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The Magazine of the College of Earth and Mineral Sciences

Impact

PennState
College of Earth
and Mineral Sciences

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On the cover...

Joshua Robinson, left, shows off a completed silicon carbide (SiC) boule while Andrew Bowen (right) displays chips frequently used to begin growing the boule.

All photos, unless noted, provided by Penn State.

Impact

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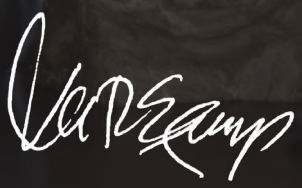
Impactful science and engineering for the coming decades

While EMS retains a strong focus on basic research, advancing knowledge of the world around us, our students and faculty are increasingly passionate about conducting research that has a more immediate, positive impact on society. Whether it's Melissa Gervais' analysis of Arctic sea-ice loss, Renee Obringer's projections of water and electricity demand in the future, or Manzhu Yu's modeling of the public health implications of wildfire smoke, the motivation is the same: applying one's expertise to the benefit of communities, local, regional, or global. Our focus on solutions for society benefits from our innovative approaches, exemplified by Tieyuan Zhu's use of fiber-optic networks to detect problems in subsurface utilities or mitigate geohazards. And innovation happens when we forge partnerships and collaborations with other units at Penn State, other academic institutions, government agencies, non-profits, and industry, exemplified by Josh Robinson's silicon-carbide innovation alliance. Think of EMS not just as earth and mineral sciences. EMS is everything listed below and more...

I hope you enjoy the issue and I look forward to hearing from you in the near future.



Lee Kump, The John Leone Dean

EMS is...


Image: Pixabay

Penn State part of $6.6M consortium to improve weather forecasting

Researchers at Penn State are part of a multi-university team receiving $6.6 million in recommended funding from the National Oceanic and Atmospheric Administration. The group will establish a new multi-university data assimilation consortium to improve weather forecasts using enhanced numerical weather prediction systems.

"CADRE will partner closely with NOAA to improve computer model forecasts of weather extremes, including tornadoes, hurricanes, winter storms, heavy rain, heat waves, wildfires, and storm surges," said David Stensrud, professor of meteorology and atmospheric science. "These computer model forecasts form the basis of the weather forecasts widely used by society."

https://tinyurl.com/4k24zzmb

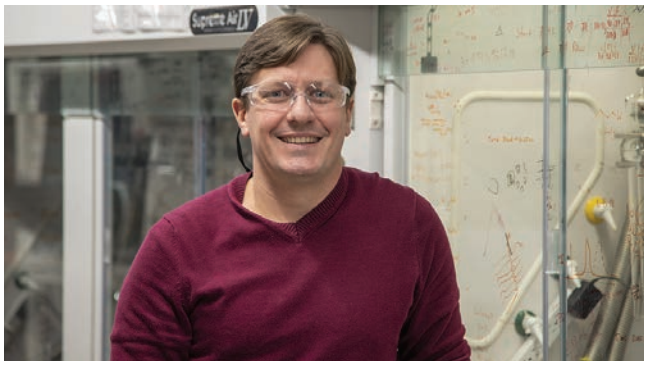
Scientists examine how wastewater practices in Florida Keys impact water quality

Wastewater contains nutrients that can overfeed algae, leading to harmful algal blooms and pollution issues in the ocean and other waterways.

Many treatment facilities in the Florida Keys perform initial biological and chemical treatment of wastewater and then inject it into shallow wells, less than 100 feet underground. In theory, remaining nutrients like inorganic phosphate would adsorb or stick to the surface of the porous limestone bedrock as the wastewater plume travels in the subsurface before reaching coastal waters. But potential wastewater contamination has been detected in groundwater and near shore waters, suggesting current wastewater treatment and disposal techniques may be insufficient, according to Penn State research.

https://tinyurl.com/5xmyasps


Image: NOAA



$4.5M grant to fund 3D-printed high-performance ceramics project

Penn State scientists were awarded a five-year, $4.5 million Multidisciplinary University Research Initiative grant to use light energy to create high-performance ceramic materials at lower temperatures than previously possible.

Led by Robert Hickey, assistant professor of materials science and engineering, and co-led by Jon-Paul Maria, professor of materials science and engineering, the team seeks to create a one-step process to produce ultra-high-temperature ceramic materials without bulk heating. The team is focusing on the potential of using light to convert polymer precursor molecules—starting materials that are easy to process—into the final ceramic product. https://tinyurl.com/3t6huy24

Designing and assessing market designs to improve electrical grid reliability


Image: Pixabay

Mort Webster, professor of energy engineering, is leading a team to evaluate prospective market design changes to efficiently integrate batteries and other unconventional resources into wholesale electricity markets, with the aim of improving electrical grid reliability.

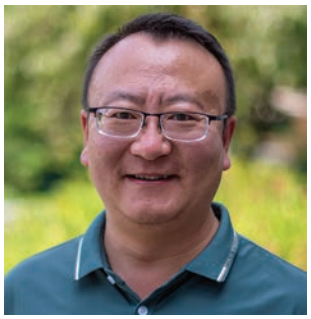
They will partner with PJM Interconnection (PJM) and ISO New England Inc. (ISO-NE). PJM and ISO-NE together manage the electricity grid covering nineteen states, including Pennsylvania, and account for more than one-fifth of the electricity consumed in the U.S. Through the DOE-funded project, Webster will model their electricity markets and develop market design changes to achieve the best performance across reliability, efficiency, and investment incentives, which could entice companies to build the flexible generators needed to balance supply and demand.

https://tinyurl.com/msdh63fp

NIH grant for new tool development to help assess obesity-related behaviors

Zhenlong Li, associate professor of geography, has been awarded a grant from National Institutes of Health's National Institute on Minority Health and Health Disparities to study how environmental factors contribute to obesity, particularly in racial and ethnic minority communities.

"This award marks a significant milestone in my research," Li said. "It offers an exciting opportunity to broaden the scope of my work and apply geospatial methods to develop innovative solutions for addressing critical public health challenges beyond infectious diseases."



Li and his team will develop a novel tool to assess obesity-related behaviors at multiple geographic levels—ranging from neighborhoods to counties across the U.S.—and potentially offer insights that can inform more targeted public health interventions. Li said this will provide policymakers with actionable data to help reduce health disparities, particularly in racial and ethnic minority communities that often face greater barriers to accessing healthy resources. https://tinyurl.com/48uu6zj3

Waste heat to green energy: Approach boosts thermoelectric generator efficiency

Thermoelectric generators that can convert waste heat to clean energy could soon be as efficient as other renewable energy sources, like solar, according to a team led by Penn State scientists. Using high-entropy materials, the researchers created more efficient thermoelectric materials than previously possible, an advancement that they said could even help make long-distance space exploration possible.

"These findings show a new direction in how we can improve thermoelectric devices to be really efficient," said Bed Poudel, research professor in materials science and engineering and co-author on the study. "Our work provides a new avenue toward creating very exciting thermoelectric materials and could lead to even greater advances with future material development."

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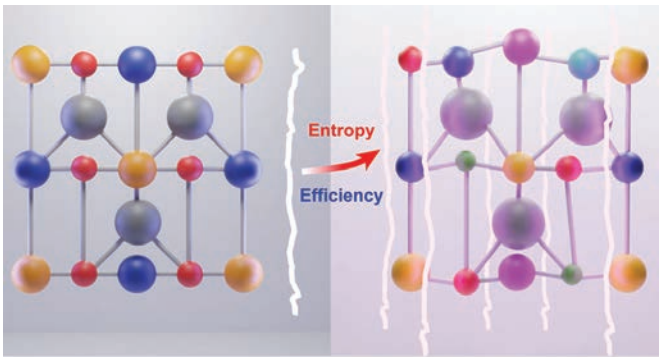

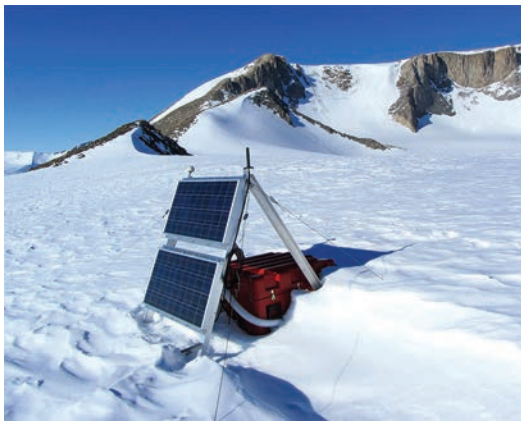

Earth beneath ice sheet key to predicting sea level rise from warming climate

Andrew Nyblade, professor of geosciences, was part of an international team of researchers who co-authored a study that yields new insights into the link between global warming and rising sea levels.

The team's findings suggest that Earth's natural forces could substantially reduce the melting of the West Antarctic Ice Sheet and its impact on rising sea levels but only if carbon emissions are swiftly reduced in the coming decades. By the same token, if emissions continue on the current rising trajectory, Antarctic ice loss could lead to more sea level rise in the future than previously thought, according to the researchers.

"The West Antarctic Ice Sheet is one of the largest ice masses on Earth and how it responds to future warming from greenhouse gas emissions is one of the greatest uncertainties in estimating future ice sheet stability and projecting ice mass losses," Nyblade said. https://tinyurl.com/mpy5rcru

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NSF grant awarded to manage salt contamination of tidal river water supplies


Image: USGS

Salt contamination of water supplies in tidal rivers is a growing problem around the world, threatening the safe drinking water of billions of people. Penn State researchers are part of a multi-institution team of scientists and engineers who are developing tools to help monitor and manage decision-making to address this critical issue.

Raymond Najjar, professor of oceanography, said the team is developing a coupled watershed-estuary model that simulates the transport and fate of major salt ions by leveraging recent advances in hydrological and estuarine modeling. They plan to use the Chesapeake Bay and its tidal rivers as a pilot study site to better understand the saltwater intrusion process. https://tinyurl.com/nhzb8tm9


Image: USGS

New tool to help decision-makers navigate possible futures of the Colorado River

The Colorado River is a vital source of water in the Western United States, providing drinking water for homes and irrigation for farms in seven states, but the basin is under increasing pressure from climate change and drought. A new computational tool can help decision-makers explore many plausible futures and identify consequential scenario storylines— or descriptions of what critical futures might look like—to help planners better address the uncertainties and impacts presented by climate change.

"One of the ways states like Colorado are preparing for the future is by making plans for how things might evolve based on the available science and inputs from various stakeholders," said Antonia Hadjimichael, assistant professor of geosciences and lead author of the study.

https://tinyurl.com/46d874m6

$1.3M NSF grant to fund research into restoration of degraded ecosystems


Image: Conservation South Africa

Restoring degraded ecosystems has emerged as a global policy priority to address the interlinked concerns of deforestation and land degradation, biodiversity loss, and climate change while delivering social benefits. An international team of researchers led by Ida Djenontin, assistant professor of geography, is investigating the socioecological outcomes of restoration in degraded woodlands ecosystems.

The researchers will investigate how restoration changes ecological and social conditions, identify what drives the ecological and social changes induced by restoration, and develop cost-effective indicators and tools to advance systematic assessment of socio-environmental benefits and tradeoffs of restoration interventions. https://tinyurl.com/ym4a7mx5

Lumpy, bumpy hail: Realistic hail shapes may improve modeling of severe weather

Though often compared in size to round objects—peas, golf balls, or even softballs—hailstones do not fall from the sky as smooth spheres. A new approach for modeling hailstorms that uses more realistic hailstone shapes could improve our understanding of hazardous weather.

"If you model an idealized spherical hailstone, the growth will be rather unrealistic and it may lead to you conclude that a certain kind of storm environment will grow big hailstones, and that might not actually be true," said Yuzhu Lin, a doctoral candidate in meteorology and atmospheric science.

