THE BRIDGE

A new wave of research

CEE researchers work to understand the chaotic nature of tsunami debris

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FALL 2021

CIVIL & ENVIRONMENTAL ENGINEERING
UNIVERSITY *of* WASHINGTON

Conserving water and helping farmers

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MESSAGE FROM THE CHAIR

We are thrilled to be back on campus, albeit masked, for autumn quarter. After one and a half years of remote learning, faculty and students appreciate in-person classroom discussions, office hours and research meetings. Students are also enjoying hands-on learning, including mixing and testing concrete in the Construction Materials Lab and fluid mechanics labs in the newly remodeled Harris Hydraulics space (featured in this edition of *The Bridge*). Our undergraduate student clubs are already busy planning for the construction of a concrete canoe and steel bridge, following online competitions last year. A personal highlight at the start of the academic quarter was meeting incoming graduate students in-person at the department's outdoor "welcome" event. With vaccinations required for all members of the UW community, I look forward to the day when we can put our masks away.

This issue of *The Bridge* highlights a few of the many research projects that made significant progress during remote operations. Associate Professor Mike Motley and a team of researchers are working to make sense of the chaotic nature of tsunami debris and Professor Anne Goodchild and her team developed an app that provides real-time curb parking availability in the Belltown neighborhood. This edition of the newsletter also recognizes the success of Professor Faisal Hossain's satellite-based irrigation advisory system, which celebrated five years of implementation and now benefits more than 100,000 farmers in three countries.

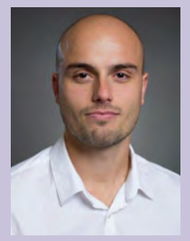
I am continually impressed with the accomplishments of our CEE alumni, and this issue of *The Bridge* introduces alumnus Maynard Okereke (BSCE '06) who is expanding diversity in STEM fields through a platform called Hip Hop Science, which enables him to conduct outreach to schools and other organizations. This fall, we also celebrate the promotion of three faculty from assistant to associate professors with tenure. And, we fondly remember the accomplishments and contributions of Professor Emeritus Demetrios Spyridakis, who passed away in October 2021.

Laura Lowes
Chair & Professor

Three CEE faculty promoted

Congratulations to the following faculty members who were promoted in September in recognition of their hard work and achievements!

PAOLO CALVI
Promoted to associate professor for his work in the structural engineering and mechanics group.



RICHARD WIEBE
Promoted to associate professor for his work in the structural engineering and mechanics group.

MARI WINKLER
Promoted to associate professor for her work in the environmental engineering group.

DEPARTMENT NEWS

Harris Hydraulics Lab remodel

Enhancing the student learning experience

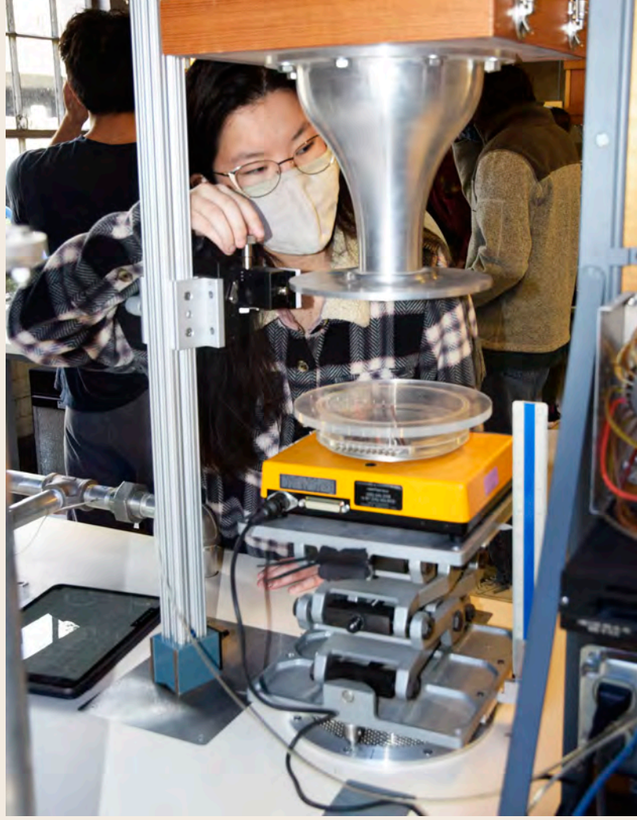
Things are flowing much better in the CEE fluids lab, located in the 100-year-old Harris Hydraulics Laboratory, following a substantial renovation project. Completed just in time for autumn quarter, the project enhances the student experience through the addition of more hands-on workstations as well as flexible teaching space.

"Now we have smaller groups of two to four students working on experiments," says Professor Alex Horner-Devine. "It's a big shift to move to something where everyone gets their hands wet and is participating rather than watching."

Prior to the remodel, up to a dozen students gathered around a single experiment during lab sessions. Now, the renovated space features four water flow benches, four small water flow channels and three air flow benches. Adjacent to the lab space is a flexible teaching area, where students are led through the theory they will be testing in the lab experiments.

"This is the biggest renovation since I've been here," says Horner-Devine, who has been teaching fluid mechanics courses at the UW for 17 years. "Another key thing about the space is that whereas it used to be just CEE undergraduate space, it is now College of Engineering (COE) instructional fluid mechanics space."

During an introduction to fluid mechanics (CEE 347) lab where students learn to measure the force of an air jet, junior Ingrid Phillips (left) watches junior Daniel Tsukada (center) adjust the height of the force scale. The students are gathered around one of three air flow benches relocated to the renovated lab space.



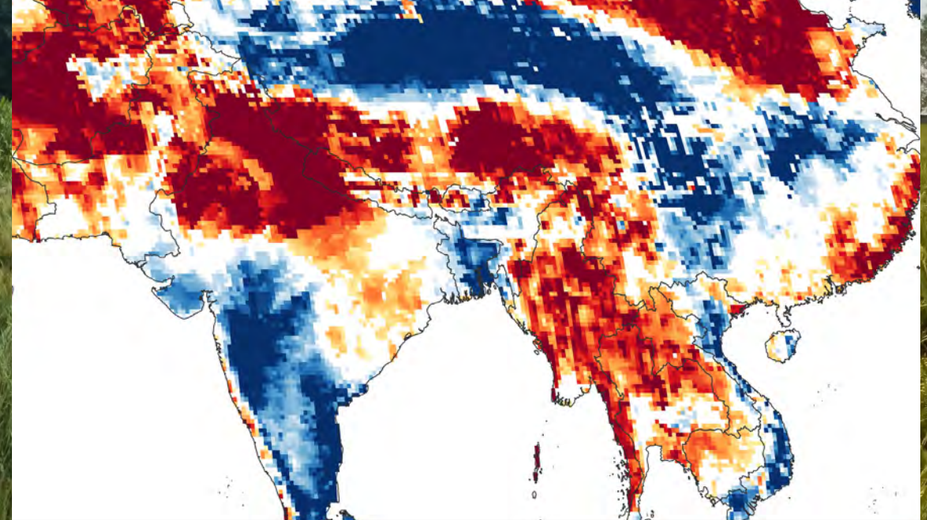
In the newly renovated Harris Hydraulics Lab, junior Nelly Sunstrum positions a pitot tube to measure the speed of air in the jet.

