

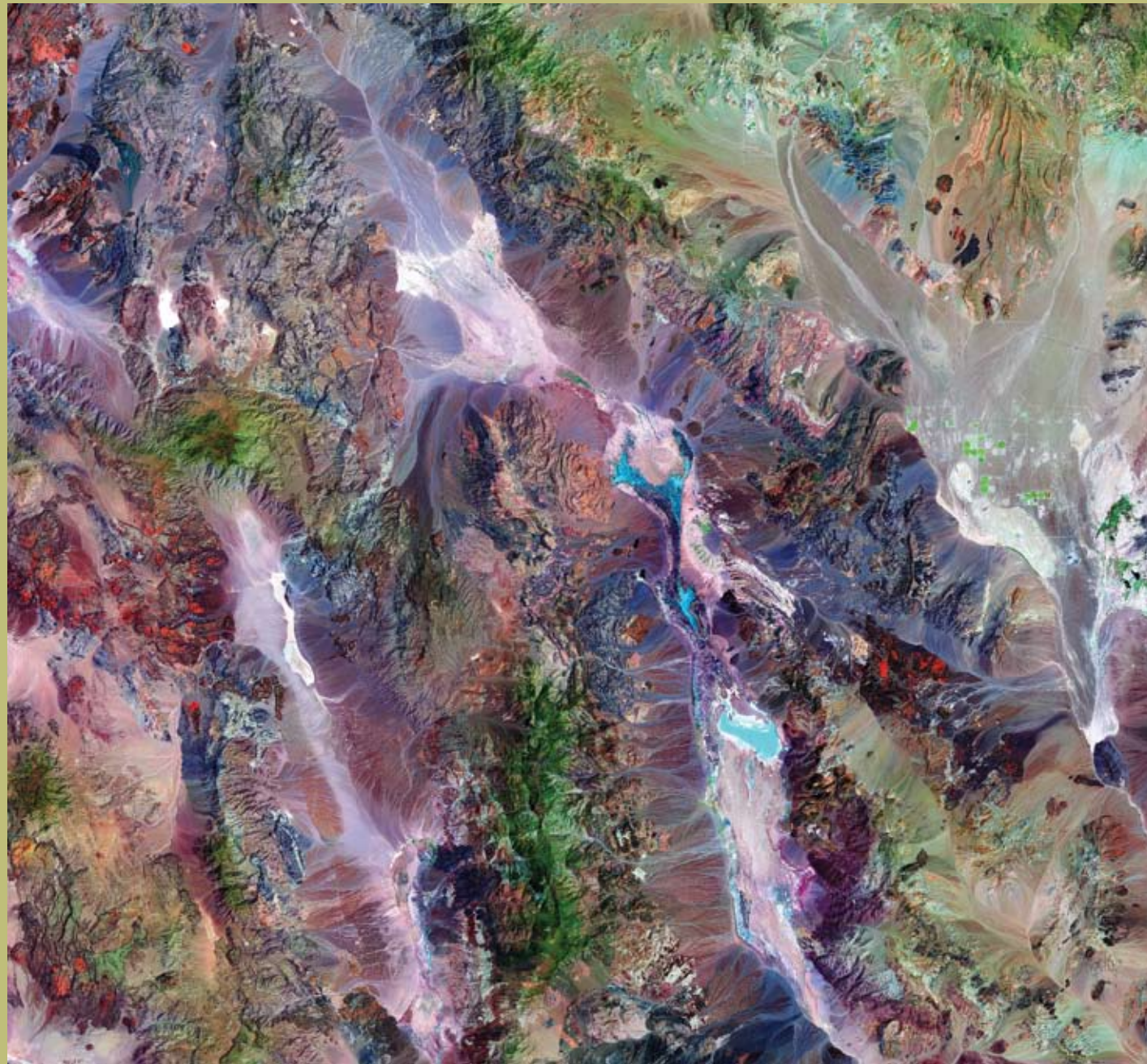


CGRER

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH



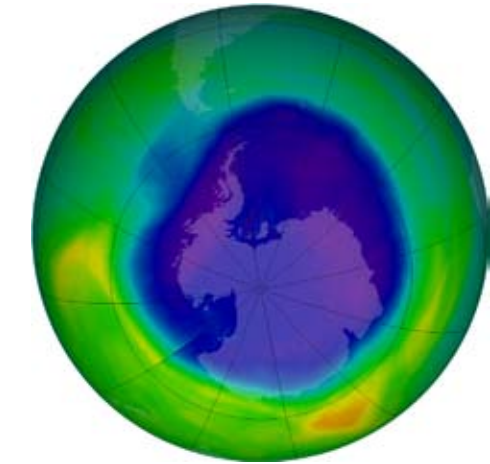
2007 ANNUAL REPORT



Death Valley National Park, June, 2000

Images courtesy NASA Earth Observatory
unless otherwise indicated.

Cover photos: top, Hurricane Felix taken from the
International Space Station, September, 2007;
bottom, Brandberg Massif in Namibia



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Glacial dust storm off coast of
Alaska, November, 2005

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 (IATL), CGRER is supported by revenues generated from public utilities, as mandated by the State of Iowa's Energy Efficiency Act. Funds are used to support research and provide services to faculty members and students across the state who are interested in environmental change. CGRER membership is composed of faculty

and professional staff from Iowa's colleges and universities. CGRER currently is composed of 73 members from 22 departments at seven 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.

*Taklimakan Desert dust storm
August, 2007*



Executive Summary

Last year, 2007, was a landmark year. It produced a near-record global average temperature, unprecedented fires in Greece and California, and record drought in Australia, the southeastern U.S., and Chile. We witnessed the release of the *4th Scientific Assessment from the Intergovernmental Panel on Climate Change* (IPCC), and the awarding of the Nobel Peace Prize jointly to the IPCC (for spreading that scientific message) and Al Gore (for his movie *An Inconvenient Truth*). I don't know if it was these events, or the United Nations meeting in Bali on climate change, or the alarming images of ice melting rapidly in the Arctic, but there's greater sentiment for action than ever before. Images of glaciers melting and polar bears floundering are incredibly powerful. Whatever the reason, it seems people are ready for action, and 2008 is an exciting time to be alive.

CGRER, too, had a banner year, if somewhat less calamitous. We are developing new research projects, our students are

winning awards and making a difference in the world, and our outreach is transferring the message at the local, regional, and global scales. We're excited about CGRER's new internship program,

through which a master's-level journalism student is funded to publish stories about significant CGRER research. Soheil Rezayazdi's articles can be found on our webpage. The internship was originally proposed by our Advisory Board.

In 2007, CGRER faculty and students participated in large field experiments that focused on the sensing and modeling of atmospheric chemistry that comprises air pollution. CGRER members also helped with the conceptual design of the WATERS Network, which will allow monitoring and predictions of the changing quantity and quality of our nation's waters during hydrologic events like floods and droughts, and in response to drivers like climate and land-use change.

Biofuels and energy independence were much in the news in 2007. Co-director Schnoor led a group of six scientists to produce a timely report for the National Research Council, *Water Implications of Biofuels Production in the United States*, which points the way to a more sustainable biofuels future. Technological

breakthroughs to lessen the environmental impacts (for example, to lessen water and agricultural chemical use) are much needed. Policy breakthroughs to encourage the rapid, cost-effective emergence of technologies like cellulose fermentation and thermochemical conversion of mixed biomass are also necessary, as is the wider use of farming practices that minimize pollution. Perennial crops like switchgrass, poplar/willow plantations, mixed prairie plantings, and even corn stover and yard clippings may be used in the future to produce cellulosic ethanol, with corn ethanol serving as a bridge to a more environmentally beneficial biofuels future.

