THE UNIVERSITY OF ALABAMA® | Alabama Water Institute

NEWSLETTER

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TWO UA ENGINEERING FACULTY TO BE RECOGNIZED BY ASCE

By Arayna Wooley,
UA College of Engineering

The Environmental & Water Resources Institute, one of the nine technical institutes a part of the American Society of Civil Engineers, has recognized two trailblazing professors from The University of Alabama who have made strides in water research.

Dr. Hamid Moradkhani, who serves as Alton N. Scott Professor of Civil and Environmental Engineering and director of the Center for Complex Hydrosystems Research, is being awarded the 2021 Arid Lands Hydraulic Engineering Award.

"I am honored to receive this recognition for such a prestigious award. This would not have been possible without great contributions from my dedicated students and postdocs over the years," Moradkhani said.

Moradkhani's research spans across hydrosystems with an emphasis on natural disasters. Particularly, droughts and floods, data assimilation, machine learning, remote sensing and climate change take the forefront of his research.

In the acceptance email, Thomas Smith III, ASCE's executive director, said Moradkhani was given the award for his contributions to data assimilation and regional water scarcity and drought studies.

Dr. Robert Pitt, retired Cudworth Professor of Urban Water Systems in the civil, construction and environmental engineering department, will receive the 2021 Julian Hinds Award.

"It is a great honor to be recognized by my peers and to be included on the list of past distinguished Julian Hinds Award recipients," Pitt said.

Pitt works on various research projects focusing on stormwater management and teaches occasional workshops on urban water systems. He has helped develop green infrastructure controls and continues to work on urban stormwater quality model development.

Smith said Pitt was chosen for the award because of his contributions in the water resources engineering field and urban water resources research.

Both recipients are fellows in the organization as well as active members of ASCE and EWRI committees. Moradkhani has been involved in the Water and Society Committee and the EWRI Watershed Council. He served as chair of the Uncertainty and Risk Analysis Technical Committee and has organized multiple panels and conference tracks over the years. Pitt worked with the Water Resources Safety Committee and the Stormwater Pathogens Committee.

They were nominated by peers and selected by the ASCE/EWRI awards committee for this distinction.

Moradkhani and Pitt will be attending the virtual award ceremony in June.

MOFTAKHARI AWARDED EARLY-CAREER RESEARCH FELLOWSHIP

By Arayna Wooley,
UA College of Engineering

National Academies' Gulf Research Program has named a University of Alabama engineering faculty member one of the 20 recipients of their 2020 Early-Career Research Fellowship.

Dr. Hamed Moftakhari, an assistant professor of civil, construction and environmental engineering, was selected because of his strong scientific and technical background, participation in interdisciplinary collaborations, community and civic engagement, effective communication and interpersonal skills.

"Getting among the top 20 awardees ensures me that here in Alabama we are working on the forefront of research, and our research products will be well-received and appreciated beyond our state or region," Moftakhari said.

The fellowship includes a $76,000 grant and a community of colleagues and researchers for support and mentorship. The two-year award began Sept. 1. Because the award is not tied to a single project, fellows have the leniency to conduct innovative and creative research.

"The early years of a researcher's career are a critical time. This program gives fellows the independence and flexibility to explore untested ideas and develop lasting collaborations," said Lauren Alexander

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MOFTAKHARI AWARD

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Augustine, executive director of the Gulf Research Program. "The 2020 class of fellows are a distinguished group of individuals who have demonstrated superior scholarship, exceptional scientific and technical skills, and the ability to work across disciplines."

The fellowship is given to rising scientific leaders who work toward community and environmental development as well as safe energy systems on U.S. coastal regions and the Gulf of Mexico.

Moftakhari's research involves coastal hydrology and is mainly focused on extreme events, like hurricanes, and minor repetitive events, like nuisance floods, which pose threats to people and assets in low-lying coastal regions. The intensity and/or frequency of these hazardous events are expected to increase over time due to human activities and sea level rise, and his research explores sustainable measures to mitigate the impact of these events.

