PennState
College of Earth
and Mineral Sciences

Earth and Environmental
Systems Institute

2025

EESI DOES IT

CONTENTS

EESI Does It is a publication of the Earth and Environmental Systems Institute in the College of Earth and Mineral Sciences at Penn State.

Acting Director: *Robert Nicholas*
Editor/Lead Writer: *Adam Smeltz*
Design: *Jeralyn Brewer*

Earth and Environmental Systems Institute
217 Earth and Engineering Sciences Building
656 White Course Drive
University Park, PA 16802
814-863-6020
info@eesi.psu.edu
eesi.psu.edu

Front cover: *Christelle Wauthier, associate professor in the Penn State Department of Geosciences and a faculty affiliate of the Earth and Environmental Systems Institute, stands at Pacaya volcano in Guatemala in March 2022.* ***Credit: Judit Gonzalez Santana***

SCIENCE SNAPSHOTS

New tool helps forecast volcano slope collapses and tsunamis

The science behind the deadly collapse of the sides of volcanos – like those at Mount St. Helens, Washington, and Anak Krakatau, Indonesia – remains largely unknown. To help scientists forecast such catastrophes, Christelle Wauthier, associate professor in the Department of Geosciences and faculty affiliate in the Earth and Environmental Systems Institute at Penn State, led the development of new models that can gauge a volcano's stability.

The models can help local authorities and communities by evaluating the potential for collapse long before ground may give way entirely and suddenly. "The input of magma below the volcano puts the crust under a tremendous amount of pressure – much stronger than water pressure," Wauthier says.

Research found ground more likely to give way on volcano slopes with shallow fault dips under the surface, specifically if magma opens the crust under the volcano summit.

Read the full story at bit.ly/438dal1. ■

EarthTalks highlights critical minerals research

Essential for the economy and national security, several dozen critical minerals underpin clean energy, military technology, electric vehicle batters, the power grid, and other advanced systems. To broaden awareness and understanding of these resources, the Earth and Environmental Systems Institute focused its fall 2025 EarthTalks seminar series on needs, opportunities, and research in the area.

Speakers in the ten-event series have highlighted ongoing work and viewpoints both at the University and across the sector, including at the federal level. All the talks are available for viewing on YouTube.

U.S. Geological Survey Director Ned Mamula led off the series on Sept. 8. Penn State is among roughly a dozen universities that will anchor an "academic powerhouse" helping secure the future of critical minerals domestically, Mamula said.

Read the full story and access seminar recordings at bit.ly/3XfW4hv. ■

Imperfect underground processes help filter wastewater

For seaside communities reducing their pollution from runoff, nitrogen – and the nitrogen-containing nitrate molecule – are prime targets. But underground microbes that many South Florida communities depend on to consume nitrate are an imperfect, if still helpful, antidote – a research finding that scientists at Penn State said may help coastal areas with cleanup strategies.

The team at the University studied an area near a wastewater treatment facility in Marathon, Florida. Their findings indicate that while underground microbes converted some nitrate and phosphate from wastewater, they did not successfully capture all of those nutrients.

"Both nitrate and phosphate are greatly reduced between injection (underground) and the time the effluent reaches nearshore waters," says lead author Miquela Ingalls, assistant professor of geosciences in the College of Earth and Mineral Sciences at Penn State. "Yet the contaminant levels shifted widely over time. How much nitrate and phosphate had already been removed from the water, or still remained, varied by orders of magnitude."

Lee Kump, the John Leone Dean in the College of Earth and Mineral Sciences and faculty associate in the Earth and Environmental Systems Institute, is among the study's contributors.

Read the full story at bit.ly/43F53MY. ■

Algal blooms can upset delicate balances of marine and plant life in environments like the Florida Keys National Marine Sanctuary. Here, coral polyps appear on the sanctuary's Molasses Reef. ***Credit: Brent Deuel/National Oceanic and Atmospheric Administration***

As environmental conditions shift, researchers ask farmers what they see

Susan Kotikot

Ranked as highly vulnerable to the changing climate, Kenya faces droughts that force thousands from home and fatal floods that devastate livelihoods. Long-term forecasts signal more dramatic rainstorms and heat on the way, with estimates linking more than 70 percent of natural disasters in the East Africa country to extreme climatic events, according to the World Bank Group.

Kenyans experience that volatility in different ways, and there's no unanimity in how they interpret local effects, says Susan M. Kotikot, a recent postdoctoral fellow in the Department of Geography and the Earth and Environmental Systems Institute at Penn State (EESI).

In a study, Kotikot and her collaborators found wide variations in how Kenyan crop growers and livestock farmers perceive changes in rainfall and effects on their productivity. Separate research in Nepal by EESI associate Nicolas Choquette-Levy also explored the nuances of climate-related perceptions in agriculture.

The Kenya study "creates awareness that we're not always addressing the challenges that people are seeing," Kotikot says. "When government authorities are crafting policies, aid, and other responses to climate change, they can't be based solely on scientific statistics such as precipitation totals and temperature trends. They have to involve local people, their ideas, and their individual experiences."

While she centered work on Narok County – in southern Kenya – findings highlight international needs for flexible adaptation to fast-evolving conditions, Kotikot says.

The study published in the Annals of the American Association of Geographers grew from her interests around rainfall, land productivity, and climate change. Prior studies illustrate the distinct challenges forecasting precipitation patterns in East Africa because of its climate, she says.

Kotikot and co-authors wanted to see how perceptions of rainfall and climate-related productivity vary among different categories of land users. Narok County stood out for its diverse climate, topography, land use, and activities, allowing the researchers to examine a distinct combination of conditions in a small area.

They also looked at how socioeconomic, environmental, and locational characteristics contribute to climate-related perceptions. The study surveyed crop and livestock farmers on land under private and group ranch ownership.

