods of 1993 and other climatic anomalies can best be understood if analyzed in light of long-term midwestern climatic patterns and trends. By placing last summer's floods in perspective, examination of cave stalagmites may significantly assist researchers in predicting Iowa's future climates.

How can the negative aspects of flooding be reduced? Hydrometeorologist Konstantine Georgakakos, a research engineer with the Iowa Institute of Hydraulic Research, is hoping that improved use of Iowa's large reservoirs could pose some answers. A month after the severe flooding commenced, he received a National Science Foundation grant to determine this century's frequency of floods of similar magnitude and extent in Iowa. A detailed analysis will be accomplished using computer models that link the degree of soil saturation to rainfall. The models then will tie predictions of weather and flooding to operating procedures for Iowa's reservoirs. The use of computer-based mathematical models to determine the timing of water release from a reservoir should dramatically decrease the likelihood of downstream flooding. This new study plays off of Konstantine's earlier work on hydrologic simulation and weather prediction in the upper Des Moines River basin, including investigations of the relationship between soil moisture and climate funded by a CGRER seed grant in 1992.

Taking a different tack, Iowa State University's Eugene Takle, a professor of atmospheric science and agronomy, ventures that his efforts with weather prediction will allow communities to prepare better for approaching severe weather. Current National Weather Service forecasting models predict only approximate rainfall for broad areas. Gene's tests of a sophisticated fine-resolution model will determine its ability to predict midwestern rainfall to the extent, for example, that the amount of water to fall on an entire drainage basin could be accurately foretold by as much as a day. Such forecasts could improve the planning of crucial control operations such as levee management and sandbagging.

Although theories about 1993's widespread flooding wafted through the Midwest's moist air this past summer, no one was willing to hazard a declaration concerning the floods' causes, much less venture whether these waters were part of nature's variability or human-induced alterations. But the summer's driving rains pounded one point home: short-term climatic variations can shock us into different uses of the land and attitudes toward our earth. The research of CGRER members already is shaping these emerging uses and attitudes by concretely guiding how Iowa and Iowans will cope with major floods in the future. •

What's up at CGRER?

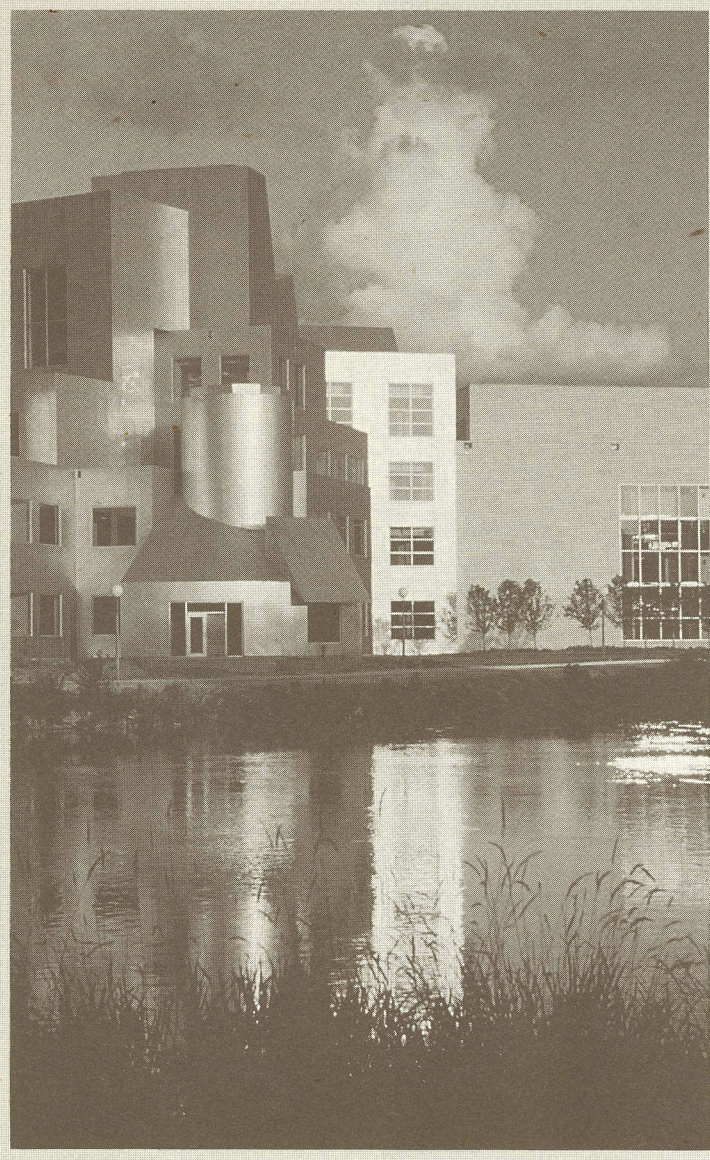
CGRER's efforts took wing this past May when the Center officially moved into the university's Iowa Advanced Technology Laboratory, a stunning new metallic structure on the Iowa River just north of the Iowa Memorial Union, designed by award-winning architect Frank Gehry. CGRER occupies two administrative offices on second floor, ten carrels assigned to CGRER projects and their graduate assistants, and a computer laboratory. Both administrative assistant Jane Frank and data systems coordinator Mark MacLennan, the Center's two full-time staff members, are usually easily located and happy to welcome visitors interested in CGRER activities.

