



THE CENTER FOR GLOBAL & REGIONAL
ENVIRONMENTAL RESEARCH



2018 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: Earth (photo by NASA)

Middle: Algal bloom on Swan Lake (photo by Grace Wilkinson)

Bottom: Iowa landscape (photo by Mary Moye-Rowley)

This page:

Top: Wild fires in California (photo from Wikipedia Commons)

Bottom photo: CGRER is housed in the Iowa Advanced Technology Laboratories on the University of Iowa campus. (photo by Mary Moye-Rowley)

Photo page 1: Air pollution in Mongolia (photo by Nyamdorj)



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 (UI) campus in the Iowa Advanced Technology Laboratories (IATL), CGRER is supported by revenues generated from investor-owned 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 currently is composed of 131 members from 16 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 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

EXECUTIVE SUMMARY

Looking back on 2018 offers the opportunity to reflect on how climate science and policy has advanced over the last 30 years.

The Center for Global and Regional Environmental Research (CGRER) was officially established in 1990, but the seeds of the organization were first planted in the late 1980's through a campus wide grass-roots initiative focused on climate change.

significant negative impacts. Hansen's testimony was a catalyst for research and policy discussions on climate change that continue to this day.

Hansen's forecast has proven to be an accurate prediction of how global temperatures have actually changed from 1988 to present (a 0.6°C increase over these 30 years). This illustrates that we have a fundamental understanding of the earth's climate system and that our

It was declared by the World Health Organization that "air pollution is the new tobacco" and is responsible for seven million avoidable deaths per year.



In 1988, Iowa native and UI alum James Hansen testified to congress on the dangers of human-caused climate change. In his presentation, Hansen revealed results determined by his team

at [NASA's Goddard Institute for Space Studies](#) whose work evaluated the impact of three scenarios of future greenhouse gas emissions on global temperature changes and climate impacts.

Hansen strongly stated that humans were the driving force behind greenhouse gas emissions and changing climate. He also warned that continued increases in greenhouse gas emissions over the coming decades would have

climate models have continued to improve over the past 30 years.

Also established in the late 1980's was the [Intergovernmental Panel on Climate Change \(IPCC\)](#), a council responsible for five assessment reports that have shaped greenhouse gas emission policies world-wide, most notably the 1997 Kyoto Protocol and the 2015 Paris Agreement. It is important to note the influence of the United States in establishing these protocols as well as to reflect on the impact of government administration in determining both involvement and outcome. Along with Russia, the US chose not to ratify the Kyoto Protocol and now intends to withdraw from the [Paris Agreement](#).

Over the last 30 years, CGRER members have made significant contributions to climate change science and policy discussions, with a particular focus on climate change and its impacts on the midwest. CGRER organized and hosted a symposium on this topic in 1994, and in 1996 assisted the State of Iowa in the development of its first greenhouse gas action plan.

Events in 2018 remind us that while we have made progress in understanding climate change, continued efforts are still necessary. The Paris Agreement seeks, through voluntary efforts, to keep global temperature increases below 2°C in order to avoid the most dangerous consequences of climate change. IPCC published a special report in October on the impacts of warming above 1.5°C. The report points out that climate change impacts are significantly larger if warming exceeds 1.5°C. We are on a trajectory to exceed this number within the next 10-30 years if heating continues at its current rate. An important message of the report is that there is still time to avoid exceeding this increase, but doing so requires greater urgency in reducing greenhouse gas emissions.

The good news is that US greenhouse gas emissions peaked around 2009 and have decreased by about 15% since. The bad news is that our greenhouse gas emissions were 3.4% higher in 2018 than in 2017.

As you will learn in this year's report, CGRER continues to make valuable contributions to research and training in environmental change with a



The first UN Global Conference on Air Pollution and Health was held in October, 2018 in Geneva, Switzerland.

focus on accelerating progress towards mitigating and adapting to climate change. This is accomplished by contributions to major reports such as the [fourth-annual National Climate Assessment](#) as well as by disseminating up-to-date climate change information through the annual [Iowa Climate Statement](#).

There is a growing awareness for urgency in dealing with climate change from the private sector where the message from the world economic leaders confirms that climate is the biggest risk to both business and the world. [The World Economic Forum](#) identified climate and environmental issues as the greatest global risks to business in 2019. On a smaller scale, cities are also recognizing this urgency and have started taking actions to ensure that progress is possible. Notably, [Iowa City adopted its first Climate Action and Adaptation Plan](#) which sets community-wide greenhouse gas reduction goals of 26-28% for the year 2025 and 80% by 2050.

There continues to be a growing awareness of the links between climate change and other environmental problems such as air pollution. Win-win solutions exist for simultaneously reducing air pollution impacts and greenhouse gas emissions. At the first [UN Global Conference on Air Pollution and Health](#) held in October, it was declared by the World Health Organization that "air pollution is the new tobacco" and is responsible for 7 million avoidable deaths per year. The conference closed with a commitment to reduce the number of deaths due to air pollution by 2/3 by the year 2030. Working towards achieving this aggressive goal will lead to significant further reductions in greenhouse gas emissions.

We hope you enjoy learning more about CGRER and its valuable member activities through this 2018 annual report.

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

Greg Carmichael and Jerry Schnoor at the March for Science in Iowa City. (photo by Mary Moye-Rowley)



EXECUTIVE COMMITTEE

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Chemical
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Chemistry,
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Mechanical
& Industrial Engineering,
University of Iowa

(photo by Amy Parker)



MESSAGE FROM THE CGRER ADVISORY BOARD

Cities are leading the way in rising to the challenges of climate change. For these efforts to continue to be successful, science-based research is essential. Research done by members of CGRER is a necessary resource for cities across Iowa to assist communities in planning for the future.

includes measurable actions to meet both short-term and long-term greenhouse gas emissions reduction goals set by the Council. These goals are identical to those the US agreed to adopt for the Paris Climate Agreement. 35 actions were identified to reach a goal of 80% reduction by the year

I have come to count on the research and resources at CGRER to keep me informed and up to date on climate science and climate-related risks.

Iowa City recently adopted its first Climate Action and Adaptation Plan in response to the greenhouse gas reduction targets set by the City Council. Though the federal government

2050. Establishing community partnerships with the UI, local businesses, the utility industry, and residents will be necessary to meet this goal. With many of these partnerships already underway, the city is progressing quickly to meet several of the short-term goals.

decisions on how to adapt building requirements and increase resiliency in the face of climate change that will impact municipal operations.

Cities have many challenges to face due to changing climate. Climate-related issues such as flooding, impacts on ecosystems, issues with water supply, infrastructure resiliency, building design, public health, inequitable impacts on low-income residents, and economic growth are some of the many topics that Iowa communities are working to address. CGRER responds to these issues by providing accessible resources on their website to address these pressing topics.

Iowa City Climate Action and Adaptation Plan has a Toolkit that includes the Environmental Protection Agency's Household Carbon Footprint Calculator to help individuals understand what they can do to reduce greenhouse gas emissions.



is not currently moving forward to address climate change, many cities across the country are taking action to both mitigate and adapt to the local issues caused by climate change.

The goal of the Iowa City Climate Action and Adaptation Plan is to create a framework that

The annual Iowa Climate Statement is one example of how CRGER provides up-to-date information on how communities in Iowa can prepare for climate change. In 2018, the statement contained information on how buildings in Iowa must withstand a hotter, more humid climate. Cities can use this type of information to make informed



The first of two community meetings in the creation of the Iowa City Climate Action and Adaptation Plan. Volunteers give input for the plan. On the far right is Eric Tate, UI Geographical and Sustainability Sciences, a CGRER member of the steering committee.

I have been honored to be an Advisory Board member for CGRER, which has been an asset in Iowa City's climate work in many ways. I have relied on the professional relationships with CGRER staff, members, and Advisory Board members in my position as Sustainability Coordinator for Iowa City. I have come to count on the research and resources provided by CGRER to keep me informed and up-to-date on climate sci-

ence and climate-related risks. Cities across the state of Iowa can depend on CGRER as a reliable partner as we work to make a positive impact on the issues of climate change. Together we can build resilient communities.

