I O W A WATCH

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

FALL 1998

This issue of *IoWatch* focuses on carbon—an element that is both critical to life and, in overabundance, can threaten life. CGRER's efforts and researchers are devoting considerable attention to keeping carbon-based compounds in balance and in their proper place.

Rebalancing the Carbon Cycle

Carbon. From the time when the first living organisms coalesced in a sea permeated with long-chained molecules, this element has been essential to life on earth. Like water and oxygen, we cannot live without it.

Carbon's importance arises from its crucial provision of both structure and energy to living creatures. Carbon's very long chains and rings are the backbones of most organic molecules. Break living bodies of any sort into organs, break the organs into cells, and the cells into molecules, look inside, and you will find a string of carbon atoms. If you could somehow pull all of these carbon strings out of the organism, little would remain of either the organism's form or function.

But carbon also flows through organisms and, when doing so, provides the energy that allows them to laugh, play, migrate, reproduce — to perform virtually any function that we associate with being alive. This energy comes stored in the molecular bonds that hold the carbon chains together. Think about it. If you need an energy boost, you grab a *carbo*-hydrate—a food with quickly digested and readily available carbon compounds.

Given the importance of long-chained carbon compounds, it was crucial that living creatures developed mechanisms for producing these complex molecules and assuring that they could be readily transferred from one organism to another. Hence the significance of the carbon cycle, which is diagrammed in a simplified form in Figure 1. Through this cycle, carbon (in the form of carbon dioxide, or CO_2) is pulled from the atmosphere by green plants, which engage the sun's energy to form the long carbon chains (a process called photosynthesis). The carbon chains, and the energy they contain, are then handed from one creature to another as a series of meals — from corn to pig to human, from grass to rabbit to decomposing fungi. Eventually, the molecules release their energy and break back down to emit CO_2 (a process called respiration).

The CO_2 released into the atmosphere plays another crucial role. CO_2, with other greenhouse gases, provides an insulating blanket that holds in the sun's warmth and heats the earth's surface to a temperature that is hospitable to life — about 60°F warmer than it would be otherwise.

The problem . . .

The carbon cycle has remained roughly in balance through the eons, with carbon playing its multiple roles in a healthy and sustainable manner. But beginning about 200 years ago, the Industrial Revolution instigated a major shift in the amount of carbon stored in various forms. Society's conversion from an agrarian to industrial state, along with its transfer of work from muscle power to machines, required cheap and abundant power sources. Complex carbon-based molecules — stored as fossil fuels — came to the rescue.

Ever since, oil, coal, and natural gas have powered the production and transport of goods around the globe, fueling virtually every structure and activity that we associate with modern life. Unfortunately, the obvious benefits of these fuels come coupled with unavoidable problems. One of these problems derives from the source of fossil fuels, which were formed from plant remains buried millions of years ago. These fossil fuels are, in essence, buried treasures of energy-storing carbon chains. Burning the fuels releases not only energy, but also the CO_2 that had long ago been sequestered in these buried plants.