"If we can improve hail forecasts, we can help the public stay safe and mitigate damage during hailstorms and aid hail-sensitive industries like insurance and agriculture," said Matthew Kumjian, professor of meteorology and Lin's adviser. https://tinyurl.com/2xev4n3p

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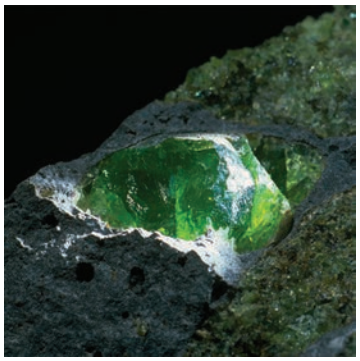
$1.1M award to fund project exploring potential of geologic hydrogen



Penn State researchers received $1.1 million in funding from the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E). Engineering the production of subsurface hydrogen could potentially unlock substantial resources for clean energy and lead to the decarbonization of our most energy-intensive industries. The team, led by Shimin Liu, the Deike Chair Professor in Mining Engineering, will work to better understand how to explore and potentially extract geological hydrogen from its subsurface reservoirs.

"Until now, hydrogen has never been treated as a primary energy resource," Liu said. "Our intent to artificially engineer a geomechanical system that can sustain hydrogen production has never been done before. So, at each step, we will need to assess, evaluate and develop a new process or technology."

https://tinyurl.com/4eeychk9

Ecofriendly glass invented at Penn State secures partner for product development

LionGlass, a new family of glass engineered by researchers at Penn State, has secured its first corporate partner, a move toward bringing the ecofriendly alternative to standard soda lime silicate glass to market.

Bormioli Luigi, an Italian glassmaker that specializes in producing high-end packaging for fragrance, cosmetics, and tableware, is the first company to enter an official partnership with Penn State to perform research and development with the goal of scaling up, manufacturing, and ultimately commercializing LionGlass.

"This is an enormous opportunity to work with this material and create a more sustainable glass with far less carbon dioxide emissions and energy consumption than standard glass," said Elisa Biavardi, the chemical laboratory manager for Bormioli Luigi. "I see it also as an opportunity to learn from one another as we explore the possibilities for this major innovation in glassmaking." https://tinyurl.com/336w227h

$4.99M DOE grant to build domestic supply chain for critical minerals

A Penn State research team led by Sarma Pisupati, professor of energy and mineral engineering and director of Penn State's Center for Critical Minerals, received a $4.99 million grant from the U.S. Department of Energy to develop and assess advanced separation technologies for the extraction and recovery of rare earth elements and other critical materials from coal, coal wastes, and coal by-products. The goal is to help to establish a 100 percent domestic supply chain, reducing U.S. reliance on foreign suppliers.

"The two main goals of this project are to reduce the net import reliance on critical minerals and to help clean up the environment," Pisupati said. "We want to demonstrate a 100% domestic supply of critical minerals that are essential for the United States' economy. Thousands of abandoned mines spew out acid mine drainage, and we want to remove the critical minerals from this waste. We are taking waste and turning it into a treasure. This can help reduce the taxpayer money needed for cleanup and help solve a national security problem." https://tinyurl.com/2uft2zv2

Online geospatial certificate program receives accreditation

The United States Geospatial Intelligence Foundation (USGIF) recognized Penn State's graduate certificate in Geospatial Intelligence Analytics, which is offered online in collaboration with the John A. Dutton Institute for Teaching and Learning Excellence, Penn State World Campus, and the Department of Geography.

"We are pleased that our geospatial intelligence program once again meets the rigorous requirements outlined in the USGIF accreditation standards and criteria," said Gregory Thomas, associate teaching professor and program director. "Students in our program can be confident that they are obtaining the necessary GEOINT competencies and skills to obtain a competitive advantage in this discipline."

https://tinyurl.com/3p6nkjmk

Image: Pixabay

The sense of sound

How fiber optic cables can spot geohazards and save cities from both cost and danger

by David Kubarek

In 2019, a storm was keeping Tieyuan Zhu up at night. It wasn't a dog's howl chasing the cracks of thunder or the thought that water might be creeping into the basement. He had just installed his novel acoustic sensing technology in some of the fiber optic cable lines beneath Penn State's University Park campus, and he was curious if the data was being logged on a tiny server near his Deike Building office.

In the morning, he rushed into the office of David Stensrud, then head of the Department of Meteorology and Atmospheric Science, to compare data.

It matched.

Even better, in something that even surprised Zhu, associate professor of geosciences, the acoustic data showed the directional strength of the storm. This meant that the spatial resolution was even stronger than he thought.

Distributed Acoustic Sensing (DAS) technology

Zhu is an expert on what happens below ground. He's a trained geoscientist who often takes out-of-the-box approaches to solving traditional problems. DAS is one such approach.

"I like to think of myself as an untraditional earth scientist," Zhu said. "I'm interested in advancing science but with a goal in mind of advancing society. I'm always asking how can these tools be used to solve societal issues."

Because things happening below ground create motion—simple physics—they also create acoustic signals in the same way the stereo speaker physically moves to create sound as a turntable needle rides the grooves of a record, again creating sound from the motion. DAS technology assigns acoustic signals to all those physical motions.

Using DAS, Zhu's team taps into the fiber optic cable and fires a laser down the line. It returns, recording all movement as well as where the movement occurred along the way. It even records how far away the sound was in all directions. Because the cable indiscriminately records all motion, there's a lot of extraneous data. Using machine learning, Zhu's team has worked for years applying filters to isolate only the data they want.

Penn State, Pittsburgh, and beyond

Since then, Zhu's team has shown how DAS can spot a whole range of underground issues. It's effective at real-time tracking of storms, traffic patterns, sinkholes, water leaks, flooding – just about anything that creates a low frequency sound wave.

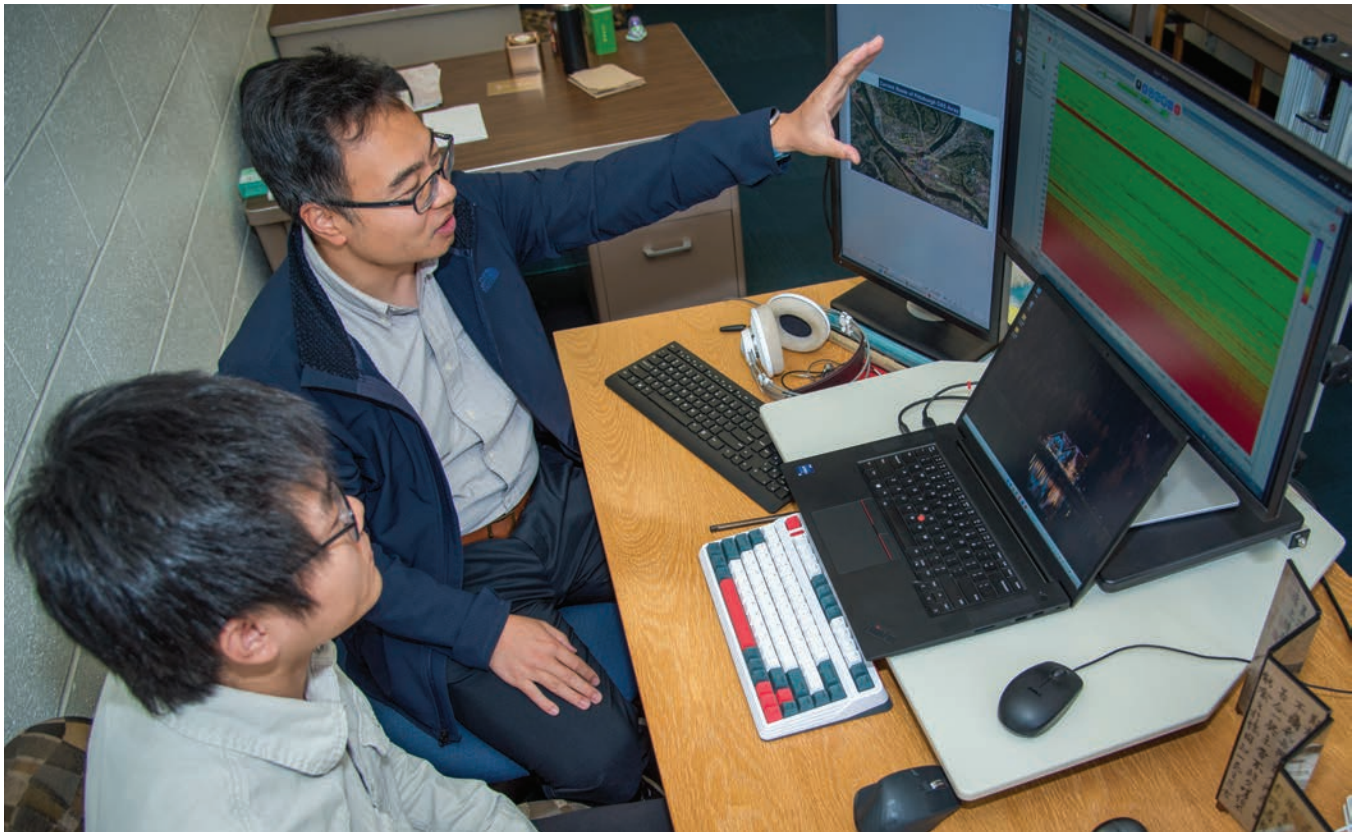
For a fun proof of concept, the team tracked the scoring of a Penn State football game and identified four songs by the band Grouplove during Movin' On, Penn State's student-run music festival.

Pilot work that started at Penn State recently led to a large-scale project in Pittsburgh. Zhu's team secured one of only nineteen Civic Innovation Challenge grants – $937,000 – sponsored by the National Science Foundation. Zhu is principal investigator on a team that includes Carnegie Mellon University and researchers across Penn State. Civic grants are awarded to rapidly transitioning emerging technologies that address community challenges.

Zhu's team installed DAS in roughly 18 linear miles of fiber optic cable in sections that cover the residential area of Oakcliffe, downtown Pittsburgh and the city's West End. The locations were chosen for the variation in terrain and development.

Early results are promising.

"The beautiful thing is that the data has been so spatially accurate," Zhu said. "We can see within meters what is happening."



Postdoctoral scholar Zhinong Wang, left, looks over real-time acoustic sensing data from Pittsburgh with Tieyuan Zhu.

Pittsburgh is a perfect analog for most east coast cities. It's heavily populated, topographically diverse, and littered with an aging infrastructure. According to the Franco Harris Pittsburgh Center at Penn State, a partner on the project, geohazards are very costly for the city.

Zhen Lei, professor of energy and environmental economics, has been tasked with looking at the social impact of the project. Often, higher income areas are equipped with more resources. Yet, fiber optic cable can be an equalizer. It's throughout the city. The team hopes to show DAS is effective at tracking hazards in all parts of the city, even lower income areas.

Zhu said DAS wins on cost and accuracy. For example, he said, a single water leak sensor costs about $1 million annually to operate. Because each sensor only tracks data in the spot it's located, many sensors are needed. However, fiber optic cables are everywhere. In the test area, DAS is currently recording at a resolution of about four meters. The only barrier, Zhu said, is dealing with the data. In 4 months of operation, about 200 terabytes of data have been sent back to Penn State. However, the cost of managing that data is less than the cost of a single water sensor, Zhu said.

> *"The beautiful thing is that the data has been so spatially accurate."*
>
> *~Tieyuan Zhu*

In that time, researchers relied on existing sensors and ground-truthing to calibrate and corroborate DAS.

