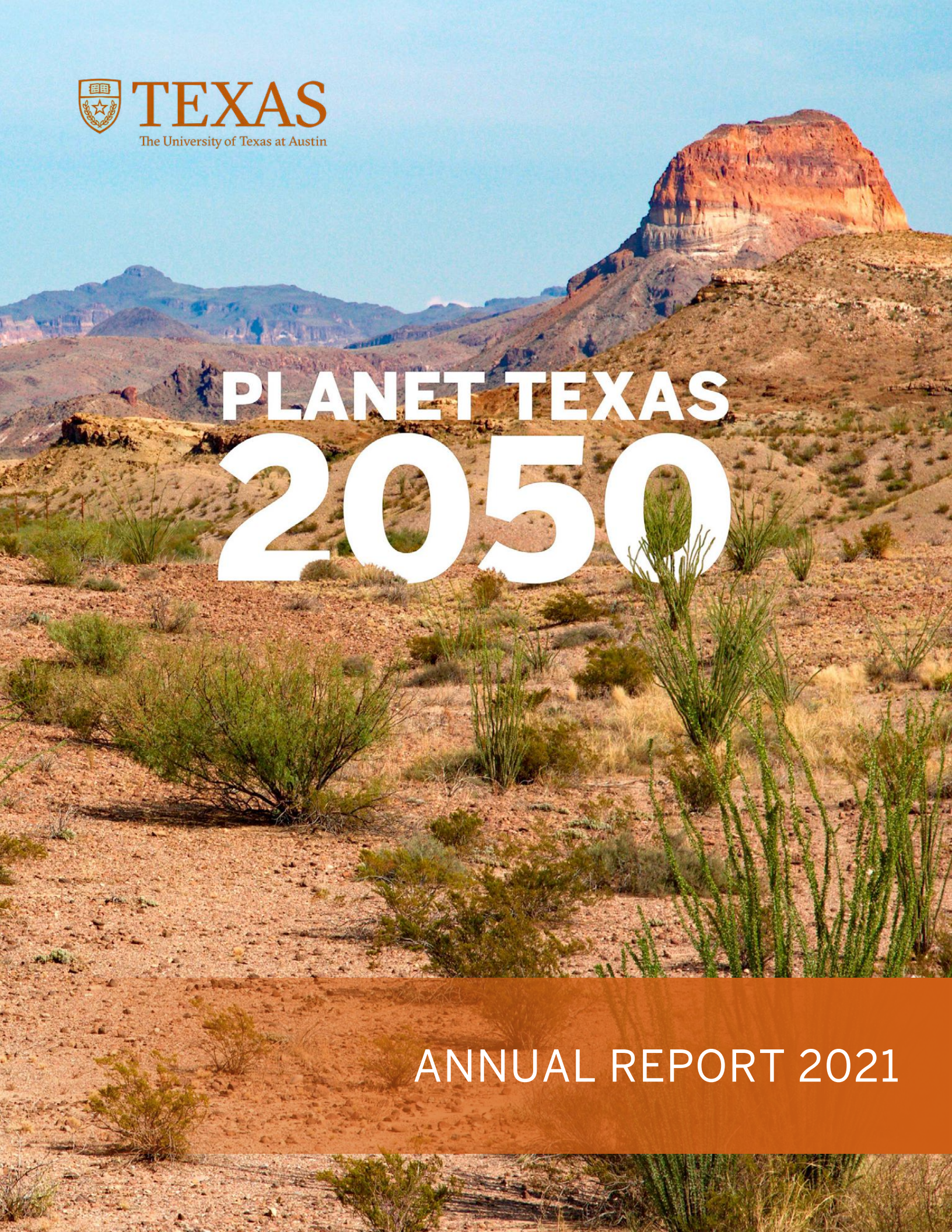
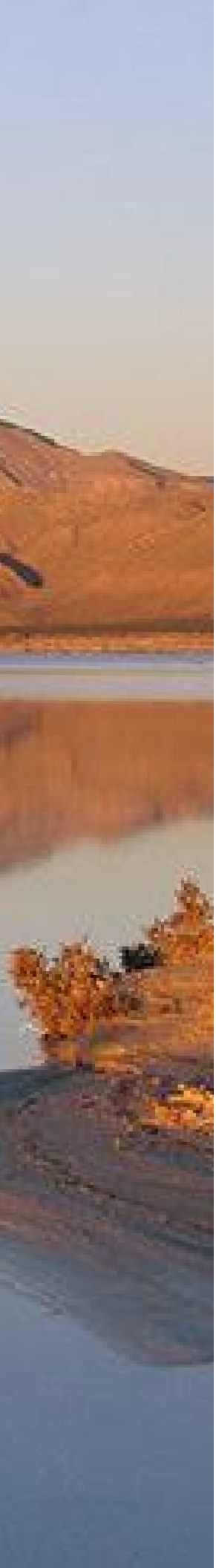

TEXAS
The University of Texas at Austin
PLANET TEXAS
2050
ANNUAL REPORT 2021

Grand Challenges Are Moonshot Goals

To reach those goals and address the most urgent issues affecting our society, researchers from different disciplines must share knowledge, ask questions, and tear down academic barriers.



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Waterfall in the popular turtle pond near the UT Tower on campus.

BRIDGING BARRIERS

We are bridging barriers between fundamental knowledge and real-world problems by connecting disciplines, techniques, and ways of thinking.

In 2016, The University of Texas at Austin introduced an initiative with one overarching mission: break down academic silos and foster research that addresses the toughest questions facing humanity and the world.

Bridging Barriers serves as an incubator for some of the boldest interdisciplinary projects at UT by supporting researchers from across the Forty Acres as they form broad teams tasked with identifying urgent, real-world issues — and figuring out the best way to solve them in less than a decade.

These projects are rooted in collaboration and academic freedom to produce practical solutions to social, environmental, and humanitarian crises. From artificial intelligence to climate change to health inequity, teams around campus are working on solutions to some of the greatest problems of our generation.

To learn more about Planet Texas 2050 and all of UT's research grand challenges, visit the **Bridging Barriers website.**

MAKING TEXAS RESILIENT IS OUR GRAND CHALLENGE

Today, the state's population is 29 million. By 2050, that number is predicted to double.

Add to that the environmental stress from climate change, and the things we rely on to live — water, energy, dependable infrastructure, and the ecosystems and social governance to support them — will be at unprecedented risk. Limited resources will be in even greater demand.

These are global trends, but Texas is a perfect bellwether. Our geographic location, varied landscapes, diverse communities, and social and economic conditions mean that we are experiencing many of these challenges first. From catastrophic weather events to rapid urbanization and the emergence of new, lethal pathogens, our state is a living laboratory. And with scholars across all major disciplines benefiting from the fastest supercomputer at any university, the Planet Texas 2050 team is uniquely positioned to predict future crises and help our region plan accordingly.

Planet Texas 2050 is an eight-year sprint to find solutions that will make our communities more resilient and better prepared. We're examining new and complex research questions, launching educational programs and tools, and partnering with organizations, institutions, and community groups throughout the state.

Just as important, what we discover will have applications that extend far beyond our region. We'll share our findings, tools, and processes with researchers across the U.S. and the world who are facing similar challenges in the 21st century.

Read on to see how we're redefining resilience, using scholarly innovation to aid in disaster response, and confronting climate change.

Planet Texas 2050 is composed of six flagship projects that address different aspects of the climate crisis and include work with frontline communities to come up with solutions.

