

ISSUE 1 - 2026

FIELD NOTES

FROM THE BUREAU OF ECONOMIC GEOLOGY

WATER and the LONE STAR STATE



Lorena Moscardelli
Director
State Geologist of Texas



The University of Texas at Austin
Jackson School of Geosciences



CRITICAL MATERIALS RESEARCH CENTER

THE UNIVERSITY OF TEXAS AT AUSTIN

The **Critical Materials Research Center** at The University of Texas at Austin will be led by the Bureau of Economic Geology and adopt an interdisciplinary approach to our research, in collaboration with the Jackson School of Geosciences and UT Energy Institute.

To learn more, visit:

CMRC.beg.utexas.edu



The University of Texas at Austin
Jackson School of Geosciences

The University of Texas at Austin
Energy Institute

ISSUE 1 - 2026

Published by
Bureau of Economic Geology

Editor
Lorena Moscardelli

Co-Editor
Carson Werner

Art Director
Ted Hennessy

Photography
Carson Werner (unless otherwise noted)

Copy Editor
Susan Quaglino

FIELD NOTES is the Bureau of Economic Geology's biannual publication that presents research and insights at the intersection of energy, environment, and economics. Each issue features innovative studies, practical solutions, and forward-thinking perspectives that shape the future of resources in Texas and beyond. Topics span the full breadth of the Bureau's work—from water and energy research to environmental stewardship, resource sustainability, and the critical role of the subsurface in modern society.

[Click here for more information and to subscribe to FIELD NOTES.](#)

Contact us: fieldnotes@beg.utexas.edu

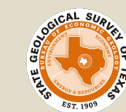
Address
Bureau of Economic Geology
The University of Texas at Austin
10100 Burnet Rd., Bldg. 130
Austin, TX 78758-4445

Telephone (512) 471-1534
Fax (512) 471-0140

[@bureau-of-economic-geology](#)

[@BureauofEconomicGeology](#)

www.beg.utexas.edu



The University of Texas at Austin
Jackson School of Geosciences

ON THE COVER: The Pedernales River at Pedernales Falls State Park, Texas. Photo by Carson Werner.

FIELD NOTES

FROM THE BUREAU OF ECONOMIC GEOLOGY

Message from Bureau Director and State Geologist of Texas



WATER and the LONE STAR STATE

Water is easy to take for granted—until it's not there. As the state grows and droughts intensify, securing reliable water supplies has become urgent. Under Drought-of-Record conditions, Texas could face a shortage of 3.6 million acre-feet of water per year by 2030, according to the Texas Water Development Board (TWDB).

Texas has seen this before. From 1949 to 1957, the state endured extreme drought. Rainfall dropped by up to 50%, temperatures soared, towns hauled in emergency water, crops failed, and half of Texas farms and ranches disappeared—leaving an economic toll estimated at roughly \$30 billion in today's dollars.

Those extremes helped shape modern Texas. But today, the stakes are even higher. More than 30 million people live here now, and that number is projected to reach nearly 51 million by 2070. More people, more extreme weather, and finite water supplies mean the margin for error is shrinking fast.

That's where the **Bureau's Texas Applied Water Research team** comes in. **The Bureau of Economic Geology**—founded in 1909 and the oldest research unit at The University of Texas—has played a central role in water and environmental research for more than a century. As the **State Geological Survey of Texas**, the Bureau continues to help Texans understand the resources they depend on every day.

Today, the **Texas Applied Water Research team** is tackling some big, practical questions:

Where is usable water available? How are water and energy systems connected? How can we reduce risks from floods, hurricanes, and other natural hazards? How does water move through landscapes and underground? And just as importantly, how do we make complex data clear and useful for communities, decision-makers, and the public?

This issue offers a window into that work—and why it matters, even if you don't think much about water unless it's flooding your street, missing from your tap, or flowing into your glass. You'll also meet the people behind the science—both new faces and familiar ones—who are working to generate the knowledge Texas needs to better understand its water and prepare for the future.

Lorena Moscardelli
Bureau Director and State Geologist of Texas



WATER RESOURCES PODCAST

WITH **Bridget Scanlon**



Some estimates suggest there are now more podcasts than stars in the known universe. Yet only one is hosted by one of the world's most knowledgeable and respected hydrogeologists: **Bridget Scanlon**. With over 40 years of experience, few are better suited to offer the deep insights and forward-thinking perspective she brings to every episode. Is she the real deal? She has her own Wikipedia page—and if that's not enough, she is both a GSA and AGU fellow, a member of the National Academy of Engineering... the list goes on.

On the **Water Resources Podcast**, Bridget talks with experts about the challenges—and potential solutions—to water resource problems related to climate change, like droughts and floods, as well as overexploitation by humans. Episodes range from specific issues facing cities like San Antonio to impacts on the global food trade. With over 70 episodes and counting, there's no shortage of topics to explore.

Plus, it's probably healthy to take a break from celebrities talking to their celebrity friends about being celebrities and listen to real facts from real scientists and water experts.

CONNECT & LISTEN:

wrp.beg.utexas.edu



CONTENTS



4
Water Systems & Drought in the Texas Hill Country
Turning scattered water data into drought-ready tools for the Texas Hill Country



7
Shaping Texas Water
Training the next generation of water scientists



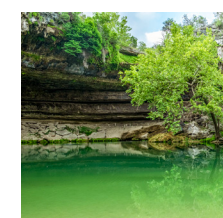
8
TxSON: Monitoring the Invisible
Soil moisture data can save lives and ecosystems



14
Listening to an Aquifer
Turning background noise into a groundwater monitoring tool



15
Building Sustainable Data Centers in Texas
Navigating Texas' data center water challenge



16
Preserving Hamilton Pool
Just because this iconic Texas landmark has never gone dry doesn't mean it won't



20
From Wet to Dry and Back Again
Understanding the swings between flood and drought to build water resilience



22
Not Just Rocks
How the Near Surface Observatory helps the state manage natural hazards



28
Mapping the Brazos Alluvium Aquifer
Making sense of a complicated water resource in east-central Texas



30
Advancing Flood Prediction and Resilience in Texas
AI-powered flood forecasting to give Texas communities critical time to act



32
From Maps to Action
Mapping underserved communities to guide critical infrastructure investments



34
Inside Hurricane Helene
Lessons from Helene: better forecasting, data, and warnings for the next big storm

WATER SYSTEMS & DROUGHT in the TEXAS HILL COUNTRY

Justin Thompson inspects the water well at UT's White Family Outdoor Learning Center.



A big storm rolls through Texas. Your cookout is ruined, but your lawn is green again (happy now, HOA?), and the U.S. Drought Monitor shifts from “severe” to “none.” Problem solved? Not quite. If soils were bone-dry while groundwater and reservoirs were already struggling to meet demand, water levels can continue to decline even after a drought “officially” ends. Many of drought’s most significant impacts happen underground—out of sight, and often out of mind.

Despite the focus on using drought-of-record conditions in the Texas water planning process, we still don’t fully understand how drought impacts our hydrologic systems, especially the parts we can’t see, like soil moisture and groundwater. (See the [TxSON article](#) for why soil moisture matters so much.)

Bad News and “Opportunities”

The 2011–2015 drought was devastating for many Texas communities. In some places it exceeded the historic drought of the 1950s and became the new drought of record. There was one silver lining: significantly more data was captured during the 2011–2015 drought, presenting an opportunity for detailed research.

Texas has an abundance of water data: stream gauges, monitoring wells, reservoir levels, precipitation records. But it’s scattered across agencies, stored in different formats, and often needs significant processing before it’s useful to decision-makers, policymakers, or the public. Turning raw data into information people can really use requires expertise and resources.

Researchers at the Bureau, led by Justin Thompson, are taking on this challenge by digging into more than a decade of data from the Texas Hill Country, from 2010 to 2024. They’re asking three big questions: Can we pull all the available water data into one clear, easy-to-use picture? How does drought ripple through everything—from soil moisture to groundwater? And what can this tell us about reducing drought risk and better protecting our water resources?

Synthesizing Data

By pulling available water data into a common framework, researchers can answer fundamental questions in an approachable way: Where is water located? What type? How much? When does it change? Who manages and uses it?

The team is building on existing hydrologic methods but treating these systems holistically—accounting for all the ways water moves in and out, including human manipulation like pumping, diversions, and reservoir operations.

They are developing a web-based visualization and mapping tool that shows how water system volumes change over time and allows users to compare key parameters—such as soil moisture, groundwater levels, and precipitation—for their area of interest in the Hill Country.