"My plan is to develop a comprehensive resilience assessment framework that would help examining resilience of food-energy-water systems, built and natural, in the Gulf Coastal regions against projected threats," Moftakhari said.

Fellows are decided based on relevant research, merit, impact and mentor recommendations. Dr. Hamid Moradkhani, UA's Alton N. Scott professor of engineering, will serve as a senior mentor during Moftakhari's fellowship.

"I feel grateful for having fantastic mentors throughout my education and career, and especially Hamid Moradkhani who supported my application," Moftakhari said.

To be eligible for the Early Career Fellowship, researchers must have received their degree within the last 10 years and hold a scientific research position in the industry or academia. Moftakhari received his doctorate in civil and environmental engineering in 2015.

GROUNDWATER IMPACT ON OCEANS CANNOT BE IGNORED, MAJOR STUDY FINDS

A novel international review of available investigations found groundwater's influence on oceans is a critical component of coastal ecosystems' health.

By Adam Jones

Published today in Nature Reviews Earth and Environment, the study involves data from Mobile Bay collected by researchers at The University of Alabama. It's the first paper to summarize groundwater's contributions to the nutrients delivered to coastal waters on a global scale, said Dr. Natasha Dimova, an associate professor of geological sciences and co-author on the paper.

Dr. Dimova, right, and Dini Adyasari, a visiting doctoral student from the University of Bremen, Germany, check monitoring stations that detect the properties of groundwater just after discharge into the bay.

Using peer-reviewed data collected at more than 200 sites in coastal areas around the world, the study revealed groundwater, which is water that seeps underground and flows from land into the ocean through the seabed, contributed more nutrients than rivers in 60 percent of the sites and was an important contributor in many others.

Excessive nutrients, particularly nitrogen from crop fertilizers, drive widespread areas of low oxygen in coastal waters that threaten marine life, but nutrient contributions from groundwater are often overlooked in water quality models and in policies that almost exclusively consider surface water, the main contributor of nutrients to the seas.

"This is the first work that demonstrates that nutrient contributions from groundwater discharge is a factor on a global scale, and not a local issue in 'our backyard,'" Dimova said. "It also prompts us to investigate the changes different containments undergo before discharging to the coastal zone. We must know this to take proper measures on coastal water quality. Local fishery communities depend directly on such information."

Although groundwater contributes less than 3% of water to Mobile Bay, it plays an outsized influence on its water quality, according to previously published research from Dimova's research group. In the dry season, groundwater brings half of the nitrogen derived as ammonium into the bay, according to studies by Dimova.

Nitrogen is critical for the health of coastal waters, but too much of it brings problems that can affect water quality and economic activity, such as the lively seafood industry. It can lead to harmful algae blooms that result in jubilees, moments when huge numbers of marine life such as fish and crabs swarm shallow waters that can cause a massive fish kill.

The global review found that, along with fresh water from underground aquifers, there is also groundwater that is essentially recycled sea water mixed with fresh water that seeps in and out of the ground with the tides, releasing nutrients stored from decaying organic material, sometimes stored for hundreds of years.

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GROUNDWATER IMPACT

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Dimova found a similar phenomenon in Mobile Bay where the coastal sediment can capture nutrients from fresh groundwater, leaving the mix of fresh and saltwater right along the coast to release a changed groundwater that lacks oxygen.

"We suggest that this discharge on the seafloor, along with other environmental factors developing in the bay, is a factor in the development of 'bottom-up' hypoxia and the jubilees along the Alabama-Mississippi coastline," she said.

The field of coastal groundwater research took off in the 1990s when methods for detecting groundwater seepage using naturally occurring radioisotopes of radon and radium were developed, allowing for much easier and automatic data collection. Dimova's former lab at Florida State University, where she earned her doctorate, is one of two labs that pioneered this method development.

Along with data from Mobile Bay, Dimova and her students contributed data from other locations including Southern Spain and Alaska.

The effort was led by Dr. Isaac Santos, professor of marine chemistry at the University of Gothenburg in Sweden, the corresponding author on the paper that involved contributions from researchers at 13 universities.