CGRER's ranks also include 45 faculty members from nineteen departments in the liberal arts, engineering, medical, and law colleges at the University of Iowa and Iowa State University, and their over-100 graduate students. Eight of these members (plus the two co-directors) form the CGRER Executive Committee, which meets monthly to oversee Center activities and facilitate communications among members. An advisory board of nine individuals from the state legislature, utilities, academia, and state agencies meets biannually.

CGRER promptly established its computer laboratory for environmental and spatial data analysis. Here members can use any of the eight UNIX-based workstations to develop and run their computer simulation models and to manipulate spatial and temporal data. A variety of sophisticated software programs allow them to visualize three-dimensional phenomena, construct map overlays, and create real-time animations, among other things. The Center is grateful to Hewlett-Packard for its donation of $275,000 of equipment and to the University of Iowa for additional funding.

Outdoor teaching and research laboratories are being established at three sites within 20 miles of the university. Equipment there will be monitoring a variety of meteorological and biogeochemical variables to provide baseline data for future research, as well as train graduate students in field monitoring procedures.

In October, 1993, CGRER was honored with election to membership in UCAR (the University Corporation for Atmospheric Research). This NSF-funded consortium of North American institutions operates NCAR (the National Center for Atmospheric Research in Boulder) and manages a variety of other atmospheric science institutions and activities.



CGRER is housed on the second floor of the new Iowa Advanced Technology Laboratory (IATL) located on the east bank of the Iowa River.

Dr. Hiram Levy of the Geophysical Fluid Dynamics Laboratory, Princeton, New Jersey, is on campus this semester to work on a monograph on tropospheric ozone and to collaborate with Gregory R. Carmichael. Center co-directors hope that he will be the first of many visiting scientists to energize interdisciplinary interacions and studies in global change. That goal also will be furthered by the Center's next planned installation, a media resource center, and by the upcoming symposium, Global Change II: A Midwest Perspective, to be held in April. •

DID YOU KNOW:

in 1851 Iowa may have experienced floods of a magnitude similar to those of 1993, but the inadequacy of historic records makes comparison of the two years impossible.

the 1993 summer floods followed a prolonged period of cool, wet, cloudy weather which greatly decreased evaporation of soil moisture and set lake and river levels climbing months before severe flooding began.

some towns, such as Chelsea (Tama County), were flooded as many as five times in 1993.

virtually all of Iowa's maximum precipitation records were broken in 1993.

from November 1, 1992, through August, 1993, 47.50 inches of precipitation fell across Iowa, an amazing 20.75 inches more than normal and nearly 12 inches above the previous record.

from May to September of this last year, only 13 days escaped measurable rainfall somewhere in Iowa.

the wet weather's effects continue to be felt in indirect ways such as the subsidence of Des Moines homes because of extremely saturated soils.

the June, 1991, explosion of Mount Pinatubo in the Philippines may have contributed significantly to the 1993 weather anomalies: the millions of tons of atmospheric ash would have decreased sunlight and favored prolonged "global cooling," and in the process reduced evaporation of moisture from the soil.