ART BY CHAMP TURNER

FROM THE CHAIR

The world is changing around us: Texas' population is expected nearly to double by 2050, and most of the state has warmed between a half and 1-degree Fahrenheit in the past century. We are seeing new tropical diseases emerge, and we're experiencing more extreme weather events.

That's why our vision is to transform research into action by working with communities across the state to co-design a more sustainable future.

Of course, that vision has matured since we launched in 2018, and so has our team. In our early days, we launched more than two dozen individual projects covering just as many topics. That process informed our decision to invest, instead, in a set of six interrelated flagship projects that explore biodiversity, environmental justice, AI-enabled modeling, hazard preparedness, building regenerative cities, and historical responses to climate change. These flagships will allow us to build deeper community relationships while also providing baseline stability for our research teams.

I am proud of the partnerships we have developed, such as with the Texas Department of Emergency Management and the National Hurricane Center, as well as those that have matured in this last year. All are rooted in our values of community-engaged research and equity, and they will ensure that our research outputs are driven by the needs and lived experiences of the communities we serve.

We are excited for you to learn more about these partnerships and our accomplishments over the past year in this report and for you to follow our progress as we continue this important journey.

FERNANDA LEITE
Associate Professor
Department of Civil, Architectural and Environmental Engineering

PLANET TEXAS 2050 CHAIR, 2020-2021

MILESTONES

OCTOBER 2020

Planet Texas 2050 announces the creation of six flagship projects: end-to-end, research-to-implementation endeavors, each led by dynamic interdisciplinary teams and representing a wide swath of UT expertise across biology, computing, sustainability science, participatory methods, community planning, hydrology, civil engineering, and public health.

JANUARY 2021

Planet Texas 2050 successfully transitions its leadership team to be made up of flagship project leads who will serve rotating two-year terms. This ensures continuity while also fostering new, innovative ideas.

APRIL 2021

Planet Texas 2050's Artist-in-Residence program awards funds to The Drag, a student-run audio production house, to create a six-episode podcast that will explore climate change-related stories across Texas.

JULY 2021

The Federal Emergency Management Administration (FEMA) awards a $1.2 million grant to Planet Texas 2050 researchers to complete the design of Pin2Flood, a web-based application that will allow first responders to track flooding in real-time, changing the way emergency departments respond to disasters.

SEPTEMBER 2021

Planet Texas 2050 collaborates with the City of Austin, the Austin Independent School District, and the nonprofit EcoRise to launch the Austin Youth Climate Equity Council, which will engage high school students as leaders in Austin's climate equity strategies.

SEPTEMBER 2021

SXSW Interactive **selects a Planet Texas 2050 panel for its 2022 festival**. Researchers from UT Austin, UT Rio Grande Valley, and the Museum of South Texas History will lead a discussion about their work that combines old photos of flooded streets with current data sets to learn more about past disasters and help predict future climate-related emergencies.

FY21

PLANET TEXAS 2050 HIGHLIGHTS

IN NUMBERS

SCHOLARLY OUTPUT & PUBLICITY

39 scholarly works

39 news articles, blog posts and university stories

EXPANDING NETWORKS

35 University of Texas departments and units

38 hosted events

161 Planet Texas 2050 active researchers

BUILDING CAPACITY

$5.7M TO DATE Awarded in external funding

Contributed its expertise to more than $10M TO DATE in externally funded projects and centers across UT to date

ENGAGING STUDENTS

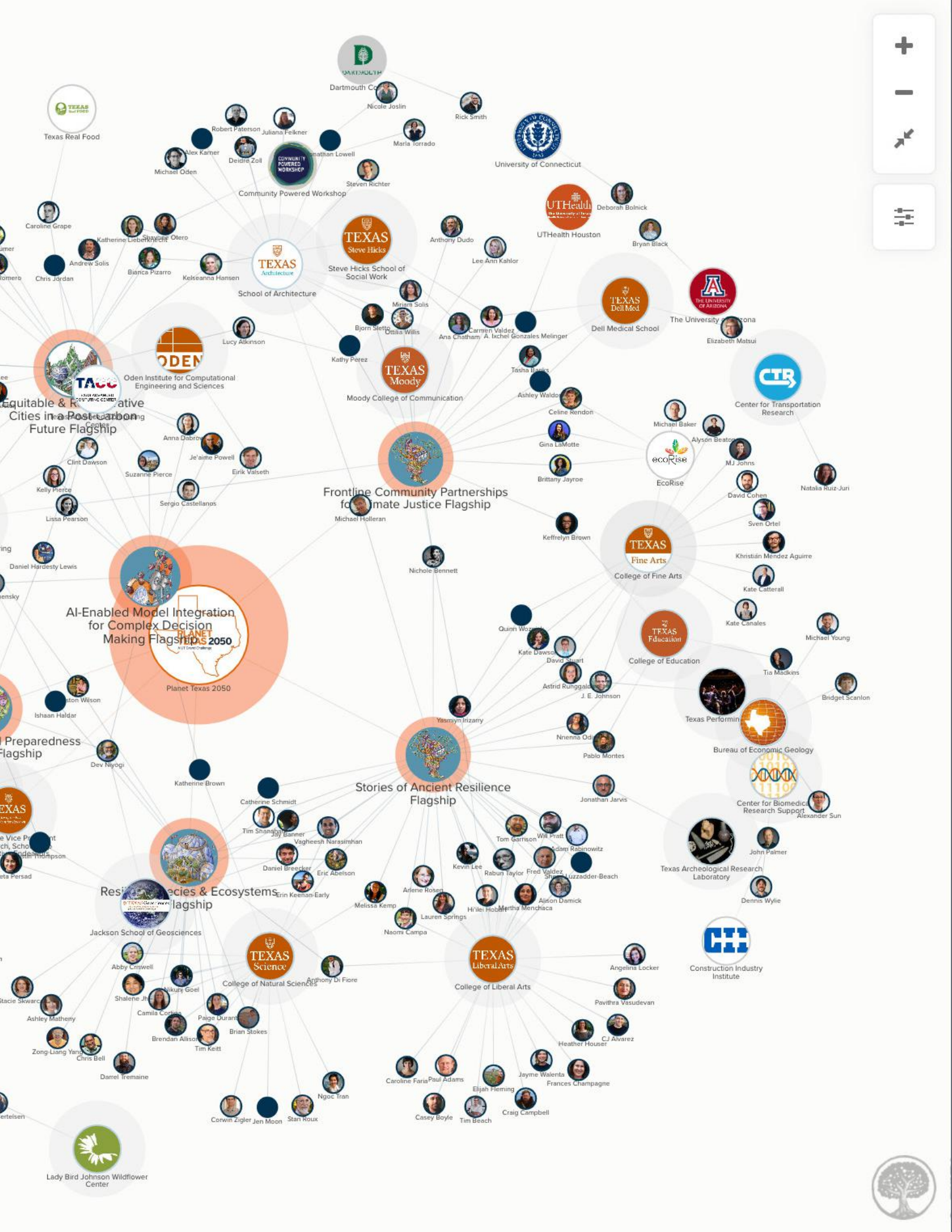
61 undergraduate & graduate student researchers

31 external partners

OUR NETWORK

The Planet Texas 2050 grand challenge team includes researchers from more than two dozen different disciplines, including engineering, architecture, geosciences, anthropology, computer science and the arts. We also work with partners from The Nature Conservancy, the City of Austin, and the Texas Division of Emergency Management, among many others. No single entity has the capacity to address the demographic and climatic changes happening in our state, which is why these collaborations are instrumental. The strength of our network determines the strength of our contributions.