Brenda Nations
Sustainability Coordinator
City of Iowa City



Flooding in Iowa City in 2008. (photo by IFC)



ADVISORY BOARD MEMBERS

Cori Burbach
Sustainable Community Coordinator
City of Dubuque

Bob Dvorsky
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Tim Harden
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Kris Kilibarda
State Science Consultant for
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Mary Skopec
Iowa Lakeside Laboratory
Regents Resource Center

Marnie Stein
Iowa DNR

Nick Wagner
Iowa Utilities Board



Iowa City (photo by Amy Parker)



OUTREACH

CGRER members continue to find relevant and engaging ways to communicate the most up-to-date and necessary information regarding research, technological advancements, and educational opportunities to the citizens of Iowa and beyond.

IOWA CLIMATE STATEMENT 2018:

SOBERING IOWA WEATHER EXTREMES PREDICTED TO BRING HOTTER HEAT WAVES AND MORE WIDESPREAD INTENSE RAINFALL

In 1991, climate scientists predicted that climate change in the midwest would lead to a warmer, wetter climate, including warmer winters and more rain in spring and early summer.

It was a prediction that has proven undeniably true. US climate scientists are projecting that by mid-century, 5-day heat wave temperatures in Iowa will increase by about 7°F for the average year and by 13°F once per decade compared to heat waves in the late 20th century. As it stands now, the average annual 5-day maximum temperature during a heat wave in Iowa is in the range of 90-95°F.

Scientists also suggest that the strongest rainfall events of the year covering areas as large as a third of Iowa are projected to double in intensity by mid-century, with most of this change taking place before 2025.

“These are really scary numbers which will have negative consequences for the elderly, the economy, for corn and soybeans, as well as cattle, hogs and poultry, even under sheltered confinement. We must start now to adapt our built environment, including buildings and flood mitigation systems, to this changing climate,” said **Jerry Schnoor**, UI professor of Civil and Environmental Engineering and co-Director of CGRER.

Iowa is already seeing the effects of increased temperature and rainfall. Over Memorial Day weekend, Iowa experienced a brief heat wave. This past summer and into the early fall months, Iowans also experienced extreme rainfall.

“Warming over the Gulf of Mexico is helping feed large rain events in Iowa and the Midwest,” Schnoor said. “That’s why we’re prone to intense downpours and major flooding like Des Moines



Flooding at the Iowa Memorial Union in Iowa City in 2008. (photo by IFC)

saw on June 30 and like eastern Iowa experienced this past fall. People’s homes and businesses are being flooded that have never been flooded before.”

Figuring out exactly how, why, and when to adapt buildings to the changing climate is a focus for **Ulrike Passe**, associate professor of Architecture and Director for the Center for Building Energy Research at ISU.

“Buildings in Iowa must withstand a hotter, more humid climate, with more frequent and extreme rainstorms and dry spells,” Passe said. “Buildings can be designed to withstand heavier driving rain by integrating rain screens, larger gutters and downspouts, and steeper roof slopes. Water will also enter buildings from the foundation or basement walls. In particular, heavier rain events and higher water tables affect foundations,



Water can be seen passing through cement in this permeable paving demonstration.

and standards going forward must reflect that.”

According to **Passe**, keeping building occupants comfortable during hot summer periods will require strategies that include greater insulation of buildings, more controlled ventilation, planting of shade trees, and weatherizing buildings now to control air conditioning costs under the future effects of a warmer climate.

Deciding how best to adapt our built environment to these changes was the focus of the

eighth-annual Iowa Climate Statement 2018: Designing Buildings and Communities for Iowa’s Future Climate. Released in October, the statement was signed by a record 201 science faculty and researchers from 37 Iowa colleges and universities. The statement describes the urgent need to fortify buildings and public infrastructure from heat and precipitation.

The statement recognizes that widespread extreme rainfall will continue to challenge Iowa community stormwater control efforts. “Iowa communities would benefit from adopting localized plans that invest in smart runoff management to reduce the effects of flooding by infiltrating the rain where it falls and slowing the runoff from infrastructure,” **Passe** said. “Green infrastructure like bioswales, rain gardens, urban forestry, and permeable pavement can all reduce the impact of heavy rain downpours.”

According to **Schnoor**, “reducing carbon emissions remains the best long-term strategy to mitigate additional climate change damage, but adaptation now is necessary in today’s changed climate. Changing our built environment to be more sustainable and resilient can help reduce future climate change while protecting us from the changes that have already occurred. The time to act is now.”



Bioswales are landscape elements designed to concentrate or remove debris and pollution from surface water runoff. This bioswale is under construction.

Residential rain gardens can help reduce the impact of heavy downpours.



Ulrike Passe and Jerry Schnoor present the Iowa Climate Statement at a press conference in October.

IOWA CLIMATE STATEMENT CONTRIBUTORS

The eighth-annual Iowa Climate Statement was written by a group of Iowa science faculty and researchers and edited with the input of science faculty from across the state. The lead authors of the 2018 statement include **Ulrike Passe**, associate professor of Architecture, Director, Center for Building Energy Research, ISU, **Gene Takle**, emeritus

professor of Agronomy, ISU, and **Jerry Schnoor**, co-director CGRER.

Also contributing to the statement were **David Courard-Hauri**, professor, Director, Environmental Science and Policy Program, Drake University; **Peter S. Thorne**, professor and Head, Occupational & Environmental

Health, Director, Environmental Health Sciences Research Center, UI College of Public Health; and **David Osterberg**, emeritus professor, UI College of Public Health. Editing was completed with assistance from Nancy G. Wyland, Center Coordinator, Environmental Health Sciences Research Center, UI College of Public Health.



IOWA CITY CLIMATE PLAN

This past September, after years of research, community input, and strategic planning, Iowa City proudly adopted its very first Climate Action and Adaptation Plan. The creation of the plan positions Iowa City as one of a select number of cities across the country leading the way in climate mitigation and adaptation.

This detailed plan outlines 35 action steps to be taken by both the community at-large and the city government which will result in an 80% reduction of community-wide greenhouse gas emissions by 2050. These actions are organized into



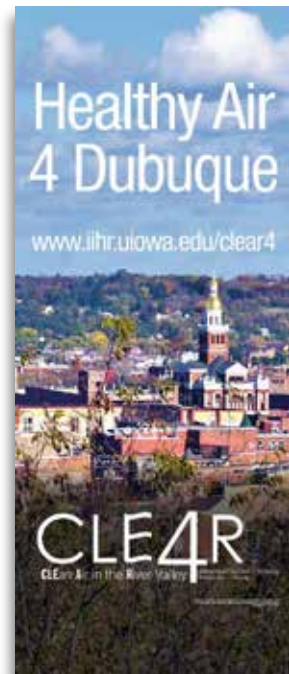
Iowa City community members participate in the creation of the Climate Action and Adaptation Plan. (photo by Katelyn Weisbrod)

five categories: buildings, transportation, waste, adaptation, and sustainable lifestyle. By categorizing the actions this way, the Climate Action and Adaptation Plan provides a clear framework for community members to undertake at home and at work.

The plan itself was created over a year and a half and was guided by a Council-appointed committee. Community input,

gathered from an online survey and two community meetings, was also included in the plan. The steering committee, now acting as an Advisory Board, continues to meet monthly to assist with implementation of the strategic plan. Progress updates will be provided annually to the public in a transparent effort to communicate community-wide advancements and the effectiveness of the plan.

CLE4R AND HEALTHY AIR FOR DUBUQUE



CLE4R is an environmental education project led through collaborative efforts by the UI, CGRER, the City of Dubuque, and several Dubuque-area partners to improve air quality in Dubuque and the surrounding Upper Mississippi River Valley communities. The "CLEAR" in CLE4R stands for CLEAn Air in the River Valley. The "4" in CLE4R stands for Environmental

Education, Technology, Partnerships, and Planning. Since launching in October 2015, CLE4R has reached over 2,500 people through workshops, classes, and science

fairs to raise awareness, increase practical knowledge, and help foster better decision-making capacities regarding the issue of air pollution.

The project is directed by **Charles Stanier**, UI professor of Chemical and Biochemical Engineering, and is funded by the Environmental Protection Agency's Environmental Education Program. Communities of the Upper Mississippi River Valley face periodic concerns with air quality, particularly with atmospheric particles more commonly known as haze and fine particulate matter, or PM. Air pollution by particulate matter smaller than 2.5 microns (PM2.5) is an issue in the river communities of eastern Iowa and western Illinois.