The renovated lab space will be utilized across CEE, Mechanical Engineering and Aeronautics & Astronautics. Funded by the COE, the remodel project was undertaken as part of a renewed focus on investing in undergraduate teaching spaces as well as enhancing collaboration across departments.

Located on the south end of campus, the Harris Hydraulics Laboratory was constructed in the 1920s to house hydraulics research facilities. Minor renovations have been completed over the years, and an addition to the building was completed in 1959. The building is now utilized by several UW departments.

The renovation project also entailed constructing floors in two areas where no prior flooring existed and removing a wooden staircase. Outdated space-consuming equipment was also removed, including two 30-feet-long water flow channels and a large full-scale tank.

"Although we have lost the ability to observe some things at full scale, we've gained the ability for students to experiment with flow behavior and change flow settings like they couldn't before," says Horner-Devine. "Now, more students are involved in solving problems during lab experiments."



Satellite system SUCCESS

Conserving water, improving crop yield and helping farmers

Five years ago, when Professor Faisal Hossain helped implement a new satellite-based irrigation advisory system in Pakistan, it was uncharted territory. But that territory now includes three countries and more than 100,000 farmers who benefit from water conservation and improved crop yield.

"Because this was never something I planned to do, I am pleasantly surprised at how successful the system has been and how it's grown and expanded to other countries like India and Bangladesh," Hossain says. "This is one of the most enjoyable things I've worked on."

Water scarcity is a pressing issue throughout South Asia and beyond. While modern-day irrigation practices enable more farming and food production, they are estimated to consume between 60-90% of global freshwater. To help conserve water by preventing the overwatering of crops, the Pakistan Council of Research in Water Resources began working on a project in 2015 to utilize satellite-based data to provide irrigation advisories to farmers. When the government agency realized that available information wasn't user-friendly for farmers, they reached out to Hossain.

"I had an epiphany; we do all this great scientific research driven by making it user-inspired," Hossain recalls. "I realized this is not hard to solve, we just need to package it in a way that is user-ready."

The advisory system that Hossain and his research team helped develop utilizes weather and satellite data and estimated water consumption by crop to generate text messages that are delivered directly to farmers' cell phones. The system can be used for a variety of crops, from rice to bananas to wheat. Examples of messages include "Dear farmer friend, we would like to inform you that the irrigation need for your banana crop is two inches this week" and "Corn fields do not need irrigation due to sufficient rainfall prediction this week."

"I grew up in a farmer family in Bangladesh, so I understand the stressful time that farmers pass during the winter dry season," says alumnus Nishan Kumar Biswas (Ph.D. '21), who worked on the advisory systems during his graduate studies. "Farmers don't have access to weather forecast information and crop water demand. Thus, they don't know if plants need water right at the moment and if there will be any rain in the upcoming days."

Expanding east

First implemented in Pakistan, the irrigation advisory system has since expanded to India and northeastern Bangladesh, now serving more than 100,000 farmers. In Bangladesh, which is the world's fourth largest rice producer, the system is being considered for adoption countrywide in 2022 by the government's Department of Agricultural Extension (DAE).

In each country, the system is tailored to the specific needs of the farmers. For example, farmers in India and Bangladesh grow a wider variety of crops on a smaller scale than farmers in Pakistan. To account for the greater variety in crops, the researchers introduced inexpensive low-power ground sensors in India. The sensors collect information specific to each plot of land, such as temperature and humidity, which is used to generate a greater number of irrigation advisories. And depending on the country, text messages are customized to reflect how farmers in a particular area may measure water. For example, a text message may advise farmers to "apply half a finger of irrigation," which is about 1.5 inches.

"We realized that we had to customize the solution," Hossain says. "We couldn't use the same exact method somewhere else, as it would be received differently given different customs and culture."

The researchers have also been eager to add innovations along the way. In Bangladesh, the advisory system was made "smarter" by adding additional satellite data that helps track farmers' individual water use. This allows the DAE to strategically target farmers in specific areas where severe over-irrigation occurs.

Irrigation impact

Throughout the three countries, studies and assessments indicate that the advisory systems have been largely beneficial. During dry-season rice production, a control group study was conducted in Bangladesh, supported by the Asian Development Bank. The study revealed that the farmers utilizing the advisory system used significantly less water and diesel fuel, which powers water pumps. On average, the advisory system reduced irrigation water use and fuel consumption by up to 40% while increasing earnings by up to 30% through increased rice production, a benefit of not overwatering crops.

Informal assessments in the other two countries similarly revealed that the advisory systems were valuable. In India, 85% of farmers reported the system was beneficial. Farmers there also saw an increase in wheat yield by up to 25% when compared to the historical yield. In Pakistan, farmers saw up to 40% savings in irrigation water and a 15% increase in crop yield.

"I get a lot of joy when farmers tell us this advisory system is giving them so much benefit," Hossain says. "At the end of the day, that's what we are supposed to do. We are supposed to make the world a better place."

Photo above left: Checking his cell phone, a Pakistani farmer reads estimates of how much irrigation water he will need over the next few days. Middle: Based on satellite data, a map shows shallow groundwater storage in southern Asia for March 15, 2021. Areas in blue have more abundant water and red and orange areas contain less water than usual when compared to long-term records for the month. Right: In a rice field in Bangladesh, a farmer stands next to a sign that indicates his farm is participating in the trial of the irrigation advisory system.