Research Team: Justin Thompson (PI), Hassan Dashtian, Wonhyun Lee, Mary Eminue, Maria Ulatowski, Aylar Samadi, Preston Fleck, Audrey Donovan, Jon Paul Pierre

Sponsor: Texas Imperative (State Funding)

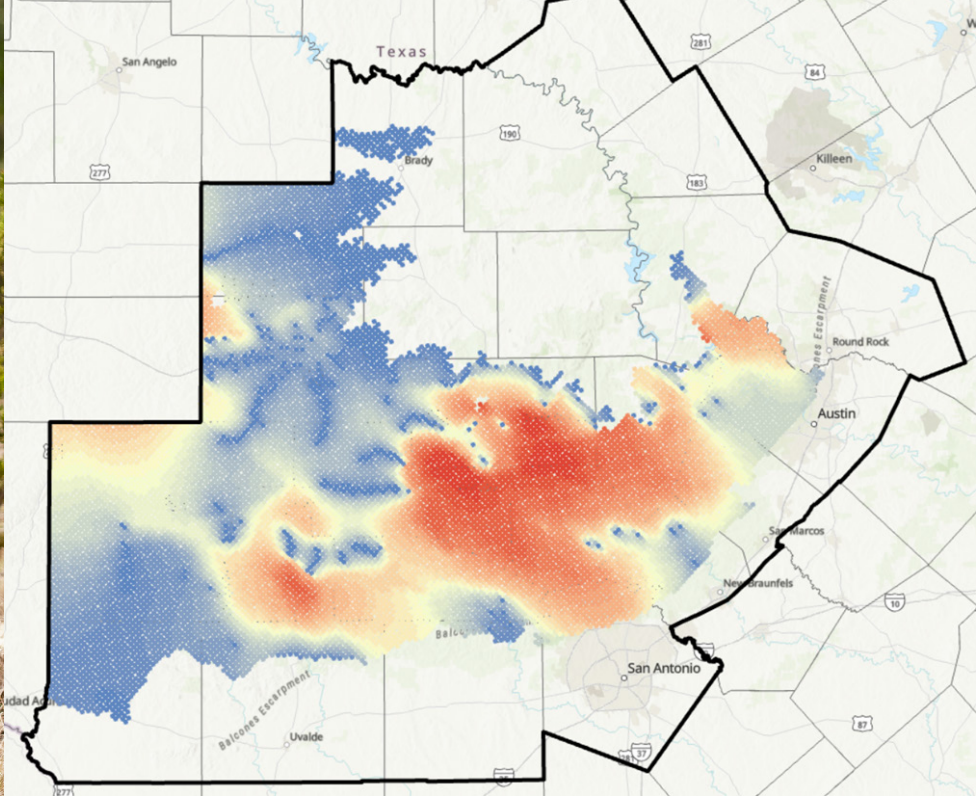
Status: In Progress



Did You Know?

The 1950s Texas “drought of record” (1947–1957) lasted nearly a decade, turning pastures to dust, forcing mass cattle sell-offs, and triggering a rural-to-urban population shift. The drought finally broke in the spring of 1957 when a series of large storms brought much-needed rain, along with hail, tornados, and destructive flooding.

Photo: Creative Commons



Photos: Marcus leading a field course for professionals and students at the White Family Outdoor Learning Center outside Austin, Texas.

MARCUS GARY: SHAPING the FUTURE of TEXAS WATER EDUCATION

Above Left: Justin explains how the high permeability of the limestone rock that makes up much of the Hill Country shapes the way water moves in this area.

Above Right: Projected drawdown of the Edwards-Trinity Plateau Aquifer in the 2006–2071 period generated using the Groundwater Availability Model and 2021 groundwater planning process data.



Did You Know?

The Bastrop Complex Fire (2011), fueled by extreme drought conditions, destroyed more than 1,300 homes and scorched over 34,000 acres.

Photo: Patsy Lynch, Public Domain

Drought Impacts on Water Systems

The team is in the early stages of using historical data and machine learning to figure out not just how Hill Country water systems responded to past droughts, but how they might respond to future ones—ones that could be longer or more extreme than anything we’ve seen to date.

They’re looking at connections between the things that drive drought, like heat and lack of rain, and what actually happens in the water systems. The key is identifying which impacts are linked and whether there are feedback loops. Does one system’s failure make another worse? And critically, they’re accounting for human decisions, like drought management plans and reservoir operations, because those can completely change how a water system would respond naturally.

Water Resource Drought Risk and Resilience

Putting the synthesized data and deeper understanding of drought together will enable better water resource management in the Hill Country.

One area the researchers are exploring is the vulnerability of groundwater wells. The team is looking at what conditions cause wells to fail and what can be done to restore production. Many public water systems and individual houses that are dependent on groundwater lack the resources to predict these failures, ending up in water supply emergencies.

The second area focuses on the efficacy of drought contingency plans. By analyzing past instances when drought contingency plans were enacted using these newly developed tools, they can evaluate the success, or failure, of those plans. They can also forecast the effectiveness of these plans on hypothetical future droughts.

Ultimately, this project will transform scattered water data into practical tools that help Texas Hill Country communities better anticipate, withstand, and recover from drought. ➔

After 25 years at the USGS and the Edwards Aquifer Authority—and now in a joint appointment at the Jackson School of Geosciences, where he conducts research at the Bureau of Economic Geology and teaches in the Department of Earth and Planetary Sciences—**Marcus Gary** knows Central Texas water. He’s a real adventurer—a certified diver who has explored some of the world’s deepest underwater caves and a field geologist who has worked all over Texas.

For the past 15 years Marcus has been sharing his deep knowledge of Texas hydrology with a new generation of scientists by teaching and leading water-related field courses for the university. Now, thanks to a \$1,000,000 anonymous donation to the Jackson School, that program is getting a serious upgrade. The money will help fund student internships and research, buy necessary field equipment and instruments, and connect the public with the valuable data that is being collected through this program.

When he’s not in the field with students, Marcus is using funding from the Texas Water Development Board (TWDB) to study the interaction between groundwater and surface water along the Devils River in West Texas. The Devils River is a spring-fed river system renowned for its pristine ecosystem and high species diversity. The river is fed by the Edwards-Trinity Aquifer System, and that water eventually contributes to the Rio Grande/Amistad Reservoir, supporting critical habitats for threatened and endangered species, and serving as a valuable recreational resource for Texans. ➔

[Read a news story from the Jackson School about Marcus and the donation to the hydrology program.](#)



Calibrating the precipitation gauge at a TxSON station located at the Lady Bird Johnson Wildflower Center.

TxSON

Tracking the Water You Can't See



How often do you think about soil moisture? Maybe you check to see if you need to water your house plants or your garden, thinking this is the year you grow **one** respectable watermelon—though let's be honest, it'll be underwhelming, and you'll wonder why you, yet again, didn't just stick to peppers.

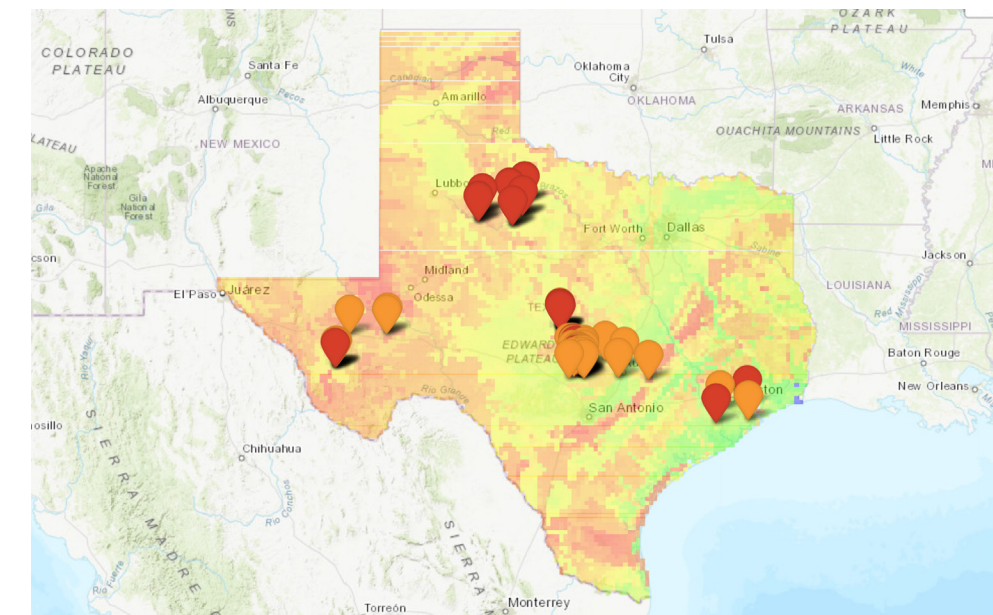
So yes, soil moisture is partly to blame for your sad little melon. But it's way bigger than that: When the soil is saturated, heavy rain becomes floods. When soils are dry, they suck up the water before it recharges our rivers and aquifers. It also has a vital role in keeping ecosystems alive. And for a long time, we weren't keeping track of it.

Enter TxSON

The Texas Soil Observation Network (TxSON) is a statewide soil moisture monitoring effort that tracks water stored beneath our feet. The stations cover parts of the Texas Hill Country around Fredericksburg, West Texas near Marfa, and regions of North Texas south and west of Lubbock, providing real-time measurements of soil moisture, as well as temperature and precipitation. These observations fill an important data gap in one of the nation's most under-monitored hydrologic components.

TxSON puts an emphasis on careful sensor placement, measuring moisture at multiple depths, maintaining consistent long-term records, and ensuring the data is reliable and well-documented. The stations contribute to the broader ecosystem of soil-moisture monitoring in Texas and serve as an important complement to networks like TexMesonet, run by the Texas Water Development Board.

TxSON now has over 10 years of nearly continuous hourly data, collected from dozens of stations. This dataset has been downloaded 34,500+ times by researchers worldwide and is used to validate NASA's SMAP satellite, which measures soil moisture from space (yes, space). High-quality soil moisture observations improve drought and flood forecasting, strengthen groundwater models, and support conservation planning.



Research Team: Jon Paul Pierre (PI), Michael Young, Hassan Dashtian

Sponsor: Jackson School of Geosciences and State Funding

Status: In Progress

Jon Paul (pictured on page 11) is an ecohydrologist and conservationist who specializes in soil and vadose zone processes, working with landowners and land managers to achieve their land stewardship goals. He spends his free time biking, hiking, kayaking, and collaborating with cats, dogs, and other animals on important outdoor projects, like hiking and swimming, sometimes permitting other humans to tag along.