Explore our network map or browse the **team list on the Planet Texas 2050 website** to see how our connections are contributing to our mission of making Texas more resilient.


Dartmouth College
Nicole Joslin
Rick Smith
Texas Real Food
Robert Paterson
Juliana Felkner
Alex Karner
Deidre Zoll
Jonathan Lowell
Michael Oden
Community Powered Workshop
Steven Richter
Marla Torrado
University of Connecticut
UTHealth Houston
Deborah Bolnick
Bryan Black
Caroline Grape
Katherine Lieberknecht
Shaveeta Otero
Andrew Solis
Chris Jordan
Bianca Pizarro
Kelseanna Hansen
School of Architecture
Steve Hicks School of Social Work
Anthony Dudo
Lee Ann Kahlor
Miriam Solis
Bjorn Sletto
Ottalia Willis
Ana Chatham
Carmen Valdez
A. Ixchel Gonzales Melinger
Dell Medical School
The University of Arizona
Elizabeth Matsui
Lucy Atkinson
Kathy Perez
Oden Institute for Computational Engineering and Sciences
Moody College of Communication
Tasha Banks
Ashley Waldon
Celine Kendon
Center for Transportation Research
Michael Baker
Alyson Beaton
Gina LaMotte
MJ Johns
Brittany Jayroe
EcoRise
Natalia Ruiz-Juri
David Cohen
Sven Ortel
Anna Dabrow
Je'aime Powell
Eirik Valseth
Clint Dawson
Suzanne Pierce
Kelly Pierce
Sergio Castellanos
Lissa Pearson
Frontline Community Partnerships for Climate Justice Flagship
Michael Holleran
Keffrelyn Brown
Khristián Mendez Aguirre
Kate Catterall
Daniel Hardesty Lewis
Nichole Bennett
College of Fine Arts
Kate Canales
Michael Young
Quinn Wozniak
Kate Dawson
David Stuart
Astrid Runggaldier
J. E. Johnson
College of Education
Tia Madkins
Bridget Scanlon
Texas Performin
Bureau of Economic Geology
Yasmiyn Irizarry
Nnenna Odi
Pablo Montes
AI-Enabled Model Integration for Complex Decision Making Flagship
Planet Texas 2050
Ishaan Haldar
Dev Niyogi
Katherine Brown
Stories of Ancient Resilience Flagship
Jonathan Jarvis
Center for Biomedical Research Support
Alexander Sun
Catherine Schmidt
Tim Shanahan
Jay Banner
Vagheesh Narasimhan
Tom Garrison
Will Pratt
Adam Rabinowitz
Kevin Lee
Rabun Taylor
Fred Valdez
Daniel Breecker
Eric Abelson
Erin Keenan-Early
Arlene Rosen
Melissa Kemp
Lauren Springs
Naomi Campa
Hi'ilei Hobbs
Martha Menchaca
Alison Damick
Texas Archeological Research Laboratory
John Palmer
Dennis Wylie
Jackson School of Geosciences
Abby Criswell
Nikura Goel
Shalene Jha
Camila Cotinez
Paige Durant
Brian Stokes
Brendan Allison
Tim Keitt
Ashley Matheny
Zong-Liang Yang
Chris Bell
Darrel Tremaine
College of Natural Sciences
Anthony Di Fiore
College of Liberal Arts
Angelina Locker
Pavithra Vasudevan
Heather Houser
CJ Alvarez
Construction Industry Institute
Caroline Faria
Paul Adams
Elijah Fleming
Jayme Walenta
Frances Champagne
Casey Boyle
Tim Beach
Craig Campbell
Ngoc Tran
Corwin Zigler
Jen Moon
Stan Roux
Lady Bird Johnson Wildflower Center

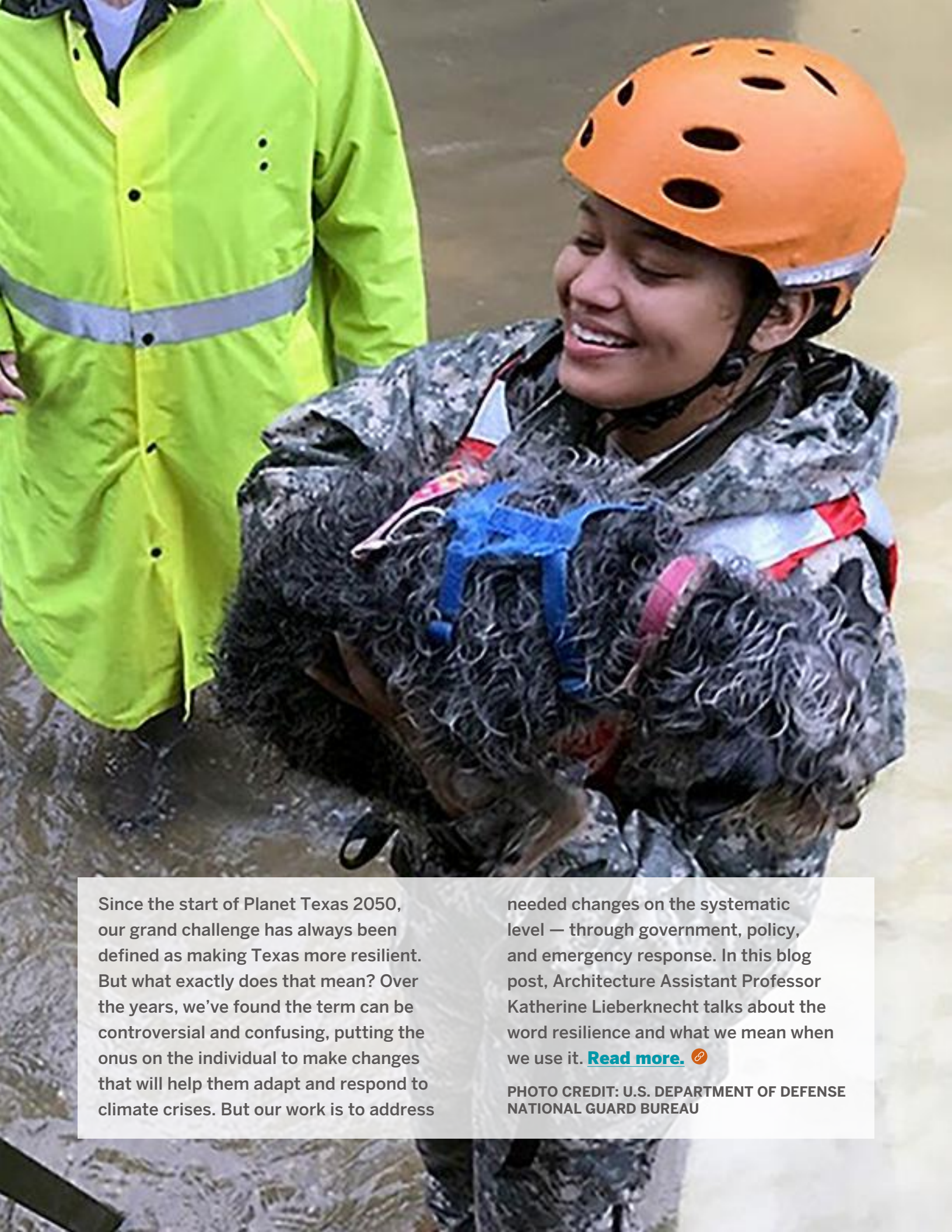
REDEFINING RESILIENCE

Devastating hurricanes and floods are nothing new for people living in Texas, especially near the Gulf Coast, but the increasing strength and frequency of these storms and the incessant battering communities are taking from them are raising important concerns about what it will take to make communities more resilient. But what exactly do we mean by *resilient*?