Most of the 115 respondents believed local rainfall either decreased or became more variable in recent years. Both groups reported poorer outputs or conditions.

"Perceptions are probably more influenced by extreme events than by long-term patterns," Kotikot says. "Negative perceptions — a sense that precipitation or productivity has decreased — likely reflect increasingly unbalanced rainfall distribution through the seasons, with a lot of dry days and few intense, rainy days."

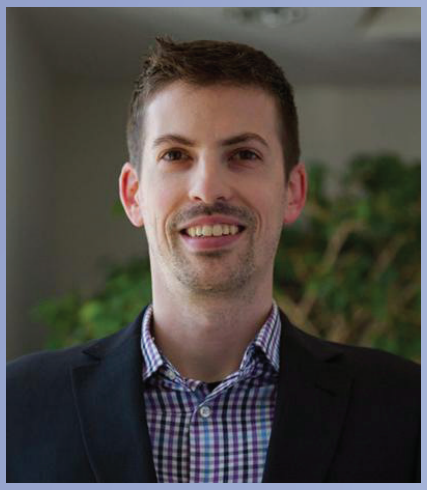
Findings signal a need for education and policy that promote climate-sensitive agricultural practices as well as other livelihood strategies, the group wrote. Co-authors include Erica Smithwick, the EESI director, and Karl Zimmerer, a professor in the Department of Geography. Kotikot recently joined the University of Connecticut as a visiting research assistant

professor in the Department of Geography, Sustainability, Community, and Urban Studies.

Choquette-Levy, an assistant professor in the Penn State Department of Geosciences, found perceptions of climate-related risks often lead Nepali farmers to double down on agriculture. Those households may see greater risks of poverty, he and co-authors reported recently in the journal Population and Environment.

"In a lot of places in the world, small-scale farmers are the backbone of the local food supply," says Choquette-Levy, the study's lead author. "Although several farmers do it out of love, many believe they don't have other options for making a living, so it's important to provide farmers with the resources to explore other options when climate makes farming less viable."

Findings from Nepal underscore an urgency for government and nongovernment organizations to equip crop growers with practical information about climate, adaptation, and alternative sources of income, the researchers said.



Nicolas Choquette-Levy

A cow, left, and two water buffalo linger in the shade at an agricultural property in Bharatpur Municipality, Chitwan District, in Nepal. A recent study led by Nicolas Choquette-Levy, an assistant professor and a faculty associate in the Earth and Environmental Systems Institute at Penn State, developed a survey of about 500 farming households in the Chitwan Valley. ***Credit: Nicolas Choquette-Levy***

Choquette-Levy began the study as a doctoral student at Princeton University, developing a survey of farming households in Nepal's Chitwan Valley. Growers in the region are among an estimated 500 million small-scale farmers worldwide, many expected to face climate-related hazards, according to the study.

In interviews between May and July 2022, farmers tied changing climate conditions to greater risks for their agricultural yields. The Chitwan Valley logged roughly twice the global average temperature increase, and a drop-off in total precipitation, since 1970, according to the study.

At the same time, farmers believed climate-related risks in non-farming work – such as extreme heat confronting day laborers and eco-tourism workers – were even more dire, the researchers found. When farming families detect high climate risks, they may "further retrench into farming-based activities," the researchers said in the paper.

The group cited several likely factors for the pattern, including financial constraints and a fear of lost harvests.

"People who had experienced droughts or floods ended up refocusing on farming for their income sources," Choquette-Levy says. "Even as crop yields declined, we saw retrenchment in established farming activities. And there was very low trust in government to help farmers manage these risks."

He returned to Nepal in summer 2025 to look into prospects for follow-up studies and to meet policymakers. The paper includes policy suggestions, including expanded access to climate information and financial

CONTINUED ON PAGE 17

WATER RESILIENCE A GROWING FOCUS AS FACULTY LOOK TO INFORM POLICY, STRATEGY

Kimberly Van Meter had become the bearer of bad news.

As a water system scientist, she grounded her early research in legacies: environmental footprints of excess nutrients like nitrogen, left behind by agriculture. When farmers cut down on fertilizer and rethought their livestock management, Van Meter had to be blunt:

That will help water quality, but it's going to take a lot of time – even a few decades – for those changes to have a big effect in the natural landscape, she told her audiences. Many found the reality check depressing.

Now, to jump-start improvements in water quality, Van Meter is prioritizing wetland restoration as an engine for clean-up. Her NASA-funded research in the area is part of a growing focus on water resilience within the Earth and Environmental Systems Institute at Penn State (EESI), where faculty associates including Antonia Hadjimichael and Rachel Housego are helping define the field.

"Restoring wetlands is a win-win because we know they improve biodiversity and can help with flood control, too," says Van Meter, an EESI associate and associate professor in the University's Department of Geography.

The so-called "bathtub rings" of the Hoover Dam, straddling the Arizona-Nevada border and part of the Colorado River Basin, were visible during a research trip in August 2025. ***Credit: Antonia Hadjimichael***

NASA satellite observations are helping her study how wetland improvements bolster natural processes that filter agricultural runoff and strengthen downstream water quality. Federal agencies are heavily invested in data-driven decision-making that protects wetlands and informs regulations, she says.

The land areas are part of her climate-related research as well. While wetlands store a lot of carbon, they can also emit methane and nitrous oxide – both greenhouse gases, Van Meter notes.

"How we think about the trade-offs in the context of water quality and other ecological benefits is a big area of my work," says Van Meter, who is also studying artificial-intelligence-based models to predict water quality. "And how we communicate these issues to policymakers and decision-makers is incredibly important."

She and Housego, a hydrogeologist and assistant professor in the Department of Geosciences, share a research focus on pollution from excess nutrients. Along Lake Erie, Housego and colleagues in her Hydrogeology Research Group are studying how farm drainage travels toward the lake.