Above: Tyson McKinney and Bissett Young installing a TxSON station at the Lady Bird Johnson Wildflower Center.

Left: Map showing the locations of TxSON stations in the state overlying SMAP soil moisture data.

The TxSON station at the Lady Bird Johnson Wildflower Center provides additional data to the science team at the center.



Bureau Researchers Hassan Dashtian and Jon Paul Pierre working on a TxSON station in west Austin, Texas.

Photos this page courtesy Jon Paul Pierre



Why It Matters

Floods happen when soil can't absorb more water.

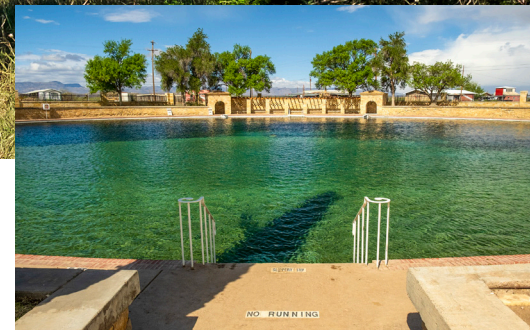
In 2015, the Wimberley flood killed 13 people and destroyed 350 homes. The soil was completely saturated. When the information is available, real-time soil moisture data can give forecasters and emergency managers critical hours of warning before conditions turn dangerous.

Droughts persist because soil takes forever to recharge.

During the 2011 Texas drought, researchers estimated Texas lost 50 million acre-feet of water. (For context: Texans use about 18 million acre-feet per year.) In some regions, changes in soil water storage accounted for a substantial portion of those losses. Even after rain returned, it took years for soils to recover—prolonging the drought impacts.

Beyond the Hill Country: Springs, Pupfish, and Groundwater Models

For the past several years, Bureau researchers working with The Nature Conservancy have been monitoring desert springs in West Texas: Diamond Y, Sandia, and Karges Springs. These are tiny oases that support some of the rarest species in North America: endangered pupfish, snails found literally nowhere else on Earth, and ecosystems hanging by a thread.



Did You Know?

San Solomon Springs stands out as a significant artesian spring system located in West Texas and is recognized as an important geoheritage site for its hydrologic and geological significance. Renowned for its role in sustaining Balmorhea State Park's massive spring-fed swimming pool—the largest of its kind globally—the springs draw their water from a substantial underground aquifer system. This remarkable source creates a perennial oasis amid the arid Chihuahuan Desert landscape, offering not only recreational opportunities but also vital habitat for rare and endangered species such as the Comanche Springs pupfish and the Pecos gambusia. The ecological importance of San Solomon Springs is underscored by its ability to support both biodiversity and human enjoyment, making it a unique and treasured resource in the region.

The data show how quickly springs respond to rain, drought, and upstream changes. In some cases, conditions have become so dry that managers are weighing active intervention, like pumping water in, simply to prevent the loss of endangered species.

The information feeds directly into regional groundwater models and is being used by conservation groups and groundwater districts to better understand how pumping, climate variability, and geology interact. Desert springs are resilient, but not invincible. Keeping them alive depends on sustained attention, good data, and acting before small changes become permanent losses.

The big takeaway is simple: you can't manage what you don't measure. By tracking the water we can't see, TxSON helps Texans make better decisions—earlier, and smarter. 🇹🇽

 [Learn more about the TxSON Program and explore the data.](#)

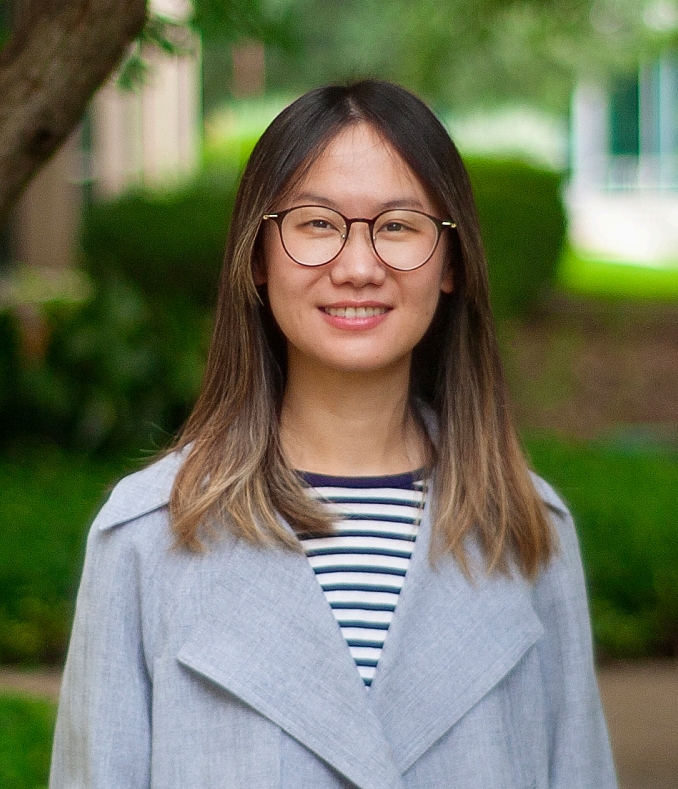
TxSON has stations in a wide variety of places, like Mimm's Ranch in Marfa, Texas. Some are easier to access than others.



BALMORHEA

April 2026: A welcome view from Balmorhea State Park as storms roll through the Davis Mountains, bringing much-needed rain to the area.





A TexNet seismic station. TexNet operates over 200 stations across the state that continuously and accurately record seismic data.

Shujuan (above left) is a geophysicist whose research lies at the intersection of seismology, groundwater hydrology, and energy science. She develops 4-D seismological methods to study how shallow fluid-rock systems evolve over space and time.

Research Team: Shujuan Mao (lead-PI), Justin Thompson (PI), Andrey Bakulin (PI), and Alexandros Savvaidis (PI)

Sponsor: Bureau of Economic Geology and Earth and Planetary Sciences

Status: In Progress

LISTENING to an AQUIFER

The ground beneath your feet is always moving. You probably don't notice it—unless it's an earthquake—but everyday activities like trucks driving down the road, waves crashing on the beach, and people walking down the street, generate faint vibrations in the ground. Usually, these signals are treated as unwanted noise, obscuring earthquake measurements. But what if this “noise” could be used to reveal how groundwater levels change over time?

Researchers at the Jackson School of Geosciences are doing just that. Using recent advances in geophysics, they are turning ambient seismic noise into a useful signal to monitor the Carrizo-Wilcox Aquifer in Central Texas. The Carrizo-Wilcox stores more water than any other aquifer in the state and is a critical source of water to the rapidly growing population along Interstate 35.

Researchers are analyzing data from 24 seismic stations distributed across the Carrizo-Wilcox Aquifer to test whether this technique can track changes in groundwater storage over time. This new monitoring approach offers clear advantages. Background vibrations occur constantly and everywhere, enabling continuous observation across large areas while avoiding the expense, access issues, and spatial limitations of drilling wells.

Better yet, Texas already has much of the necessary infrastructure in place. The Texas Seismological Network (TexNet) at the Bureau of Economic Geology operates a statewide array of seismic stations that continuously record ground motion, and pre-existing fiber-optic cables in the area are being repurposed to capture even more data.

If successful, this method could provide a cost-effective way to monitor one of Texas' most critical water resources—transforming background noise into a powerful tool for aquifer management. Given the scale of current and proposed groundwater-pumping projects, the stakes are high: these activities could significantly affect local and regional groundwater storage. Communities that depend on this water—and the decision-makers responsible for managing it—want to understand how the aquifer will respond. ↴

 [Learn more about Shujuan's research projects.](#)

Chief economist and COMPASS Principal Investigator, Ning Lin, speaking to members of the Data Center Water Task Force.




BUILDING SUSTAINABLE DATA CENTERS in TEXAS

AI seems to be everywhere these days. It's helping geoscientists improve flood predictions, supporting doctors in diagnosing disease... and who knows, maybe it even helped write this article. And even if the skeptics turn out to be right and today's AI hype cools off, one thing won't change: we'll still need data centers—lots of them. Someone has to store your emails, your playlists, and all those videos from the era when flash mobs felt like a great idea.

Data centers are rapidly multiplying across Texas. The state has become one of the largest and fastest-growing data center markets in the country—a big win for the economy and our digital infrastructure. But there's a tradeoff: data centers need water.

Keeping rows of servers from overheating requires water, and even more is needed to generate the energy that powers these facilities in the first place. And as you've hopefully gathered from this issue of Field Notes, water in Texas is precious.

That's where the COMPASS research group at the Bureau comes in. Our scientists are studying the water, energy, and infrastructure demands of Texas' data-center boom to help decision-makers balance economic growth with responsible resource management and regional resilience. Because powering new technologies works best when it's grounded in good science—and thoughtful planning. ↴

 [Read the white paper on the evolving demands of water use for data centers in Texas.](#)



PRESERVING HAMILTON POOL

Why This Iconic Texas Landmark Has Never Gone Dry

Living in Central Texas can be both a blessing and a curse. The bad news first: more often than not, it's hotter than heck. But, if you can get in your car without melting, we are blessed by an abundance of natural swimming holes.

Brian Hunt explains the geology of Hamilton Pool and how it impacts the movement of water.