Photo credits: Faisal Hossain, Pakistan Council of Research in Water Resources, NASA/USGS, Department of Agricultural Extension-Bangladesh and Asian Development Bank

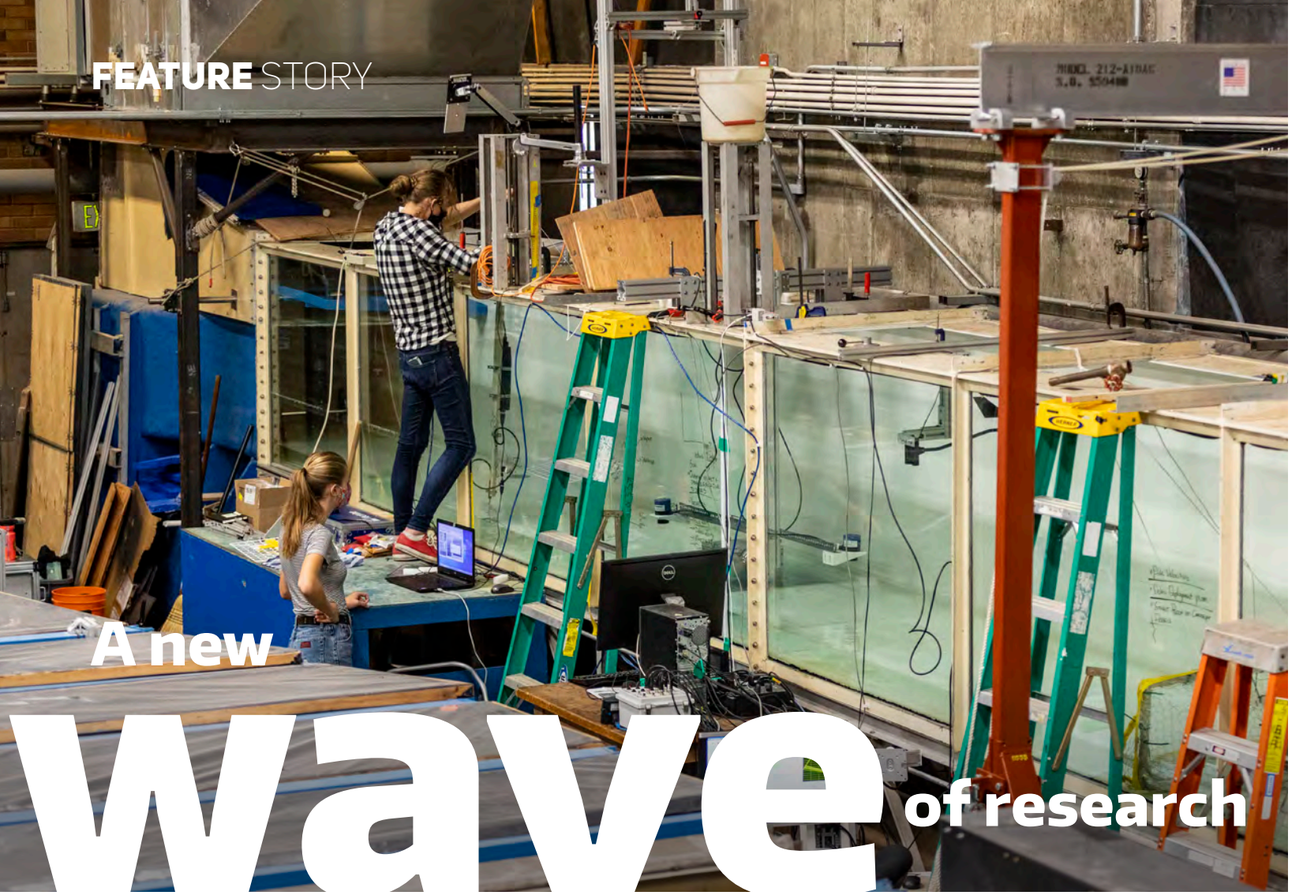
Timeline of implementation

2016:
700 farmers in Pakistan trial the Integrated Rice Advisory System (IRAS)

2017:
10,000 farmers use IRAS in Pakistan

2018:
50,000 farmers in two countries use the advisory system after the Provision of Advisory for Necessary Irrigation (PANI) system is implemented in India

2020:
100,000 farmers in three countries use the advisory system after the Irrigation Advisory System (IAS) is trialed in northeastern Bangladesh



A new wave of research

Working to understand the chaotic nature of tsunami debris

Making sense of chaos isn't an easy task, but a team of CEE researchers is up for the challenge. With an elevated risk of a tsunami event in the Pacific Northwest, the researchers are working to better understand how debris collectively causes tsunami-induced damage in coastal communities.

"The idea we came up with was to really embrace the chaos of the event and the fact that debris is rarely a single shipping container. It's usually a house that has separated into its individual components or a parking lot full of cars," says CEE Associate Professor Mike Motley. "We are looking for ways to quantify something that is random and amorphous."

The research is timely, with a major subduction zone earthquake predicted for the Pacific Northwest, which could trigger a tsunami along the Washington coast, extending up into British Columbia and down into California. The Cascadia Subduction Zone, which last ruptured in A.D. 1700, is active roughly every 300-600 years.

Photo above: Inside the wave flume at UW's Harris Hydraulics Lab, Ph.D. student Nikki Lewis adjusts the vertical position of the test specimen within the tank. Photo credit: Dennis Wise and Dana Brooks / University of Washington

"It's a very urgent concern. There have been tsunamis in Chile, American Samoa, Indonesia and Japan. We are the one area that hasn't been directly impacted in the past 20 years," Motley says. "The interesting thing here is we get one shot — once the subduction zone event occurs, it resets and we wouldn't expect to see another event for several hundred years."

To ensure that structures are designed to withstand a tsunami event, the researchers' goal is to inform the tsunami building codes used in the United States. Now in its second year, the three-year National Science Foundation-funded project is led by Motley in collaboration with CEE Professors Pedro Arduino and Marc Eberhard. Also involved are graduate students Nikki Lewis, Dakota Mascarenas, Justin Bonus and undergraduate students Abbey Serrone and Haley Herberg.

Debris damage

Joining forces with waves and water, debris can cause major damage during a tsunami. While existing research details how a single piece of debris impacts the built environment during a tsunami, there is a gap in understanding how different types of debris, called a debris field, interact with structures simultaneously.

"If you look at any tsunami event, the flow itself isn't comprised of only water, but everything the tsunami picks up when it goes through an area. Debris can include trees, collapsed buildings, vehicles and fixtures," says Ph.D. student Nikki Lewis. "Anything that can be swept away in a flow and transported to a different location can cause damage to another structure."

To learn how different types of debris act together to cause damage during a tsunami, the researchers are investigating the collective forces in a debris field. They are also exploring a phenomenon called damming, which occurs when debris collects in an open space, such as between two columns on a bridge. This creates a dam that causes additional debris and fluid to accumulate, which may cause the structure to give way — and potentially join the debris field.