Aspects of Dimova's research for this paper were funded by the National Science Foundation.

UA RESEARCHER STUDYING IMPACT OF HUMANKIND'S WATER FOOTPRINT

By Brock Parker

Dr. Mesfin Mekonnen

Water touches everything. Every aspect of life relies on it, whether it's nourishing the human body, sanitation or the production of everyday items. Water leaves a footprint larger than most things on the planet.

Dr. Mesfin Mekonnen, an assistant professor in civil, construction and environmental engineering at The University of Alabama, studies the water footprint and how it directly and indirectly affects the world.

"The global water footprint, sustainability of production and consumption, water scarcity and linking how consumers impact water systems in faraway places is the core of my research area," Mekonnen said.

Mekonnen became interested in environmental sciences while he was living, working and earning bachelor's degrees in economics and chemical engineering in his hometown of Addis Ababa, Ethiopia. While working in the country's Ministry of Mines and Energy, he became familiar with environmental impact assessment studies and witnessed industries routing untreated wastewater into the rivers.

Mekonnen received a Joint Japan/World Bank fellowship to study environmental science and technology at the UNESCO-IHE Institute for Infrastructure, Water and Environment in the Netherlands. It was here that he became familiar with the concept of the water footprint and began developing a footprint calculator for his master's thesis. His work caught the attention of Dr. Arjen Hoekstra, who offered him the chance to earn his Ph.D.

"The water footprint was at its early stage of development, making it more attractive to make a significant contribution," Mekonnen said.

Working as a postdoctoral researcher after receiving his Ph.D. in water engineering and management from the University of Twente in the Netherlands, Mekonnen gained more experience in water footprint assessment, modeling water use in crop and animal production, water productivity assessment and assessing global water scarcity. Later, he worked as a research assistant professor and postdoctoral associate at the Daugherty Water for Food Global Institute at the University of Nebraska.

Seeking a permanent position where he could expand his water research, Mekonnen applied for a faculty position at UA in 2020.

"During my visit here, the leadership and the faculty made it clear that water was one of the priority areas of the University," he said. "My own background check confirmed that."

Mekonnen was soon hired by UA's College of Engineering, and his talents were encouraged and supported by the Alabama Water Institute Executive Director Scott Rayder and AWI Global Water Security Initiative Director Michael Gremillion.

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UA RESEARCHER STUDYING IMPACT OF HUMANKIND'S WATER FOOTPRINT

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"Mesfin's research will enable our society to better appreciate water's impacts on all aspects of our livelihoods as water-related crises will become more widespread in the coming decades," said Gremillion.

Thanks to funding from the AWI and GWSI, one of Mekonnen's current projects is the Global Hydrology and Water Footprint Assessment Tool.

"The goal is to develop a dynamic tool to be used by the center and others interested in finding answers to some of their questions," he said.

According to Mekonnen, some questions are related to what extent the production of a certain product is going to deplete rivers and affect ecosystems, which product will be exposed to water-related risk, and what the water footprint of a certain product is and how can it be reduced. He also said a multinational company in the U.S. may want to know if the materials it sources from other countries will be exposed to disruption due to water scarcity.

"The Global Hydrology and Water Footprint Assessment Tool project will help me develop my research as it will generate valuable data for other researchers, industries, environmental groups and policy makers," said Mekonnen. "In addition, I can use some of the modeling exercises to integrate in my course and teach students."

Mekonnen will be collaborating with UA's Center for Complex Hydrosystems Research, Center for Water Quality Research and Center for Sustainable Infrastructure. He will also be developing and submitting a CAREER proposal in the area of nutritional sustainability of food systems to the National Science Foundation.

"The food system is one of the main sources of environmental impact: water pollution and depletion, greenhouse gas emissions, nutrient pollution and land use change," he said. "The effects are not localized as consumers in the U.S. may have a large impact in faraway places, and consumers in other countries may also contribute to depletions here, such as the High Plains aquifer in the western U.S."