Brian (left) is a hydrologist and field geologist with over 20 years of experience mapping Texas geology and advancing groundwater research. He loves teaching and finds joy in the outdoors through his work.

One of the most famous, and beautiful, swimming holes in Texas is Hamilton Pool—a jade green pool fed by a fifty-foot waterfall with a collapsed grotto for shade. It has attracted people for over 8,000 years, and continues to draw thousands of visitors a year. In recorded history it has never gone dry, but that doesn't mean that it never will.

Hamilton Pool Preserve and neighboring Reimers Ranch Park—also home to a number of springs and natural pools—are located about twenty-five miles west of Austin in Travis County. Creeks are the lifeblood of this area. Hamilton Creek cascades over the cliff above Hamilton pool keeping it filled, even in times of drought. But the interesting part of the story is happening out of sight, beneath our feet in the subsurface. The water source to the creeks primarily comes from natural springs that are fed by groundwater from a small portion of the Trinity Aquifer. The rock layers that form this section of the aquifer are full of cracks and voids that can store, and move, large quantities of water.

Groundwater is vital just about everywhere, but in southwestern Travis County it supplies drinking water to homes, sustains wildlife and lush landscapes, and supports the recreational experiences that make these natural areas so beloved. However, over the last 50 years the water level in the Trinity Aquifer has been decreasing, in some places considerably, meaning certain springs have stopped flowing and wells have gone dry. If more springs go dry, eventually Hamilton Pool will, too.

The area around Hamilton Pool is beautiful, so much so that people continue flocking to the region despite the sweltering Texas heat. This growing population places increasing pressure on the very water resources that make the landscape so appealing. At the same time, this area, already prone to drought, is getting hotter and drier. As demand rises and rainfall declines, water levels in the Trinity Aquifer continue to drop. Without meaningful conservation measures, the ecological and recreational environments that make these parks special could suffer lasting damage.



Did You Know?

Hamilton Pool Preserve, a collapsed limestone grotto long valued as a natural swimming hole, was purchased by Travis County in 1985 and formally designated a protected nature preserve in 1990 to conserve its unique geology, hydrology, and Hill Country ecosystem.

Research Team: Brian Hunt (Bureau Lead), Marcus Gary, Bridget Scanlon, Vicky Kennedy (Kennedy Resource Consulting)

Sponsor: Travis County

Status: Project Completed



Above: Bureau researchers conduct a dye tracing test to determine subsurface flow paths. While the color is alarming, the dye is harmless and biodegradable.

Below: Brian taking measurements in neighboring Roy Creek, which is part of the same hydrogeologic system as Hamilton Pool.

Photos this page courtesy Brian Hunt

Since 2021 Travis County has commissioned the Bureau to conduct a multi-year study of the geology and hydrology in the Hamilton Pool and Reimers Ranch area to better understand these threats and identify pathways to better preserve these resources. In a recent Bureau study that was sponsored by Travis County, researchers led by Brian Hunt employed several approaches to understand how this portion of the Trinity Aquifer functions and how pumping groundwater from wells directly impacts spring flow.

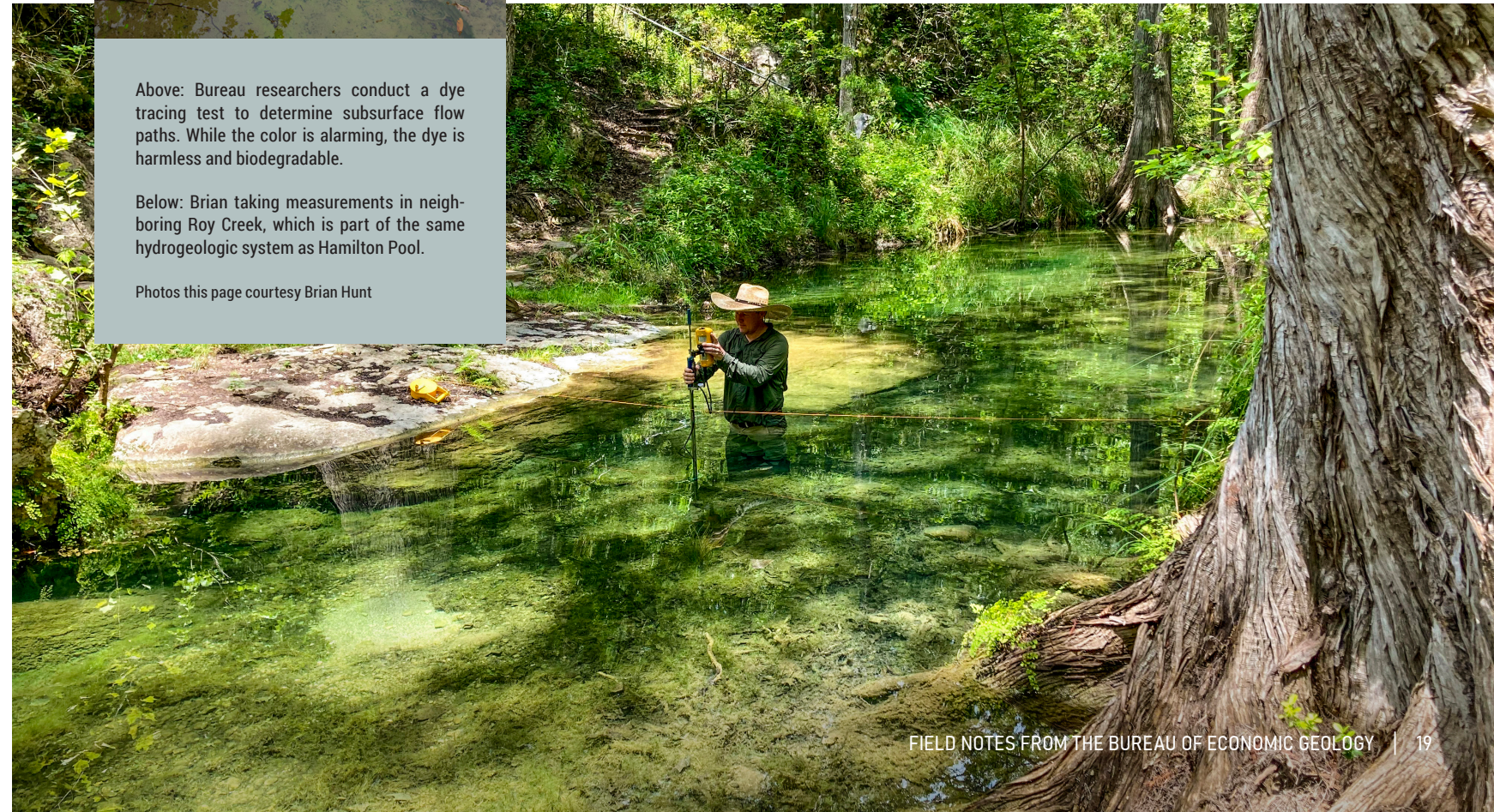
They created detailed geologic maps to better understand the area's rock formations; knowing where the rocks are more porous and permeable gives a better understanding of where recharge—refilling of the aquifer—occurs and how water may flow underground.

Much like a doctor running tests on a patient, the researchers used various diagnostic tools to measure the health of the aquifer that, due to its underground nature, are not readily observable with the naked eye. Monitoring wells allow direct measurement of water level heights in the aquifer. An alarmingly bright neon dye, which looks like radioactive ooze but is a harmless, biodegradable tracer, was injected in wells and recharge features to determine subsurface flow paths. Also, various chemical analyses provided insight into subsurface water dynamics. Taken together, these cool tools helped solve the intricate puzzle of understanding water flow behavior beneath the surface.

The study has already had a significant impact by delineating the vulnerable “Hamilton Pool segment” of the Middle Trinity Aquifer. This prompted the Groundwater Conservation District to establish a special management zone that will enable the implementation of conservation rules to protect this area. Brian and his team provided essential science to help shape regulatory policy and influenced a nearby housing development to change their plan from using Trinity Aquifer groundwater to the same Highland Lakes system that supplies Austin. This means less stress on the aquifer and a better chance that on some blistering August day 8,000 years from now, someone, or some *thing*, will still be able to dive into Hamilton Pool's jade waters. 🇹🇽



Watch a video about the geology and hydrology of Hamilton Pool.





FROM WET to DRY and BACK AGAIN

Adapting Irrigation and Recharge for U.S. Water Resilience

Forecasting the future is never an enviable task. When predictions are right, they fade into the background; when they're wrong, even by a little, people remember. Anyone who has checked two weather apps before planning a weekend, then a third to break the tie, then a fourth because that one seemed suspiciously optimistic, then just stared at the sky for a while, knows how uncertain forecasts can be. Long-term climate projections are even harder, especially in Texas, where conditions swing between deep drought and sudden floods.

As temperatures rise, soils and vegetation become thirstier, increasing groundwater use during dry periods. At the same time, extreme rainfall events can deliver huge amounts of water—enough to replenish aquifers if we can capture it. When rain falls over porous soils, much of it seeps underground and refills our water reserves. But when those same storms hit compacted or saturated soils, water has nowhere to go. It runs off quickly, heightening the risk of destructive and costly flooding.

Researchers at the Bureau are working to understand these dramatic swings and develop strategies that make water availability more reliable in a world defined by such extremes.

Water Whiplash

Over the past 15 years, Texans have lived through some of the clearest examples of climate whiplash in the nation. In 2011, dusty fields, empty reservoirs, and relentless heat defined the worst drought in modern record—one that lingered through 2014, straining communities, ecosystems, and every sector dependent on water.