Action is the watchword in Des Moines also. The state legislature and Governor Culver committed Iowa to a better environment and to energy independence in 2007. No fewer than three bills were enacted, bills that created the Office of Energy Independence, the Iowa Power Fund, and the Iowa Climate Change Advisory Council (ICCAC). CGRER has been active in advising on all three initiatives, and Schnoor has been fortunate to be named the chair of the ICCAC. In 2008, ICCAC will produce scenarios for how Iowa can reduce its greenhouse gas emissions by 50% or even 90% by 2050. It's clear that with

wise planning, the state can benefit both economically and environmentally as the world transitions from the fossil fuel age. Witness the rapid increase in wind turbine manufacturing in Iowa and the increase in our capacity to 1000 MW of wind power. Manufacturing jobs that have been lost overseas from Iowa towns are being replaced by companies manufacturing wind turbines, blades, and towers in Cedar Rapids, Fort Madison, West Branch, Newton, and Keokuk. It's the biggest and best environmental news story of the year, and it's a model for Iowa's future.

Iowa is already a leader in biofuels and wind energy. We can be justly proud of these accomplishments, but we must continuously improve our technologies and the educational base that produces them if we are to be sustainable and competitive tomorrow. Let's become the national leader in energy efficiency, sustainable agricultural production, and environmental quality, as well as biofuels and wind energy. That's the future where children can grow and prosper in this great state.

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

CGRER Executive Committee

David Bennett
Geography, UI

Jonathan Carlson
College of Law, UI

Dennis Dahms
Physical Geography, UNI

Jeff Dorale
Geoscience, UI

Vicki Grassian
Chemistry, UI

Paul Greenough
History and Behavior Science, UI

Steve Hendrix
Biological Sciences, UI

Diana Horton
Biological Sciences, UI

Sarah Larsen
Chemistry, UI

Lou Licht
Ecolo-Tree Inc.

Michelle Scherer
Civil & Environmental
Engineering, UI

Peter Thorne
Occupational &
Environmental Health, UI

You-Kuan Zhang
Geoscience, UI

*Subtropical Storm Andrea,
May, 2007
(NASA Goddard Space Flight Center)*



Message from the Advisory Board

When I worked in the Iowa Department of Natural Resources in the 1990s, the American Geophysical Union's (AGU) pronouncement on global warming was pretty wimpy. The 40,000-member organization could only manage this consensus statement at its January 1999 meeting: "*AGU believes that the present level of scientific uncertainty does not justify inaction in the mitigation of human-induced climate change...*" With that statement as ammunition, it was hard for me to convince the "fish hooks and bullets guys" in the Natural Resources department that our cold-water trout streams might be in jeopardy, and that we should consider planting trees along stream banks to cool the waters.

Five years later, the AGU was sure of the science. It then declared: "*It is virtually certain that increasing atmospheric concentrations of carbon dioxide and other greenhouse gases will cause global surface temperatures to be warmer.*" The organization also realized

the importance of the confirmation of the science, and released its statement at the National Press Club in December 2003.

Public policy has matured dramatically, just as science has, and this maturation has not all been about Al Gore. A number of governors, including Republicans in Minnesota, Florida, and California, have recognized the grave problems we face. They have adopted policies to encourage energy efficiency, and renewable electricity production to reduce their state's carbon footprint. The U.S. Supreme Court dealt a blow to the present administration's pleas for voluntary carbon-limiting measures by forcing the U.S. EPA to regulate carbon dioxide emissions. Recently Australian voters threw out leaders who had sided with the present U.S. administration on global warming policy. The new Australian government endorsed the Kyoto protocol at the recent U.N. climate meetings in Bali.

CGRER is in a wonderful position to contribute to the policy debate and to help find solutions to climate change. On the regional policy level, co-director Jerry Schnoor chairs the new Iowa Climate Change Advisory Council, which will help guide the state toward policies that are climate-change friendly. On the national and international levels, Schnoor chaired a new National Research Council panel that studied water and renewable energy, and helped review two of the reports that were released in 2007 by the Intergovernmental Panel on Climate Change.

Good policy arises from good science, and many CGRER researchers are involved in producing global

and regional research on energy and environmental issues. Co-director Greg Carmichael has been doing a NASA project on the movement of air pollutants around the globe; he will be involved in experiments in the Arctic this coming spring. Several researchers have been involved in the WATERS National Environmental Observatory project featured in last fall's *IoWatch* newsletter. Charlie Stanier and others have been devising new technologies to measure air pollutants at their source.

Part of science is training students to continue the work of the center. In 2007 Marcelo Mena, a CGRER graduate research assistant who had just received his

doctorate, became the Director of the School of Environmental Engineering at the Universidad Andres Bello in Santiago, Chile. Another new graduate Elliott Campbell, now at Stanford, has an article under review for publication in *Science*. Other students have been drawn into policy issues through CGRER's involvement in shaping the UI's campus energy policies, and into outreach activities such as the UI's annual Energy-Expo. CGRER is indeed making its mark.

David Osterberg

Grey Glacier,
Torres del Paine National Park,
Chile, June, 2007

CGRER Advisory Board Members

We welcome Mark Kresowik, Chip Levy, and Bill Stigliani, all of whom joined CGRER's Advisory Board in 2007.

Steven Guyer (chair)
MidAmerican Energy Holdings
Company

Robert Dvorsky
Iowa Senate

Jim Klosterbuer
Alliant Energy

Mark Kresowik
Iowa Organizer,
Sierra Club's National Coal Campaign

Hiram "Chip" Levy III
NOAA,
Geophysical Fluid Dynamics
Laboratory

John Norris
Iowa Utilities Board

David Osterberg
UI, Occupational and
Environmental Health

William Stigliani
UNI, Center for Energy &
Environmental Education

Sharon Tahtinen
Iowa Department of Natural Resources

Dialogue

CGRER PROMOTES INTERDISCIPLINARY DIALOGUE
TO ADDRESS IOWA'S NEEDS

In 2007, the nation's focus on climate change sharpened considerably. Not only were scientists discussing its reality and consequences, those themes were also heard routinely from politicians and from the general public. Even the natural world seemed to proclaim its reactions, with the discovery that Arctic sea ice was melting far faster than numerical models had predicted.

CGRER's members continued to play a major role in shaping the climate-change discourse. For example, Jerry Schnoor was appointed as chair of Iowa's newly-formed Iowa Climate Change Advisory Council, commissioned by Governor Chet Culver. The 27-member group has been asked to report on Iowa's greenhouse gas emissions and devise proposals for cutting those emissions. On a larger geographical scale, CGRER members Raymond Arritt, Bill Gutowski, Jerry Schnoor, and Gene Takle have in past years worked with the International Panel on Climate Change (IPCC), the organization that in 2007 shared the Nobel Peace Prize with Al Gore.

In 2007, Schnoor also became chair of a National Research Council (NRC) committee examining the effects of biofuel production on surface and ground-water quality and quantity – a topic of increasing importance as biofuels rise in popularity. In 2007,

Dust storm over Canary Islands, March, 2007

the NRC committee held a colloquium and produced a report, *Water Implications of Biofuels Production in the United States*. The 58-page report concluded that proposed increases in biofuel production (especially from corn) are not sustainable in the long run because of the concomitant intensification of agricultural environmental problems (such as ground-water depletion, water pollution, and soil erosion). The report received a tremendous amount of press coverage, in over 150 papers ranging from the *Washington Post* to the *New Orleans Picayune*.

