# THE CENTER FOR GLOBAL & REGIONAL ENVIRONMENTAL RESEARCH

## 2016 ANNUAL REPORT


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

*Cover photo: Flood walls protected part of Cedar Rapids from high water in September. The Iowa Flood Information System (IFIS), an online source of real-time flood information that is free and available to the public, logged more than 140,000 visits in 2015 and some 80,000 hits during the 2016 floods. Iowans used these new resources developed by the Iowa Flood Center to protect communities from one of the worst floods in recent Iowa history. (photo by David Herwaldt/IIHR—Hydroscience & Engineering)*

*Top photo: Hurricane (photo by NASA)*

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

*Photo at right: Eric Tate received a CGRER grant to study the effects of winter road maintenance on municipal water supplies in Iowa.*

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 (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 128 members from 14 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

As you will learn from this year's annual report, 2016 was a year of transition and transformation for CGRER. On campus we see the many ways that the 2008 flood has transformed the University of Iowa. We have adapted to the floods by hardening infrastructure, relocating buildings, and enhancing emergency response capabilities. CGRER members have contributed to these transformations in many ways, and the lessons learned have given us an expanded vision of how we can be of use.

*The new Hancher Auditorium, a replacement for a building damaged in the 2008 flood, opened in September on the UI campus.*

Increasingly, our members and students are working with large amounts of data generated by our enhanced capabilities to sense the environment and our ability to perform sophisticated computer simulations. A great example is the Iowa Flood Information System (IFIS). This website helps inform the public about flood risks by bringing together information from sensors measuring the height of rivers with radar-observed rainfall rates and computer-simulated flood forecast predictions.

The nature and breadth of the ways in which CGRER members engage in environmental-related big data can be seen by reading the profiles of our new members. Two of our new members, Caglar Koylu and Jun Wang, were brought to campus as part of the Iowa Informatics Initiative, which is hiring 24 new faculty in big-data related areas. Caglar's research explores the development of computational and visual methods for analyzing spatial information with applications in diverse areas including disaster management. A main component of Jun's research is related to developing new methods to observe atmospheric composition from space. To support such efforts, CGRER continues to invest in high-performance computing and visualization hardware and software.

Another important transition is related to the ways we carry out our scholarship. Our work is increasingly interdisciplinary and is closely coupled to real problems with diverse stakeholders. Mitigation and adaptation to changing environments are active research areas within CGRER. As we conduct our studies, communities are making decisions on actions to become more resilient to such changes. Connecting scholars with stakeholders in the larger world has become a major focus of CGRER. A great illustration of this is the Iowa Water Shed Approach described in the research section of this annual report. This grant connects diverse stakeholders from eight rural Iowa watersheds to develop strategies to reduce flood risks.

*The UI has a system of removable flood walls around some of its buildings. (photo by IIHR)*

The need to better connect communities and researchers is also impacting the way we train students. The education of the next generation of researchers to address the changing environment and related problems continues to be a top CGRER priority. For example, CGRER members are leading a newly funded $3 million NSF grant focused on transforming the way we train graduate students to address interconnected water, food and energy challenges. In addition, in October we hosted the fourth-annual Iowa Climate Science Educators Forum, during which up-to-date climate science

*At forums sponsored by the Iowa Water Shed Approach, members of the public gave feedback on plans to reduce flood risk in their communities. (photo by IIHR)*

*Pete Weyer and Jake Slobe discuss health concerns associated with elevated nitrate levels in drinking water. (photo by Jenna Ladd)*

was discussed and experiences in teaching climate science and communicating it to diverse communities were shared. We also launched the Iowa K-12 Climate Science Education Forum. CGRER and the UI College of Education are working with Iowa educators to engage in classroom investigational learning activities about climate change as part of the adoption of the Next Generation Science Standards.

*Iowa Climate Festival participants (photo by Josh Van Stippen)*

CGRER's outreach activities are designed to communicate the diverse ways that climate and environmental change impacts us. A sampling of activities in 2016 include: the release of the sixth-annual Iowa Climate Science Statement, signed by 187 faculty and researchers from 39 Iowa colleges and universities; co-sponsorship of the Iowa Climate Festival held at the UI Museum of Natural History; and the launch of a new monthly podcast, EnvIowa, hosted by our CGRER interns Jenna Ladd and Jake Slobe. In addition, CGRER was honored to receive the Iowa United Nations Association's Garst Media Award for Iowa Environmental Focus, our blog devoted to environmental news and research.

CGRER members are engaged in research, training and service that connect communities both near and far. At the international level, our activities included a focus on sustainable cities. We assisted with sustainability efforts in India and also participated in the United Nations Conference on Housing and Sustainable Urban Development (Habitat III), during which a new urban agenda was adopted.

In this annual report, we are excited to share with you our 2016 activities. We invite your comments and suggestions on how we can better connect communities and assist in efforts to address the impacts of a changing environment.

**Gregory R. Carmichael,**

**CGRER Co-Director with Jerald L. Schnoor**

# MESSAGE FROM THE CGRER ADVISORY BOARD

In 2016, a number of notable events and milestones related to climate change and extreme weather occurred in Iowa. These milestones underscore the importance of CGRER's mission to better understand the effects of global environmental change.

In June, the University of Iowa celebrated a full recovery from the devastating flood of 2008. In the eight years since then, flood mitigation, expenditures and permanent recovery efforts have totaled nearly $650 million for the 2.5 million square feet of space spread throughout more than 20 campus buildings, including at the Iowa Advanced Technology Laboratories which house CGRER. A recovery celebration marked the completion of three major replacement buildings in 2016: Hancher Auditorium, the Visual Arts Building, and the Voxman Music Building. All told, these investments will serve to mitigate future flood damages and allow the UI to move forward in providing services to students and the community at large.

In September, large precipitation events, including nearly 11 inches in Floyd County in northeast Iowa, contributed to record flooding on the Shell Rock River and the second-highest flood on record on the Cedar River. According to the Iowa Department of Agriculture and Land Stewardship Climatology Bureau, at least three communities in northeast Iowa recorded new record annual precipitation totals by the end of September. MidAmerican Energy Company provides natural gas and electric service to customers in a number of the communities affected by this flood. Throughout the flood event, MidAmerican Energy service crews worked in coordination with state and local officials to respond to rising flood waters and to minimize impacts to customers and energy delivery infrastructure.

> The statewide flood mapping project and the resources provided for planning and response efforts underscore the value of CGRER's mission and the continued need to understand changing climactic conditions.

*The floods of 2008 brought destruction throughout eastern Iowa. (IIHR photo)*

As part of the flood response efforts, I worked with staff at the Iowa Flood Center (a CGRER member organization) to obtain flood inundation and preliminary flood modeling data for six communities on the Shell Rock and Cedar Rivers. The flood inundation data was available for most areas at half-foot intervals corresponding to river gauge elevations. MidAmerican Energy used this information to evaluate customer impacts from predicted river crests and coordinate response efforts accordingly.

*Dan Ceynar adjusts a stream stage sensor. (photo by Iowa Flood Center)*

The high quality of the flood inundation data products allowed MidAmerican Energy to better refine response activities and to significantly reduce customer impacts as a result. For example, in Cedar Rapids, MidAmerican Energy temporarily disconnected approximately 1,700 natural gas meters at customer properties that were within inundation areas for the forecasted flood crest. This number represents less than one third of the disconnections that were required during the 2008 floods. This reduction is attributable in no small part to the flood response and protection efforts of the city and citizens of Cedar Rapids. These efforts were aided not only by the fine-scale inundation maps developed by the Iowa Flood Center, but also by the more accurate flood forecasting made possible by the Iowa Flood Center's real-time river gauge sensors deployed throughout the Cedar River watershed. Fine-scale inundation mapping and better flood forecasting, both developed in part due to the 2008 floods, allowed MidAmerican Energy operations to specifically target individual customer homes and businesses rather than disconnecting large areas based on broad-scale Federal Emergency Management Administration flood hazard mapping.



