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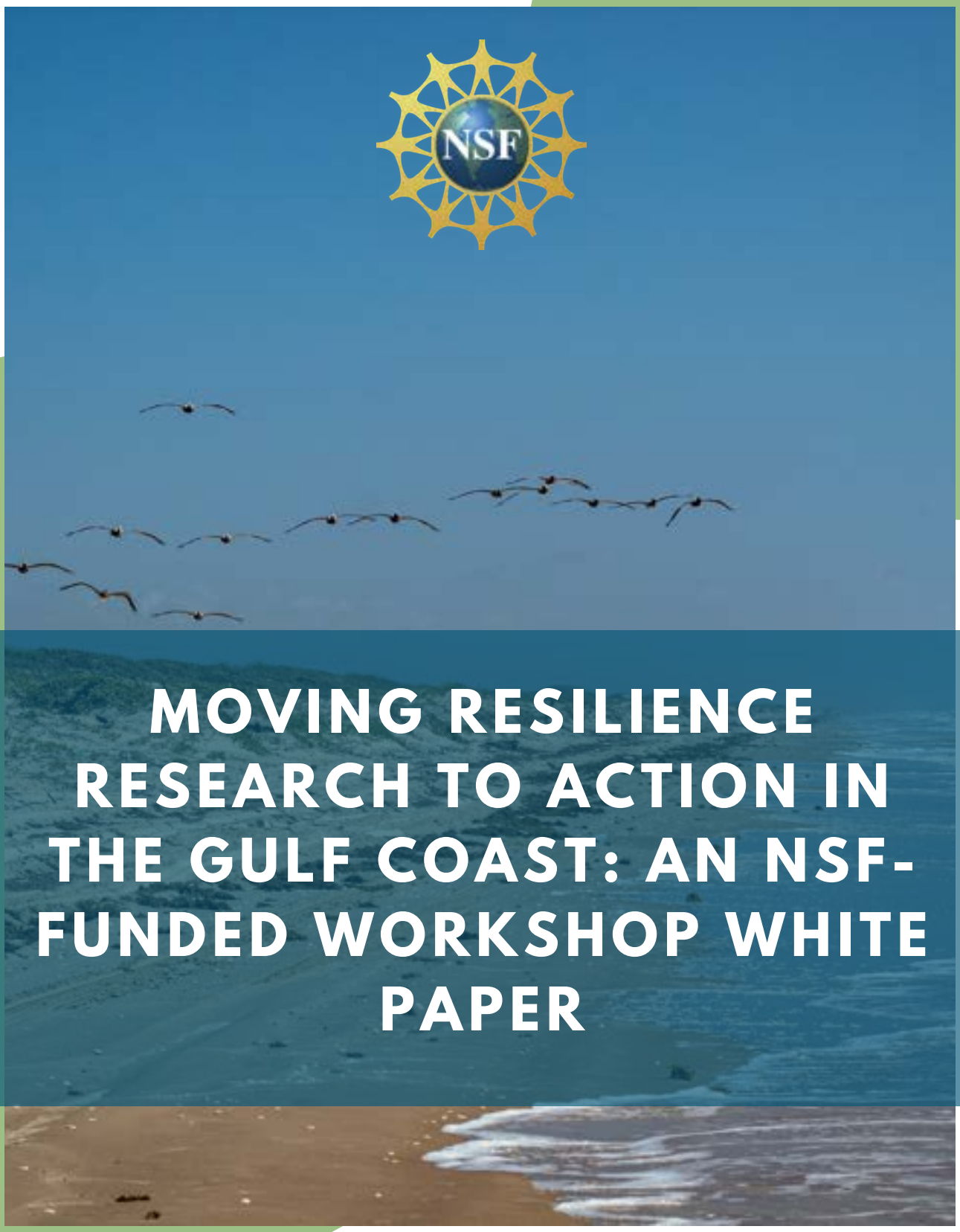

MOVING RESILIENCE RESEARCH TO ACTION IN THE GULF COAST: AN NSF-FUNDED WORKSHOP WHITE PAPER

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TABLE OF CONTENTS

OBJECTIVES AND SIGNIFICANCE

The purpose of our three-day virtual workshop was to bring together scholars and stakeholders to begin building a community of practice focused on moving climate resilience research to action in the Gulf of Mexico Region (shortened to Gulf Region). Climate change is affecting the lives and livelihoods of millions of people in the Gulf Region, from the tip of Florida to the Texas coast. Across this vast swath of coast, urban centers such as Houston, the fourth largest and one of the most diverse cities of the U.S. (US News and World Report 2020), mid-sized cities, and small coastal towns are all nested within one of the planet's most biodiverse and productive ecosystems (Noss 2016).