The word is often used to describe communities affected by devastation and trauma from hurricanes, drought, and flooding. Real resilience, however, requires more than community residents coming together post-disaster. It requires local, state, and federal governments, as well as industry and other organizations, to make substantial changes and investments that will safeguard communities in the future. The climatic and growth challenges we are experiencing today in Texas are not isolated to individuals or even specific neighborhoods, cities, or regions. Our focus, therefore, must lie in how to make statewide *systems* more resilient. We believe the first step in doing this is to change the popular narrative of what 'resilience' is.

For the past year, our team has been reconsidering our understanding of this term by looking both to the historical past and to our present-day challenges to see how our systems have — and have not — supported communities, sustainably and equitably, amid compounding natural disasters tied directly to climate change.

In this section, you can learn more about how we define resilience, what past societies can teach us about facing climate shocks today, and how storytelling gives us context for understanding climate change's effects on people and communities.



Since the start of Planet Texas 2050, our grand challenge has always been defined as making Texas more resilient. But what exactly does that mean? Over the years, we've found the term can be controversial and confusing, putting the onus on the individual to make changes that will help them adapt and respond to climate crises. But our work is to address needed changes on the systematic level — through government, policy, and emergency response. In this blog post, Architecture Assistant Professor Katherine Lieberknecht talks about the word resilience and what we mean when we use it. **Read more.**

PHOTO CREDIT: U.S. DEPARTMENT OF DEFENSE NATIONAL GUARD BUREAU

A 2019 excavation of Histria, a once-bustling residential and industrial area in a major seaport city, then a cemetery in a shrinking provincial backwater, and now an open field seven kilometers from the sea.

PHOTO CREDIT: VALENTIN BOTTEZ

The Planet Texas 2050 flagship project Stories of Ancient Resilience uses archaeological investigation to explore the ways past societies responded to climate challenges and pressures on shared resources like water. The hope is that this knowledge can impart new insights that will help us today as we grapple with similar challenges. For example, one thing archaeological evidence can teach us is the way societies migrated over time.

Mobility has always been an important part of resilience, and it could be key now if we want our communities to survive as cities are threatened by rising sea levels and drought. **Read more from Classics Associate Professor Adam Rabinowitz as he takes us along on an excavation of ancient Greek ruins and tells us what the city's demise could mean for present-day responses to climate change.**

Planet Texas 2050's Artist-in-Residence program awards funds to projects that use the arts to convey the gravity of climate change on a personal level. This year, we are proud to support The Drag Audio production house at UT Austin to create a six-episode podcast that will explore climate change stories from across Texas. Student-producers will work with UT researchers to understand the science behind climate change as they tell the personal stories of floods, fires, and drought across the state and what communities are doing to try to adapt. **Learn more about the podcast.**

Third year journalism student Aurora Berry (left) and University of Texas at Austin journalism graduate Will Brooks (right) work together on an environmental podcast in an on-campus recording studio.

PHOTO CREDIT: THOMAS MEREDITH

USING SCHOLARLY INNOVATION TO AID IN DISASTER RESPONSE

The COVID-19 pandemic has taught us how vulnerable we are when not only one disaster strikes but another comes right on its heels. Coronavirus hospitalizations in Texas hit a peak in summer 2020, followed by the most active hurricane season on record and a deadly winter storm in February 2021. Emergency management agencies had to plan for hurricane evacuation scenarios and temporary shelters with the very real risk that COVID-19 transmissions could put more lives in danger if they couldn't shelter people safely with sufficient protective gear and social distancing. This past year has given us a glimpse into our likely future, where we will not be able to catch our breath between one disaster and the next if we don't do something tangible to change course now.

That's why Planet Texas 2050 researchers are working with city governments, community planners, and nonprofit organizations to design long-term solutions that support the state in preparing for, responding to, and recovering

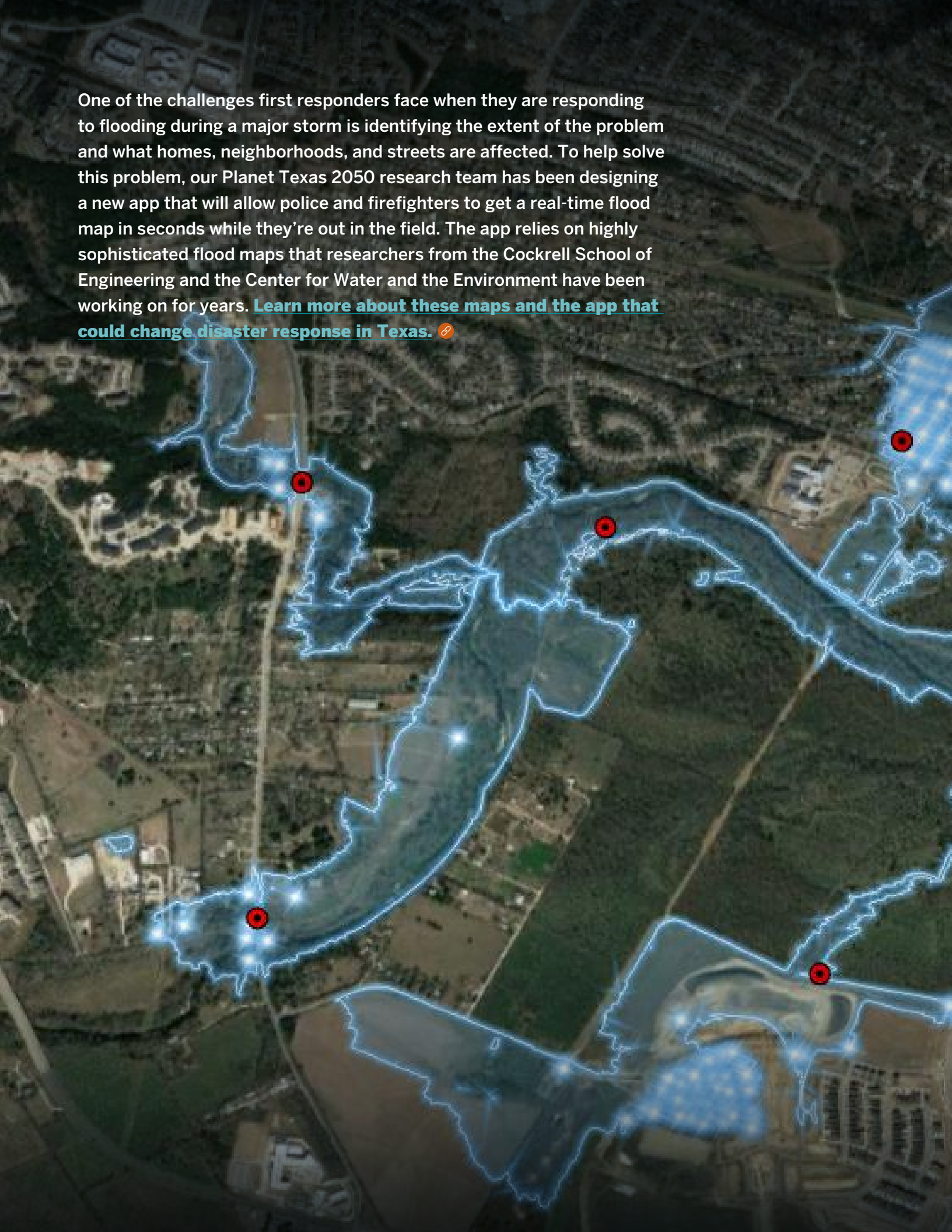
In addition to deadly flooding, Texas has begun to see some new challenges, such as extreme cold. In February 2021, the state was hit by a catastrophic winter storm that left millions without power and water. One of our Planet Texas 2050 teams has been using advanced modeling to help predict when certain electrical substations will be thrown offline during an extreme weather event. This can help energy companies, policymakers, and state agencies decide where to make infrastructure investments. **Read on to learn more.**

PHOTO CREDIT: JONATHAN CUTRER

from these compounding disasters. Some of the ways we are doing this include designing highly sophisticated flood maps using LiDAR data and new mobile technology that will enable emergency departments to identify communities at risk during major storms and help them decide, in real time, where to send critical resources. The same maps can also help local and state governments decide where to shore up infrastructure to protect communities when future hurricanes — and even winter storms — strike Texas.