*Tom Stoeffler checks on water quality sensors in an Iowa stream. (photo by Iowa Flood Center)*

The third significant milestone that occurred in 2016 was the completion of the Iowa Flood Center's statewide flood mapping project in November. The flood mapping project, which began in 2010 with funding from the U.S. Department of Housing and Urban Development, provides flood maps for every stream in Iowa that drains at least one square mile. The flood mapping products include the inundation maps used in the Cedar River flood response in 2016 and can be used to evaluate the extent of flood risk for communities statewide based on updated rainfall information. The statewide flood mapping project and the resources provided for planning and response efforts underscore the value of CGRER's mission and the continued need to understand changing climactic conditions so that affected individuals, businesses and communities can evaluate, prepare for and respond to the increased frequency and magnitude of extreme weather events.

While I have only served on the CGRER Advisory Board since 2015, the impacts of a changing climate have held my interest from an early age. The experiences from the flood of 1993, including the displacement and rebuilding of my family's small business in West Des Moines, Iowa, helped to shape and influence the course of my life, studies and career. Those experiences were a large part of the reason I chose to pursue environmental studies at Cornell College in Mt. Vernon, Iowa, which included courses on climate change from my advisor and CGRER member Rhawn Denniston.

I'm grateful for the varied and valuable accomplishments of CGRER during this past year.

**Jesse Leckband**
**MidAmerican Energy**

*The online Iowa Flood Information System includes maps delineating 100-year (blue) and 500-year (orange) floodplains. (photo by Iowa Flood Center)*


## ADVISORY BOARD MEMBERS

**Bob Dvorsky**
Senator,
Iowa State Legislature

**Tim Harden**
Alliant Energy

**Mark Kresowik**
Beyond Coal Campaign,
Sierra Club

**Jesse Leckband**
MidAmerican Energy

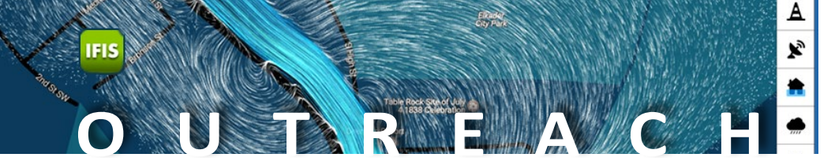
**Hiram "Chip" Levy**
Retired from Geophysical Fluid Dynamics Laboratory, NOAA

**David Osterberg**
Occupational and Environmental Health,
University of Iowa

**William Stigliani**
Center for Energy and Environmental Education,
University of Northern Iowa

**Sharon Tahtinen**
Iowa Department of Resources

**Nick Wagner**
Iowa Utilities Board




# OUTREACH

CGRER members shared their expertise with the larger world through a variety of initiatives during the year. Outreach efforts included the Iowa Climate Festival, a seminar on drinking water issues in Iowa, and the sixth-annual Iowa Climate Statement, which described ways agriculture can adopt climate-smart conservation practices.

## IOWA CLIMATE STATEMENT 2016

The sixth-annual *Iowa Climate Statement* was released in October. Signed by 187 faculty and researchers from 39 Iowa colleges and universities, *Iowa Climate Statement 2016: The Multiple Benefits of Climate-Smart Agriculture* describes how conservation strategies can help Iowa improve soil and plant health, store carbon, and create cleaner water. Iowa farmers are experiencing real effects from climate change, including heavier rains and increased flooding and soil erosion. The statement advocated for proven climate-smart conservation methods, including reducing cropland tillage to prevent soil erosion and the promotion of land set-aside programs that can permanently store carbon in soils. Government representatives are urged to help Iowa's farmers and land managers establish a multi-faceted vision for land stewardship by vigorously implementing federal, state, and other conservation programs. The statement received significant press coverage throughout Iowa.


## DRINKING WATER SEMINAR

**David Cwiertny, Craig Just, Larry Weber** and **David Osterberg** participated in the symposium *Iowa's Drinking Water: Could Flint Happen Here?* Held in June at the Iowa Events Center in Des Moines, the day-long conference explored the challenges faced by water providers in their efforts to reliably deliver safe drinking water to Iowans.

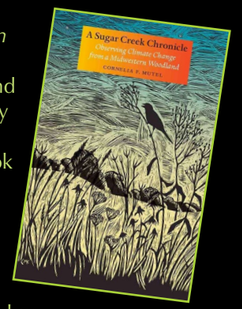
AAAS
ADVANCING SCIENCE, SERVING SOCIETY

## U.S. CONGRESSIONAL FELLOW

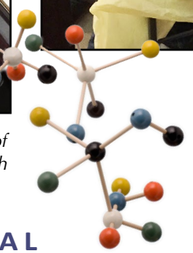
**David Cwiertny** was selected to serve as a 2016-17 American Association for the Advancement of Science (AAAS) Congressional Fellow. AAAS creates opportunities for scientists to offer their expertise and analytical skills to legislators while also learning more about the policy making process firsthand. As a Congressional Fellow, he will serve as Democratic staff on the House Energy and Commerce Committee, providing technical and scientific expertise to both the Energy and Power and Environment and Economy Subcommittees.



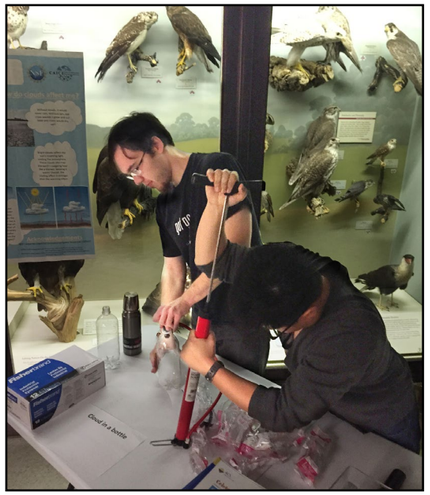
## CLIMATE CHANGE MEMOIR




**Connie Mutel's** new book *A Sugar Creek Chronicle: Observing Climate Change from a Midwestern Woodland* weaves climate change science with the story of her life and her love for the natural world. Published by the University of Iowa Press and partially supported by a grant from CGRER, the book is meant to appeal to a general audience. It explains the science of climate change in a straightforward, compelling way and suggests practical ways individuals can take action to combat this global problem. Mutel has given presentations on her book in locations throughout the Midwest, and it has been featured in media outlets that include Iowa Public Radio, regional newspapers, and a variety of online publications.



*Scientific information was presented in a variety of forms at the Iowa Climate Festival. (photos by Josh Van Stippen)*



## IOWA CLIMATE FESTIVAL

CGRER was a co-sponsor of the 2016 Iowa Climate Festival, which was held in October at the UI Museum of Natural History. **Elizabeth Stone** was the organizer of the event and **Jerry Schnoor** was one of the presenters. The event included discussion of the recent Paris Agreement, climate change impacts in Iowa and strategies for mitigation, and how cities and individuals can adopt more sustainable practices. A Climate Science Fair was held in the afternoon, with hands-on experiments relating to topics such as what makes a gas a greenhouse gas, how clouds form, how particles in the air cool the earth, and how people's carbon footprints affect the ocean.