The program impact has been assessed using questions from selected events that indicate large increases in the areas

of "Actionable Air Quality Knowledge" and "Sensors and Data," as well as small increases in the categories of "Motivation" and "Background Air Quality Knowledge."

Although it is not possible to determine if these increases in awareness are due entirely to CLE4R, what is measurable is the fact that air quality in Dubuque has continually improved during the project period. Since the idea for CLE4R was first conceived in January 2014, the average PM2.5 level near Dubuque has fallen by 25% and the ratio of good days to moderate days has improved from 4:1 to nearly 8:1.

All parts of the affected area have unhealthy air during some portions of the year, and the affected community has taken steps not only to stay in compliance with the Clean Air Act, but to improve overall air quality.

LEGISLATIVE BREAKFAST RECEPTION

This past March, CGRER co-hosted its annual legislative reception with the Iowa Flood Center at the Iowa Statehouse. This reception provides a unique opportunity to visit with policy makers about the environmental issues facing Iowans, as well as to showcase the ongoing work at the UI to assist policy makers in addressing these pressing issues.



Senator Kevin Kinney and Kate Giannini, Communications Specialist, IIHR Hydrosience & Engineering.

Gabriele Villarini, Director, IIHR Hydrosience & Engineering and Senator Ken Rosenboom.



Witold Krajewski and Representative Tom Moore.



IOWA WATERSHED APPROACH



The Iowa Watershed Approach (IWA) is a statewide watershed improvement program that slows the movement of water through the landscape using conservation practices such as strategically sited farm ponds and wetlands. For three years, IWA has worked to restore Iowa's natural resiliency to heavy rainfall while improving water quality, creating wildlife habitats, and protecting vulnerable populations and infrastructure.

The US Department of Housing and Urban Development awarded Iowa \$96.9 million for the IWA, which is a collaboration of many organizations and agencies statewide, including the Iowa Flood Center. The IWA is working in eight rural watersheds to voluntarily engage watershed

stakeholders and move toward a more resilient state.

In 2018, watershed planning efforts continued with conservation practice implementation expected to begin in the spring of 2019. Qualifying landowners will be glad to know that a cost-share of up to 90% is now available for flood mitigation structures. This is an increase from the original 75% cost-share. Landowners are responsible for the remaining 10% or can find funding through local match programs.

The IWA Flood Resilience Program has developed social vulnerability maps that are available online through the Iowa Watershed Approach Information System. This valuable tool serves water resource professionals, emergency managers, and elected officials to better serve



Curious young student checks out the latest flood maps.

the needs of their communities. The IWA has also deployed nine water-quality stations and 20 hydrologic network stations around the state. The IWA program goals are being delivered through watershed management authority quarterly meetings, landowner meetings, a program website, and numerous outreach events.



CGRER COMMUNICATIONS

CGRER's blog, Iowa Environmental Focus, features daily news, research, and analysis of leading environmental issues impacting Iowa and beyond. The blog is written by CGRER interns and captures photos and video pertaining to relevant environmental topics. In addition to the Iowa Environmental Focus, CGRER engages Iowans through Facebook and Twitter.

Sara E. Mason, UI associate professor of Chemistry, became the new voice of CGRER's weekly On The Radio news segment. These short one-to-two minute segments highlight the work of CGRER members as well as current Iowa environmental

news and issues. The weekly radio segment is shared with nearly 100 Iowa radio stations and is available on the Iowa Environmental Focus blog.



Sara E. Mason (at left) and CGRER intern Natalia Welzenbach-Marcu record an On The Radio news segment.

CGRER 2018 INTERNS

Natalia Welzenbach-Marcu is a UI undergraduate pursuing a BA in Cinema and a BA in Art. Welzenbach-Marcu studies Mandarin and was previously the vice president of the Organization for the Active Support of International Students, a group created to help bridge the gap between domestic and international students on campus. She plans to get an associates degree in Sociology after graduation.

Kasey Dresser is a third-year undergraduate student at the UI. Dresser is currently working towards a BA in Political Science, a certificate in Writing, and minors in Cinema and Rhetoric. Dresser is from San Diego, CA, and is an active member on the UI campus through her involvement in multiple student organizations. After graduation,



CGRER interns Kasey Dresser, Natalia Welzenbach-Marcu, Julia Poska and CGRER's Outreach and Community Education Director, Joe Bolkcom.

she hopes to work in government and continue to increase public knowledge about the importance of issues like climate change.

Julia Poska is a third-year Journalism and Geography student at the UI where she is learning to cover the challenges and victories of environmental science. Poska's work has

appeared in The Daily Iowan, Fools Magazine, and Civil Eats. She serves as co-president of the UI Gardeners, an organization that maintains a 1/3 acre organic garden on the west side of campus and brings fresh, sustainably grown produce to the UI community.

CGRER MEMBERS



Chandrashekhar Charavaryamath



Ibrahim Demir



Steven Hall



Gregory LeFevre

A SAMPLING OF AWARDS, ACHIEVEMENTS & APPOINTMENTS

Chandrashekhar Charavaryamath received the Certificate of Outstanding Contribution in Reviewing from the Editors of Food and Chemical Toxicology.

Ibrahim Demir received the 2018 Early Career Research Excellence Award from the International Environmental Modeling and Software Society. Demir was also the recipient of the Association of State Floodplain Managers 2018 Outreach Award.

Steven Hall was named co-chair of the Terrestrial Biogeochemistry Working Group of the National Ecological Observatory Network (NEON), was appointed to the UN Environmental Program International Nitrogen Management System (INMS) task force, and his lab member Wenjuan Huang received the ISU Postdoctoral Scholar Research Excellence Award.

Gregory LeFevre was a selected participant in the 2018 National Academy of Engineering Frontiers of Engineering conference in Tsukuba, Japan. He was also a visiting scholar at the German Bioeconomy Institute (BioSC), RWTH University of Aachen, Germany, and was the recipient of the 2018 Royal Society of Chemistry Emerging Investigator Award.

Maurine Neiman received the UI College of Liberal Arts and Sciences 2018 Outstanding Outreach and Public Engagement Award.

Jerry Schnoor served as the Theme Chair of the 255th American Chemical Society National Meeting held in New Orleans in March. Schnoor was also the keynote lecturer at the Illinois 150 Conference in April and a panelist at the WorldCanvass conference held in Iowa City in April. Schnoor lectured widely in China in 2018 and received two awards this past year: The International Expert Award from The 111 Honor Program at Peking University, and The Global Expert Award from Zhejiang University in Hangzhou China.

Scott Spak was an adviser on the Sioux City Downtown Greenspace Plan. It won the 2018 inaugural Iowa Chapter of the American Planning Association Exemplary Student Project Award.

Betsy Stone was awarded the UI's James Van Allen Natural Sciences Fellowship and her student Elias Hasenecz earned recognition for the best student poster at the International Aerosol Conference in St. Louis in September of 2018.

Qian Xiao was invited to speak at the First International Symposium on Lifecourse Epidemiology and Spatial Science in Amsterdam.



Maurine Neiman



Jerry Schnoor



Scott Spak



Elizabeth Stone



Qian Xiao

EDUCATION

The educational efforts made by CGRER members influence the world beyond the walls of academic institutions. This past year, CGRER members completed a state-wide science curriculum and traveled around the world as representatives to conferences, forums, and meetings.

CLIMATE SCIENCE EDUCATION FINAL REPORT CGRER AND UI COLLEGE OF EDUCATION 8TH GRADE SCIENCE INITIATIVE

Several years ago, in response to Iowa's grade level alignment of the Next Generation Science Standards (NGSS), CGRER and the UI College of Education teamed up to develop free eighth grade science curricula centered on land use and climate science.

NGSS standards, resources, and lesson materials into six bundles. Each bundle was designed to engage Iowa's middle schoolers with local data and information on relevant topics like athletic concussions and agriculture.

"It's very place-based," said Nathan Quarderer, a PhD student in Neal's science education group. "It's our thinking that if you can focus on these issues in your own backyard, you can inspire kids to be lifelong learners."

Lessons are built on NGSS principles with hands-on activities designed for groups and individuals. Through this method, students will have ample opportunities to get curious, generate questions, and lead themselves to answers.

