Spring 2019

iQ: iSEE Quarterly

An update from the Institute for Sustainability, Energy, and Environment

What's new in research ...

$5M Extension for Crops *in silico*

The University of Illinois at Urbana-Champaign's Crops *in silico* (C*is*) project has received a $5 million grant from the Foundation for Food and Agriculture Research (FFAR) to continue building a computational platform that integrates multiple models to study a whole plant virtually.

"Four crops — corn, soybean, sorghum, and wheat — account directly or indirectly for about 60 percent of human calories. Yet they are susceptible to declining yields due to the impending stresses of climate change, including water shortages, elevated carbon dioxide levels, and soil degradation," said Amy Marshall-Colón, U of I Assistant Professor of Plant Biology and the Principal Investigator for the new four-year grant.

With the global population increasing and the climate continuing to change, understanding how crops respond and adapt to environmental changes is needed to address food insecurity. Developing crops using traditional methods is research-, labor- and cost-intensive. However, C*is* allows researchers to quickly determine and test characteristics that help crops thrive in specific environments. This modeling allows researchers to conduct more experiments than can be realistically achieved in a field. With C*is*, billions of possible changes and combinations of changes can be tested to achieve more productive and sustainable crops in different environments.

Congrats!

C*is* Co-PI Steve Long, Professor of Crop Sciences and Plant Biology, was elected this spring to the National Academy of Sciences.

The original project created a platform to link computational models to simulate plant growth and development. The new funding will allow C*is* researchers to quickly and accurately test how a plant responds to a combination of changes. The grant also makes the entire platform available to the public.

Co-Investigators include Illinois' Matthew Turk, Assistant Professor of Astronomy and Research Scientist at the National Center for Supercomputing Applications (NCSA); Stephen P. Long, Professor of Plant Biology and Crop Sciences; Kaiyu Guan, Assistant Professor of Natural Resources and Environmental Sciences; and Meagan Lang, NCSA Research Scientist. Collaborators from other institutes include Jonathan Lynch, Professor of Plant Science at Pennsylvania State University; Bedrich Benes, Professor of Computer Graphics Technology at Purdue University; Lee Sweetlove, Professor of Plant Sciences at Oxford University; and James Schnable, Assistant Professor of Agronomy and Horticulture at the University of Nebraska.

Read the full news release on the iSEE website.

What's inside ...

In the Spotlight: C*is*' Colleen Heinemann

"Before finding high-performance computing and scientific visualization, I really didn't know what area of computer science I wanted to work in."

It might come as a surprise that Colleen Heinemann, a Ph.D. student in the Informatics Department at the University of Illinois at Urbana-Champaign, wasn't always convinced of her passion within computer science. Through curiosity, determination, and refusing to remain in her comfort zone, Heinemann unites her strengths in research and creative problem-solving with her scientific interests to blaze new trails in high-performance computing (HPC) research.

Heinemann began her undergrad at Bradley University studying Computer Science and Animation, interested in both but unsure of how they might add up to a career. In her senior year, one of these opportunities — a Blue Waters internship at Illinois — ended up changing her life. Working with the supercomputer introduced Heinemann to real-world programming and sparked the realization that HPC and scientific visualization could come together.

"I knew that I wanted to somehow incorporate science into whatever I was going to be doing, but I didn't major in biology or chemistry because I liked all of (the sciences), and couldn't decide which one I liked best," she said.

Heinemann's work with U of I's Crops *in silico* project enables the jump from computer to life science via a field she never anticipated entering: plant biology. The project leverages computational modeling to optimize crops' nutritional value.

"As populations continue to grow, we need more food … but the Earth is only so big, and there are only so many places that you can plant sustainable crops," Heinemann said. "Rather than continuing to expand the number of crops, the idea is to maximize on what we have available."

Read the full profile.

iSEE Researchers Publish Papers

Two studies conducted by iSEE's seed-funded Critical Infrastructure and Transportation project team were recently published in major science publications:

• William N. Lubega, a Ph.D. Candidate in Civil and Environmental Engineering, and Ashlynn S. Stillwell, Assistant Professor in Civil and Environmental Engineering, take a comprehensive economic analysis approach exploring water efficiencies in thermal power plants in a paper published in *Water Resources and Economics*.

• Tushar Apurv, a Ph.D. Candidate in Civil and Environmental Engineering, Ximing Cai, Professor of Civil and Environmental Engineering and iSEE's Associate Director for Campus Sustainability, and Xing Yuan, Professor of Hydrology and Water Resources at Nanjing University, use statistical analysis to help solve drought management planning in the U.S. That study was published in *Journal of Hydrometeorology*.

