



THE CENTER FOR GLOBAL & REGIONAL
ENVIRONMENTAL RESEARCH



2022 ANNUAL REPORT





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The names of CGRER members and those affiliated with CGRER are highlighted in boldface throughout this report.

*Cover photos:
Top: Lake Michigan from space by NASA Earth Observatory.
Main Photo: North Liberty, IA farm by Mark Gromko.*

CGRER is housed in the Iowa Advanced Technology Laboratories on the UI campus. Photo above by Paul McCray.

Right: Twenty acre wetland complex in the Middle Cedar Watershed installed through the Iowa Watershed Approach. Photo by Iowa Flood Center (see pages 10, 17).



THE CENTER FOR GLOBAL & REGIONAL ENVIRONMENTAL RESEARCH



THE CENTER FOR GLOBAL & 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 campus in the Iowa Advanced Technology Laboratories, CGRER is supported by the rate-payers and utilities of Iowa, a program begun by the State of Iowa's Energy Efficiency Act of 1990. Funds are used to support research and provide services to faculty members and students across the state who are interested in environmental change.

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 requires the reinterpretation of many fields of science and engineering, the humanities, health 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.

promote dialogue among specialists and agencies

educate students and the general public

foster and support relevant research projects



A SOFT LANDING FOR CLIMATE CHANGE: A VISION FOR THE FUTURE

2022 found CGRER at a critical juncture. The center's funding ended and because of this, the future of CGRER is uncertain. In order to continue, the organization must find a new funding model that will equip CGRER staff and members to continue to do critical work.

As you will see in this year's report, CGRER makes valuable contributions to the state and beyond through its research, training, and outreach activities. We are proud of

average temperature rise will undoubtedly exceed 1.5 °C in a few decades and may exceed 3 °C in this century; a circumstance that will produce a temperature that Earth has not experienced in 2 million years. The younger generations see the urgency and recognize climate change as a crisis multiplier and they are calling for action now. "The time for small steps in the right direction is long gone," climate activist Greta Thunberg said at the 2021 World Economic Forum. We agree with her.

Iowans need to urgently address climate change by working together and making strategic investments that continue to champion our leadership in renewable energy...

the accomplishments and contributions made by CGRER's students, faculty, staff, and friends. We aim to use this statement to reflect upon the importance of CGRER's mission and higher education in finding climate solutions.

Where is our sense of urgency? The looming threats of climate change have been known since the 1980s. Yet greenhouse gas emissions have increased by 70% since that time and our planet's temperature continues to rise. Whatever the reasons, without a sense of urgency we have lost decades in terms of reducing greenhouse gas emissions and have instead proceeded in the wrong direction. Our global average temperature rise has been speeding up since 1970 and is now increasing faster each year than at any time in the past 50 years. As things stand, without dramatic cuts in carbon emissions, Earth's

A soft landing for humanity and nature, one where we avoid the worst impacts of climate change, is still possible. We know what we need to do. We need to reduce our use of fossil fuels by electrifying everything we can as quickly as we can and we need to switch to renewable energy sources for electricity that does not release carbon dioxide. We need to increase energy efficiency and expand the removal of carbon from the atmosphere.

Iowa's universities and colleges have important roles to play in addressing climate change. CGRER is the only state-wide center focused on climate and related issues. CGRER has gathered a membership of 100-plus scientists from colleges and universities across the state. The educational and research efforts of these scientists have increased the understanding of climate change and decreased their

institutions' carbon footprints. These efforts have been essential.

We believe universities have a moral mandate to listen to their students while simultaneously preparing their minds and bodies to meet future challenges. At present, this means seizing the opportunity to meet student demands for recognizing pressing climate-change challenges. Shouldn't we be doing all we can to ensure their future safety and hope for their future? Perhaps this is a new role for universities, but perhaps it is also time for a revamp of educational policy, just as it was after the tumultuous Vietnam War when students internationally called for a more relevant education that placed their future realities at the center of their educational activities.

We passionately feel that our educational institutions should become hubs for research and policy development and undertake initiatives that foreground climate knowledge designed to spur innovations in technologies, policies, and governance needed to meet the challenges of climate change. Because climate change affects all human experience and all academic disciplines, including artistic fields, it is essential that universities and colleges do not relegate climate change to isolated scientific centers or a few courses. While climate science is clear and doesn't lie, sustainable solutions require a greater understanding of the social dimensions of mitigation and adaptation. This is why holistic, campus-wide approaches are needed to answer student demands.

Specifically, we envision Iowa's universities becoming destinations for climate-solution activities. Here are our suggestions for all-campus initiatives that could be developed and targeted at climate solutions:

- 1 Cohesive portfolios of climate-related courses from across campus (engineering, natural sciences, social sciences, health sciences, arts, and humanities); as well as interdisciplinary seminars that bring climate-focused students and faculty together.
2 A "Climate Corps" of undergraduates engaged in research and experiential learning around climate solutions and community engagement.
3 New interdisciplinary degree and certificate programs that expose students to the breadth of climate issues, engage students with their local communities and promote climate-related solutions across campus.
4 Climate solutions "institutes" designed to expand competitive research in climate-related areas and coordinate climate-focused activities across campus. Targeted areas of research could include climate change and human health, resiliency (transportation systems, extreme weather events, land use change), societal impacts (equity, migration), monitoring climate change, and carbon removal and storage. CGRER is a valuable example of such an institute, and we hope that it can be a foundational element moving forward.
5 Experiential learning opportunities to support the above activities and facilitate community-based climate solutions.

We cannot be daunted by the challenges of addressing climate change. Rather we must seize the opportunities available to us to achieve a soft landing for humanity and for nature. Iowa can play a big role in piloting us toward this future. Iowans need to urgently address climate change by working together and making strategic investments that continue to champion our leadership in renewable energy; reduce carbon dioxide, methane, and other greenhouse gas emissions; and establish higher education hubs for climate solutions that empower our youth and their actions. These opportunities offer the prospect of a bright future for Iowa.



Gregory R. Carmichael
Jerald L. Schnoor
CGRER Co-Directors

EXECUTIVE COMMITTEE

- Kelly Baker Occupational and Environmental Health University of Iowa
Rhawn Denniston Geology Cornell College
Emily Finzel Earth and Environmental Sciences University of Iowa
Gregory LeFevre Civil and Environmental Engineering University of Iowa
Louis Licht Ecolotree, Inc.
Corey Markfort Civil and Environmental Engineering University of Iowa
Heather Sander Geographical and Sustainability Sciences University of Iowa
Sylvia Secchi Geographical and Biochemical Engineering University of Iowa
Charles Stanier Chemical and Biochemical Engineering University of Iowa
Elizabeth Stone Chemistry University of Iowa



ADVISORY BOARD MESSAGE

In 2022, 29 natural disasters occurred globally incurring damages totaling more than a billion dollars. Hurricane Ian, which devastated parts of Florida, South Carolina, and North Carolina, amassed more than \$20 billion in damage and was responsible for 137 fatalities. A sustained drought in Europe produced nearly \$20 billion in damage, while China experienced both devastating floods in June through September (totaling \$12 billion in damages and causing more than 200 deaths) and a

Despite the backdrop of all this negative and disheartening news, I find a consistent bright spot in the innovative and groundbreaking research that is done at CGRER.

yearlong drought (totaling \$8.4 billion in estimated losses). Pakistan lost 1693 people to horrific floods during the monsoon season. Additionally, severe thunderstorms around the globe wreaked havoc on lives, homes, and livelihoods.

At times, it appears that we have become numb to the overwhelming volume of disasters such as these. This feels especially true given that the number of disasters with damages exceeding \$20 billion has increased dramatically since 1980.

Or maybe numb isn't the correct word. Perhaps we are preoccupied with the disasters at our own doorstep.

This past year, much of Iowa was locked in a pervasive drought. The U.S. Drought Monitor for October 27 showed the majority of the state was either in a "Moderate" or "Severe" drought with parts of west-central Iowa in "Extreme" or "Exceptional" drought. In September, a two-mile portion of the Ocheyedan River in northwest Iowa was pumped entirely dry of water.

Hurricane Ian devastated parts of Florida, South Carolina, and North Carolina, amassed more than \$20 billion in damage, and caused 137 fatalities. Photo: Flickr MyFWC.



From my home along the shores of West Lake Okoboji, I watched rocks steadily emerge from the lake as water levels dropped throughout the summer. Residents of this vacation community worried about how drought would affect the Iowa Great Lakes and the subsequent recreation opportunities. This was a genuine concern given that tourism is the ultimate driver of our local economic engine. The answer soon arrived as one drought-related effect reared its ugly head in early summer—blue-green algae blooms. Fueled by warm, stagnant water and excess nutrients, which resulted in “do not swim” beach advisories at several popular spots. Visitors canceled vacations, parents worried about kids playing in the lakes, and water operators wondered about possible drinking water issues lurking in the toxic algae.

Despite the backdrop of all this negative and disheartening news, I find a consistent bright spot in the innovative and groundbreaking research that is done at CGRER. CGRER-affiliated faculty develop interdisciplinary and practical research that revolutionizes how we approach and solve some of today's most difficult environmental problems.

CGRER's extraordinary leadership and engagement model positions the organization at the forefront of critical research that will help us navigate the challenges of the future. Climate change, energy policy, harmful algal blooms, wastewater, and drinking water quality are just a few of the important areas of research that will inform agencies and policymakers as they shape the future of Iowa. As you read this annual report, I hope that you too are excited by the future of CGRER and continue to support its important mission.