Faculty Focus

"I came of age in the late 1960s and early 1970s, when concern about environmental problems included anti-industrial sentiments. My interest in the natural environment had always been strong. But even then I viewed most environmental problems as linking back to a chemical component. And I realized that technology—whether seen as good or bad—was going to remain a significant part of the environmental equation. Industry and technology may have created the problems, but they also were the means for solving them. So I thought that I'd better learn a lot about both." In this way, Greg Carmichael quietly explains the path that led to his career as a professor of chemical and biochemical engineering and co-director of CGRER.

Jerry Schnoor, who co-directs CGRER with Greg, grew up in Iowa about the same time, and from an early age shared Greg's environmental interests. But he traces his professorship in civil and environmental engineering to one person. "Mary Sievert—that's why I'm where I am today," he says, referring fondly to the teacher at Davenport Central High School who sparked his interest in chemistry.

Once launched, the tracks of Greg's and Jerry's careers ran parallel in several ways. Both received undergraduate degrees in chemical engineering from Iowa State. Both moved on for doctorates elsewhere, Jerry to the University of Texas and Greg to the University of Kentucky. Both returned to Iowa City for their first teaching positions, and both have stayed ever since, each racking up over fifteen years of service at the University of Iowa. Both have become accomplished in executing the triumvirate of professorial activities—teaching and guiding graduate students, research, and service to the extra-university community—and both have collected many honors in the process.

Greg has served twelve years as chair of the Department of Chemical and Biochemical Engineering. He has in recent years chaired or served on the university's Research Council, the Research Foundation Board, the Governor's Science Advisory Board, and boards of several other state, national, and international groups including the Atmospheric Chemistry Committee of the American Meteorological Society, which he presently chairs. In addition to teaching a full load of courses and working with a research group of six to eight graduate students and a similar number of undergraduates, he has brought in over 2.5 million dollars of research support in contracts and grants. Greg presently has projects with the NSF, NASA, NOAA, DOE, World Bank, and Central Research Institute for Electric Power, Japan.

Jerry, recently named University of Iowa Foundation Distinguished Professor, is a diplomate of the American Academy of Environmental Engineers, associate editor of the journal *Environmental Science and Technology*, and editor of John Wiley and Sons' environmental texts and monographs. Noted as a gifted teacher as well as researcher, he is justifiably proud his breadth of service, including his present position as president of the university's Faculty Senate.

BY FOSTERING TRUE PARTNERSHIP ARRANGEMENTS WHEREBY FACULTY MEMBERS FROM VERY DIFFERENT DISCIPLINES TOGETHER ATTACK COMPLEX PROBLEMS, OUR STUDENTS WILL BE ABLE TO TACKLE MORE CUTTING-EDGE PROBLEMS.

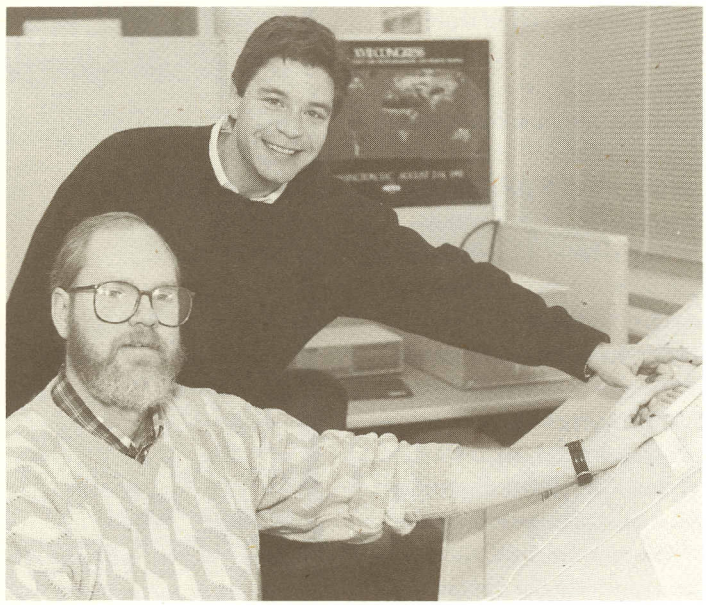
Throughout their energetic professional lives, both Greg and Jerry have made concrete attempts to establish ties with researchers in related disciplines. Thus neither is surprised that they now occupy desks side by side, in a center dedicated to promoting such links among faculty members and researchers throughout the state. "Anyone who works deeply in an area is forced to extend beyond the subject at hand," states Greg. His efforts in atmospheric chemistry—in trying to understand how humans have impacted the atmospheric environment—have always demanded that breadth. Physics, meteorology, chemistry, computer science—