Just in the last five years, the area has been affected by numerous coastal storms (e.g., Harvey, Imelda, Michael, Laura, Irma, Ida). Louisiana, for example, experienced a record in landfalls in 2020, massive flooding in 2016 and regular flooding along the Mississippi River, subsidence of coastal lands, and record heat and drought. Hurricane Michael in 2018 was the first Category 5 hurricane to ever hit the Florida Panhandle, leaving thousands of residents without housing, power, food and water, and shutting down schools, stores and businesses for weeks and months, while damages from the storm continue to impact communities in the region years later (Ozguven 2019).

These natural hazards are compounded by hazards from large-scale industrial infrastructure, including those along "Cancer Alley" in Louisiana, such as Beaumont's petrochemical and military complexes, and Houston's petrochemical ship channel. The Gulf Region encompasses the most hazard-prone region of the U.S., and is home to a disproportionately high number of people who are considered socioeconomically vulnerable to disasters (due to poverty, age, racial or ethnic marginalization, lack of healthcare infrastructure, limited access to education, and sociopolitical factors). This area also has a reputation as an environmental justice battleground area (Bullard 2008; Bullard and Wright 2009; Cutter and Finch 2008; Taylor 2014). These chronic stressors are worsened by climate change impacts (such as sea level rise, more frequent flooding, expanded flood zones, changing temperatures), evolving population dynamics (increasing economic inequality, poverty, health disparities, deindustrialization, disaster migrations, climate gentrification, etc.), aging infrastructure capacity and condition, and rapid industrial and technological change (Laska 2020).

In order to create a more resilient future, we will have to make massive shifts and complex decisions about how we build and adapt our communities, what technologies and tools will best support these decisions, and how we consume resources to minimize impacts, all while ensuring resilience is justice-centered. The Gulf Region is a bellwether of change, providing both successful and failed adaptation examples for the entire world as climate impacts increase.

Motivated by these factors, the Resilience Workshop provided an opportunity for researchers, policymakers, and communities to work together to ask and answer two main questions:

- How can we move research findings into actionable knowledge to improve resilience in the Gulf Coast region?
- How can we shape the research enterprise to undertake co-design of research and research translation so that the needs of non-academic stakeholders are centered and prioritized?

JUSTIFICATION FOR THE WORKSHOP

The workshop addressed needs within the research community and in communities at the intersection of research and practice. First, there are many researchers in STEM, social sciences, and humanities focused on questions relating to climate resilience in the Gulf Region. However, these researchers are not linked in region-specific interdisciplinary or research-to-action networks. This means that there is a lack of awareness among research colleagues about work others are doing that is relevant to their own, and there is a lack of coordination among research thrusts such that stakeholders might be able to more efficiently interact, influence, or use the knowledge outputs of resilience research. In addition, the lack of coordination presents a risk that stakeholders and community representatives will be overburdened by duplicative requests for participation in research projects. Second, the Gulf Region is uniquely diverse in its interfaces between urban centers and rural areas, and resilience research must address these challenges, among other major gaps that exist in our understanding of the interplay of human and natural systems in this region. Data about human and natural systems are inherently diverse, generating problems when working across disciplinary silos. Data are generated and captured by a myriad of individuals and agencies. The collected data are underused because of limited access, usability issues, or simply lack of knowledge that the data exist between domains. The data can also seem overwhelming because of the sheer volume of information, the lack of coordination between researchers, and the need for tools to glean insights from the data and analyses.