But while Planet Texas 2050 is big on putting research into action for a better future, we are also committed to supporting communities *today*. To help during acute events, we have developed important partnerships with the Austin Fire Department, the National Hurricane Center, and the Texas Division of Emergency Management to ensure our work goes from campus to those on the ground. Learn more about these partnerships and our collaborative work designing new flood management tools in the pages ahead.

One of the challenges first responders face when they are responding to flooding during a major storm is identifying the extent of the problem and what homes, neighborhoods, and streets are affected. To help solve this problem, our Planet Texas 2050 research team has been designing a new app that will allow police and firefighters to get a real-time flood map in seconds while they're out in the field. The app relies on highly sophisticated flood maps that researchers from the Cockrell School of Engineering and the Center for Water and the Environment have been working on for years. **Learn more about these maps and the app that could change disaster response in Texas.**



VIDEO CREDIT: Cockrell School of Engineering

In 2020, The University of Texas at Austin joined forces with Texas A&M University on a first-of-its-kind project that will use data analytics and advanced modeling to change the way the state responds to disasters. The project, housed under A&M's Institute for a Disaster Resilient Texas, relies on supercomputers at the Texas Advanced Computing Center and a framework designed by Planet Texas 2050 researchers. The aim is to bring together hazard data from multiple, disparate sources and harmonize them in a way that will allow local government and city planning agencies, even those without specialized scientific training, to create accurate simulations and maps that aid in disaster response, flood infrastructure planning, and other challenges related to extreme weather. **Read more about this important collaboration.**

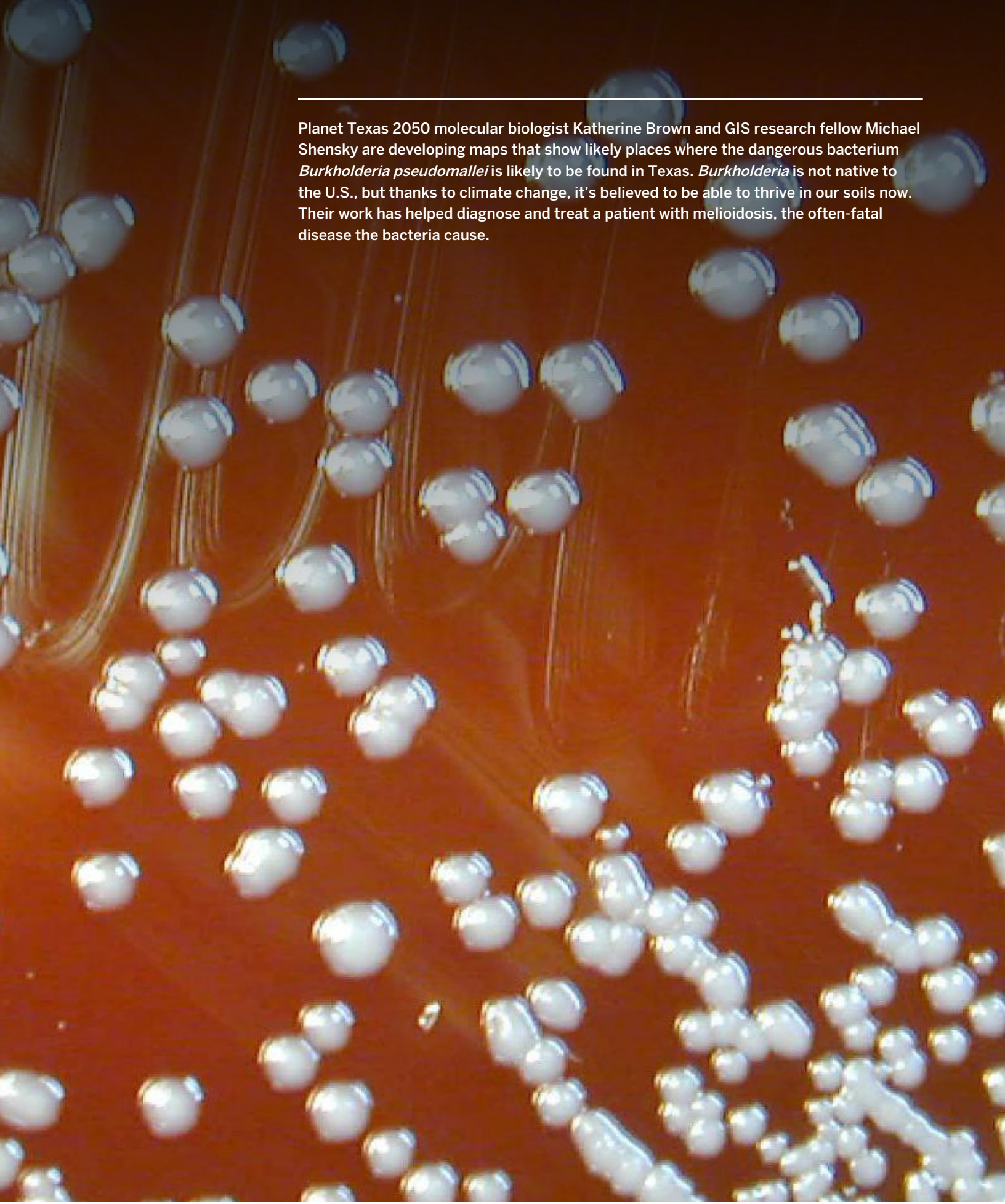
Suzanne Pierce (right), Texas Advanced Computing Center research scientist and founding member of Planet Texas 2050, stands with Texas A&M University Marine and Coastal Environmental Science Professor Samuel Brody (left) in front of maps showing flood risk across the state of Texas.

PHOTO CREDIT: BRIAN BIRZER

CONFRONTING CLIMATE CHANGE

The unfolding consequences of climate change are affecting our state in new ways. As it gets hotter and wetter in our part of the world, tropical diseases such as dengue fever or soil-borne pathogens like *Burkholderia pseudomallei*, which have rarely been observed before in the U.S., are moving north from Central America, Mexico, and Puerto Rico. Changes in atmospheric pressure mean slow-moving storms like Hurricane Harvey will become more common, with the potential to drop more rain and leave more damage in their wake. Global warming means Texas could see decade-long megadroughts that will critically affect the state's water supply. At the same time, the delicate ecosystems that support life on earth are deteriorating rapidly. Floods, droughts, cyclones, and sea level rise are contributing to the loss of tree cover and topsoil, making it more difficult for wildlife — and people — to thrive without the protections and benefits nature provides.