Mary Skopec
Iowa Lakeside Laboratory
Regents Resource Center



Chris Brunet received a CGRER Field Research Travel Grant to conduct Siloxane Field Sampling in New York.



Chamari Mampage received a CGRER Field Research Travel Grant. Here Mampage collects aerosol samples at University of Melbourne, Australia. Photo: Betsy Stone.



Briante Najev, left, and Humu Mohammed, right, collect freshwater snails, latched to rocks, from New Zealand lakes. Najev's international dissertation research is funded by a CGRER Field Research Travel Grant. Photo: Chelsea Higgins.



This NASA Earth Observatory image shows algae in the great Lakes. Direct measurements of the water show that the bloom in Lake Erie is mostly microcystis aeruginosa, a toxic algae.



ADVISORY BOARD

Stratis Giannakouros
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University of Iowa

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Alliant Energy

Scott Koepke
Grow Johnson County
Hunger Relief Farm

Jesse Leckband
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David Osterberg
Occupational and
Environmental Health
University of Iowa

Peter Rolnick
Emeritus Professor of Physics
Truman State University

Mary Skopec
Iowa Lakeside Laboratory
Regents Resource Center



Lake Erie algae bloom.

IOWA CLIMATE STATEMENT 2022: THE MANY BENEFITS OF OUR TREES

Trees live a long time, decades or even centuries. Existing and future trees will grow in a climate that is warmer and that will have greater extremes of precipitation over the next 40-80 years. Recent results from [IPCC model projections](#) for climate (if emissions continue to rise rapidly) show Iowa becoming much hotter, with 5-15 days each year over 106°F during the period 2041-2060. Precipitation is likely to increase in winter and decrease in summer, leading to more floods and droughts, and further stresses on both urban trees and rural woodlands.

The August 2020 derecho is emblematic of the impact of climate change on our trees: this extreme weather event led to the loss of an estimated 7 million rural and urban trees in Iowa. Many tree-planting programs are now underway to begin to replace them. These new trees give us a connection to our future, as many of those we plant now could be growing well into the next century, in a new and

changing climate. Attention to the species of trees we plant and their care will be crucial for their survival. Strategies are needed both to sustain the many benefits of existing large mature trees and to increase planting of appropriate new trees for mitigating and adapting to climate change.

Urban trees are especially beneficial for reducing the urban heat island effect. Trees cool the urban environment by providing shade. They also dissipate the sun's radiant energy by releasing water to generate evaporative cooling. A [Midwest electric utility](#) explains that the proper placement of just three trees can save an average household between \$100 and \$250 in energy costs annually, and a well-designed landscape provides a return on initial investment in less than 8 years. Trees also provide a myriad of other important ecosystem services, for example by controlling stormwater, improving soil quality, providing wildlife habitat, and cleaning the air. The many benefits of urban trees are greater than the costs of planting and maintaining street and park trees.

Longer dry periods mean that proper watering is crucial for newly planted trees. During drought, even mature trees should be watered out to the "drip line" which extends as far as the tree's canopy. In addition, under extreme heat stress even well-watered trees can suffer regardless of the amount of moisture in the soil. Mature trees that show signs of heat stress (such as scorched, yellow or wilted leaves or



Trees are cool.
Three Well Placed Trees
Save an Average Household
\$100 - \$150
in Annual Energy Costs

Source: First Energy Corp. Smart Landscaping and Energy Efficiency. 6/24/22 [firstenergy-corp.com/help/saving_energy/trees](https://www.firstenergy-corp.com/help/saving_energy/trees)

needles) even under well-watered conditions may mean that species is not able to adapt to climate changes and should be avoided in future plantings. Additional tree maintenance should include pruning to increase structural integrity and provide resistance to and recovery from storm damage while increasing the life span and ecosystem services provided by the tree.

We also need to plant diverse species of trees to promote resilience given an increasing number of pests/pathogens also associated with climate change. Choosing long-lived tree and/or native species to plant in urban and rural areas will more effectively store carbon: in [today's carbon economy](#), the CO2 emissions of an average global citizen can be absorbed by approximately 165 mature trees.

With their wealth of ecological and social benefits, the trees we have are valuable, and we need to support and strengthen on-going tree planting programs. In the face of climate change we should both plant more trees and provide essential care for the precious trees we already have.



IOWA CLIMATE STATEMENT 2022

Lead authors: **Heather Sander**, Associate Professor, Geological and Sustainability Sciences, UI; **Jan Thompson**, Morrill Professor, Natural Resource Ecology and Management, ISU; **Jerry Schnoor**, Co-director, UI Center for Global and Regional Environmental Research; **Gene Takle**, Emeritus Professor of Agronomy, ISU; and **David Courard-Hauri**, Chair of Environmental Science and Sustainability, Drake University.

Contributing authors: **Matt Dannenberg**, Assistant Professor, Geographical and Sustainability Sciences, UI; **Bill Gutowski**, Professor of Meteorology Department of Geological and Atmospheric Sciences, ISU; **David Osterberg**, Emeritus Professor, College of Public Health, UI; **Ulrike Passe**, Professor of Architecture, Director Center for Building Energy Research, ISU; and **Peter S. Thorne**, Professor and Head, Occupational & Environmental Health, Associate Director, Environmental Health Sciences Research Center, College of Public Health, UI.

Endorser affiliations are for identification purposes only and do not reflect views of their academic institutions.

Endorsing Institutions:

- Central College
- Clarke University
- Clinton Community College
- Coe College
- Cornell College
- Des Moines Area Community College
- Des Moines University
- Dordt University
- Drake University
- Ellsworth Community College
- Grandview University
- Grinnell College
- Hawkeye Community College
- Indian Hills Community College
- Iowa Central Community College
- Iowa Lakes Community College
- Iowa State University
- Iowa Western Community College
- Kirkwood Community College
- Luther College
- Maharishi University of Management
- Morningside College
- Mount Mercy University
- Northeast Iowa Community College
- Simpson College
- Southeastern Community College
- Southwestern Community College
- Saint Ambrose University
- University of Iowa
- University of Northern Iowa
- Upper Iowa University
- Waldorf University
- Wartburg College



IOWA ENVIRONMENTAL FOCUS

CGRER's blog, Iowa Environmental Focus, features daily environmental news, reports on faculty research, and analysis of leading environmental issues impacting Iowa and the world. The blog is compiled and written by CGRER's communication interns who capture stories, photos, and videos pertaining to climate change and other environmental issues. In addition to the Iowa Environmental Focus, CGRER engages Iowans through Facebook and Twitter.

Recent stories featured on the blog include a recap of how the manufacturing company 3M plans to stop making 'forever chemicals' by the end of 2025; a story on how Hawaii's coral reefs are now protected under a \$2 million insurance policy; and how hundreds of thousands of tons of bacteria are being released from melting glaciers.

Read the full articles and follow the blog at: <https://iowaenvironmentalfocus.org/>



CGRER INTERNS

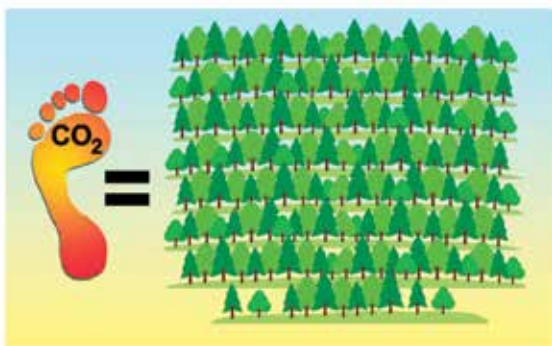


Elyse Gabor is in her third year at the UI where she is pursuing a BA in Journalism and Mass Communications and a BS in English and Creative Writing. In addition to her responsibilities as an intern for CGRER, Gabor serves as a Content Marketing Assistant at the Iowa College of Law. After graduation, Gabor plans to pursue a career in public relations.



Grace Smith is a third-year UI student working toward a BA in Journalism and Mass Communication, as well as a degree in Cinematic Arts. In addition to her responsibilities as a communications intern for CGRER, Grace is a photojournalist, filmmaker, and projects reporter for The Daily Iowan. After graduation, Grace hopes to pursue photojournalism and visual storytelling.

Carbon Footprint of Average Global Citizen Absorbed Annually by Trees
One Citizen = 165 Mature Trees



Source: European Environment Agency. Trees Help Tackle Climate Change. Accessed 7/18/22. Trees help tackle climate change — European Environment Agency (europa.eu) The Nature Conservancy. What is Your Carbon Footprint? (Accessed 5/5/22) <https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/>

FINAL WORDS FROM CGRER'S OUTREACH & EDUCATION DIRECTOR



Joe Bolkcom

Since 2008, I have served as CGRER's Outreach and Education Director. In this part-time role, which I left at the end of last year, I have appreciated working with many talented and hardworking science faculty and staff at the UI and at colleges and universities across Iowa.

I am especially grateful to have worked for CGRER co-directors **Jerry Schnoor** and **Greg Carmichael**. Since 1990, they have done an amazing job guiding the work of the center and have excelled as leading climate scientists at the UI and

The lead authors present the 2017 Iowa Climate Statement.



beyond. I have also had the pleasure of working with many talented UI journalism and mass communication students to help develop their writing and communication skills by working to boost Iowans' understanding of climate change and the environmental problems that face our state.