Then 2015 arrived as the wettest year on record. The state jolted from one extreme to the other in a single season.

The early 2020s brought another severe drought, with some regions nearing 2011 levels. By 2025, parts of Texas remained in extreme drought, forcing groundwater districts to impose conservation measures and limit pumping. The pattern is clear: Texas swings between extremes of water availability, and planning for those swings is increasingly urgent.

Climate cycles like El Niño and La Niña influence the odds of wet or dry years but guarantee nothing. Water managers must store enough to endure multiyear droughts while maintaining reservoir capacity to absorb sudden floods. That balance makes planning extraordinarily difficult.

The Hidden Cost of Pumping

Groundwater plays a far larger role in America's water system than most realize: roughly half of the water in rivers and streams begins as groundwater. It's not an isolated pool underground—it's inseparable from the rivers, springs, and wetlands that define Texas landscapes.

When we pump more groundwater during droughts, aquifer levels drop—but there's a hidden cost. Much of that pumped water would have otherwise fed springs, streams, and wetlands. Scientists call this "capture." Groundwater pumping doesn't just lower aquifers, it reduces the surface flows that wildlife and communities depend on most during dry periods. Aquifer health and river health are directly linked.

In a state where conditions can flip from flood to drought and back again, efficiency alone is not enough. Even the most careful use of water cannot protect communities if wet season water is not stored for future dry years. The risk is shifting from the total amount of water Texas has to whether that water is available at the moments it is most needed.

Banking Water for Dry Times

If the extremes are becoming more extreme, long-term resilience will depend on storing water across seasons and years. Managed aquifer recharge offers one promising pathway. Aquifers naturally refill through soils and geological features such as sinkholes, but they can take in much more if we intentionally direct excess floodwaters into them.


Research at the Bureau shows that nearly 30 million acre-feet of water—roughly twice the state's annual water use—could have been captured for recharge during high flow events between 2015 and 2017. Other studies suggest that some aquifers have space to store up to 20 million acre-feet of additional water. These findings point to real, practical opportunities to strengthen Texas' water security.

Planning for Uncertainty

The biggest challenge is that we still cannot say exactly when extreme wet or dry periods will occur. To address this, researchers at the Bureau are combining on-the-ground measurements, satellite data, historical records, and advanced climate models to understand how conditions may change over time. These efforts help identify which regions are likely to experience the strongest swings, how long those swings may last, and how they will affect reservoirs, groundwater supplies, agriculture, and communities.

What sets this work apart is its emphasis on uncertainty. Instead of offering a single forecast, the models map out a range of plausible futures and their probabilities. For decision-makers who must plan despite incomplete information, this provides something far more useful than a simple prediction: a clearer understanding of risks, confidence levels, and potential outcomes.

We may never forecast Texas weather with perfect precision. But we *can* give water managers, city planners, and legislators tools to prepare for a wider range of possibilities—helping communities across the state build resilience in an era when the timing and intensity of water matter more than ever. ↘

 [Read a journal article using these techniques to look at freshwater availability in Texas.](#)

Did You Know?

Seco Sinkhole is a large, almost 40-foot-wide, karst sinkhole in Medina County, Texas. Water, like that of the Memorial Day floods in 2015 seen here, can be diverted from Seco Creek into the sinkhole. Sinkholes like this allow large volumes of water to significantly recharge karst aquifers in a short amount of time.

Photo: Marcus Gary, Edwards Aquifer Authority



Research Team: Ashraf Rateb (PI), Bridget Scanlon, Rong Fu (UCLA)

Sponsor: Texas Water Development Board

Status: In Progress

Ashraf is a geodesist and hydroclimate researcher who uses satellites to track Earth's shifting water and ground. Off-duty, he's in a corner café with black coffee, still suspicious of anything that looks too straightforward.



NOT JUST ROCKS

How the Bureau's NEAR SURFACE OBSERVATORY Responds to Texas Geologic Hazards



Top: Jeff Paine and Kutalmis Saylam (pictured), along with John Andrews and Jennifer Morris, responded to the Daisetta sinkhole in 2023 providing field measurements and data to help understand the risk of further collapse.

Below: Benjamin Grunau and Jennifer Morris help map the Texas Coast as part of the NSO team.

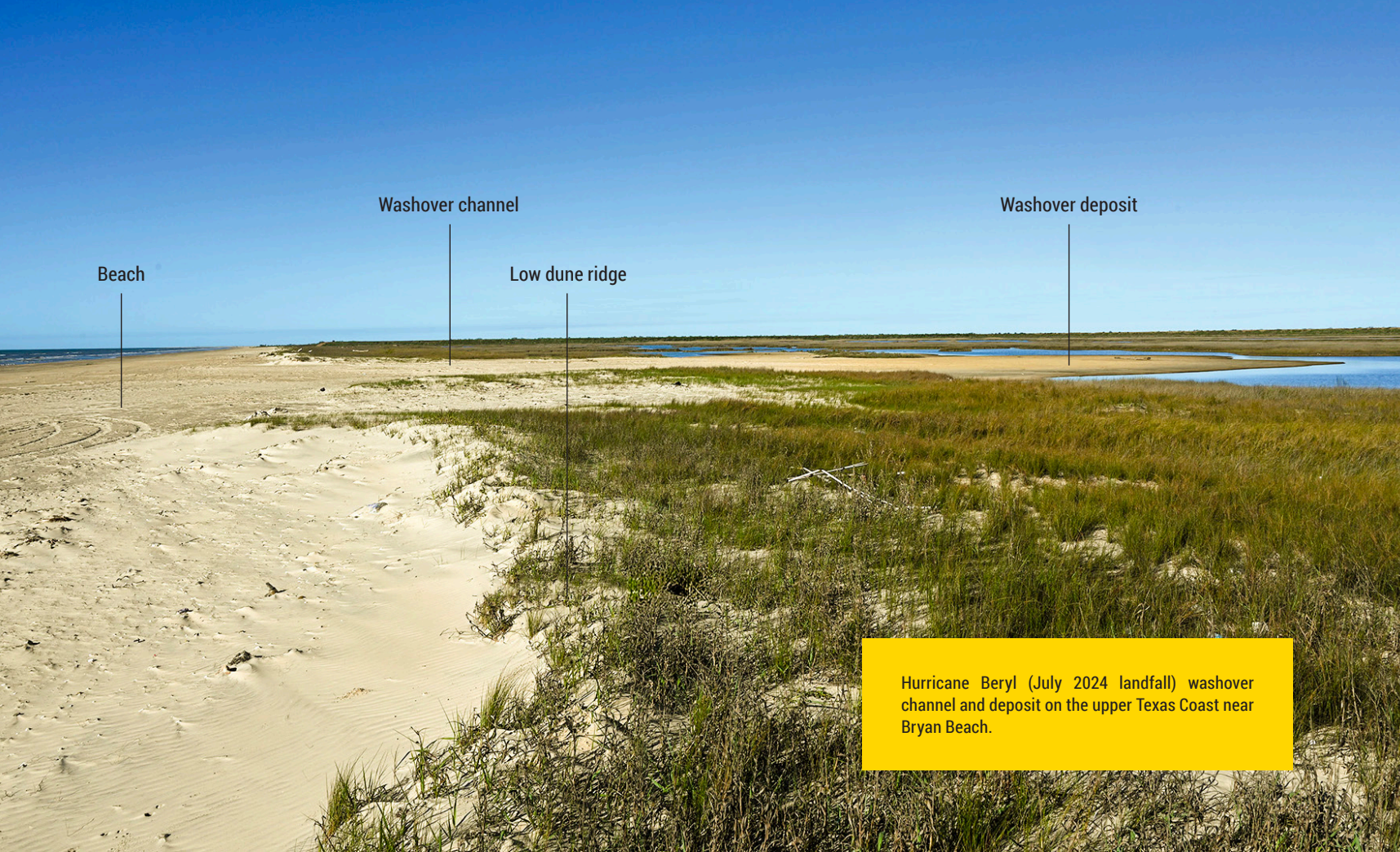


NSO Team: Jeff Paine, John Andrews, Tiffany Caudle, Brent Elliott, Benjamin Grunau, Mark Helper, Brian Hunt, Rich Kyle, Jennifer Morris, Kutalmis Saylam, Shelby Short, and Chock Woodruff

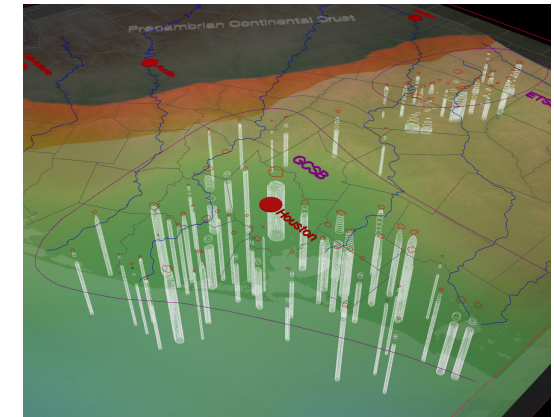
Jeff (opposite page) is a geologist and geophysicist who founded the Bureau's Near Surface Observatory, spending 40+ years deploying instruments to solve field problems in geologic mapping, coastal geology, hazards, and groundwater salinization. He brings the same curiosity and collaborative spirit to producing a podcast with his kids, riding motor- and bicycles, and moonlighting as an appliance repairman, mechanic, and baker.