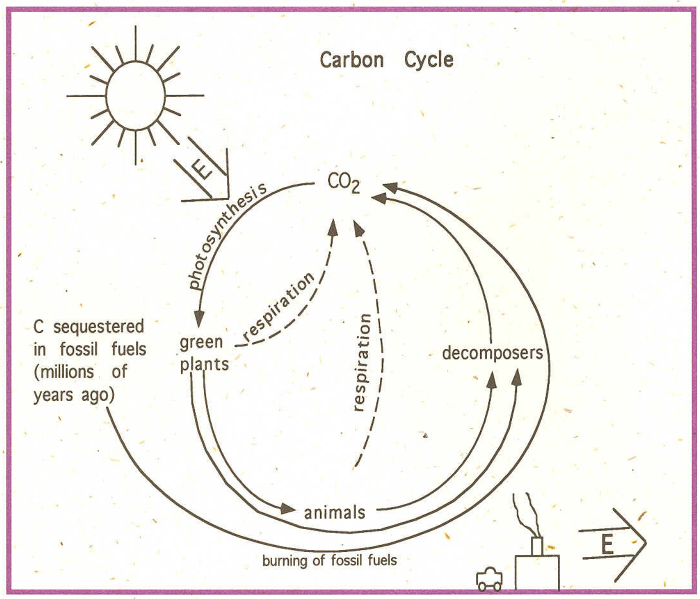

Figure 1. Carbon, for eons, has cycled repeatedly from the atmosphere through photosynthesis into living organisms, and then (through respiration and decomposition) back into the atmosphere. Through this cycle, the sun's energy is trapped and made available to living organisms. The carbon cycle was roughly balanced until about 200 years ago, when the massive burning of coal, oil, and natural gas started to release large quantities of carbon held in these fossil fuels into the atmosphere. Several of CGRER's research efforts have focused on mechanisms for reestablishing balance and sustainability to this cycle.

The results of our fossil fuel consumption have been significant. Researchers analyzing the content of tiny air bubbles trapped within Antarctic ice cores have discovered that during the last 160,000 years, atmospheric CO_2 has waxed and waned, in general being lower during cold periods and higher during warm periods (see Figure 2.). However, because of the massive release of CO_2 from fossil fuels, the rate of CO_2 evolution has never been as high as it is today. In addition, the total amount of atmospheric CO_2 has not approached current levels during the past 160,000 years. In the last 200 years, atmospheric CO_2 has risen from 280 ppm to 360 ppm, with today's growth curve skyrocketing upward. The United States releases about a quarter of the total annual CO_2 generated, thus becoming by far the earth's major CO_2 producer.

These skyrocketing CO_2 levels have become a major concern because of their potential link to warming global temperatures. The earth's temperature has risen 1°F in the last 100 years. Climate models predict that a continued rise in greenhouse gases will warm the average earth temperature another 2 to 6.5°F in the coming 100 years, with the most probable estimate being 3.5°F. The warming would not be uniform; some areas would be hotter, some perhaps even cooler. Such a temperature rise would result in the flooding of coastal areas and islands, worsen droughts and rainstorms, and shift climatic and agricultural zones northward, in addition to causing other significant problems.

The world's response . . .

What can be done about so massive a problem, a problem that strains the limits of our scientific understanding as well as our political and economic flexibility? How can one transform the energy base of the earth's societies, steering them away from CO_2-producing fossil fuels? And how could anyone even conceive of sifting invisible, diffuse CO_2 from the earth's atmosphere? Put another way, how can the carbon cycle be returned to a balanced state that equates with long-term sustainability?

As overwhelming as these questions may seem, they have formed the crux of recent international climate-change discussions. The United Nations Framework Convention on Climate Change grew out of the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, in 1992. In all, 174 nations have ratified the Climate Change Convention and thus have agreed to voluntary limits to their greenhouse gas emissions.

Last December, at a follow-up meeting held in Japan, the signatory nations agreed to the Kyoto Protocol, which stipulates specific

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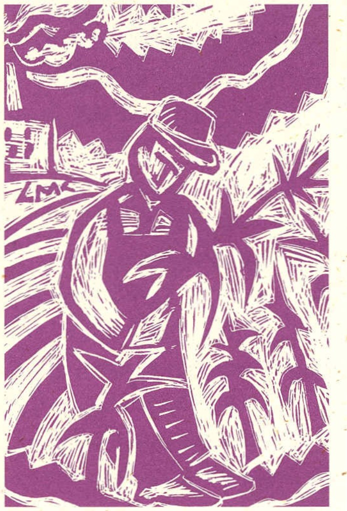
Further Deciphering the Carbon Cycle . . .

The complexities of carbon cycling are far from understood. We need more basic information on where carbon is stored, how it is released from organic tissues, and what roles it plays in ecosystems. Such information will feed into attempts to control the negative features of this greenhouse gas. Several CGRER members are working to refine our knowledge of the flow of carbon in its various forms. Four examples follow.