## IOWA UNITED NATIONS ASSOCIATION AWARD

In May, CGRER was honored by the Iowa United Nations Association for its communications and outreach efforts. **Jerry Schnoor** accepted the Garst Media Award for Iowa Environmental Focus, CGRER's blog devoted to environmental news and research. CGRER was lauded for its outreach efforts that share scientific research and expertise with the general public and policy makers. At the same meeting, **Connie Mutel** received the Garst Memorial Leadership Award for 2016.


*John Fraser of the Iowa United Nations Association presents the Garst Media Award to Jerry Schnoor.*

*Above photos: CGRER members visit with legislators at the annual CGRER-IFC Legislative Breakfast at the Iowa State Capitol.*

## LEGISLATIVE BREAKFAST

In March, CGRER researchers discussed their work with lawmakers at the annual legislative breakfast reception at the Iowa State Capitol. CGRER sponsors the reception each year with the Iowa Flood Center. The event helps legislators and other public officials learn about the valuable work being done by researchers at the two centers, including research on flood mitigation and other environmental challenges. The event also allows faculty and staff at the centers to gather ideas and learn from state legislators about environmental issues in their home districts.

CGRER members in attendance included **Witold Krajewski**, director of the Iowa Flood Center and **Larry Weber**, director of IIHR—Hydroscience & Engineering. The two spoke about the recent $96 million grant from HUD to improve Iowa watersheds (see page 16). **Craig Just** gave an update on the Iowa Small Community Wastewater Technology Park and Training Program. **Chandru Charavaryamath** spoke about his work on the mechanisms of lung inflammation following exposure to swine barn air.



## CGRER COMMUNICATIONS

### CGRER MEDIA OUTREACH

CGRER's blog, Iowa Environmental Focus (www.iowaenvironmentalfocus.wordpress.com), continues to be a valuable resource for online engagement and environmental education. Its stories, videos and photos about environmental news and research are created by CGRER's communications interns.

In addition, a new monthly podcast was launched in September. EnvIowa, which is hosted by interns **Jenna Ladd** and **Jake Slobe**, discusses environmental news, research and initiatives that affect Iowans. Listeners can access the podcast on iTunes and Iowa Environmental Focus.

**Elizabeth Stone** records CGRER's weekly news segments that are distributed to radio stations throughout Iowa. The one-to-two-minute segments highlight the work of CGRER members as well as current Iowa environmental issues and efforts toward greater sustainability. The audio recordings are available on Iowa Environmental Focus.

### CGRER INTERNS

**Jenna Ladd** serves as a media specialist for CGRER while also working toward an MA in Rehabilitation and Mental Health Counseling. Her CGRER responsibilities include providing blog content, writing radio scripts and generating multimedia coverage of events. She also helped to create CGRER's new podcast, EnvIowa. Upon graduation, she hopes to integrate climate change action with mental healthcare through the utilization of horticulture and outdoor therapy techniques.

EnvIowa
Center For Global & Regional Environmental Research

**Jake Slobe** serves as a media specialist for CGRER while pursuing a BA in Journalism and Mass Communication at the UI. He also plans to receive a Certificate in Sustainability. Before coming to the UI, Jake served as a writer and editor at the Communique while attending Kirkwood Community College.

*Jenna Ladd (left) and Jake Slobe (right) work closely with Joe Bolkcom (center), CGRER Outreach and Community Communication Director.*

*Elizabeth Stone records a CGRER radio spot with the assistance of student media specialists Cora Bern-Klug and Jenna Ladd. (photo by Joe Bolkcom)*

# CGRER MEMBERS

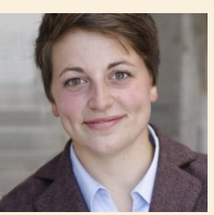
## A SAMPLING OF AWARDS, ACHIEVEMENTS & APPOINTMENTS

◀ **Greg Carmichael** was inducted into the Hall of Distinction at his alma mater, the University of Kentucky College of Engineering.

**Tori Forbes** was named a UI Dean's Scholar, an award that recognizes excellence in research and teaching. In addition, her graduate student **Andrew Knight** received the Ballard Seashore Dissertation Fellowship.

◀ **Konstantine Georgakakos** was named a Fellow by the American Association for the Advancement of Science. He was honored for his work on hydrometeorological models and flood forecasting systems and their application for the benefit of society.

**William Gutowski** was elected as a Fellow of the American Meteorological Society.



◀ **Kayley Lain**, a student of **H.S. Udaykumar** and **Scott Spak**, was named an Iowa Space Grant Consortium Fellow. The program supports outstanding STEM graduate students whose research supports NASA's mission.

**Maurine Neiman** was appointed to the editorial board of the *Proceedings of the Royal Society of London B: Biological Sciences*.

▲ **Jerry Schnoor** received the Dixy Lee Ray Award from the American Society of Mechanical Engineers. The award recognizes significant achievements and contributions in environmental protection.

**Charlie Stanier** was appointed to the U.S. Department of Agriculture's Agricultural Air Quality Task Force.

A paper co-authored by **Ion Bogdan Vasi** received Best Paper Award from two sections within the American Sociological Association and was covered in media outlets that include *Reuters* and *The Guardian*. "No Fracking Way! Media Activism, Discursive Opportunities and Local Opposition against Hydraulic Fracturing in the United States, 2010-2013" was published in the *American Sociological Review*.


▲ **Gabriele Villarini** received the American Geophysical Union's James B. Macelwane Medal, which is presented to only 3-5 young researchers each year selected from the AGU's more than 60,000 members.

▲ **Victoria Walker**, a graduate student in Agricultural Meteorology at ISU advised by **Brian Hornbuckle**, received a NASA Earth and Space Science Fellowship.

An innovative self-cleaning culvert design by **Marian Muste** ▶ received a national award from the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Council (RAC). RAC Region 3 selected four top research projects for 2016 for inclusion in the "Sweet Sixteen" High Value Research Projects.



## A SAMPLING OF GRANTS AWARDED TO CGRER MEMBERS

**Greg Carmichael** is co-PI on three grants. He received a $431,071 grant from NASA for *Integrating Satellite Soil Moisture Into Weather, Emission, and Air Quality Modeling* (2016-2019). The UI's portion is $98,694. The second is a $703,678 grant from NOAA for *Improving Emissions, Predictions and Impact Assessments of Biomass Burning Smoke and Dynamic Air Quality Using FIREX Observations, Ground Networks and Satellite Data* (2016-2020). The UI's portion is $150,001. The third is a $367,145 grant from NASA for *Novel Use of NASA Data with Emission Data Assimilation to Support U.S. National Air Quality Forecasting Capability and WMO Regional Chemical Reanalysis* (2016-2019). The UI's portion is $44,895.

**David Cwiertny** and **Gregory LeFevre** (co-PIs) received a $40,000 grant from the University of Iowa Center for Effects of Environmental Contamination for *Fate of Neonicotinoid Insecticides in Water and Wastewater Treatment Systems*. (2016-2017).

**Diane Debinski** (co-PI) received a $439,000 USDA Agriculture and Food Research Initiative (AFRI) grant *Adaptive Management of Invasive Species to Enhance Agro-ecosystem Services in Grasslands* (2016-2019).

**Rhawn Denniston** (PI) and colleagues received a $358,417 NSF grant *Collaborative Research: Reconstructing Holocene Dynamics of the Indo-Pacific Tropical Rain Belt using Australian Stalagmites and Coupled Climate Models* (2016-19). Cornell College's portion was $104,085.