She's especially interested in whether nitrate and phosphate are wending through groundwater or more on the surface.

"I realized there's been so little work in the Great Lakes overall on the groundwater side of things," Housego says. "It's not that the Great Lakes themselves aren't researched, but we've lacked understanding of the groundwater component of the hydrologic cycle."

Using wells near Erie, Pennsylvania, and supported by the Pennsylvania Sea Grant program, her team is looking to estimate groundwater and nutrients entering the lake and determine whether groundwater is causing bluff erosion. They're also using their data to create curricula that meet the commonwealth's recently adopted Science, Technology & Engineering, Environmental Literacy and Sustainability (STEELS) standards in local schools.

Kimberly Van Meter

Antonia Hadjimichael

Rachel Housego

Elsewhere, Housego and colleagues in the College of Earth and Mineral Sciences are looking at phosphate from treated sewage that's injected into groundwater in the Florida Keys. The team is researching whether the pollutant, which sticks to sedimentary rocks, can be re-released into the environment when exposed to salt water.

All these efforts fit into Housego's definition of water resilience. The broad, evolving discipline often refers to water's ability to recover from stressors — including pollution and disaster — in both natural and human-created settings. To Housego, the focus should range from protecting water for community use to shielding and restoring ecosystems.

Her research collaborators include Hadjimichael, also an assistant professor in the Department of Geosciences and an interdisciplinary Earth scientist. They worked together on models predicting how patterns of saltwater intrusion in the Mid-Atlantic region may shift amid changing climate conditions.

"As sea level rises, the saltwater pushes inland and triggers mixing between the two different types of water," Housego says. "That affects whether you can use it for drinking and what coastal ecosystems will look like, the kind of plant life that can survive."

A Wilson Faculty Fellow, Hadjimichael is principal investigator of her eponymous research group. It supports socioenvironmental systems facing uncertainty, with an emphasis on resilience of water resources and the use of artificial intelligence to understand environmental issues.

"We focus on how humans respond to climate and other changes in the environment," Hadjimichael says. "As researchers, we need to be working with social scientists, anthropologists, and other peers in science to inform what resilience looks like for individual communities. How we foster resilience depends on context. We contribute to both science and society."

Hadjimichael is focusing in part on the Colorado River Basin, where she studies an area in the Rocky Mountains that includes the river headwaters.

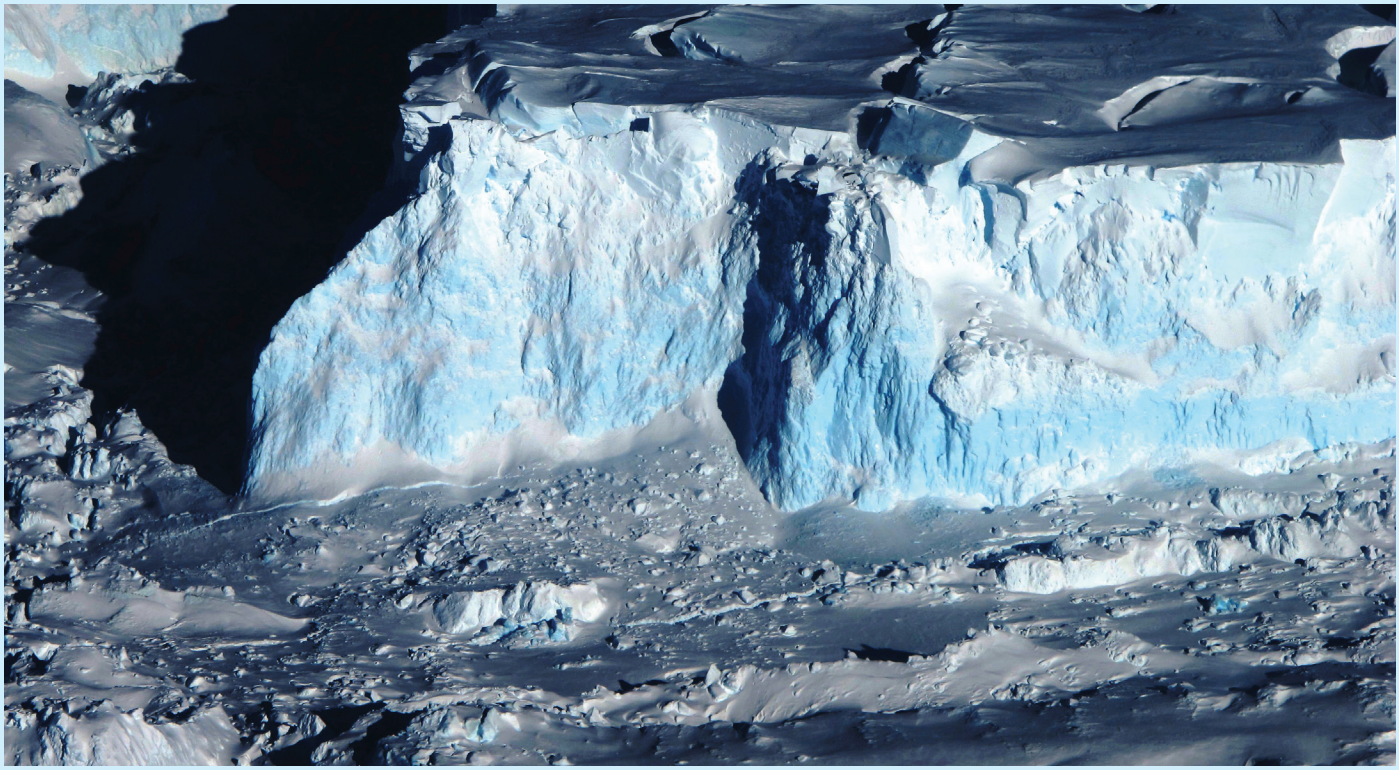
Specifically, her team is assessing whether changes in regional climate — including shifts in precipitation and temperature — will affect the amount of water entering the river and, by extension, how well it can support irrigation used by farmers.