Steve Heard (UI, Biology) has been studying the breakdown of dead leaves and other organic material within streams, a process that terminates in the release of CO_2. How much of this breakdown is due to the "shredders" and "collectors," invertebrates that break leaves into small, and then smaller still, particles? While these two types of invertebrates (along with microorganisms) are usually given credit for decomposing the majority of stream debris, Steve has shown that mechanical abrasion such as grinding by stones is also an important contributor to the breakdown process.

George Malanson (UI, Geography) has examined the cycling of carbon at alpine treeline and determined that the amount of carbon taken up by plants does not determine the location of treeline; instead, its specific location on any mountainside seems to be related to factors such as seedling establishment. In another project, he has determined that plants growing along a river's edge take up more CO_2 through photosynthesis, and also supply more carbon to the adjacent river, than do plants in the interior of floodplain forests. These streamside forests thus serve as an important suppliers of carbon to river invertebrates. Lastly, George has assisted with ecological considerations and total environmental impacts of the use of biomass (such as poplar trees, or switchgrass as described earlier) as a fuel source in Iowa.

Jim Raich (ISU, Botany) has performed evaluations of carbon accumulation and cycling in fields of corn and soybeans, in comparison with adjacent streamside buffer strips composed of differing mixtures of trees, warm-season grasses, and cool-season grasses. He found that fine root density and biomass, rooting depth, soil respiration rates, and thus organic material cycling and carbon sequestration were greater in the plantings of trees and grasses than in croplands of corn or soybeans.

Taking carbon considerations into another realm, **Dave Forkenbrock** (UI, Public Policy Center) recently published a monograph comparing the societal costs of transporting freight by truck with costs of rail transport. Comparing the CO_2 emissions of trucks with those of three types of freight trains, he calculated that emissions of trucks were about 7 to 9 times greater than those of trains for each ton-mile of freight transported. Were the costs to society of CO_2 and various air pollutants from truck transport included in the user charges, the road use tax paid by truckers would triple.

limits to greenhouse gas emissions from developed nations. This Protocol is significant as the very first agreement among the world's nations to binding (rather than voluntary) limitations on their greenhouse gas emissions.

Agreeing to such limitations is one thing. Implementing the limitations is quite another, and here comes the rub. The Kyoto Protocol addresses *net* greenhouse gas emissions: it allows nations to remain within their CO_2 limits either through decreasing emissions or through sequestering carbon — pulling carbon from the atmosphere and storing it in terrestrial ecosystems. However terrestrial ecosystems are active biological systems with complex cycles that are not easily deciphered. The soil, for example, holds about twice as much carbon as above-ground organisms, and the oceans of the world store many times more carbon. How can the sequestering and release of carbon from its multiple sinks be accurately monitored and pinned to political boundaries? The world's nations will be meeting regularly for the indefinite future to discuss this difficult bookkeeping task, with the first such meeting scheduled for November 1998 in Buenos Aires, Argentina.

CGRER's involvement . . .

Scientific research today is perhaps most beneficial when directed toward topics where the need is great, the science is inexact, and questions far outnumber answers. Understanding the intricacies of the flow of carbon is one such topic. CGRER's researchers have for years been involved in projects directed toward better comprehending the carbon cycle and returning it to a balanced, sustainable state. Current projects are described below.

Sequestering carbon . . .

One CGRER project deals with increasing the size of the "Photosynthesis" arrow in Figure 1. Newly planted buffer strips along roads and streams, and native tree plots, can be used to pull CO_2 from the atmosphere and sequester the carbon within the soil and living tissues of plants. But exactly how much carbon could such plantings sequester?

To answer this question, CGRER has been conducting the Iowa Carbon Storage GIS Mapping Project. This project, which grew out of CGRER's 1996 preparation of the Iowa Greenhouse Gas Action Plan, will produce Iowa's first comprehensive quantification of carbon storage from various forms of land use. The data collected will provide baseline information for measuring future carbon-storage gains and losses, and also will permit reliable estimates of potential carbon sequestration from plantings made in the future. Data will be presented through maps such as that shown in Figure 3. — one of the first project outcomes.