Early experiments

By conducting repetitious experiments with slight variations, the researchers hope to identify patterns that emerge. During the course of 10 weeks, more than 400 trials were conducted in a wave flume that simulated tsunami-like waves at Oregon State University's O.H. Hinsdale Wave Laboratory in spring 2021.

"If you take one piece of debris, it is easy to quantify the ways it impacts something, but there are a lot of ways numerous pieces of debris can orient themselves," Motley says. "So, we tried to do as many realizations as we could, to look at how much randomness we would get and the disparity of results for tests that are to some extent the same."

During the experiments, which ran continuously in 15-minute increments, rectangular debris blocks were lowered into a wave tank. Once released, a tsunami-like wave carried the debris toward an instrumented box equipped with sensors and other technology to measure the impact of the debris. The researchers used debris of varying sizes and quantity and arranged them in different configurations, from random to organized. The velocity of the waves also varied.

"If you envision a house that collapsed during a tsunami event, what remains could affect other structures in a random assortment of impacts. And so we tested configurations with various parameters, including how tightly packed the debris field was," says master's student Dakota Mascarenas.

Subsequent experiments were conducted at the UW's Harris Hydraulics Lab this autumn, as the researchers evaluated the facility's capabilities in preparation for additional trials in the coming year.

"The idea moving forward is to have thousands of pieces of debris that can be introduced into the flume and will be representative of a tsunami-like event," Motley says. "We hope to model the actual physical tsunami a little better on a smaller scale."

Looking for patterns

Identifying trends and patterns in the preliminary data will enable the researchers to begin building computer models capable of predicting how a debris field will interact with structures during a tsunami.

"We are already starting to see some trends shake out, such as trends based on the amount of debris that we put in the flume and the orientation of the debris field," Motley says.

Considering the complex nature of a debris field, the researchers will combine multiple modeling methods: high fidelity fluid models that explore how water flows around rigid shapes and material point models that evaluate how objects interact in a fluid flow. The modeling work will be undertaken in collaboration with the Natural Hazards Engineering Research Infrastructure SimCenter at University of California, Berkeley.

"We are on a quest for understanding," Lewis says. "We want to ensure that design guidelines are suitable for future tsunamis, which are so chaotic and unpredictable that it's hard to intuitively say what will happen."

Photo below left: An inside view of the wave flume, which circulates water in a continuous fashion and simulates tsunami-like conditions.

Below center: Undergraduate student Haley Herberg organizes debris for future tests. To study the effect of geometry and mass when the debris strikes the specimen, the debris was cut into various thicknesses and lengths.

Below right: Associate Professor Mike Motley diagrams the test parameters being studied through the experiments.

Photo credit: Dennis Wise and Dana Brooks / University of Washington

REMEMBERING

Demetrios 'Dimitri' Spyridakis

Growing up amid the stunning turquoise and emerald waters of Greece, perhaps it is no surprise that Professor Emeritus Demetrios "Dimitri" Spyridakis dedicated his life's work to keeping waterways pristine. A longtime CEE faculty member, Spyridakis passed away at the age of 89 in October 2021.

"Dimitri was, above all, a fabulously warm, generous and fun person," remembers Professor Emeritus Mark Benjamin. "He was much beloved by students."

Spyridakis received a bachelor's degree from Athens Agricultural College in Greece, followed by a Ph.D. in soil chemistry from the University of Wisconsin, Madison, where he was an instructor for five years. He then joined the University of Washington and taught courses in water and soil chemistry for 25 years until retiring in 1995.

Spyridakis conducted research on water pollution, with a specific interest in the role of lake sediments contributing to lake eutrophication through the release of nutrients. Eutrophication occurs when a body of water is overwhelmed with nutrients and minerals, which can result in blooms of algae that are often toxic and can degrade water quality.

"Few people were studying the role of sediments in the 1970s," says Professor Emeritus Gene Welch. "Dimitri brought a vast knowledge of the chemical and physical aspects of lake sediments and the rate of accumulation — all aimed at the control of lake eutrophication."

Spyridakis's journey to the United States in 1957 to pursue graduate studies in Wisconsin was full of adventure. His brother arranged for him to depart from Greece with the owner of a merchant marine ship. Arriving in Virginia with very little money, Spyridakis's shipmates collected funds to help him reach New York, where he connected with the Greek community. The president of the local Greek Club gave him $100, which was enough to buy a Greyhound bus ticket to Madison. Arriving in Wisconsin, Spyridakis was a complete stranger, but he quickly found housing and a part-time job to help pay for tuition thanks to members of the local Greek community.

Spyridakis's Greek heritage continued to be an important part of his life. He visited Greece frequently over the years with his family, and colleagues even joined him on occasion.

"A small group of friends and I visited Dimitri in Athens while he was on sabbatical. He treated us royally, taking us to a bunch of his favorite haunts and treating us to some very special ouzo," Benjamin recalls.

Spyridakis is survived by his wife Jan, a professor emeritus and former chair of the UW Human Centered Design & Engineering Department, and two children.

FACULTY AWARDS

Professor Bart Nijssen is the recipient of the American Geophysical Union Edward Flinn III Award for his work to spearhead the development and ongoing improvement of hydrologic models used by researchers around the world. For more than 20 years, Nijssen has served as one of the main programmers for the Variable Infiltration Capacity Model, which is used to solve water and energy balances in major river basins.

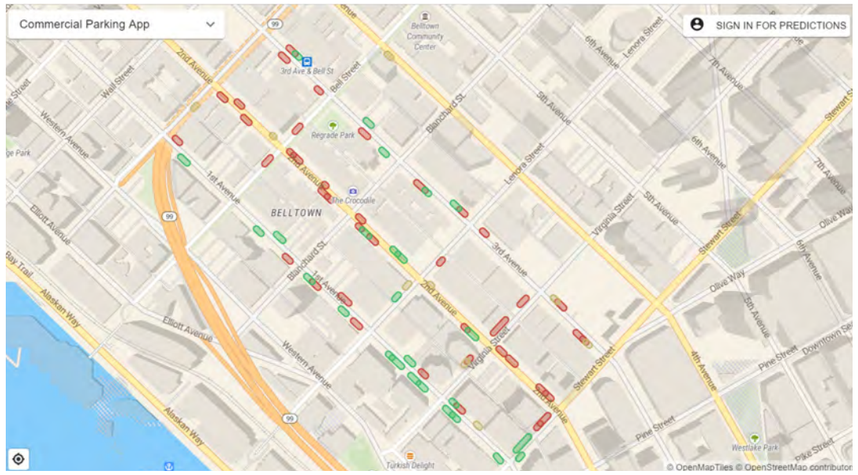
Directed by Professor Anne Goodchild, the **UW CEE Online Master of Supply Chain Transportation & Logistics (SCTL) program** has been honored with the 2021 ITE Transportation Education Council Innovation in Education Award. The program is the first of its kind to focus exclusively on the logistics and transportation elements of the supply chain.