Although the idea is still in the early stages of development, Mekonnen would like to create a telecoupled framework to link the food system with diverse effects across different spatial levels and learn how to ensure that the provision of required nutrition does not lead to major environmental impacts.

Mekonnen said he believes the results of these projects will have far-reaching benefits.

"There are global tools, but they are all static and provide data that is not up-to-date," he said. "At the end of the project, I hope we will have a dynamic tool that will provide the latest data and have the capability to do further analysis."

HOW TO GET AFFILIATED WITH THE ALABAMA WATER INSTITUTE

If you have expertise that could contribute to addressing complex water issues, please register yourself on our website. All registered members are considered affiliated with AWI and have access to all AWI resources.

To register, visit the AWI website: ***awi.ua.edu***

Eligibility Criteria:

- A faculty/staff/student appointment at The University of Alabama.
- Research expertise in a water-related field.
- Completion of registration form.

Questions?
Please contact Stefanie O'Neill at: soneill2@ua.edu or 205-348-9128.

The Alabama Water Institute is currently seeking guests for its podcast. Take advantage of this opportunity to promote your research to a wider audience.

Contact Brock Parker at: brockparker@ua.edu or 205-348-5328
for more details and to schedule a recording.

NEARLY A THIRD OF MOBILE BAY MARSHES GONE SINCE 1980S, STUDY FINDS

About half a football field of marshes on the edges of Mobile Bay vanished annually over the past 35 years, according to a study by researchers at The University of Alabama.

By Adam Jones

The study of satellite and aerial images from 1984 to 2019 showed a loss of about 30 percent of saltwater marshes, critical for the health of oceans. The annual decrease of roughly 2,488 square meters means about 1% of marshes around the bay retreated each year over the course of the study, according to findings published in the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

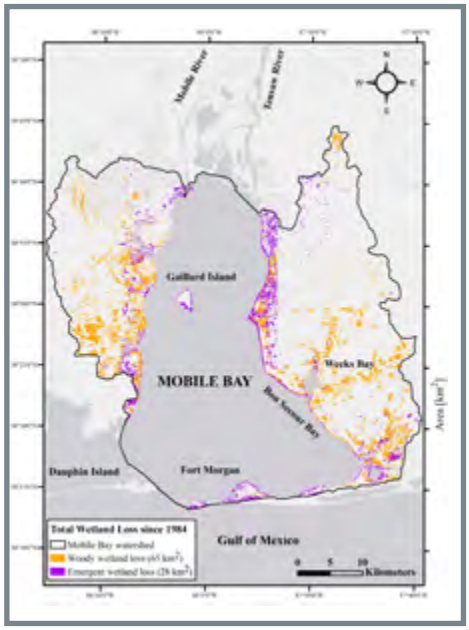
The project is the first to apply analyzation of satellite images through computer modeling to quantify not only the change in marshes, but to show how land along the bay changed through time, providing detailed, annual information that fine-tuned models with the ability to show how future actions should influence marsh and wetland habitat.

"This is the first time that the team here has tried to quantify the losses in the past decades because of the availability of high-quality satellite images," said Dr. Behzad Mortazavi, professor and chair of biological sciences and a leading researcher of Mobile Bay and its marshes. "There is variability year to year, but the long-term trend is clear: we are losing marshes."

For the study, Mortazavi teamed with scientists at UA's Center for Complex Hydrosystems Research, who used publicly available images to classify land and program a machine learning model to show gains and losses of land types over time.

"The classical type of understanding of two snapshots of history verses the present doesn't give you the deep understanding of the dynamics underneath. We have enough data now to calibrate for long-term projections," said Dr. Hamed Moftakhari, assistant professor of civil, construction and environmental engineering. "We developed powerful models that benefit from high-performance computing on campus. These models help us build a basis that will let the stakeholders and decision-makers come together around a table. It creates an environment that favors effective communication among them by visualizing the results of their decisions."

The health of the bay requires marshes, which act like nature's wastewater treatment plants, Mortazavi said. Besides removing excess nutrients from freshwater entering the bay, marshes stabilize the shoreline, buffer waves, gird against coastal flooding and serve as habitats for wildlife. However, they are disappearing along the world's coasts, and Mobile Bay has been no different.