One of the main projects I have helped lead for the past twelve years has been to organize, research, compile, and publish the Iowa Climate Statement. This effort was made possible through the leadership of key faculty from Iowa's public and private colleges and universities. This effort has been led by a core writing group of Iowa's top academic climate and environmental faculty including **Dave Courard-Hauri**, **Gene Takle**, **Jerry Schnoor**, **Greg Carmichael**, **David Osterberg**, **Peter Thorne**, **Bill Gutowski**, **Dave Swenson**, **Ulrike Passe**, **Kamyar Enshayan**, **Betsy Stone**, **Silvia Secchi**, and **Eric Tate**.

The work of climate scientists has not been easy. For at least 30 years, powerful special interests and some political leaders have undermined efforts of the climate

science community to share well-understood, basic physics on how carbon dioxide and other gases build up in our atmosphere and impact our ability to live safely on earth. This well-funded effort to sow disinformation and doubt has not deterred scientists from their work of sharing what they know about the perils we face. In fact, their predictions over the past three-plus decades have been stunningly accurate.

The Iowa Climate Statement has provided trusted Iowa science leaders an important voice to share the latest Iowa-specific impacts on how climate change and extreme weather events impact and will continue



Betsy Stone works with CGRER interns to create a 60 second radio segment.



Ted Neal teaches a climate science curriculum.

to affect agriculture and the people living in the Midwest, as well as what we can do to address these specific threats. The statement has been endorsed by hundreds of science faculty and researchers at virtually every Iowa college and university.

In addition to the Iowa Climate Statement, our outreach has included producing and distributing hundreds of *On the Radio* 60-second radio segments to Iowa radio stations on Iowa environmental issues and research. We produced and shared dozens of videos featuring the research and projects of faculty and students. We curated thousands of climate change and environmental news and research stories at our daily *Iowa Environmental Focus* blog and Facebook page; hosted ten legislative breakfast receptions at

the statehouse; organized annual Climate Science Educators Forums and several annual climate and environmental symposiums. Finally, we helped develop, in collaboration with UI College of Education expert **Ted Neal**, a climate science curriculum for Iowa seventh and eighth-grade students.

As the negative impacts of climate change become more costly and the need to adapt and mitigate becomes a necessity, the

This well-funded effort to sow disinformation and doubt has not deterred scientists from their work of sharing what they know about the perils we face.

work of Iowa's academic research centers that advance agricultural sustainability, climate change, and energy research and solutions could not be more relevant and necessary. Sadly, Iowa politicians who have controlled state government for the last six years have quietly ended funding for the work of the ISU Leopold Center for Sustainable Agriculture, ISU Iowa Energy Center, and CGRER.

These decades-old, legislatively created academic research centers have served Iowans well. They have brought

researchers, science, and practical solutions to addressing Iowa's most challenging climate and environmental problems. The problems have not disappeared. Fortunately for Iowans, nor will the ongoing work of the dedicated science faculty and researchers at Iowa's under-funded public and private colleges and universities.

Iowa's growing climate, environmental and public health challenges are immense. In the coming decades, one extreme

weather disaster after another will dramatically impact our way of life. Will we be prepared? Will we be able to adapt? Will we be able to feed ourselves?

Without a doubt, sometime down the road, Iowa's political leaders will once again turn to the scientists at their public universities and ask for help. We can only hope that happens sooner rather than later.

Joe Bolkcom
CGRER Director of Outreach and Community Education

TREES CAN KEEP US COOL AS IOWA ANTICIPATES MANY MORE DANGEROUS HOT AND HUMID DAYS

Climate change is here. In Iowa, we have witnessed more frequent and intense heavy precipitation, floods, droughts, and powerful derechos, all of which create conditions that threaten our trees. The Iowa Climate Statement [2022: The Many Benefits of Our Trees](#) is focused on the climate threats and strategies to expand and support urban trees and rural woodlands.

"Iowa is going to become much hotter in the decades ahead. It is projected that Iowa will go from having a handful of 95° days in 2022 to having as many as 35 95° days per year in 2050. And 95 95° days a year by 2080," said **Jerry Schnoor**, CGRER co-director. "Projections also

indicate Iowa will experience 5-15 days each year over 106°F during the period 2041-2061."

"The August 2020 derecho, the most destructive thunderstorm in US history is emblematic of the impact of climate change on our trees. This extreme event led to the loss of an estimated 7 million rural and urban trees in Iowa," said **Dave Courard-Hauri**, Chair of Environmental Science and Sustainability Program, Drake University. "Recovering from this event will take years of coordinated efforts and millions of dollars of investment."

"Attention to the species of trees we plant and their care will be crucial for their survival. Strategies are needed both to sustain the many benefits

of existing large mature trees and to increase planting of appropriate new trees for mitigating and adapting to climate change," said **Jan Thompson**, Morrill Professor, Natural Resource Ecology and Management, Iowa State University. "Tree keep us cool. The proper placement of just three trees can save an average household between \$100 and \$250 in energy costs annually."

"With their wealth of ecological and social benefits, the trees we have are valuable. We need to plant diverse species of trees to promote resilience and support and strengthen Iowa's ongoing tree planting programs," said **Heather Sander**, Associate Professor, Geographical and Sustainability Sciences, University of Iowa. "In the face of climate change, we should both plant more trees and provide essential care for the precious trees we already have."

The 12th annual Iowa Climate Statement 2022: *The Many Benefits of Our Trees* was endorsed by 203 Iowa science faculty and researchers from 33 Iowa colleges and universities. CGRER has coordinated the release of annual climate statements since 2012. These statements, vetted by Iowa's top experts, place pivotal climate change research into an Iowa-specific context, encouraging preparedness and resilience in the face of a climate crisis.

Joe Bolkcom
CGRER Director of Outreach and Community Education

IOWA FLOOD CENTER OUTREACH PROGRAM: EVERYWHERE ALL THE TIME



After two years of working remotely, Zoom meetings, and virtual conferences, the [Iowa Flood Center](#) outreach team welcomed the chance to safely resume some in-person activities. In the fiscal year 2022, the IFC had one of its greatest

Iowa Flood Center Graduate Assistant Stephanie Erps uses a table-top model to educate students about watersheds and flooding.

years for outreach programming to date, participating in nearly 80 events including STEAM (Science, Technology, Engineering, Arts, and Mathematics) festivals, county fairs, field days, watershed tours, teacher workshops, and more. IFC's dedication to its education and outreach program has earned it the reputation of "being everywhere, all the time," and is helping to build a more flood-resilient Iowa.

SCHNOOR DELIVERS GRAND CHALLENGES ARNTZEN LECTURE



Jerald Schnoor gave the 2022 Grand Challenges Arntzen Lecture at Arizona State University.

In November, **Jerald Schnoor**, CGRER co-director and UI professor of civil and environmental engineering, gave the 2022 Grand Challenges Arntzen Lecture at Arizona State University. The theme for the series was "Sustainability in the Face of Climate Change."

Schnoor's lecture, which took place at the Walton Center for Planetary Health Auditorium, discussed the changes that have occurred on Earth with special emphasis on the atmosphere, biosphere, and oceans, as well as prospects for stabilizing the climate and transitioning out of the fossil fuel age. With record heat waves and drought, Schnoor acknowledged how we are

experiencing not "the new normal," but rather an ever-increasing stress and deterioration of our planet. He noted how greenhouse gases are at the highest concentration found in the atmosphere for at least 2 million years, and our average temperature on earth is the warmest in at least 2,000 years. Schnoor addressed these challenges and changes with special emphasis on the atmosphere, biosphere, and oceans.

The lecture series was inspired by Dr. Charles (Charlie) Arntzen, who gained recognition for developing genetic strategies for using plants to manufacture pharmaceuticals and produce cost-effective vaccines or drugs to save lives around the world, especially in developing nations.

SCHNOOR RECEIVES OUTSTANDING ACHIEVEMENTS IN ENVIRONMENTAL SCIENCE & TECHNOLOGY AWARD

For his pioneering research on phytoremediation as a sustainable remediation technology, discovering novel pathways for the uptake, sequestration, and degradation of organic chemicals in the environment, and for his fundamental contributions, leadership, and service in water quality engineering science, in modeling, chemistry, molecular biology, and policy, **Jerald Schnoor**, UI College of Engineering's Department of civil and environmental engineering and CGRER co-director, was awarded the Outstanding Achievements in Environmental Science & Technology Award: The Americas



Region from the American Chemical Society (ACS).

Through this award, ACS recognized Schnoor as a global leader and mentor in solving complex environmental problems that have significant societal relevance and positive impact in the world.

The award noted Schnoor's pivotal research in the 1990s on how plant enzymes transform contaminants dominated subsequent phytoremediation research developments and paved the way for this technology to become common practice around the world.

THE IOWA CLIMATE ASSESSMENT: VARIABILITY, TRENDS, AND IMPACTS

The climate of Iowa has undoubtedly changed in the last three decades. Some of the factors that indicate this change represent weather variable levels never experienced in the twentieth century. Some elements of Iowa's changing climate—such as fewer extreme high summer temperatures, fewer extreme cold winter temperatures, and longer growing seasons—have been favorable for human comfort, household energy use, and crop growth. However, other changes have not. For example, there are more extreme winds, more floods, and more humidity. In the last 42 years, Iowa has experienced 64 weather disasters, each of which created damage of more than \$1 billion dollars. Fifty of these have occurred since 2000.