Associate Professor Paolo Calvi, Professor John Stanton and **alumna Otgonchimeg "Audrey" Davaadorj (MSCE '18)** received the Precast/Prestressed Concrete Institute's 2021 Charles C. Zollman Award. The honor recognizes their work to investigate the transfer of shear stress across cold joints — planes of weakness in concrete structures — in their paper "Shear stress transfer across concrete-to-concrete interfaces: Experimental evidence and available strength models."

Professor Alex Horner-Devine and **alumna Margaret McKeon (Ph.D. '20)** are the recipients of the Pritchard Award, which recognizes the best physical oceanography paper published in the journal Estuaries and Coasts. The researchers collaborated with Sarah Giddings, an assistant professor at the University of California, San Diego, on the paper "Seasonal changes in structure and dynamics in an urbanized salt wedge estuary."

Professor Faisal Hossain has been selected as a fellow of the American Meteorological Society (AMS) in recognition of his work to improve lives around the world by developing irrigation advisory and monitoring systems. The AMS reserves the honor for those who have made "outstanding contributions to the atmospheric or related oceanic or hydrologic sciences or their applications during a substantial period of years."

Real-time parking availability? There's an app for that



A parking app shows available curbside parking in the Belltown neighborhood. Green indicates available parking and red identifies spaces that are already taken.

Delivery drivers spend a significant amount of time doing something other than delivering packages: searching for parking. But that may change one day soon, thanks to a team of researchers that has developed a real-time parking availability app.

"The idea is that if drivers had this information, they could make better and more efficient decisions about parking and routing," says Supply Chain Transportation and Logistics Center (SCTL) Director and Professor Anne Goodchild. "The crux of their job is finding parking and making quick deliveries, yet they have no visibility into parking availability."

As part of a multi-pronged approach to improve the "final 50 feet" of the goods delivery system, which is when delivery drivers must locate both parking and customers, a team of researchers in SCTL's Urban Freight Lab oversaw the development of the parking app. The researchers are currently evaluating the technology to determine how it may benefit delivery drivers, as well as reduce traffic congestion and carbon emissions. The project is funded by a three-year U.S. Department of Energy grant, which is now in its final year.

Testing the technology

Available since January 2021, the app provides real-time parking data for two locations in the Seattle area. The primary location for the study is downtown Seattle's Belltown neighborhood, where more than 270 electromagnetic sensors were installed every 10 feet in the curb lane. On a smaller scale, several camera-based sensors were installed in Bellevue.

"None of the carriers have real-time curb visibility — this is new technology," Goodchild says.

The researchers are currently analyzing data collected last summer when they rode along with delivery drivers. The researchers also solicited input via focus groups with Urban Freight Lab partners, which includes parcel and goods delivery companies.

"The experiment we did was quite fun. We got fake packages and a randomly generated list of delivery addresses in the study area," says postdoctoral research associate Giacomo Dalla Chiara. "Some of the drivers used the app and others used only the visibility of the curb to find available parking."

Inspired by data

The idea to develop the app was inspired by a recent study conducted by Dalla Chiara and Goodchild, which revealed that almost 30% of a commercial vehicle's driving time is spent cruising for parking — when drivers circle around their destination searching for parking.

"We quantified how inefficient the current system is, which was the motivation for this solution," Goodchild says.

Sparking solutions

Since the researchers are primarily focused on developing a proof-of-concept solution, they hope the technology will be a catalyst for public and private sector solutions and continued development. This may include rolling the technology out to commercial carrier companies.

"Our purpose is to evaluate the potential for this type of solution to benefit regional transportation and reduce carbon emissions," Goodchild says.

A RAPID transformation: Natural hazards research

$6 million NSF renewal funds continued reconnaissance advancements

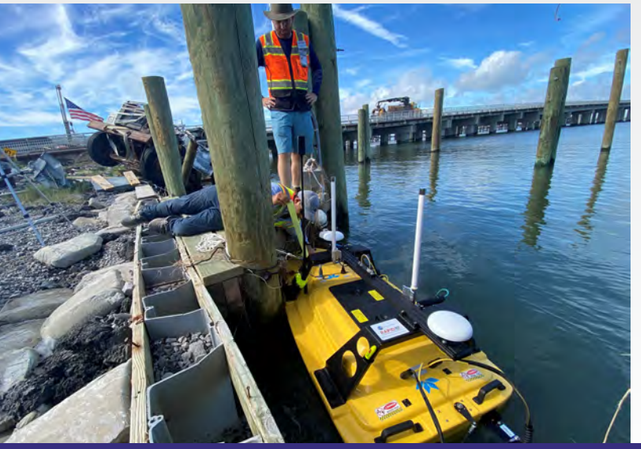
Three years ago, data gathering protocols and procedures for reconnaissance missions were perhaps as unpredictable as the natural disasters themselves. Only a handful of researchers owned instrumentation, data collection was non-standardized and information gathered was often not shared beyond personal hard drives.

"Before RAPID, it was ad hoc, DIY or sometimes BYO (bring your own) equipment to a reconnaissance mission," says CEE Professor Joe Wartman, who directs the Natural Hazards Reconnaissance Facility (known as RAPID).

The first center of its kind in the world, RAPID has transformed how data is gathered, processed and saved in the aftermath of natural disasters. A $6 million renewal grant from the National Science Foundation (NSF) provides four additional years of funding — and a 30% budget increase allows the center to advance the natural hazards reconnaissance field through new initiatives.

Growing demand

Headquartered in UW CEE, RAPID has responded to 70 natural disasters including hurricanes, earthquakes, tsunamis, landslides and wildfires. Since the facility officially launched in 2018 following two years of preparations, there has been an increase in demand for reconnaissance support. This is due to a "new class" of disasters, says Wartman, which includes extreme events such as landslides triggered by warming temperatures as well as wildfires.



Following Hurricane Ida, RAPID researchers collect data throughout Grand Isle, Louisiana, using a 360-degree Street View camera system mounted on top of a vehicle.