When people think about geology, they think about really, really old stuff. Well, first they think “rocks,” then old stuff. But geology isn’t just about the deep past—it’s also about what’s happening right now: from the Texas Gulf Coast’s constantly shifting shorelines, sinkholes that suddenly open up and threaten to swallow buildings and roads, to where to find critical minerals. This is all geology. And the Bureau has been studying these events statewide for over 50 years. For the last 20 years, the Near Surface Observatory (NSO) has helped the state respond to natural disasters and prepare for future ones.

When the sinkhole in Daisetta, Texas collapsed further in 2023, emergency responders knew who to call: Jeff Paine and the NSO team. This group and its predecessors have been monitoring Gulf Coast shoreline change since the 1970s and have documented the effects of hurricane after hurricane. They have the tools to do it: high-resolution lidar, drones, surface instruments, probes for water wells, even a remote-controlled boat—whatever’s needed to figure out what’s happening at, or just below, ground level.



Hurricane Beryl (July 2024 landfall) washover channel and deposit on the upper Texas Coast near Bryan Beach.



3D Visualization at NSO

To facilitate comprehension, collaboration, and communication with the public, project data can be imported into an interactive, web-based 3D viewer developed by John Andrews at the Bureau. The structure, placement, and extents of subsurface geologic data—salt diapirs and the Louann Salt formation, for example—are more readily understood by researchers and the public alike in this 3D presentation setting.

Shoreline Change Project

Research Team: Jeff Paine (PI), Tiffany Caudle, John Andrews, Kutalmis Saylam

Sponsor: General Land Office

Status: Project Completed

Top: John Andrews flies a drone at Daisetta to determine sinkhole depth and measure how the surface elevation has changed.

Bottom: Jeff Paine taking advantage of manicured grounds to acquire time-domain electromagnetic induction (TDEM) data at the Sewanee International Airport, Tennessee.

Photos courtesy Jeff Paine

Shoreline and Dune Changes

The Texas Coast is among the most dynamic geologic environments on Earth. The position of the shoreline reflects a delicate balance between sea-level rise, sinking land (subsidence), incoming sediment, sediment moved by wind and waves, and storm impacts. Because much of the Texas Coast is heavily populated, understanding shoreline movement is critical for assessing threats to communities, identifying habitat loss, and distinguishing natural changes from human-caused ones. While sand may seem limitless when you're pouring it out of your shoes after a day at the beach, it is actually a finite and strategic resource—the second most commonly used in the world after water. The 142 million cubic yards of sand stored in Texas beach and dune systems represents a critical natural resource that must be carefully monitored and managed.

The NSO team tracked shoreline change along 367 miles of Texas Coast over the last 100 years (1930–2024), utilizing historic aerial photos, GPS measurements, and modern lidar surveys. Some key findings of the study were:

- The Texas Gulf Coast shoreline has been retreating at an average rate of **4.2 feet per year**.
- **81% of the coast is retreating**, resulting in a net loss of **17,246 acres since 1930**—about 183 acres lost every year.
- Each millimeter of annual sea-level rise translates to approximately **3 to 6 feet of shoreline retreat per year**.

Using high-resolution lidar data captured in 2024, the team also analyzed dune conditions along the coast. Lidar emits thousands of laser pulses per second that bounce off objects and return to a sensor, providing highly accurate measurements. The findings reveal significant vulnerability—over half of the shoreline has dunes that are too small to provide effective coastal protection.

Dunes provide a critical barrier against storm surge, waves, and winds during hurricanes. They also act as sand reservoirs, helping beaches recover after storms. The study found a concerning cycle: erosion prevents dunes from building up, and low dunes provide less protection against further erosion.

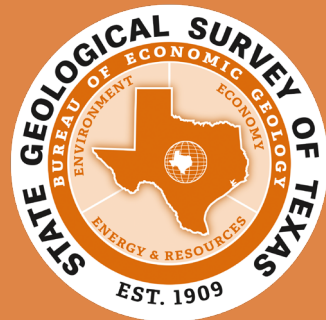
Why It Matters

Rapidly eroding shorelines threaten habitats, beaches, tourism, residential communities, roads, bridges, and industrial facilities. Erosion also increases a region's vulnerability to tropical storms. By monitoring shoreline change, the NSO gives citizens, planners, and regulators critical information about future trends and whether changes are accelerating, slowing, or holding steady. 🇹🇽

 [Learn more about the Shoreline Change Project.](#)



BUREAU of ECONOMIC GEOLOGY



OUR MISSION

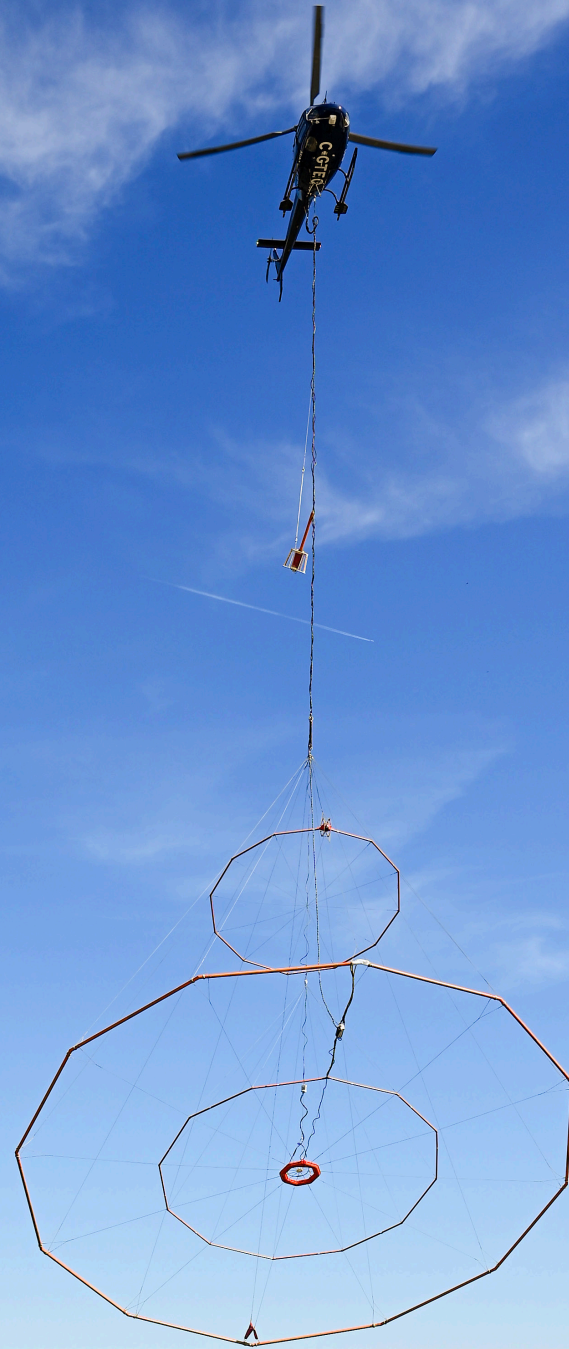
To serve society by conducting objective, impactful, and integrated geoscience research on relevant energy, environmental, and economic issues.

OUR VISION

To be a trusted scientific voice to academia, industry, government, and the public, whom we serve.



A helicopter flown by Geotech Ltd. lands near College Station, Texas with the airborne electromagnetic system that is providing insight into the structure of the Brazos Alluvium Aquifer.



MAPPING the BRAZOS ALLUVIUM AQUIFER

The Brazos Alluvium Aquifer stretches 350 miles along the Brazos River, a narrow ribbon of groundwater stored in loose sand, gravel, silt, and clay deposited by the river (alluvium). Despite its importance, the aquifer's structure is complex and poorly understood. The Bureau is using airborne electromagnetics to get a picture of what is happening over 100 feet underground.

Picture a helicopter towing a 60-foot metal hula hoop about 140 feet above the ground. That hoop generates an electromagnetic field that penetrates the subsurface. Different materials—clay, sand, fresh water, salty water—respond differently to the field, and sensors detect those responses. The result is a detailed picture of what's underground, collected quickly over large areas.

Research Team: Jeff Paine (PI), Benjamin Grunau, Jennifer Morris, Geotech Ltd. (airborne survey)

Sponsor: Texas Water Development Board

Status: In Progress

This technology reveals the aquifer's hidden architecture: where water flows easily through coarse sand and gravel, where clay layers block movement, and where there are saltier zones. Understanding this structure means better decisions about where and how much water can be safely withdrawn. This is critical information as Texas faces growing water demands and extended droughts.

The work is just beginning, but with a deeper understanding of the aquifer, this vital water source may serve Texans for generations to come. 🇹🇽

 [Learn more about the Near Surface Observatory.](#)

Below: Close up of the airborne system electromagnetic transmitter (outer loop), receiver (innermost coil), and magnetic field sensor (foreground).

Photos courtesy Jeff Paine



Wonhyun is a coastal ocean and flood modeler with more than 15 years of experience advancing modeling and community resilience. He finds energy through exercise and his passion for tennis.

ADVANCING FLOOD PREDICTION and RESILIENCE in TEXAS

In the early morning darkness of July 4, 2025, the clouds opened up over Central Texas. What meteorologists call a “rain bomb,” intense rainfall concentrated over a relatively small area, triggered catastrophic flash flooding. The Guadalupe River surged upward more than 30 feet in little over an hour. The resulting torrent was indiscriminate and merciless. When the waters finally receded, over 100 lives had been lost. The tragedy left a lasting wound on families and communities—an impact that will shape memories, recovery efforts, and local resilience for years to come.