While it is expected that records will be broken in some weather variables each year, isolated incidents, unusual trends, and new recurring features raise the prospect that some changes are beyond natural variability. Iowa's climate is closely linked to the global climate, so understanding local changes sends us to the global scale in search of trends and incidents that are or will cause a change in Iowa.

Fortunately, in 2022, the United Nations Intergovernmental Panel on Climate Change released its sixth Assessment Report which provides information on recent trends and future projected global and regional changes in climate. Additionally, by mid to late 2023, the interagency U.S. Global Change Research Program will issue its fifth U.S. National Climate Assessment report. These comprehensive reports, together with Iowa's rich 130-plus years of weather records, will reveal past cause-effect relationships with global climate and enable the use of global climate projections to determine the scope of future variability, trends, and impacts of climate changes in Iowa.

A team of scientists, primarily from Iowa's universities, is being assembled to conduct an Iowa Climate Assessment by reviewing the scientific evidence for climate change and its impacts on the state. The assessment will focus on past variability as well as projections of future climate trends and extremes and resulting impacts on the natural environment, water resources, agriculture, and human health.

The report will also review and highlight Iowa's opportunities



In the last 42 years, Iowa has experienced 64 weather disasters, each of which created damage of more than \$1 billion dollars. Fifty have occurred since 2000. Photo: Mary Moye-Rowley.

for participating in developing new measures for adapting to current and near-term climate trends as well as mitigating the long-term effects of climate change. The assessment will be policy-informing but not policy prescriptive and will be published by the Iowa Natural Heritage Foundation <https://www.inhf.org/iowa-climate-assessment/>. In order to take full advantage of ongoing global and national assessments, the Iowa assessment will become available after mid-2023.

Gene Takle
Emeritus Professor of Agronomy,
ISU

SCHNOOR SPEAKS AT WORLD FOOD PRIZE

In October, **Jerald Schnoor**, CGRER co-director and UI professor of civil and environmental engineering, delivered a talk titled "Climate Change and our Future" as part of the World Food Prize events that took place in Des Moines, Iowa.

The World Food Prize is an international honor that recognizes the achievements of individuals who have advanced human development by improving the quality, quantity, or availability of food in the world. The honor of 2022

Laureate was awarded to Dr. Cynthia Rosenzweig who was recognized for her seminal contributions to understanding and predicting the impacts of the interaction between climate and food systems.

Schnoor's speech, which was part of the USDA-Foreign Agricultural Service Borlaug Fellows portion of the event, focused on "where we are going, what we should expect, and what we can do about" increasing greenhouse gas concentrations, amounts of methane and nitrous oxide in the air, and warming global

temperatures. The event, whose theme was "Feeding a Fragile World," was conducted in a hybrid format to accommodate both in-person and virtual participants. Schnoor and fellow lecturers spoke about the role of agriculture, food security, and climate change in addressing adaptation and mitigation solutions to reach the SDGs by 2030. Lecturers also addressed scalable solutions for adaptation and mitigation to limit planetary warming below 1.5° C and achieve the Sustainable Development Goals.

TRASH TO TREASURE: REVITALIZING WASTEWATER TREATMENT YIELDS ECONOMIC OPPORTUNITIES IN RURAL IOWA TOWNS

Iowa is using State Energy Program funds to improve energy efficiency in wastewater treatment facilities to benefit rural communities across the state.

Striving for Equity in Rural Energy Resources

Revitalizing rural America means giving it the same access to resources and opportunities as urban areas. As part of a strategy to drive this rural-urban equity, the Iowa Economic Development Authority (IEDA), in partnership with UI, is working to develop innovative energy and wastewater solutions for rural Iowa communities where municipal wastewater treatment costs often stifle local economic vitality.

Through the Iowa Wastewater and Waste to Energy Research Program (IWWERP), IEDA and UI spearheaded the construction of a state-of-the-art tech park and have supported nearly 50 communities in improving the energy efficiency of their wastewater treatment facilities and testing new technologies to capture nutrients and generate renewable natural gas.

The U.S. Department of Energy's (DOE) State Energy Program (SEP) provided funding to support this program, which helps advance shared goals of promoting economic growth, improving environmental quality, reducing energy costs and waste, and bolstering the resilience of energy infrastructure.

What Is Wastewater and Why Treat It?

Wastewater is storm runoff and water used by homes, industries, and businesses that can be treated by removing harmful substances like excessive phosphorus and nitrogen, bacteria, viruses, mercury, lead, and more, before being released back into the environment. These substances can pollute land, water, and agriculture, making food dangerous to consume and recreation areas too polluted to enjoy.

Not only that, but poor wastewater can cause water scarcity, waste energy, and overall contribute to climate change and poor public health. Proper wastewater treatment is vital in maintaining healthy environments for humans and nature alike and ensuring water security.

Proper wastewater treatment also has a variety of economic benefits for communities. Treated wastewater is an effective fertilizer yielding healthier crops and can even be used to generate electricity. More efficient wastewater treatment can also unlock savings for ratepayers, as communities have experienced a 24% increase in wastewater treatment rates from 2008 to 2016 from aging, leaky infrastructure.

As many U.S. wastewater treatment facilities are nearing the end of their lives, revitalizing them, and building new ones, can increase energy efficiency and deliver lower prices for consumers, especially those in rural and low-income communities with fewer resources to upgrade facilities.



BES Water Solutions is working with IWWERP to optimize biological and physical-chemical treatment processes for small-town wastewater lagoons. The units can remove ammonia and suspended solids while providing pH adjustment and disinfection. Photo: Iowa Economic Development Authority.

Spurring Innovation in Wastewater Treatment

To better support communities' wastewater needs and spur innovation in wastewater treatment technologies, IEDA launched IWWERP in December 2020 with a \$3.8 million grant award to UI. UI then partnered with Iowa Department of Natural Resources, Iowa Water Environment Association, and Iowa Rural Water Association to construct the IWWERP Tech Park at the Iowa City Municipal Water Resource Recovery Plant.

The Tech Park features a state-of-the-art, \$1.5 million revolving algal biofilm research facility, which was commissioned in December 2022, and the UI main campus offers full-service labs for water chemistry, microbiology, algae biomass, and biogas characterizations, along with a wide range of instruments.

IWWERP researchers work closely with commercial vendors, such as technology manufacturers and engineering consultants, to develop and test new and improved technologies. Five private companies are currently participating in the



The Tech Park features a state-of-the-art, \$1.5 million revolving algal biofilm research facility, which was commissioned in December 2022. Photo: "Extracting Resources and Renewable Energy from Waste" video courtesy of UI.

optimization of technologies at the IWWERP Tech Park or at field locations with IWWERP support.

Communities can also take advantage of IWWERP's comprehensive analytical capabilities and technologies to address their unique local wastewater treatment needs. As of October 2022, nearly 50 communities in Iowa have been impacted by IWWERP activities.

Reaching Clean Energy Goals

The wastewater treatment facility in Atlantic, Iowa, which treats roughly one million gallons of wastewater per day, was the first to realize early energy savings. The Atlantic facility implemented changes to the aeration sequence which resulted in better nutrient removal and cost savings of nearly \$5,000 per year—a significant chunk of money for a facility with an annual budget of \$95,000.

IWWERP is also working with Sioux City to improve production of renewable natural gas through co-digestion of non-municipal organic wastes. After a recent digester cleanout caused a major loss in biomethane production, IWWERP provided technical assistance to the city and helped increase renewable natural gas production by 18% and physical gas revenue by 25%.

IWWERP is a great example of how states can leverage federal funding and partnerships with industry, universities, and municipalities to empower rural communities while also cleaning the environment, generating energy and cost savings, and creating new energy opportunities. DOE looks forward to continuing its support for IEDA's efforts to expand Iowa's economy while protecting and improving Iowa's natural environment.

Julie Howe
Technology Project Specialist

The wastewater treatment facility in Atlantic. Photo: Snyder & Associates.



On screen: Jim Mihelcic (University of South Florida) and Jerry Scnoor. In front: Craig Just, Megan Lindmark, David Cwiertny and Kelly Baker.

Megan Lindmark received her PhD from UI in civil and environmental engineering in the Sustainable Water Development Program where she was a member of the Just Research Group. Lindmark is passionate about drinking water solutions for resource-constrained communities. Her research focuses on using advances in cellular technology to elevate and improve existing systems and ultimately positive health outcomes. Prior to her time at Iowa, Lindmark worked in Uganda investigating borehole well water quality with a regional health center, and in Panama exploring the effect of land use practices on microbial communities present in stream water.

Currently, she is developing cell phone-enabled sensor-based monitoring systems for chlorination systems in Central America with NGO partner EOS International. Lindmark, who received a B.S. in environmental science at Drake University and defended her PhD dissertation in December, recently had a review paper on passive chlorinators published in Environmental Science and Technology. Her third paper will be about the SMART Chlorinator system. Lindmark hopes to continue to generate research-driven solutions to drinking water challenges for communities that need them most.

EDUCATION

RILEY POST WINS 3MT AWARD

Riley Post, UI civil and environmental engineering, won the 2022 Graduate College Three Minute Thesis (3MT) Competition. 3MT is a research communication competition that challenges graduate students to clearly and concisely articulate complex research to non-specialist audiences. Contestants represent an array of disciplines and reflect the passion for discovery common among all of Iowa's graduate students.

