TICKLE COLLEGE OF ENGINEERING
INSTITUTE FOR A SECURE & SUSTAINABLE ENVIRONMENT

News from ISSE Spring 2021

Institute for a Secure & Sustainable Environment

Director's Message

ISSE Director Dr. Mingzhou Jin

I am pleased to highlight several of ISSE's research projects in this issue. To summarize our current state of research: ISSE has nine principal investigators who are currently leading 20 active sponsored projects, and there are 14 unique agencies funding these projects.

These projects address regional tourism challenges, pore water/air interactions in saturated sheared sand, and the Year 1 Progress report to NSF for the FEWSUS project, which concerns the nexus of food, energy, and water (FEW) systems. One of ISSE's 2020 Seed Grant Projects reports survey results of community attitudes about composting. Attitudes have changed because increased interest in gardening, caused by COVID-19 shutdowns, has upset the balance of supply and demand for compost. Finally, the newly-selected 2021 Seed Grant winners are presented in the Research section.

ISSE provides an important platform for interdisciplinary research to promote environmental sustainability. The Health Environment team led by Dr. Qiang He won the 2021 UTK Success in Multidisciplinary Research award. The team integrates expertise in environmental engineering, health, infrastructure, human factors, automation, systems engineering, and data science to attack complex health problems in a systematic way. Besides Dr. He, the team includes Shuai Li and Mingzhou Jin, who are affiliated with ISSE, and five other researchers from the Tickle College of Engineering, College of Arts & Sciences, College of Nursing, and the UT Institute of Agriculture.

A notable achievement of our education activities is the success of UT's Sustainable Communities Course for the Appalachian Teaching Project referred to as Giving Back to Appalachia, which has been taught by Dr. Tim Ezzell for 20+ years.

ISSE has forged a unique partnership with a local business, Diversified Power International (DPI), headquartered in Piney Flats, Tennessee. Aiming to support local economy and small businesses, a UTK team led by Qiang He provided pro bono technical support to DPI. Another collaboration arising from ISSE's outreach is between Drive Electric Tennessee, TVA, and TDEC for an electric vehicle fast charging network partnership.

As always, ISSE is indebted to the support given by the Tickle College of Engineering. It is the key to our continuing success.

TICKLE COLLEGE OF ENGINEERING
INSTITUTE FOR A SECURE & SUSTAINABLE ENVIRONMENT

UTK/CEE/ISE Research Aids Local Business in Algal Bloom Control

Algal blooms frequently lead to oxygen depletion and severe impacts on aquatic life. Some algal blooms can release toxins harmful to human health, making algae control a priority in communities affected by excess nutrients. This past winter, Qiang He (CEE) and his students tested an ultrasonic device to control algae for Diversified Power International (DPI), a local business headquartered in Piney Flats TN. Equipped with electronic circuits that generate specific frequencies, low wattage amplifiers, and piezo transducers, the Hydro BioScience ultrasonic units emit over 2,000 different frequencies on two separate bandwidths to create an environment of critical structural resonance specifically targeting algae. With the goal to support local economy and small businesses, the UTK team provided voluntary technical support to DPI. This collaboration led to DPI receiving a large investment that they will use to hire dozens of new people locally. UTK collaborators are negotiating a research grant now with Qiang He as the PI and Mingzhou Jin as Co-PI.

FEWSUS Hosts Invited International Workshops

FEWSUS is hosting a series of invited international workshops this spring:

Socioeconomic Nexus of Urban Food, Energy and Water Systems, April 25-26

Wastewater Zero for Urban Sustainability and Health, May 13-14

Urban Wetland Infrastructure: Past, Present and Future, May 27-28

These meetings aim to exchange research and perspectives and establish multiple international working groups for transdisciplinary collaborations of research and education in socioeconomic sustainability of urban FEW systems, safe reuse of urban wastewater, and conservation and construction of urban wetland infrastructure. In addition, on April 27 FEWSUS is sponsoring a student symposium, open to undergraduate and graduate students. This virtual event will showcase student research that addresses sustainable urban systems through cutting-edge research in the food-energy-water nexus. The symposium will cover multiple United Nations' Sustainable Development Goals: zero hunger, clean water and sanitation, affordable and clean energy, sustainable cities and communities, and responsible consumption and production.

Bing Cao Joins TNWRRC

Bing Cao received her undergraduate degree in Environmental Science in China and her Master's degree in Biosystem Engineering at the University of Tennessee. She has extensive experience in environmental research and the water industry with an emphasis in natural and constructed wetland function restoration, stormwater management, and watershed modeling tools for both urban and agricultural regions. Bing Cao is the president and consultant for a local environmental engineering company. She is also the mother of two amazing children, a fat cat, and a weird dog. In her free time, Bing enjoys cooking and hiking, and playing video games with her husband on the couch.

Drive Electric TN - How to Develop a Community Electric Vehicle Ecosystem

Last Fall, East Tennessee Clean Fuels Coalition, Tennessee Department of Environment and Conservation Field Offices, and DriveElectricTN presented a webinar, DRIVING EV LEADERSHIP: How to develop a Local Electric Vehicle (EV) Ecosystem in Your Community. TDEC Commissioner David W. Salyers kicked-off the event with a presentation, followed by local and statewide leaders that discussed to how to develop a local EV ecosystem.

One goal for this community leadership event is to foster relationships and create a diverse, local team to develop community EV Ecosystems by establishing a DriveElectricTN Chapter.

New Sponsored Research

Utilizing Coal-Derived Solid Carbon Materials Towards Next-Generation Smart and Multifunction Pavements

Drs. Hongyu Zhou and Baoshan Huang (CEE) received a grant from the DOE's National Energy Technology Laboratory to use coal-derived solid carbon materials towards next-generation smart and multifunction pavements. This research demonstrates the use of coke-like coal char, a key byproduct of the coal pyrolysis process, in the design and scale-up construction of a multifunctional pavement system that transforms roadways into multifunctional elements capable of self-sensing, self-heating, and self-healing.

TVA Funds ISSE Team for Workplace Charging Infrastructure

Recently funded by Tennessee Valley Authority, ISSE's Drs. Mingzhou Jin and Yulong Zhang, and Ms. Nawei Liu will develop an integrated workplace charging planning and operation optimization framework for several major metropolitan areas within the TVA service area. The quantitative analysis results will guide future workplace charging infrastructure land use requirements, charging infrastructure capital investment, grid infrastructure expansion requirements, and smart charging opportunities. An expansion of this work could provide TVA with a full workplace charging requirement map within the entire TVA service area. The team will work closely with Oak Ridge National Lab.

RESEARCH

Research Activity

Hydrologic Connectivity Using Regenerative Stormwater Conveyance

PI: Jon Hathaway

In natural systems, stormwater moves to streams and river networks by way of floodplains, wetlands, and riparian forests, which offer treatment and runoff detention. As watersheds are urbanized, these natural flowpaths are short circuited by storm drains and pipes that bypass these ecosystem services. This causes increased peak flows in receiving waters with erosion, volume control, and pollutant problems. Regenerative stormwater conveyances (RSCs) are an emerging design solution for urban runoff to decrease flow energy, increase infiltration rates, and remove pollutants. Positioned at the stormwater outfall, RSCs comprise an open channel step-pool system lined with vegetation and are sized to fully contain the 100-year storm. These pools are separated by riffle and weir boulder structures to safely convey water during large storm events.

In Powell, Tennessee at Collier Preserve, a public park needs a remediation method for the erosive flows produced at a stormwater outfall bringing offsite drainage through the property. Implementing an RSC in this area will protect the park's trails, increase water quality of the receiving waters, and serve as a public attraction. The watershed routing to the site is 5.06 ha of predominantly field and forested land. The site itself consists of two 1.07 m diameter pipes that spill onto 61 m of previously unmanaged forest until discharging into a swale connected to Beaver Creek.

All background monitoring equipment has now been installed at the Collier Preserve site. A weir was designed and placed at the stormwater outfall to record inflow data, and in the downstream swale four sensors were established to document outflow conditions. A total of 17 groundwater wells have also been installed across the site. Combined, these sets of information will provide valuable insight to site conditions that will be used within the RSC design and identify surface and groundwater hydrologic changes after the implementation of the RSC.

Earlier this year, Dr. John Schwartz, director of the Tennessee Water Resources Research Center, and Dr. Jon Hathaway received a grant from the Environmental Protection Agency to study the loss of headwater wetlands that have resulted from the Southeast region's rapid and explosive urbanization. Efficient drainage systems route water quickly to local streams, bypassing floodplains and drying once vibrant wetlands. New techniques studied by the University of Tennessee show promise in restoring hydrologic connections allowing wetlands to be reestablished in these environments. The goals of this project are 1) to demonstrate the possibilities that Regenerative Stormwater Conveyances offer for recreating wetlands in urban environments and 2) to identify and document best practices for design of these systems.