Several science teachers around the state have already begun to pilot this curriculum. Mandy Dunphy of Solon Middle School tried bundles four, five and six

Encouraged by their early progress, the collaborators continued to work together to develop material for the entire eighth grade school year. Now, a full year ahead of full NGSS implementation, the team has completed an online textbook that will be classroom ready by the fall of 2019.

CGRER member **Ted Neal**, UI clinical associate professor of Science Education, led a team of graduate and pre-service teaching students alongside CGRER scientists to develop the material. This goal was accomplished by grouping

Ted Neal works with students on curricula exploring land use and climate science. (photo by Mei-Ling Shaw Williams)



Students using a stream table learn how water moves through land and how erosion and pollution effect communities. (photo by Mandy Dunphy)

last spring, and is using the full book this year.

Dunphy said her kids have been interested and engaged in the material. For her classes last spring, the land use bundle was an especially big hit. This bundle focuses on agricultural practices and impacts, something Solon's students see every day.

"For me, it was a really easy decision to get my kids involved in the science that's actually happening around them," she said.

Using anything new the first time can create challenges. Dunphy said she did not finish bundle six before school let out for the summer and struggled to adapt the material for the full spectrum of student



Many of the students in Solon Middle School had never experienced a prairie first hand. Their goal was to make observations and identify one plant. (photo by Mandy Dunphy)

needs. Still, she said she sees the curriculum's value and recommends it to others.

CGRER members **Charles Stanier** and **Scott Spak**, UI associate professors of Chemical Engineering and Urban Planning respectively, identified the climate change impacts most important to Iowa in general and to the average eighth grader in particular. They carefully considered an appropriate geographical scale and analysis level for each impact, including increased precipitation and delayed timing of spring.

In light of common misconceptions and skepticism about climate science, the curriculum aims to help students identify trustworthy information, guiding teachers and students through a variety of reliable data sources.

"In a perfect world, they'd develop some appreciation for the process," Stanier said of his hopes for students who use the book.

To make sure the brand new material works, Quarderer is leading an assessment on bundle six. Using a 20 question survey, he and his team are measuring learning outcomes for 75 students in pilot classrooms like Dunphy's.

So far, the results show statistically significant improvement for students using this curriculum. Soon, the results will be compared to those from a control group in Waterloo. Quarderer said the survey is available to any teacher interested in measuring learning in their own classroom.

NEW DEGREES ON UI CAMPUS

U2G Geoinformatics 5-Year BA and MS Program

The department of Geographical and Sustainability Sciences recently announced a new 5-Year Undergraduate to Graduate (U2G) program that allows undergraduates majoring in Geography to also complete an MS in Geoinformatics in just five years. The program provides motivated geography students with the opportunity to gain advanced training in geoinformatics, and to gain the knowledge and skills needed to succeed in the rapidly growing and diversifying profession.

As part of the UI's U2G program, participants will graduate with both a BA in Geography and an MS in Geoinformatics. While typically earning an MS



in Geoinformatics requires two years of study beyond the bachelor's degree, the combined degree program allows students to cross-credit up to 12 semester hours of coursework and complete the MS requirements in just one year. The combined degree program is well-suited for Geography majors that have a particular interest in geographic information science, informatics, and statistics.

SUSTAINABLE WATER DEVELOPMENT GRADUATE PROGRAM

A new graduate program in the department of Civil and Environmental Engineering at the UI will offer a revolutionary new approach to engineering education: the Sustainable Water Development (SWD) Graduate Program. With \$3 million in grant funding from the National Science Foundation Research Traineeship program, the SWD program will prepare students to meet the resource challenges of communities most in need as professional engineers, researchers, or educators. "This is not a 'one-size-fits-all' MS/PhD program," says **Michelle Scherer**, professor in the department of Civil and Environmental Engineering. "Students can tailor the curriculum to fit their unique

interests and career goals — everything from politics to public health, chemistry to microbiology, and informatics to entrepreneurship and beyond — all while earning a generous student stipend." Scherer is co-PI on the grant with **David Cwiertny**.

SWD students will conduct innovative research at the food, energy, and water nexus, focusing on the impacts of climate change, resource recovery from waste, technologies for sustainable and healthy communities, and more. Community service and professional development, including immersive internships with diverse project partners, will complement the research.

UCAR MEMBERSHIP RENEWED



The University Corporation for Atmospheric Research (UCAR) is a nonprofit consortium of more than 117 North American academic institutions focused on research and training in the Earth System science community.

2018 marked the 25th year of the UI's membership in this valuable organization.

UCAR fosters community networking resources by offering an array of services that individual

member institutions could not maintain on their own. UCAR also alerts its membership to legislative and budgetary issues that may affect their work. UCAR educates members of Congress on scientific problems and societal impacts, while advocating on behalf of broad community interests. **Scott Spak**, assistant professor, Urban and Regional Planning, and **Charlie Stanier**, professor UI college of Engineering, are the UI representatives to this group.



David Ortiz, an ISU graduate student working with Grace Wilkinson, collects samples from Swan Lake, a lake that often sees large blooms of cyanobacteria. (photo by Ellen Albright)

SEED GRANTS

In 2018, CGRER awarded a seed grant total of \$139,991 to four projects.

Simultaneous aerobic & anaerobic groundwater pollutant biodegradation processes: Potential for enhanced biodegradation rates, novel ecological relationships, and sustainable commercial applications. **Timothy Mattes**, UI Civil & Environmental Engineering, \$35,000.

A river runs through it: Surveying Iowa City residents on water use, water quality, and flood management. **Silvia Secchi**, UI

Geographical & Sustainability Sciences, \$35,000.

Developing early warning tools of harmful algal blooms in lakes. **Grace Wilkinson**, ISU Ecology, Evolution, & Organismal Biology, \$34,991.

Detection, attribution, and projection of changes in temperature extremes, heat waves, and heat stress across the US midwest. **Wei Zhang**, UI IHR-Hydroscience & Engineering, \$35,000.

A SAMPLING OF GRANTS AWARDED TO CGRER MEMBERS

Rhawn Denniston was awarded two NSF grants in 2018. He is co-PI on Collaborative Research: Bridging the Gap from Northern Iberia to Northwest Africa to Reconstruct Atmospheric Dynamics and Hydroclimate for the Last 2,500 Years (2018-2020); and is PI on the grant EAGER: Development of a High-Resolution, Multi-Century Paleofire Reconstruction from Tropical Australian Stalagmites (2018-2019).

Ibrahim Demir was PI on a \$192,000 grant from the EPA titled Improving Data Integration and Exchange for EPA Current Discovery Tool (2018-2020). He was also co-PI on two NSF funded grants: a \$1 million grant for Framework: Software: Collaborative Research:

CyberWater—An open and sustainable framework for diverse data and model integration with provenance and access to HPC (2018). Also a \$1 million grant for An Integrated Big Data Framework for Water Quality Issues in the Upper Mississippi River Basin (2018-2021). Demir was co-PI on a \$75,000 Iowa DOT funded grant: Transfer of the Iowa DOT Culverts Web-Tool Prototype to Iowa DOT Mainframe (2018-2019).

Gregory LeFevre (PI) and **David Cwiertny** (co-PI), received a \$332,125 NSF grant for Nicotinic Fate Across the Source Water to Drinking Water Continuum: Transformation Reactions are the Pesticide Pharmacophore to Yield Products of Enhanced Mammalian Toxicity (2018-2021).

Maurine Neiman received a \$271,349 grant from the Carver Trust for her work as PI on the Science Booster Club expansion project (2018-2021). This grant supports graduate student interns to lead informal science education efforts aimed at improving community knowledge of and comfort with scientific issues related to climate change and evolution. Neiman also received a \$99,000 grant from the NSF and is PI for Genomic and functional tests of mitochondrial-nuclear coevolution (2018-2020).

Elizabeth Stone received a \$300,000 NSF grant for Characterization of Atmospheric Pollen under Weather Extremes (2019-2020).

GREGORY CARMICHAEL NAMED AGU FELLOW



Gregory Carmichael, CGRER co-Director, was inducted as a Fellow of the American Geophysical Union (AGU) at the 100th Annual Conference held in Washington D.C. in December. This program recognizes AGU

members who have made exceptional contributions to earth and space sciences as valued by their peers and vetted by a committee of Fellows. Fellow honors are limited to 0.1% of the membership.