**William Gutowski** (PI) and colleagues received a $5,990,259 U.S. Department of Energy grant *A Hierarchical Evaluation Framework for Assessing Climate Simulations Relevant to the Energy-Water-Land Nexus* (2016-2019).

**Witold Krajewski** (PI) and **Brian Hornbuckle** (co-PI) received a $658,439 NASA grant *Exploring Utility of SMAP Products for Real Time Flood Forecasting* (2016-2019).

◀ **Maurine Neiman** (PI) received a $7,340 NSF grant *Improving Graduate Student Preparedness for Entering the Workforce* (2016-2017) and a $19,825 NSF grant *Transposable Element Dynamics Across Reproductive Modes and Ploidy Levels in Natural Populations* (2016-2018). In addition, she is co-PI on two other grants: a $2,000 Iowa Center for Research by Undergraduates Research Fellow Grant *Does Parasite Pressure Drive the Evolution of Life History Variation (Part III)?* (2016-2017) and a $2,000 Iowa Center for Research by Undergraduates Research Fellow Grant *Does Parasite Pressure Drive the Evolution of Life History Variation (Part II)?* (2015-2016).

**Scott Spak** (co-PI) received a $100,000 NESI-SES grant *Renewable Energy Planning for Smart Communities* (2016-17).

**Jun Wang** is PI or Co-PI (institutional PI) on three grants. The first is a $99 million NASA Earth Venture grant *Multi-angle Imager for Aerosols* (2016-26). The UI's portion is $1,267,840. The second is a $1 million NASA grant *GeoTASO Measurements of Aerosols and Tropospheric NO2, CH2O, and O3 Vertical Column Density (VCD) in Support of KORUS-AQ* (2016-19). The UI's portion $151,116. The third is a $500,000 NSF and USDA grant *Management Opportunities to Reduce On-field Losses and the Life-cycle Environmental Consequences of Accelerated Nitrogen Cycling in High Temperature Regions* (2016-19). The UI's portion is $102,870.

*Maurine Neiman collects snails from New Zealand's Lake Grasmere in the Southern Alps.*

*Rhawn Denniston studies cave formations as part of his research on ancient climate change. (photo by Rhawn Denniston)*

# EDUCATION

CGRER members are helping to educate the next generation of researchers and scientists who will help address the many environmental issues facing the world. Educational efforts during the year included several climate science teaching initiatives and the development of a new graduate program in sustainable water development at the University of Iowa.

## SUSTAINABLE WATER DEVELOPMENT PROGRAM

A number of CGRER members are involved in a $3 million NSF grant that will establish a Sustainable Water Development Program at the UI. Set to launch in the fall of 2017, the program will train graduate students to address the water, food and energy challenges that face communities with limited resources. This often includes rural areas, agricultural-based communities and developing countries. Around 50 MS and PhD students will be accepted into the program over 5 years. The program will train students to become water professionals as researchers, professors, entrepreneurs, and consultants, as well as civic, professional and global engineers. In addition, a graduate certificate in Sustainable Water Development will be offered to students. The Sustainable Water Development degree will be housed in the Department of Civil and Environmental Engineering and will build upon strengths across the campus in the area of water sustainability. **David Cwiertny** is PI for the grant and director of the program; **Michelle Scherer** is a co-PI and associate director; **Eric Tate**, **Craig Just**, and **Gabriele Villarini** are co-PIs. **Jerry Schnoor, Witold Krajewski** and **Kelly Baker** are senior personnel on the project.

## SCIENCE BOOSTER CLUB PROJECT

(photo by Nick Fetty)

**Maurine Neiman** received a Community Impact Grant from the UI Office of Outreach & Engagement. The $8,695 grant funds an expansion of the Science Booster Club Project, a partnership between the UI and the National Center for Science Education that has served more than 50,000 children and adults in Iowa. Science Booster Clubs support local science education by providing a platform for fun, community-based science events. The events educate people about current science issues, with the goal of developing a nationally applicable model to create community-based support for science education, especially involving climate change and evolution-related topics.

## IOWA K-12 CLIMATE SCIENCE EDUCATORS FORUM

CGRER and the UI College of Education are helping teachers in Iowa K-12 classrooms adapt to new science education standards. The Next Generation Science Standards (NGSS) emphasize investigative learning rather than rote memorization. The standards are the result of a collaborative effort between states and stakeholders in science, science education, higher education and industry. Within the four major domains of physical science—life science, earth and space science, and


engineering—students will engage in investigational learning about climate change.

**Scott Spak** of CGRER and **Ted Neal** of the UI College of Education are leading efforts to ease the transition for educators, including surveying teachers and administrators to see what resources they need to teach climate change science effectively. While the new standards aren't mandatory for another three years, many school districts are already implementing them. CGRER and the College of Education have hired two graduate research assistants to help implement this project: **Susanna Herder** is pursuing a MA in Teaching in Secondary Science and **Andrea Malek** is working on an MS in STEM Education.



## ENVIRONMENTAL SCIENCE EDUCATOR WORKSHOP

**Art Bettis** (at left) was co-leader of a day-long workshop in June attended by nearly two dozen eastern Iowa K-12 teachers. The workshop taught hands-on activities and lesson plans that educators can use to better connect with their students in the fields of science, technology, engineering and mathematics. Sponsors included the UI Department of Earth & Environmental Sciences, the UI College of Education, the UI State Hygienic Laboratory and the Intensively Managed Landscapes Critical Zone Observatory, an NSF-supported research collaborative that studies the impact agriculture has on land, air and water in the Midwest. In the morning, teachers were at a research site in rural Iowa County learning about hands-on activities and potential field trip opportunities. The teachers took water samples and tested them for metrics such as nitrate levels. In the afternoon, the teachers took part in a curriculum development exercise at the State Hygienic Lab.

## IOWA CLIMATE SCIENCE EDUCATORS FORUM

In October, CGRER hosted the fourth-annual Iowa Climate Science Educators Forum in West Des Moines. The event provides educators, researchers, and students the opportunity to discuss the most up-to-date climate-related research as well as learn methods for engaging students when teaching about climate change.

The event, which attracted 45 participants, included presentations by a number of CGRER members. Event organizer **David Courard-Hauri** presented information on the *Iowa Climate Statement 2016*. **Scott Spak** spoke about the Next Generation Science Standards implementation in Iowa. **Elizabeth Stone** shared educational tools from the Center for Aerosol Impacts on Climate and the Environment. **Connie Mutel** spoke about her recent book (see page 7) and offered suggestions on how climate scientists can more effectively communicate their work to the general public. **Diane Debinski** discussed her research on climate change adaptation within grassland ecosystems, and **Rick Cruise** shared information about the impact of increasingly intense rainfall on soil erosion.

*David Courard-Hauri organized the Iowa Climate Science Educators Forum.*

## COURSE ON CLIMATE CHANGE

In September, **Jerry Schnoor** taught a four-week course on Climate Change in the UI's Senior College. The course examined the physical basis of climate change and how scientists know that humans are the major cause of global warming, as well as the ways its effects can be mitigated.

## NEW AGRONOMY COURSE

**Brian Hornbuckle** developed a new course for first-year agronomy students, a class that is part of a re-design of ISU's agronomy undergraduate curriculum that will help students better deal with the increasingly large amounts of data relating to environmental conditions and agriculture. The goal is to prepare students to make science-based decisions relating to the environmental impacts of agriculture. This course was launched in the fall semester and will be taught once a year.