New Research Identifies Opportunities and Challenges in Appalachia's Tourism Economy

PI: Tim Ezzell

On February 10, 2021, Appalachian Regional Commission released Extending Our Welcome: Trends and Strategies for Tourism in Appalachia, a new report produced in partnership with University of Tennessee, Knoxville and Collective Impact. Using qualitative and quantitative research, including publicly available data, surveys administered as part of the research, and on-site visits, the report looks at the history of tourism in Appalachia and makes recommendations for communities looking to employ it as an economic strategy. Though the research was conducted prior to COVID-19, many of these findings remain relevant—bearing in mind the pandemic's impact on the tourism industry and public safety guidelines—and useful for current and future tourism planning.

Extending Our Welcome found that most of Appalachia's 420 counties experience modest levels of tourism and often struggle to strengthen this sector because they lack capacity and resources. To help those areas better establish tourism infrastructure and support more vibrant asset-based economies, the report makes several recommendations:

- Embracing major changes in modern tourism, including the role played by technology and the diversity of the current traveling public,
- Educating and training local officials to help them better understand local tourism strategies,
- Connecting communities, especially rural areas, with hands-on technical assistance in tourism planning and hospitality,
- Training rural communities to prepare for and welcome visitors of all backgrounds,
- Practicing good stewardship of public lands, which are the foundation of Appalachian tourism,
- Creating authentic local experiences unique to a community's natural and cultural assets, and
- Addressing issues, like substance abuse, affecting Appalachia's front line tourism workforce.

In addition to providing recommendations, the report profiles 12 communities and establishments across eight states as a source of best practices in Appalachia's current tourism landscape.

"Now more than ever, Appalachian communities have an important opportunity to extend their welcome to visitors," said UTK's Dr. Tim Ezzell, who led the university's research efforts for this report. "As COVID subsides, Appalachia's assets—public lands, outdoor recreation, clean open spaces, and welcoming, authentic communities—offer safe and convenient opportunities for Americans looking to travel again. We hope the lessons and ideas in this report can help Appalachian communities leverage pent-up demand for travel and create opportunities for economic recovery and growth."

Left: Regenerative stormwater conveyances are an emerging design solution for urban runoff to decrease flow energy, increase infiltration rates, and remove pollutants. Grad student Gillian Palino works on wells and weir installation.

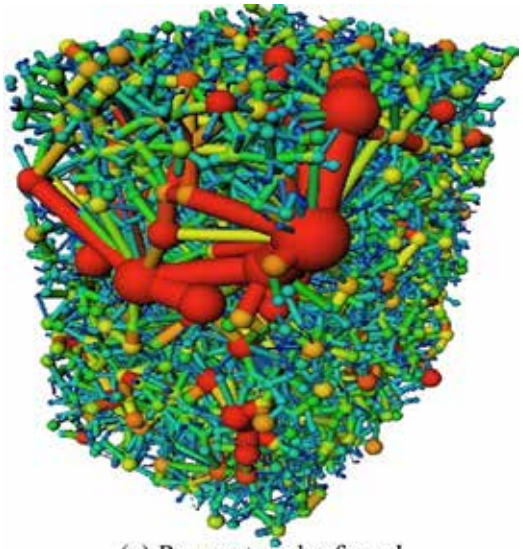
3D Dynamic Evolution of Pore Water-Air Interaction within Saturated Sheared Sand

PI: Khalid Alshibli

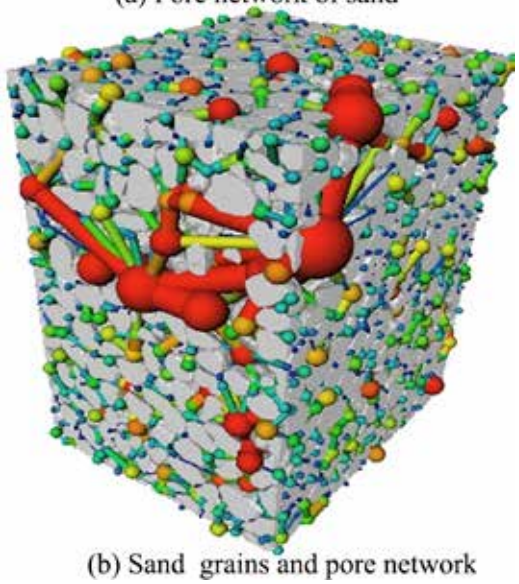
Many foundation systems are supported by water-saturated sand deposits. At the micro-scale, the voids between sand grains (pore space) are filled with water. The sand resists applied foundation loads through friction and interlocking between particles which is known as the shear strength of sand. The presence of air within the pore space in addition to water introduces new forces and fundamentally changes the shear strength of sand. Alshibli's preliminary experiments show that standard procedures to saturate laboratory sand specimens may suffer from a major shortcoming despite decades of use and wide acceptance by the geotechnical community.

It is difficult to eliminate all air bubbles from sand pore space and the widely used assumption of a 100 percent saturated state for a sand specimen with no change in degree of saturation is not correct. If the degree of saturation of a sand specimen changes from fully saturated to partially saturated during loading, then current testing procedures yield inaccurate measurements of shear strength which has a major impact on interpreting experimental measurements. This award will use dynamic four-dimensional (three space dimensions and time) imaging to investigate the role of air on the failure behavior of sand. The findings of this research advance knowledge in measuring and interpreting shear strength of sand, which have broad impacts on geotechnical engineering research, design, and practice.

The goal of this research is to monitor the evolution of sand-water-air interaction using fast dynamic synchrotron microcomputed tomography imaging at 6-micron resolution under shear loading conditions. This research will (i) investigate the influence of particle morphology and gradation on the degree of saturation of sheared sand; (ii) monitor local water-air interaction within pore space of sheared sand under drained condition; and (iii) evaluate the effects of specimen density on the change of degree of saturation of sheared sand. The following fundamental questions will be answered: (1) what is the minimum value of pore water pressure to maintain the same degree of saturation in sheared sand; (2) does the sand specimen remain 100 percent saturated when it is sheared; (3) if air bubbles develop; how they will evolve and what are the factors that affect their onset and growth. 3D probing of dynamic particle-water-air interaction is expected to offer unique measurements to support the development of a new particle-scale theory that better describes the behavior of saturated sheared granular materials.



(a) Pore network of sand



(b) Sand grains and pore network

FEWSUS Reports Year 1 Progress

PI: Jie (Joe) Zhuang

In its first year, FEWSUS created a robust international Research Coordination Network (iRCN) to help develop urban sustainability and resiliency within the framework of the nexus of food, energy, and water (FEW) systems. The goals of the iRCN are to build a comprehensive FEW-system database to support global urban sustainability; create a focused FEW network to inspire urban outreach and engagement programs; facilitate the formation of multinational transdisciplinary research teams to address the interests of urban stakeholders; and educate and train a future FEW workforce capable of implementing sustainable urban development. Measurable outcomes are to form research networks among countries of different urbanization and income levels, create effective strategies and approaches that promote transdisciplinary collaboration and stakeholder engagement, and establish a workforce training network.

Significant Results in Year 1:

FEWSUS established a global research network that includes Argentina, Australia, Brazil, Chile, China, Colombia, Czech Republic, Denmark, Ecuador, Greece, Guatemala, Israel, Mexico, Netherland, United Kingdom, and the U.S. Through a series of meetings, three international working groups have been formed to collaborate on pressing urban issues. Each group is working on a review article to summarize the progress and challenges of selected topical research areas.

FEWSUS has partnered with Global Challenges University Alliance (GCUA) to establish an international student community to address United Nations' SDGs related to urban and environmental sustainability. Students from participating countries were selected for training, communication, and collaboration across social, political, economic, and cultural systems. FEWSUS also created an annual study abroad program for undergraduate students who will be recruited from UT and other U.S. universities to travel to China each summer. The program will be implemented in 2022.

FEWSUS is expanding the database built by the FEWSTERN project. The database emphasizes links between urban sustainability and FEWS nexus. Working with UT's Office of Information Technology, hired undergraduate students are collecting and entering the information.

Seed Grants

2020 Seed Grant Project Progress:

Analyzing Strategies for Diverting & Managing Organic Waste Streams in Tennessee

PI: Chris Clarke

In response to the sudden increase in gardening demand and reduced access to compost due to COVID-19 shutdowns, University of Tennessee helped several community partners in Knoxville (SEEED, Beardsley Community Farm, Knoxville Botanical Garden, Sustainable Future Center, and City of Knoxville) to rapidly organize and implement community compost drop-sites in the spring of 2020. Aged compost from a nearby horse stable was delivered to non-profit sites via City of Knoxville trucks, where citizens could pick up and load compost for home garden use. Four sites were established in April of 2020, and 100 cubic yards of compost were picked up by residents within one month and put into home gardens producing food for the season. Community partners are continuing the compost drops this spring (2021) with an additional 100 cubic yards distributed to neighborhoods.

We conducted a follow up survey of participants and other community members and found that:

- Nearly all respondents support having community compost in their neighborhoods.
- Most all are willing to save home food scraps for community composting (94%).
- Most would prefer the composting site to be within 1 mile (93%).
- Respondents have a high willingness to volunteer at a community composting operation (78%).
- 29% of respondents are willing to pay for food scrap pickup, with an average amount willing to pay of $6.60 per week.
- A majority of respondents would like to deliver food scraps to community composting themselves (53%).
- Most would be willing to pay $2-$5 per 5-gallon bucket of finished compost.