"Using existing fiber optic networks is an innovative and cost-effective way to gather information on water flows underground, as well as changes in flow, without having to deploy and maintain a large number of costly flow monitors throughout the underground system of pipes," said Beth Dutton, senior project manager of stormwater at Pittsburgh Water. "We welcome exploring new technologies such as this to more effectively leverage our ratepayers' resources to address Pittsburgh's challenges."

Visualizing the data

Making sense of the mounds of data is something that comes easy for people like Zhinong Wang, a postdoctoral scholar hired this spring to help on the project. But it's useless if city officials can't make sense of it.

He's been working with Shouvik Majumder, an undergraduate student in computer science in the College of Engineering, to develop filters so that city planners can visualize and isolate data.

In just a few months, Majumder created a graphical user interface so that DAS data can be filtered with the click of a mouse.

Thinking bigger

Zhu's goal is bigger than one city. He wants to show DAS is cheaper and more effective at tracking geohazards in any city. He said all of the technology scales. There are many cities with an aging infrastructure, rising costs, and increased challenges to dealing with geohazards, traffic, and even yet-to-be-developed uses.

A few of Zhu's students are exploring novel uses for DAS while earning their doctorates. So far, DAS has proved helpful in oil and natural gas monitoring, geothermal assessments, and carbon sequestration monitoring.

Joe Miller, a graduate student, is using DAS to track things like mine blasts, traffic, and earthquakes near the University Park campus. He points to research that shows DAS improving warning times for a slew of geohazards.

"If you really want to make an impact, you need to ask yourself the 'who cares' question," Miller said. "And people care about better predicting these hazards. Revealing when hazards are going to happen is the holy grail of geophysics."

As he watches the news during hurricane season, Zhu's still spotting new opportunities for DAS to help emergency responders. For example, flash flooding occurs when the ground can't absorb any more water. Yet, until DAS, he said there were no cost-effective means for tracking this.

"DAS can show when the ground is below its threshold and when it's surpassed it," Zhu said. "If we have fiber optic cable, we now have a way to track this. The list of things we can accomplish is continuing to grow and seems limitless." ⌘

A growing partnership

Penn State to drive industry, job gains while advancing manufacturing of critical material, silicon carbide

by David Kubarek

While creating two-dimensional semiconductor materials at Penn State, Joshua Robinson has always focused on the end game. He's interested in advancing science, but—most importantly—he's interested in driving industry advances via research and discovery.

Something he recently created at Penn State has the promise to do that.

The newly launched onsemi Silicon Carbide Crystal Center (SiC3) at Penn State—a center created exclusively with more than $14 million in industry, academic, and government funding—has the potential to expand a University-industry partnership while driving workforce development across the entire Appalachian Region of the U.S.

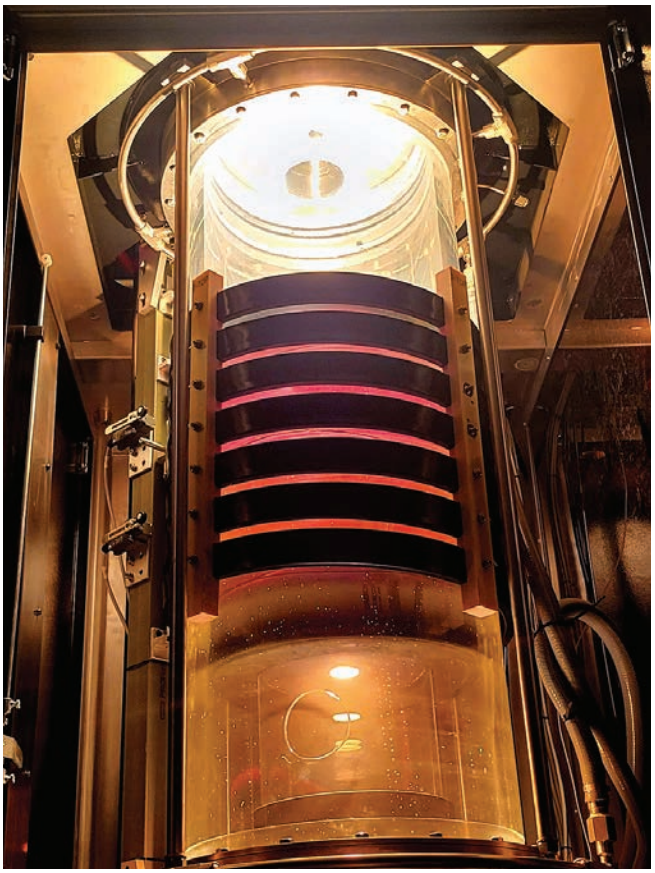
The center is part of the greater Silicon Carbide Innovation Alliance (SCIA), a coalition of industry leaders, academic institutions and government support with a focus on becoming the nation's central hub for research, development, and workforce training in SiC crystal technology. onsemi is pledging $8 million over 10 years and a continuously growing list of SCIA founding partners, including Morgan Advanced Materials, Pureon, Zadient, Lapmaster-Walter, and several others in negotiation at the time of this publication are collectively pledging an additional roughly $500,000 annually, with similar amounts of in-kind material donations.

SiC for today and tomorrow

That effort centers around one material: SiC. It's a superior semiconductor to silicon for nearly all energy-intense applications. As we move toward a greener energy landscape, SiC beats silicon on nearly all counts: The wide bandgap allows SiC to handle much higher voltages and temperatures while being manufactured in a smaller footprint. In the age of high voltage power transmission and switching for electric transportation, supercomputing and military applications, it's a must.

(Left photo) Joshua Robinson, left, shows off a completed silicon carbide (SiC) boule while Andrew Bowen, right, displays SiC pieces frequently used to begin growing the boule.

(Upper right photo) A single SiC boule is heated in this furnace to 3,812 degrees Fahrenheit for ten days.



The con? Cost.

The main drawback is that SiC is incredibly expensive and energy intensive to make. It starts with a K-Cup-style graphite crucible where a base SiC material in either powder or chip form is heated using microwaves to 2,100 degrees Celsius (3,812 degrees Fahrenheit)—nearly half the surface temperature of the sun—for a period of ten days. During this time, a dome-like crystal known as a boule forms like a stalactite at the top of the crucible, is removed and then heated for an additional few days to burn away the remains of the graphite around the boule, ultimately yielding an SiC crystal covered in an oxide that gives it its rainbow color. Each run can cost as much as $8,000-15,000, depending on material source.

After that, the ultra-hard material is processed with the only thing harder: diamond. Boule processing technology is continually evolving, but the current process involves slicing the boule with diamond wire, then grinding and lapping the slices—called wafers—with diamond pads and slurries, and finally polishing to near atomic smoothness using a combination of chemical and mechanical processes.

If all goes well, a colorful SiC boule is created (left), and a "crown" on the source SiC forms (right).

Subsequently, a thin layer of ultra-high purity SiC is grown on the SiC wafer and electronic devices are fabricated on the surface before they are diced and packaged into the "widgets" that control the flow of electricity for many advanced energy applications. There can be as many as 2,000 steps from start to finish, but the single most expensive part of the process is growing and processing the SiC boule.

Typically, the manufacturing process takes place at various sites all around the world, but the sharing of technology is largely secret among manufacturers and is not standardized. That's stifled both advances in research and workforce development. Those issues are what prompted industry leaders at onsemi to partner with Robinson and Penn State.

"Companies have been making SiC for decades but there's a vast amount of research that's been overlooked," Robinson said. "That's why they're so interested in partnering with Penn State. Through this industry partnership, we're going to be able to shine a light on the fundamental science behind industrial-scale crystal growth while putting the tools in place to train workers with that knowledge."

The need for SiC semiconductors already outpaces supply in the U.S. and is expected to grow by more than 200 percent by 2030, according to the U.S. Department of Energy.

Industrial scale manufacturing

Often, materials are created on a research scale at the University's state-of-the-art Materials Research Institute. The onsemi SiC3 and Penn State's SCIA are different. Securing $3 million in Air Force funding—matched by Penn State—Robinson secured 2,400 sq. ft. in research space in the EMS Energy Institute for the planned installation of four industrial-scale SiC furnaces and all necessary equipment to process the boules into wafers.

This facility is allowing his team—led by T. Andrew Bowen, a doctoral candidate in materials science and engineering—to create industrial size, 6-inch and 8-inch SiC boules while researching the industrial-scale process. They'll be able to use the same tools they use for materials research to shed light on best synthesis practices and create standards that lead to the best SiC yields.

"Companies have been making silicon carbide for decades but there's a vast amount of research that's been overlooked. That's why they're so interested in partnering with Penn State."

~Joshua Robinson

Leveraging the expertise of professor and SCIA Associate Director Adri van Duin and Yuan Xuan, associate professor of mechanical engineering, they'll create digital twins of the furnaces to accelerate rapidly toward optimized SiC crystal growth processes.

Bowen is about to earn his Ph.D. and planned to relocate but the prospect of this new project convinced him to stay.

"What the alliance is hoping to accomplish is too exciting to pass up," Bowen said. "I really, truly believe

Robinson, center, oversees the creation of the new 2,400-square-foot SiC research facility at University Park.

in both the research and the workforce development that is going to be accomplished here. I couldn't imagine a better position just after graduating."

While Penn State is finalizing the research space, Bowen and newly hired research engineering assistant, Ian Binnie, have been busy growing boules in upstate New York in space loaned from industry partner Aymont Technologies.

Bowen is approaching the manufacturing process from a research and discovery point of view, but he said that's not what excites him most about the project. He's a former active duty Army veteran with ties to Pennsylvania and the Appalachian Region. He likes the prospect of helping to create new jobs in the semiconductor industry, particularly for his fellow veterans.

Driving workforce development

It's not just the Penn State team who are excited at the prospect of workforce development.

The Appalachian Regional Commission—an economic development partnership agency of the federal government and thirteen state governments including Pennsylvania—this year awarded Penn State $600,000 to develop a series of educational courses, workshops, and paid academic and industrial internships focused on workforce development in Pennsylvania for the growing semiconductor industry.

Co-lead by Prof. Suzanne Mohney, professor of materials science and engineering and electrical engineering, a team at the Materials Characterization Laboratory are rapidly pulling together for-credit courses to be offered in spring 2025 and workshops in summer 2025 focused on semiconductor characterization for a broad spectrum of education levels.

David Fecko, director of MRI industry collaborations, says usually these partnerships begin with a lot of asking on Penn State's part but, with the SCIA, the companies are driving the talks.

"There seems to be an unmet need out there for this type of facility," Fecko said. "It's because silicon carbide is such a big growth area; it's in rapid expansion."

Beginning of something big

In October, Robinson and the SCIA team attended the International Conference of Silicon Carbide and Related Materials when he fully realized this could have a big impact and was generating more buzz

than he's accustomed to. He's used to a few faculty inquiring about collaborations. But, for the first time, he saw a line of people from industry at the SCIA exhibit.

"We probably had fifty companies tell us the work we're doing is of significant interest. They said they love what we're doing because it's been needed for decades," Robinson said.

It was then that he realized that this was something bigger, with the potential for greater impact that extended beyond Penn State.

He said partnerships like this are exactly what a land-grant University can accomplish. His team can drive fundamental research, improve industrial-scale manufacturing, and train the next generation of workers to roll out this technology.

"This partnership could impact an industry and a community equally, and very positively," Robinson said. "I'm excited about its potential for the commonwealth and the nation."

For more information or for potential membership to SCIA, please visit www.scia.psu.edu or email SCIA@psu.edu ⌘

Morgan Advanced Materials

Morgan Advanced Materials honored as Penn State's Corporate Partner of the Year

Morgan Advanced Materials, a global manufacturer of ceramics and carbon materials, was named as Penn State's 2024 Corporate Partner of the Year. The annual award celebrates corporate partners that have demonstrated exceptional commitment in the promotion and support of Penn State, have excellent track records of philanthropy and research, and actively engage Penn State students and alumni in the workplace and the classroom.