That’s the catch with the Hill Country: the rugged limestone hills and canyons that make it so appealing are the same features that make it prone to dangerous floods. Steep slopes and thin rocky soil funnel rainwater into river channels, causing levels to rise quickly and dramatically. It had been over 20 years since the last major flood in this area, but it won’t be the last.

While there has been investment in flood management, monitoring, and forecasting, the flood risk in Texas is growing. Water is moving faster than our ability to forecast, communicate, and respond. Not because we lack data or models, but because we haven’t integrated them in a way to get useful information out quickly enough to save lives.

A New Approach

Researchers at the Bureau are working on this problem through a Department of Energy-funded program called MuSiKAL.* Like most government programs, it has an acronym that’s longer than this sentence, so here’s what matters: it’s designed to improve how we understand complex environmental systems for better predictions. The core idea is a “digital twin,” a living, adaptable representation of the real world that can use all available data sources, from traditional observations to the latest artificial intelligence tools.

Floods aren’t confined to rivers. The Texas Gulf Coast has an equally storied history of hurricane damage, and MuSiKAL recognizes the connections between coastal storm surge and flooding further inland. These are complex systems where small changes in rainfall location, soil moisture, or river runoff can lead to dramatically different outcomes. Traditional modeling struggles to capture this uncertainty, especially when time is precious.

How It Works

MuSiKAL integrates traditional physics-based models with artificial intelligence. Those physics models are important for understanding river flow and storm surge, but they’re slow and require significant computing power. When time is of the essence, that’s a problem.

Here’s where MuSiKAL differs. Instead of running one slow simulation, the system rapidly runs through thousands of storm variations to determine where flooding is most likely, where uncertainty is highest, and where small changes can lead to dramatically different outcomes.

That still leaves you with massive datasets that would make any human analyst’s brain hurt. But AI? It doesn’t complain, at least not yet. Machine learning models identify flood patterns in seconds rather than hours, while

remaining grounded in real-world physics. The result is a feedback loop: the models identify where more data is needed, and new data continuously improves predictions.

Why It Matters

The benefit for public safety is obvious, but flood risk affects infrastructure, supply chains, and the economy. Decisions about where to build critical facilities, how to design infrastructure, and when to issue warnings all depend on timely and trustworthy information.

MuSiKAL’s approach enables a fundamental shift in decision-making. Rather than relying on single answers (Will this location flood?), it provides insight that reflects real-world uncertainty: What range of outcomes is possible? How likely are they? Where are the greatest risks?

MuSiKAL is still evolving. The next phase includes interactive visualization tools designed for emergency managers and planners, creating an adaptive system that updates in real-time as storms develop and new data arrives. This perspective is essential for managing flood hazards in an era of intensifying climate extremes. It bridges the gap between cutting-edge science and the real-world decisions that shape resilience, safety, and long-term planning. ➔

[Read a journal article about Storm Surge and Flood Modeling of the Texas Gulf Coast.](#)

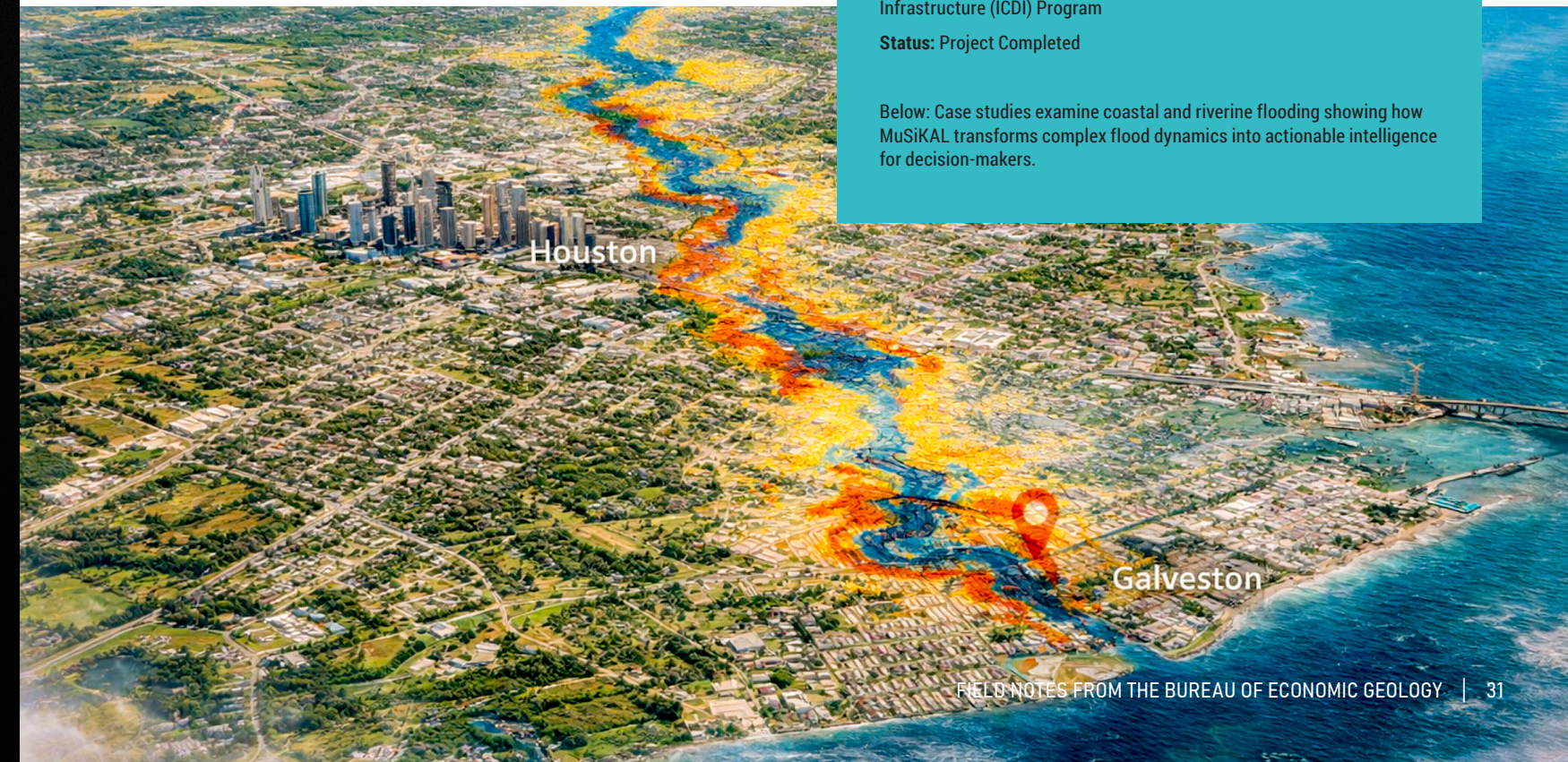
* Multiphysics Simulations and Knowledge Discovery through AI/ML Technologies

Research Team: Wonhyun Lee, Alex Sun, and Bridget Scanlon from the Bureau, as well as colleagues from partner organizations

Sponsor: Department of Energy Integrated Computational and Data Infrastructure (ICDI) Program

Status: Project Completed

Below: Case studies examine coastal and riverine flooding showing how MuSiKAL transforms complex flood dynamics into actionable intelligence for decision-makers.



FROM MAPS to ACTION

Supporting Local Planning in Texas Colonias

If you grew up with the comforts of modern society, it's easy to assume they've always been there and always will be: When you turn on the sink, water comes out. When you remember to put out your trash bin, someone comes and takes it away. And it's easy to assume that just about everyone, at least in Texas, doesn't worry about these fundamental resources.

Yiming is a geospatial scientist who wrangles satellite images to decode urban sustainability and water risk. Off-screen, she collects great food, outdoor adventures, new experiences, and shade in Texas.

Perhaps you've seen photos of informal settlements in other parts of the world—makeshift homes built from salvaged materials, wooden planks, corrugated metal, plastic sheets. But they're here as well: almost 500,000 people live in unincorporated, low-income settlements called **colonias** along the Texas-Mexico border. Colonias lack the basic infrastructure most of us take as a given: running, drinkable water, sewer systems, trash collection, drainage, and reliable utilities.

Because these communities sit outside the usual city systems, there is very limited data on what's being built or how far these neighborhoods stretch. There are a variety of social challenges presented by this issue, namely health and disease, but from an environmental perspective, they are more vulnerable to floods and other hazards.

Mapping colonias is challenging. Their informal and often unregulated development means traditional surveys and official maps can quickly become outdated. The last comprehensive colonia mapping occurred over a decade ago. Researchers at the Bureau are helping to tackle this problem by using a combination of satellite imagery and artificial intelligence to generate up-to-date maps of these areas.

Satellites don't all see the world the same way: some take frequent snapshots with less detail, while others capture sharper images but less often. AI tools enable the resolution of the less detailed data to be increased, sort of like an old movie being converted to 4K, or depending on your age, VHS to DVD. This increased resolution data can now be integrated with the existing high-resolution data for a significantly more up-to-date picture. The resulting maps are supported by real people on the ground. By partnering with other agencies and residents of colonias, the accuracy of the maps can be checked and strengthened.