Participating organizations are now discussing how to implement community composting long term, where neighbors can drop off food scraps to be composted at locations within the city.

2021 Seed Grants Selected

ISSE has awarded three seed grants to research projects related to environmental sustainability that have potential for external funding. The seed grant supports project teams as they develop the capability to secure external funding. ISSE expects teams to submit at least one external grant proposal and one article to a peer-reviewed publication. Funding began on January 1, 2021 and will terminate on December 30, 2021.

Geochemical Interaction between CO2 and Caprock for safe Carbon Sequestration

Khalid Alshibli, PI, Civil & Environmental Engineering; Nicholas Dygert, Co-PI, Earth & Planetary Science.

Drs. Khalid Alshibli and Nicholas J. Dygert received funds from ISSE to understand the chemical reaction between Carbon dioxide (CO2) and rocks when it is stored deep into the ground for safe storage (sequestration) of CO2. CO2 emission into the atmosphere from human and industrial processes continues to pose a major environmental and health threat to public health worldwide, and many governments have launched initiatives to reduce the impact of CO2 emission. According to a report by the Intergovernmental Panel on Climate Change (IPCC), United Nations (2005), about 13,466 MT/ year of CO2 is emitted from fossil fuels and biomass where power plants and cement production are the top sources for CO2 emission. Some technologies can capture 85%-95% of CO2 processed in a capture plan (IPCC 2005). Carbon dioxide capture and storage (CCS) is a process of separating CO2 from industrial facilities and other point sources and injecting it in deep geological formation for long-term storage. Deep saline aquifers, depleted gas and oil fields, and coal mines are good potential places to store CO2.

CO2 needs to be injected deep into porous rocks, deeper than 3000 feet, at a pressure higher than 3000 psi. To prevent the upward flow of CO2, which is caused by its low density, it must be trapped below a thick, low permeability rock such as limestone, shale, or salt rock (caprock). There are many challenges associated with CCS that include potential leaks of CO2 into the atmosphere and groundwater through natural/reactivated faults or man-made operations (e.g., abandoned oil wells). CO2 pressure can be a source for seismic damage and fracture of the caprock. A chemical reaction could occur between CO2 and the caprock, which may compromise the integrity of the caprock and result in the leak of CO2 back into the atmosphere.

The overall aim of the project is to characterize CO2-caprock geochemical interaction at micro and nano-scales. The research team will use world-class analysis tools at the Advanced Photon Source (APS), IL to image specimens of limestone samples collected from a depth of 800 ft from East Tennessee before and after exposing them to CO2 at 3000 psi pressure at a temperature similar to field temperature for a long duration. Nanoscale changes of the pores within the limestone may occur and can potentially cause a clogging (desirable) or dissolution of the rock. The dissolution of the rock will open channels for CO2 to flow upward back to the earth's surface.

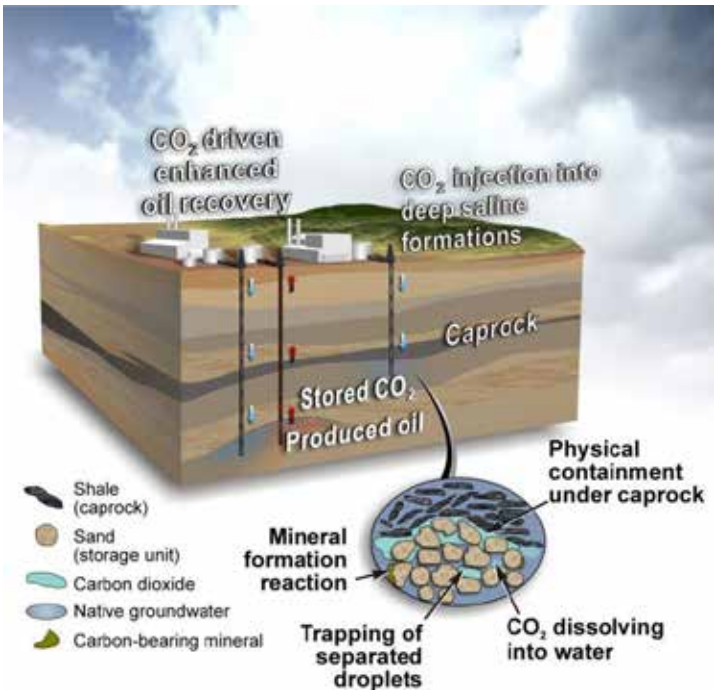


Image source https://www.c2es.org/content/carbon-capture/

Toward Precision Environmental Health Risk Management: Feasibility of Personalized Exposome Monitoring

Qiang He, PI, Civil & Environmental Engineering; Shuai Li, Civil & Environmental Engineering, and Courtney Cronley, Social Work, Co-PIs.

Evidence is mounting that environmental factors play critical roles in the etiology of many diseases. For example, environmental exposure to microorganisms has repeatedly been found to be inversely related to the manifestation of atopic diseases such as asthma and hay fever (Ege et al., 2011). Epidemiological research has identified exposures to environmental pollutants such as airborne particulate matter (APM) as important factors involved in the pathogenesis of Alzheimer's Disease (Heusinkveld et al., 2016; Liu et al., 2020).

Humans are exposed to numerous chemical, physical, and biological factors, such as microorganisms and particulates, in the environments, collectively defined as the human exposome. The exposome plays important roles in human health, particularly in the development and progression of diseases such as cancer, infectious diseases, and chronic inflammatory diseases (Vermeulen et al., 2020). The ongoing COVID-19 pandemic has exposed disparities in environmental exposure as individual transmission risks have been shown to correlate with one's socio-economic determinants (Hu et al., 2020). Indeed, unequal environmental exposure, i.e., environmental inequality, has been identified as a leading cause of rising health disparity and has become a growing area of public health research (Brulle & Pellow, 2006). Thus, monitoring and understanding the exposome is particularly valuable to develop strategies to reduce environmental inequity and manage health risks. However, precision management of environmental health risks requires personalized monitoring of the exposome, which until now is conducted exclusively at the population level. Therefore, we must develop methodologies feasible for personalized exposome monitoring to reduce exposure risks and mitigate environmental inequity.

The specific objectives of this seed project are to 1) test the feasibility of personalized monitoring of human exposomes in the indoor environment; and 2) compare the exposomes of individuals with contrasting socio-economic determinants, to test the hypothesis of potential differences in the indoor exposome between individuals of distinct socio-economic status. With innovative personalized exposome monitoring, results from this innovative seed project will generate unique preliminary data to develop proposals for external funding.

Bioengineering of the Duckweed Plastid Genome: A Model Plant for Aquatic Bioremediation

Scott Lenaghan, PI, Biochemistry & Cellular and Molecular Biology; Barry Bruce, Co-PI, Food Science.

The complete chloroplast genome for Lemna minor L. has been sequenced, along with comparative genomics of other duckweed species. Recently, PI Lenaghan published a modular cloning plastid engineering (MoChlo) kit for assembly of plastid transformation vectors. Using this kit and the available plastomic information, the team will synthesize homology arms for four insertion sites for homologous recombination in the native plastome of duckweed. The MoChlo kit contains 95 plastid regulatory sequences that can be used to control expression of transgenes in duckweed, as most plastid regulatory sequences are highly conserved and function in a variety of species. Thus, the kit's available resources provide a facile entry point for developing methods for plastid engineering in duckweed using existing resources with minimal gene synthesis. At the same time, the team will develop a method for automated duckweed tissue culture and chlorophyll analysis, using the robotic platform in PI Lenaghan's lab.

Previously, researchers at CASB have automated high-throughput protoplast isolation, transformation, and screening in switchgrass, corn, rice, tobacco, and soybean. We will use this expertise to develop an automated protocol for vegetative propagation of duckweed, which will enable more rapid screening of compounds to select for transplastomic duckweed.