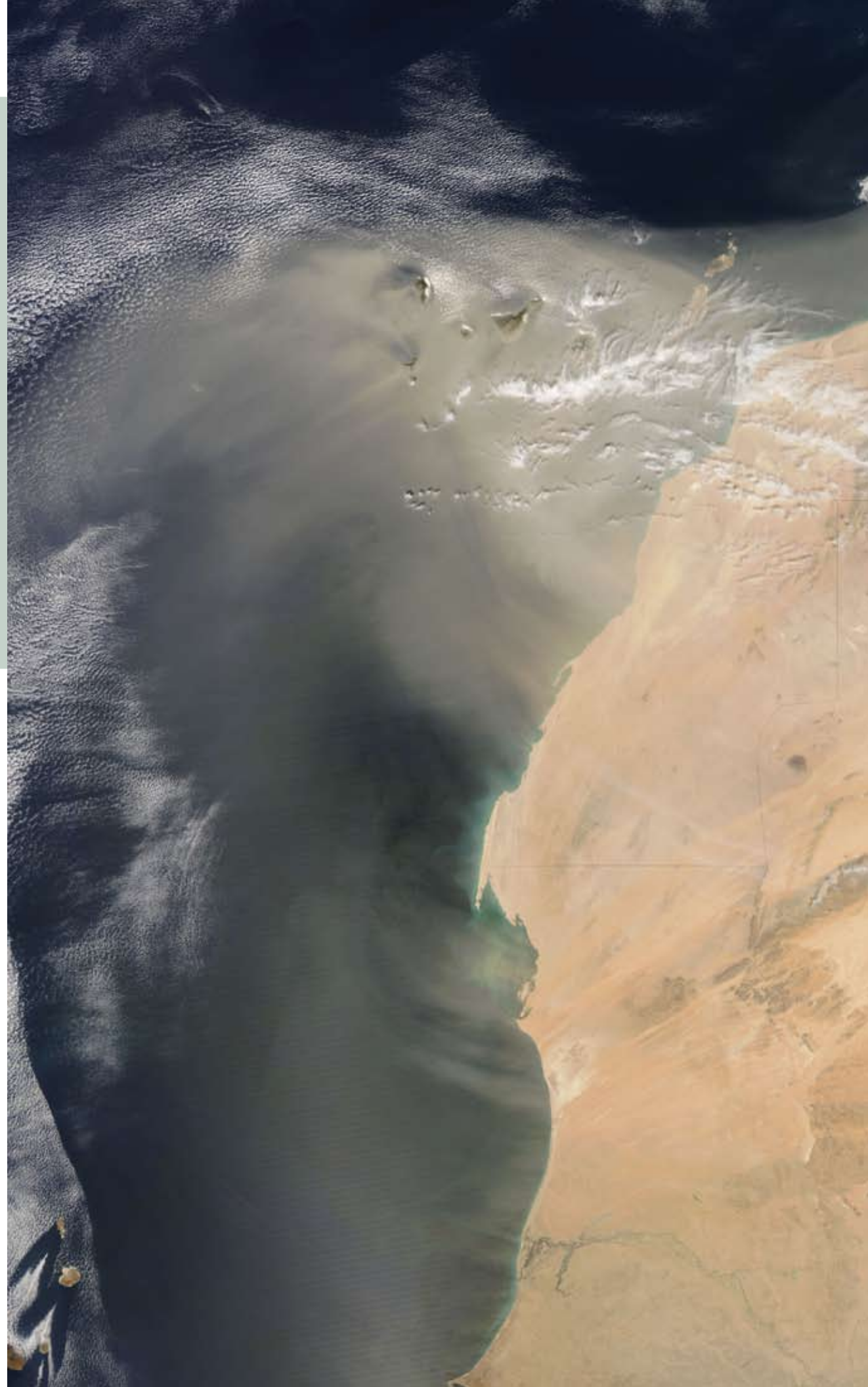
Schnoor and other CGRER members continued to be active forces for climate consciousness on and beyond the UI campus, for example by testifying before the House Environment Committee and speaking to the Iowa Association of Municipal Utilities.

CGRER's atmospheric pollution focus has fed multinational discourse on air pollution, weather, and climate change. Greg Carmichael, for example, was a lead author of the Interim Report, *Hemispheric Transport of Air Pollution 2007*.¹ The report was produced through HTAP (the United Nations Economic Commission for Europe Task Force on Hemispheric Transport of Pollution, which is charged with looking at hemispheric air pollution's effects on national attempts to meet air quality standards). Thereport stated that in

addition to the west-to-east transport of particulate pollutants from nation to nation, the entire northern hemisphere is witnessing rising background levels of ozone large enough to override national ozone-control attempts.

Carmichael also chairs the scientific advisory group for the World Meteorological Organization's GURME committee, which in 2007 launched a pilot project to develop a multi-hazard forecasting system that would become a part of Shanghai's push toward sustainability. And the large Atmospheric Brown Cloud research project (in which Carmichael is participating) completed its fifth year in 2007; its successes in interpreting regional climate and testing previous models were published in a special issue of the *Journal of Geophysical Research*. Lastly, a new National Research Council panel convened early in 2007, with the task of producing a report on *Developing Meso-Scale Meteorological Observations to Meet Multiple National Needs* in 2008. Three of the panel's twelve members – Greg Carmichael, Witold Krajewski, and Gene Takle – are CGRER members.

¹*Air Pollution Studies No. 16, United Nations Publication Sales No. E.08. II.E.5 ISSN 1014-4625 ISBN 978-92-1-116984-3, Geneva, 2007.*



CGRER's 2007 Seminar Series

Speaker
Affiliation
Title of Seminar

Richard Hooper
CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science), Washington, D.C.
Scientific and Operational Concepts for Environmental Observatories: Thoughts on NEON, WATERS, CUAHSI and CLEANER

Speaker
Affiliation
Title of Seminar

Stephanie Vay
NASA Langley, Chemistry & Dynamics Branch, Virginia
An Overview of Regional Scale Observations of Atmospheric CO₂ from NASA Research Aircraft

Speaker
Affiliation
Title of Seminar

Dennis Keeney
Institute for Agriculture and Trade Policy, Minneapolis
Ethanol's Power Politics: Potential Social and Environmental Outcomes

Speaker
Affiliation
Title of Seminar

Nikolaos Nikolaidis
Hydrogeochemical Engineering & Soil Remediation Lab, Technical University of Crete, Greece
Integrated Water Resources Management in Mediterranean Countries

Speaker
Affiliation
Title of Seminar

David Hernandez Palmar
Universidad Rafael Belloso Chacin, and Fundación Cinemateca Nacional, Maracaibo, Venezuela
Owners of the Water: Conflict and Collaboration over Rivers – Film Screening and Discussion

Speaker
Affiliation
Title of Seminar

Paul Shepson
Climate Change Research Center, Purdue University, West Lafayette, Indiana
Connections Between Atmospheric Nitrogen Deposition and Net Ecosystem Exchange of Carbon

Visiting Scientists

CGRER HOSTED THREE VISITORS IN 2007

Alessio D'Allura from Arianet Srl, an environmental consulting company in Milan, Italy, spent one year setting up a collaboration between Arianet and CGRER to continue the development of air quality simulation and analysis tools. While at CGRER, he also participated in the INTEX B field experiment.

Narisara Thongboonchoo, a professor at King Mongkut's Institute of Technology, Bangkok, visited for ten days in March, as part of a collaboration to study Southeast Asia's atmospheric brown clouds, more specifically the use of satellite data to improve estimates of black carbon emissions from biomass burning.

Ken Rahn, a retired professor from the University of Rhode Island who is collaborating on the identification of aerosol sources in Asia, visited CGRER from October 1-3.