"We're trying to establish the impacts for different locations, different elevations, so we're developing tools to quantify that," Hadjimichael explains. "Our data also could be used to inform conservation policy and water allocations."

Elsewhere, her efforts with Housego explore coastal agricultural communities that drew so much from groundwater aquifers, the resource is no longer usable, Hadjimichael says. Their study investigates how the condition took shape and long-term implications.

To Hadjimichael, water is often a lens that brings light to nuanced social and scientific issues. Interdisciplinary collaboration within EESI is vital for research outputs but also for fostering community, direction, and professional growth, including researchers' confidence, she says.

"EESI supports scientists by empowering their strengths and putting them into spaces where they build off one another and draw mutual inspiration," Hadjimichael says. "It keeps our work from silos and brings out our potential to make a difference together." ■



The Thwaites Glacier in West Antarctica is known for its rapid changes, fractured surface, and fast ice flows.
Credit: James Younger/NASA

Novel technique helps assess fractures in 'Doomsday Glacier'

A total collapse of the roughly eighty-mile-wide Thwaites Glacier, the widest in the world, would trigger changes that could lead to eleven feet of sea-level rise, according to scientists who study Antarctica.

Shujie Wang

To better predict fractures that could lead to such a collapse — and to better understand the processes driving changes in Antarctic ice shelves — a team led by researchers at Penn State's Earth and Environmental Systems Institute (EESI) developed a new method to evaluate cracks that destabilize ice shelves and accelerate those losses.

They reported their technique for analyzing fractures in the ice shelves, which are floating tongues of ice connected to land that extend out to float on ocean water, in the *Journal of Geophysical Research: Earth Surface*.

Drawing from NASA satellite data, the researchers focused on measuring vertical fractures in the Antarctic ice sheet — which has been shrinking by around 136 billion tons every year but is still the largest on Earth — over time. The group specifically evaluated ice fractures in the Thwaites Glacier, the so-called "Doomsday Glacier" in West Antarctica, to develop their method. It could help reveal the structural integrity of ice shelves and if – and when – they might give way, the researchers say.

"We know little about fractures, and their behavior is much more complex than conventional models suggest," says lead author Shujie Wang, an assistant professor of geography and EESI associate. "Conventional models depend largely on simplified models and scarce, hard-to-obtain field observations."

Modeling ice-shelf retreat is complex, especially due to limited data on ice fracturing. This challenge is pronounced at the Thwaites Ice Shelf, an extension of the Thwaites Glacier that is known for its rapid changes, fractured surface, and fast ice flow, according to the researchers. They see the Thwaites shelf as a bulwark against further disintegration of the glacier.

Richard Alley, Evan Pugh University Professor of Geosciences at Penn State and a co-author on the paper, likens ice shelves to flying buttresses. The architectural feature holds up exterior building walls much the way that ice shelves hold back the non-floating part of the ice sheet.

Richard Alley

"We've seen ice shelves break off, but we've never seen one grow back," Alley says. "This new research indicates we can estimate better the point at which these will break off. It's helping to establish the early-warning signals."

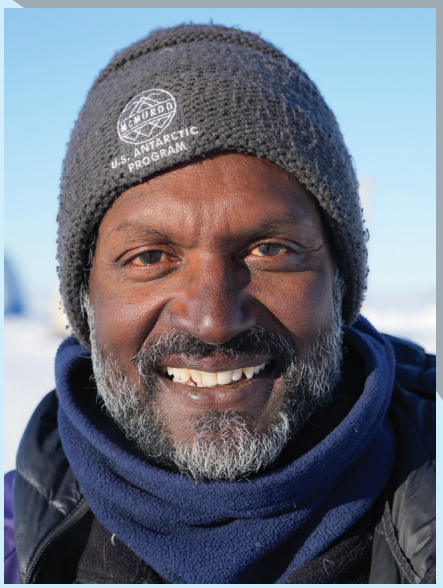
To establish more detail about fracture depth and activity, the research team analyzed data collected by NASA's Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) from 2018 to 2024. The satellite very accurately measures glaciers, ocean heights, tree canopies, and other natural features.

The researchers developed a workflow for processing and analyzing the satellite data to measure fractures over time. Among their discoveries, they found more aggressive fracturing in the Thwaites shelf's eastern part and relative stability to the west.

Although they did not determine certain causes for the differences, they say warmer winter air, reduced sea ice, and changes in the ocean circulation beneath the ice shelf are potential contributors to fracture growth that require more research.

Worsening fractures promote faster ice flow and a domino effect of fissures and instability within ice formations, according to the researchers. Wang says the study should contribute to understanding of fracture origins.

"We believe that if the Thwaites Glacier gets very unstable, it will have catastrophic consequences," she says. "It's an important area to be studied, to say what's going to change next."



Sridhar Anandakrishnan

While conventional modeling of ice-shelf fractures has depended on theory, the new observations provide a foundation for more refined models that should emerge from longer-term research, Wang says.

Part of her hope is that better predictions on the behavior of Antarctic ice will lessen uncertainty around sea-level changes, contribute to public confidence in scientific research, and help inform policymaking.

"I feel this is a bridge, really," Wang says.

Other contributors to the paper from Penn State include Sridhar Anandakrishnan, an EESI affiliate and a professor in the Department of Geosciences. One of twelve Fulbright Scholars from Penn State for 2024-25, Anandakrishnan was based at the University of Tasmania, in Australia, for his Fulbright work, titled "East meets West: integrating results from recent research in East and West Antarctica." ■

Q&A: Wauthier on using remote data to protect lives

As more satellites launch into orbit, Christelle Wauthier sees hope in observations they're sending back.