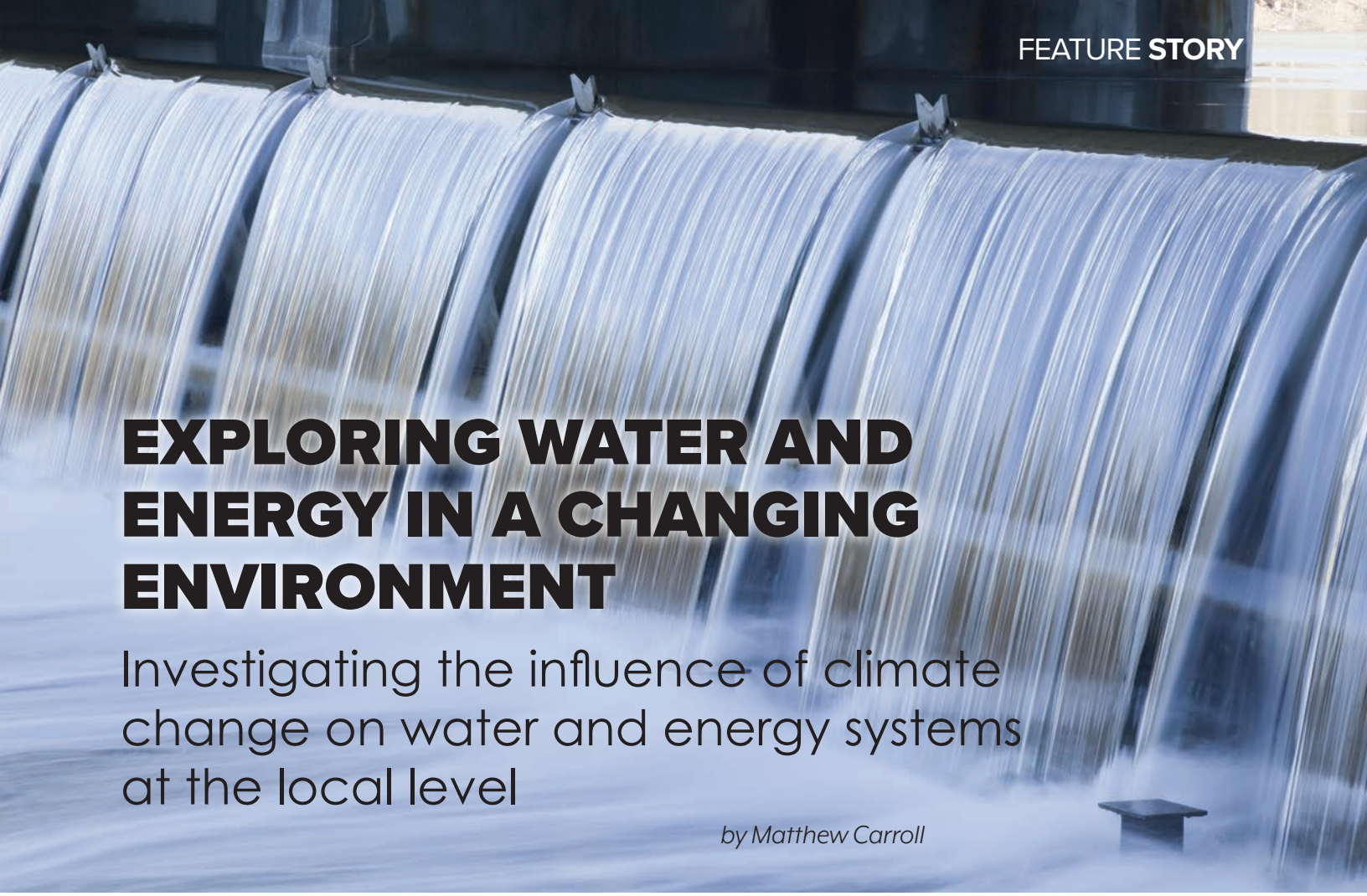
"Morgan Advanced Materials stands out as a beacon of excellence in corporate partnership," said Penn State President Neeli Bendapudi. "Materials science and engineering has long been one of our University's strongest areas of teaching and research, and over the past three decades, Morgan has made significant investments through philanthropy and sponsored research that have propelled us forward in this area."

Morgan Advanced Materials' Performance Carbon division, which operates three manufacturing facilities in Pennsylvania, specializes in creating carbon, graphite and silicon carbide products for the semiconductor, transportation, energy, and industrial processes sectors.

The development of carbon materials has been a major focus of Morgan's relationship with Penn State dating back to the 1990s, when Morgan became a member of the University's Carbon Research Center.

Morgan's support also has focused directly on strengthening student experiences at Penn State. The company has made generous gifts to programming across multiple disciplines—primarily physics, engineering, and the Materials Research Institute—which have sought to build student community and diversity, while also exposing participants to unique perspectives on how global companies operate and hire incoming graduates.

Earlier this year, Morgan signed a memorandum of understanding with Penn State to catalyze research and development of silicon carbide, and a commitment by Morgan to become a founding member of Penn State Silicon Carbide Innovation Alliance, as well as to supply the graphite materials and solutions needed for SiC development to Penn State for use by internal and external partners. ⌘



EXPLORING WATER AND ENERGY IN A CHANGING ENVIRONMENT

Investigating the influence of climate change on water and energy systems at the local level

by Matthew Carroll

In 2021, a historic drought gripped California, forcing the state to cut back on power generation from hydro-electric power plants to help maintain the state's water supply. To make up for the lost power, the state ramped up generation from natural gas plants that were slated for retirement.

"The electricity had to come from somewhere, and if the hydro plants fall off, then decision-makers are going to have to ramp up burning fossil fuels, which leads to more intense and frequent droughts and might make this situation more common," said Renee Obringer, an assistant professor of energy and mineral engineering.

Obringer's research focuses on addressing these kinds of complex interrelated issues surrounding the impact of climate change on water and energy systems.

That includes scientific questions about trade-offs associated with how we prioritize energy or water supply in the face of climate change, but also how those decisions impact people at the local level. Because while climate change is a global problem that will require solutions at national or international scales, the impacts are felt locally, she said.

"What I try to do in my research is take this global problem and narrow it down and look at what's happening in different cities, at local levels, and focus more on adaptation," Obringer said. "My thinking is if we talk more about these local impacts, we show people what they might experience, and what their neighbors might experience. And that may build some grassroots efforts to encourage those larger, national, and regional solutions to their local problems."

Above photo: Water flowing through a hydroelectric dam. Droughts have caused power generation from hydroelectric power plants to be curtailed. Credit: Pixabay

Energy-Water Nexus

Water and energy systems are interconnected—power plants need water for cooling and electricity is required for water treatment and distribution in communities.

"When we need to generate more electricity, then we have this simultaneous impact on water,"

Obringer said. "And if we need more water to be treated and distributed, we have a simultaneous impact on energy. My research looks at questions like if we increase our electricity needs, does that negatively impact our water supply during droughts, and if we are increasing air conditioning use during like a drought, how does that impact our water supply."

Last year, Obringer and colleagues used utility data to model how climate change may impact residential water and electricity use across forty-six cities in the United States.

Their model projected strong regional differences for future water and electricity demand, with some cities possibly experiencing increases in summer water and electricity demand of up to 15 and 20 percent, respectively, because of climate change. The researchers published their findings, which could inform how cities learn from each other in planning for climate change mitigation, in the journal *One Earth*.

"We're trying to understand how future climate change scenarios might impact water-electricity demand in U.S. cities," Obringer said. "What do these changes actually show in terms of how our bulk demand is changing, and how do we bridge the gap between research data and practice to help management agencies plan resilience to future change and better serve residents?"

More recently, Obringer and a colleague published a dataset containing more than a decade of monthly water and electricity consumption data, from 2007 to 2018, for those forty-six cities in the journal *Scientific Data*.

While electricity consumption data is managed by the state and relatively easy to acquire, water data is often managed by localized water providers and may require traveling to individual cities to make copies of records. Obringer collected the data by filing requests under the Freedom of Information Act.

"We wanted to publish our dataset because acquiring this water consumption data is difficult," she said. "We thought, 'even if we only have forty-six cities, that's better than what was available before, which was zero, because you have to go through each of these agencies individually."

Obringer said the data can be used to evaluate the possible impacts of climate change on the water-electricity demand nexus by finding relationships between usage and climate.

"Using machine learning, we can take the known data—how much water a city used and what the weather was like—and find a mathematical relationship," Obringer said. "We then substitute in future climate data and estimate how demand might change if precipitation drops or if temperatures rise."

Conserving water may become an important water policy in the Colorado River Basin, which supplies water to forty million people in the Western United States and is threatened by drought, changing climate, and growing demands. Credit: Pixabay

Increased demand, limited supply

The Colorado River Basin, which supplies water to forty million people in the Western United States, is threatened by historic drought, a changing

climate and water demands from growing cities.

Because supply-based solutions like expanding reservoirs and providing more water are not an option, resource managers have increasingly focused on encouraging conservation behaviors in these areas.

The megadrought in the Southwestern United States is the driest—and longest—in the past 1,200 years, depleting water reservoir levels to critically low levels. Credit: U.S. Department of Energy

"The Colorado River Basin is undergoing a nearly unprecedented level of drought—possibly the worst the region has experienced in 100 years," Obringer said. "Recently, water managers have increasingly looked toward encouraging conservation behaviors, but the success of these strategies requires an understanding of community-specific attitudes and beliefs."

Changing attitudes about water conservation could significantly impact water consumption and help address this issue, according to research Obringer and a colleague published this year the *Journal of the American Water Resources Association*.

The scientists used a machine learning technique called agent-based modeling to explore how households from various archetypes—like those who are willing to conserve water and those who prefer other solutions—will act under new conditions brought on by a changing climate.

This scenario testing revealed a statistically significant improvement to water availability after successfully changing water conservation attitudes to be more participatory, the researchers wrote in the paper. However, the work does not factor in potential decreases in water availability caused by climate change.

"We found that if we do work to change some of these attitudes, it can, in the long term, lead to more water availability in the future," Obringer said.

Local impact, global solutions

Instead of explaining what two degrees Celius of global warming means, Obringer said her modeling approach can show households what they might experience under climate scenarios—like how much their electricity bill might increase.

"I hope people see what these impacts might be and then decide whether to make individual changes in their home or not," she said.