Campbell, J.E., **G.R. Carmichael**, **J. Schnoor**..., **C.O. Stanier**, et al. 2007. "Analysis of Anthropogenic CO₂ Signal in ICARTT Observations Using a Regional Chemical Transport Model and Observed Tracers." *Tellus Series B* (59): 199-210.

Committee on Water Implications of Biofuels Production in the United States, **Jerry Schnoor** chair. 2007. *Water Implications of Biofuels Production in the United States*. Washington, D.C.: National Research Council, National Academies of Science.

Debinski, D.M., and M. Cross. (invited chapter, in press). "Conservation and Global Climate Change." In S. Levin and D. Wilcove (eds.): *The Princeton Guide to Ecology*, Conservation Biology section. Princeton: Princeton University Press.

George Malanson and colleagues co-authored two papers in a special issue of *Physical Geography* (*Alpine Treeline, Climate, and Environmental Changes*, issue 28): "Alpine Treeline of Western North America: Linking Organism-to-Landscape Dynamics," and "Influences of Geomorphology and Geology on Alpine Treeline in the American West: More Important Than Climatic Influences?"

Grassian, V.H., G. Meyer, H. Abruña, et al. "Chemistry for a Sustainable Future." *Environmental Science and Technology* 41: 4840-4846.

Gutowski, W.J., H. Wei, C.J. Vörösmarty, and B.M. Fekete. 2007. "Influence of Arctic Wetlands on Arctic Atmospheric Circulation." *Journal of Climate* 20: 4243-4254.

Gutowski, W.J., Jr., K.A. Kozak, **R.W. Arritt**, J.H. Christensen, J.C. Patton, and **E.S. Takle**. 2007. "A Possible Constraint on Regional Precipitation Intensity Changes Under Global Warming." *Journal of Hydrometeorology* 8: 1382-1396.

Hadley, O.L., V. Ramanathan, **G. R. Carmichael**, et al. 2007. "Trans-Pacific Transport of Black Carbon and Fine Aerosols (D<2.5 µm) into North America." *Journal of Geophysical Research* 112, D05309, doi: 10.1029/2006JD007632.

Just, C., M. Muste, A. Kruger, and D. Kim. 2007. "Clear Creek Environmental Hydrologic Observatory: Adaptive Sensor Network," *Proceedings of the World Environmental and Water Resources Congress 2007: Restoring our Natural Habitat*, held May 15-19, 2007, Tampa, FL.

Larese-Casanova, P., and **M.M. Scherer**. 2007. "Fe(II) Sorption on Hematite: New Insights Based on Spectroscopic Measurements." *Environmental Science & Technology* 41(2):471-477.

Marian Muste served as a guest editor for "Acoustic Velocimetry for Riverine Environments," a special issue of the *Journal of Hydraulic Engineering*.

Mogili, P.K., K.H. Yang, **M.A. Young**, **P.D. Kleiber**, and **V.H. Grassian**. 2007. "Environmental Aerosol Chamber Studies of Extinction Spectra of Mineral Dust Aerosol Components: Broadband IR-UV Extinction Spectra." *Journal of Geophysical Research Atmospheres* 112, D21204, doi: 10.1029/2007JD008890.

O'Loughlin, E.J., P. Larese-Casanova, R. Cook, and **M.M. Scherer**. 2007. "Green Rust Formation from the Bioreduction of g-FeOOH (lepidocrocite): Comparison of Several Shewanella Species." *Geomicrobiology Journal* 24(3):211-230.

Pathak, R. K., **C.O. Stanier**, N.M. Donahue, and S.N. Pandis. 2007. "Ozonolysis of A-Pinene at Atmospherically Relevant Concentrations: Temperature Dependence of Aerosol Mass Fractions (Yields)." *Journal of Geophysical Research* 112, D03201, doi: 10.1029/2006JD007436.

A Sampling of CGRER-Member Publications

Stanier, C., R. Pathak, and S. N. Pandis. 2007. "Measurements of the Volatility of Aerosols from a Pinene Ozonolysis." *Environmental Science and Technology* 41: 2756-2763.

Takle, E.S., J. Roads, B. Rockel, **W.J. Gutowski, Jr.**, **R.W. Arritt**, et al. 2007. "Transferability Intercomparison: An Opportunity for New Insight on the Global Water Cycle and Energy Budget." *Bulletin of the American Meteorological Society* 88: 375-384.

Yadav, V., and **G.P. Malanson**. 2007. "Progress in Soil Organic Matter Research: Litter Decomposition, Modeling, Monitoring, and Sequestration." *Progress in Physical Geography* 31: 131-154.

Zeng, Y., **G.P. Malanson**, and D.R. Butler. 2007. "Geomorphic Limits to Self Organization in Alpine Forest-Tundra Ecotone Vegetation." *Geomorphology* 91: 378-392.

Education

CGRER PROMOTES EDUCATION TO ADDRESS IOWA'S NEEDS

CGRER and its members continue to attract and educate students who are destined to become tomorrow's global change experts. Over the years, dozens have been housed at CGRER and hundreds more have been mentored by CGRER members. These students may benefit from the provision of office space and computational facilities, and as well as courses and programs focused on global change issues. One sign of CGRER's educational success is the students' presentations of posters and papers at scientific meetings, such as the American Geophysical Union's (AGU) Fall Meeting held each December in San Francisco. In 2007, AGU presenters included students Bhupesh Adhikari, Elliott Campbell, Piotr Lewandowski, Marcelo Mena, and Chao Wei (all of whom worked on CGRER's large

air-quality forecasting field experiments described in earlier publications), as well as CGRER post-doctoral fellow Courtney Hatch. Many additional students presented their research results at other professional conferences, with some applying for CGRER's Graduate Student Travel Grants: in 2007, thirteen students were awarded from \$400 to \$750 for such travels (see listing on page 14).

In 2007, CGRER and the UI Department of Journalism and Mass Communication paired for the first time to provide a science-focused internship for

a journalism graduate student. Soheil Rezayazdi, a first-year master's student with skills in writing for diverse audiences, is working with CGRER for the 2007-2008 academic year to disperse information about global-change research. His efforts have concentrated on strengthening the News and Features section of CGRER's web page, both through posting his own stories about CGRER members and their research, and through incorporating similar materials from other sources. In 2007, Soheil's stories covered Holly Moriarty

(one of Jerry Schnoor's students) and her award-winning project to compost discarded food from a UI residence hall; Umran Dogan and his research on asbestos and erionite (which cause mesothelioma); Konstantine Georgakakos and his efforts to develop a worldwide flash-flood warning system; and Keri Hornbuckle and her research on synthetic fragrances and freshwater mussels. The journalism internship is considered a win-win situation: through Soheil's efforts, CGRER is strengthening its public

image and informing the public about global-change-related research, even as a future journalist is gaining familiarity with scientists and scientific research.

CGRER continues to foster broader educational efforts on the UI campus. In 2007, for example, CGRER was a co-sponsor of "Iowa HEALS," a three-week series of lectures and events focusing on global change issues (such as global warming); CGRER members were leaders of some events. On October 17, CGRER's Jerry Schnoor was a panel member of "Opportunity 08: Energy

and National Security," a Brookings Institute-organized forum on the UI campus to encourage presidential candidates and the general public to focus on critical issues facing the nation. In 2007, CGRER's newsletter *IoWatch* summarized efforts to establish a series of National Environmental Observatory Networks, and CGRER's website underwent a complete redesign. It continues to serve as a UI campus resource for environmental information, and it received around two million hits in 2007.

Snow cover over the northeast United States, February, 2007

Travel Grants for Graduate Students

Grants are awarded to students traveling to professional conferences to make oral or poster presentations, whose advisors are CGRER members. A total of \$8,280 was awarded in 2007.