CONFERENCE TRAVEL GRANTS FOR GRADUATE STUDENTS

In 2018, \$18,322 was awarded to graduate students advised by CGRER members who traveled to professional conferences to make oral or poster presentations.



Hannah Molitor at the ACS Meeting in New Orleans.

In 2018 the American Chemical Society (ACS), held its annual spring meeting in New Orleans. Thousands of presentations on new discoveries in science took place. The topics included food and nutrition, medicine, health, energy, the environment, and other fields where chemistry plays a central role.

The following students were awarded CGRER travel grants to attend the meeting. UI Chemistry: Alaa Alminshid, Jennifer Bjorklund, Jacob Grant, and Diamond Jones. UI Civil & Environmental Engineering: Hannah Molitor, Luiza Notini de Andrade, Danielle Webb, Zhe Zhou. UI Chemical & Biochemical Engineering: Hayder Alalwan.

CGRER travel grants were also awarded to:

Christiansen, Megan
Chemical & Biochemical Engineering, UI
American Association for Aerosol Research International Conference

Hasencz, Elias
Chemistry, UI
American Association for Aerosol Research International Conference

Islam, Md Robiul
Chemistry, UI
American Association for Aerosol Research International Conference

Jahnke, Jacob
Environmental Science & Engineering, UI

International Symposium on Halogenated Persistent Organic Pollutants

Lang, Kristine
Horticulture in College of Agriculture & Life Sciences, ISU
American Society for Horticulture Annual Conference

MacDougall, Brandon
Geographical & Sustainability Sciences, UI
North American Conference for Biology

Quarderer, Nathan
Department of Teaching & Learning, UI
American Geophysical Union Fall Meeting

Quinteros, Kevin
Ecology, Evolution, & Organismal Biology, ISU
Joint Conference on Evolutionary Biology

Rau, Austin
Geographical & Sustainability Sciences, UI
American Association of Geographers

Rich, Holly
Ecology, Evolution, & Organismal Biology, ISU
American Geophysical Union Fall Meeting

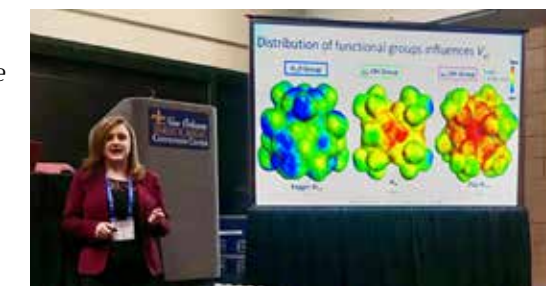
Rosenblume, Justin
Earth & Environmental Science, UI
International Sedimentological Conference

Yang, Hongyi
Urban & Regional Planning, UI
American Planning Association National Conference

Ye, Chenglong
Ecology, Evolution, & Organismal Biology, ISU
American Geophysical Union Fall Meeting

Yeh, Hsiang-Lan
Mechanical Engineering, ISU
American Chemical Society Colloid & Surface Science Symposium

Zhao, Chang
Geographical & Sustainability Sciences, UI
American Association of Geographers



Jennifer Bjorklund presented her research at the ACS meeting in a talk titled, "Modeling aluminum nanoclusters in variable chemical environments with first-principles DFT and thermodynamics."

RESEARCH

CGRER is committed to advancing research efforts to more fully understand the impacts of environmental change. This valuable research provides real-life solutions to local, regional, and global environmental problems.

NATIONAL SCIENCE FOUNDATION GRANT AWARDED TO TIMOTHY MATTES



Vinyl Chloride (VC) is a known human carcinogen and common groundwater contaminant. It is derived mainly from incomplete anaerobic degradation of other widely used chlorinated solvents. An improved understanding of the role aerobic processes play in VC degradation has the potential to make future remediation efforts much more sustainable.

The ongoing work with aerobic VC biodegradation has been the main focus of research for **Timothy Mattes**, UI professor of Civil and Environmental Engineering, since 2004.

According to Mattes, “conventional anaerobic treatment of chlorinated solvents typically involves adding a large excess of electron donor, such as emulsified vegetable oil, to the contaminated site. Although this may effectively drive complete VC removal, there are a number of possible externalities stemming from this, including metals mobilization, and generation of large quantities of greenhouse gasses.”

Matte’s research has suggested that the use of combined aerobic and anaerobic biological treatment processes could greatly reduce these impacts, as well as the impacts related to the manufacturing and transport of the electron donor.

Since beginning his research at UI, Mattes has been gradually moving from laboratory pure culture studies of the VC biodegradation pathway to investigating the abundance and activity of aerobic VC-degrading bacteria in the environment.

Matte’s team recently observed that aerobic and anaerobic VC-degrading bacteria were located very close to each other in contaminated sediment samples and hypothesized that these quite different bacteria are living together in biofilms. Testing this hypothesis and showing that a combined aerobic and anaerobic VC biological treatment process is possible is a primary goal of the Matte’s newly granted National Science Foundation project.

GREAT LAKES OZONE STUDY



The 2017 Lake Michigan Ozone Study (LMOS 2017) was a collaborative, multi-agency study of air pollution along the Wisconsin-Illinois Lake Michigan shoreline. The study used an aircraft, ship-based measurements, and ground stations to study the chemistry and meteorology

involved with spring and summertime pollution. **Charles Stanier**, professor UI department of Chemical and Biochemical Engineering, helped lead this effort.

The Lake Michigan region is seasonally impacted by episodes of high ozone concentrations. These episodes are influenced by complex meteorology and significant transport of pollutants. The goal of the study was to better understand ozone formation and transport along the western shore of Lake Michigan in order to assist researchers and air quality managers who study, predict, and manage ozone concentrations in this region.

Two particularly challenging issues that LMOS 2017 targeted were understanding the factors that determine the size, location, timing, and intensity of ozone-rich air masses, and understanding the details of the chemistry and meteorology

that create the sharp gradients in ozone concentrations often observed between the lakeshore and nearby inland locations. To address these issues, field activities were conducted from May 22–June 22, 2017.

Three sessions on LMOS 2017 and similar studies were held at the American Geophysical Union meeting in December of 2018. Key findings from this report are that oxides of nitrogen, produced by engines and power plants in the atmosphere are lower than expected, and ozone concentrations are higher than predicted by atmospheric chemistry models. The LMOS team is working to understand and explain these findings, as well as many others.



Headlamps light the way for Denniston and his students near the entrance of a cave on Cape Range, Western Australia. (photo by Darren Brooks)



Detailed monitoring near this Portuguese stalagmite allows for a more accurate interpretation of the environmental signals in the dripwater. (photo by Diana Thatcher)

CGRER CURRENT MEMBER FEATURE: RHAWN DENNISTON

The overarching goal of my research is to reconstruct changes in rainfall over the last several millennia using stalagmites from tropical Australia and central and southern Portugal. Both projects were kick-started by CGRER seed grants that led to multi-year research grants from the NSF. Each project includes in-depth involvement with Cornell College undergraduates in the geology, environmental studies, and biochemistry programs.

In Australia, we focus on changes in rainfall derived from the Australian summer monsoon and from tropical cyclones. Of particular interest are extreme rainfall events and droughts. By reconstructing extremes in rainfall (both wet and dry events), we hope to better understand what climatic conditions have aligned to produce these events

in the past, with an eye toward what may happen in the future.

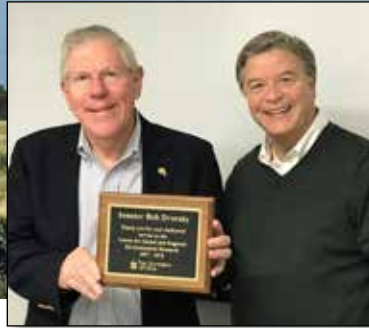
Droughts are of major socioeconomic and scientific interest in Australia, which has suffered three major droughts in the last 120 years. Determining the origins of these droughts is aided by understanding the nature and timing of previous droughts, but few such records are available prior to the historical era. Stalagmites appear capable of providing some help to this problem. In addition to recording physical evidence of extreme rainfall, these same stalagmites also preserve chemical evidence of past droughts. Our work suggests that drought activity has increased markedly over the past 2000 years in comparison to the preceding two millennia.