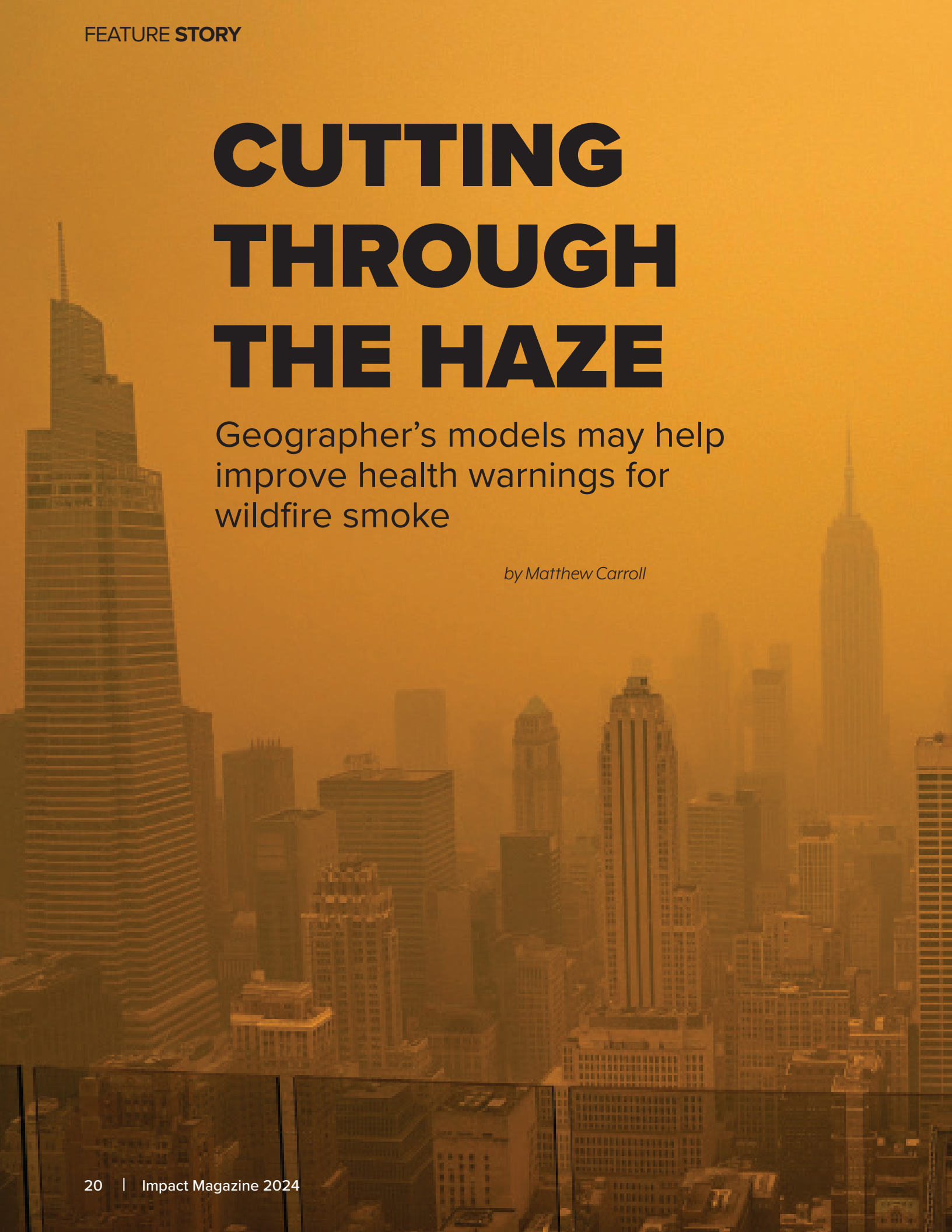
While it is not practical to advise residents in certain parts of the county to avoid using air conditioning, if people understand impacts like potential increases in energy costs, they may be more willing to support the kinds of national or global policies that could address climate change, Obringer said.

"At the local level, we're doing adaptation and we're trying to build resilience," Obringer said. "But if people start to see what these impacts are, they may raise their concerns up the ladder and tell the people who actually can make these larger mitigation choices that we need to do better." ⌘

CUTTING THROUGH THE HAZE

Geographer's models may help improve health warnings for wildfire smoke

by Matthew Carroll



When residents of Centre County, Pennsylvania, opened their doors and windows in June 2023, they were greeted by the faint smell of woodsmoke and a haziness in the air.

In what may have been a first for many, they were experiencing smoke from massive Canadian wildfires burning hundreds of miles to the north.

Skies turned orange in cities like Philadelphia and officials in Pennsylvania ordered a Code Red, meaning air pollution concentrations reached unhealthy levels for the general public for outdoor activities.

Under the changing climate, these massive Canadian wildfires sending smoke long distances to the Eastern United States may become the norm, said Manzhu Yu, assistant professor of geography.

Yu is working on ways to better model pollution from smoke, potentially helping public health officials in urban and rural areas better warn high risk populations when air quality is especially harmful.

Her latest work examines the impact of wildfire smoke combined with other air pollution that already negatively affects air quality – like ozone pollution.

"As climate change continues to cause ecological changes and challenges, it is likely that wildfire activities will continue to rise," Yu said. "Because of this, it is an urgent research priority to accurately predict air pollutant concentrations induced by wildfire smoke, especially in wildfire-prone areas."

A perfect storm

It rained for days in Western North Carolina, and streams and rivers were already high just as Hurricane Helene was preparing to make landfall in Florida. Then the hurricane dropped another foot of rain on the already saturated ground and brought unprecedented devastation to the state, leading to more than 100 deaths and billions of dollars in damage.

Left photo: Wildfire smoke in New York City on June 7, 2023. Credit Anthony Quintano, Flickr.

This was an example of a co-occurring or compound weather event. When multiple weather or climate hazards happen simultaneously, their combined impact is greater than the sum of the individual effects.

"Recently, I've been studying co-occurring weather because with the changing climate that's what we are often seeing right now," Yu said. "It's not just the intensification of one type of extreme weather event. It's the compounding of them. For hurricanes, it might be storm surge and heavy precipitation creating coastal flooding. For wildfires, it can be compounded with drought, creating ideal conditions for a severe blaze."

Yu's latest research focuses on compounding impacts of air pollution from wildfire smoke and from ozone pollution, a type of air pollution formed primarily from photochemical reactions between two major classes of air pollutants, volatile organic compounds and nitrogen oxides.

"It is an urgent research priority to accurately predict air pollutant concentrations induced by wildfire smoke, especially in wildfire-prone areas."

~Manzhu Yu

Smoke and other sources of air pollution contain tiny particles, called fine particulate matter (PM 2.5). These tiny particles can reach the lungs and trigger respiratory health issues like asthma, especially for people with pre-existing heart and lung conditions.

Since ozone pollution can trigger asthma, it is important to study both and not just one source of air pollution, Yu said.

"What if fire-induced PM 2.5 and ozone are both peaking in his particular area after one of these wildfire smoke events," Yu asked. "Then the coexistence becomes very hard for people to cope with because they're used to one of them being very high but the other being very low."

Yu is analyzing a health outcome dataset from the Hershey region from the time of the wildfire smoke intrusion in June 2023 to study whether peaks in both types of air pollution triggered more reports of child asthma.

"PM 2.5 and ozone both have potential to trigger asthma, and we want to see if this is making a difference in health outcomes," she said. "One

part that I think is lacking in this research area is underling health outcomes. It is actually the end point of our research studying air pollution—it is always connected to people's health."

Using models to improve warnings

Yu and her team developed a model that combines wildfire smoke forecasts and data from ground-based sensors to improve smoke forecasts.

The team found that the refined forecasting model better estimated the magnitude and timing of PM 2.5 spikes and that urban and rural communities already burdened by existing environmental pollution face higher air pollution levels during unexpected smoke events than other areas.

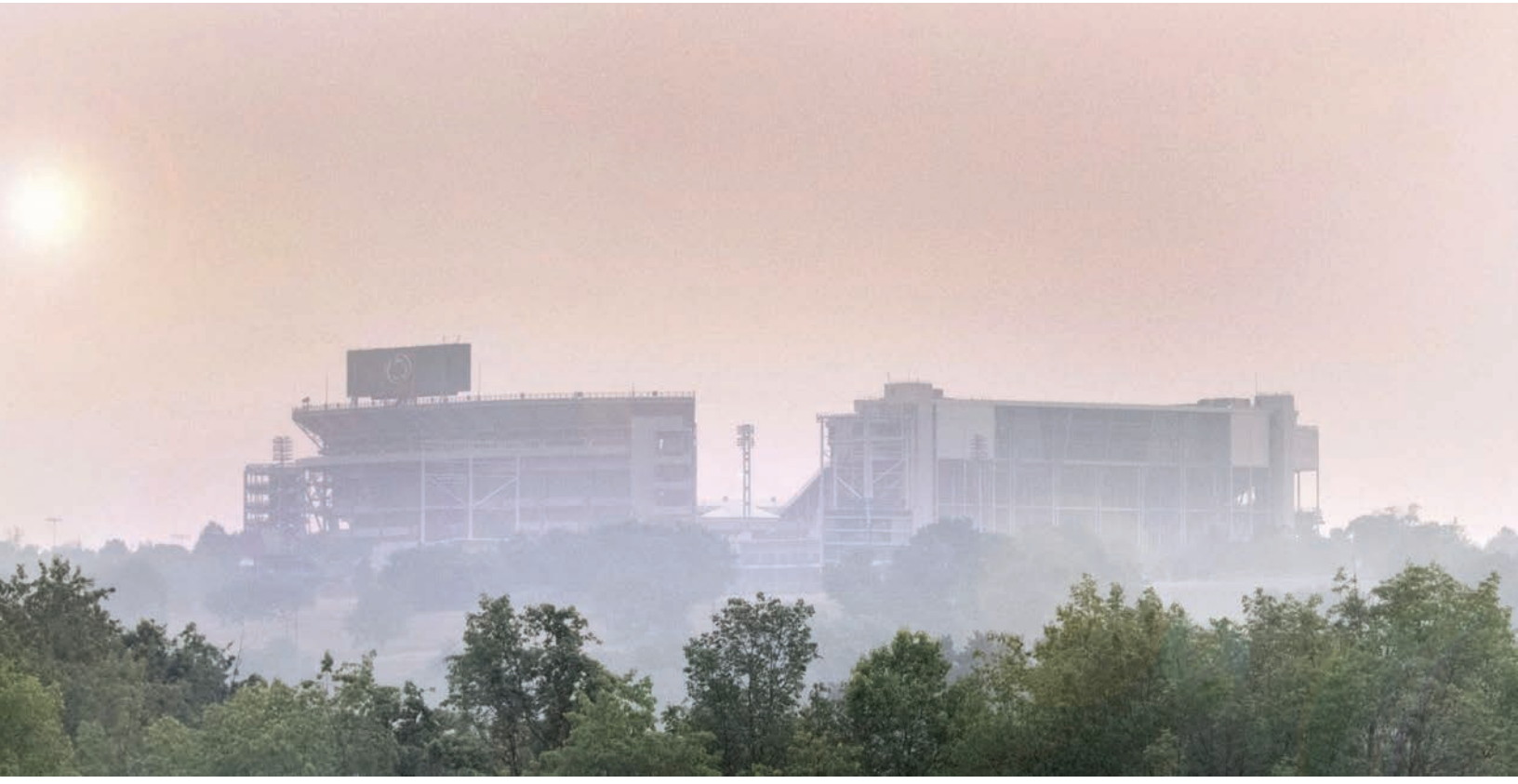
They also used anonymized mobility data from devices like smartphones to see how people changed their travel activities during the smoke events. Their findings suggest that their model can help decision makers find ways to better warn people who may be at high risk to stay home when air quality reaches dangerous levels.

"The good news, according to our findings, is that when people hear about wildfire smoke, they tend to reduce their mobility," Yu said. "But we found that during these smoke events, cities like New York City and Philadelphia and the surrounding counties still showed high mobility activities. We probably need to think about targeted interventions in urban areas because with so many people living in the area, exposure rates to unhealthy air are very high."

Yu said future work may involve wildfires in South America that are having a large impact on the Global South.

Massive fires have burned in the Amazon Basin, sometimes set to clear land for agricultural uses or logging. And Yu said the smoke from these fires is blowing over the Atlantic Ocean and reaching West Africa, where it poses potential health impacts.

"September was the worst on record in the Amazon Basin, particularly in Bolivia and Brazil," she said. "Both countries are having huge burns, and their wildfire smoke is trans-boundary. It is passing to West Africa. So, we are starting to look into that, especially for fire sensitive areas." ⌘



(Above photo) A haze covers Beaver Stadium in June 2023 when smoke from Canadian wildfires blanketed skies across the northeastern U.S.

OCEAN, SEA-ICE, AND ATMOSPHERE

Complex interactions impact ocean circulation, daily weather

by Matthew Carroll

This summer, Arctic sea ice reached near-historic lows, according to researchers at NASA, part of a decades-long trend of ice loss in the region as the world continues to warm from climate change.