I am fortunate that the civil and environmental engineering (CEE) department prioritizes communication in its graduate program. They do this by requiring students to enroll in four semesters of Coaching Seminars focused on research communication. Academia is rife with technical jargon, overly complicated methods, and convoluted figures that alienate the greater community from our work. CEE faculty participate in this seminar in order to equip graduate students with the tools needed to present research in a meaningful way.

The process starts by breaking down the primary research question using only the 1000 most used English words and iteratively building from this point to construct a presentation that is informative, entertaining, and approachable. It is no coincidence that the past three 3MT winners have been from CEE. The combination of critical feedback paired with in-class practice makes delivering the

3MT during the competition much easier. The topic of my 3MT focused on how, over the past several decades, Midwestern states have seen a rise in both the frequency and the magnitude of flooding. While a changing climate plays a major role in these increases, towns and cities are expanding into floodplains exacerbating the effects of these events. At its simplest, flooding is a combination of rainfall (where it falls and when) and the amount of storage a river contains to accommodate that rain. While we can't control the rain to reduce flooding, reservoirs, levees, and sandbag walls change the storage in a watershed enough to reduce flooding, though recent floods have overpowered even these time-tested solutions.

My research aims to add additional storage to river systems by utilizing the ponds and wetlands throughout a watershed, adding gated outlets so we can control the water



Riley Post with UI President Barbara Wilson.

level at each pond, and operating them as a system to reduce flooding. Combining locations in this fashion adds large amounts of storage to a river system and through hydrologic modeling, I have been able to show drastic reductions in flooding.

I am naturally a curious person so attending 3MT competitions is enjoyable. There is a tremendous amount of work being done throughout the UI and 3MT brings researchers together by providing an opportunity to share work in an approachable way. This opportunity allows someone like me to learn about immunology, gender studies, cancer research, history, and exercise science in one afternoon. The presentations this year were fantastic and I am humbled to have won the competition.

Riley Post
UI civil and environmental engineering

GUTTIKUNDA AWARDED AGU INTERNATIONAL AWARD

Sarath Guttikunda, a global leader in air quality analysis who earned a PhD from the University of Iowa in 2002, was named the winner of the 2022 American Geophysical Union (AGU) International Award.

The award is given annually to a mid-career or senior scientist team, individual, or group in recognition of making an outstanding contribution to

furthering the Earth and space sciences and using science for the benefit of society in developing nations and is among the AGU's highest honors.

The chemical engineer, atmospheric scientist, TED fellow, and founder of Urban Emissions (India), has worked to bridge the gap between science and policy. Two programs are at the heart of his work: air quality forecasting,

and the Air Pollution knowledge Assessments (APnA) program for cities with applications in Africa, Asia, Europe, and Latin America.

Guttikunda first gained experience building and applying air quality forecasting systems while pursuing a Ph.D. in chemical engineering and environmental policy at UI under the guidance of **Greg Carmichael**, professor of chemical and biochemical engineering.

CLIMAGEDDON: UNDERSTANDING CLIMATE CHANGE AND ASSOCIATED IMPACTS ON HEALTH

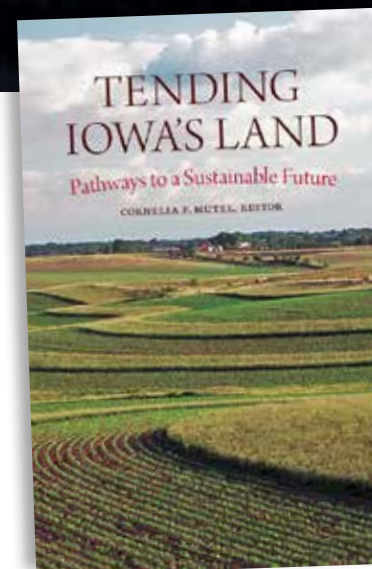
For the past six years, **Peter Thorne**, UI Occupational and Environmental Health, has taught the popular *Climageddon: Understanding Climate Change and Associated Impacts on Health* in the College of Public Health.

In this course, students learn about the discovery of global warming, underlying physicochemical principles, environmental impacts, climate disasters, species extinctions, public health effects, renewable

energy and the grid, ethics and environmental justice, and policy options relating to global climate change.

Additionally, they learn why climate change presents an existential threat and is the grandest challenge for the twenty-first century. Students are challenged to consider climate change solutions for adaptation and mitigation and their role in creating a sustainable future. Through the development of

team presentations delivered to the class, students take a deeper dive into a topic of their choosing. Past examples of these presentations include the impacts of fast fashion, diets centered around meat, climate change effects on coral reefs, mitigation of greenhouse gases through carbon farming, geoengineering, as well as policy and ethical issues regarding how global climate solutions should be funded.



TENDING IOWA'S LAND: PATHWAYS TO A SUSTAINABLE FUTURE

environmental problems and their implications for the future. The book is written in a straightforward, friendly style that draws readers into the questions at hand. Sixteen of Iowa's premier scientists consider what's happened to our deep prairie topsoils (originally the richest on Earth), once-crystalline waters, dependable climate, and native biological diversity, and why these changes are important. Chapters go on to outline viable solutions to the problems, as well as future visions that would benefit agriculture and the state's natural environments, thus helping to raise the quality of life for all. Mutel says the book's intended purpose is as a text for environmental studies or environmental science college students, as well as the general lay public.

The book's can-do, positive spirit is heightened by 12 essays written by Iowans who have dedicated their lives to improving the environment and making the state more sustainable. Together, the essays and science

chapters create an energizing call to action for everyone who cares about Iowa, nature and environmental issues and our common future.

The book is written to empower, rather than depress, its readers. Collectively we can indeed tackle our environmental difficulties. We know what will work and what to do. The future lies in our hands. The time for action is now.

"As a lifelong Iowan, this tapestry of science, history, and personal stories moved me to think about our changing climate and my own actions. While many of our current circumstances seem dire, Connie and the amazing team of contributors gave me hope by shining a bright light on the path forward," said Joe McGovern, president of the Iowa Natural Heritage Foundation.

Tending Iowa's Land is available from the University of Iowa Press or other online sources, and can be ordered from local bookstores.

NSF BLUEGAP PROJECT LED BY UI RESEARCHERS



Ibrahim Demir and David Cwiertny. Photo: IIHR.

UI College of Engineering's **David Cwiertny** and **Ibrahim Demir** were selected to lead a portion of a multi-institution, multi-disciplinary National Science Foundation (NSF) project designed to tackle a problem at the intersection of climate, sustainability, food, energy, pollution, and the economy.

The Blue-Green Action Platform, or BlueGAP, aims to connect communities across watersheds to address economic and health

challenges caused by nitrogen pollution in their water and local environment. BlueGAP is a systems model focused on local experiences and knowledge to show people the costs and benefits of actions at specific leverage points of nitrogen management.

"Nitrogen pollution is a continental-scale problem that affects communities across the U.S. in many ways. BlueGAP aims to amplify the voices of those community champions working to improve water quality through compelling storytelling and engaging data visualizations that will also help raise awareness and empower others to take action," said Cwiertny, the project's co-principal investigator.

The team will be developing next-generation information

platforms with visualization, data analytics, and artificial intelligence capabilities to support communities in understanding and acting on their water quality challenges. "Artificial Intelligence and visual data analytics systems will play a significant role in making information and knowledge more accessible to communities to support their decision-making," said Demir.

The project was awarded \$5 million over two years, \$1.5 million of which will go to supporting the UI team's efforts. BlueGAP is one of six multi-disciplinary teams selected for phase 2 funding through NSF's \$30 million Convergence Accelerator Networked Blue Economy investment to take aim at big-picture challenges related to the blue economy.

MENA-CARRASCO RECOGNIZED AS TOP 30 GLOBAL LEADERS



Marcelo Mena-Carrasco. Photo: Insider Magazine.

Insider Magazine's inaugural "Climate Action 30" highlighted 30 global leaders working toward climate solutions. The list included **Marcelo Mena-Carrasco** as well as activists, influencers, academics, scientists, business executives, entrepreneurs, and public-sector and nonprofit leaders working to address the climate crisis through collectivism, community, and accountability.

The article outlined Mena-Carrasco's work as a professor of civil and environmental engineering at the Pontifical Catholic University of Valparaíso in Chile; the CEO of the Global Methane Hub; and a former Chilean environment minister. It concluded by summarizing Mena-Carrasco's call to action by stating that "global Methane Hub supports investments that lay the groundwork for transformative methane-mitigation work. Reducing methane emissions will not solve the climate crisis by itself. However, we cannot avert climate catastrophe without drastically and rapidly reducing methane. It is one of our best shots at bending the warming curve."

The feature can be read in full on the Insider Magazine website.



Larry Weber. Photo: IIHR.

WEBER RETURNS AS IIHR—HYDROSCIENCE & ENGINEERING DIRECTOR

Larry Weber, the Edwin B. Green Chair in Hydraulics and professor of civil and environmental engineering, accepted a three-year appointment as director of UI IIHR-Hydroscience and Engineering beginning September 1, 2022. Weber served as IIHR director for 13 years before joining the Dean's Office where he served as executive associate dean from 2017-2018.

In his time as IIHR director, Weber expanded IIHR funding significantly, worked in collaboration to establish the Iowa Flood Center and the Iowa Nutrient Research Center, and integrated the Iowa Geological Survey into the UI. Weber brings to this role his institutional knowledge, his commitment to research excellence, and his dedication to the IIHR mission and its community.