This work is done in collaboration with Alan Wanamaker from ISU (lead investigator on the Portugal project), Caroline Ummenhofer of Woods Hole Oceanographic Institute, and Yemane Asmerom of the University of New Mexico. The work in Australia is closely coordinated with cavers and naturalists John Cugley, David Woods, and Darren Brooks. The work in Portugal is carefully integrated with Diana Thatcher (doctoral student at ISU) and Portuguese scientists Nuno Bicho (Universidade do Algarve) and Frederico Regala (Associação de Estudos Subterrâneos e Defesa do Ambiente).

Denniston (center, holding carbon dioxide meter) and his students are involved in two multi-year, NSF-sponsored studies of past climate variability in the Australian tropics. (photo by Darren Brooks)



SENATOR DVORSKY RETIRES



After 32 years of service, Senator Bob Dvorsky retired from the Iowa Legislature at the end of 2018. Senator Dvorsky served on the CGRER advisory board since its inception in 1990. CGRER wishes to thank Senator Bob for his years of dedicated service to the state of Iowa.

At left: Bob Dvorsky and Jerry Schnoor.

NASA AEROSOLS AND CLOUD CONVECTION PRECIPITATION STUDY

Greg Carmichael, CGRER co-Director, was named co-chair of the Science Community Cohort (SCC) of the A-CCP study. The SCC is an external group consisting of national and international leading scientists and application practitioners in the field of Aerosols and Clouds, Convection, and Precipitation, whose role is to provide general

advice on all matters relating to the science directions of the A-CCP study. A-CCP is a cross-NASA Center project to define new satellite missions focused on improving our understanding of the climate variability and change, as well as weather and air quality. The study is planned to run through 2022.



Greg Carmichael

VISITING SCIENTISTS & SCHOLARS



CGRER members at the UI hosted several visiting scholars and scientists in 2018. This group brought unique perspectives,

insights, and expertise to students and faculty on the UI campus. The visiting scholars were invited

to Iowa to share their research about aerosol impacts on air quality and climate change.

Visiting scholars from the Chinese Academy of Science were Weizheng Hou and Jingjing Song.

Visiting scholars from Yonsei University were Hyunkwang Lim, Seoyoung Lee, and Jhoon Kim.

In addition, Kazumasa Tamada and Yoshihiro Hirasawa from the National Institute of Technology in Japan, visited Iowa in 2018. Working alongside Greg Carmichael, Tamada and Hirasawa were able to experience Iowa culture including a memorable trip to a UI football game.

CGRER'S HIGH PERFORMANCE COMPUTING ENVIRONMENT

CGRER provides high-performance computing resources to support the interdisciplinary research done by its members and their students.

CGRER research is conducted primarily on a shared computing cluster capable of delivering the CPU power and storage in a high-end parallel computing environment. This computing cluster known as Argon is located at the Information Technology Facility on the UI Oakdale campus. CGRER

has invested in the Argon cluster in order to provide researchers necessary priority when conducting research and analysis. The Argon cluster is continually evolving and because of this has the ability to keep researchers on the cutting edge with machine learning and artificial intelligence capabilities.

Additionally, the UI has an unlimited site-wide license for all Environmental Systems Research Institute products. Jeremie Moen is on the campus GIS Technical Advisory Committee



The Argon Computing Cluster on the UI campus. (photo by Ben Rogers)

and facilitates campus requests for support. Jeremie also provides Business Intelligence guidance for resources available to CGRER.

A SAMPLING OF PUBLICATIONS BY CGRER MEMBERS

Wagner, J.R., T. Taguchi, J.Y. Cho, C. Charavaryamath, and D.J. Griffon. Evaluation of stem cell therapies in a bilateral patellar tendon injury model in rats. *Journal of Visualized Experiments*, doi:10.3791/56810.

Nath Neerukonda, S., S. Mahadev-Bhat, B. Aylward, C. Johnson, C. Charavaryamath, and R.J. Arsenault. Kinome analyses of inflammatory responses to swine barn dust extract in human bronchial epithelial and monocyte cell lines. *Innate Immunity*, doi:10.1177/1753425918792070.

Nordgren T.M., and C. Charavaryamath. Agriculture occupational exposures and factors affecting health effects. *Current Allergy and Asthma Reports*, doi:10.1007/s11882-018-0820-8.

Sermet, Y., and I. Demir. An Intelligent system on knowledge generation and communication for flooding. *Environmental Modeling and Software*, doi:10.1016/j.envsoft.2018.06.003.

Denniston, R.F., Y. Asmerom, V.J. Polyak, A.D. Wanamaker, C.C. Ummenhofer, W.F. Humphreys, J. Cugley, D. Woods, and S.L. Lucker. Short Communication: Decoupling of monsoon activity across the northern and southern Indo-Pacific during the Late Glacial. *Quaternary Science Reviews*, doi:10.1016/j.quascirev.2017.09.014.

Ye, C., D. Chen, S.J. Hall, S. Pan, X. Yan, T. Bai, H. Guo, Y. Zhang, Y. Bai, and S. Hu. Reconciling multiple impacts of nitrogen enrichment on soil carbon: plant, microbial, and geochemical controls. *Ecology Letters*, doi:10.1111/ele.13083.

Muerdter, C. P., C.K. Wong, and G.H. LeFevre. The Role of vegetation in bioretention for stormwater treatment in the built

environment: pollutant removal, hydrologic function, and ancillary benefits. *Environmental Science: Water Research and Technology*, doi:10.1039/C7EW00511C.

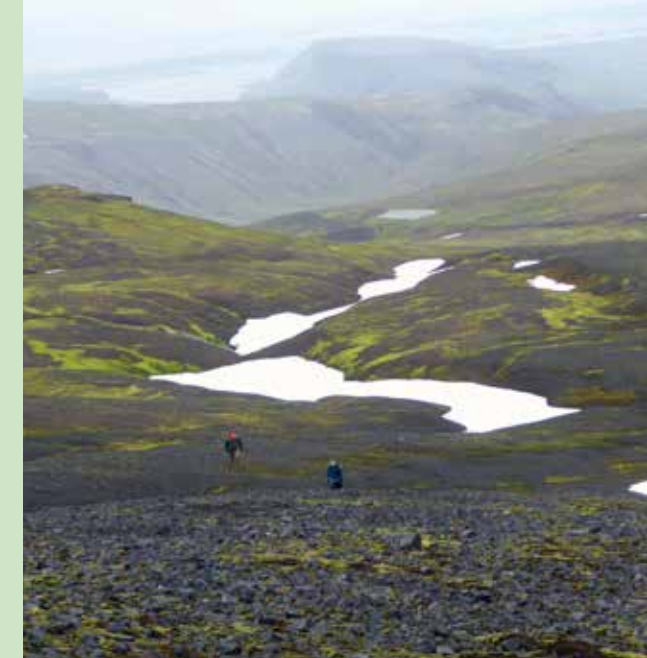
Malanson, G.P., D.B. Fagre, and D.L. Zimmerman. Scale dependence of diversity in alpine tundra, Rocky Mountains, USA. *Plant Ecology*, doi:10.1007/s11258-018-0852-0.

Carbajo Fuertes, F., C.D. Markfort, and F. Porté-Agel. Wind turbine wake characterization with nacelle-mounted wind lidars for analytical wake model validation. *Remote Sensing*, doi:10.3390/rs10050668.

Verhaegen, G., K. E. McElroy, L. Bankers, M. Neiman, and M. Haase. Adaptive phenotypic plasticity in a clonal invader. *Ecology and Evolution*, doi:10.1002/ece3.4009.

Halldorsson, S.A., E. Bali, M.E. Hartley, D.A. Neave, D.W. Peate, G.H. Gudfinnsson, I. Bindemann, M.J. Whitehouse, M.S. Riishuus, G.B.M. Pedersen, S. Jakobsson, R. Askew, C.R. Gallagher, E.R. Gudmundsdottir, J. Gudnason, W.M. Moreland, B.V. Oskarsson, P. Nikkola, H.I. Reynolds, J. Schmith, and T. Thordarson. Petrology and geochemistry of the 2014-2015 Holuhraun eruption, central Iceland: compositional and mineralogical characteristics, temporal variability, and magma storage. *Contributions to Mineralogy and Petrology*, doi:10.1007/s00410-018-1487-9.