The effects of climate change are varied and wide-reaching, creating numerous challenges we must tackle simultaneously. Just as important, these challenges do not affect all people equally. Low-income and marginalized communities have less access to the resources needed to prepare for and recover from disasters. Part of our work includes ensuring that the most vulnerable among us — often ignored in climate planning — help co-create solutions that work for them. We are doing this by forming partnerships with trusted and longstanding community organizations and local government agencies in Houston, Austin, and San Antonio to ensure mitigation strategies are applied equitably. Read ahead to learn what we are doing to help Texans in the face of these cascading challenges, including mapping heat islands and using new technology to monitor changes in the natural environment.



Planet Texas 2050 molecular biologist Katherine Brown and GIS research fellow Michael Shensky are developing maps that show likely places where the dangerous bacterium *Burkholderia pseudomallei* is likely to be found in Texas. *Burkholderia* is not native to the U.S., but thanks to climate change, it's believed to be able to thrive in our soils now. Their work has helped diagnose and treat a patient with melioidosis, the often-fatal disease the bacteria cause.


RU

An assistant professor from UT Health Science Center at Houston hangs a heat sensor at a bus station in North Austin.

PHOTO CREDIT: THOMAS MEREDITH

The urban heat island effect explains why more metropolitan areas experience higher temperatures than rural areas. Each environment absorbs and holds different amounts of heat because of things like concrete, which retains the sun's heat, or ample tree cover along sidewalks and in neighborhood parks, which has a cooling effect. Low-income communities tend to suffer from the heat island effect more than affluent communities because reduced investment means more asphalt and fewer green spaces. To get a sense of what the urban heat island effect looks like in Austin, our researchers have been mapping the city's hotspots using satellite data and heat sensors and working with local communities to come up with cooling solutions. **Learn more about this NOAA-funded project.**

Just like heat affects communities differently, so, too, does flooding. And, again, low income and marginalized communities suffer the worst outcomes. Climate change threatens to amplify these inequities and put communities with poor infrastructure and less access to resources at greater risk. Our researchers have been working directly with the cities of Houston and San Antonio to understand the different strategies they are using to address climate change and how they are working towards climate equity. Planet Texas 2050 researchers plan to develop a case study and policy brief sharing lessons learned from these cities' climate planning efforts. **Read on to learn more.**

PHOTO CREDIT: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Climate change doesn't just look like extreme heat and extreme flooding. It also affects our ecology and biodiversity. A team of our researchers is harnessing new technology to understand more about our changing landscapes, collecting data like weather, water flows, and animal noises 24 hours a day to probe environmental conditions and understand the speed and degree of change in natural habitats across Texas. **Learn more about how technology can advance field research.**

PHOTO CREDIT: COLLEGE OF NATURAL SCIENCES

Above the Llano Estacado region of West Texas.

PHOTO CREDIT: FREDLYFISH4

LOOKING AHEAD

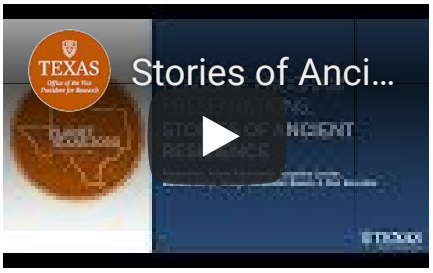
In 2020, we announced the launch of Planet Texas 2050's six flagship projects, which address critical climate change and population growth challenges affecting Texas today. These projects are the synthesis of the knowledge we took from our first years of research and explore everything from ecosystems to historical responses to climate stress.

Much of 2021 was a planning year, during which we put together teams, formed community partnerships, and refined our methods and objectives. For some of our teams, they were able to further develop the models and new technologies they had been designing since the start of the grand challenge. These include advanced flood maps that will help first responders on the ground assess real-time flood risk as well as cyber tools like interactive dashboards and computational modeling that will allow governments, city planners, and other agencies to conduct decision-making hazard simulations during crises.

We are excited to see where these take us in the next five years and beyond. Learn more about each flagship project below.

Listen to researchers talk about each project by viewing videos from last year's 'Unfurling the Flagships of Planet Texas 2050' event.

STORIES OF ANCIENT RESILIENCE



RESILIENT SPECIES AND ECOSYSTEMS

NETWORKS FOR HAZARD PREPAREDNESS AND RESPONSE

NETWORKS FOR HAZARD PREPAREDNESS AND RESPONSE

In Texas, the most deadly and costly natural disaster is flooding. Preparation and response are limited because existing flood and risk maps don't account for the ways that river flooding, surface flooding, storm surges, and terrain interact. By overlaying new, finely tuned flood maps with specially designed street maps that indicate all known structures, residences, and even which communities are most vulnerable, state agencies and local governments can respond to disasters faster and allocate resources better. This project will focus specifically on communities in Southeast Austin and Southeast Texas that have endured significant flooding events.

STORIES OF ANCIENT RESILIENCE

Human responses to climate stress and catastrophic events like hurricanes, drought, and resource conflict have been oversimplified for years — portrayed as either miraculous tales of survival or total collapse. This project seeks to understand, instead, what ancient societies can tell us about resilience — not as the ability to bounce back to a previous state after a crisis, but as the ability to embrace transformation to bounce forward, and as the ability to preserve core values and traditions even in the face of tremendous loss. Research focuses specifically on ancient water management and human mobility and migration, using a variety of methods ranging from ancient DNA analysis to LiDAR survey to chemical analysis of water and bone. This quantitative information is integrated with the qualitative results of archaeological excavations and historical investigation to develop vivid alternative narratives of survival, change, and adaptation in times of stress.

RESILIENT SPECIES AND ECOSYSTEMS

Texas' landscapes and ecosystems are changing fast. They're losing tree cover and topsoil, making it more difficult for wildlife and people to thrive without the protections and benefits nature provides. A remote network of visual and acoustic sensors placed across the state will act as eyes and ears, detecting environmental and biodiversity-related information like weather, water flows, and animal noises. By listening to birds and other wildlife 24 hours per day, sound data can be used to probe environmental conditions, helping us better understand the speed and degree of change in natural habitats across Texas. Bird behavior and presence can tell us much about the health of an area, especially when human activity clears more and more ranches, farms, and open space for new housing developments, shopping centers, and roadways. In addition to looking at birds, we will also look at new species of disease-carrying/causing organisms, such as mosquitoes, that are migrating northward into the U.S. The project team will train citizen scientists to help classify project data and create easily understandable maps and models for use by city agencies, nonprofits, and other researchers.

Learn more about each project by viewing videos from our 'Unfurling the Flagships of Planet Texas 2050' event.

FRONTLINE COMMUNITY PARTNERSHIPS FOR CLIMATE JUSTICE

EQUITABLE AND REGENERATIVE CITIES IN A POST-CARBON FUTURE

AI-ENABLED MODELING INTEGRATION

FRONTLINE COMMUNITY PARTNERSHIPS FOR CLIMATE JUSTICE

Climate change and pollution affect some populations more severely than others, and the disparities are often stark. Our urban planning and public health researchers are working with frontline communities to understand the consequences of carbon emissions for health, as well as the challenges and opportunities behind decarbonization strategies. The research team uses community-based participatory research methods, including surveys, photovoice, and storytelling, to center the experiences of affected communities. Partners, including the City of Austin, the Austin Independent School District, and the nonprofit EcoRise, will then use these data to pursue small-scale greening projects, inform larger-scale climate mitigation initiatives, and shape environmental education curriculum.