The main takeaway is that this technique enables continuous monitoring of informal settlements like colonias. This is bigger than Texas. These approaches can be applied in other vulnerable regions of the United States and beyond where there are similar issues. This is a critical piece in the puzzle for reducing risks—of all kinds—to people in these under-served communities. These maps are foundational to making improvements that planners, utilities, health agencies, and community organizations can use to reduce risk, prioritize investments, and strengthen resilience for those who need it most—and, ultimately, for the state as a whole. 📍

[View a technical poster about this project.](#)

Research Team: Bridget Scanlon (Bureau Lead), Yiming Zhang, Jon Paul Pierre, Hassan Dashtian, Brent Porter, John Malito, Wonhyun Lee, Manmeet Singh (Univ. KY), Keri Stephens & Nancy Darcy (Moody School of Comm., UT Austin), Dean Kyne (UTRGV)

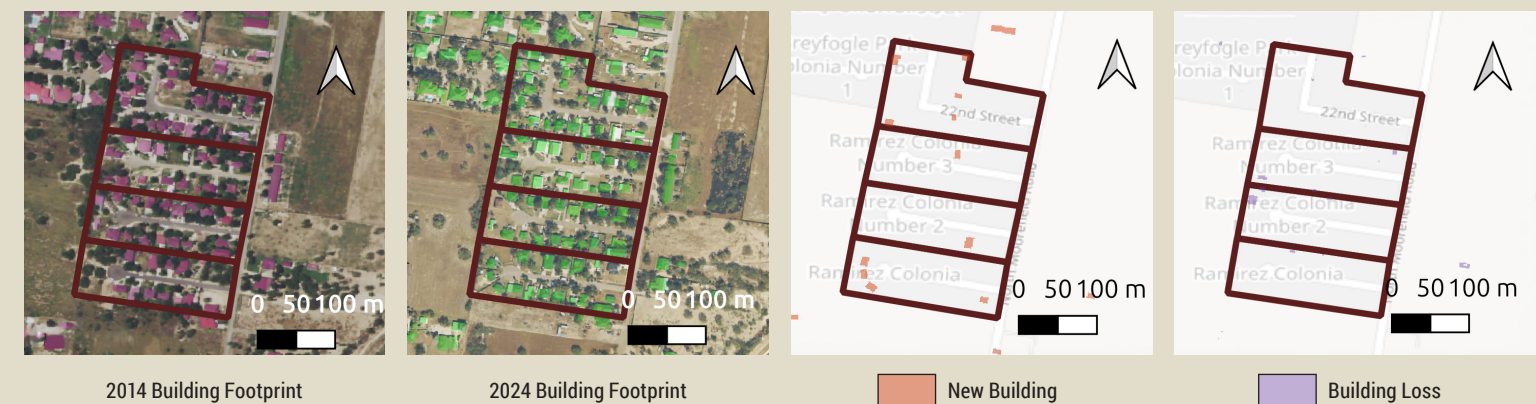
Sponsor: General Land Office (GLO)

Status: In Progress



Did You Know?

Colonias are low-income communities, frequently unincorporated, that are predominantly situated along the 1,200-mile stretch of the Texas-Mexico border. These neighborhoods, which began to emerge in the 1950s and 1960s, are typically marked by inadequate housing, unpaved roads, and limited access to essential water and sewage services. Today, more than 500,000 people reside in colonias, facing significant challenges due to these persistent infrastructure gaps.



Researchers at the Bureau are helping to tackle the difficult task of mapping colonias by using a combination of satellite imagery and artificial intelligence to generate up-to-date maps of these areas.

A satellite image of Hurricane Helene, showing a well-defined eye and a dense, swirling cloud structure over the Gulf of Mexico. The hurricane is moving towards the coast of the United States.

INSIDE HURRICANE HELENE

What We Learned from the
Storm—and from AI—and
Why It Matters for Texas

Big Bend in Texas isn't known for hurricanes and probably never will be. But Florida also has a Big Bend, and in just over a year it was hit by three different hurricanes. One of those was Hurricane Helene, making landfall as a Category 4 hurricane in September 2024, causing tens of billions of dollars in damage and killing over 250 people, with North Carolina particularly devastated. And while our Big Bend is out of cyclonic harm's way, the Texas Gulf Coast holds the grim record for America's deadliest natural disaster: the 1900 Galveston hurricane that killed an estimated 8,000 people. Research at the Bureau, led by **Hassan Dashtian**, has revealed lessons from Helene that can help protect not only Texas' vulnerable coast, but communities worldwide.

Lesson 1: How Much Did It Really Rain?

There are different tools for measuring rainfall totals from large storms like Helene, from satellites to ground radar to the latest computational models, and they all produce different totals. While they mostly agree on where the heaviest rain fell, the satellite data missed the peak rainfall over North Carolina, where some areas received over 30 inches. That's a critical gap that could mean the difference between being ready or being caught off guard by a catastrophic surprise. Having the most accurate rain totals provides the most robust data for disaster management.

Research Team: Hassan Dashtian (PI)
Sponsor: National Science Foundation
Status: In Progress



Hassan uses data analytics to study energy and environmental topics. He has a background in petroleum/chemical engineering and computer science. Although he's an expert in soil moisture, he hopes to be remembered as a poet.

Left: The Bolivar Peninsula had pockets of complete devastation from Hurricane Ike (2008). A number of houses remained standing next to pilings where neighboring houses once stood.

Photo: Jocelyn Augustino, FEMA, The U.S. National Archives



Did You Know?

The 1900 Galveston hurricane remains the United States' deadliest natural disaster with an estimated 8,000 lives lost and thousands of buildings destroyed. The Galveston Seawall was built in 1902 to help protect the city from future storms.

Photo: Griffith & Griffith, Library of Congress, Public Domain

physics-based tools—an early sign of how transformative this technology may become. There's still room for improvement in inland rainfall predictions, but the pace of progress is striking.


Lesson 4: Fear, Facts, and Social Media

"Never read the comments" is sound advice, but for researchers studying public reactions to Hurricane Helene, those comments offered valuable insights. By analyzing YouTube videos and their associated comments, they uncovered a surprising pattern: while video titles tended to use fear-driven language—nearly half included fear-driven framing—the comments told a very different story. Viewers expressed far more sadness (about 41%) and even joy (around 26%), with fewer than 8% of comments showing fear. This contrast suggests that the public was more resilient—and more skeptical of alarmist messaging—than many media outlets implied. Researchers also found a one-day delay between the peak of fear-based news coverage and when social media users echoed that fear, highlighting how audiences respond on a different timeline than traditional media.

What It All Means

Understanding rainfall measurement differences helps emergency managers make better decisions about when and where to call for evacuations. Knowing about the "brown ocean effect" helps forecasters anticipate which storms may remain dangerous well after moving inland. As AI-based forecasting continues to improve, these models could give communities several additional days to prepare. And recognizing the gap between fear-mongering headlines and how the public actually responds allows officials to craft warnings people are more likely to trust, and act on, rather than tune out.

Texas has a long history with hurricanes, and the Bureau's researchers are working hard to secure funding to ensure that the next time a major storm is on the horizon, we'll have better tools and better answers. ➔

 [Learn more about this project.](#)

Lesson 2: The "Brown Ocean Effect"—Wet Soils Boost Inland Rainfall

Warm, saturated soils can act as a substitute ocean for hurricanes, providing the moisture and energy needed to fuel intense rainfall for 2–3 days after landfall—even hundreds of miles inland. Using a hurricane model developed at UT Austin in collaboration with NOAA's Hurricane Research Division, Bureau researchers discovered that this "brown ocean effect" was a critical factor in making Helene's rainfall so catastrophic.

Lesson 3: AI Models Are Outpacing Traditional Models

AI models are showing remarkable promise. Some predicted Helene's path up to a week in advance and came within 85 miles of the actual track—a level of accuracy that, in several cases, outperformed traditional physics-based models. What makes this breakthrough especially noteworthy is that these systems don't rely on solving the complex atmospheric physics equations used by conventional forecast models. Instead, they use neural-network approaches similar to large language models (LLMs), "learning" from decades of global weather data to recognize patterns and generate fast, highly accurate predictions. Four different AI models produced more accurate track and intensity forecasts further in advance than traditional



THE TEXAS IMPERATIVE



The Texas Imperative is a set of focused multidisciplinary studies of vital state resources, conducted at the Bureau of Economic Geology at The University of Texas at Austin. Their goal is to inform state and local leaders, state agencies, industry, and the public about the location, quantity, and potential economic and environmental impact of these resources.

AREAS OF STUDY:

Water Systems & Drought Initiative	Economic Mineral Resources Program	Geothermal Initiative	Geologic Hydrogen & Helium	Lithium Resources
---	---	------------------------------	---------------------------------------	--------------------------



BUREAU OF ECONOMIC GEOLOGY

TO LEARN MORE, VISIT:

www.beg.utexas.edu/research/the-texas-imperative



DISCOVER TEXAS GEOHERITAGE





Santa Elena Canyon, Big Bend National Park

The **Bureau of Economic Geology** is identifying Texas sites that tell Earth's geologic story. From iconic landscapes to ancient fossils, these places advance science, inspire learning, boost local economies, and connect Texans to the ground beneath their feet. Whether uncovering Earth's past, building understanding about vital water resources, or showcasing natural beauty, geoh heritage sites deepen our understanding of the planet and our relationship with it.

Learn more about the Texas Geoheritage Program



BUREAU OF
ECONOMIC
GEOLOGY



BUREAU *of* ECONOMIC GEOLOGY

STATE GEOLOGICAL SURVEY *of* TEXAS

117 years working at the
intersection of energy,
environment, and economics