Read more about the papers and the project team.

iSEE Hires Proposal Developer/Financial Specialist

John Pirtle joined iSEE in February 2019 as a Proposal Developer and Financial Specialist to help bolster the Institute's expanding research portfolio.

Pirtle received both his Bachelor's in Business Administration and Masters of Public Administration from the University of Illinois at Springfield. Prior to coming to iSEE, Pirtle held grant proposal positions at Ohio State University and Illinois' Beckman Institute and the National Center for Supercomputing Applications (NCSA).

PIRTLE

As a Proposal Developer and Financial Specialist for iSEE, his day consists of preparing budget projections for faculty and other researchers, developing budgets and budget justifications, and working with granting organizations and faculty/staff to submit proposals.

Pirtle's favorite part about the sustainability mission at Illinois is the excellent research and work that faculty are conducting — and that they're thinking about our needs for "tomorrow."

iSEE Seed-Funds 9 New Research Projects

The Institute announced in February that it would provide seed funding for nine interdisciplinary research projects at the University of Illinois at Urbana-Champaign — iSEE's largest group of projects to date.

The projects, supported by a total of more than $250,000 from the Institute, will focus on collecting preliminary data or information that will help secure future funding from major external granting agencies.

Four projects are a part of iSEE's Campus as a Living Laboratory program, which was designed to link campus sustainability targets to national and global sustainability and environmental challenges.

"We are excited to announce funding for projects that propose innovative, interdisciplinary solutions to the grand challenges our planet faces," iSEE Associate Director for Research Madhu Khanna said. "iSEE was created to foster this type of 'actionable' research."

The new projects feature studies of air and water pollutants, infrastructure, extreme weather, green energy sources, and climate change resilience.

"iSEE has been seed-funding projects since its first year on this campus in 2013-14, and a majority of those we originally supported have continued through external funding," Khanna said. "This is a testament to the strength of Illinois research. What our investigators may uncover through their research could have a lasting impact on communities for generations."

Read the full article with short descriptions of the projects.

CABBI Profile: Adam von Haden Digs through Roots

Growing up in Wisconsin, surrounded by cornfields, cows, and the lush Northwoods, inspired Adam von Haden to pursue Environmental Science as an undergraduate.

"Green Bay is situated with agriculture to the south and forests to the north. I spent a lot of time in the summer outdoors and camping," said von Haden, now an Illinois postdoctoral researcher at the Center for Advanced Bioenergy and Bioproducts Innovation (CABBI). "Starting when I was 12, I worked at my uncle's Christmas tree farm, and I've also worked at his apple orchard. It was a mix of agriculture and working outside. Most of my jobs have involved outdoor work."

Starting at the University of Wisconsin-Eau Claire in Computer Science, von Haden switched majors and universities, setting him on a professional pursuit in sustainability at the University of Wisconsin-Green Bay.

Von Haden's curiosity for what's in the ground — and how it impacts our planet — led him to move south to Illinois and CABBI in January 2018. He's part of Evan DeLucia and Wendy Yang's Sustainability Theme lab teams, marrying his passion for soils, vegetation, and computers to study greenhouse gases and crop nutrients.

Though CABBI employed von Haden to work with crops he was less familiar with, like sorghum and Miscanthus, he's no stranger to working within a Bioenergy Research Center. His Ph.D. research took place at the University of Wisconsin-Madison's Great Lakes Bioenergy Research Center (GLBRC), also funded by the U.S. Department of Energy. His experience with bioenergy spans nearly 10 years.

"Moving to Illinois was the perfect transition for me. I was finishing up my Ph.D. when CABBI was just starting. It really worked out well for me because of my background," von Haden said.

Now he spends a majority of his time at the Illinois Energy Farm, getting his hands dirty working in the field and within the soil.

"We take measurements of different plant and soil processes that either we don't understand in general or that we don't have enough information about for a specific crop," he said.

Full profile on the CABBI website.

Quick CABBI updates

More from CABBI:

- Since late October, the Center has published 11 papers in scholarly journals.
- On May 2-3, CABBI hosted a Bioenergy Research Center Modeling Workshop at the University Club in Chicago with more than 50 participants.
- The annual retreat for CABBI scientists is set for June 26-27 at the I Hotel and Conference Center in Champaign.

What's new in education ...

Q Magazine Issue 2 Published

When climate change ramps up the severity of tropical storms, geographically vulnerable countries must cope with the wreckage. Engineering student Mark Healy takes us to Puerto Rico in the aftermath of devastating Hurricane Maria, where residents are still plagued by toxic water and a battered, or nonexistent, infrastructure.