IOWA WATERSHED APPROACH PROGRAM AND WEBER RECEIVE NATIONAL RECOGNITION



The Iowa Watershed Approach (IWA) was a six-year (2016-2022) program, that helped bring over \$100 million to the state, primarily funded by the U.S. Department of Housing and Urban Development.

The IWA leveraged local, state, and federal partnerships to develop equitable strategies to reduce flooding, improve water quality, and increase community resilience to water resources challenges.

The IWA worked progressively with agriculture and landowners to identify priority areas in select watersheds to implement flood mitigation practices, such as ponds, terraces, and wetlands, which work to restore the landscape's natural resiliency to heavy rainfall. IWA researchers used GHOST (Generic Hydrologic Overland-Subsurface Toolkit), a new state-of-the-art watershed-scale hydrologic model developed for the project by IFC researchers.

GHOST informed the implementation of the IWA's flood mitigation practices. Volunteer landowners received

up to 90 percent cost-share assistance to implement the practices. The dual program also focused on community flood resilience programming to protect vulnerable populations from future flooding. At the program's sunset in 2022, nearly 700 conservation practices were installed and \$40 million was allocated for conservation.

Larry Weber, IWA project lead, was instrumental in building and promoting Iowa's unique watershed management authorities (WMAs) to help carry out the goals of the Iowa Watershed Approach. The WMAs are at the heart of the IWA, bringing together representatives from cities, counties, soil and water conservation districts, and other partners and stakeholders who work together on strategic watershed planning and management activities. The WMAs build local capacity and serve as a mechanism to sustain and advance the goals of the IWA into the future.

"It's all about people. I will always hold dear the friendships I've made through the WMAs with people from all corners of the state," says Weber.

The success of the IWA depends on collaborative partnerships among many statewide organizations and local stakeholders; together, they carry out the work necessary to achieve the IWA goals. Partners include but are not limited to: U.S. Department of Housing and Urban Development; Iowa Economic Development Authority; Iowa Homeland Security and Emergency Management; University of Iowa; Iowa State University; University of Northern Iowa; Iowa Department of Natural Resources; Iowa Department of Agriculture and Land Stewardship; cities of Coralville, Dubuque, and Storm Lake; and many Iowa counties and private contractors. These partnerships have evolved to support many other projects built on the framework of the Iowa Watershed Approach.

"I'm incredibly proud of the work that's been accomplished through IWA," says Weber. "We have a lot of work left to do, but the goal is for the momentum to continue moving forward."

Weber says he feels a deep-rooted passion and commitment to the state of Iowa and its natural resources. "I feel a responsibility to the people of Iowa."



UI ESTABLISHES NEW CENTER FOR HYDROLOGIC DEVELOPMENT

In 2022, the UI College of Engineering announced the formation of a new research center: the Center for Hydrologic Development (CHD).

Initial funding for the new center came from the Cooperative Institute for Research to Operations in Hydrology (CIROH) housed at the University of Alabama and funded by the National Oceanic and Atmospheric Administration (NOAA). The UI expects about \$21 million from CIROH in the first five years.

The CHD will build on over a century of hydrologic research and education at IIHR—Hydroscience and Engineering (IIHR), established in 1920. The new center will also complement the work of the Iowa Flood Center (IFC), founded in 2009 and representing the first and only center in the nation focused solely on flood-related research and education.

Larry Weber, director and co-founder of CHD and professor



The Center for Hydrologic Development is located in the Hydroscience & Engineering building on the Iowa River.

of civil and environmental engineering, expects the center to play a critical role in helping NOAA's National Weather Service achieve its goal to achieve a Weather-Ready Nation.

"The new Center for Hydrologic Development will build on the work of the Iowa Flood Center and provide a mechanism for researchers and students to expand IFC innovations beyond Iowa," said Weber, who is also co-founder of the Iowa Flood Center.

The CHD will focus on several key areas of research, including

expansion and improvement of water prediction capabilities and advancement and acceleration of community water resources modeling.

"Establishing the Center for Hydrologic Development at the University of Iowa will ensure we remain national leaders in hydrologic research and education," said Weber. "As a key CIROH partner, we will have a conduit to share our innovations with NOAA to fast-track wide-scale implementation of our new tools. It doesn't get much better than that."

CGRER INVESTS IN HIGH PERFORMANCE STORAGE SERVER

CGRER provides high-performance computing resources that support the interdisciplinary research of its members and their students. The research computing power focuses on a shared high-performance computing cluster capable of delivering extensive resources and software in a

parallel computing environment. This computing cluster, known as Argon, is located at the Information Technology Facility at the UI's Oakdale campus.

CGRER is an investor in the Argon cluster. This resource provides researchers with dedicated resources when conducting research and

analysis. The Argon cluster continually evolves and includes graphical processing units, built-in machine learning, and artificial intelligence capabilities. CGRER implemented a 400-terabyte high-performance storage server in 2021 to use in conjunction with the computer cluster, ensuring CGRER researchers access to vast amounts of data storage space in the years to come.

The UI has transitioned to an ArcGIS Online license for Environmental Systems Research Institute products. CGRER is a part of a coordinated campus support system. **Jeremie Moen** is a member of the campus GIS Technical Advisory Committee and facilitates requests for support of ArcGIS Online.



The Argon Computing Cluster on the UI campus. Photo: Ben Rogers.

SCHNOOR RECEIVES LIFETIME ACHIEVEMENT AWARD



Jerry Schnoor. Photo: Justin Torner.

Jerry Schnoor, Allen S. Henry Chair in Engineering in the UI College of Engineering's Department of civil and environmental engineering and CGRER co-director, was given the UI's prestigious Leadership in Research Award. This is a lifetime achievement award recognizing research and scholarly accomplishments over a career.

The award was administered in the fall of 2022 by The Office of the Vice President for Research as part of the annual Discovery

and Innovation awards program. Schnoor was nominated by **David Cwiertney**.

"Jerry is an exceptional scholar and leader at the University of Iowa, a nationally-recognized expert in environmental engineering, and a champion for science in the public sphere," said Marty Scholtz, Vice President for Research. "It's an honor to recognize his lifetime of research excellence, education, and service."

A SAMPLING OF AWARDS, ACHIEVEMENTS & APPOINTMENTS

Ibrahim Demir received the UI Distinguished Achievement in Publicly Engaged Research Award from the Office of the Vice President for Research. Demir was also awarded the Early Career Faculty Excellence Award from the UI College of Engineering.

Sarath Guttikunda, a global leader in air quality analysis who earned a Ph.D. from the University of Iowa in 2002, was named the winner of the 2022 American Geophysical Union (AGU) International Award.

William Gutowski, along with M. Bukovsky, L. Mearns, D. Paquin and S. Pryor, convened the workshop "Use of Storylines from Regional Simulation for Climate Hazards and Stakeholder Engagement" under the auspices of CORDEX-North America which was hosted by Ouranos, Montréal in April.

Lu Liu was the invited speaker at the International Outstanding Youth Environment Forum held in November. The title of Liu's talk was "Modeling the resilience of Houston's wastewater system under wet weather."

Ulrike Passe, ISU Architecture, delivered the keynote address at the 2022 Comfort at the Extremes Conference, which was held in

September at The Royal College of Physicians of Edinburgh. Passe spoke about "Improving ventilation on the macro and micro scale" with a specific focus on Resilient Comfort: Climate Change, COVID and Ventilation. Additionally, Passe served as a member of the Technical Advisory Group of the Des Moines Climate Action Plan.



Lily Jones



Sayre Satterwhite

Sayre Satterwhite, a student of **Corey D. Markfort**, was named the National Oceanic and Atmospheric Administration 2022 Scholar. The scholarship provides financial support for Satterwhite's third and fourth years in the form of two stipends, an internship opportunity at an NOAA facility, and logistical support to attend and present at NOAA's annual conference, as well as two additional national scientific conferences.

Scott Spak received the Iowa Initiative for Sustainable Communities Faculty Excellence and Service Award and also led the Iowa City Solar 2035 report to the Johnson County Clean Energy District, which was developed by Spak's Environmental Policy and Management course.

Elizabeth A. Stone was awarded a Fulbright U.S. Scholar Fellowship and was named an Honorary Professorial Fellow at the University of Melbourne in Australia. Two of Stone's students achieved recognition as well.

Lily Jones was awarded an NSF Graduate Fellowship and has gone on to attend graduate school at Colorado State University. **Chamari Mampage** earned a student poster award from the American Association of Aerosol Research for her poster presentation in October 2022.