The reconnaissance community has also grown considerably. In 2016, there was only one organization that responded to extreme events. Today, the RAPID facility actively supports a community of seven extreme event reconnaissance organizations, as well as universities, government agencies and international organizations. The center offers both mission planning and deployment support as well as a suite of more than 100 unique state-of-the-art pieces of equipment.

"We offer not just a high-quality portfolio of some very pricey instruments, but a range of instruments that are tailored for specific disasters," Wartman says. "Some are better for looking at structural concerns and others for coastal engineering concerns."

New initiatives

The RAPID researchers are now focusing their efforts on enabling even more advancements in the field. To do so, they will offer additional project support both before and after teams deploy to disaster sites.

"One of the things we learned from the first grant is that we collected some fantastic data, but the challenge after collecting it is processing it into a digestible form," Wartman says. "A big theme of the renewal is getting users past that bottleneck."

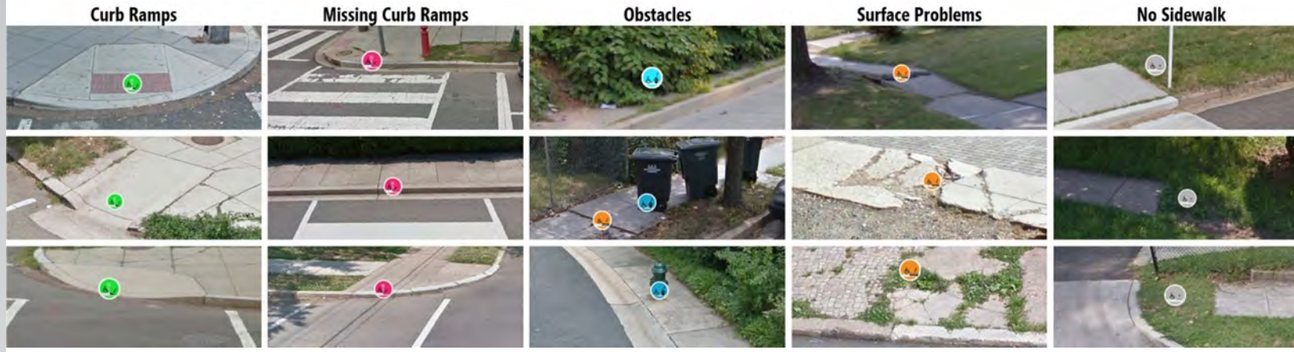
To supplement an existing four-day hands-on intensive training workshop, the center plans to offer a variety of data processing trainings. Workshops at various universities will also help increase the participation of underrepresented populations.

Data driven

Central to its mission, the center will continue to emphasize the importance of sharing data with the broader research community. So far, more than 100 terabytes of unique natural hazards data has been archived. From using data sets to verify landslide models to perhaps even informing artificial intelligence research, the options are endless, Wartman says.

"There will be uses for the data that I can't even imagine in this day and time," says Wartman. "We've built a community of researchers with an understanding that what is collected will be openly shared, which does a lot to ensure transparency in engineering and science."

Responding to Hurricane Ida in Grand Isle, Louisiana, in September, RAPID Operations Manager Michael Grilliot prepares to launch a bathometric survey vessel in the Gulf of Mexico.



PacTrans: A driving force in transportation research

Since 2012, the Pacific Northwest Transportation Consortium (PacTrans) has headquartered transportation research and initiatives for Washington, Oregon, Idaho and Alaska as the University Transportation Center for Federal Region 10. The center's mission to develop data-driven solutions that address mobility challenges throughout the region wouldn't be possible without financial support from the U.S. Department of Transportation (USDOT). Below is a summary of what a $14.35 million USDOT Fixing America's Surface Transportation Act grant has helped make possible.

Research impact

During the past six years, PacTrans has funded 122 research projects. More than 15 different colleges and departments within PacTrans' consortium of five research partners were involved in the research: University of Washington, Oregon State University, University of Idaho, Washington State University and University of Alaska Fairbanks, and education partners Gonzaga University and Boise State University. The projects have led to the development of new theories, methods and technologies that are summarized in 136 peer reviewed journal publications, 221 conference papers and presentations, and 24 book chapters and edited manuscripts.

Photo above: Project Sidewalk, a machine learning-enabled platform that utilizes crowdsourcing for collecting sidewalk accessibility data, is supported by PacTrans. Project Sidewalk was developed by Jon Froehlich, a UW associate professor in the Paul G. Allen School of Computer Science & Engineering.

Technology transfer

PacTrans has funded 21 technology transfer projects, enabling researchers to collaborate with external industry and agency partners to put their findings and initiatives into practice. A few highlights include:

- Technology to assess rockfall hazards on roadways has been implemented at two state departments of transportation.
- Mobile technology for sensing traffic has been evaluated in numerous pilot studies and is currently in the process of patenting.
- A machine learning-enabled platform that utilizes crowdsourcing for collecting sidewalk accessibility data has been implemented in pilot studies worldwide.

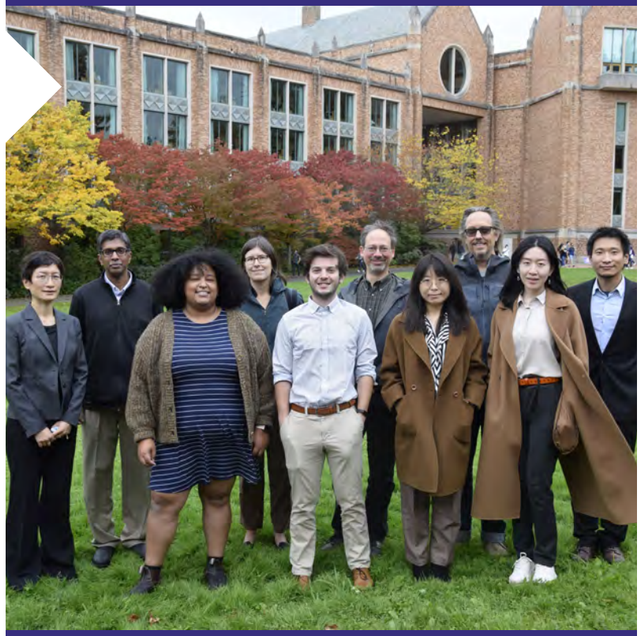
Student education

Throughout the Pacific Northwest, PacTrans is the largest supplier of transportation professionals to the workforce. This is a result of equipping more than 1,000 students with hands-on transportation experience. In addition to funding 24 PacTrans graduate fellows and three PacTrans undergraduate research fellows, more than 800 students have received financial support to present research at conferences, workshops and symposia. Consortium partners have also worked with agency and industry partners to create internship programs that provide students with real-world experience.