Back in the Midwest, the watery world is the theme of two pieces pitch-perfect for nature-loving readers of *Q Magazine*, a product of students in the undergraduate Certificate in Environmental Writing through iSEE, the School of Earth, Society & Environment, and the Department of English. Mallory Shaw tours the wetland beauties of the restored Emiquon, while Clarissa Ihssen mixes science and nostalgia in reflecting on her lifelong love of muskie fishing in northern Wisconsin.

In the second issue of Volume 1, released in March, editors debuted the newest section of *Q*, "@Illinois," which showcases innovative environmental research on our great campus. Thanks to a powdered rock with extraordinary chemistry, the next big thing in agriculture could be climate mitigation — and it's all being tested right here in our backyard.

[Read the latest issue of *Q*.]


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7 Named Levenick iSEE Teaching Sustainability Fellows

In Spring 2019, iSEE named its first cohort of Levenick iSEE Teaching Sustainability Fellows. The Institute awarded grants to seven instructors seeking to implement sustainability in current courses on the University of Illinois' Urbana-Champaign campus — or to create new courses directly tied to sustainability.

The five courses:

- ARTD 451: Ethics of a Designer in a Global Economy (taught by Eric Benson, Associate Professor and Chair of Graphic Design in the School of Art + Design, and Nekita Thomas, Assistant Professor of Graphic Design);
- CHP 395: Climate Change, Law and Health (taught by Warren Lavey, Adjunct Professor of Law and Natural Resources and Environmental Sciences, and Dr. Holly Rosencranz, Clinical Associate Professor of Medicine);
- GLBL 298/ESE 389: Food Systems Sustainability (taught by J. Cory Pettijohn, Research Assistant Professor of Geology and Teaching Assistant Professor in the School of Earth, Society & Environment);
- A new FSHN course: Environmental Impacts of Food & Nutrition Systems (taught by Melissa Prescott, Assistant Professor of School/Childhood Foods and Nutrition); and
- A new ARCH course: Building Energy Use (taught by Yun Kyu Yi, Assistant Professor of Architecture).

The iSEE program consists of four elements to help Fellows best incorporate sustainability into their courses: a retreat, held in April — and attended via teleconference by interested instructors from the University of Illinois at Chicago as well — to help begin developing lesson plans; summer feedback from iSEE and subject matter experts in sustainability; a fall progress check-in with the Fellows; and a spring 2020 debriefing at which time the 2019 cohort will meet the newly named 2020 Fellows.

[Read more about the program.]

What's new in campus sustainability ...

U of I Campus Tops in Big Ten with STARS Gold Recertification

In March 2019 — for the fourth time in a row — the University of Illinois at Urbana-Champaign earned Gold Level honors in the Sustainability Tracking, Assessment & Rating System (STARS), the nation's most comprehensive sustainability rating system.

The Gold rating was made possible by outstanding energy and resource savings work performed by Facilities & Services, as well as inclusion of sustainability across most campus academic units in degree programs and more than 500 courses. But the campus in particular got a shout-out for some significant innovations, including the new student-written professionally published *Q Magazine*, the Field to Flame project using a biomass boiler to heat the main greenhouse at the Illinois Energy Farm, and the Student Sustainability Committee-funded Inner Voices Social Issues Theatre project.

STARS is a self-reporting framework for colleges and universities to measure their sustainability performance, and 942 institutions have used the tool.

As of its certification March 7, Illinois was one of 108 schools to achieve Gold in version 2.1 of the STARS tool — and it had the top score among the four Big Ten Conference schools certifed Gold. Illinois was also certified STARS Gold in 2017, 2015, and 2013.

Read more about campus sustainability awards.

Greek Life, iSEE Partner to Spark Green Action by Campus Sororities, Fraternities

The college lifestyle is fast-paced, encouraging students' "to-go" mentality and behaviors, whether that be employing reusable coffee cups or Styrofoam food containers.

But this type of lifestyle is traumatic to the earth. University of Illinois juniors Julia Irle and Ezra Wallon are trying to change this mindset, specifically within Greek life.

Although both Irle, a member of Kappa Alpha Theta, and Wallon, a member of Phi Kappa Phi, try their best to lessen their carbon footprint, they recognize how hard it can be to make lifestyle changes.

"For some reason when someone tells you that you need to change your lifestyle, it comes off very personal," Irle said. "And I think that is hard for people to grasp that it isn't a personal concept.

"Sustainability is something that unifies people at large."

This concept of unity is one reason Irle wanted to help Greek life, an already united front, to become more sustainable.