Their remote sensing technology can detect even slight movement in ground surfaces – one among many data points that could foreshadow natural catastrophes like volcanic eruptions, landslides, and earthquakes.

The challenge is to evaluate the data and find long-term patterns within them. Emerging tools in artificial intelligence and machine learning are especially key, promising to help scientists spot warning signs ahead of disaster and alert vulnerable communities, says Wauthier, an associate professor in the Penn State Department of Geosciences.

Her new initiative in the Earth and Environmental Systems Institute at Penn State (EESI) – known as Transcending Natural Hazard Forecasting, or TRAIN – is fostering an interdisciplinary research group in the field. Wauthier directs the initiative alongside two EESI associates. Guido Cervone, the TRAIN associate director, is a professor in the Department of Geography and the Department of Meteorology and Atmospheric Science, and the director of the Institute for Computational and Data Sciences. Renee Obringer, the early-career representative at TRAIN, is an assistant professor in the Department of Energy and Mineral Engineering.

Christelle Wauthier visited the summit of Kilauea volcano, on the southeastern part of the island of Hawaii, in February 2023. ***Credit: Matthew Patrick/U.S. Geological Survey***

Wauthier, an EESI affiliate, also is the current president of the natural hazards section of the American Geophysical Union (AGU); Cervone is a past president of the section. Wauthier spoke with EESI Does It about her aspirations for TRAIN.

Q Your work puts a premium on safeguarding communities against catastrophe. What about satellite technology first captured your interest?

A Wauthier: This goes back to my master's and doctoral work. I used radar remote sensing and satellite imagery to track surface changes at volcanoes in Africa. The accuracy was remarkable: From some 750 kilometers high, the satellites detected a few centimeters of ground motion. Once a satellite is engineered and operational in orbit, it provides you with valuable images for years.

Q How much of this technology's potential have scientists fulfilled? Can you preview what you expect for the long term?

A Wauthier: The research community at large has a humongous amount of data from satellites. We're doing pretty well using that information to time and track major storms and hurricanes, including their strength.

But we are behind on processing the entire database of satellite data to forecast other natural hazards, like earthquakes. Right now, we might be able to forecast that an earthquake will

happen within, say, 20 years, but we haven't yet used the data fully to sharpen those predictions. We need deep, long-term analyses of remote data to create more precise estimates for the timing and magnitude of many extreme natural hazard events.

Q The EESI leadership approved TRAIN in 2025, making it the institute's newest initiative. What made this the moment to create the program?

A Wauthier: Natural hazards continue to be a high priority for government agencies because disasters keep happening – threatening infrastructures, our economy, and the people. That's not going to stop. At the same time, through the AGU's natural hazard section and other current and timely natural hazard centers and initiatives in the U.S., EESI has strong visibility to promote progress in the field.

The initiative gives us an opportunity to create a research community across disciplines at Penn State, from atmospheric science to economic and social impacts and beyond. It also puts us in a prime position to respond to funding opportunities, develop workshops, and support student and interdisciplinary research on cascading multi-hazards, for example.

Q Is there a moment that crystallized your focus on protecting people against natural disasters?

A Wauthier: Every time you're on a volcano and get to know the people in the nearby communities, you realize how many people are living so close, and sometimes not realizing the risk they face. You see the force and impact of past eruptions, the damage and changes made to the landscape. If we can forecast their exact timing, location, and magnitude better, we can keep people from being in harm's way; we can avoid deaths. Information can save lives.

Read more on Penn State News: bit.ly/43EK39i. ■

POLITICAL-INDUSTRIAL ECOLOGY INITIATIVE LIFTS EMERGING FIELD

A granddaughter of coal miners in northeastern Pennsylvania, Jennifer Baka grew up watching what the energy industry can do to the human body.

Her maternal grandfather, who quit school in third grade to work in the mines, developed black lung disease, caused by coal dust. She never knew her paternal grandfather, who died in a mining accident when his son – her father – was 4 years old.

Asthma and cancer seemed to be everywhere in her industrial hometown near Scranton, where bad air and mine fires were parts of life, she recalls.

"You start to take for granted that this is normal, that people are dying," says Baka, an associate professor in the Department of Geography and a faculty associate in the Earth and Environmental Systems Institute at Penn State (EESI).

She says such human tolls, social impacts, and environmental effects should be part of holistic assessments for industrial systems, to inform thorough cost-benefit analyses, regulation, and collective decision-making. With support from EESI, she recently launched the Political-Industrial Ecology Initiative at Penn State – one of the institute's newest programs.

Jennifer Baka

A well pad under construction in Washington County, Pennsylvania, seen here in December 2022, was the largest ever built in the state at that time.
Credit: Jennifer Baka

The endeavor builds on Baka's own research in political-industrial ecology (PIE), an emerging area that evaluates industry's socioecological significance in local places. Researchers in the field explore justice- and equity- guided methods for "altering, reducing, and transforming industrial society," as Baka puts it on the PIE Initiative website.

Her plan is to foster a research community of PIE scholars and "get this nascent field on the map," she says. In recent field work, she evaluated Shell Polymers Monaca, a petrochemical complex in Beaver County, Pennsylvania. The $14 billion, natural-gas-powered facility covers nearly 400 acres along the Ohio River, turning out over 1 million tons of plastic pellets annually since opening in November 2022.

In an analysis published in the Annals of the American Association of Geographers, Baka used a PIE approach to illustrate how the plant fits into broader industrial systems, along with downstream effects and the limits of available information. She determined more than 20,000 infrastructure components, such as compressor stations, pump stations, pipelines, and an export terminal, support the Shell plant.