This form of carbon sequestering admittedly is a short-term solution to the problem. Any carbon tied up in rapidly growing plants will, when the plants die and decay, be returned to the atmosphere. However, young rapidly-growing forests pulling carbon from the atmosphere constitute a powerful mechanism for tying up carbon for a few decades, while we search for longer term solutions such as alternatives to fossil fuels. Also, to the extent that trees can be harvested and used as feedstocks and as biofuels to replace fossil fuel combustion, there is a net benefit to the carbon balance.

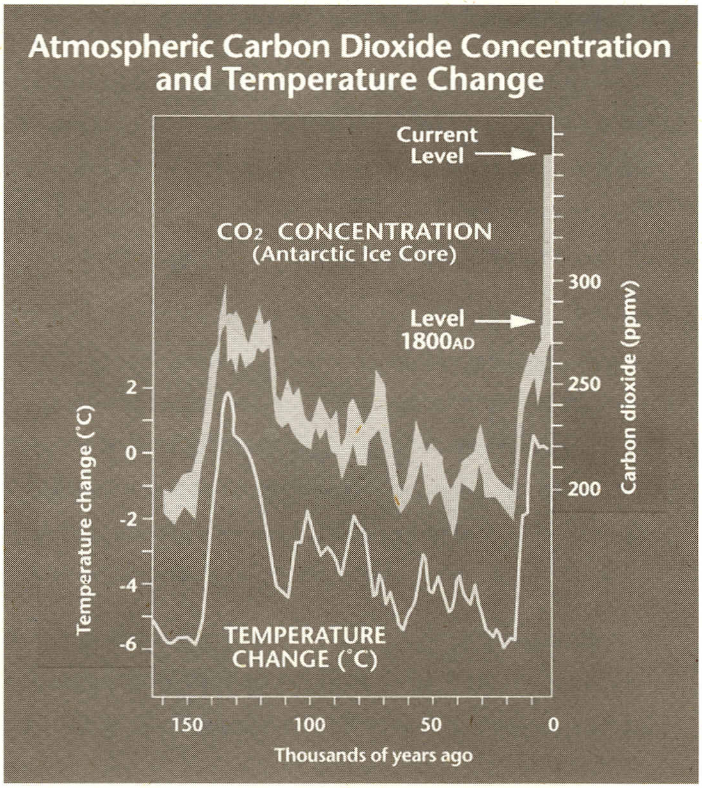


Figure 2. Data from tiny air bubbles trapped in an Antarctic ice core show that atmospheric CO_2 concentrations and temperatures from 160,000 years ago to pre-industrial times are closely correlated. CO_2 concentrations in the last 100 years have shot skyward and show no sign of slowing; the temperature during this period has raised 1°F. At present, CO_2 concentrations are increasing 0.5% per year, or 1.5 ppm, reflecting an average of 3.4 gigatons (Gt) of net CO_2 accumulation in the atmosphere each year. The majority is a product of the approximately 6 Gt released annually from fossil fuels and industrial activity, although some of this (1.6 Gt) reflects continued destruction of the globe's forests.
(graph source: Climate Change, State of Knowledge. 10/97. Executive Office of the President, Office of Science and Technology Policy, Washington D.C.)

Analyzing Deregulation . . .

The second CGRER project is concerned with decreasing the size of the "Burning of Fossil Fuels" arrow in Figure 1. — that is, decreasing the release of CO_2 through fossil fuel combustion. CGRER, through a grant administered by the Iowa Utilities Board, is analyzing the change in greenhouse gas emissions (including CO_2) that would accompany a deregulation of the electric power industry. First, the emissions of every power plant in Iowa had to be calculated — an analysis that revealed that Iowa utilities as a whole emitted over 27 million tons of CO_2 in 1996. Now CGRER is predicting the effects that deregulating the energy industry will have on greenhouse gas emissions, according to Iowa Utilities Board market estimates. In a deregulated market, customers will be able to choose their power company. Thus, because power is relatively inexpensive in Iowa, deregulation will increase the demand for Iowa's power. Preliminary results indicate that deregulation of the electric utilities market will provide Iowa utilities with an incentive to increase production. Because Iowa's utilities will use relatively efficient large coal-fired units (rather than smaller, less efficient units) to meet this demand, efficiency (as measured by the pounds of CO_2 emitted per million BTUs generated) will improve. Nevertheless, total emissions of CO_2 in Iowa are expected to increase because of the increased power being produced.