Active Sponsored Projects

PI	Sponsor	Title	Start
Khalid Alshibli	National Science Foundation	3D Dynamic Evolution of Pore Water-Air Interaction within Saturated Sheared Sand	8/1/20
Mingzhou Jin	US - NSF - National Science Foundation	Coupled FEWS-Sustain Global Crop US-China	Continued
Mingzhou Jin	DOE - ORNL - UT Battelle - Oak Ridge National Laboratory	Industrial Landfill Waste Management	Continued
Mingzhou Jin	DOE - ORNL - UT Battelle - Oak Ridge National Laboratory	Policy Study - Adoption of Alternative Fuel Vehicles	Continued
Mingzhou Jin	DOE - ORNL - UT Battelle - Oak Ridge National Laboratory	Smart Manufacturing	11/10/20
Mingzhou Jin	DOE - ORNL - UT Battelle - Oak Ridge National Laboratory	Analysis for Regional and Global Land Ecosystem Modeling	8/1/20
Mingzhou Jin	East Tennessee Clean Fuels Coalition	Administrative Support for East Tennessee Clean Fuels	Continued
Mingzhou Jin	TVA housed in CURENT	Mapping and Requirement Analysis for EV Workplace Charging in Metropolitan Area	2/1/21
Timothy Ezzell	Appalachian Regional Commission	Appalachian Leadership Insitute	Continued
Timothy Ezzell	Appalachian Regional Commission	Trends and Strategies for Tourism in Appalachia	Continued
Timothy Ezzell	East Tennessee State University	Appalachian Teaching Project 2020-2021	8/15/20
Sheila Webster	National Partnership for Environmental Technology Education	National PETE DOE Worker Training	Continued
John Schwartz	Tennessee Dept of Environment and Conservation	TN Stream Quantification Tool Training	5/1/20
John Schwartz	National Park Service-Great Smoky Mountains	Improving the GRSM's understanding of its natural resources and processes thereby enhancing protection of the Park's resources	Continued
John Schwartz	National Park Service	Southern Appalachian Cooperative Ecosystems Studies Units, Characterizing Water and Soil Chemistry from the chimney tops to fire	Finished Aug 2020
Schwartz/ Gangaware/ Hathaway/He	DOI - USGS - US Geological Survey	Tennessee Water Resources Research Center Program	Continued
Jon Hathaway	US - EPA - US Environmental Protection Agency	Restoring Floodplain Wetlands and Hydrologic Connectivity Using Regenerative Stormwater Conveyance	Continued
Kristen Wyckoff	West Virginia University	Appalachian Community Technical Assistance and Training Program	Continued
Yaoping Wang	DOE - ORNL - UT Battelle - Oak Ridge National Lab	Data Analytics Support for Integrated Earth Model	3/13/19
Hongyu Zhou	DOE-NETL	Utilizing coal-derived solid carbon materials towards next-generation smart and multifunction pavements	1/1/21

Education Activity

Giving Back to Appalachia – UT's Sustainable Communities Course for the Appalachian Teaching Project

From Volunteer Stories, Produced by the UT Office of Communications and Marketing

Each fall semester, Professor Tim Ezzell ('88, '96, '02) and his sustainable communities class choose a community project, which may range from building signage for a state park to developing a plan for revitalizing tourism in an aging downtown area. Their projects have taken them to cities and towns across Pickett, Polk, Johnson, Morgan, Fentress, Cocke, and other Tennessee counties. The sustainable communities course is the university's contribution to the larger Appalachian Teaching Project (ATP), an ARC applied research program for Appalachian college students. The project, which celebrates 20 years this fall, is a partnership between about a dozen universities across as many states. UT has been a partner since the ATP first launched in 2001.

For the project this past fall, the class worked with Loretto, a city of 1,800 residents in rural Lawrence County, where they focused on community and public health measures that could benefit the area in the event of a crisis like a pandemic. Students collected wastewater samples to test for COVID-19 at UT, explored installing a telehealth kiosk for residents to get basic services without putting themselves at risk of illness, and used grant money from the Appalachian Regional Commission to create an outdoor study space beside the public library. They presented their project to the ARC as part of a virtual symposium in 2020.

Ezzell, a native of East Ridge, Tennessee, and three-time UT graduate, didn't expect so much of his career to be defined by service to the region he calls home. Like many at UT, he saw a need and chose to meet it. Twenty years later, his course continues showing UT's commitment to Appalachia and rural communities across Tennessee.

TNWRRC Training

Since July 1, 2020, Tennessee Water Resources Research Center has offered seven different courses: Levels 1 and 2 of Tennessee Erosion Prevention and Sediment Control (TNEPSC) Training Program for Construction Sites plus a TNEPSC Recertification course; Levels 1 and 2 of Tennessee Hydrologic Determination Training and its corresponding Recertification course; and the Storm Water Control Measure Inspection and Maintenance Workshop. TNWRRC has offered a total of 36 course sessions and trained 2,000 professionals in these workshops. The workshops were a combination of in-person, Zoom, and online video recorded courses.

TNEPSC offers three training workshops for developers, contractors, engineers, and other professionals, inspection personnel, and enforcement officials responsible for all aspects of preparation and implementation of Storm Water Pollution Prevention Plans for preventing erosion and controlling sediment at construction sites one acre or more in size.

Tennessee Hydrologic Determination Training is a course for conducting hydrologic determinations. Successful completion of the training course is one of the requirements for certification as a Qualified Hydrologic Professional.

Storm Water Control Measure Inspection and Maintenance Workshops are available to design engineers and architects as well as plan reviewers and other local municipal program personnel. They provide insights on avoidance and minimization approaches to site layout, design guidance on specific permanent stormwater control measures, and experience using tools developed to assist designers and plan reviewers with implementation of runoff reduction and pollutant removal requirements.

Outreach & Partnerships

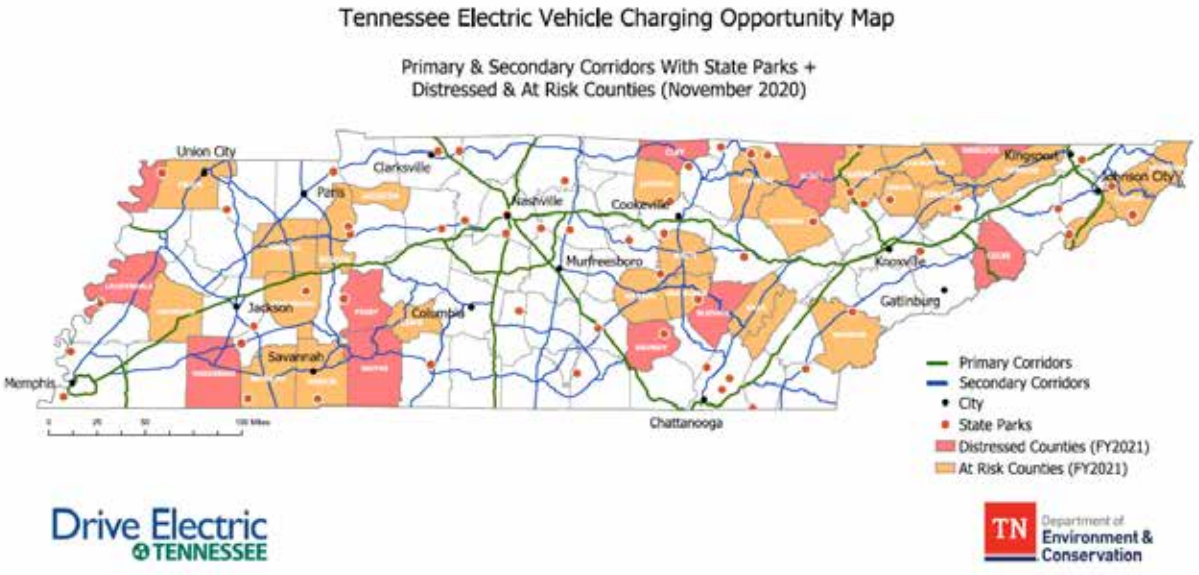
Drive Electric Tennessee: TVA and TDEC Announce Electric Vehicle Fast Charging Network Partnership

On February 3, 2021, the Tennessee Valley Authority and the Tennessee Department of Environment and Conservation announced an unprecedented partnership to develop an electric vehicle fast charging network across Tennessee. Access to fast charging stations spaced no more than 50 miles apart across major interstates and highways will significantly reduce barriers to widespread EV adoption. This project has an anticipated cost of $20 million dollars, $5 million of which will be funded by TDEC as part of the State's Volkswagen Diesel Settlement Environmental Mitigation allocation for light-duty EV charging infrastructure. The remaining costs will be covered by TVA, other program partners, and program participant cost share.

This initiative will add roughly 50 charging locations throughout the state, tripling the existing fast charging network. These stations will be open to all consumers and will include both CCS and CHAdeMO fast charging plugs to support all vehicle types. Drive Electric Tennessee and TDEC have identified stretches of interstate and highway that would benefit from this network. With more accessible charging, TVA and TDEC aim to have 200,000 light-duty EV's on the roads by 2028, a massive increase from the 11,034 vehicles that were registered as of December 2020.

"Innovative partnerships with state agencies like TDEC and our local power companies are essential in developing one of the nation's most comprehensive EV fast charging networks, starting in Tennessee," TVA President and CEO Jeff Lyash said. "Through this partnership, TVA is positioned to be a national leader in electric transportation by making it easier for local power companies to install fast charging stations, which make electric vehicles an easy choice for consumers to make."

EV adoption will promote job availability and economic development in the region, reduce carbon emissions from the transportation sector, and provide cost savings for both fleets and individuals.



Drive Electric TENNESSEE

TN Department of Environment & Conservation

Baker Center Presents Energy & Environment Forum Series

Since 2010, the goal of the Baker Center Energy and Environment Forum has been to provide an intellectual meeting place for the disparate researchers and students around the University interested in the interface of science and policy topics surrounding energy and the environment. The Forum aims to draw people out of home departments and to expose them to new perspectives on energy, environment, and sustainability topics and to stimulate interdisciplinary discussion and research teams that will be competitive for external funding.