knowledge of all these fields is fed into Greg's sophisticated mathematical models that trace the long-range transport of atmospheric pollutants.

In recent years, Greg's extensive research on acid rain has expanded to include investigations of ozone in the troposphere, that lowest level of the earth's atmosphere where ozone is transformed by sunlight into a deadly pollutant. (Only in the upper atmosphere is ozone a beneficial shield from the sun's ultraviolet radiation). And although he continues his studies of midwestern air pollutants, his focus has been drawn to Asia, where rapid industrialization and population growth are being matched by exploding levels of air pollutants.

There he is asking whether pollution assessment and control technologies developed for western nations can alleviate the burgeoning air pollution of the eastern hemisphere. And he is adjusting technologies for use in countries where trained personnel, electricity, reliable transportation, and other such amenities are at a minimum. For example, under a $1.2 million World Bank grant, Greg now is establishing an air pollution monitoring network in Asia using a passive, non-electrified sampler, and he is training local scientists in its use. He also is simplifying a computer model that predicts future levels and movement of air pollutants, given differing scenarios of industrial growth. This model, Greg hopes, will be used by Asian governments to chart governmental policies and plans concerning industrial growth.

Greg's work in Asia will directly impact future air quality in the Midwest. The testing of his models on another continent will increase the validity and reliability of their use on this continent—and hence will increase their strength as planning tools. And if Greg's plans for Asia succeed on a grander scale—if through his teaching and modeling he helps Asia reduce its growth of air pollutants, which if left unattended are predicted to exceed those of the developed world within a decade—the air flowing around the world from Asia will remain cleaner and healthier for Iowa's citizens as well.



Greg Carmichael and Jerry Schnoor, Co-Directors of CGRER

Jerry, like Greg, develops mathematical models that can predict the magnitude and transport of environmental pollutants. But Jerry's research traditionally has focussed on water quality and groundwater studies, which only recently have been extended to the modeling of greenhouse gasses as well. He also has sought ways of encouraging living organisms to rid the earth of environmental poisons. His "bioremediation research" questions, for example, whether trees planted around landfills, mine tailings, or other areas of contaminated soils could pull toxicants from the earth and then store or metabolize these pollutants. Preliminary results indicate that such plantings could indeed reduce the flow of soil pollutants into streams and groundwater.

Jerry consistently extends his efforts beyond university portals into the policy realm. "To me, the most interesting challenge is to try to come up with technologically feasible, socially just, and politically acceptable policies," he contends. He also expounds his belief that engineers and scientists need to become more active in expressing knowledgeable perspectives on issues. This belief has led Jerry to active consultation efforts in the "Black Triangle" of Eastern Europe, a land so heavily polluted through industrial development that children at times are assigned gas masks for outside play at recess. In addition, Jerry attended the June, 1992, Earth Summit in Rio de Janeiro, on behalf of the Iowa Division of the United Nations Association, returning home to become an outspoken advocate of the treaties and charter developed for that summit. Experiences such as this lead Jerry to proclaim the great personal pleasure and satisfaction he takes in his job. "With my opportunities to work with students, faculty, and researchers far and near, to share similar views with them, and to take real steps toward solving problems, I feel I have the best job in the world," he asserts.