Name	Department	Conference
Ozan Abaci	Civil & Environmental Engineering, UI	World Environmental & Water Resources Congress
Ryan Asman	Civil & Environmental Engineering, UI	32 nd International Association of Hydrologic Research Congress
Dimitrios Dermisis	Civil & Environmental Engineering, UI	32 nd International Association of Hydrologic Research Congress
Elisabeth Gustafson-Wagner	Biological Sciences, UI	Weinstein Cardiovascular Development Conference
Yang Oh Jin	Civil & Environmental Engineering, UI	107 th General Meeting of American Society for Microbiology
Luke Juran	International Programs, UI	Leadership Summit on Microfinance in India
Ramasubramanian Kanthasamy	Chemistry, UI	49 th Rocky Mountain Conference on Analytical Chemistry
Gokhan Kirkil	Civil & Environmental Engineering, UI	5 th International Symposium on Environmental Hydraulics
Pradeep Mandapaka Venkata	Civil & Environmental Engineering, UI	9 th International Precipitation Conference
Achilleas Tsakiris	Civil & Environmental Engineering, UI	32 nd International Association of Hydrologic Research Congress
Gabriele Villarini	Civil & Environmental Engineering, UI	9 th International Precipitation Conference
Bill Wombacher	Civil & Environmental Engineering, UI	International Conference on Analysis of Emerging Contaminants in the Environment
Vineet Yadav	Geography, UI	Annual Meeting of the Association of American Geographers

A Sampling of CGRER-Member Educational Events and Presentations

Diane Debinski spoke on *Quantifying Interannual Variation in Ecological Communities: A Window to Understanding Potential Effects of Climate Change in the Greater Yellowstone Ecosystem* at a Roundtable Meeting on Climate Change and Conservation in the Greater Yellowstone Ecosystem held in Bozeman, Montana, on May 6.

For five weeks in the summer, **Vicki Grassian** was a Visiting Researcher at the Environmental Molecular Sciences Laboratory at Department of Energy's Pacific Northwest National Laboratory in Richland, WA.

Bill Gutowski presented invited lectures on his climate-change modeling efforts at the Arctic System Model Workshop (Fairbanks), the Federal University of Technology (Akure, Nigeria), and professional meetings in Italy and Texas.

Stephen Hendrix presented the invited seminar, *The Effects of Local and Landscape Features on Diversity of Solitary Bees in Tall Grass Prairie Fragments*, at a Botanical Society of America conference in Chicago, and at the Department of Entomology, University of Illinois.

Craig Just presented the talk, *Global Warming: Personal Actions to Save Money, Save Time, Save the Planet* at a UI Alumni Association – Lifelong Learning course.

Wilfrid Nixon worked on a new course (and ultimately a text book) on Technology and Leadership.

R. Rajagopal team-taught the course *International Environmental Policy* in the summer, as he had done for the previous two years.

Michelle Scherer spent the summer in Germany doing a sabbatical at The University of Tuebingen as part of her Faculty Scholar Award. She

and her collaborator looked at how iron biogeochemistry affects the fate of pollutants in the environment.

Charlie Stanier greeted his new post-doc, Sang-Rin Lee from Clarkson University, who will join him in his research on developing a screening model for personal exposures to air toxins from urban vehicular traffic.

Gene Takle and **Diane Debinski** presented climate change talks at a Midwestern U.S. Fish and Wildlife Endangered Species Coordinators meeting in Des Moines on October 1.

Gene Takle, **Ray Arritt**, **Bill Gutowski**, and colleagues presented a climate change poster, *Trends in US Surface Winds over the Last Quarter of the 20C: Observations and Model Results*, at the American Geophysical Union's fall meeting in San Francisco.

Phytoplankton in bloom in Australia's Shark Bay, November, 2004



Research

CGRER FOSTERS GLOBAL CHANGE RESEARCH
TO ADDRESS IOWA'S NEEDS

GREER-related research projects are increasingly being linked to climate change, the possibility of rapid climate change, and associated policy questions. This shift has been a natural response to increased climate-change concerns among politicians, governmental funding agencies, and the public. The shift also signals a maturation of research techniques and questions: both numerical models and field studies can now trace environmental changes in far greater detail than ever before possible.

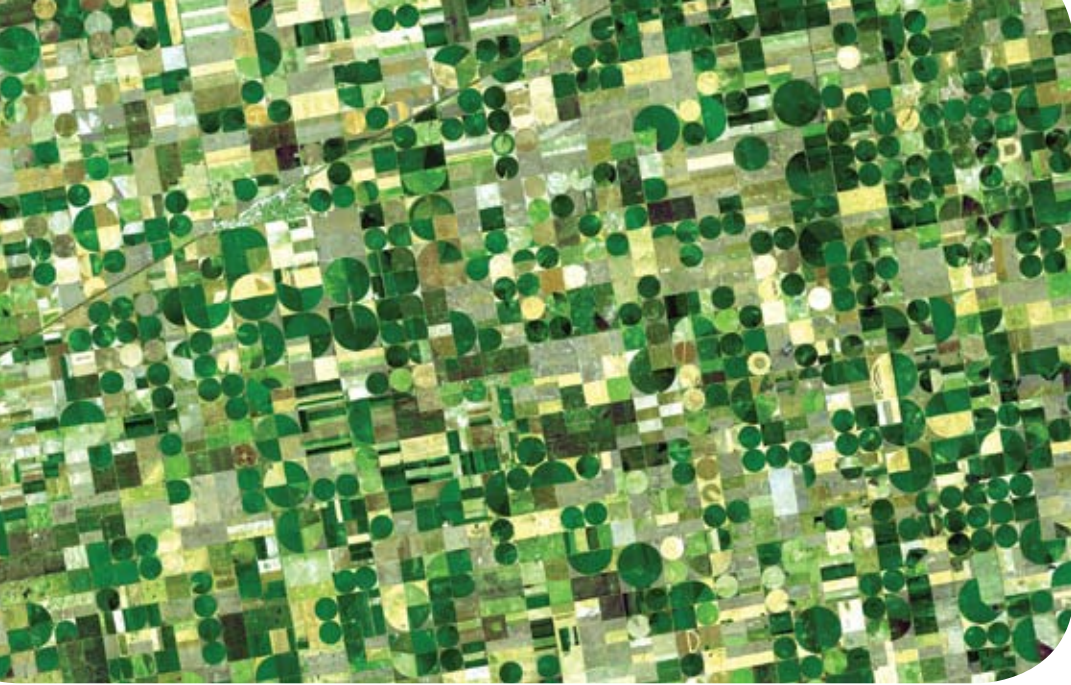
Additional Climate Change Research Initiatives

Diane Debinski continues to quantify the ecological effects of climate change in the Greater Yellowstone Ecosystem, Wyoming, an effort underway since 1997. She has been combining the use of satellite images and field surveys to evaluate how plants, birds, and butterflies native to mountain meadows respond to changes in precipitation and soil moisture. Her understanding of climatic responses within these relatively pristine ecosystems will increase understanding of species responses in human-modified ecosystems; the complex and sensitive Yellowstone communities also will provide an early warning system for tracking climate responses elsewhere.

In the past few years, George Malanson has expanded his Glacier Park alpine-treeline research to mountains throughout the western U.S. Through his considerations of climate change and tree expansion, he has found that treeline location is controlled by a complex of features (including soils and geomorphology), not by temperature alone. He may soon be initiating considerations of tundra species' responses to climate change.