Growing Green Power . . .

A third CGRER project, the Biomass Power for Rural Development Program, is attempting to create an entire new loop for the production of energy, a closed loop that provides for the trapping as well as release of CO_2. This trial program, funded primarily by the U.S. Department of Energy, proposes to tie up CO_2 in "biofuels," fast-growing plants that can be used as fuel sources. Since any CO_2 released by the combustion of these plants would have been drawn from the atmosphere quite recently, the resulting energy would be produced without any net CO_2 emissions. Actually, biofuels do better than breaking even on CO_2 emissions. Because of the relatively small amount of energy needed to process biofuels, and the ability of their roots to store carbon in the soil, the use of biofuels leads to a

IOWA: Carbon in the first layer of soil

Figure 3. CGRER is helping to develop a workable mechanism for pulling carbon from the atmosphere and storing it within living plant tissues and the soil. The first step is to determine how much carbon is already stored in Iowa. The CGRER project will generate GIS maps such as this one, which shows that the amount of carbon presently stored in Iowa's soil varies from nearly none, up to over 100 tons per acre in the rich flatlands of the Des Moines Lobe.

net *reduction* of atmospheric CO_2 relative to fossil fuel combustion. Chariton Valley Resource Conservation and Development, Inc. plans to establish switchgrass on 40,000 acres of marginal, Conservation Reserve Program-enrolled cropland as an energy crop. This switchgrass is slated to be burned with coal in an existing power plant, with the expectation of its generating 35MW of power. CGRER's role will be to develop the estimates of net emissions of CO_2 (as well as other gases) from the switchgrass growth, harvest, and combustion, and to compare these data to emissions data relating to coal mining, processing, and combustion.

Benefits to Iowans . . .

All three of these projects will help Iowans improve the health of their environment, and also will involve Iowans in actions that address the risks of global warming to future generations.

CGRER's projects also pose economic advantages for Iowans. The Biomass Power Program, if successful, may transform switchgrass and other grasses into cash energy crops that could generate about $200 per acre annually. In the existing project alone, up to 500 local farmers will have a chance to sell this new cash crop to the cooperating power plant.

In addition, in the future, Iowa's economy on multiple fronts may be boosted by the creation of *emission credits* for CO_2. As governmental bodies and industries work through the details of implementing the Kyoto Protocol, energy-producing nations and industries with higher-than-expected releases of CO_2 may be required to purchase credits — permissions to release CO_2 — from producers (or nations) with lower-than-expected release rates. Such emission credits are already sold on the open market for SO_2, and are now being established for NO_x. Many consider it only a matter of time before CO_2 credits enter the marketplace. Thus energy efficiency itself will become an economic commodity, with efficient power plants gaining the profits.

Credits in the future also may be purchased from individuals involved in large-scale CO_2 sequestering efforts. Iowa farmers would be likely to gain here, through entering set-aside programs focused on a new crop: tree plantings or permanent grasslands that pull in and sequester atmospheric carbon. Thus, the import and storage of carbon may, in the future, join the export of grains as one of Iowa's chief agricultural commodities. Tying economic incentives to the production of pollutants is an important first step toward internalizing the total environmental cost of various forms of consumption.

Expansion into Policy and International Affairs . . .

If efforts to rebalance the carbon cycle are to be meaningful, they must be integrated into governmental policy and applied around the globe. Greg Carmichael (UI Dept. of Chemical and Biochemical Engineering and co-director of CGRER) has been working toward that end. His research focuses on developing and applying computer models that address the long-range transport and fate of air pollutants and trace gases such as CO_2. For the past several years, he has concentrated on the magnification of such pollutants by economic development in Asia.