"You have just the plant, but you have to trace back all the way to the fracking wells" that supply the gas, says Baka, an energy geographer. "It's in effect a disaggregated factory spread across the landscape. People have a sense of infrastructure being built, but they don't necessarily have a sense of how it all fits together."

PIE evaluations can help residents understand "what's going on in their own backyards" while equipping agencies to rethink the regulatory status quo and consider cumulative industrial effects, she says. The complete scope of industrial impact is "poorly understood" because regulators look at individual facilities instead of integrated systems, she wrote in the article.

Baka is approaching the fifth and final year of a grant-funded project to study the Shell plant in deep detail, from its regulation to health and environmental concerns in surrounding communities. The work is supported in part by the National Science Foundation and Penn State's Institute of Energy and Environment.

Meanwhile, the overall PIE Initiative, in its second year, includes collaborators Mark Ortiz, an assistant professor in the Department of Geography, and Christine Costello, an assistant professor in the Department of Agricultural and Biological Engineering, both at Penn State.

By engaging families in industrial communities and understanding their needs, Baka says, the researchers hope to improve residents' livelihoods over time. She sees that as part of Penn State's historic land-grant mission, which includes public service through outreach and engagement.

"If we're in this process of trying to reindustrialize the United States, we need to have thorough evaluation methods and be cognizant of the full range of impacts," Baka says. "We can't repeat the mistakes of the past. Our approach offers us a new way to allow reindustrialization – thinking through social and environmental implications to chart a new course." ■

THEMATIC FRAMEWORK SPOTLIGHTS EESI'S IDENTITY

Erica Smithwick

Rob Nicholas

From its origins in the 1980s, the Earth and Environmental Systems Institute at Penn State (EESI) has broken boundaries. Its founding idea – that researchers create more knowledge when they collaborate across disciplines – has underpinned exploration from Antarctic ice to African weather.

But such a broad, growing portfolio can be tough to explain to people newly acquainted with the institute, says Director Erica Smithwick. Conveying impact is key as EESI strengthens ties – including with communities that depend on its research, funders that support it, and scholars keen to join in.

That's why the institute is introducing a six-theme framework that helps organize work, articulate mission, and raise visibility. Highlighted in EESI's recent website redesign, the themes will also encourage unity and community within the institute while helping researchers identify more areas where they can cooperate.

"The themes help us define our work and express what we're doing – both to the wider world and within Penn State," says Rob Nicholas, the EESI acting director while Smithwick is on sabbatical through June 2026. "They help us organize and plan. They capture where we are and help underpin what we're trying to do."

Imagined and refined in a two-year, community-building effort across the institute, the themes have already prompted reflection over disciplinary and interdisciplinary approaches. In creating the themes, EESI researchers weighed how they communicate their work – particularly to colleagues in and stakeholders beyond the College of Earth and Mineral Sciences (EMS), which hosts the institute – and how to define core areas of focus, such as biodiversity, resilience, and hazards.

Those focal points echo through the themes:

- **Earth System Science and Global Change**
- **Human Impacts of Environmental Change**
- **Biodiversity across Space and Time**
- **Natural Hazards, Disturbances, and Resilience**
- **Landscape Ecology and Biogeochemistry**
- **Planetary Sciences and Habitable Worlds**

As national attention turns to higher education, Smithwick and Nicholas are positioning the framework as part of EESI's long-range foundation. The institute has sought for over a year to reinforce the utility and timely relevance of its research, introducing tools like rapid reports that address urgent scientific developments.

A signature EESI event, the semiannual EarthTalks seminar series, featured this fall the necessity and development of critical minerals. Speakers ranged from Penn State faculty to

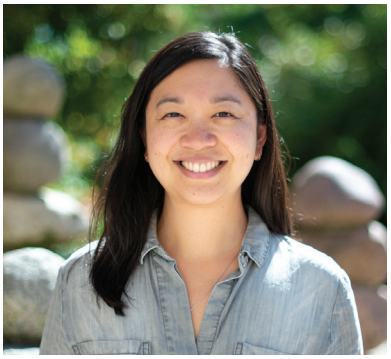
CONTINUED ON PAGE 19

Lau appointed to lead core analytical facility

Kimberly Lau, an assistant professor in the Department of Geosciences, has succeeded Susan L. Brantley as director of the Laboratory for Isotopes and Metals in the Environment (LIME). Brantley, a former director of the Earth and Environmental Systems Institute at Penn State (EESI), retired in December 2024.

EESI Director Erica Smithwick announced the leadership appointment in June 2024, noting that Lau, a sedimentary geochemist, will work "to expand LIME's impact across campus and with external users and partners." The lab is a core analytical facility under EESI.

"Leveraging her approach to research innovation in the environmental and Earth sciences, Kim is eager to maintain and grow LIME's success within EESI, the College of Earth and Mineral Sciences, and beyond," Smithwick said in the announcement.



Kimberly Lau

Smithwick also announced the appointment of Matthew Fantle, a professor in the Department of Geosciences, as scientific director for LIME.

ENVIRONMENTAL SCHOLARS PROGRAM

The Environmental Scholars Program is a cornerstone of efforts in the Earth and Environmental Systems Institute (EESI) to engage and empower students in doctoral and master's programs. The program encourages student research excellence, diversity, and building relationships across departments and research groups.

Environmental Scholars receive starter funding to support their research independence over their first two years of graduate school. They become members of EESI's interdisciplinary community; participate in events – including a few just for them, such as a springtime symposium; and develop ties among departments in the Penn State College of Earth and Mineral Sciences, says Peter Wilf, a professor of geosciences and chair of the program.

Each year, a faculty committee chooses a set of Environmental Scholars, nominated by EESI faculty associates, from graduate student applicants in EESI-affiliated departments.