## CONFERENCE TRAVEL GRANTS FOR GRADUATE STUDENTS

*In 2016, $21,300 was awarded to graduate students advised by CGRER members who were traveling to professional conferences to make oral or poster presentations.*

Ibrahim Al-Naiema
Chemistry, UI
*American Association for Aerosol Research Conference*

Laura Bankers
Biology, UI
*International Conference on Polyploidy, Hybridization, and Biodiversity*

Can Dong
Chemical & Biochemical Engineering, UI
*American Geophysical Union Fall Meeting*

Oronde Drakes
Geographical and Sustainability Sciences, UI
*Annual Meeting of the Association of American Geographers*

Junchuan Fan
Geographical & Sustainability Sciences, UI
*GIScience 2016*


Jeffrey Alan Gepper
Urban & Regional Planning, UI
*National American Planning Association meeting*

Hamidreza Ghasemi Damavandi
Electrical Engineering, UI
*Data Compression Conference*

Shahin Hajilar
Civil, Construction,
& Environmental Engineering, ISU
*Transportation Research Board (TRB) Annual Meeting*

Nicholas Herkert
Environmental Engineering
& Science, UI
*SETAC World Congress/ SETAC North America Meeting*

Xu Huang
Chemistry, UI
*American Chemical Society National Meeting*

Nathan Janechek
Chemical & Biochemical Engineering, UI
*American Association for Aerosol Research Conference*

Thilina Jayarathne
Chemistry, UI
*American Geophysical Union Fall Meeting*

Rebecca Kauten
Geographical & Sustainability Sciences, UI
*American Association of Geographers Annual Meeting*

Kathryn Klarich
Civil & Environmental Engineering, UI
*SETAC-Society of Environmental Toxicology & Chemistry Meeting*

Joanna Krajewski
Journalism & Mass Communication, UI
*American Public Health Association Annual Conference*

Yingyang Lai
Urban & Regional Planning, UI
*American Planning Association 2016 National Conference*

Xikun Liu
Civil & Environmental Engineering, UI
*International Symposium on Microbial Ecology*

Juliana Lucchesi
Urban & Regional Planning, UI
*American Planning Association National Conference*

Audrey McCombs
Ecology, Evolution
& Organismal Biology, ISU
*Greater Yellowstone Ecosystem Biannual Conference*

Kyle McElroy
Biology, UI
*International Conference on Polyploidy, Hybridization, and Biodiversity*

Munir Ahmad Nayak
Civil & Environmental Engineering, UI
*Workshop on Bayesian Environmetrics*

Finn Piatscheck
Ecology, Evolution
& Organismal Biology, ISU
*International Fig Symposium*

Elizabeth Rumpza
Urban & Regional Planning, UI
*American Planning Association National Conference*

Muhammed Sermet
Electrical & Computer Engineering, UI
*GPU Technology Conference*

Justin Van Goor
Ecology, Evolution
& Organismal Biology, ISU
*International Fig Symposium*

Haoyi Xiong
Geographical & Sustainability Sciences, UI
*Association of American Geographers Meeting*

Enes Yildrim
Civil & Environmental Engineering, UI
*American Geophysical Union Fall Meeting*

Christina Zinkgraf
Education, UI
*Imagining America Conference*



## FIELD RESEARCH TRAVEL GRANTS FOR GRADUATE STUDENTS

*In 2016, $13,690 was awarded to graduate students advised by CGRER members who were traveling to sites to complete field research for their thesis or dissertation.*

Jared Becker
Mechanical & Industrial Engineering, UI

*Cooking in Developing Countries, a Solar Solution*

Mohamed Elsaadani
Civil & Environmental Engineering, UI

*NASA Soil Moisture Active Passive (SMAP) Validation Experiment*

Kathleen Goff
Earth and Environmental Sciences, UI

*Geochemical Analysis of Fracture Networks in Loess and Till of Iowa: Implications for Modeling Geochemical Evolution of a Quaternary Landscape*

Camille Karnatz
Natural Resource Ecology and Management, ISU

*Assessing the effectiveness of best management practices to increase infiltration in urban and rural environments*

Bret Lang
Natural Resource Ecology and Management, ISU

*Urban habitat use by butterflies: Adapting protocols for routine monitoring in urban settings*

Audrey McCombs
Ecology, Evolution, and Organismal Biology, ISU

*Using occupancy surveys and genetic analysis to examine the viability of the* Parnassius clodius *butterfly population in Grand Teton National Park*

Trevor Rundhaug
Civil & Environmental Engineering, UI

*NASA Soil Moisture Active Passive (SMAP) Validation Experiment*

Michael Sara
Earth and Environmental Sciences, UI

*Quantifying morphological and chemical trends in mafic eolian environments from Askja, Iceland as an analog to Mars*

Gabriel Perez Mesa
Civil & Environmental Engineering, UI

*NASA Soil Moisture Active Passive (SMAP) Validation Experiment*

*Top: A student working with Camille Karnatz monitors soil infiltration.*
*At left:* Parnassius clodius *butterfly in Grand Teton National Park.*
*Below: Michael Sara in the Icelandic Highlands with volcanoes and glaciers in the background.*

# RESEARCH

CGRER supports research that deepens our understanding of environmental change and provides solutions to local, regional and global problems. Initiatives in 2016 included a major flood mitigation and watershed improvement program in Iowa, research on the forecasting of hurricanes, and efforts to help develop farming practices that will improve water quality.

## HURRICANE RAINFALL

Just weeks before Hurricane Matthew caused record flooding in North Carolina, **Gabriele Villarini** published research in the *Journal of Hydrology* that examined how accurate current forecasting systems are in predicting rainfall from tropical cyclones. Comparing five state-of-the-art weather prediction models, he and his fellow researchers found that current models can forecast reasonably well both where and how much rainfall a tropical cyclone can produce up to two days in advance. However, the forecast's accuracy decreased drastically when the lead time increased to five days. The research was based on 15 North Atlantic tropical cyclones that came within 300 miles of the U.S. coastline from 2007 to 2012.

## IOWA WATERSHED APPROACH

*(Photo by IIHR)*

The Iowa Flood Center (IFC) played a major role in securing $96.9 million in funding for the Iowa Watershed Approach (IWA). The project is a flood mitigation infrastructure and watershed improvement program that brings together many Iowa agencies and organizations, including the Iowa Economic Development Authority, Homeland Security and Emergency Management, and the Iowa DNR. Awarded by the U.S. Department of Housing and Urban Development, the grant funds efforts in eight rural Iowa watersheds to develop strategies aimed at flood risk reduction, water quality improvement, and increased community resilience. One of its goals is to create a program that can be replicated throughout the Midwest and the U.S. Volunteer landowners in the watersheds will receive up to 75% in financial assistance to implement practices such as farm ponds, wetlands, terraces, and bioreactors. These conservation practices have yielded impressive results in a pilot program coordinated by the IFC in three sub-watersheds in Iowa: Otter Creek in the Turkey River, Beaver Creek in the Upper Cedar, and South Chequest Creek in Chequest Creek. CGRER members **Larry Weber, Witold Krajewski, Craig Just** and **Eric Tate** played key roles in securing the grant for the state of Iowa.