AI-ENABLED MODELING

Scientists are frequently asked to provide models and simulations about complex systems — from weather and climate to disease transmission — but they may not accurately reflect on-the-ground conditions. Research scientists at UT's Texas Advanced Computing Center are developing technologies that can combine and analyze data in new ways to make more accurate predictions. The project will include a first-of-its-kind model that interlaces hurricane projections with storm surge and flooding models in a dynamic, interactive system. These can be applied at a large, region-wide scale, allowing faster, better-informed decisions for people to deal with both sudden disasters like flash floods as well as more gradual changes from droughts and rising temperatures. Long term, this project seeks to design an artificial intelligence-enabled modeling framework that becomes the de facto example of how data and community feedback can be integrated to inform decisions in real time.

EQUITABLE AND REGENERATIVE CITIES

Migration to urban centers across Texas continues at a breakneck pace, placing immense strain on systems such as water, housing, transportation, and energy while exacerbating inequities. In this project, a team will work with the City of Austin and residents to design community resilience hubs where people can go during disasters. The design will consider factors like green infrastructure, water conservation, renewable energy, and local food production so that the hubs also serve as a model that can be implemented across the state to help reduce resource use, minimize pollution, and regenerate ecosystems.

RESEARCH AND SCHOLARLY OUTPUT

In fiscal year 2021, Planet Texas 2050 researchers produced nearly 40 scholarly works, including peer-reviewed articles, preprints, conference proceedings, and presentations. Those that formally acknowledge financial support from Planet Texas 2050 are marked with an asterisk.

A Different Type of Disaster Response Digital Volunteer: Looking Behind the Scenes to Reveal Coordinating Actions of Disaster Knowledge Workers | *Journal of Contingencies and Crisis Management* | William Roth Smith, Brett W. Robertson, Keri K. Stephens, Dhiraj Murthy
view

***A Recently Discovered Spring Source of the Aqua Traiana at Vicarello, Lazio** | *American Journal of Archeology* | Rabun Taylor, Edward O'Neill, Katherine W. Rinne, Giovanni Isidori, Michael O'Neill, R. Benjamin Gorham
view

***Artificial Intelligence for Modeling Complex Systems: Taming the Complexity of Expert Models to Improve Decision Making** | *ACM Transactions on Interactive Intelligent Systems* | Yolanda Gil, Daniel Garijo, Deborah Khider, Craig A. Knoblock, Varun Ratnakar, Maximiliano Osorio, Hernán Vargas, Minh Pham, Jay Pujara, Basel Shbita, Binh Vu, Yao-Yi Chiang, Dan Feldman, Yijun Lin, Hayley Song, Vipin Kumar, Ankush Khandelwal, Michael Steinbach, Kshitij Tayal, Shaoming Xu, Suzanne A. Pierce, Lissa Pearson, Daniel Hardesty-Lewis, Ewa Deelman, Rafael Ferreira Da Silva, Rajiv Mayani, Armen R. Kemanian, Yuning Shi, Lorne Leonard, Scott Peckham, Maria Stoica, Kelly Cobourn, Zeya Zhang, Christopher Duffy, Lele Shu
view

***Automated Coding Using Machine Learning and Remapping the U.S. Nonprofit Sector: A Guide and Benchmark** | *Nonprofit and Voluntary Sector Quarterly* | Ji Ma
view

***Assessing Proxy System Models of Cave Dripwater $\delta^{18}O$ Variability** | *Quaternary Science Reviews* | Jun Hu, Sylvia G. Dee, Corinne I. Wong, Ciaran J. Harman, Jay L. Banner, Kendra E. Bunnell

***Bouncing Forward: How Lessons from the Pandemic Can Help Us Adapt to Climate Change** | *LBJ School of Public Affairs (policy tool kit)* | R. Patrick Bixler, Paola Passalacqua, Regina M. Buono
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***Circular Economy in the Construction Industry: An Overview of United States Stakeholders' Awareness, Major Challenges, and Enablers** | *Resources, Conservation, and Recycling* | Beatriz C. Guerra and Fernanda Leite

***Constraining Speleothem Oxygen Isotope Disequilibrium Driven by Rapid CO_2 Degassing and Calcite Precipitation: Insights from Monitoring and Modeling** | *Geochimi et Cosmochimica Acta* | Peter E. Carlson, Alexandra L. Noronha, Jay L. Banner, John W. Jenson, Mark W. Moore, Judson W. Partin, Michael Deininger, Daniel O. Breecker, Kaylyn K. Bautista
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***Community-Centered Climate Planning: Using Local Knowledge and Communication Frames to Catalyze Climate Planning in Texas** | *Journal of the American Planning Association* | Katherine Lieberknecht

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Evapotranspiration Climatology of Indiana Using In Situ and Remotely Sensed Products | *Journal of Applied Meteorology and Climatology* | Dev Niyogi, Sajad Jamshidi, David Smith, Olivia Kellner
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Exploring Groundwater Recoverability in Texas: Maximum Economically Recoverable Storage | *Texas Water Journal* | Justin C. Thompson, Charles W. Kreitler, Michael H. Young
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Floodplain and Terrace Legacy Sediment as a Widespread Record of Anthropogenic Geomorphic Change | *Annals of the American Association of Geographers* | L. Allan James, Timothy P. Beach, Daniel D. Richter
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Global to USA County Scale Analysis of Weather, Urban Density, Mobility, Homestay, and Mask Use on COVID-19 | *International Journal of Environmental Research and Public Health* | Sajad Jamshidi, Maryam Baniasad, Dev Niyogi