Because of Asia's size, vibrant economies, and large population growth, CO_2 and pollutants from energy consumption are high. Total energy-related carbon emissions in East Asia, for example, have been growing by 4.5% a year compared to a world average of 0.6% a year. These emissions are expected to continue to soar. Because of their magnitude and consequent effects outside the region of origin, Asia's CO_2 and air pollutants have become an issue of worldwide political consideration.

One recent expression of the concern over this "globalization of pollution" was Carmichael's invitation to be one of two speakers at a seminar hosted by the federal government's U.S. Global Change Program. He spoke on Capitol Hill in June to about a hundred legislators, embassy officials, congressional staffers, administrators of environmental groups, and other such policy makers. His talk, "Development of Asian Megacities: Environmental, Economic, Social, and Health Implications," educated about a hundred Washington decision makers and, by doing so, will feed his insights into the framing of future discussions and policies. Talks such as this raise the consciousness of policy makers to the need for regional and international cooperation in guiding the rapid development of a continent whose environmental health and future will generate worldwide repercussions.

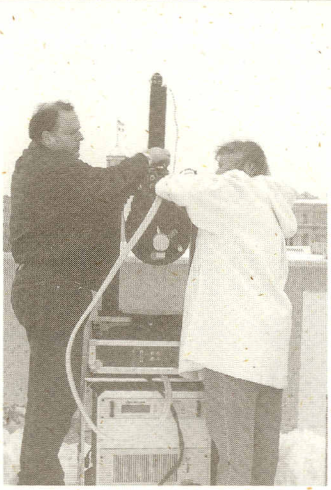
A Sustainable Carbon Cycle . . .

All complex carbon compounds are tiny storage vaults for the sun's energy. We know now that those vaults can be opened to fuel a forest or our own bodies, our cars, our hospitals, and our factories. The trick is not how to do so — it's how to do so in a sustainable manner. It's how to maintain the cycles so that carbon can continue to provide *balanced* services — as a global temperature regulator as well as an energy source and structural building block for life on earth. CGRER's research is directed toward further deciphering and better tending the intricacies of the carbon cycle so that the earth's thin film of carbon-dependent life can continue to flourish.

Faculty Focus

CGRER has welcomed five new members to its ranks in the last year. Here's an introduction to them and to their work.

Bill Eichinger, a former research scientist at Los Alamos National Laboratory, came to the Iowa Institute of Hydraulic Research and the UI's Department of Civil and Environmental Engineering in January, 1997. Eichinger, a hydrometeorologist and experimentalist, studies atmospheric transport and surface-atmosphere processes of diverse atmospheric variables, such as evaporating moisture, rainfall, air pollutants, and even the wind. His extremely precise measurements are taken using laser-based instruments, including laser-radar instruments known as lidar. These measurements allow him to characterize the earth's surface and its impact on the atmosphere, the partitioning of solar energy into latent and sensible heat, and the emission rates of a variety of substances into the atmosphere — all of which affect the weather. Bill's goal is to improve theoretical understanding of earth-atmosphere interactions on a micro-scale, thus providing a detailed but crucial component of the large-scale weather and global change story. His membership in CGRER, he states, allows him to relate his efforts to those of multiple disciplines investigating global atmospheric changes over extended time periods. By dialoging with others concerned broadly with global climate change, and by discussing with them what we don't know and what we need to know, he ensures that his work remains in context and relevant.

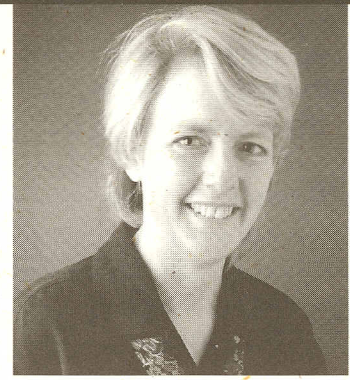


Bill Eichinger and his wife set up his lidar equipment.