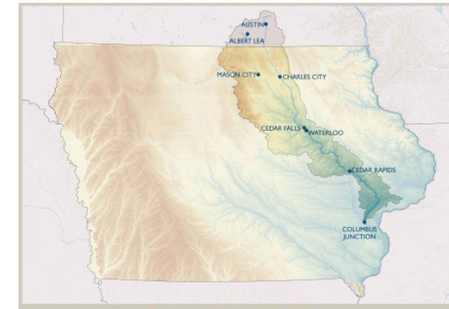
## DUST LINKED TO ASTHMA PREVENTION

**Peter Thorne** was one of the lead researchers on a study showing a protective effect of agricultural exposures early in life on the development of asthma. The research, which was published in the *New England Journal of Medicine*, compared the Amish of Indiana and the Hutterites of South Dakota. Even though the two groups share comparable genetic backgrounds, diets, and lifestyles, about 21% of Hutterite children aged 6-14 have asthma while only 5% of Amish children do, which is about half the national average. The study suggests that the farming practices of the two groups help account for the difference. Hutterite communities operate large, industrialized farms while the Amish children often play in dairy barns that are located near the family home. Researchers found that Amish house dust was much richer in microbial products derived from farm animals, which triggers an immune response that helps protect the children from asthma.



## WATER RESEARCH IN THE IOWA/CEDAR RIVER BASIN

A supplemental $200,000 NSF grant is funding research on sustainability, resilience, and adaptive capacity in the Iowa/Cedar River Basin, with a goal of helping farmers to adopt better nutrient management practices and improve water quality despite increasingly severe storms and a changing climate. The project is a supplement to a larger grant from NSF's Coupled Natural and Human Systems Program, which funds research on the complex ways human actions interact with biological processes. The project involves an interdisciplinary team from four institutions. At the UI, the principle investigator (PI) is **David Bennett**, with **Marian Muste** and **Jerry Schnoor** serving as co-PIs. Their research includes working with farmers in the Clear Creek Watershed to install sensor equipment that gives real-time information on the interaction between farming practices and water quantity and quality. It is part of the NSF Smart & Connected Communities initiative.




CEDAR RIVER WATERSHED

*(Map by IIHR)*

## IMPROVING U.S. WATER INFRASTRUCTURE

*Municipal water pipes can become filled with corrosion. (photo by Tang and Pieper of Flintwaterstudy.org)*

In the aftermath of the water crisis in Flint, Michigan, **Jerry Schnoor** offered valuable expertise on a national level. In an editorial in the *Journal of Chemical Education*, he described the ways in which aging water infrastructure, particularly lead pipes and faucets, represent a significant community health hazard in thousands of communities. Old water infrastructure needs maintenance, repair, and replacement, and funds should be established to accomplish this task. In an article in *Science*, Schnoor and four co-authors wrote that a key concern in tap water is microbial contamination. The U.S. uses residual disinfectant to address this issue, but this process can lead to the formation of potentially carcinogenic by-products, issues with corrosion, and poor taste. They concluded that the drinking water infrastructure in the U.S. is in serious need of investment.

## MANAGEMENT OF RESERVOIR RESOURCES

Research at California's Hydrologic Research Center, which is directed by **Konstantine Georgakakos**, is being used by the state of California to better manage water resources. Over the past ten years, Georgakakos and colleagues have conducted the Integrated Forecast and Reservoir Management (INFORM) demonstration project, which gives forecasts for inflow into the major reservoirs of Northern California. The success of the project has led California's Department of Water Resources to use INFORM in its operations. With lead times between six hours and nine months, INFORM helps reservoir managers balance trade-offs between objectives that include water conservation, hydroelectric energy generation, ecosystem health, and flood control. INFORM is also being used by other California agencies to examine potential impacts of climatic changes in reservoir operations.

*Shasta Lake is the largest reservoir in California. (photo: Wikipedia Commons).*


*Isao Murase (second from left) and Masanori Miwa (at right) visited the National Advanced Driving Simulator at the UI's Research Park.*

## CGRER VISITING SCIENTISTS

Toshihiro Kitada, president of the National Institute of Technology, Gifu College traveled from Japan to Iowa to meet with UI President Bruce Harreld to renew a student exchange program between the UI and Gifu College. Kitada also visited CGRER to meet with students to discuss research in environmental modeling.

In addition, two Gifu College students, Isao Murase and Masanori Miwa, visited CGRER to learn about U.S. engineering education as part of the exchange program.

## CGRER AIDS TO RESEARCHERS

CGRER provides high-performance computing and visualization resources to support the interdisciplinary research done by its members and their students. CGRER research is done primarily on shared computing clusters capable of delivering the CPU power and storage needed for high-end parallel computing environments. Two computing clusters, Neon and Argon (which will be fully functional in January, 2017), are located at the UI Research Park at the Oakdale campus. CGRER has invested financially in both clusters, which provides our researchers priority when conducting research and analysis.

In addition, the UI has an unlimited site-wide license for all Environmental Systems Research Institute products (ESRI). **Jeremie Moen** is on the campus GIS Technical Advisory Committee and facilitates campus requests for support.

*The Argon Computing Cluster on the UI campus is utilized by many CGRER members. (photo by Ben Rogers)*



## SEED GRANTS

*In 2016, CGRER awarded a total of $243,664 in Seed Grants to seven projects.*

*Development of Chemically Functionalized, High Surface Area Nanofiber Networks for Carbon Capture;* **David Cwiertny**, UI Civil & Environmental Engineering, and **Vicki Grassian**, UI Chemistry; $35,000.

*Mobility of Naturally-Occurring Radioactive Materials (NORM) in Bit Cuttings from Unconventional Drilling Operations;* **Tori Forbes**, UI Chemistry; $35,000.

*Towards effective and reliable removal of MCs from drinking water through biologically active filtration;* **Kaoru Ikuma,** ISU Civil, Construction and Environmental Engineering; $35,000.

*Enhanced Plant Uptake of Contaminants of Emerging Concern under Simulated Global Change Conditions;* **Gregory LeFevre,** UI Civil and Environmental Engineering, $35,000.

*An Integrated Photoelectrochemical/ Supercritical System for CO2 and Wastewater Utilization, and Fuel Production;* **Syed Mubeen,** UI Chemical and Biochemical Engineering, $34,561.

*The Changing Aerosols in the Midwestern U.S. Advanced Tools to Relate Sources, Composition, Climate, and Land Use;* **Charles Stanier,** UI Chemical and Biochemical Engineering, and **Elizabeth Stone,** UI Chemistry; $35,000.

*Quantifying Salinization Vulnerability of Municipal Water Supplies from Winter Road Maintenance: A Case Study in Eastern Iowa;* **Eric Tate**, UI Geographical & Sustainability Sciences; $34,103.

*Eric Tate tested this stormwater outfall in Cedar Rapids for contamination from winter road maintenance. (photo by Eric Tate)*

## A SAMPLING OF PUBLICATIONS BY CGRER MEMBERS

Nelson, A.W., A.J. Johns, E.S. Eitrheim, A.W. Knight, M. Basile, **A. Bettis III**, M. K. Schultz and **T.Z. Forbes.** 2016. Partitioning of naturally-occurring radionuclides (NORM) in Marcellus Shale produced fluids influenced by chemical matrix. *Environmental Science: Processes and Impacts,* doi: 10.1039/C5EM00540J.

**Connerly, C.**, L. Laurian, J. Throgmorton. 2016. Planning for Floods at the University of Iowa: A Challenge for Resilience and Sustainability. *Journal of Planning History*, oi:10.1177/1538513216646131.

*(photo by Iowa Flood Center)*

McGranahan, D.A., T. Hovick, D. Elmore, D.M. Engle, S.D. Fuhlendorf, S.L. Winter, J.R. Miller, and **D.M. Debinski**. 2016. Temporal variability in aboveground biomass decreases as spatial heterogeneity increases. *Ecology*, doi: 10.1890/15-0906.1.

**Denniston, R.F.**, C.C. Ummenhofer, A.D. Wanamaker, M.S. Lachniet, **G. Villarini**, et al. 2016. Expansion and contraction of the Indo-Pacific tropical rain belt over the last three millennia. *Scientific Reports*, doi: 10.1038/srep34485.