And lastly, for over a decade, Vicki Grassian and associates have been using controlled laboratory studies to gain insight into atmospheric processes, in particular the effects of aerosolized mineral dusts on the chemical balance of the atmosphere. Now her work is being applied specifically to climate and its changes. For instance, she and Michelle Scherer are examining the bio-availability of iron in ocean-deposited dusts: iron in the correct form can stimulate oceanic life and biological processes, which in turn increase the ocean's uptake of atmospheric carbon dioxide. Grassian, Mark Young, and Paul Kleiber are developing and utilizing new instruments to measure the absorption and scattering of solar radiation by atmospheric dusts, a process that modifies the incoming and outgoing solar flux. Grassian is also beginning to turn her attention toward reducing carbon dioxide levels in the Earth's atmosphere by using extremely small nanoparticles (with

Southern California wildfires, October, 2007



Crops growing in Kansas, June, 2001 (NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team)

Monitoring Environmental Changes

Several research projects are poised to track nature's responses, thus providing the monitoring that is crucial to deciphering changing climates and their effects. In 2007, for example, CGRER members at IIHR-Hydrosience & Engineering received over a million dollars to equip an Environmental-Hydrologic Observatory on the Mississippi River's Navigation Pool 16 (see "Integration of National Research Initiatives..." page 20). Measurements of a variety of water quality and sediment parameters will be taken at the entrance to and exit from this pool. The implementation of high-tech sensors and communication technologies transmitting detailed, real-time data to distant researchers will permit, for the first time, immediate and comprehensive assessment of changes in the river's condition, and will feed into numerical models for river forecasting and prediction.

Witold Krajewski and Anton Kruger recently received an NSF grant to acquire four transportable, remotely controlled radar systems that together will form a synchronized network to provide high-spatial-resolution, real-time rainfall data for use in hydrology.

And two CGRER-related monitoring field stations became operational in 2007. One, a Tall Tower near West Branch, is outfitted with instruments that continuously monitor carbon dioxide and other greenhouse gases in eastern Iowa. Maintained by Charlie Stanier and students, this is one of a NOAA-funded nationwide network of monitoring towers.

The second is a new observatory for monitoring atmospheric aerosols and radiation, and for tracing hemispheric transport of pollutants, in Central Asia's Kyrgyzstan (see "Transcontinental Transport of Air Pollution from Central Asia..." page 20). This observatory, one of many now functional across Asia, sprang in part from Greg Carmichael's numerous efforts to investigate air pollution and related climate change and to develop air-pollution forecasting models for that continent.

The WATERS Environmental Observatory

Jerry Schnoor continues to lead the WATERS (Water and Environmental Research Systems Network) project, which is prerequisite to establishing a multidisciplinary, comprehensive digital field observatory, one of several National Environmental Observatory Networks, that will focus specifically on water and hydrology (see CGRER's Fall 2007 newsletter). Year 2007 efforts will result in a decision by NSF to fund a Phase II WATERS Network Project Office in 2008. CGRER members Keri Hornbuckle, Craig Just, Witold Krajewski, Marian Muste, Thanos Papanicolaou, and Larry Weber all have contributed to the conceptual design documents produced by the WATERS Network Project Office.

As part of the WATERS effort, in 2007, Marian Muste organized a week-long Upper Mississippi River Basin Observatory (UMBRO) International Planning and Design Workshop, held in Iowa City. The workshop included forty participants from a number of universities and nations, and was designed to catalyze the collaborative network necessary for forming the UMBRO network.

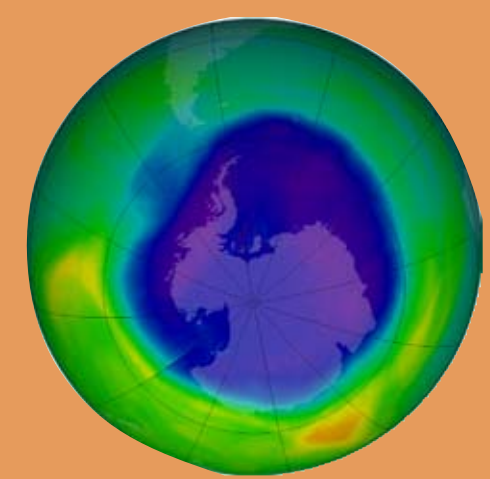
Several CGRER members continue their research engagement in a prototype field observatory, the Clear Creek testbed near Coralville. In 2007, they completed Phase I research for the testbed and began preparation for Phase II. The large Environmental-Hydrologic Observatory grant received in 2007 (described above) will serve as a major boost to the WATERS program.

Additional Climate Change Research Initiatives

Diane Debinski continues to quantify the ecological effects of climate change in the Greater Yellowstone Ecosystem, Wyoming, an effort underway since 1997. She has been combining the use of satellite images and field surveys to evaluate how plants, birds, and butterflies native to mountain meadows respond to changes in precipitation and soil moisture. Her understanding of climatic responses within these relatively pristine ecosystems will increase understanding of species responses in human-modified ecosystems; the complex and sensitive Yellowstone communities also will provide an early warning system for tracking climate responses elsewhere.

In the past few years, George Malanson has expanded his Glacier Park alpine-treeline research to mountains throughout the western U.S. Through his considerations of climate change and tree expansion, he has found that treeline location is controlled by a complex of features (including soils and geomorphology), not by temperature alone. He may soon be initiating considerations of tundra species' responses to climate change.

And lastly, for over a decade, Vicki Grassian and associates have been using controlled laboratory studies to gain insight into atmospheric processes, in particular the effects of aerosolized mineral dusts on the chemical balance of the atmosphere. Now her work is being applied specifically to climate and its changes. For instance, she and Michelle Scherer are examining the bio-availability of iron in ocean-deposited dusts: iron in the correct form can stimulate oceanic life and biological processes, which in turn increase the ocean's uptake of atmospheric carbon dioxide. Grassian, Mark Young, and Paul Kleiber are developing and utilizing new instruments to measure the absorption and scattering of solar radiation by atmospheric dusts, a process that modifies the incoming and outgoing solar flux. Grassian is also beginning to turn her attention toward reducing carbon dioxide levels in the Earth's atmosphere by using extremely small nanoparticles (with their relatively large surface areas) to sequester atmospheric carbon dioxide.



Aids to Researchers and the UI Community

CGRER continued to offer state-of-the-art computing and visualization resources to members and their students. In 2007, CGRER's computing facilities were supplemented by multiple Linux workstations. These high-performance machines utilize multiple processors and large system memory to allow for modeling and visualization of very complex data sets. The workstations have played a key role in modeling and forecasting the movement of air pollutants, efforts crucial to CGRER's large atmospheric field experiments. CGRER also functions as one of four departments on the UI campus that supports and distributes geographical information system (GIS) software through a campus-wide site license with ESRI.



Northwest coast of Sumatra after the January, 2005 tsunami

Seed Grants Awarded by CGRER

In 2007, CGRER awarded a total of \$137,730 in seed grants to five recipients.

Principal Investigators
Amount Awarded/Title

Vicki H. Grassian and **Mark A. Young**, Department of Chemistry, UI
\$20,000—Heterogeneous Photochemistry of Atmospheric Aerosol

Principal Investigators
Amount Awarded/Title

Amy Kaleita, Agricultural and Biosystems Engineering, and **James K. Newman**, Environmental Sciences, ISU
\$30,000—Optimization of Environmental and Economic Benefits of Corn Harvesting for Biofuel Production

Principal Investigators
Amount Awarded/Title

Witold Krajewski, Civil & Environmental Engineering, UI
\$30,000—Observational and Modeling Studies of Rainfall Interception by Corn Plants

Principal Investigators
Amount Awarded/Title

Marc Linderman, Geography, **Kate Cowles** and **Dale Zimmerman**, Statistics and Actuarial Science, UI
\$28,450—Inter-Calibration of Global Remotely Sensed Vegetation Measures

Principal Investigators
Amount Awarded/Title

Richard Schultz and **Thomas Isenhardt**, Natural Resource Ecology and Management, ISU
\$29,280—The Effect of Harvesting Trees, Shrubs and Native Grasses on Soil Carbon Sequestration and Greenhouse Gas Flux in Riparian Buffers Designed to Provide Biomass for Biofuel Production

A Sampling of CGRER-Member New Research Grants

Artificial Nest Utilization in Prairie Remnants by Mason Bees. 2007-08. Prairie Biotic Research. \$1,000. PI: **Stephen Hendrix**.