Recipients for the 2025-26 Academic Year

- Olivia DiPrinzio (geosciences)
- Anthony Delgadillo Salas (geosciences)
- Jenna Haver (geography)
- Lara Williams (geosciences)

Recipients for the 2024-25 Academic Year

- Emma Perkins (geosciences)
- Michael Emeka Enemuo (energy and mineral engineering)
- Nishant Tiwari (geography)
- Samrin Sauda (geography)

Recipients for the 2023-24 Academic Year

- Kiely Hine (geography)
- Alexander Massa (meteorology and atmospheric science)
- Ava Spangler (geosciences)

MARILYN L. FOGEL STUDENT RESEARCH FUND IN BIOGEOSCIENCES

Started in 2021 by Marilyn Fogel and her husband, Chris Swarth, the Marilyn L. Fogel Student Research Fund in Biogeosciences is designed to engage more Penn State students in interdisciplinary research.

Its mission continues following Fogel's death on May 11, 2022. Professor emerita in earth and planetary sciences at the University of California, Riverside, Fogel was 69. She had a long battle with ALS.

Fogel became a preeminent biogeoscientist after her undergraduate years at Penn State, where she started in biology before pursuing field work with geologists. Fogel graduated from the University in 1973.

"The fund has enabled many students to jump into field research and to explore new areas of interest," says Susan L. Brantley, an Atherton Professor and Evan Pugh University Professor Emerita of Geosciences, and a former director of the Earth and Environmental Systems Institute at Penn State (EESI). "Many EESI students are like Marilyn in that they cross disciplines to investigate the world."

Dedicated to supporting research activities for both undergraduate and graduate students affiliated with EESI, the fund has a particular emphasis on field or laboratory research focused on geology, ecology, meteorology, biogeochemistry, climate change, and geography.

The fund has supported two recipients per year since the announcement of its first two — Shuyu Chang and Kaitlyn Horisk — in December 2021. One of the 2022 recipients, Bridget Reheard, was named the student marshal for the College of Earth and Mineral Sciences' summer 2025 commencement ceremony in August. Reheard also was named a Goldwater Scholar and awarded an Ernest F. Hollings Undergraduate Scholarship from the National Oceanic and Atmospheric Administration.

Recipients for 2025

- Faisal Elias (geography)
- Miranda Sturtz (geosciences)

Previous Recipients (2023-2024)

- Juliana Drozd (geosciences)
- Carolina Carrion Klier (geography)
- Roger Ort (geosciences)
- Bridget Reheard (geosciences)

Faisal Elias

Miranda Sturtz

Bridget Reheard

NEW FACULTY ASSOCIATE: Nicolas Choquette-Levy

Nicolas Choquette-Levy became the newest faculty associate in the Earth and Environmental Systems Institute (EESI) when he joined Penn State in January 2025.

An assistant professor of climate risk and decision-making in the Department of Geosciences, Choquette-Levy earned his doctoral degree in science, technology, and environmental policy from the School of Public and International Affairs at Princeton University.

EESI is a central part of what drew him to Penn State, he says, citing the institute's strengths and opportunities in interdisciplinary research. His interests cross engineering, public policy, and the sciences.

"Because of EESI, I have a built-in community where I know whom to approach for expertise outside my own," Choquette-Levy says. Already he has worked with faculty peers in geosciences, geography, meteorology and atmospheric science, and beyond.

His international research includes communities' perceptions of climate risk, computational models that simulate community adaptations to climate policy, and prospects for related public policy. In Brazil, Choquette-Levy is collaborating with policymakers on responses to Amazon rainforest deforestation that maintain livelihoods for farmers.

Elsewhere, his joint efforts are examining climate-related migration and remittances —the practice of workers' sending money home to their families. It's an increasing form of financial support — in some cases outpacing government assistance — as many communities deal with deepening climate risks, Choquette-Levy says.

He's also exploring support for Pennsylvania farmers whose cropland may not be highly productive.

"I'm really interested in how different stakeholders perceive risk and how they make decisions about risk," Choquette-Levy says. "We have a lot of great research monitoring Earth and observing changes to the environment. I'd love to work with people to translate physical monitoring of environmental changes into support for decision-makers on the ground." ■

Brantley led with inclusivity

Longtime professor Susan L. Brantley, who led the Earth and Environmental Systems Institute at Penn State (EESI) for nearly two decades, retired from the University faculty in December 2024.

Appointed as EESI's second director in 2003, Brantley led the institute until June 2021. Brantley used her directorship to help researchers address societal questions related to the sustainability of life on Earth and how to communicate with the public about these issues.

"I was lucky enough to be director of EESI at a time of great change," says Brantley, now an Atherton Professor and Evan Pugh University Professor Emerita of Geosciences. "I appreciated the chance to grow earth systems ecology, critical zone science, environmental data science, and climate and water science through hiring and funding opportunities."

A driving force in the development of critical zone research — the cross-disciplinary study of Earth's thin outer layer — Brantley advised close to 40 doctoral candidates at Penn State, more than two-thirds of them women. She served on the University faculty for nearly 40 years.

At EESI, Brantley leaves a legacy of inclusivity that brings together "faculty and students in all earth-related disciplines" and "always welcomes discussion that crosses from energy and fuels to climate and landscape," she says. "I also am proud that

I left EESI as an environment that nurtures new ideas."

The institute enabled Brantley to "pursue great science while helping many people do great things within their own careers," she adds. "In fact, the only thing I regret about retirement is that my ability to help junior scientists is less than it was as EESI director."

Brantley and her husband, Andy Nyblade, professor and former head of the Department of Geosciences at Penn State, plan to do more traveling to visit their daughters — both early career geoscientists – in New York and Colorado.