Tom Hasenberg grows a semiconductor laser with the molecular beam epitaxy machine.

Tom Hasenberg, previously a research project manager at Hughes Research Laboratory in Malibu, CA, who works with semiconductor materials and devices, joined the UI's Department of Physics and Astronomy in May of 1997. Tom came to CGRER to connect with other researchers who might need to use the products of his research: the mid-wave infrared lasers he and his colleagues develop that can detect, for example, minute amounts of atmospheric pollutants. Tom describes himself as a practical-minded person who is driven by applications. He is most positive about the potential uses of his sophisticated lasers in environmental monitoring devices and medical diagnostics. CGRER allows him opportunities to discuss the former with researchers such as Bill Eichinger. "The more we realize the effects we have had on the natural environment, the more we will need to do to address those effects," states Tom, "and monitoring environmental changes with our lasers and other such devices is the first step in the process."

Keri Hornbuckle taught at the State University of New York at Buffalo before transferring her allegiance to the UI's Department of Civil and Environmental Engineering in the fall of 1998. She states that she is delighted to be here, not only because she is a native Iowan and loves the state, but also because of the excellent facilities she has for her research into the fate and transfer of atmospheric organic pollutants. Keri's efforts focus on persistent agricultural and industrial compounds such as PCBs, DDT, atrazine, and hexachlorobenzene, that are likely to circulate through the atmosphere for some time following their release. She monitors and analyzes the transfer of such compounds between various interfaces, for example from the atmosphere to lakes, soil, or vegetation. Keri was interested in joining CGRER in part because climate (and thus climate change) influences the circulation and transfer of organic pollutants in a major way. In addition, her research efforts — field studies, performing analyses for trace pollutants, and modeling their transfer — provide data that support, or may be supported by, climate and atmospheric circulation models being used and developed by other CGRER researchers. Keri hopes that being a CGRER member will magnify the impact of her



Keri Hornbuckle

work by allowing communication and collaboration with other CGRER members interested in atmospheric processes, and that through collaboration her studies will have a greater influence on other scientists and on policy makers.

Hong Jiang came to the UI Department of Geography in the fall of 1997 from her graduate studies at Clark University in Worcester, MA. There, as here, she investigated Critical Zones: specific regions where environmental change may be critical to the health of the global environment. More specifically, she has been studying land degradation, soil erosion, and sandification in the Ordos Plateau, Inner Mongolia, China. She asks how these environmental changes are linked to their human dimensions, especially social and cultural change: how the changing environment both affects human life and is affected by human factors.

Hong Jiang (far right) and her research team take a watermelon break on the Ordos Plaateau (inner Mongolia) in July of this year.

She also examines the links between regional land use/ cover change and global change. Although her research involves field work, important tools of her trade include remote sensing, computer modeling, and GIS. Hong also teaches classes on GIS and remote sensing, as well as on the human dimensions of global change. She hopes that her connection to CGRER will provide a vehicle for communicating with others who are teaching about global change and performing related research, and that it may involve her in collaborative interdisciplinary environment-related research with other CGRER members.

Dave McGinnis was a Research Scientist at the University of Colorado's Cooperative Institute for Research and Environmental Sciences (CIRES) before he came to the UI's Geography Department in the fall of 1997. He is concerned with how well global and regional climate models simulate water resources, especially in relation to high-elevation snowpack. Understanding the snowpack—water resource relationship is crucial to the management of the western dam and reservoir system. Dave is attempting to create trustworthy statistical models that translate across scales — that is, he wants to relate large-scale atmospheric variables accurately to small-scale surface variables. His efforts to move climate models from the global to the local level are crucial to deciphering global change because, as Dave says, "global change — and its impact on humans — occurs on a local level." Dave says that joining CGRER was the natural thing for him to do."The purpose in doing research is to bring new information, in an integrated sense, to our understanding of the changing relationship between humans and the earth. CGRER is a vehicle for that multidisciplinary integration," Dave claims.

Dave McGinnis

What's Up at CGRER?