And this is not just a problem for polar bears—the loss of sea ice impacts both global ocean circulation and daily weather patterns around the world, including North America, according to Melissa Gervais, associate professor of meteorology and atmospheric science and co-hire with the Institute for Computational and Data Sciences.

Gervais studies the complex, coupled interactions between sea ice, ocean, and atmosphere that may influence atmospheric circulation and impact daily weather.

"The atmosphere, ocean and sea ice are constantly influencing one another," Gervais said. "Having a better understanding of these interactions can help us better understand and project changes in the daily weather that people experience. I think it's a really important direction for us to go in terms of research, because people experience daily weather—and they can better understand the impacts in terms of changes in daily weather. And climate is really an amalgamation of daily weather."

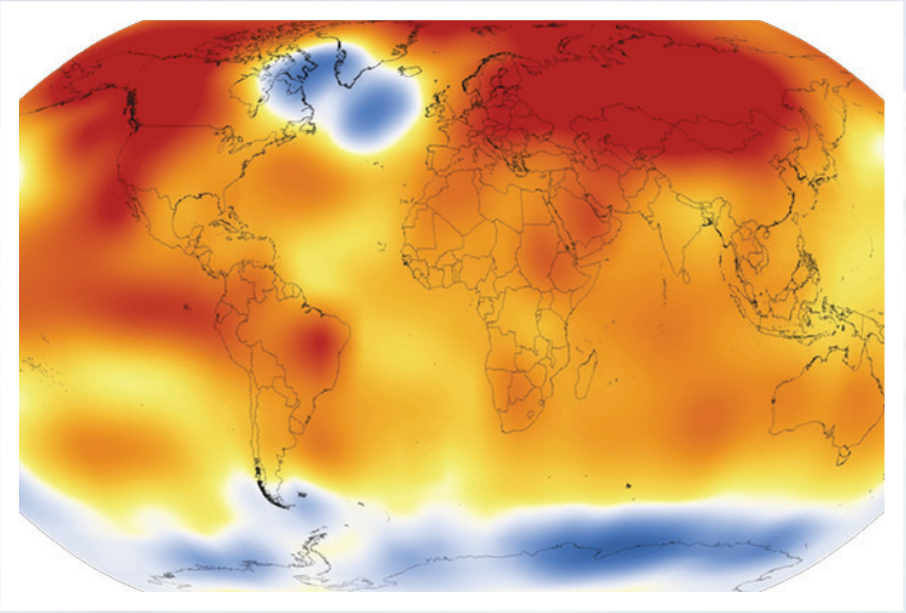
(Above photo) Iceberg floating in the Labrador Sea south of Greenland. Credit: Melissa Gervais

As a doctoral student at McGill University in Canada, Gervais had two advisers—a sea-ice dynamicist and a synoptic meteorologist—giving her a background in the formation and modeling of sea ice and the study of daily weather.

"My interests fell in the climate realm in between," she said. "I've always existed between different research communities, and I really like that. I feel like this provides a unique perspective where you can see opportunities to understand things that we don't normally think about."

Anomaly in the Atlantic

While global temperatures continue to set record highs, an anomaly exists in the North Atlantic Ocean, referred to as the North Atlantic warming



The North Atlantic warming hole is an area of sea south of Greenland experiencing relative cooling compared to much of the rest of the world's seas (upper blue area on map). Credit: NASA

hole. It is an area of the ocean just south of Greenland that is experiencing relative cooling compared to the rest of the seas.

The warming hole is linked to a slowdown of Atlantic Meridional Overturning Circulation (AMOC), the main ocean current system in the Atlantic Ocean, among other processes. AMOC acts like a conveyor belt, bringing warm, salty water north, where it cools and creates more dense water that sinks to the bottom of the ocean before returning south again. But cold, fresh water entering the ocean from melting glaciers may impact the circulation pattern.

Changes in the AMOC could have major climate and weather impacts in many parts of the world, and understanding potential long-term changes is important, Gervais said.

In a study published this year in the journal *Nature Communications*, Gervais and colleagues found climate model simulations of ocean temperatures in the coming decades begin to produce a wide gulf between possible temperatures in the North Atlantic by the 2050s.

The researchers traced the beginnings of the divergence to a time period just a few years from now—around 2030 and found the different paths are likely triggered by positive climate feedbacks. Gervais' former student Qinxue Gu, who received her doctorate from Penn State in 2023 and is now a postdoctoral researcher at Princeton, was the lead author on the study.

"Positive feedback means that if there is a change in one direction that might cause warming, then it will keep warming," Gervais said. "Or if there is a forcing that causes it to cool, it will keep cooling. So when these positive feedbacks are set off, it helps the different tracks diverge."

For example, cooler water temperatures would mean less sea ice melting. And the presence of ice on the ocean surface prevents the atmosphere and wind from interacting with the water. This further weakens the deep convection and can result in colder sea surface temperatures, Gervais said.

"How these systems all interact is so fascinating," Gervais said. "The sea ice kind of acts like a cap on top of the ocean. The ocean can't feel the stress from the atmosphere and so it stirs mechanically a little bit less, and that weakens the deep conduction more. That becomes a positive feedback."

Monitoring conditions in the North Atlantic could help us understand what feedbacks are triggered and which of the divergent paths sea surface temperatures will take. This may give us a better idea of when the warming hole will form and where temperatures will end up several decades out, Gervais said.

This is important because sea surface temperatures can also impact winds—or the

North Atlantic jet—that cross the ocean and help determine the climate of Europe, the Mediterranean, and parts of North America.

"If people are used to a certain climate and all of a sudden you change the game, even just by a little bit, they're not ready for whatever's coming their way," Gervais said. "And that's a huge problem. This is why it can be really helpful to have some knowledge of where the climate state is heading."

From climate change to daily weather

Traditional synoptic weather analysis of weather maps can allow us to summarize and understand the atmospheric conditions over large regions.

But this is difficult to do with large volumes of data from climate models. Instead, researchers like Gervais are turning to machine learning tools that can help with organizing the maps and classifying patterns.

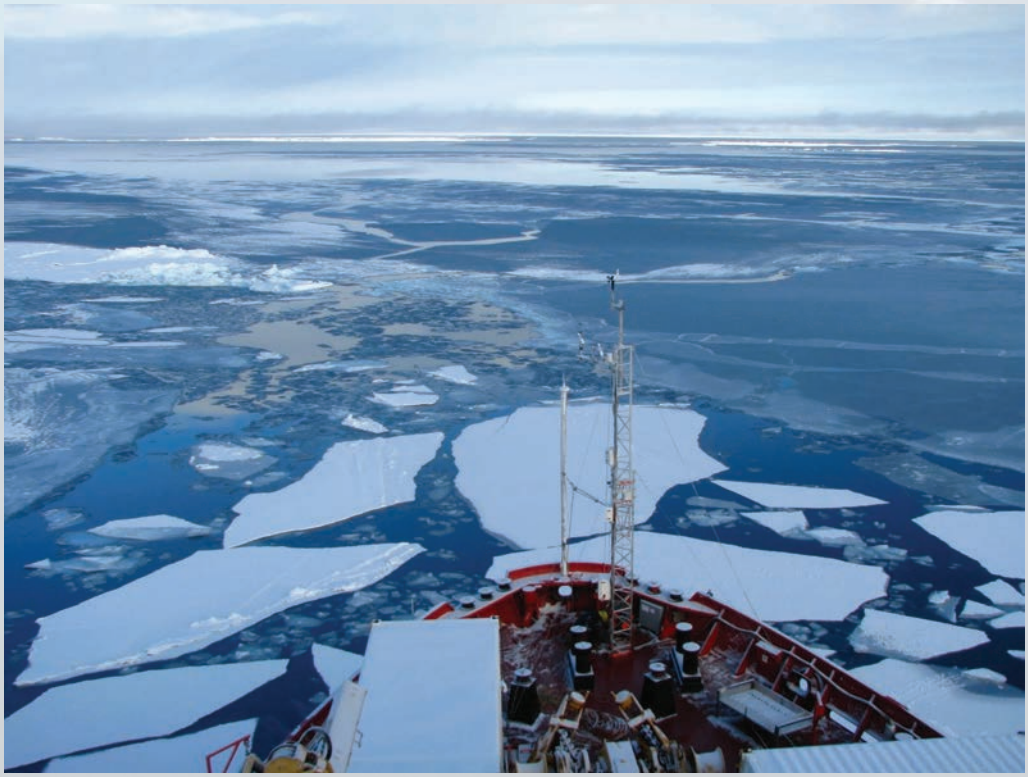
"A lot of my work is looking at climate change from a weather perspective. I often use machine learning, a tool specifically called self-organizing maps, to do this," Gervais said. "What it allows us to do is to take a huge volume of data of daily weather patterns and classify them so we can identify the main weather patterns that exist."

Gervais uses the approach as part of a Faculty Early Career Development (CAREER) award she received from the National Science Foundation to investigate the impact of sea ice loss on large-scale patterns of atmospheric variability and cold air outbreaks.

Her CAREER award findings, reported this year in the Journal of Climate, teased out the impacts of ice sea loss on the future of large-scale meteorological patterns over North America.

Gervais and her colleagues found that ice sea loss de-amplified these patterns and their impact on temperature near the surface—meaning, for example, cold weather events may be less cold.

"My CAREER award is all about sea ice, atmosphere interactions, and how sea ice loss can impact daily weather," she said. "It's at the boundary between climate and synoptic meteorology, which personally I think is a really important direction for us to go in research." ⌘



The CCGS Amundsen icebreaker traveling through Arctic sea ice in the Beaufort Sea. Credit: Melissa Gervais

Extreme weather workshop focuses on saving lives worldwide

Penn State hosted a three-day hybrid workshop in August that brought together weather experts and stakeholders from across the globe to address challenges related to weather related hazards and ways to leverage resources to overcome these challenges. The workshop, "Improving the Prediction and Communication of Weather/Climate Extremes in Africa and the United States," was led by Gregory Jenkins, professor of meteorology and atmospheric science and geography.

Jenkins said the goal of the workshop was to spark conversations about emerging needs, potential solutions, and international collaboration for improving predictive tools and communication strategies. It brought together students, researchers, meteorologists, media professionals, journalists, and others, and emphasized underserved and minority communities.

"It was interesting to bring together forecasters, journalists, and researchers in meteorology and social sciences with the goal of understanding where challenges and opportunities exist in the prediction of floods, tornadoes, and tropical cyclones," Jenkins said. "Equally important are the challenges of communicating to the public the various aspects of these hazards and the relevant action to take, as we recently saw with Hurricanes Helene and Milton. Meanwhile, in Africa, the lack of infrastructure and local resources threatens the lives and often displaces millions of people. New tools and partnerships with historically Black universities and colleges can help to address some of the needs within the United States."

https://tinyurl.com/2sk9nstp

EME mining expert testifies before Congress on critical minerals needs

The United States will need to make dramatic advances to increase its technical- and skilled-labor workforce to power its green energy future and to become less reliant on foreign nations for securing materials used in both everyday devices and critical national security applications. According to the United States Geological Survey, about 80 percent of these materials are imported from China.

That was the message Barbara Arnold, professor of practice in mining engineering in the John and Willie Leone Family Department of Energy and Mineral Engineering, told a U.S. congressional committee in September.

"When Congress stopped funding the U.S. Bureau of Mines in 1996, we lost a centralized agency to coordinate U.S. mineral activity," Arnold said. "Our reliance on foreign sources of minerals accelerated and the numbers of U.S. mining schools has decreased."

Arnold, who also testified to U.S. Senate leaders in June, said the U.S. is graduating about half the mining engineers needed to replace a rapidly retiring workforce. She cited half of the nation's mining workforce is expected to retire by 2029. About 300 mining engineers graduated in the United States in 2020, compared to the approximately 3,000 mining engineers who graduated in China that same year.