The Forum, a monthly seminar series, hosts speakers chosen for their ability to offer an exciting interdisciplinary talk on a topic that will have broad appeal across campus. The speaker list is compiled from suggestions from many campus departments. Past speakers include two former cabinet ministers (Christine Todd-Whitman, Bill Richardson), a Crafoord prize-winner (Paul Ehrlich), the most highly cited environmental scientist in the world in the last decade (David Tilman), numerous National Academy members and a long line of exceptionally distinguished scholars. While their charge is to talk on interdisciplinary topics, speakers come from an array of disciplinary backgrounds including physics, ecology, geography, sociology, mathematics, earth sciences, philosophy, economics, civil engineering, law, agricultural sciences, supply chains and logistics, etc.

Diverse funding sources have allowed the Forum to continue to focus on the interface of science and policy in energy and environment topics for the last 10 years. The organizing committee graciously acknowledges the support of the Baker Center, TVA, ISSE, TN-Score, College of Arts & Sciences, College of Law, Herbert College of Agriculture, and the Haslam College of Business.

Appalachian Leadership Institute: An Overview

The Appalachian Leadership Institute is a comprehensive leadership and economic development training opportunity for people who live or work in Appalachia and are passionate about helping their communities thrive. Appalachian Leadership Institute Fellows participate in an extensive training curriculum developed by the Appalachian Regional Commission in partnership with the University of Tennessee, Knoxville; The Howard H. Baker Jr. Center for Public Policy; Tuskegee University; and Collective Impact.

The all-inclusive, nine-month program runs from October – July each year and includes skill-building seminars and best practice reviews. The program includes field visits across the Region, followed by a capstone graduation event held in Washington, DC.

As part of the Appalachian Leadership Institute, Fellows learn how to:

- Design effective economic development project proposals
- Integrate community assets into long-lasting economic development strategies
- Identify resources available to spur economic development
- Locate and access investment capital from a variety of public and private sources
- Prepare competitive applications for public grant opportunities
- Use expanded leadership skills to create strong coalitions

ALI activities include travel and participation cost to attend all sessions, an Appalachian Leadership Institute Certificate from the Appalachian Regional Commission and the University of Tennessee, Knoxville, and access to a world class network of peers and other experts across Appalachia.

PUBLICATIONS

Publications & Presentations

Publications

Alshibli, K. A. and Jarrar, Z. (2020) "4D Dynamic Synchrotron Micro Computed Tomography Imaging of Gas-Water Interface at High Pressure and Low Temperature", ASTM Geotechnical Testing Journal, in press

Alshibli, K. A., Rawn, C. (2018) "Gas Driven Fracture During Gas Production using 3D Synchrotron Computed Tomography (SMT)"

Cao, L.; Yang, L.; Swanson, C.S.; Li, S.; He, Q. 2021. Comparative analysis of impact of human occupancy on indoor microbiomes. Front. Environ. Sci. Eng. 15(5): 89.

Chen See, J. R., O. Wright, L. V. Unverdorben, N. Heibeck, S. M. Techtmann, T. C. Hazen, and R. Lamendella. 2021. Evaluating the Impact of Hydraulic Fracturing on Streams using Microbial Molecular Signatures.

Chen, S., Y. Zhang, Q. Wu; S. Liu, C. Song, J. Xiao, L. Band, J. Vose, 2021. Vegetation cover change and CO2 fertilization more than offset gross primary productivity decline caused by reduced solar radiation in China from 2001 to 2016. Agricultural and Forest Meteorology.

Christian, L.E., T.H. Epps, G. Diab, and J.M. Hathaway (2020). "Pollutant concentration patterns of in-stream urban stormwater runoff." Water. 12(9): 2534

Cokyasar, T.*, W. Dong, M. Jin, I.O. Verbas, "Designing a Drone Delivery Network with Automated Battery Swapping Machines," Computers and Operations Research, 129, 105177, 2021.

Crain, Benjamin J., Chad Stachowiak, Patrick F. McKenzie, James N. Sanchirico, Kailin Kroetz, Paul R. Armsworth. Citizens of local jurisdictions enhance plant community preservation through ballot initiatives and voter-driven conservation efforts. The Royal Swedish Academy of Sciences, 14 February 2021.

Dannenberg, M. P., Smith, W. K., Zhang, Y., Song, C., Huntzinger, D. N., & Moore, D. J. P. (2021). Large-scale reductions in terrestrial carbon uptake following central Pacific El Niño. Geophysical Research Letters, 48, e2020GL092367.

Din G., Hassan A., Dunlap J., Ripp S., Shah A.A. 2021. Cadmium tolerance and bioremediation potential of filamentous fungus Penicillium chrysogenum FMS2 isolated from soil. International Journal of Environmental Science and Technology

Din G., Hassan A., Rafiq M., Hasan F., Badshah M., Khan S., Chen G., Ripp S., Shah A.A. 2020. Characterization of organic acid producing Aspergillus tubingensis FMS1 and its role in metals leaching from soil. Geomicrobiology Journal 37:336-344.

Dong, W., M. Jin*, P. Kelle, and Y. Wang, "Retrieval Scheduling in Crane-based 3D Automated Retrieval and Storage Systems with Shuttles," Accepted by Annals of Operations Research, 2021.

Ge, X., M. P. Thorgersen, F. L. Poole II, A. Deutschbauer, J.-M. Chandonia, P. S. Novichkov, S. Gushgari-Doyle, L. M. Lui, T. Nielsen, R. Chakraborty, P. D. Adams, A. P. Arkin, T. C. Hazen. and M. W. Adams. 2020. Characterization of a metal-resistant Bacillus strain with a high molybdate affinity ModA from contaminated sediments at the Oak Ridge Reservation. Front. Microbiol.

Ge, X., M. Thorgersen, F. Poole, A. Deutschbauer, J.-M. Chandonia, P. Novichkov, P. Adams, A. P. Arkin, T. C. Hazen, and M. Adams. 2020. Draft Genome Sequence of Bacillus sp. EB106-08-02-XG196 Isolated from High Nitrate Contaminated Sediment. Microbiol Resour Announc. October 2020 9:e01149-20.

Hale, J. and M. Jin*, "A Conceptual Framework for Witness Builds and Witness Artifacts in Additive Manufacturing," Accepted by Rapid Prototyping Journal, 2021.

Hu, D.; Zhong, H.; Li, S.; Tan, J.; He, Q. 2020. Segmenting areas of potential contamination for adaptive robotic disinfection in built environments. Build. Environ. 184: 107226.

Jarrar, Z. A., Al-Raoush, R. I., Alshibli, K. A., and Jung, J-W (2020). "Dynamic 3D Imaging of Gas Hydrate Kinetics using Synchrotron Computed Tomography", 2nd International Conference on Energy Geotechnics (ICEGT-2020), Published online 18 November 2020, E3S Web of Conferences 205, 11004.

Jarrar, Z. A., Al-Raoush, R. I., Alshibli, K. A., and Jung, J-W (2020). "Dynamic Imaging of Hydrate Specific Area Evolution during Xenon Hydrate Formation", International Conference on Civil Infrastructure and Construction (CIC2020), Feb. 2-5, 2020, Doha, Qatar.

Jarrar, Z., Alshibli, K. A., Al-Raoush, R. I., and Jung, J-W (2020) "3D Measurements of Hydrate Surface Area during Hydrate Dissociation in Porous Media using Dynamic 3D Imaging", Fuel, Vol. 256.

Kattel, G.; Reeves, J.; Western A.; Zhang, W.; Jing, W.; McGowan, S.; Cuo, L.; Scales, P.; Dowling, K.; He, Q.; Wang, L.; Capon, S.; Pan, Z.; Cui, J.; Zhang, L.; Xiao, L.; Liu, C.; Zhang, K.; Gao, C.; Tian, Z.; Liu, Y. 2021. Healthy waterways and ecologically sustainable cities in Beijing-Tianjin-Hebei urban agglomeration (northern China): Challenges and future directions. Wiley Interdiscip. Rev.-Water 8(2): e1500. DOI: 10.1002/wat2.1500

Li, R., M. Jin*, and V. Paquit, "Geometrical Defect Detection for Additive Manufacturing with Machine Learning Models," Accepted by Materials & Design, 2021.

Li, S.; Xu, Y.; Cai, J.; Hu, D.; He, Q. 2021. Integrated environment-occupant-pathogen information modeling to assess and communicate room-level outbreak risks of infectious diseases. Build. Environ. 187: 107394.

Li, S.; Yang, Z.; Hu, D.; Cao, L.; He, Q. 2021. Understanding building-occupant-microbiome interactions toward healthy built environments: a review. Front. Environ. Sci. Eng. 15(4): 65.

Liu, N., F. Xie, Z. Lin*, and M. Jin, "Empirical Estimation of Route Length Along U.S. Interstate Highways Based on Great Circle Distance," Accepted by Transportation Research Record, 2021.

Liu, Xiangping, Seong-Hoon Cho, Paul R. Armsworth, Daniel J. Hayes, Where and When Carbon Storage Can be Bought Cost Effectively from Private Forest Owners. Springer Science+Business Media, LLC, part of Springer Nature 2021, 13 January 2021.