Upcoming Symposium . . . Do existing institutions have the ability to protect the environment and respond to the challenges of climate change in order to build a sustainable world? How can Iowa protect both its environment and its economy? These are questions to be addressed in an upcoming program that CGRER is helping to plan, titled *Taking On the Challenge of Climate Change*. The four-part program, being sponsored by the Iowa Division, United Nations Association-USA, is intended to explore the risks, challenges, and solutions springing from climate change-based problems. Program objectives focus on educating the Iowa public and including Iowa and its residents in the global dialogue on climate change. The program is attempting to move away from polarized debate about climate change issues by including the concerns and ideas of all sectors of society, including individual residents as well as industrialists, educators, and other professionals, and by showcasing economic opportunities that are associated with energy efficiency.

The program will consist of three public educational meetings to be held in 1999 followed by a summary session, a Des Moines-based public hearing scheduled for November 6, 1999. CGRER is planning and hosting one of the three educational meetings — *Science and Climate Change* — which will be held on March 5, 1999, in Iowa City. Science and Climate Change is now being planned by **George Malanson** (UI, Geography Dept.). Sessions of the day-long symposium will cover paleoenvironmental information; models and monitoring; impacts of climate change on agriculture, water resources, and vegetation; and policy issues. Findings in each area will be interpreted for the general public. Other educational meetings, sponsored by other institutions, are *Model UN Summit on Climate Change for Iowa Youth* and *The Technology of Energy Alternatives*.

CGRER's attempts to rebalance the carbon cycle are not going unnoticed. In September 1998, CGRER was notified that it had received a 1998 Iowa Energy Leadership Award from the Iowa Department of Natural Resources. This award was made for CGRER's leadership, innovation, and resulting "outstanding contribution to the development of energy efficiency and renewable energy in Iowa." The November 4 award ceremony in Des Moines will include a slide presentation on CGRER's energy-related research.

Impact at Home and Abroad . . .

The effects of CGRER members' research and teaching continue to be felt close to home and in distant locations. In one interesting turn, for example, CGRER's most distant member **Konstantine Georgakakos** (Hydrologic Research Center and Scripps Institution of Oceanography) has recently published a paper that shows a savings of about $4.5 million in maximum daily flood damage if a full-forecast Global Climate Model were to be used by Saylorville Reservoir managers.

At the same time, **Gene Takle** (Geological and Atmospheric Sciences, ISU) is exporting his Global Change course to Latin America. The computerization of this class was reported in *IoWatch* three years ago. At that time, Gene was placing his classroom materials on the ozone hole, tropical deforestation, change-related population problems, and like topics onto the Internet so that students could discuss the issues electronically and perform interactive lab exercises. Gene's class materials have proven to be extremely attractive to Internet users around the globe: they have now been accessed by persons from over 100 nations, with accesses averaging over 2,000 per day and ranging up to 9,000 per day. (Take a look yourself — http://www.iitap.iastate.edu/gcp/gcp.html .)

Because of the apparent need and interest for such class materials, Gene was approached by the Inter-American Institute for Global Change Research to begin translation of the class into Spanish and Portuguese. This effort not only will offer (via computer) much-needed class materials to receptive teachers throughout the Americas; it also will allow Iowa's students to dialogue electronically with students in other countries, and will promote international dialogues about global change among students in many other countries, thus sensitizing them to the complex cultural issues associated with global change problems.

New Executive Committee Members . . .

CGRER welcomes the following newly-elected members to its Executive Committee for three-year terms: **Paul Greenough** (UI, History), **Steve Hendrix** (UI, Biological Sciences), and **Dave McGinnis** (UI, Geography). **Luis Gonzalez** was reelected for a second term. Many thanks to outgoing member **Diana Horton** for her years of Executive Committee service.

Georgakakos, KP, et al; August 1998; Assessment of Benefits of Climate Forecasts for Reservoir Management in the GCIP Region, *GEWEX News* 8(3), 5-7

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Jerald L. Schnoor

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Luis Gonzalez, Geology
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Animal Ecology
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