**Gutowski, W. J.**, F. Giorgi, B. Timbal, et al. 2016. WCRP Coordinated Regional Downscaling Experiment (CORDEX): a diagnostic MIP for CMIP6. *Geoscientific* Model Development, doi: 10.5194/ gmd-9-4087-2016.

**Hornbuckle, B.**, J.C. Patton, A. VanLoocke, et al. 2016. SMOS optical thickness changes in response to the growth and development of crops, crop management, and weather. *Remote Sensing of Environment*, doi: 10.1016/j.rse.2016.02.043.

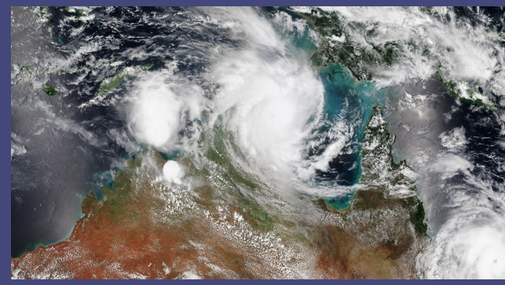
Wolfand, J.M. **G.H. LeFevre**, R.G. Luthy. 2016. Metabolization and degradation kinetics of the urban-use pesticide fipronil by white rot fungus *Trametes versicolor. Environmental Science: Processes & Impacts*, doi: 10.1039/C6EM00344C.

**Malanson, G.P., D.L. Zimmerman,** M. Kinney and D.B. Fagre. 2016. Relations of alpine plant communities across environmental gradients: Multilevel versus multiscale analyses. *Annals of the American Association of Geographers,* doi: .1080/24694452.2016.1218267.

**Neiman, M.** and A. Krist. 2016. Sensitivity to dietary phosphorous limitation in native vs. invasive lineages of a New Zealand freshwater snail. *Ecological Applications,* doi: 10.1002/ eap.1372.

*New Zealand fresh water snail (photo by Bart Zijlstrar)*

Bilal, M., J.E. Nichol, **S.N. Spak**. 2016. A new approach for estimation of hourly fine particulate concentrations using satellite aerosol optical depth



*Tropical cyclone in Australia (photo: Wikimedia Commons)*

and binning of meteorological variables. *Aerosol and Air Quality Research,* doi:10.4209/ aaqr.2016.03.0097.

Rathnayake, C., N. Metwali, Z. Baker, T. Jayarathne, **P. Thorne,** P. O'Shaughnessy, **E.A. Stone**. 2016. Urban enhancements of bioaerosols in the Midwestern United States. *Journal of Geophysical Research – Atmospheres*, doi:10.1002/2015JD024538.

**Villarini, G**. 2016. On the seasonality of flooding across the continental United States. *Advances in Water Resources*, doi: 10.1016/j. advwatres.2015.11.009.

**Villarini, G.** and **R.F. Denniston**. 2016. Contribution of tropical cyclones to extreme rainfall in Australia. *International Journal of Climatology,* doi: 10.1002/ joc.4393.

Wang, Y., **J. Wang**, X. Xu, et al. 2016. A new approach for monthly updates of anthropogenic sulfur dioxide emissions from space: implications for air quality forecasts. *Geophysical Research Letters*, doi: 10.1002/2016GL070204.

Polley, H.W., A.E. Gibson, P.A. Fay, and **B.J. Wilsey**. 2016. Biotic regulation of CO2 uptake-climate responses: links to vegetation properties. *Ecosystems*, doi:10.1007/s10021-016-0009-8.

# INTERNATIONAL EFFORTS

CGRER members work both regionally and around the globe to address problems relating to environmental change. In 2016, international efforts included combating air pollution in India, South Korea, Africa and China and helping establish global standards for sustainable urban development.

## INDIA SMART CITIES PROJECT

**Jeremie Moen** traveled with a UI team to India as part of a Geospatial Consortium held in association with the India Smart Cities Project. Jeremie showcased CGRER-related research at four Indian cities over a two-week period: Delhi, Ahmedabad, Puducherry and Madurai. His presentations focused on the genesis of CGRER, the work being done by its members in a wide range of fields, and the research it supports. In Delhi, he was joined by former CGRER researcher **Sarath Guttikunda**, who researches air pollution in India, in a talk at the Sehgal Foundation. During the trip, the team laid the foundation for future collaborations with Indian scientists, who will be taking part in Geospatial Consortium workshops hosted by the UI in 2017.

*Sarath Guttikunda and Jeremie Moen in India*


## HABITAT III'S NEW URBAN AGENDA

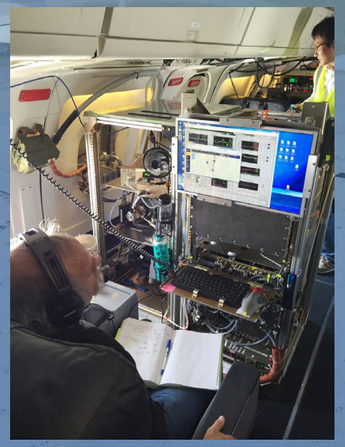
In October, **Greg Carmichael** was a member of the UN World Meteorological Organization (WMO) delegation to the 3rd UN Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador. Attended by more than 45,000 people, Habitat III adopted a New UN Urban Agenda for the next 20 years. The document sets global standards for how cities should be planned and managed to promote sustainable urbanization. Carmichael gave a talk on "Climate Change and Urban Disaster Resilience: Current and Future Challenges."

*Dehli, India, is one of the most polluted cities in the world. (photo by J. Minh-Duy Poirrier)*

## COMBATING AIR POLLUTION IN INDIA

**Greg Carmichael** is part of a team of scientists helping to draw attention to air quality issues in India, which has some of the most polluted cities in the world. Until relatively recently, the Indian government has not paid much attention to air quality. The scientists have studied pollution sources in India, both in and outside of cities. In November, they issued a report outlining 10 steps the Indian government can take to reduce toxic pollutants, including preventing agricultural burning of crop residue and the institution of a new street cleaning program to minimize dust and sand. In addition to having severe health and economic effects, air pollution has significant negative effects on climate. Carmichael's research group developed the first air quality forecasting system in India, which is now being used in three cities, with a fourth to be added in 2017. In addition, scientists from India spent time in Carmichael's lab to learn more about forecasting. The project is sponsored by the UN World Meteorological Organization (WMO) Global Atmospheric Watch program.





*Top photo: Pablo Saide inside a P-3 airplane; above: a work station on board a DC-8; at right: air pollution in South Korea*

## NASA EXPERIMENTS IN SOUTH KOREA AND AFRICA

CGRER members participated in two international NASA projects this year. Korea U.S. Air Quality (KORUS-AQ) is a joint field study between NASA and South Korea designed to advance the ability to monitor air pollution. Between April and June, a multi-aircraft experiment was conducted to better understand processes influencing air pollution in and around Seoul and to develop additional capabilities for space-based observations. **Pablo Saide** and **Greg Carmichael**, along with MS graduate student **Elizabeth Lennartson**, were in South Korea during the experiment to provide weather and air quality forecasts that were used in daily flight planning. Saide and Carmichael participated in another multi-aircraft experiment based in Namibia. NASA ORACLES (ObseRvations of Aerosols above CLouds and their intEractionS) was conducted in August and September. This project is designed to better understand how biomass-burning aerosols from Africa impact the permanent subtropical stratocumulus cloud deck off the west coast of Africa. A better understanding of these processes will improve global weather and climate predictions. Saide and Carmichael were in the field providing forecast support for the flight planning. This experiment will be repeated in the next two summers.