Arnold also said the U.S. needs to develop and implement methods to obtain the needed critical minerals from both traditional mining methods and from reclamation of mining waste sites.

https://tinyurl.com/3nvb3jue

Penn State mourns the loss of John J. Cahir

The College of Earth and Mineral Sciences and the Penn State community mourn the loss of John J. Cahir, who died on June 6 at the age of 90.

Cahir earned his bachelor's degree in meteorology in 1961 and his doctorate in meteorology in 1971 from Penn State. He spent his entire professional career at the University. In the college, he served as a professor of meteorology and as the associate dean for resident instruction. At the University-level, he served as vice provost and dean for undergraduate education from 1993 until his retirement in 2002.

John Dutton, professor emeritus of meteorology and dean emeritus of the college, said that Cahir was a superb teacher and researcher in meteorology and weather prediction and an important adviser and supporter for Penn State students who needed guidance and assistance.

"Many students who knew John as a teacher or an adviser praised him throughout their careers and for the rest of their lives," Dutton said. "As associate dean for resident instruction, John helped to shape Earth and Mineral Sciences into a superb college and then became a dynamic campus leader as the University's vice provost and dean of undergraduate education. And for many of us, he was a wonderful friend, always offering inspiring viewpoints and pointing out attractive opportunities."

Joel Myers, founder and executive chairman of AccuWeather, and trustee emeritus at Penn State, shared an office with Cahir as a graduate student, and they graduated with their doctorates together in 1971. Myers said that Cahir was a dear and amazing friend and that he will miss him greatly.

https://tinyurl.com/3pkrmdfb

Remembering climate science pioneer, Warren M. Washington

Warren M. Washington, acclaimed climate science pioneer and Penn State alumnus, died on Oct. 18 at the age of 88. He graduated with his doctorate in meteorology from Penn State in 1964 and was the second African American to earn a doctorate in meteorology nationwide.

Washington was a trailblazer in climate science and atmospheric modeling. In the early 1960s, he recognized the potential of computers to revolutionize the understanding of Earth's climate and helped develop the first-ever computer models to study the effects of atmospheric carbon dioxide concentrations on global temperatures. His groundbreaking work advanced the field of numerical climate modeling, allowing scientists to predict future atmospheric conditions and better understand climate change. In 2019, Penn State named the Warren M. Washington Building after him, the first time the University bestowed that honor to an "innovator and pioneer."

Throughout his career, he valued serving as a mentor to underrepresented members in the field. In an interview in 2018, Washington said, "I felt that I really had to give back not only to the field but to the African American community. Over the years, I've visited Black colleges; I've mentored graduate students; and I helped to form a program at the American Meteorological Society that encourages underrepresented minorities and women into the field. I've always felt compelled to increase diversity."

https://tinyurl.com/mr2bh9ps

Penn State hosts International Symposium on Mine Safety Science and Engineering

This fall, the Penn State Mining Engineering program invited engineers worldwide to Pittsburgh for the 7th International Symposium on Mine Safety Science and Engineering (ISMSSE). At the symposium, researchers and experts from academia, industry, and scientific research institutes shared new concepts and exhibited technical equipment to forward mine safety science and engineering.

Shimin Liu, Deike Chair Professor in Mining Engineering and ISMSSE chair, said it was a significant opportunity for the John and Willie Leone Family Department of Energy and Mineral Engineering (EME) to host the event. "Mine safety presents a level of complexity that no single industry or group can address alone," Liu said. "In EME, we pride ourselves on being one of the few truly interdisciplinary departments within the U.S. dedicated to tackling the challenges society faces in energy and mineral extraction, safety, and mining. I believe this makes us the ideal host to bring diverse perspectives together, foster new collaborations, and explore the most effective path forward."

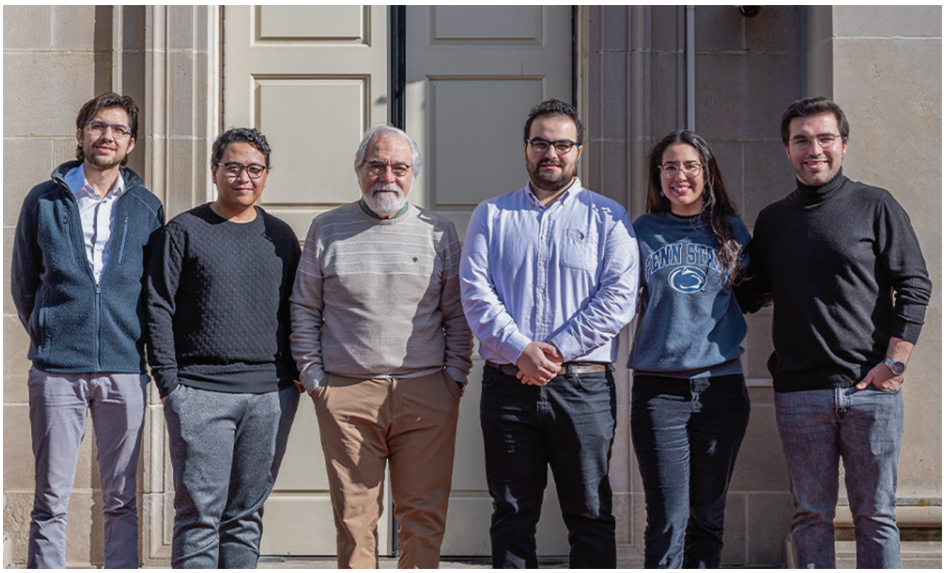
According to Liu, although the number of mine fatalities have declined, there is still a need to analyze "close call" incidents where tragedy is narrowly averted and share best practices on how to prevent them. Coal mine dust-related respiratory diseases like black lung are a persistent occupational health hazard for coal workers that require further study and discussion. Bringing together policymakers, industry partners, and researchers provides a chance for discussion to find a solution. https://tinyurl.com/ycxjc8ch

Penn State hosts International Geobiology Course

For the second year in a row, Penn State hosted the International Geobiology Course (IGC), which is an immersive and interdisciplinary course that explores how microbial life and the Earth have shaped each other. This year's course was held June 20 to July 23 and brought together doctoral students for immersive training in geobiology. Directed by Katherine Freeman, Evan Pugh University Professor of Geosciences, and Jennifer Macalady, professor of geosciences, IGC's seventeen doctoral students conducted research in central Italy and New York's Fayetteville Green Lake before traveling to Penn State to use the University's extensive research laboratory facilities to analyze their findings.

Central Italy's Frasassi cave system contains microbial life that endures harsh anoxic conditions, similar to potential life on other planets. Same for Green Lake, which researchers think approximates Earth's anoxic bodies of water that existed up until about 2.5 billion years ago.

Freeman said it's the great students and educators who make the course a blast. "My colleagues and I are delighted to bring the International Geobiology Course to Penn State," Freeman said. "This is our second year as hosts of this highly regarded course, which has taught generations of young scholars, many of whom are now scientific leaders in this innovative field. For me, hands down, the best is working with students from all over the world together with our incredibly talented team of instructors." https://tinyurl.com/mv544pbh



Team wins Chevron National Engineering Competition for use of AI in energy industry

A team of five graduate students, Nicolas Bueno, Nijat Gasimli, Ianna Gomez, Hanif Yoga, and Baran Yucel, from the John and Willie Leone Family Department of Energy and Mineral Engineering, won first place in the 2024 Chevron National Engineering Competition. The annual competition challenges teams to present novel ideas about contemporary subjects in the petroleum and energy industry, with this year's topic focused on use cases for implementing artificial intelligence (AI).

The members all agreed that the topic's broad nature would be demanding. AI can be utilized across every department in the oil industry, from operations and reservoir management to finance and human resources. The team knew they would need to be strategic about which aspect they focused on.

The team decided to divide and conquer. Each member focused on the key strengths, weaknesses, and potential uses for AI across every industry cycle stage. The team's focus on the big picture, and recommendation of a hybrid approach to implementing AI with human supervision as a safeguard and decision maker, proved to be the winning formula. https://tinyurl.com/3b3k26f8

Research to better understand early Earth diversity supported by Ford Foundation

Kayla Irizarry, doctoral candidate in geosciences, is using her Ford Foundation Predoctoral Fellowship to better understand what controlled diversity in Earth's earliest complex ecosystems. Her research focuses on the Cambrian period, about 485 million to 541 million years ago, which was a prolific time of change in the history of life known as the "Cambrian Explosion."

"The Cambrian Explosion was a dramatic transition when simple, soft bodied animals gave way to animals with limbs, heads, hard skeletal parts, and complex sensory organs like eyes," Irizarry said.

However, in the middle and late Cambrian, species diversity tended to flatten out with high background extinction rates and frequent large extinction events. Irizarry's research seeks to answer the question: Did fluctuating oxygen conditions control extinction and diversification during this diversity plateau in the latter half of the Cambrian? Irizarry said she wants to look at this question through both a geochemist lens and a paleontologist lens. https://tinyurl.com/5ewp3kab

Storm-chasing trip offers Penn State students classroom lessons on the road

Early in a ten-day trip to the Midwest to observe and study severe weather events, the Penn State Storm Chase Team had a choice: Go left or go right.

One direction would put them further northwest in Oklahoma—an area that they knew was often the center for tornadoes and other massive storms—for the next few days. The other would take them into Texas, a frequent hot spot, but further away from some potentially powerful storms.

But forecasting the weather and communication are two things they've been trained well for, said Storm Chase Team president Justin Hassel. Fourteen students and one graduate student in the Department of Meteorology and Atmospheric Science huddled in a room, splashing satellite and other data onto a nearby large screen television, deciding which way to go.

After some discussion, they headed southeast, spending the next week of their May trip chasing two massive Texas storms and visiting educational sites such as the National Weather Center in Norman, Oklahoma.

Hassel, a rising senior majoring in meteorology and atmospheric science, has been lucky enough to attend another of the team's iconic summer storm chase trips.

"It's a really incredible experience seeing all of the things you're learning in class playing out in real life," Hassel said. "We see the dynamics of supercells going up. It's the calculus and physics we're learning happening in real time. You're able to visualize those things, which is one of the main reasons I love the chase so much."

https://tinyurl.com/4eepu5xe

EME graduate student awarded Intergovernmental Panel on Climate Change scholarship

Joy Adul, a graduate student majoring in energy and mineral engineering, was one of twenty students selected to receive a scholarship from the United Nation's Intergovernmental Panel on Climate Change (IPCC) Scholarship Programme. The IPCC is the leading international body for assessing climate change.

The scholarship will help Adul develop a machine-learning-based model that could predict how renewable energy generation is impacted by climate change across the United States and Kenya.

Adul said she does not envy those who must design policies amid a climate crisis but hopes her research will provide another perspective to help them choose the solutions that could also alleviate energy poverty and inequality.

"Climate change is a global issue," Adul said. "How it will affect the United States and how it will affect Kenya may be different to an extent, but both will have to be prepared for the changes it brings. When I see the diverse voices coming together to enhance and enrich these conversations I'm excited to see what the future holds." https://tinyurl.com/357z5v92

2024 Murphy Award honors Air Force veteran

U.S. Air Force veteran Christopher Ramos received the University's 2024 Lieutenant Michael P. Murphy Award, which recognizes outstanding contributions to the geospatial intelligence community.

Ramos served for ten years in the U.S. Air Force working in special operations weather forecasting. He is currently pursuing a master of science in spatial data science, an online degree offered by the Department of Geography and the John A. Dutton Institute for Teaching and Learning Excellence through Penn State World Campus.