Liu, Z., Y. Wang, M. Jin*, H. Wu, and W. Dong, "Energy Consumption Model for Shuttle-Based Storage and Retrieval Systems," Journal of Cleaner Production, 282, 124480, 2021.

Lui, L. M., E. L.-W. Majumder, H. J Smith, H. K Carlson, N. S Baliga, F. von Netzer, M. W Fields, D. A Stahl, J. Zhou, T. C. Hazen, P. D Adams, and A. P. Arkin. 2021. Mechanism across scales: a holistic modeling framework integrating laboratory and field studies for microbial ecology. Front. Microbiol. 12:642422.

McKenzie, Patrick F, Gwenllian D Iacona, Eric R Larson, and 3 Paul R Armsworth, Partitioning tree diversity patterns to prioritize conservation investments. Environmental Conservation, 19 January 2021.

Meng, J.; Huang, J.; Oueslati, R.; Jiang, Y.; Li. S.; Chen, J.; Dai, S.; He, Q.; Wu, J. 2021. A single-step DNAzyme sensor for ultra-sensitive and rapid detection of Pb2+ ions. Electrochim. Acta 368: 137551.

Nayfach, S., S. Roux, R. Seshadri, D. Udwary, N. Varghese, F. Schulz, D. Wu, D. Paez-Espino, I-M. Chen, M. Huntemann, K. Palaniappan, J. Ladau, S. Mukherjee, T.B.K. Reddy, T. Nielsen, E. Kirton, J. P. Faria, J. N. Edirisinghe, C. S. Henry, S. P. Jungbluth, D. Chivian, P. Dehal, E. M. Wood-Charlson, A. P. Arkin, S. Tringe, A. Visel, IMG/M Data Consortium, T. Woyke, N. J. Mouncey, N. N. Ivanova, N. C. Kyrpides, E. A. Eloe-Fadrosh. 2020. A Genomic Catalogue of Earth's Microbiomes. Resource to Nature Biotechnology.

Satinover, S. J., M. Rodriguez, M. F. Campa, T. C. Hazen, and A. P Borole. 2020. Performance and Community Structure Dynamics of Microbial Electrolysis Cells Operated on Multiple Complex Feedstocks. Biotechnology for Biofuels 13:169-169.

Stachowiak, Chad, Benjamin J. Crain, Kailin Kroetz, James N. Sanchirico, Paul R. Armsworth, Protected areas established by local communities through direct democracy encompass habitat for species as effectively as protected areas planned over large spatial scales. Springer Science+Business Media, LLC, part of Springer Nature 2020, 19 November 2020

Wang, Y., Yu, Z., Jin, M. and Mao, J., 2021. Decisions and coordination of retailer-led low-carbon supply chain under altruistic preference. European Journal of Operational Research. https://www.sciencedirect.com/science/article/abs/pii/S037722172031122X

Wilpiszeski, R. L., C. M. Gionfriddo, A. M. Wymore, J.-W. Moon, K. A. Lowe, M. L. Podar, S. Rafie, M. W. Fields, T. C. Hazen, X. Ge, F. Poole, M. W. W. Adams, R. Chakraborty, Y. Fan; J. D. Van Nostrand, A. P. Arkin, J. Zhou, and D. A. Elias. 2020. In-field bioreactors demonstrate dynamic shifts in microbial communities in response to geochemical perturbations. PLoS ONE 15(9): e0232437.

Xu T., Young A., Narula J., Sayler G., Ripp S. 2020. High-throughput analysis of endocrine disrupting compounds using BLYES and BLYAS bioluminescent yeast bioassays p29-41. In Ripp S (ed), Methods in Molecular Biology - Bioluminescent Imaging, vol 2081. Humana, New York, NY.

Yang, L., Y. Wang*, R. Wang, J. Klemes, C. Almeida, M. Jin, X. Zheng, and Y. Qiao, Environmental-social-economic Footprints of Consumption and Trade in the Asia-pacific Region, Nature Communications, 11, 2020.

Yang, L., Y. Wang*, R. Wang, J. Klemes, C. Almeida, M. Jin, X. Zheng, and Y. Qiao, "Environmental-social-economic Footprints of Consumption and Trade in the Asia-pacific Region," Nature Communications, 11(1), 1-9, 2020.

Yu, X.; Zhou, J.; Song, W.; Xu, M.; He, Q.; Peng, Y.; Tian, Y.; Wang, C.; Shu, L.; Wang, S.; Yan, Q.; Liu, J.; Tu, Q.; He, Z. 2021. SCycDB: A curated functional gene database for metagenomic profiling of sulfur cycling pathways. Mol. Ecol. Resour. 21(3): 924-940.

Zhu, Gengping, Monica Papes¸ Xingli Giam, Seong-Hoon Cho, Paul R. Armsworth, Are protected areas well-sited to support species in the future in a major climate refuge and corridor in the United States? Biological Conservation 255 (2021), 12 February 2021.

Zhuang, J., Sun, H., Sayler, G., Kline, K.L., Dale, V.H., Jin, M., Yu, G., Fu, B. and Löffler, F.E., 2021. Food–Energy–Water Crises in the United States and China: Commonalities and Asynchronous Experiences Support Integration of Global Efforts. Environmental Science & Technology, 55(3), pp.1446-1455.

Zhuang, W.; Yu, X.; Hu, R.; Luo, Z.; Liu, X.; Zheng, X.; Xiao, F.; Peng, Y.; He, Q.; Tian, Y.; Yang, T.; Wang, S.; Shu, L.; Yan, Q.; Wang, C.; He, Z. 2020. The diversity, function and assembly of mangrove root-associated microbial communities at a continuous fine-scale. npj Biofilms Microbiomes 6: 52.

Presentations

Ash, K. T., Y. Li, D. C. Joyner, D. E. Williams, I. Alamilla, P. McKay, B. Green, C. Iler, F. Kara-Murdoch, C. Swift, F. Löffler, and T. C. Hazen. Contributed. Miles Away From Ordinary: Raw Wastewater Surveillance For The Novel Sars-cov-2 Virus On The University Of Tennessee - Knoxville Campus. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Campa, M. F., J. C. See, L. Unverdorben, O. Wright, K. A. Roth, J. M. Niles, D. Ressler, E. Macatugal, A. Putt, S. M. Techtmann, T. C. Hazen, and R. Lamendella. Contributed. Geochemistry, land coverage, and multiomics data differentiate streams in Pennsylvania based on unconventional oil and gas activity. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Chakraborty, R., X. Wu, D. C. Joyner, T. C. Hazen, R. G. Malana, A. P. Arkin and P. D. Adams. Invited. Applying Stable Isotopes for Source Fingerprinting of Dissolved Organic Nitrogen in Groundwater. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Dixon, E. R., K. F. Walker, D. Williams, and T. C. Hazen. Contributed. Modeling Dynamic Geochemical Processes: How Diurnal and Seasonal Water Table Fluctuations Influence Contaminated Groundwater Geochemistry. December 10, 2019, San Francisco, CA. AGU Fall Meeting.

Fukai, I., and T. C. Hazen. Contributed. Evaluation of Microbial Biosensors With Applications In Nuclear Arms Nonproliferation. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Fuqai, Isis and T. C. Hazen. 2020. Biosensors for Detecting Nuclear Production Activity in the Environment. March 12, 2020. Ann Arbor, MI. MTV, University of Michigan.

Griffths, Z., A. Putt, M. Campa, D. Joyner, J. Miller, O. Pelz, N. GaraJayeva, P. Gardinali, and T. C. Hazen. Contributed. Observing the Indigenous Microbial Community Response to Crude Oil Amendment in Aerobic and Anerobic Conditions. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Gushgari-Dolye, S., A. P. Arkin, L. M. Lui, R. Chakraborty, T. C. Hazen and X. Wu. Contributed. Functional Diversity of Arthrobacter Strains Across the Dynamic Capillary Fringe and Adjacent Sediment Zones. December 16, 2020, San Francisco, CA. AGU Fall Meeting.

Gushgari-Doyle, S., M. O. Yee, J. V. Kuehl, H. J. Smith, M. P. Thorgersen, X. Ge, A. E. Otwell, T. L. Lie, K. A. Hunt, M. W. W. Adams, E. J. Alm, N. S. Baliga, J.-M. Chandonia, A. M. Deutschbauer, D. A. Elias, M. W. Fields, T. C. Hazen, T. R. Northen, A. Mukhopadhyay, G. E. Siuzdak, D. A. Stahl, P. J. Walian, J. Zhou, R. Chakraborty, A. P. Arkin, P. D. Adams. Invited. Targeted Isolation Using Field-Informed Approaches. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU

Harik, A.-M., T. C. Hazen, D. C. Joyner, and S. Rafie. Contributed. Imaging and Analysis of Methanotroph Induced Bioaggregation in Sand. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Hazen, T. C. Invited. Careers in National Labs. U Mass Amherst online, 5/16/21.