"PacTrans has been working hard to serve as Region 10's research engine, technology showcase, education leader and collaboration platform," says PacTrans Director and CEE Professor Yinhai Wang. "With everyone's support and dedication, we've made significant contributions to solving the region's transportation challenges."

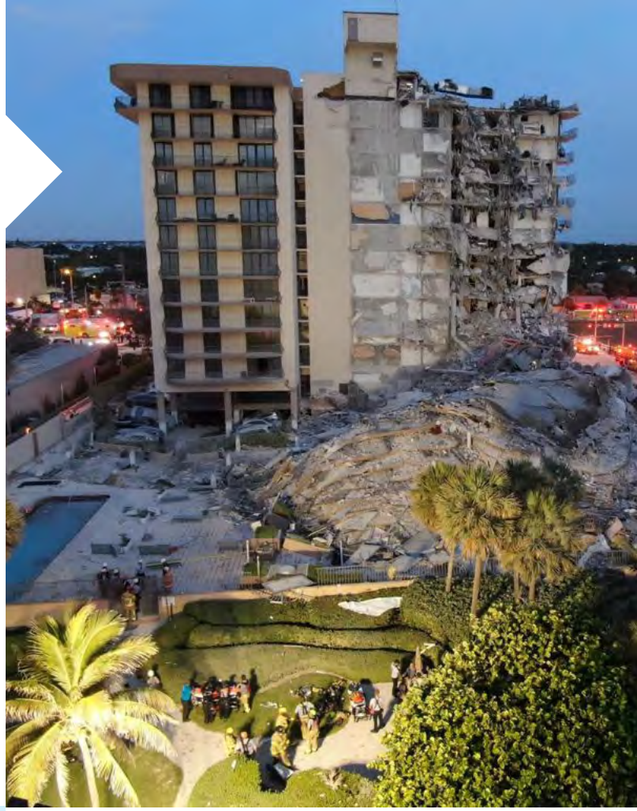
$2M from NSF to design an ‘adaptable society’

A team led by Professor Cynthia Chen has received a nearly $2 million grant from the National Science Foundation to further research into how urban societal systems can be organized to be both efficient and resilient. The Leading Engineering for America’s Prosperity, Health and Infrastructure (LEAP-HI) project supports fundamental research to generate the knowledge, mechanisms and tools needed to design an adaptable society, which can switch between different operating strategies depending on the situation. Ideally, people in these societies are informed about and can adapt to system changes without undue hardship. The LEAP-HI project will integrate people, businesses and transit into a network, enabling a better understanding of how society can adapt to different disruptions. The grant provides funding over four years to researchers at the UW, Arizona State University, the University of Notre Dame and The University of North Carolina at Charlotte.



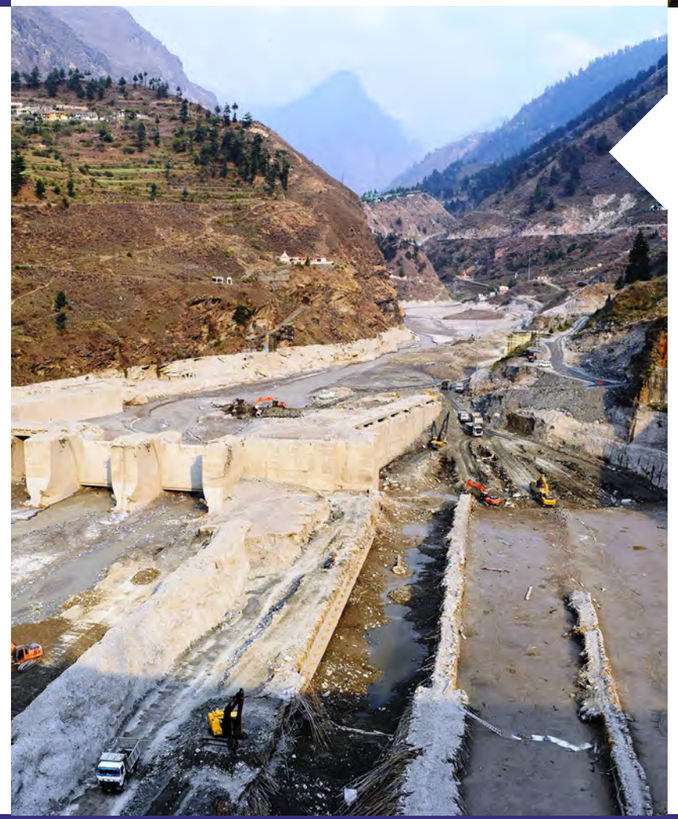
‘We need to be patient’ — Dawn Lehman on the Champlain Towers collapse

Following the partial collapse of the Champlain Towers South building, a 12-story beachfront condominium in the Miami suburb of Surfside, Florida, Professor Dawn Lehman has provided expert commentary to various news outlets. In collaboration with the Miami Herald, Lehman employed techniques to the forensic investigation that she typically uses for post-earthquake evaluation, including the use of an advanced, validated nonlinear modeling approach to investigate different collapse scenarios. While it is still unknown what caused the building collapse, Lehman gives insight into why corrosion alone is not likely to blame. “In short, corrosion is not the sole cause — it existed before the collapse. There are other important issues, and likely more than one of them contributed to this unimaginable failure,” she says. Offering a list of common culprits that may cause a building to fail, Lehman encourages the public to be patient while structural engineers from the National Institute of Standards and Technology and other organizations complete a comprehensive evaluation using forensic investigative tools. Read the full story: ce.washington.edu/news/surfside.



Research, education hub on coastal resiliency

The National Science Foundation has funded a $19 million multi-institutional team that will work on increasing resiliency among Pacific Northwest coastal communities in Northern California, Oregon and Washington. CEE faculty involved in the effort are Professors Alex Horner-Devine, Marc Eberhard, Jeff Berman and Joe Wartman. Led by Oregon State University (OSU) and the University of Washington, and based at OSU, the hub’s multidisciplinary approach will span geoscience, social science, public policy and will include community partnerships. The hub will prioritize community engagement and research and will train a new generation of coastal hazards scientists and leaders from currently underrepresented communities. The Pacific Northwest coastline is at significant risk of earthquakes from the Cascadia Subduction Zone, an offshore fault that stretches more than 600 miles from Cape Mendocino in California to southern British Columbia. The region also faces ongoing risks from coastal erosion, regional flooding and rising seas due to climate change.