Climate Legacy Initiative. 2007-2008. Vermont Law School. \$69,440. PI: **Burns Weston**.

Collaborative Research: Towards Advanced Understanding and Predictive Capability of Climate Change in the Arctic using a High-Resolution Regional Arctic Climate System Model. 2007-11. U.S. Department of Energy. \$443,558,

ISU portion to **Bill Gutowski**. PI: **Bill Gutowski**, with colleagues from the Naval Post-graduate School, U. of Colorado, and U. of Washington.

Development and Application of a Personal Exposure Screening Model for Size-Resolved Urban Aerosols. 2007-10. Health Effects Institute (Walter A. Rosenblith New Investigator Award). \$294,000. PI: **Charles Stanier**.

Ecological Genomics of Insect Induced Plant Galls. 2007-08. University of Iowa, Biological Sciences Funding Program. \$30,000. PIs: **Stephen Hendrix**, J. Miller.

Environmental Health Sciences Research Center. 2007-12.

NIEHS. \$5,000,000. PI: **Peter S. Thorne**; Deputy Director: Joel N. Kline; Associate Director: James A. Merchant.

Evaluation of Bridge-Scour Research: Pier Scour Processes and Predictions. 2007-2009. National Cooperative Highway Research Program. \$175,000. PI: **Robert Ettema**.

Integration of National Research Initiatives at The Lucille A. Carver Mississippi Riverside Environmental Research Station. 2007-08. Roy J. Carver Charitable Trust (\$900,000), with matching funds from the UI Office of the Vice President for Research (\$100,000) and IIHR (\$152,000). PI: **Larry Weber**, **Jerry Schnoor**.

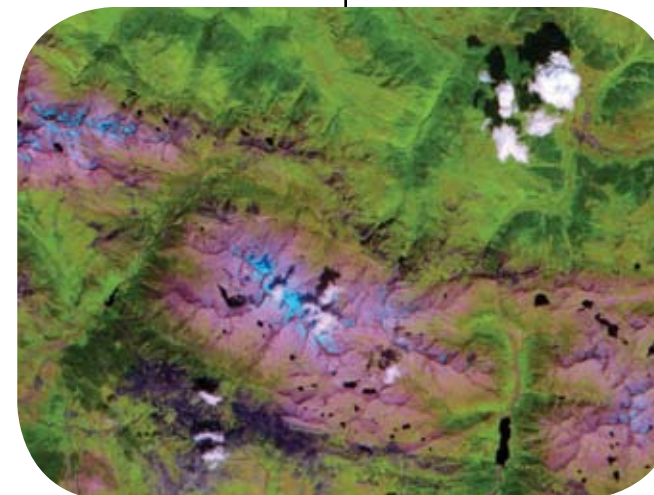
MRI: Acquisition of Mobile Facility for Providing High-Resolution Input to Hydrologic Observatories. 2007-09. NSF. \$1,360,230. PIs: **Witold Krajewski**, Anton Kruger.

Regional Scale Analysis in Support of the ARCTAS Field Experiment. 2007-11. NASA. \$592,561. PI: **Greg Carmichael**.

SGER: Can Specific Proteins be Detected and Quantified in Soil Using Proteomics Techniques? 2007-2008. \$73,656. NSF. PI: **Timothy Mattes**.

Transcontinental Transport of Air Pollution from Central Asia to the U.S. 2007-08. E.H. Pechan & Associates, Inc. \$29,830. PI: **Greg Carmichael**.

Thermal emission image of Central Pyrenees, August, 2000 (NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team)



Bill Gutowski became the editor of *Journal of Hydrometeorology* in January. He completed his term (since 2005) as a panel member of the National Academy of Sciences' *Transportation Research Board Study on Climate Change and U.S. Transportation*, but continues his membership on climate-change interagency science panels on the *Status of Climate Models* and *Weather and Climate Extremes*, run by the U.S. Department of Energy and by NOAA.

Keri Hornbuckle and **Thanos Papanicolaou** were both appointed as Robert and Virginia Wheeler Faculty Fellows in the UI College of Engineering.

Marian Muste received the UI's Hancher-Finkbine Medallion, a prestigious award to recognize the recipient's leadership, learning, and loyalty.

Vicki Grassian was named to the editorial board of *Atmospheric Environment*, and was named as a Collegiate Fellow in the UI's College of Liberal Arts and Sciences.

Dale Zimmerman's leadership and significant contributions earned him the Distinguished Achievement Award from the American Statistical Association's Section on Statistics and the Environment, an award that honored both his involvement in the association and his publications and teaching.

Wilfrid Nixon won the UI College of Engineering's Faculty Excellence Award, an Instructional Improvement Award from the UI Council on Teaching, and the American Society of Civil Engineers' (Iowa Section) Government Civil Engineer of the Year Award.

CGRER-Member Awards and Appointments

Michelle Scherer was appointed to the Editorial Board for *Environmental Science & Technology*.

Robert Ettema moved to Laramie, Wyoming, to assume the deanship of the University of Wyoming's College of Engineering. He comments that in addition to his administrative duties, he is becoming involved in the state's water issues and water quality problems associated with coal, oil, and gas recovery.

Keri Hornbuckle became Departmental Executive Officer for the UI's Civil and Environmental Engineering department.

Marian Muste is serving as an expert for World Meteorological Organization's *Commission on Hydrology, Committee for Assessment of the Performance of Flow Measurement Instruments and Techniques*.

General Information

Budget

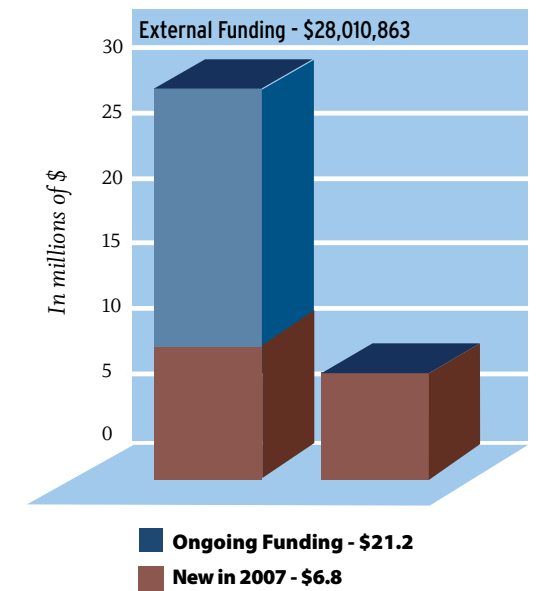
In fiscal year 2007 (July 1, 2006-June 30, 2007), 75 percent of CGRER's \$600,470 of revenue was spent on research, education, and outreach directed toward global change issues (Figure 2). The remaining 25 percent of the budget was dedicated to administration.