Officials selected Ramos because of his dedication and expertise in providing critical environmental intelligence for military mission success. Ramos also served as an instructor at the Special Tactics Training Squadron, investing in the next generation of military leaders. https://tinyurl.com/3mntz39v

Graduate student network continues to improve experiences for peers

For graduate students, college can be a trying and difficult time. Students are often far away from their lifelong support system of families and friends. An effort that began three years ago in the College of Earth and Mineral Sciences (EMS) is helping to elevate the experiences of graduate students within the college.

Two materials science and engineering graduate students, Alex Vera, who recently earned his doctorate, and Cierra Chandler, a computational material science researcher in her final year, talked with fellow graduate students across the college and drew upon their own experiences to determine that a graduate student engagement program would fill a need.

"One of the things we wanted to tackle was reducing graduate student fatigue and isolation, which were identified as the top reasons for why graduate students considered leaving," Vera said. "We wanted to give students tools to combat fatigue and isolation through an engagement network aimed at building the graduate student community across departments."

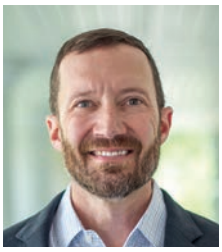
Working with the college's Diversity Council and Office of the Associate Dean for Educational Equity, they launched several activities to improve the experience.

"We've been able to build connections across the EMS community and bring a little more awareness to the issue of graduate student isolation," Vera said. "We were able to be most successful through collaboration. EMS has built a genuinely friendly environment where most students and staff are willing to help or collaborate to make graduate student life better."

https://tinyurl.com/h27sk7y4

Sridhar Anandakrishnan, professor of geosciences, received a Fulbright Scholar Award for the 2024-25 academic year to conduct advanced research in Australia.

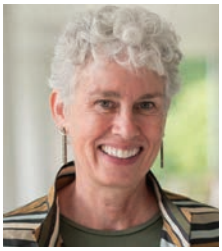
Luis Ayala, professor of petroleum and natural gas engineering and holder of the William A. Fustos Family Professor, became the head of the John and Willie Leone Family Department of Energy and Mineral Engineering, effective July 1.



Trevor Birkenholtz, professor of geography and associate head of resident graduate programs in geography, was named a Fellow for the Big Ten Academic Alliance's Academic Leadership Program.

Seth Blumsack, professor, energy policy and economics was elected to the Penn State Emerging Academic Leaders program for fall 2024.

Susan Brantley, Evan Pugh University Professor and Barnes Professor of Geosciences, was named a Distinguished Daughter of Pennsylvania for 2024.



Cynthia Brewer, professor of geography, was named associate dean for faculty affairs in the Penn State College of Information Sciences and Technology.

Guido Cervone, E. Willard and Ruby S. Miller Professor of Geography, was named interim director of the Institute for Computational and Data Sciences.

Kenneth Davis, professor of atmospheric and climate science, was named Person of the Year by the Penn State Institute of Energy and the Environment.

Nelson Dzade, assistant professor of energy and mineral engineering, received a 2024 Early Career Research Award from the U.S. Department of Energy.

Kevin Haworth, assistant teaching professor and Giles Writer-in-Residence, was appointed to Penn State's Teaching and Learning Technologies Faculty Advisory Committee for the 2024-25 academic year.

Danielle Hickey, assistant professor of materials science and engineering and of chemistry, was awarded an American Chemical Society Petroleum Research Fund Doctoral New Investigator Grant.

Robert Hickey, associate professor of materials science and engineering, was awarded the American Physical Society's 2025 John H. Dillon Medal.

Zuleima Karpyn, Donohue Family Professor of Petroleum and Natural Gas Engineering, and EMS associate dean for graduate education and research, was named a distinguished member by the Society of Petroleum Engineers.

Paul Markowski, head of the Department of Meteorology and Atmospheric Science, was named a Big Ten Academic Alliance Department Executive Officer Fellow.

John Mauro, Dorothy Pate Enright Professor in Materials Science and Engineering, elected as an academician by the World Academy of Ceramics.

Tushar Mittal, assistant professor of geosciences, was named a 2024 Packard Fellow by the David and Lucile Packard Foundation.

Clive Randall, distinguished professor of materials science and engineering and director of the Materials Research Institute, was named an Evan Pugh University Professor.

David Stensrud, professor of meteorology, was voted president-elect of the American Meteorological Society.

Ezgi Toraman, assistant professor of energy engineering and chemical engineering, was selected as a "Pioneer of Catalysis and Reaction Engineering" by the CRE division of the American Institute of Chemical Engineers.

Christelle Wauthier, associate professor of geosciences, was appointed associate director of the Institute for Computational and Data Sciences.

Karl Zimmerer, professor of geography, was elected as a member of the American Academy of Arts and Sciences.

Visit the EMS Museum & Art Gallery

The gallery of the Earth and Mineral Sciences Museum is one of the primary venues for communicating EMS science to the public. Exhibits reflect current research across the College's five departments as well as the history of Earth and Mineral Sciences at Penn State. Exhibits feature objects from the museum collections and the Steidle Collection of Industrial Art.

2024 Alumni Fellow relishes chance to give back to the University

Al-Zadjali was named a 2024 Alumni Fellow by the Penn State Alumni Associaton and returned to the University Park campus from his home country of Oman to accept his award from Penn State President Neeli Bendapudi.

Al-Zadjali was among the second cohort of students from Oman to attend Penn State. He majored in petroleum and natural gas engineering and after graduating in 1992 he returned home to assist with the country's booming oil business.

Looking back on his career, Al-Zadjali cites the long list of people who helped him succeed: his colleagues, his family, and the Penn State community.

"Penn State gave me the tools to navigate through the world and confront the challenges that arose," Al-Zadjali said. "Now, I want to give back. I truly believe that giving back will make me happier. Why? Because this University has been good to me, and I want to give whatever I can to help these students like I was helped."

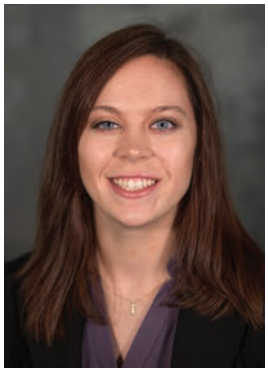
Being honored as an Alumni Fellow was a humbling experience, he said. But he said giving back is something he'd do regardless. At the ceremony, Bendapudi described the University as "a nourishing mother." As someone who found his home away from home, those words landed for Al-Zadjali.

"That's what this University is. People are accepted from all walks of life, and you can easily assimilate in this University," Al-Zadjali said. "The faculty are great. They truly do all they can to make sure that your Penn State journey is rewarding, and that's what I love the most. And Penn State is forever part of me. It's in my blood. I bleed blue and white." https://tinyurl.com/2p87hsyy

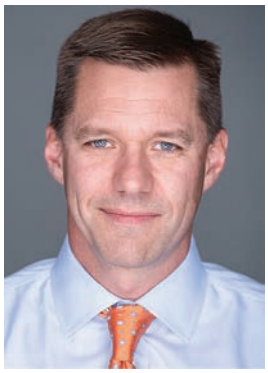
Five new members appointed to EMS alumni board

The College of Earth and Mineral Sciences has announced the appointment of five new members to the Graduates of Earth and Mineral Sciences (GEMS) board of directors, effective July 1. The GEMS board is composed of sixteen members — fifteen plus the immediate past president. It was established in 1994 to provide leadership and programming opportunities for the GEMS Alumni Society. Board members are nominated and elected by the general GEMS membership and the active board of directors and serve a three-year term. The five new members are listed below. https://tinyurl.com/5c933n9t

Jenna Bishop
ENVSE '17



Courtney Jackson
GEOG '15



Todd Krause
GEO-ENV ENG '96

Mary Reinthal
GEOSC '20

Diegue Tchienga
MIN ENG '19

Alumna Jennifer Hesterman gave EMS 2024 spring commencement address

Jennifer Hesterman, alumna and retired colonel in the U.S. Air Force, delivered the commencement address for the College of Earth and Mineral Sciences' spring 2024 baccalaureate degree commencement ceremony.

Hesterman served in three Pentagon tours and multiple command positions in the field. Her final assignment was as vice commander at Andrews Air Force Base in Maryland, where she led installation security, including the protection of Air Force One. She earned a bachelor of science degree in geography from Penn State.

She told the class of 2024 graduates to, "take risks and embrace failure as a learning point and as a stepping stone to success. Find a mentor who can help you navigate challenges, develop skills and set goals. True success is found in the lives you touch, the difference you make, the legacy you leave behind."

https://tinyurl.com/bdese7sc

Laughs ring in alumni society's 30th anniversary

If alumni of the College of Earth and Mineral Sciences really are a big family, then it is fitting they chose to celebrate a milestone by laughing with—and at—each other.

The Graduates of Earth and Mineral Sciences (GEMS), the college's alumni society, celebrated its thirtieth anniversary this summer with a comedy roast at the State Theatre in State College.

Former presidents of the GEMS board of directors and even Lee Kump, the John Leone Dean in the College of Earth and Mineral Sciences, took turns on the hot seat, receiving lighthearted jabs from GEMS members and EMS development and alumni relations staff during the event.

"It was a fun way to come together to mark thirty years and celebrate all the hard work and effort that staff and GEMS members have put in to benefit the college and its students," said Barb Arnold, professor of practice in mining engineering and a former GEMS board president, who was among those roasted at the event.

GEMS members play active roles in mentoring students and in working to recognize alumni for their achievements.

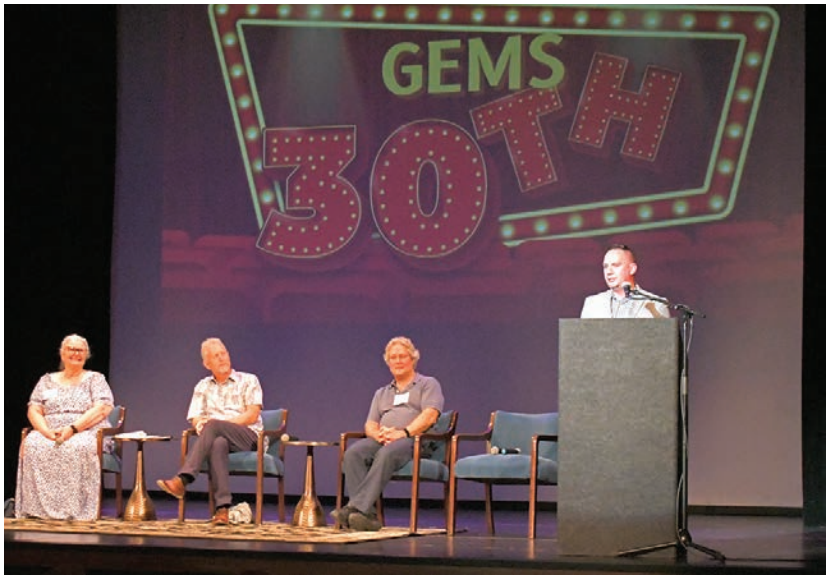
"It's a little family," said Laura Schell, who became president of the GEMS board in July. "We feed off each other's energy. We are all so excited to help, and we have a lot of fun."

Schell, who received her bachelor's degree in materials science and engineering in 2011, said that, as a student, she benefited greatly from the guidance of GEMS.

"I think for every student who goes through EMS, whether they know it or not, there is an alum who has provided something to that experience," she said.

The GEMS board plays an important role in shaping the direction of the alumni organization and supporting the advancement of EMS graduates. Schell said her vision for GEMS includes reaching out and engaging a broader group of alumni and getting more young members involved.

https://tinyurl.com/ykwbbh9e



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Get Involved or Make a Gift

EMS alums are a key part of our past, present, and future. We depend on active and engaged alumni, like you, for the continued success of our college.

Learn how you can get make a gift at www.ems.psu.edu/giving/give-college/give-now

Learn how you can get involved at www.ems.psu.edu/alumni/get-involved