Cause of deadly debris flow in India determined

Following a deadly debris flow in the Uttarakhand region of India in February 2021, more than 50 scientists including Assistant Professor David Shean and Ph.D. student Shashank Bhushan worked to determine the cause. The event began when a wedge of rock carrying a glacier broke off of a steep ridge in the Himalayan mountain range. The resulting debris flow destroyed two hydropower facilities and left more than 200 people dead or missing. A self-organized coalition of scientists came together in the days following the disaster to investigate the cause, scope and impacts. The team determined that the flood was caused by falling rock and glacier ice that melted on its descent — not by a lake or diverted river — which will help researchers and policymakers better identify emerging hazards in the region. The study, which used satellite imagery, seismic records and eyewitness videos to produce computer models of the flow, was published in the journal Science.

Meet 'Hip Hop M.D.' Maynard OKEREKE

Bringing science to underrepresented youth through creative content

CEE alumnus Maynard Okereke (BSCE '06) has made a name for himself, quite literally. Known as the Hip Hop M.D., Okereke is a science communicator working to make Science, Technology, Engineering and Math (STEM) education accessible to underrepresented youth and more through entertaining programming.

After working as a civil engineer for six years, Okereke decided to pursue his dream of working in entertainment. He moved from Seattle to Los Angeles to begin a career in music and acting, appearing in commercials and independent films. Five years ago, Okereke merged his passion for entertainment with his engineering skillset and founded Hip Hop Science, a platform that allows him to bring STEM education to more diverse audiences by collaborating with schools and other organizations.

Having spent his early years in Cameroon, Africa, Okereke knows first-hand the importance of encouraging diversity in the science field. Here he shares his approach to increasing opportunities for underrepresented youth and how he's tapped into his creative side to do so.

Photo above: Through his work to make science approachable by connecting STEM topics such as gravity to popular culture, alumnus Maynard Okereke experiences weightlessness in June 2021. The zero gravity flight was on board a custom airplane that replicates the same experience astronauts feel in space. Photo credit: GoZeroG

How did the idea for the Hip Hop M.D. come about?

After transitioning from engineering to entertainment work in Los Angeles, I started visiting casting rooms and talent offices and knew I needed to differentiate myself. I wanted to create something that truly shed light on who I was at the core and reflected my personality and humor. The Hip Hop M.D. is a representation of my true character. As both a hip-hop artist and engineer, I always felt I could only show one side or the other. Even my transition to Los Angeles was fueled by wanting to express more of my creative side. The content I created through Hip Hop Science was first sparked by listening to song lyrics and wanting to break down the facts and myths behind the subject. From there, it continued to snowball as I realized how many people were connecting to the content.

What do you do as the Hip Hop M.D.?

I use music, entertainment and comedy as tools to educate minorities and youth on a wide variety of scientific subjects: space, physics, chemistry, biology, engineering and more. The fusion of entertainment and pop culture makes STEM content more relatable to audiences who aren't traditionally exposed to these fields. I work with schools and organizations doing STEM outreach — helping to spark excitement and curiosity. I also work with companies to engage and stimulate a more diverse workforce, speaking on topics that focus on diversity and inclusion. I am able to be a more diverse face in the science field, where minorities are heavily underrepresented.

How has this approach to science education been received?

It's been rewarding seeing schools, universities, institutions and organizations respond positively about how my content has helped educate students in new and profound ways. I've shared informative content with educators on how to make STEM education more exciting in their classroom, and the feedback I've received has been amazing — students have connected with material on a deeper level. I can truly say the work I'm doing has proven incredibly valuable. It's so important to spark curiosity in our youth at an early age.

Why is diversity in STEM so important?

The STEM fields have a dramatic impact on humanity, and they are the fields of the future. Everything from medicine and engineering to technology and space science will change the landscape of our globe. It's important that minorities have a voice and presence in these fields, to ensure that our future reflects the diversity that is present in society. Currently, the STEM fields lack minority involvement, and representation is key to stimulate the next generation. Being able to see people who look like you doing incredible work in these professions is empowering, as is knowing there's a place for you at the table. The more diversity we have in these positions, the better equipped we'll be as a society to face future challenges.

What have been some of the biggest highlights so far?

This past year, I had the opportunity to go on a month-long research expedition at sea after being accepted into the Ocean Exploration Trust's Science Communication Fellowship program. The expedition took us to the North Pacific Ocean off the shores of Vancouver Island in British Columbia. The crew on board deployed seismic instruments to help develop early earthquake detection systems and collected biological samples of marine life to evaluate the impact of plastic pollution. As part of the science communication team on board, I provided live off-shore correspondence to schools and universities around the globe, as well as narrated deep sea dives we performed with underwater robots. It had always been my dream to be part of a hands-on research trip with a group of scientists, and this experience was so rewarding and fulfilling.

What does the future hold?

To share my love of science with a larger audience, one of my many goals has been to turn the Hip Hop Science platform into a show for a major television or media outlet. Bill Nye, Neil DeGrasse Tyson and Steve Irwin have been longtime idols of mine, and I would absolutely love the opportunity to communicate fun science topics to a mainstream audience.

What can others do to help inspire people of color in STEM?

We can all be advocates for diversity and inclusion. As an ally, you can support minorities at your workplace, or get involved with the education system to mentor or speak with youth. Encouraging minorities to seek leadership positions helps ensure we have a fair and balanced seat at the table. And supporting programs that work with underrepresented or underserved communities is incredibly valuable, as there are so many amazing organizations already spearheading that movement.

LEARN MORE

Keep up with the Hip Hop M.D.'s science explorations at hiphopscienceshow.com

Maynard Okereke holds a red-eared slider turtle while filming a backyard science research video on invasive species in the Southern California region.

THE BRIDGE FALL / 2021

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Send address corrections, questions and comments by email to comments@ce.washington.edu or to the return address above.

ENJOY THE VIDEO: 2021 WENK LECTURE

In early December, Tracy Kijewski-Correa presented a talk titled "Climate-Driven Coastal Hazards: The Interface of Research, Policy and Practice." The lecture explored how to foster more risk-responsive policy and practice within coastal communities, which is an urgent need after a record $210 billion in natural hazard damages in 2020.

An expert on enhancing the resilience and sustainability of hazard-exposed communities, Kijewski-Correa is the Leo E. and Patti Ruth Linbeck Collegiate Chair and Associate Professor in the Department of Civil and Environmental Engineering & Earth Sciences at the University of Notre Dame.

Enjoy the video at **ce.washington.edu/news/video**.