Mixing his dual passions for research and policy development, Jerry and Larry Bean (at Iowa's Department of Natural Resources) are proposing a project that would essentially reduce to zero Iowa's net emission of carbon dioxide from fossil fuels. This would be accomplished by balancing carbon dioxide production with strategies to reduce gas production (through increased energy efficiency) and with the planting of trees (which take up carbon dioxide from the atmosphere and convert it into living tissues.) Jerry believes that Iowa has a very real chance of leading the nation in accomplishing this goal—which would mean that Iowa would become the first state to eliminate net discharge of "greenhouse gasses" that could lead to global warming in the future.

Jerry's breadth of vision shapes his teaching efforts. He sketches environmental problems on a large canvas, looking beyond the here and now, encouraging consideration of their historic roots and

probable futures, both in this country and around the world. He encourages students to take related courses in law and public policy. And he attempts to bring students back to earth by exhorting them to consider the human dimension. "I impress on my students that all our grants and projects affect, in a positive or negative way, the daily lives of many individuals," he states, recalling how his own father, a used car salesman in Davenport, went out of business because of environmental regulations. "I never forget that."

And, realizing that wise policy begins with a knowledgeable public, Jerry regularly accepts invitations to speak to school classes, environmental groups, local clubs, and the like. In these lectures, he attempts to assuage apathy created by the overwhelming magnitude of environmental problems by stressing the challenges that these problems present. He demands the same action-oriented approach of CGRER, which he believes can "light the paths of the problem-solving process."

Together, prodded by the efforts and interests of other CGRER members, Jerry and Greg play upon their similarities and differences to seek new ways of addressing the earth's wounded environment. What are their dreams for the future? Greg's focus on continuing solid scientific research that produces both fundamental and practical applications. He trusts that CGRER will add yet another dimension to this dream: "The students are the ones who will benefit most from the Center's success," he states. "By fostering true partnership arrangements whereby faculty members from very different disciplines together attack complex problems, our students will be able to tackle more cutting-edge problems. They will become plugged into a national and international agenda, and become true interdisciplinary earth systems scientists."

Jerry's dreams take the scenario one step further, into a world where many of the university's disciplinary boundaries dissolve. "These boundaries compartmentalize faculty members' ideas and restrict researchers from attacking complex problems," he states. "And students are taught to inspect one aspect of an environmental problem rather than address the earth's systems as complex wholes. Departmental structures are, in a way, anachronistic." He views CGRER as one mechanism for creating the interdisciplinary university liaisons that will integrate diverse research and training efforts. Both he and Greg believe that such CGRER-fostered liaisons will stimulate new thought patterns which are capable of churning into reality dreams that may lead us more sanely and safely into the twenty-first century. •

Global Change II: A Midwest Perspective will be held at the University of Iowa on **April 7 and 8**. This event is an outgrowth of CGRER's very successful global change symposium held in 1989, which attracted over 200 attendees to the university's campus to hear about global change issues and their impact on the Midwest. This year, the nation's top experts will present new results of the 1993 floods and also will discuss greenhouse gas trends, stratospheric ozone depletion, biodiversity, and sustainable development. Speakers include: Timothy Wirth, U.S. State Department and former U.S. Senator from Colorado; Daniel Lashof, Natural Resources Defense Council; Don Fisher, E.I. DuPont de Nemours; Jack Fishman, NASA Langley; Eugene Takle, Atmospheric Science Program, Iowa State University; Konstantine Georgakakos, Scripps Institution of Oceanography; Frank Weirich, Department of Geography, UI; Sharad Adhakiry, Director, Department of Hydrology, Nepal, India; Steve Pyne, Arizona State University; Steve Hubbell, Department of Ecology and Evolutionary Biology, Princeton University; David Gates, Department of Botany, University of Michigan; Tom Webb, Geology Department, Brown University; David Campbell, Department of Biology, Grinnell College; Katy Hansen, Iowa Earth Charter; Andrew Steer, World Bank; Stanley Changnon, Illinois State Water Survey; James Fouts, National Institute of Environmental Health Sciences; and Ruth Harkin, Overseas Private Investment Corporation.