"Finding people with similar interests and similar cares really hypes you up to be like, 'Yes, this is something I care about and I am not going to let myself forget about it because it is easy to forget about,' " Irle said.

Originally, Irle wanted to create a sustainability chair in her sorority and realized it wasn't feasible, so she researched how other schools stayed involved during the summer of 2018.

Eventually she met Wallon. Together, they contacted iSEE, and Green Greeks was created. It has two parts: the first as a Registered Student Organization (RSO); the second as the Certified Green Chapter Program.

"There is an intersection with what iSEE is doing with the Certified Green Chapter Program. The program is essentially run through parts of Green Greeks RSO," Irle said. "You join Green Greeks, and say you want to become a Sustainability Ambassador for iSEE. Joining Green Greeks gives you community and the help to actually implement things in your chapter. And after you do that you become the ambassador for the certified program."

An Ambassador's job is to represent the sorority or fraternity trying to get certified. Once Ambassadors are chosen, they enroll their chapters through the iSEE website. Then, members can start "greening" their chapter. When they feel like they have achieved their goals, they can contact the Green Chapter team for certification.

Read the full article by iSEE Communications Intern Chloe Rice.

SSC website: ssc.sustainability.illinois.edu

What's new on projects funded by the Student Sustainability Committee ...

Eco Illini Win Competition!

Walking into the Engineering Student Project Lab, all your senses are infiltrated. You strap on safety goggles to protect from potentially harmful sawdust, while the sounds of people collaborating and motors running hum through the air.

Members of Illinois' Eco Illini Supermileage team laugh and chat as they go about sanding models and examining spokes on a wheel. On the wall behind them, a huge Shell Eco-Marathon check serves as a constant reminder of their end goal. All the while, an excited energy vibrates through the air at one of the newest developments of this year's expansion into electric power.

In years past, the Eco Illini Supermileage team has used mostly gasoline-powered drivetrains, but in 2019, the team used an electric drivetrain — one part of the car's motor and overall powering system — to win the Shell Eco-Marathon on April 3-6 in California.

"We are very pleased with these results, and they show us we have a good foundation for next year," Team President Joe Grigus said. "We see this as a validation of our development this year and hope to carry this work on to next year. We anticipate next year to be much more challenging."

The Eco Illini achieved 152 miles per kilowatt-hour, or 5,123 MPG equivalent (theoretical if gasoline were used) at the competition in April, and they will also compete in the SAE Supermileage on June 6-7 in Michigan using an electric drivetrain — one part of the car's motor and overall powering system.

Part of using the new electric drivetrain is to try to prepare the members for real-world techniques on how to handle sustainability. As industries are moving toward a focus on sustainability, the way innovators must think about these elements are changing. The student group received funding from Illinois' Student Sustainability Committee to assist in the manufacturing and development of a more eco-friendly car.

"As engineers, we are tasked with solving some of humanity's greatest problems and challenges. Responsibly interacting with our environment is one of those challenges and I aim to not shy away from in my career," said Stefan Kamzol, a sophomore in Mechanical Engineering.

Read the full article by iSEE Communications Intern Taylor Jennings.

Project Turns Scraps, Sawdust into 3D Modeling Material

Sawdust flies through the air as students quickly finish up class projects. As the day calms and the students leave, the sawdust settles near the ground. Just another day in the life of an architecture workshop and many fab-labs across campus. All the sawdust, considered waste, is collected and dumped.

But what if the sawdust could be reused for something more sustainable? At the University of Illinois at Urbana-Champaign, researchers are trying to accomplish just that.

Assistant Professor of Architecture Aaron Brakke and Architecture Master's Candidates Colter Wehmeier and Shaahin Davami take leftover sawdust from building workshops and turn it into 3D models to make sustainable materials that could be used in future projects.

Brakke said as an architect, he wants to explore different areas of sustainability when it comes to materials within his profession.

"We know we contribute greatly to carbon dioxide (CO_2) emissions, and use quite a bit of energy, and so, as architects, we want to be responsible custodians of the natural environment and we want look for ways that we can mitigate the damage that traditionally the building industry has accounted for," Brakke said.

A part of this energy consumption and CO_2 emissions comes from the architecture workshop, where Brakke and his team are collecting the sawdust from scrap materials of wood timbers, lumber, and plywood sheetings. Each fab-lab creates at least 40 pounds of leftover sawdust per semester.

After previous successful work with the Student Sustainability Committee (SSC), Brakke and his students decided to apply for funding. The researchers are now in the early stages of this project and are waiting on equipment.

"We have identified the material; we have seen the waste," Brakke said. "Now we are looking at what we can actually do with this."

Read the full article by iSEE Communications Intern Chloe Rice.