This funding, received in total from an assessment on Iowa's gas and electric utilities through the State Department of Commerce, was magnified many times in the millions of dollars of external grants and contracts awarded to CGRER members (Figure 1). In calendar year 2007, CGRER members were performing research that brought in a total of \$28.0 million in external funds. This included both those grants awarded to CGRER directly and other grants awarded to CGRER members through their respective departments. Of this amount, \$6.8 million was new funding that was initiated in 2007, while the remaining \$21.2 million came from ongoing projects.



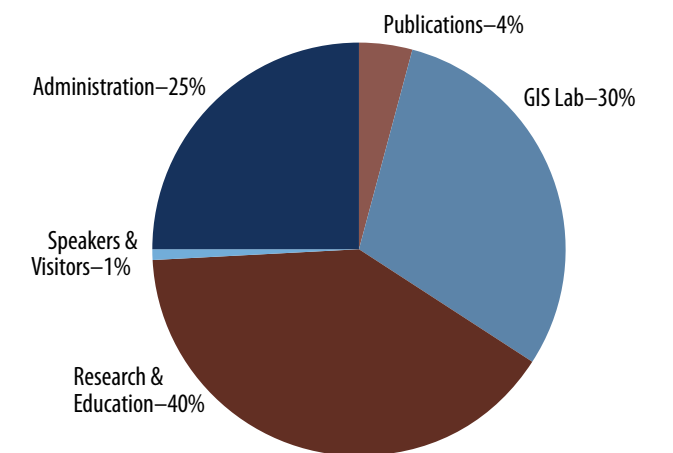
Landslide buries Valley of the Geysers, Kamchatka Peninsula, Russia, June, 2007 (NASA image, data provided courtesy NASA/GSFC/MITI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team)

Figure 1
Leveraging of CGRER's Income*



*Applies to calendar year 2007

Figure 2
CGRER's Expenses*



*Applies to fiscal year 2007

Administration & 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 thirteen members (see list, page 5) plus the two co-directors. The Executive Committee meets monthly to plan initiatives and chart CGRER's course. An Advisory Board of nine members from outside the academic community (see list, page 7) meets annually to lend oversight to CGRER's activities.

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 (UI)

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
Keri C. Hornbuckle
Craig L. Just
Witold F. Krajewski
Lou Licht
Timothy E. Mattes
Marian V. Muste
Wilfrid A. Nixon
A. Jacob Odgaard
A.N. Thanos Papanicolaou
Gene F. Parkin
Michelle Scherer
Jerald L. Schnoor
Richard L. Valentine
Larry Weber

Economics

Thomas F. Pogue
John L. Solow

Electron Spin Resonance Facility

Garry R. Buettner

Geography

Marc P. Armstrong
David Bennett
Naresh Kumar
Marc Linderman
George P. Malanson
Michael L. McNulty, Emeritus
R. Rajagopal
Gerard Rushton

Geoscience

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

History and Community & Behavioral Health

Paul R. Greenough

Law

Jonathan Carlson
Burns H. Weston

Mechanical & Industrial Engineering

Geb Thomas

Occupational & Environmental Health

William R. Field
Joel N. Kline
Peter S. Thorne

Physics & Astronomy

Donald A. Gurnett
Steven R. Spangler

Physiology & Biophysics

G. Edgar Folk, Emeritus

Statistics & Actuarial Science

Dale L. Zimmerman

Iowa State University (ISU)

Agronomy

Raymond W. Arritt
Brian K. Hornbuckle

Ecology, Evolution, and Organismal Biology

Diane M. Debinski
John Nason
James W. Raich

Geological & Atmospheric Sciences

William J. Gutowski
Germán Mora
Eugene S. Takle

Natural Resource Ecology and Management

Jan Thompson

University of Northern Iowa (UNI)

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

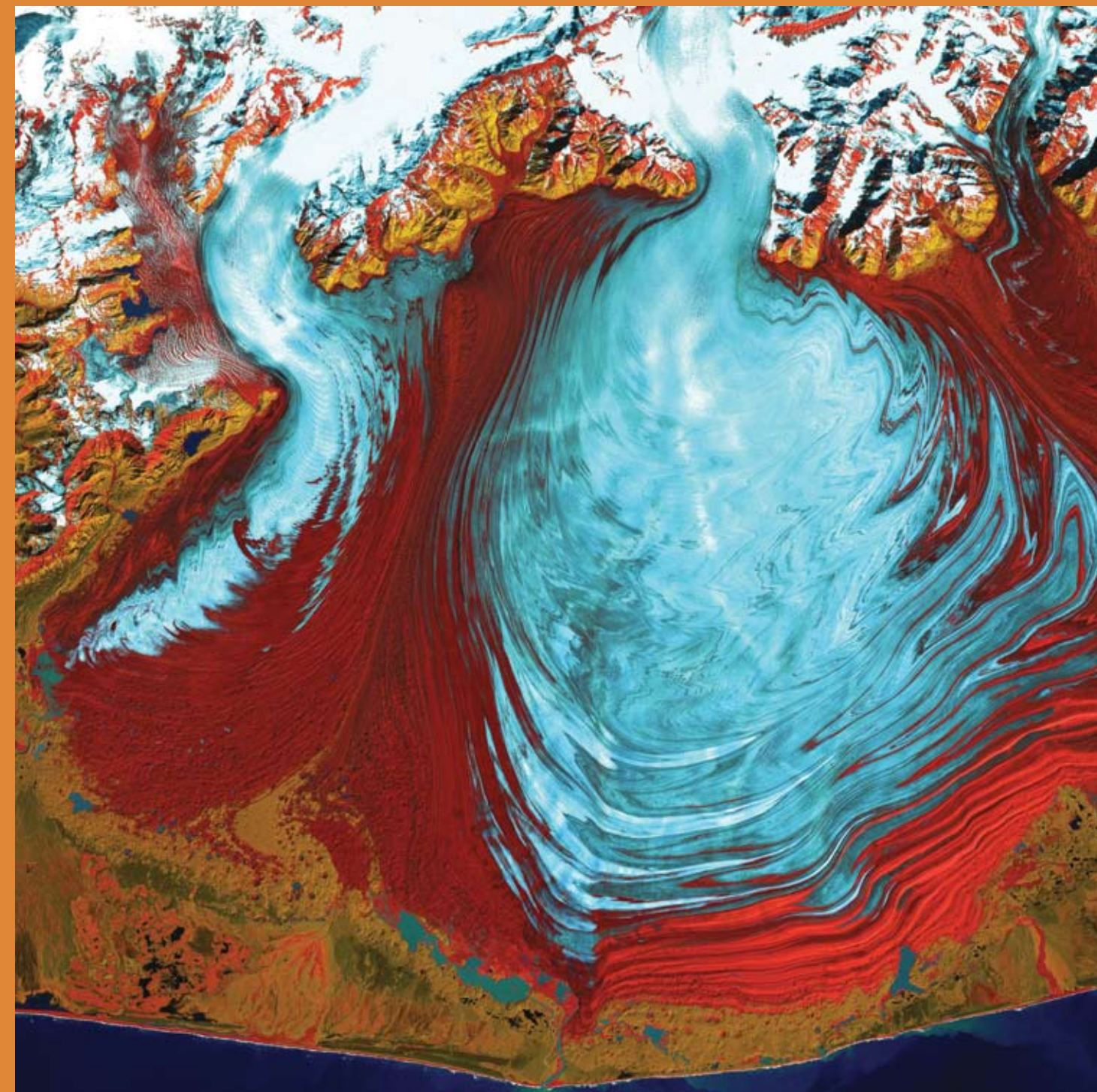
Civil & Environmental Engineering

Pedro Alvarez

University of Wyoming

College of Engineering

Robert Ettema



False color composite image of Alaska's Malaspina Glacier, August, 2000



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