For registration information or a brochure describing the symposium in greater detail, please contact: The Center for Global and Regional Environmental Research, The University of Iowa, 204 IATL, Iowa City, IA 52242. Ph. 319-335-3333 or FAX 319-335-3337

Seeds

CGRER annually awards eight to ten seed grants of up to $15,000 each. These grants assist researchers commence projects relating to environmental change, with the prospect that larger-scale funding will subsequently be found to allow their continuation. Grant applications are solicited from individuals in the physical, natural, and social sciences and related areas at public and private institutions throughout the state. Since the first round of awards in January, 1992, 25 grants (summarized below) have been awarded.

Global change inevitably brings to mind climatic change. Thus the preponderance of grants concerning ***changing climates and atmospheric trace gasses*** is no surprise. **L DANIELS** (Microbiology, U of I) examined the production of methane—a major greenhouse gas—in tropical agricultural systems and then related methane production levels to the use of various fertilizers.

R VALENTINE (Civil and Environmental Engineering, U of I) looked at the sunlight-induced degradation of dissolved organic material, and the resulting rates of carbon monoxide and carbon dioxide production. **L LICHT** (Civil and Environmental Engineering, U of I) measured the emission of greenhouse gasses from the burning of biomass fuels (such as corn and wood chips) as alternative fuels, and evaluated their impact on global warming relative to fossil fuels.

J SCHNOOR (Civil and Environmental Engineering, U of I) devised a policy-oriented model to test the effects of reforestation and energy conservation on carbon dioxide concentrations (and hence on global warming). With **Y YAN** (same affiliation), he is coupling and cross-checking computer models dealing with greenhouse gasses, thus improving predictions of trace gas characteristics during global warming. **G CARMICHAEL** (Chemical and Biochemical Engineering, U of I) considered how climate change on a global scale would affect trace gas cycles in the eastern United States and resulting changes in air pollutants, ultraviolet light penetration, and temperature. **E TAKLE** (Atmospheric Science and Agronomy, ISU) and **L MEARNS** (National Center for Atmospheric Research) have modeled future temperature variables for the Midwest given present carbon dioxide levels and a doubling of carbon dioxide, and have improved the resolution of their model by relating temperature to the earth's surface characteristics.

J FIX and **S SPANGLER** (Physics and Astronomy, U of I) investigated a radio-astronomical technique for measuring ozone concentrations accurately at all levels of the atmosphere.

Climate also includes an ***evaluation of the earth's water cycle.*** **W KRAJEWSKI** (Iowa Institute of Hydraulic Research, U of I) has helped

DID YOU KNOW:

the cool, wet weather in the Midwest was coupled with unusual weather patterns elsewhere in the country: a serious drought in the Southeast, a major heat wave along the East Coast, an unseasonably cold summer in the western mountains.

this past summer, the Midwest lay at the boundary of a stationary "dome" of high pressure over the southeastern U.S. and a strong, stationary low pressure system over the Northern Rockies, and that our widespread, severe thunderstorms were generated by the clashing of air masses at this boundary.

Iowa's first autumn freeze dates have moved steadily earlier for the past 50 years, and now on the average come ten days before they did in the 1930s and 1940s.

even if precipitation decreases, Iowa will remain vulnerable to moisture-related problems (such as flooding) for a very long time because of the state's wet soils, high water table, resulting high river flows, and high lake levels.

Taken from "Special Climate Summary, The Great Iowa Floods of 1993," prepared September 3, 1993, by Harry Hillaker, State Climatologist and CGRER Advisory Board member.

develop more accurate techniques for quantifying moisture, first by evaluating the accuracy of satellite-based large-scale remote sensing of soil moisture (which is an important indicator of more general climatic conditions), then by working on a method of estimating rainfall on the open ocean through recording underwater noise created by the rain. **T SMITH** (Mechanical Engineering, U of I) also improved understanding of remote satellite sensing of rainfall by investigating the effects of various cloud types and rainfall patterns on the radiant energy signal received by the satellite. And **K GEORGAKAKOS** (Iowa Institute of Hydraulic Research, U of I) attempted to better understand the regional variability of links between soil moisture and climate (specifically air temperature and pressure), over time, through investigating 30 years of data on these traits collected in the Des Moines River watershed.