Hazen, T. C. Invited. Environmental Systems Biology: The Whole is Greater than the Sum of it's Parts – Team Science. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Hazen, T. C., E. R. Kelly*, A. Putt, K. Walker, D. C. Joyner, I. Fukai, K. Lowe, M. Rodriguez Jr, M. W. Fields, R. Chakraborty, X. Wu, D. Stahl, T. Lie, M. W. W. Adams, F. Poole, P. J. Walian, J. Zhou, J. V. Nostrand, T. R. Northen, J.-M. Chandonia, A. P. Arkin, and P. D. Adams. Invited. Cone Penetrometer 3-D Characterization of Y-12 Site to Determine the Hydrological, Geological and Biogeochemistry Best Sites for ENIGMA Subsurface Observatories. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Hazen, T. C., I. Fukai, A. P. Arkin, E. Alm, and H. Dulai. Invited. Environmental Surveillance for Biological Traces of Radionuclide Sources. MTV Monthly Seminar, online, 15 May 2021. University of Michigan.

Hunt, K. A., A. E. Otwell, S. Bowman, S. D. Wankel, K. F. Walker, E. R. Dixon, M. Rodriguez, K. A. Lowe, D. C. Joyner, A. Carr, L. Lui, T. Nielsen, N. S. Baliga, T. C. Hazen, D. A. Stahl, A. P. Arkin, P. D. Adams. Invited. Resolving Biotic and Abiotic Controls of Nitrous Oxide Flux in a Subsurface Site Contaminated with High Nitrate Concentrations. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting.

Hunt, K. A., A. V. Carr, K. F. Walker, E. R. Dixon, M. R. Jr, K. A. Lowe, D. C. Joyner, A. E. Otwell, S. D. Wankel, N. S. Baliga, T. C. Hazen, D. A. Stahl, A. P. Arkin and P. D. Adams. Invited. High nitrous oxide emissions from a nitrate contaminated subsurface indicate significant metabolic activity. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting.

Joyner, D. C., and T. C. Hazen. Contributed. Managing Your Graduate Career: Guidelines for Success. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Li, Y., K. Ash, D. C. Joyner, D. E. Williams, C. Iler, I. Alamilla, P. McKay, B. Green, F. Kara-Murdoch, C. Swift, F. Löffler, and T. C. Hazen. Contributed. Decay of SARS-CoV-2 and Pepper Mild Mottle Virus (PMMoV) RNA in raw wastewater to inform application in wastewater-based epidemiology of the University of Tennessee student residential buildings. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Lui, L. M., H. J. Smith, F. V. Netzer, K. B. D. León, E. L.-W. Majumder, J. V. Kuehl, F. Song, A. Sczesnak, T. Nielsen, M. P. Thorgesen, T. C. Hazen, et al. Invited. Core Values: Spatial Variation in Microbial Function, Activity, and Community Assembly in Groundwater and Sediment from a Contaminated Subsurface Aquifer. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Lui, L. M., T. Nielsen, H. J. Smith, F. V. Netzer, E. L.-W. Majumder, J. V. Kuehl, F. Song, A. Sczesnak, M. P. Thorgesen, X. Ge, F. L. Poole, C. J. Paradis, T. C. Hazen, et al. Invited. A Method for Circularizing Microbial Genomes from Metagenomics Data. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Lui*, L. M., E. L.-W. Majumder*, H. J. Smith*, H. K. Carlson, F. V. Netzer, N. Nielsen, M. Peng, X. Tao, A. Zhou, M. Price, J. V. Kuehl, A. J. Hendrickson, V. Trotter, T. C. Hazen, et al. Invited. Mechanism across scales: integrating laboratory and field studies for microbial ecology as illustrated by the ENIGMA SF. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Miller, J. I., S. M. Techtmann, J. Fortney, N. Mahmoudi, D. C. Joyner, J. Liu, S. Olesen, E. Alm, A, Fernandez, P. Gardinali, N. GaraJayeva, F. S. Askerov and T. C. Hazen. Contributed. Potential for rapid microbial biodegradation of petroleum hydrocarbons in hypoxic marine environments. San Antonio, TX. October 7-9, 2019. International Petroleum Environmental Conference Annual Meeting.

Miller, J. I., Z. Griffiths, S. Techtmann, J. Fortney, N. Mahmoudi, D. Joyner, J. Liu, S. Olesen, E. Alm, A. Fernandez, P. Gardinali, N. GaraJayeva, F. S. Askerov, O. G. Brakstad, O. Pelz, M. Kuijper and T. C. Hazen. Contributed. Microbial Community Structure and Oil Biodegradation in a Hypoxic Marine Environment. May 6, 2020. Dublin, Ireland (online). SETAC SciCon SETAC Europe 30th Annual Meeting.

Needham, D. M., A. Zhang, J.-M. Chandonia, D. Chivian, L. M. Lui, W. Zheng, S. Zhao, Y. Yin, D. A. Weitz, T. C. Hazen, P. S. Novichkov, J. Zhou, E. J. Alm, A. P. Arkin and P. D. Adams. Invited. Integrating data and algorithms from the ENIGMA project into KBase. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Ning, D., Y. F., L. M. Lui, J. P. Michael, Y. Fu, J. D. Van Nostrand, R. Tian, Y. Wang, K. F. Walker, E. R. Dixon, A. D. Putt, D. E. Williams, D. C. Joyner, T. C. Hazen, A. P. Arkin, et al. Invited. Physical size matters in groundwater bacterial community assembly. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

Pineda, P., I. Alamilla, A. Salim, A. Putt, and T. C. Hazen. Contributed. Comparison of Bacterial DNA Extraction from Stream Water. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Putt, A., P. Pineda, I. Alamilla, A. Salim, A. P. Arkin, P. D. Adams, and T. C. Hazen. Contributed. Response of Filterable Microbes to a Beta-Cyclodextrin Injection. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Rafie, S. A. A., K. P. Hoyt, M. R. Schubert, M. T. Kerr, L. R. Blentlinger, A. M. Faiia, A. Szynkiewicz, J. F. Franklin, S. P. Horn, and T. C. Hazen. Contributed. Soil bacterial response to prescribed fires in a southern Appalachian clear cut with fuel manipulation. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Salim, A. A., A. Putt, and T. C. Hazen. Invited. Learning and growing as a Scholar : My Experience as an Undergraduate Researcher. April 14, 2020. Knoxville, TN. 1794 UTK Annual Scholars Showcase one of 20 finalists.

Salim, A. A., P. Pineda, I. Alamilla, A. Putt, and T. C. Hazen. Invited. A Novel approach for Characterizing the Ultra-Micro Size-Fraction Community. April 13, 2020. Knoxville, TN. EURēCA Undergraduate UTK Annual Research Meeting.

Serrano Matos, Y., A. Gonzalez, A. Rivera, D. Williams, T. C. Hazen, and G. A. Toranzos. Contributed. Prophage and CRISPR Sequences Detected in Enterococci Isolates From Soils and Waters with Low Anthropogenic Disturbances. November 20-24, 2019, Anaheim, CA. Annual Biomedical Research Conference for Minority Students (ABRCMS) 2019.

Walker, K. F., E. R. Dixon, D. C. Joyner, K. A. Lowe, F. L. Poole, X. Ge, M. P. Thorgersen, D. Ning, Y. Fan, J. P. Michael, Y. Fu, R. Tian, Y. Wang, T. C. Hazen, et al. Invited. Spatiotemporal Dynamics of Groundwater and Sediment: Geochemistry, Microbial Communities and Activities in a Contaminated Aquifer. February 23-26, 2020. Washington, DC. 2020 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.

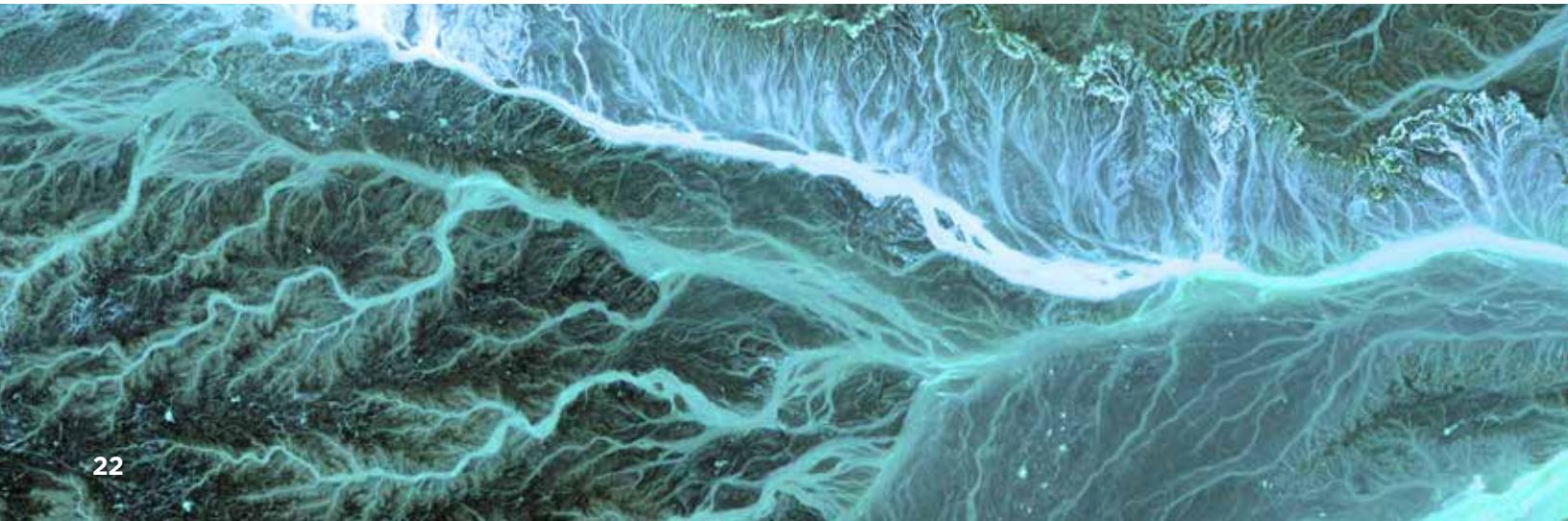
Walker, K. F., E. R. Dixon, D. C. Joyner, K. A. Lowe, F. L. Poole, X. Ge, M. P. Thorgersen, D. Ning, Y. Fan, J. P. Michael, Y. Fu, R. Tian, Y. Wang, J. D. V. Nostrand, T. C. Hazen, et al. Contributed. Diurnal and Seasonal Fluctuations with the Subsurface: A 17-Week Survey of Groundwater and Sediment in 27 Contaminated Wells. World Microbe Forum, Online, June 20-24, 2021. American Society for Microbiology and Federation of European Microbiological Societies. World Microbe Forum.