*(photo by Leo Fung)*

## WINTER HAZE RESEARCH IN CHINA

**Greg Carmichael** and **Meng Gao**, a former CGRER PhD student who is now a postdoctoral fellow at Harvard University, have discovered a chemical mechanism that helps explain severe winter haze events in China. Their research, which was published in *Science Advances*, greatly improves the forecasting of haze events and will help guide more effective control measures. The fine-particle pollution associated with winter haze threatens the health of more than 400 million people on the North China Plain.

*(photo by David Peate)*

## VOLCANIC ACTIVITY IN ICELAND

**David Peate** received a $250,479 NSF grant to study volcanic activity in Iceland. Most volcanoes in Iceland are concentrated in a NE-SW rift that traverses the center of the island. This rift marks where two tectonic plates are drifting apart, which causes the underlying mantle rocks to rise and melt, forming magma that creates volcanic eruptions at the surface. The reasons are less clear, however, why some volcanoes are found in the Snaefellsnes Peninsula in the western part of Iceland. This project aims to understand why and how the mantle melts in this region by analyzing the chemical composition of the lavas.

## NEW MEMBER SPOTLIGHT: JUN WANG

**Jun Wang**'s broad background serves him well in his new position as a professor in the UI Department of Chemical and Biochemical Engineering with a joint appointment with CGRER and the Iowa Informatics Initiative. His research focuses on the integration of satellite remote sensing and chemistry transport models to study air quality, wildfires, and aerosol-cloud interaction. He has done extensive work with NASA, including serving as a science team member on several of its satellite missions. In addition, he enjoys interdisciplinary work in areas related to public health, agriculture, climate change, renewable energy, supercomputing, scientific visualization, data mining, and education in Earth Science.

## CGRER ADMINISTRATION

CGRER is directed by University of Iowa professors **Gregory Carmichael** (Department of Chemical and Biochemical Engineering) and **Jerald Schnoor** (Department of Civil and Environmental Engineering). Center activities are guided by an elected Executive Committee that consists of twelve 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 nine 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 (ECS). 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.

*At right, Jerry Schnoor and Greg Carmichael. At left, Joe Bolkcom, Amy Parker and Jeremie Moen*

## NEW MEMBERS

**Wei Bao** is an assistant professor of Epidemiology in the UI College of Public Health. He has a broad background in biology, medicine, nutrition and epidemiology. His research primarily focuses on nutrition and physical activity in relation to diabetes and obesity across the lifespan. He has a particular interest in identifying biomarkers and mechanisms for diabetes and obesity, with emphasis on gestational diabetes and women's health. Recently, he has developed a research interest in elucidating the interplay of food and environmental chemicals in human health.

**David Courard-Hauri** is director of the Environmental Science and Policy Program at Drake University. He has co-authored a series of three environmental science textbooks, and has published modeling work in fields that include carbon sequestration, butterfly movement, cell-signaling, and the psychological drivers of overconsumption. His current research is in the field of ecological economics, where he has challenged conventional metrics in benefit-cost analysis using agent-based modeling, monte carlo simulations and survey instruments.

**Steven J. Hall** is an assistant professor of Ecology, Evolution and Organismal Biology at ISU. His research focuses on understanding greenhouse gas production, decomposition, and nutrient cycling across terrestrial and aquatic ecosystems. His study systems include tropical forests, cities, and Corn Belt agriculture. His work includes solutions-oriented sustainability science in addition to basic research.

**Aileen Keating** is an associate professor of Animal Science at ISU. Her research focuses on reproductive physiology and toxicology. She studies the impact of chemical exposure on female reproduction, including how chemicals can detrimentally affect gamete quality, the ability of the follicle structure housing the oocyte to grow and produce hormones, and DNA damage and repair processes in the ovary. She also studies how the ovary can biotransform chemicals to make them less or more toxic.



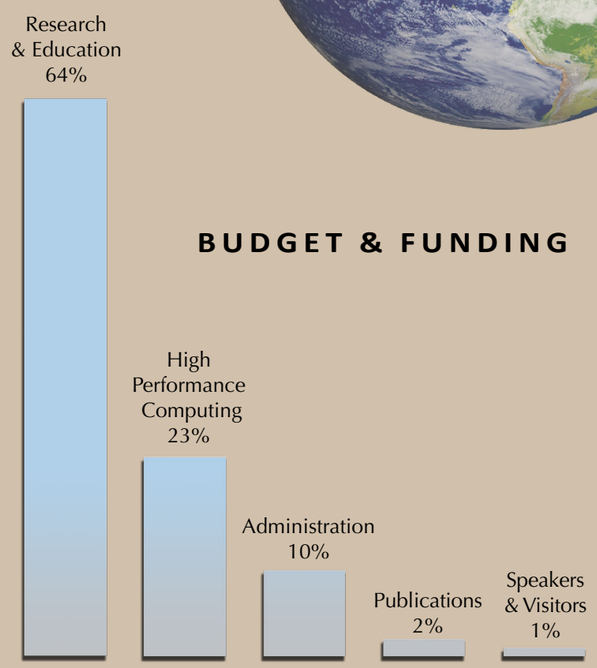
**Caglar Koylu** is an assistant professor of Geographical and Sustainability Sciences and a member of the UI's Informatics Initiative cluster faculty. His research interests include the development and evaluation of computational and visual methodologies for analyzing spatially embedded networks such as migration, the flow of commodities and information. Analysis of flows using a computation-visualization framework is crucial for understanding and communicating patterns in a variety of areas including disaster management, public health and security, climate, and environmental conservation.

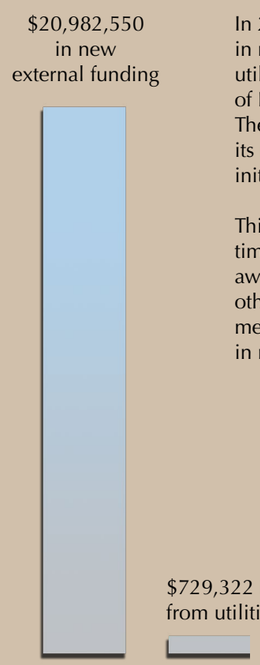
**Gregory LeFevre** is a UI assistant professor of Civil & Environmental Engineering. His primary research area is non-point source pollutants, which are the leading cause of water quality degradation. He studies the biotransformation mechanisms (e.g., plants, bacteria, fungi) of trace organic contaminants and how to create low-energy, engineered natural treatment technologies that improve water quality.

**Ted Neal** is a clinical instructor of Science Education at the UI. He serves on the state's science leadership team, which helped bring the Next Generation Science Standards (NGSS) to Iowa. He is working with CGRER to develop professional development programs and materials on climate science geared to middle and high school teachers, and he serves on the Recreational Services guidance board, helping to introduce the outdoors to students through School of the Wild and Wildlife Camps.

**Behrouz Shafei** is an assistant professor of Civil, Construction and Environmental Engineering at ISU. His research interests include the vulnerability assessment of structures under mechanical and environmental stressors, the evaluation of uncertainties in aging mechanisms, and the mitigation of disasters in civil infrastructure components.

## BUDGET & FUNDING




In 2016, CGRER received $729,322 in revenue from investor-owned 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.

This funding was magnified many times in the research money awarded to CGRER members from other sources. In 2016, CGRER members brought in $20,982,550 in new external research funding.



## MEMBERS

### UNIVERSITY OF IOWA

**Anthropology**
*Margaret E. Beck*
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