Marsh loss seen in satellite images is isolated in purple and orange colors in a map of the Mobile Bay watershed.

Marsh loss is attributed to urbanization and land development as barriers to marshes growing inward, sea level rise, loss of sediments flowing from dammed inland rivers as well as natural contributors such as tropical storms.

Mortazavi's research has found Mobile Bay's marshes are vanishing through comparisons of present-day images with historical maps and records, which lines up with global research on marsh habitats. However, this is the first detailed analysis of marshes, wetlands and all land types around Mobile Bay each year over a longer period of time.

"I was blown away," said Mortazavi of the results of the study. "I was really amazed that in such a short time we have lost nearly a third of the marshes. This has real implications for this state."

The model created for the project, validated with the annual data since 1984, can show, for instance, how marshes should respond to a powerful hurricane or a land development, Moftakhari said. It can be the foundation for communication among stakeholders considering policies or land use, he said.

ALABAMA WATER INSTITUTE AWARDS MULTIPLE EQUIPMENT GRANTS

By Brock Parker

In the ongoing efforts to support water-related research at The University of Alabama, the Alabama Water Institute has awarded five faculty members a total of $76,630 through the AWI Equipment Support Program.

Dr. James Harris, assistant professor in UA's Department of Chemical and Biological Engineering, has been awarded $30,130 from the AWI for a diffuse reflectance UV-Visible spectroscopy system, the first of its kind in Alabama. This system will allow UA researchers to quickly and easily measure oxidation states and coordination numbers of metal atoms in solid samples, which will help them detect and reduce the amount of pollutants in water. The equipment also received $25,000 in cost-share funding.

"The entire group of faculty members and I are extremely grateful for the support of the research infrastructure here at UA in general and of this AWI equipment support request in particular," Harris said.

The AWI awarded $25,000 to Dr. Kenneth Hoadley at Dauphin Island Sea Lab for a flow cytometer, which will allow researchers there to study the diversity and function of microbial and plankton dynamics in a variety of habitats. Hoadley requested the cytometer to speed up analysis of microbial communities, and it will also be beneficial to students wanting to learn more about those communities in a marine environment. A cost-share in the amount of $59,572 was also awarded.

"This is very exciting and a major new resource that will undoubtedly be utilized by numerous faculty members for both research and training," said Hoadley, an assistant professor in UA's Department of Biological Sciences.

"The entire group of faculty members and I are extremely grateful for the support of the research infrastructure here at UA in general and of this AWI equipment support request in particular."
-Dr. James Harris, assistant professor, Department of Chemical and Biological Engineering

Dr. Feng Yan, assistant professor in the Department of Metallurgical and Materials Engineering, was awarded $10,000 from AWI for a glovebox. The glovebox is designed to control air-sensitive and hazardous materials, and Yan's version will prevent toxic materials from being exposed. Yan currently has six active research projects through various federal agencies where this glovebox will be useful in areas of water research.

He was also given $16,457.10 in cost-share funding.

Dr. Mark Elliott, associate professor in the Department of Civil, Construction and Environmental Engineering, was awarded $6,500 from AWI, along with $6,507 in cost-share funding, for a Sterlitech crossflow filtration system with digital pressure gauges. They system will allow Elliott's research group and others on campus to leverage their expertise in wastewater and membrane technology to make substantial advances in understanding how emerging functionalized membranes perform in real-world applications.

The AWI has awarded $5,000 to Dr. Evan Wujcik, assistant professor in the Department of Chemical and Biological Engineering, to purchase a high-speed camera for nanofiber research. The camera will complement Wujcik's current electrospinning equipment, which is used in nanofiber production. Both applied and fundamental fiber studies will be made possible by the camera, allowing for an increase in the consistency and quality of the nanofibers for filtration, detection and remediation.

For more information about how to apply for AWI support program and for deadlines, contact Stefanie O'Neill at soneill2@ua.edu

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