CONFERENCE TRAVEL GRANTS FOR GRADUATE STUDENTS

Uchekukwu Akporere

UI Chemistry
American Chemical Society
National Meeting

Yazeed Alabbad

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Renato Amorim

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Kate Borchardt

ISU Ecology, Evolution, and
Organismal Biology
Entomological Society of
America

Issi Burger

ISU Ecology, Evolution, &
Organismal Biology
The Society for Integrative &
Comparative Biology

Wei Chen

ISU Geological and Atmospheric
Sciences
American Association of
Geographers Annual Meeting

Jessica DeYoung

UI Chemistry
American Chemical Society
National Meeting

Carlos Erazo Ramirez

UI IHR—Hydroscience &
Engineering
American Geophysical Union
National Meeting

Fatemeh Ganji

ISU Civil Construction &
Environmental Engineering
American Geophysical Union
National Meeting

Blake Hudson

UI Chemistry
American Chemical Society
National Meeting

Sadya Islam

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Lily Kraft

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Breanna Marmur

ISU Natural Resource Ecology
and Management
Iowa Water Conference

Alyssa Miannecki

UI Civil & Environmental
Engineering
Illinois Emerging Contaminants
in the Environment Conference

Alexander Michalek

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Briante Najev

UI Biology
Evolution Conference

Riley Post

UI Civil & Environmental
Engineering
American Geophysical Union
National Meeting

Victoria Rivera

UI Chemistry
American Chemical Society
National Meeting

Amelia Sweet

UI Chemistry
American Chemical Society
National Meeting

Beiming Tang

UI Chemical & Biochemical
Engineering
American Geophysical Union
National Meeting

Bo Yi

ISU Ecology, Evolution, and
Organismal Biology
American Geophysical Union
National Meeting

FIELD RESEARCH TRAVEL GRANTS FOR GRADUATE STUDENTS

Christopher Brunet

UI Civil & Environmental
Engineering
Siloxane Field Sampling
New York

Teresa Feldman

UI Chemistry
*Bioaerosols and Convective
Storms*
Colorado

Chamari Mampage

UI Chemistry
Comparative analysis of

*atmospheric pollen fragments
in Melbourne, Australia, Great
Plains, and the Midwestern
United States*
Australia

Jeewani Meepage

UI Chemistry
*Molecular characterization
and quantification of principal
oxidized volatile methyl siloxanes
in ambient air sample*
New York

Briante Najev

UI Biology
*Can phosphorus limitation help
explain the maintenance of
ploidy polymorphism and sexual
reproduction in a New Zealand
freshwater snail?*
New Zealand

DECARB 2040: A YEAR IN REVIEW

The central question of the Decarb 2040 exploration was: “how can research and development, education and outreach, markets, and socio-economic policy shift evolving barriers and attitudes towards the adoption of carbon management practices & energy technologies?”

The Decarb 2040 faculty members and students formed a convergent science team to learn from one another about the evolving barriers and attitudes regarding carbon management and energy technologies. The project participants became more knowledgeable about the carbon and energy landscapes in the Midwest as well as on state-of-the-science research on technology adoption, low carbon heating and cooling of buildings, and emerging agricultural carbon markets.

Beyond the central question, the group worked together to address the following supporting science questions and outcomes.

Technology Pathways

The often suggested strategy of electrification of building thermal control via heat pumps is likely to backfire on price and technology acceptance grounds. Given the highly uncertain future pathways for electricity availability, electricity pricing, and natural gas pricing, what are feasible decarbonization strategies/technology options for commercial and home heating?

The team published one paper and developed tools relevant to pros and cons of technology pathways for commercial and home heating. No current decarbonization pathway (heat pumps, passive solar, solid biofuels, gaseous biofuels, hydrogen blends, e-methane) can cost-effectively compete with natural gas in the retrofit space. However, heat pumps (both ground source and air

source) are the most feasible option for commercial buildings, and for residential new construction. The market is very sensitive to incentives, electricity pricing, natural gas pricing, and carbon pricing. The inflation reduction act allows up to \$14,000 in incentives for home electrification, so heat pumps should begin penetrating retrofit and new construction projects starting in 2023.

Adoption

How do residential and commercial property, buildings, and landowners make decisions about the adoption of rooftop solar, ground mount solar arrays, and partnering with utilities on solar arrays and wind turbines?

While the diffusion of solar energy has been researched by social scientists, prior research cannot identify the mechanisms that drive adoption (e.g., uncertainty about roles of visual exposure, peer pressure, or rational persuasion). We contribute to this interdisciplinary research by conducting a field experiment that examines different causal mechanisms of adoption.

Professor Ion B. Vasi worked with a graduate student Mario Paez-Arellano to develop an online experiment to study the blue marble effect. This experiment examines how novel communication frameworks can contribute to the adoption of solar PV technology. Vasi and Paez-Arellano continue to collect data and submitted a paper for publication at the end of the year.

Rural Communities

What are the decarbonization and energy independence challenges, opportunities, barriers, and successful strategies specific to rural communities? How do these intersect with rural-urban equity issues?

REWIRING AMERICA

Image: Saul Griffith

The Hawkeye Decarbonization Summit was a two-day workshop that brought together 282 Decarb2040 partners, the UI community of researchers, staff and students interested in decarbonization, practitioners, and funding agency representatives to explore the path forward. The event featured over 25 speakers and panelists, including a keynote delivered by Saul Griffith, and was presented both in-person and virtually and required registration.

To help address this question, the team built relationships with researchers at ISU, farm groups, and the carbon market participant ESMC, as well as with other researchers with relevant expertise. The linkages between climate policy, energy policy, and rural decarbonization are a fast-moving target given the governor's carbon task force taking place during the jumpstart project. Additionally, BECCS, or bioenergy with carbon capture and sequestration, has been massively incentivized by the 2022 Inflation Reduction Act. This will force major investment and operational changes in Midwestern crop production and land use for the foreseeable future; a change that will impact rural communities, water quality, habitat, agrochemical use, and beyond. The first wave of this is carbon pipelines, the capture of carbon from corn ethanol and ammonia plants, and increased demand for corn.

Charles Stanier

UI Chemical and Biochemical
Engineering



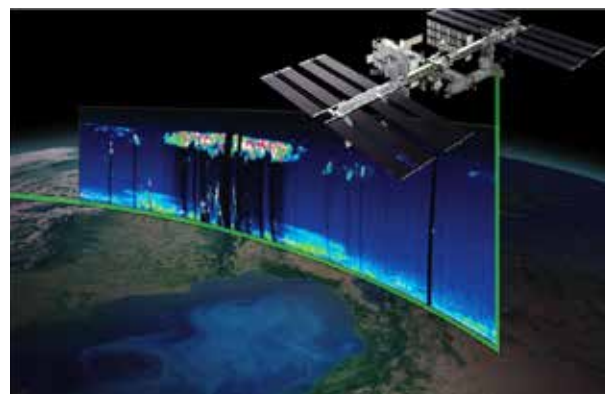
Neil Bernstein banding birds at the Indian Creek Nature Center in Cedar Rapids, Iowa.

Neil P. Bernstein is an adjunct professor in the earth and environmental sciences department at UI and professor emeritus at Mount Mercy University. He has taught field ecology, behavior, ornithology, and ichthyology classes at Iowa Lakeside Laboratory since 1986. Since 1996, his research has focused on conservation ecology of ornate box and yellow mud turtles, endangered, and threatened species in Iowa.

More recently, he has expanded bird banding operations. His teaching involves all ages but especially focuses on his past UI students. While finishing up his research, he continues to focus on educating future generations to become involved in environmental preservation and research.



Matthew McGill is a Professor in the department of chemical and biochemical engineering. He received his PhD in atmospheric science from the University of Michigan, Ann Arbor. His research focuses include lidar remote sensing, Doppler lidar, radiative transfer, atmospheric physics, atmospheric dynamics, interferometry, and instrument development.



Matthew McGill develops lidar (laser based) remote sensors to study clouds and aerosols in the Earth's atmosphere. He was responsible for development of the Cloud-Aerosol Transport System lidar that was operated from the International Space Station from 2015-2017.



A SAMPLING OF PUBLICATIONS BY CGRER MEMBERS

Wise, E. K. and **M. P. Dannenberg**. Simulating the impacts of changes in precipitation timing and intensity on tree growth. *Geophysical Research Letters*, doi:10.1029/2022GL100863.

Yildirim, E. and **I. Demir**. Flood Risk Assessment and Quantification at the Community and Property Level in the State of Iowa. *International Journal of Disaster Risk Reduction*, doi:10.1016/j.ijdrr.2022.103106.

Denniston, R. F., C. C. Ummenhofer, K. Emanuel, R. Ingrosso, F. S. R. Pausata, A. D.

Flooding during a tropical cyclone (hurricane) in Exmouth, Western Australia. Photo: Darren Brooks.



Wanamaker, M. S. Lachniet, K. T. Carr, Y. Asmerom, V. J. Polyak, J. Nott, W. Zhang, G. Villarini, J. Cugley, D. Brooks, D. Woods, and W. F. Humphreys. Sensitivity of northwest Australian tropical cyclone activity to ITCZ migration since 500 CE. *Science Advances*, doi: 10.1126/sciadv.add9832.

Shenk, L. and **W. J. Gutowski**. Mind the gaps! Climate scientists should heed lessons in collaborative storytelling from William Shakespeare. *WIREs Climate Change*, doi:10.1002/wcc.783.



A group of mudsnails of all growth sizes from juvenile to adults, compared to a dime. Photo: Wikipedia.

Prakash, S. and **C. D. Markfort**. A Monte-Carlo based 3-D ballistics model for guiding bat carcass surveys using environmental and turbine operational data. *Science Direct*, doi: 10.1016/j.ecolmodel.2022.110029.

Donne, C., K. Larkin, C. Adrian-Tucci, A. Good, C. Kephart, and **M. Neiman**. Life-history trait variation in native vs. invasive asexual New Zealand mud snails. *Oecologia*, doi:10.1007/s00442-022-05222-8.

WHERE ARE THEY NOW?

Sarath Guttikunda: The Lasting Impact of CGRER

My current research work on air quality focuses on one simple idea: provide information to people working on the ground, in the easiest format possible.