For a complete story from Penn State News, visit bit.ly/4385r6C. ■

CONTINUED FROM PAGE 5

resources for low-income farmers.

Choquette-Levy is exploring how to apply findings closer to home in Pennsylvania, where family farmers are navigating their own changed conditions. Nepali farmers "are already ahead of us in approaching climate change in some ways," he says.

"Growers in Nepal have no choice," Choquette-Levy adds. "We cultivate some of the same crops in both parts of the world – including corn, apples, and vegetables. It would be instructive to see how we can combine Nepali climate knowledge with the farming resources and entrepreneurship in Pennsylvania."

Read more on Penn State News: bit.ly/4pnAuDV. ■

Taylor, former director, pursued conservation, fire research

Alan Taylor, associate director of the Earth and Environmental Systems Institute (EESI) and longtime professor of geography at Penn State, retired from the University in December 2023.

Taylor served as EESI interim director from July 2021 to December 2022 and, during that time, directed a documentary capturing the institute's history.

Now professor emeritus of geography, Taylor pursued broad research interests in his career, including the influences of land use and climate on fire and forest conditions. In the mid-1980s in China, he collaborated with the World Wildlife Fund to help protect giant pandas. In 1990, he was among the first wave of environmental geographers hired in the University's College of Earth and Mineral Sciences.

Taylor more recently researched fire severity in dry forests of the western U.S. His greatest joys included field work with students, he said.

"Working with students in a research setting is where the action is," Taylor said. "It's something Penn State can provide across the University, and we as faculty can really have an impact by embracing those opportunities."

In retirement, Taylor has been traveling, visiting family and competitively trail-riding horses with his wife, Kristin, while keeping a hand in wildfire research.

Read the full story at bit.ly/4og8EbO. ■

Liermann, chemist, strengthened research results

A longtime pillar of the Earth and Environmental Systems Institute (EESI) community, analytical chemist Laura Liermann is retiring at the end of 2025.

Liermann, an assistant research professor, arrived at Penn State as a graduate student in 1986, earning her master's degree in the Department of Biochemistry and Molecular Biology. She began a research collaboration in 1997 with Susan L. Brantley, now an Atherton Professor and Evan Pugh University Professor Emerita of Geosciences.

From an initial study of bacteria-mineral interactions, Liermann went on to work on numerous biogeochemistry projects and then to the Laboratory for Isotopes and Metals in the Environment (LIME), a core analytics facility under EESI. Liermann retires as the lab's administrative director, having served as an analytical chemist for the past decade. (See Page 14 to read about Kimberly Lau, LIME's director.)

Liermann's expertise has bolstered research planning and maximized results. "By investigating interactive processes in nature, researchers address broader issues like climate change and weathering," she says.

In retirement, Liermann is looking to travel more and embrace free time. A fan of the outdoors, she hopes to do more hiking and gardening. ■

Remembering Jenni Evans

Jenni Evans, professor emerita of meteorology and atmospheric science at Penn State, died April 3, 2025, at her home in Boalsburg, Pennsylvania. She was 63.

Evans, who was interim director of the Earth and Environmental Systems Institute in 2013, served in a variety of leadership positions at the University. A global leader in meteorology, she was director emerita of the Institute for Computational and Data Sciences.

"Beyond her scientific achievements, Jenni was an inspiring mentor – especially to early career women in the geosciences – and a tireless advocate for diversity and inclusion," says Paul Markowski, distinguished professor and head of meteorology and atmospheric science. "Her leadership extended to the highest levels of our professional societies, including serving as centennial president of the American Meteorological Society.

"Through it all, she brought a rare combination of brilliance, humility, warmth, and resolve."

In a previous interview, Evans shared pride in helping launch students into their careers. "Seeing their successes makes me very happy. I enjoyed helping students find the thing that really excited them at that stage of their career and helping them think about the next step that's right for them."

Evans is survived by her husband, Bruce, colleagues, students, and the many individuals whose lives she touched through her work and mentorship.

For a complete story from Penn State News, visit bit.ly/47CC2m6. ■

CONTINUED FROM PAGE 13

industry and government leaders, driving turnout in person and online.

At the same time, the institute recently launched two initiatives. One of them, the Political-Industrial Ecology Initiative led by Assistant Professor Jennifer Baka in the Department of Geography, operates in the emerging area of political-industrial ecology. It's a sub-field of geography that places resource development in historic, economic, and political contexts.

The other new initiative, Transcending Natural Hazard Forecasting led by Associate Professor Christelle Wauthier in the Department of Geosciences, focuses on predicting natural hazards like volcanic eruptions. Wauthier's research includes the use of remote sensing data, like ground measurements taken via satellite, to forecast natural risks.

Taken together, the efforts illustrate EESI's hands-on, practical sensibility and problem-solving mindset. Overlapping interests with the EMS Energy Institute at Penn State – with which EESI shares support staff – contribute to wider interdisciplinary efforts in energy scholarship.

"We want people to be more involved in what EESI is doing. There's always an open door. There's always an invitation," says Smithwick, who became EESI director in January 2023. "Whether you're an alum or whether you're a student, we're working every day to welcome people in." ■

PennState
College of Earth
and Mineral Sciences

Earth and Environmental
Systems Institute

217 Earth and Engineering Sciences Building
656 White Course Drive
University Park, PA 16802

Nonprofit Org.
U.S. Postage
PAID
State College, PA
Permit No. 1

Drainage headed toward Lake Erie, seen here near the Penn State Lake Erie Regional Grape Research and Extension Center in Erie County, is a research focus for Rachel Housego, a faculty associate of the Earth and Environmental Systems Institute. The photo was taken as part of a Pennsylvania Sea Grant-supported project to understand groundwater-driven nutrient loading. ***Credit: Chris Shelton***

HELP SUPPORT EESI: raise.psu.edu/eesi