Wang, Y. (Presenter), J. Mao, M. Jin, F. Hoffman. 2020. Developing a Gridded Upscaled Soil Moisture Dataset Using Sparse in situ Observations. AGU Fall Meeting. Online virtual meeting, United States.

Wu, X., D. C. Joyner, T. C Hazen, R. G. Malana, and R. Chakraborty. Invited. Applying Stable Isotopes for Source Fingerprinting of Dissolved Organic Nitrogen in Groundwater. Goldschmidt2020.

Wu, X., L. Lui, Y. Liu, N. Justice, T. Simmons, T. Nielsen, S. Jagadamma, N. J. Hess, T. C. Hazen, A. P. Arkin, and R. Chakraborty. Contributed. Insights into the Depth-resolved Geochemical Constraints on Microbial Community Structure and Metabolic Potential for Carbon Cycling in Shallow Subsurface Sediment. December 10, 2019, San Francisco, CA. AGU Fall Meeting.

Zhang, A., D. M. Needham, A. E. Kazakov, W. Zheng, S. Zhao, Y. Yin, D. A. Weitz, T. C. Hazen, E. J. Alm, N. S. Baliga, et al. Invited. Strain dynamics and functional diversity of 22 high-quality single cell genomes from ENIGMA ground water. February 22-24, 2021. Washington, DC. 2021 Genomic Sciences Program (GSP) Annual Principal Investigator (PI) Meeting. ORAU.



Awards

Special Service Award: Terry Hazen, Governor's Chair for Environmental Biotechnology (CEE)

Many of the college's leaders took on extra responsibilities beyond their full-time positions this past year for the good of the university and the state. TCE Interim Dean Matthew Mench recognized Terry Hazen for his work chairing a committee on COVID testing for Fall 2020 semester and then establishing weekly wastewater testing for all student residences on campus from early September to the present. Dr. Hazen was also lauded for his high number of citations in academic scholarly papers worldwide.

Research Achievement Award Winner: Joshua Fu, John D. Tickle Professor (CEE)

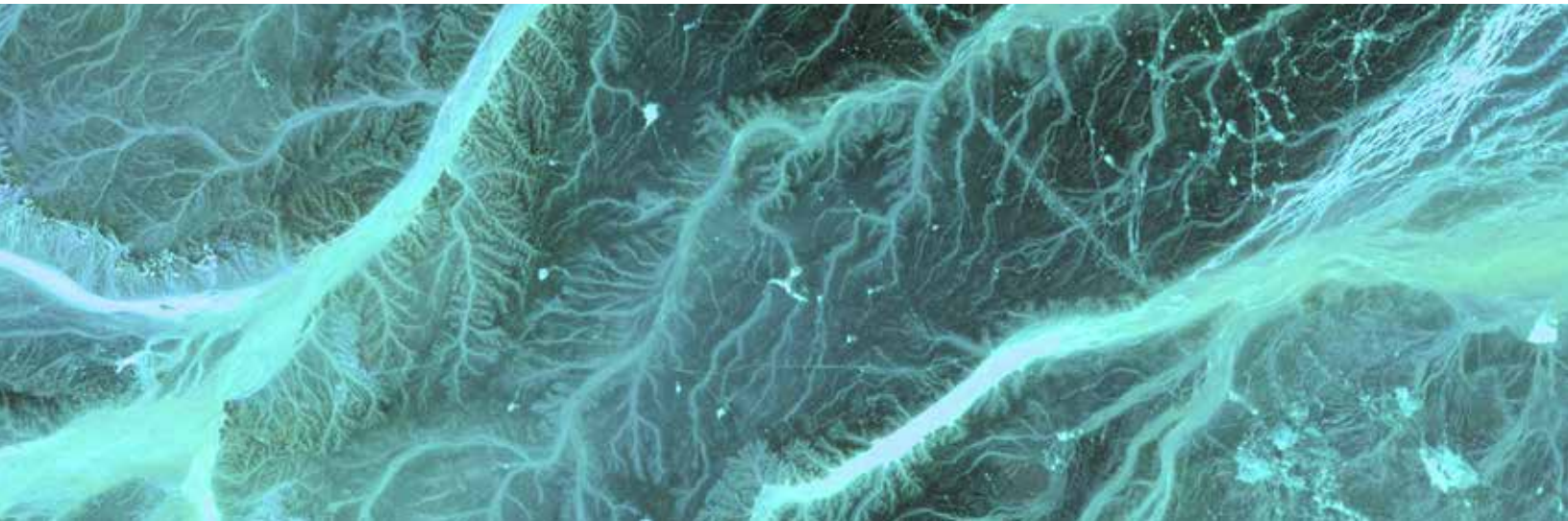
This award recognizes faculty members who have been tenure-line for more than 10 years and have received national or international recognition in their field. Dr. Fu's work in the areas of air quality modeling and climate change is nearly encyclopedic in scope. His work includes studies both at the global and regional scales. His work also comprises the full spectrum of atmospheric pollutants, including particulate matter, ozone, dust, nitrogen deposition, carbon black, aerosols, acid deposition, and greenhouse gases, emanating from diverse sources such as industrial emissions, electrical power generation, transportation, forest fires and erosion.

2021 UTK Provost Success in Multidisciplinary Research Award: Healthy Environment Team

The Success in Multidisciplinary Research award is given to a team of faculty members in more than one academic college who have succeeded in gaining major external resources and recognition for multidisciplinary research. The members of this multiciliary team share common interest and have a strong passion to achieve a healthy environment. Their convergent research integrates expertise in environmental engineering, health, infrastructure, human factors, automation, systems engineering, and data science to systematically attack complex health problems. Team members are Team Leader Qiang He (CEE); Shuai Li (CEE); Mingzhou Jin (ISE); Xueping Li (ISE); Jindong Tan (MABE); Nina Fefferman (Ecology & Evolutionary Biology); Tami Wyatt (College of Nursing); and Jun Lin (Department of Animal Sciences).

He, Li, Tan Awarded Best Paper from Building & Environment

Professor Qiang He, Assistant Professor Shuai Li (CEE), and Professor Jindong Tan (MABE) recently won the **Best Paper Award from Building and Environment** for their paper, *Segmenting areas of potential contamination for adaptive robotic disinfection in built environments*. The research integrates robotic decontamination and infrastructure design, which could help mitigate the threat of pathogens like COVID-19 in buildings of mass gatherings, such as airports, offices, and restaurants.



Institute for a Secure & Sustainable Environment
The University of Tennessee
311 Conference Center Building
Knoxville, Tennessee 37996-4134

Non-Profit Org.
U.S. Postage PAID
Permit No. 481
Knoxville TN

Notable Student Success

Scarbrough's Paper Wins IISE Regional Competition

Kalina Scarbrough's extension to her original study, *Developing Machine Learning Models to Analyze Sensor Data*, won first place at the **Institute of Industrial and Systems Engineer's Mid-Atlantic Technical Regional Competition**. The paper discusses her research with Dr. **Anahita Khojandi** (ISE) as part of an **ISSE Seed Grant Project**. The project, which started two years ago, is about how to efficiently monitor green infrastructures, specifically bioretentions, and predict their future state. She has been invited to present this work at the IISE Annual Conference in May 2021. Building on her winning paper, Ms. Scarbrough is writing an academic journal article, *Real-Time Sensor-Based Prediction of Soil Moisture in Green Infrastructure: Case Study*, that she hopes to have published in the coming months. Kalina is a junior in Industrial and Systems Engineers with a minor in reliability and maintainability. She expects to graduate in May 2022.