What might be the ***direct human response to climatic change?*** **G BUETTNER** (General Medicine, U of I) is using sophisticated technologies (electronic paramagnetic resonance) to detect and identify free radicals and catalytic iron in the skin, substances that hypothetically are induced by the sun's ultraviolet radiation and cause skin cancer—one health concern related to ozone depletion. **E PLUTZER** (Political Science, ISU) has applied a cultural theory of risk perception and political division to citizen groups in the European Economic Community, thereby theoretically developing techniques for mediating environmental disputes. And **J CURRY-ROPER** (Geography, Central College) is studying the community-wide world views of nine rural Iowa social groups, in order to better understand the range of possible human responses to environmental change.

A few grants address the ***responses of non-human species to changing environments.*** **S HENDRIX, R CRUDEN,** and **L RIGNEY** (Biology, U of I) are examining how the reduction of native plant populations—the prairie phlox in particular—to isolated remnants impacts genetic diversity, fitness, and the ability to withstand further environmental stresses such as changing climate. And **G MALANSON** and **M ARMSTRONG** (Geography, U of I) have improved the precision of computer simulation models for predicting the response of important tree species of eastern North America's fragmented forests to changes in climate—an important potential result of global warming.

The ***response of agricultural species and practices*** has not been overlooked. **S TIM, R KANWAR** (Agricultural and Biosystems Engineering, ISU) and **R JOLLY** (Economics, ISU) are considering the ramifications of climatic change on crop production, farm profits, and hydrology specifically in Iowa. And **D WARREN** (Center for Indigenous Knowledge, ISU) is documenting how farmers in India have already responded to rapidly changing environments (such as deforested hillsides and saline soils) through developing innovative alternative food production systems.

Examination of past climates and environments can help us understand present trends and future possibilities. **L GONZALEZ** and **M REAGAN** (Geology, U of I) determined that analysis of stalagmites can be used to determine shifts in climate (such as periods of high precipitation) over the past 10,000 years. **R BAKER** (Geology, U of I) and **D HORTON** (Biology, U of I) have studied both ecosystems and climates of the past 10,000 years, in particular searching the southern boundaries of the prairie province for fossiliferous deposits that would allow more detailed investigations. **W GREEN** (Office of the State Archaeologist, U of I) is considering whether studies of wood-charcoal remains from archaeological sites can elucidate prehistoric environmental changes in this same prairie province, such as prairie expansion, changes in forest composition, and the effects of anthropogenic fire. **J ENLOE** (Anthropology, U of I) is studying prehistoric human remains farther from home, in northern Europe, where he is searching ancient campsites for signs of prehistoric hunters' behaviors that allowed occupation of new lands during times of gross environmental change.

CGRER also promotes ***training in the broad interdisciplinary aspects of global change.*** Along these lines, **B WESTON** (Law, U of I) has interpreted and clarified the 1992 multilateral Convention on Biological Diversity. His project will help establish an ongoing Law, Science, and Global Environmental Policy Project within the University of Iowa's law and engineering colleges. •

The University of Iowa's Center for Global and Regional Environmental Research (CGRER) promotes interdisciplinary efforts that focus on the multiple aspects of global environmental change, including its regional effects on natural ecosystems, environments, and resources, and on human health, culture, and social systems. Center membership is composed of interested faculty members at any of Iowa's colleges and universities.

Center goals are promoted by encouraging interdisciplinary research and dialogue among individuals whose disciplines touch upon any of the multifaceted aspects of global change. More specifically, the Center awards seed grants, fosters interdisciplinary courses, provides state-of-the-art research facilities and equipment, and holds seminars and symposia. The Center encourages students to broaden their studies and research through considering the multi-disciplinary aspects of global and regional environmental problems. Through such activities, the Center attempts to assist Iowa's agencies, industries, and citizens as they prepare for accelerated environmental change that may accompany modern technologies.

Housed in the Iowa Advanced Technology Laboratory at the University of Iowa, the Center was established by the State Board of Regents in 1990 and received funding through the year 2001 from a public utility trust fund, as mandated by the State of Iowa's Energy Efficiency Act.

IOWATCH is published biannually. Comments, questions, and requests for additional copies should be directed to:

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