Herkert, N., S.N. Spak, A. Smith, J.K. Schuster, T. Harner, A. Martinez, and K.C. Hornbuckle. Calibration and evaluation of PUF-PAS sampling rates across the Global Atmospheric Passive Sampling (GAPS) Network. *Environmental Science Processes & Impacts*, doi:10.1039/c7em00360a.



CGRER funding allowed graduate students Jacob Siebach and Alex Maruszczak (pictured at Kettisborgir) to collect key samples from remote areas of the Snaefellsnes Peninsula to help understand why there are volcanoes in this part of Iceland.

Jayarathne, T., C.E. Stockwell, A. Gilbert, K. Daugherty, M.A. Cochrane, K.C. Ryan, E.I. Putra, B.H. Saharjo, A.D. Nurhayati, I. Albar, R.J. Yokelson, and E.A. Stone. Chemical characterization of fine particulate matter emitted by peat fires in Central Kalimantan, Indonesia, during the 2015 El Niño. *Atmospheric Chemistry and Physics*, doi:10.5194/acp-18-2585-2018.

Zhang, W., G. Villarini, A. Vecchi, and J.A. Smith. Urbanization exacerbated the rainfall and flooding caused by hurricane Harvey in Houston. *Nature*, doi:10.1038/s41586-018-0676-z.

Zhang, W., and G. Villarini. Uncovering the role of the East Asian jet stream and heterogeneities in atmospheric rivers affecting the western United States. *Proceedings of the National Academy of Sciences of the United States of America*, doi:10.1073/pnas.1717883115.

Zhang, D., C.E. Matthews, T. Powell-Wiley, and Q. Xiao. Ten-year change in neighborhood socioeconomic status and colorectal cancer. *Cancer*, doi:10.1002/cncr.31832.

INTERNATIONAL EFFORTS

Central to the work of CGRER is the goal of promoting dialogue among specialists and agencies on both local and global platforms. In service of this effort, this past year CGRER members traveled across the world to foster collaborative and interdisciplinary dialogues, research, and educational opportunities.

JOURNEY TO THE CENTER OF THE EARTH

The Snaefellsjökull volcano looms large on the western end of Iceland's Snaefellsnes Peninsula and is known to many as the place where travellers, as novelist Jules Verne imagined, could journey to the center of the earth.

Yet to geologists like **David Peate**, UI professor of Geochemistry, department of Earth & Environmental Sciences, it is unclear why this volcano even exists.

Icelandic volcanoes are traditionally found in a NE-SW rift crossing the center of the island, marking where the North American and Eurasian tectonic plates drift apart. This separation causes underlying mantle rocks to rise and melt forming magma that creates volcanic eruptions at the surface. But the Snaefellsnes region is over 100 km from this particular boundary. Peate has launched a NSF-funded project to investigate why the mantle melts in this region and how these melts are stored in the crust before being transported to the surface.

Although Peate possessed some Snaefellsnes lava samples from previous trips to Iceland, he was missing key samples from the island's less accessible areas. Support from CGRER was critical in allowing two graduate students, Jacob Siebach and Alex Maruszczak, to accompany Peate on a field sampling trip in the summer of 2017 to fill in these gaps. After an orientation to Iceland geology, visiting the classic

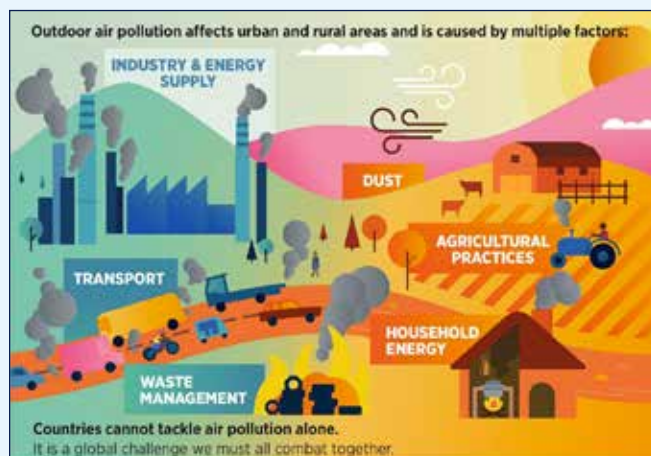


Jacob Siebach and Alex Maruszczak in Iceland.

localities within the main volcanic rift zone, the team converged on the Snaefellsnes Peninsula.

Samples from the fieldwork were shipped to Iowa and prepared for chemical analysis using analytical facilities located in the Department of Earth & Environmental Sciences (ICP-MS and Electron Microprobe). Maruszczak completed his MS thesis in 2018 in which he used compositions of volcanic glass and minerals to show that most magmas were stored at depths of 15-30 km near the base of the crust prior to being erupted at the surface. Siebach, a third year PhD candidate, used mineral data to show that the temperature of the mantle beneath Snaefellsnes is similar to the rift zone, and is now modeling how melt generation can occur in this region.

WORLD HEALTH ORGANIZATION SUMMIT ON AIR QUALITY



In October, **Gregory Carmichael**, CGRER co-Director, was offered membership and an invitation to talk at the World Meteorological Organization's delegation to the first UN Global Conference on Air Pollution and Health.

At this event, over 900 participants met to discuss strategies for reducing air pollution as a means of achieving the Sustainable Development Goals. Included in this conversation were Ministers of Health and Environment, representatives of intergovernmental agencies, health professionals, as well as research, academic, and civil society representatives.

At the conference, the World Health Organization (WHO) declared that air pollution is responsible for 7 million avoidable deaths per year, with nine out of ten people worldwide breathing air containing pollutants above WHO Air Quality guideline levels.

AIR POLLUTION IN ASIA AND THE PACIFIC: SCIENCE-BASED SOLUTIONS

Gregory Carmichael, CGRER co-Director, was a contributing author to the report *Air Pollution in Asia and the Pacific: Science-based Solutions* which was released this past October. The report is the first comprehensive scientific assessment of the air pollution outlook in Asia and the Pacific. It details 25 policy and technological measures that will deliver benefits across all sectors in this particular geographic region.

According to the report, effectively implementing the stated measures would result in a 20% reduction in carbon dioxide and a 45% reduction in methane emissions, preventing up to one third of a degree Celsius in global warming. Resulting reductions in ground-level ozone would reduce crop losses by 45% for maize, rice, soy and wheat combined.



FIELD RESEARCH TRAVEL GRANTS FOR GRADUATE STUDENTS

In 2018, \$4,929 was awarded to graduate students advised by CGRER members who traveled to sites to complete field research for their thesis or dissertation.

Anthony Emigh
Civil & Environmental Engineering, UI
Global Community-Based Flood Prediction Using State-of-the-Art Satellite Data



Anthony Emigh (right) receives a certificate for completing training in global community-based flood prediction using state-of-the-art satellite data.

Alaine Hippee
Biology, UI
Impacts of Sunflower Domestication on the Evolution of its Specialist Insect Herbivores



Alaine Hippee hikes trails in North Carolina's Duke Forest in search of species of sunflowers.

Brandon MacDougall
Geographical & Sustainability Sciences, UI
Mammal Species Distribution along an Urban-Rural Gradient in the US Corn Belt



Brandon MacDougall checks equipment used for non-invasive camera trapping of wildlife at one of many study sites spread across Johnson County, Iowa.

Holly Rich
Ecology, Evolution, & Organismal Biology, ISU
Contributions of Iron to Peat Bog Carbon Stabilization and Losses



Breanna Marmur collects a soil core from an urban riparian buffer, a stormwater best management practice. (photo by Christopher Gannon)



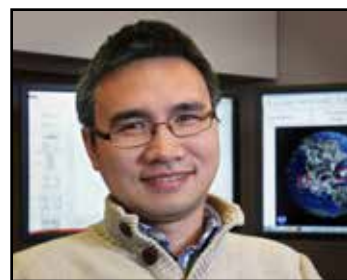
Matt Dannenberg is an assistant professor in the UI department of Geographical and Sustainability Sciences. He studies global change ecology, land-atmosphere carbon and water exchange, and the impacts of climate variability and change on terrestrial ecosystems primarily using remote sensing and tree rings. Current research projects include examining how changes in precipitation extremes affect growth and carbon uptake of North American ecosystems, and how variation in coupled ocean-atmosphere circulation patterns affect vegetation phenology and carbon cycling at continental to global scales.