***Hurricane Scenario Generation for Uncertainty Modeling of Coastal and Inland Flooding** | *Frontiers in Climate* | Kyoung Yoon Kim, Wen-Ying Wu, Erhan Kutanoglu, John J. Hasenbein, Zong-Liang Yang
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Hurricane Harvey: Equal Opportunity Storm or Disparate Disaster? | *The International Journal of Justice and Sustainability* | Katherine Lieberknecht, Deidre Zoll, Junfeng Jiao, Katherine Castles
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Intersecting Fluvial and Pluvial Inundation Estimates with Sociodemographic Vulnerability to Quantify Household Risk in Urban Areas (in review) | *Water Resources Research* | Mark Preisser, Paola Passalacqua, R.Patrick Bixler, J. Hofmann
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Is Satellite Sun-Induced Chlorophyll Fluorescence More Indicative than Vegetation Indices Under Drought Condition? | *Science of the Total Environment* | Junjun Cao, Qi An, Xiang Zhang, Shan Xu, Tong Si, Dev Niyogi
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***Measuring the Impact of Immersive Virtual Reality on Construction Design Review Applications: Head-Mounted Display versus Desktop Monitor** | *Journal of Construction Engineering and Management* | Bing Han and Fernanda Leite
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A Dynamic Traffic Assignment Approach to Evaluating Incident-Induced User Delay Costs with Integrated Corridor Management: A Case Study in Austin, Texas | *International Conference on Transportation and Development 2021* | Tianxin Li, Natalia Ruiz Juri, Jun Liu, Heidi W. Ross, Randy B. Machemehl, John Nevares, and Adam Kaliszewski
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***"Not a Big Climate Change Guy" Semiotic Gradients and Climate Discourse** | *Environmental Communications* | Paul C. Adams
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Pathways to Urban Sustainability Through Individual Behaviors: The Role of Social Capital | *Environmental Science & Policy* | Samer Atshan, R. Patrick Bixler, Varun Rai, David W. Springer
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Prediction Capabilities of GeoFlood for the Delineation of Flood-prone Areas: The Tiber River Case Study | *EGU General Assembly 2021* | Claudia D'Angelo, Paola Passalacqua, Aldo Fiori, Elena Volpi
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***Recent Advances Clarifying the Structure and Function of Plant Apyrases (Nucleoside Triphosphate Diphosphohydrolases)** | *International Journal of Molecular Sciences* | Greg Clark, Katherine A. Brown, Manas K. Tripathy, Stanley J. Roux
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***Revisiting Urban Expansion in the Continental United States** | *Landscape and Urban Planning* | Steven M. Richter
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Scale Invariance in the Spatial-Dynamics of Biological Invasions | *NeoBiota* | Andrew M. Liebhold, Timothy H. Keitt, Nikunj Goel, Cleo Bertelsmeier
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***Strategic Evacuation for Hurricanes and Regional Events with and without Autonomous Vehicles** | *Transportation Research Record: Journal of the Transportation Research Board* | Jooyong Lee and Kara M. Kockelman
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***Traits of a Bloom: A Nationwide Survey of U.S. Urban Tree Planting Initiatives (TPIs)** | *Urban Forestry & Urban Greening* | Theodore S. Eisenman, Tamsin Flanders, Richard W. Harper, Richard J. Hauer, Katherine Lieberknecht
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***Tropical Wetland Persistence Through the Anthropocene: Multiproxy Reconstruction of Environmental Change in a Maya Agroecosystem** | *Anthropocene* | Samantha Krause, Timothy P. Beach, Sheryl Luzzadder-Beach, Duncan Cook, Steven R. Bozarth, Fred Valdez, Thomas H. Guderjan
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***Unpacking Adaptive Capacity to Flooding in Urban Environments: Social Capital, Social Vulnerability, and Risk Perception** | *Frontiers in Water* | R. Patrick Bixler, Sandeep Paul, Jessica Jones, Matthew Priesser, Paola Passalacqua
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Urban Climate is Central to the Next-Generation Weather and Climate Models, Field Studies, and Societal Needs | *Urban Climate* | Jorge E. Gonzalez and Dev Niyogi
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Urban Climate and Resiliency: A Synthesis Report of State of the Art and Future Research Directions | *Urban Climate* | Jorge E. González, Prathap Ramamurthy, Robert D. Bornstein, Fei Chen, Elie R. Bou-Zeid, Masoud Ghandehari, Jeffrey Luvall, Chandana Mitra, Dev Niyogi
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***Wetland Farming and the Early Anthropocene: Globally Upscaling from the Maya Lowlands with LiDAR and Multiproxy Verification** | *Annals of the American Association of Geographers* | Sheryl Luzzadder-Beach, Timothy P. Beach, Nicholas P. Dunning
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Global Rates and Patterns of Channel Migration in River Deltas | *PNAS (In Review)* | Teresa Jarriel, J.M. Swartz, Paola Passalacqua

Toward Co-Production for Urban Resilience: A Multi-Hazard Approach in Austin, Texas | *International Journal of Hazard Risk Reduction (in revision)* | R. Patrick Bixler, Euijin Yang, Steven M. Richter, Marc Coudert

GRANTS AND AWARDS

To date, the team has received $5.7M in external grants, gifts, and awards for Planet Texas 2050-related research. Of this funding, $3.3M was received in FY21 and is detailed below. Planet Texas 2050 has also contributed its expertise to more than $10M in other externally funded research projects and centers at The University of Texas at Austin.

National Oceanic and Atmospheric Administration
Climate Program Office Extreme Heat Risk Competition, FY2021
"Extreme Heat Risk Initiative: Urban Climate Science for Decision-Making & Evaluation of Heat-Health Interventions for Austin, TX"
$148,864

National Oceanic and Atmospheric Administration
Climate Program Grants
"Understanding current and future coastal flood risk: How do local governance networks shape resilience efforts in response to perceived hazards?"
$114,395

National Oceanic and Atmospheric Administration
Environmental Literacy Grants
"Environmental Literacy Grants: Supporting the education of K-12 students and the public for community resilience"
$215,000

Texas Division of Emergency Management
"Spatial Flood Analysis: Pin2Flood"
$1,213,145

National Science Foundation
Navigating the New Arctic
"Capturing Indigenous Knowledge to Co-Design more Effective Operations, Maintenance and Management of Water Infrastructure"
$846,899

National Science Foundation
Navigating the New Arctic
"Water Infrastructure in the Arctic: Vulnerabilities at the Intersection of Social, Natural and Physical Systems"
$198,857

Geosciences Professor Dev Niyogi (left) and Public Affairs Assistant Professor Patrick Bixler (right) walk through a parking lot in the Rundberg neighborhood in Austin nearby where they installed heat sensors to identify urban hot spots. Their work is part of a National Oceanic and Atmospheric Administration-funded project to come up with heat interventions.

PHOTO CREDIT: THOMAS MEREDITH

National Science Foundation
Dynamics of Integrated Socio-Environmental Systems (CNH2)
"CNH2-L: Using Sound to Advance Conceptual Frameworks of Resilience of Integrated Grassland-Pastoralist Systems"
$52,136

Microsoft
Research gift for AI-enabled models for integrating complex decision-making
$65,000

Microsoft
Research gift for reimagining more equitable and resource-efficient metropolitan areas via circular economy
$35,000

Construction Industry Institute
"Value and Opportunities of a Circular Economy on Capital Projects"
$173,425

Texas A&M University at Galveston
"Technical Program Planning Support for the Texas Disaster Information System"
$150,000

The Nature Conservancy
Planet Texas 2050 Postdoctoral Fellow Support
$39,000

Go Austin/Vamos Austin community organizer Frances Acuña speaks to residents in North Austin about the heat in their neighborhood as part of a project to map areas with high temperatures.

PHOTO CREDIT: THOMAS MEREDITH

OUR COMMUNITY PARTNERS

- Austin Fire Department
- Austin Independent School District
- Austin Technology Incubator
- Austin Youth River Watch
- City of Austin
- Central Texas Food Collaborative
- Community Powered Workshop
- EcoRise
- Global Database Community Consortium Go Austin/Vamos Austin (GAVA)
- Houston-Galveston Area Council
- Indigenous Cultures Institute
- Institute for a Disaster Resilient Texas
- Museum of South Texas History
- National Center for Atmospheric Research
- National Hurricane Center
- National Water Center
- Round Rock Independent School District
- Sabine River Authority
- Science Journal for Kids
- Southeast Texas Regional Advisory Council
- Southeast Texas Regional Flood Coordination Study
- Texas Data Repository Steering Committee
- Texas Department of Emergency Management
- Texas General Land Office
- Texas Parks and Wildlife Department
- Texas Real Food
- The Austin Common
- The Nature Conservancy
- U.S. Defense Advanced Research Projects Agency

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- Aerospace Engineering and Engineering Mechanics
- African and African Diaspora Studies
- Anthropology
- Art and Art History
- Center for Water and the Environment
- Civil, Architectural and Environmental Engineering
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- Computer Science
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- Division of Community Engagement and Health Equity
- Geography and the Environment
- Geological Sciences
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- Integrative Biology
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- Stan Richards School of Advertising and Public Relations
- Steve Hicks School of Social Work
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- The Mesoamerica Center
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- UT Libraries

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Geological Sciences and Civil, Architectural and Environmental Engineering

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