I am part of an independent research group in India called Urban Emissions. We aim to bridge the knowledge gap using publicly available information in data-sparse regions of Asia, Africa, Eastern Europe, and Latin America, using models and ever-expanding big data information. These regions are marked with the highest proportion of premature deaths linked to air pollution.

I got the flavor of working on air pollution control during my undergrad studies at the Indian Institute of Technology in Kharagpur, India. There I began looking at the combination of amino acids to increase their absorption efficiency for SO₂ and CO₂ gasses. My journey in air quality research started in 1997 with PhD under the guidance of **Gregory Carmichael**. The freedom he provided to explore various research ideas along with the range of projects I was exposed to during my five years at CGRER helped me release the true potential of data generation, analysis, and management for understanding and explaining science to scientific and non-scientific communities.

Working on the RAINS model (now GAINS at IIASA, Austria) I learned the importance of simplifying the science for broader use as well as how to disseminate pertinent information. For one week in 2000, for a project with the World Bank, CGRER hosted a delegation of Chinese officials from Beijing, Shijiazhuang, and Changsha. The delegation discussed how RAINS sulfur modeling can be used, the exact data needs, and how to explain the results for successful final decision-making.

Between 2000 and 2001, during NASA's TRACE-P and ACE-Asia field experiments, CGRER was tasked with providing support for flight planning using advanced air quality forecasting tools. I must thank my CGRER colleagues at the time—**Jeremie Moen, Youhua Tang, Giuseppe Calori, Jung-Hun Woo, and Gakuji Kurata**—each of whom provided mentorship in the emissions and pollution modeling methods. At Urban Emissions, the tools we are currently developing and those we have put to use for the last 15 years are all rooted in what I learned as part of CGRER.

Finally, it was an honor to be named the 2022 recipient of the American Geophysical Union's International Award. I am proud to be part of this fellowship of scientists and to have the opportunity



Sarath Guttikunda and Greg Carmichael at the 2022 American Geophysical Union award ceremony in Chicago. Photo: Pallavi Pant.

"We need to focus on the basics of building emission inventories and understanding source contributions to start seeing results of better air quality."

to build a career that, in many ways, is a continuation of my research at CGRER.

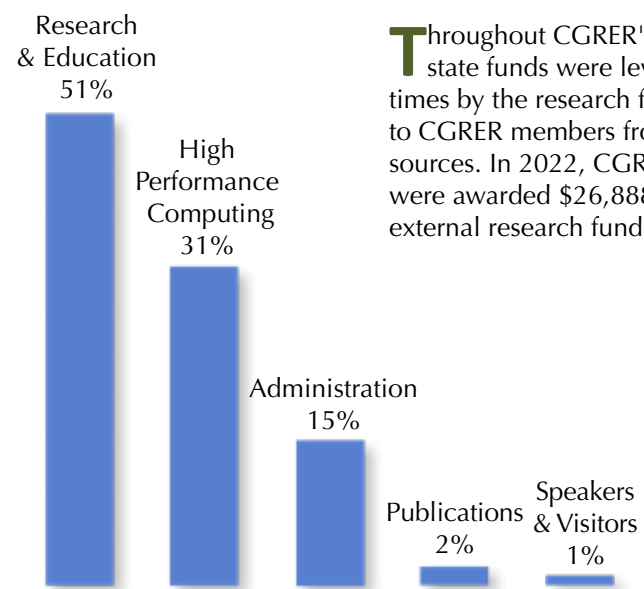
I take this opportunity to make what may seem like a simple observation as it pertains to environmental research and policy. While there is plenty of room for creativity and pushing the envelope on research, without the proper foundation in place, we are wasting resources and time with no results, especially in developing countries. We need to focus on the basics of building emission inventories and understanding source contributions to start seeing results of better air quality. I plan to continue to apply what I learned at CGRER on this journey.

Sarath Guttikunda
Urban Emissions



Social gathering of the Chinese delegation and CGRER colleagues at Greg Carmichael's residence in 2000. Photo: Sarath Guttikunda.

CGRER BUDGET & FUNDING



Throughout CGRER's history, state funds were leveraged many times by the research funds awarded to CGRER members from other sources. In 2022, CGRER members were awarded \$26,888,619 in new external research funding in 2022.

CGRER ADMINISTRATION



Joe Bolkcom, Amy Parker, Greg Carmichael, Jerry Schnoor, and Jeremie Moen.
Photo: Mary Moye-Rowley.

CGRER is directed by UI's **Gregory Carmichael**, professor of Chemical and Biochemical Engineering, and **Jerald Schnoor**, professor of Civil and Environmental Engineering. Center activities are guided by Carmichael and Schnoor along with an elected Executive Committee that consists of 10 members (page 3). The Executive Committee meets monthly as needed to plan initiatives and chart CGRER's course. An Advisory Board of 10 members (page 5) from outside the academic community meets annually to lend oversight to CGRER's activities.

CGRER employs two full-time staff members. **Amy Parker** is Research Support Coordinator. **Jeremie Moen** manages the computer facilities with the support of Engineering Computer Services. In addition, **Joe Bolkcom** serves as half-time Director of Outreach and Community Education. CGRER reports directly to the UI Vice President for Research.

CGRER MEMBERS

University of Iowa

Anthropology

Margaret E. Beck
Michael S. Chibnik, Emeritus
Russell L. Ciochon, Emeritus
James G. Enloe
Matthew E. Hill, Jr.
Meena Khandelwal

Biological Sciences

Andrew A. Forbes
Stephen D. Hendrix, Emeritus
Maurine Neiman

Chemical & Biochemical Engineering

Gregory R. Carmichael
A. Umrans Dogan
Matthew McGill
Charles O. Stanier
Jun Wang

Chemistry

Tori Z. Forbes
Gregory K. Friestad
Sara E. Mason
Scott K. Shaw
Elizabeth Stone
Mark Young, Emeritus

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Keri C. Hornbuckle
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Witold F. Krajewski
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Michelle Scherer
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Gabriele Villarini
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Community & Behavioral Health

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Ingrid Ukstins Peate
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Frank H. Weirich
You-Kuan Zhang, Emeritus

Economics

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Electrical & Computer Engineering

Ananya Sen Gupta

Electron Spin Resonance Facility

Garry R. Buettner

English

Barbara Eckstein, Emeritus
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Epidemiology

Wei Bao
Qian Xiao

Geographical & Sustainability Sciences

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Matthew Dannenberg
Caglar Koylu
Marc A. Linderman
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Michael L. McNulty, Emeritus
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Silvia Secchi
Kathleen E. Stewart
Eric Tate

Health and Human Physiology

Qian Xiao

History

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IIHR-Hydroscience & Engineering

Ibrahim Demir
Corey D. Markfort
Marian V. Muste
Cornelia Mutel, Emeritus
Wei Zhang

Iowa Geological Survey

Keith E. Schilling

Journalism & Mass Communication

Kajsa E. Dalrymple

Law

Jonathan Carlson

Mechanical & Industrial Engineering

Geb Thomas
H.S. Udaykumar

Occupational & Environmental Health

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Joel N. Kline
Peter S. Thorne

Physics & Astronomy

Paul D. Kleiber
Steven R. Spangler, Emeritus

Sociology

Ion B. Vasi

Statistics and Actuarial Science

Kate Cowles, Emeritus
Dale L. Zimmerman

Urban and Regional Planning

Charles Connerly, Emeritus
Scott Spak

Iowa State University

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Richard M. Cruse
Brian K. Hornbuckle

Animal Science

Aileen F. Keating

Architecture

Ulrike Passe

Biomedical Sciences

College of Veterinary Medicine
Chandrashekhar Charavaryamath

Civil, Construction, & Environmental Engineering

Li Lui
Behrouz Shafei

Ecology, Evolution, & Organismal Biology

Steven J. Hall
Chaoqun (Crystal) Lu
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Ajay Nair

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University of Northern Iowa

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Physical Geography

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Colorado State University

Civil & Environmental Engineering

Robert Ettema

Cornell College

Geology

Rhawn Denniston

Drake University

Environmental Science & Policy

David Courard-Hauri

FDA Arkansas Regional Laboratory

Michael D. Wichman

Hacettepe University, Turkey

Geological Engineering Department

Meral Dogan

Hydrologic Research Center

Konstantine P. Georgakakos

Indiana University

Public & Environmental Affairs

Adam S. Ward

Montana State University

Ecology Department

Diane M. Debinski

Oregon State University

Biological and Ecological Engineering,

Adam S. Ward

Texas State University

Department of Anthropology

Jill Pruetz

University of California-San Diego

Chemistry & Biochemistry, Nanoengineering, and Scripps Institute of Oceanography

Vicki H. Grassian

University of Nebraska-Lincoln

School of Natural Resources

Cory T. Forbes

Rice University

Civil & Environmental Engineering

Pedro Alvarez

USDA, Agricultural Research Service, National Laboratory for Agriculture and The Environment

A.N. Thanos Papanicolaou



THE CENTER FOR GLOBAL & REGIONAL
ENVIRONMENTAL RESEARCH



2022 ANNUAL REPORT



The University of Iowa
424 IATL, Iowa City,
Iowa 52242
(319) 335-3333
www.cgrer.uiowa.edu

Writer & Editor: Nina Lohman
Designer: Mary Moye-Rowley

Printed by The University of Iowa
Printing Department

Top Photo: Thomas Pesquet, NASA
Storm photo: Christine Neumaier