Emily Finzel is an associate professor of Earth & Environmental Sciences at the UI. Prior to her time at Iowa, she worked for the Alaska State Geological Survey and ExxonMobil. Her research focuses on sedimentary processes in modern and ancient environments with the goal of deciphering the spatial and temporal formation and evolution of sedimentary basins. Her research contributes to understanding the surface response related to deeper earth processes, and has applicability to resource recovery and management, including groundwater, oil and gas, and other earth materials. She currently has projects in southwestern Montana, the Black Hills in South Dakota, and south-central Iowa.

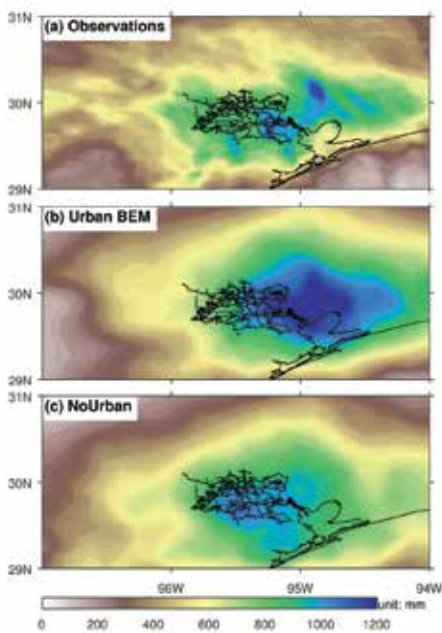


Qian Xiao is an assistant professor of Health and Human Physiology at the UI. She holds a secondary appointment in the department of Epidemiology. Her research interests focus on understanding the role of social, economic, and physical environments in shaping health behaviors and outcomes.



(At left) Wei Zhang's figure showing observed and simulated extreme rainfall during hurricane Harvey.

Wei Zhang is an assistant research scientist at the UI IHR-Hydrosience & Engineering. His research focus is on the simulation, attribution, prediction, and projection of extreme weather and climate events including extreme precipitation, heat stress, hurricanes and atmospheric rivers in the current and future climates. He has been working on combining state-of-the-art climate models, multi-source observations, and data analytics for research on these extremes.



**WHERE ARE THEY NOW?
CGRER MEMBER FEATURE:
MARCELO MENA CARRASCO**



Mena Carrasco in Chile, with a monitoring device. (Photo: Universidad Nacional Andres' Bello)

After graduating with honors in biochemical engineering in Valparaiso, Chile, Marcelo Mena Carrasco earned his MA and PhD in Civil and Environmental Engineering from the UI. Mena Carrasco credits CGRER as an influential force in honing his focus on the relationships between airborne pollutants, weather, and climate. After his time in Iowa, Mena Carrasco received a postdoctoral fellowship at MIT in the joint programs of Science and Policy of Global Change.

Mena Carrasco is an atmospheric modeling specialist with an acute focus on air quality forecasting, inverse modeling, and dynamical downscaling of climate models and emissions inventory development. He actively contributes to policy work related to the life cycle emissions of biofuel production and the externalities of local and global emissions. Formerly the vice minister and minister of the environment for Chile, Mena Carrasco led the design of the first ever green taxes on mobile and point sources, air quality management strategies, and climate policy. His work influenced the ratification of the Kigali and Paris Agreements. Additionally, Mena Carrasco has generated policy work in the fields of waste management, recycling, and plastic pollution; including the first ban on plastic bags in all of the Americas.

Mena Carrasco's efforts on marine and land conservation have led to awards from National Geographic for Planetary Leadership, the UN Environment for Champions of the Earth, and the Climate and Clean Air Coalition's Clean Air Honorary Award. Mena Carrasco is currently the Practice Manager for Climate Research and Analytics at the World Bank. In 2013 was presented the UI Alumni Association Distinguished Young Alumnus Award.



Jerry Schnoor and Greg Carmichael.



Jeremie Moen, Amy Parker and Joe Bolkcom.

CGRER ADMINISTRATION

CGRER is directed by UI professors **Gregory Carmichael**, Department of Chemical and Biochemical Engineering and **Jerry Schnoor**, Department of Civil and Environmental Engineering. Center activities are guided by an elected Executive Committee that consists of 11 members (listed on page 3) plus the two co-directors. The Executive Committee meets monthly as needed to plan initiatives and chart CGRER's course. An Advisory Board of 13 members (listed on 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 CGRER's Research Support Coordinator. **Jeremie Moen** manages CGRER's 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's Vice President for Research.



UNIVERSITY OF IOWA

Anthropology

Margaret E. Beck
 Michael S. Chibnik
 Russell L. Ciochon
 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. Umran Dogan
 Charles O. Stanier
 Jun Wang

Chemistry

Tori Z. Forbes
 Vicki H. Grassian
 Sarah C. Larsen
 Sara E. Mason
 Scott K. Shaw
 Elizabeth Stone
 Mark Young

Civil & Environmental Engineering

Allen Bradley
 David M. Cwiertny
 William E. Eichinger
 Keri C. Hornbuckle
 Craig L. Just
 Witold F. Krajewski
 Lou Licht
 Gregory LeFevre
 Corey D. Markfort
 Timothy E. Mattes
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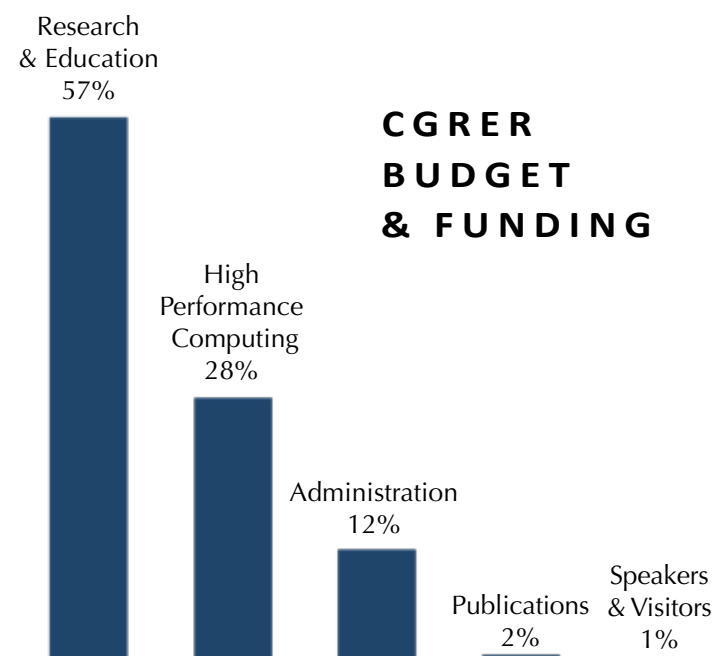
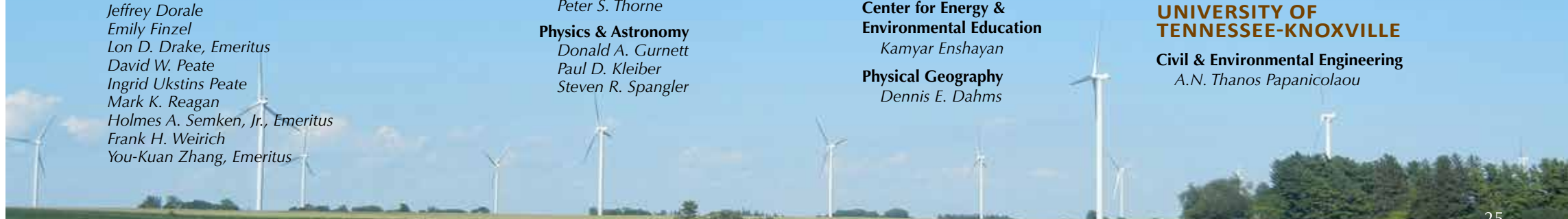
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\$17,433,988 in new external funding



In 2018, CGRER received \$747,159 in revenue from the rate-payers of Iowa utilities as mandated by the State of Iowa's Energy Efficiency Act. These funds helped CGRER assist its members in a wide variety of initiatives.

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\$747,159 in revenue from utilities





THE CENTER FOR GLOBAL & REGIONAL
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*Weather balloon launch. See page 12.
(Photo by Tim Schoon)*