Moving resilience research forward more quickly requires coordination across data types, disciplinary boundaries, and sector boundaries that has yet to be fully envisioned. A third facet of the challenge is the reality that university researchers are not the right group to lead and own the implementation of research insights. In fact, much resilience research does not move into practice at all, and a renewed focus on how to best bridge this divide is needed. There is a need for a cadre of facilitators who interface between researchers, policymakers, and communities. And finally, educating the future generations of researchers, policymakers, and advocates is a critical function of Gulf Region schools and universities, and we must do a better job of preparing the younger generation and other stakeholders for the challenges ahead, particularly in the complex business of working together across multiple scales to research, understand, and implement resilience interventions. Education and strategic collaboration will allow science – and climate change – to become mainstream and inform adaptation and resilience solutions.

Defining "Resilience Research"

Resilience is commonly defined as the capacity of a system to absorb disturbance and reorganize, while undergoing change so as to still retain essentially the same function, structure, identity, and feedback (Meerow et al. 2016). It has roots in systems theory and has a variety of interpretations and applications, including ecosystems management, disaster preparedness, and community planning (Adger 2000; Adger et al. 2005; Meerow and Newell 2019). Based on the work of the Resilience Alliance, "resilience" is the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience (Holling 1973; Gunderson and Holling 2002; Scheffer et al. 2001; Walker et al. 2004; Resilience Alliance 2020). We emphasize a definition of resilience that recognizes the benefits of preparedness and adaptive change to emerging circumstances, a centering of equity, and the ability to move forward and recover critical functions after a crisis, which sometimes means moving forward in a new direction.

This workshop brought together scholars, practitioners, and stakeholders committed to outcome-oriented research around coastal resilience, or "resilience research." Despite the importance of the Gulf Region within the U.S. and the world, a network of researchers and stakeholders focusing holistically on this geographical area has never been established. Various smaller scale initiatives, university-specific networks, and individual research projects exist; however, they are not integrated, coordinated, or amplified to generate fundamental knowledge about the processes that drive community, ecological, and system-scale resilience to so many compounded stressors. Efforts to build networks between researchers focused on the Gulf Coast hazards and disasters are increasing. These include such initiatives as the Gulf Research Program at the National Academies of Sciences, Engineering, and Medicine (GRP 2020); the NSF-funded Convergence facilities (Peek et al. 2020); and the various Extreme Events Reconnaissance networks (e.g., Converge 2020; Steer 2020).

To deeply and authentically engage with the challenge of implementing research insights, we must develop a shared vision grounded in communities' values and co-developed with residents and stakeholders, while also connecting localized experiences to broader networks of action, reaction, and influence within the integrated human, environmental, and technical systems. For this workshop, we brought together researchers, practitioners, community stakeholders, and decision-makers to consider how science can best understand and contribute to resilience through the ecological, infrastructural, and social shifts occurring in the Gulf Region.

WORKSHOP FORMAT, PARTICIPANTS, & AGENDA

Our Workshop Steering Committee designed the three-day workshop in a virtual format and invited participants from a variety of backgrounds/areas of expertise, including natural and social scientists, engineers, community stakeholders, professionals, and policymakers. The goal was to catalyze dialogue to bridge knowledge gaps, initiate development of shared language around resilience research themes, explore approaches to move research into meaningful action, and foster collaboration among disparate disciplines and stakeholders.

Our facilitation team helped plan and coordinate sessions, as well as facilitate discussions. We also had event support from The University of Texas at Austin's Office of the Vice President of Research, Scholarship and Creative Endeavors via Planet Texas 2050, a research grand challenge program at UT Austin.

The workshop included a variety of activities for participants to engage in:

- Pre-Workshop preparations: All participants were asked to answer a short survey (survey questions shown in Appendix A) which the Steering Committee used to plan breakout sessions.
- Plenary sessions: Invited talks and panel discussions from leading researchers, interface organizations, and community representatives to discuss the outcomes of breakout sessions (see below), research and engagement needs, future research directions, etc.
- Lightning talks: Short presentations by emerging/young researchers, practitioners, or community representatives whose abstracts or project examples had been selected.
- Small group/breakout discussions on defined topics, with professional facilitation.

A total of 231 individuals registered for the workshop. The breakdown of registered participants is shown in Figure 1. Of the 231 registrants, 66 actively participated in the workshop.

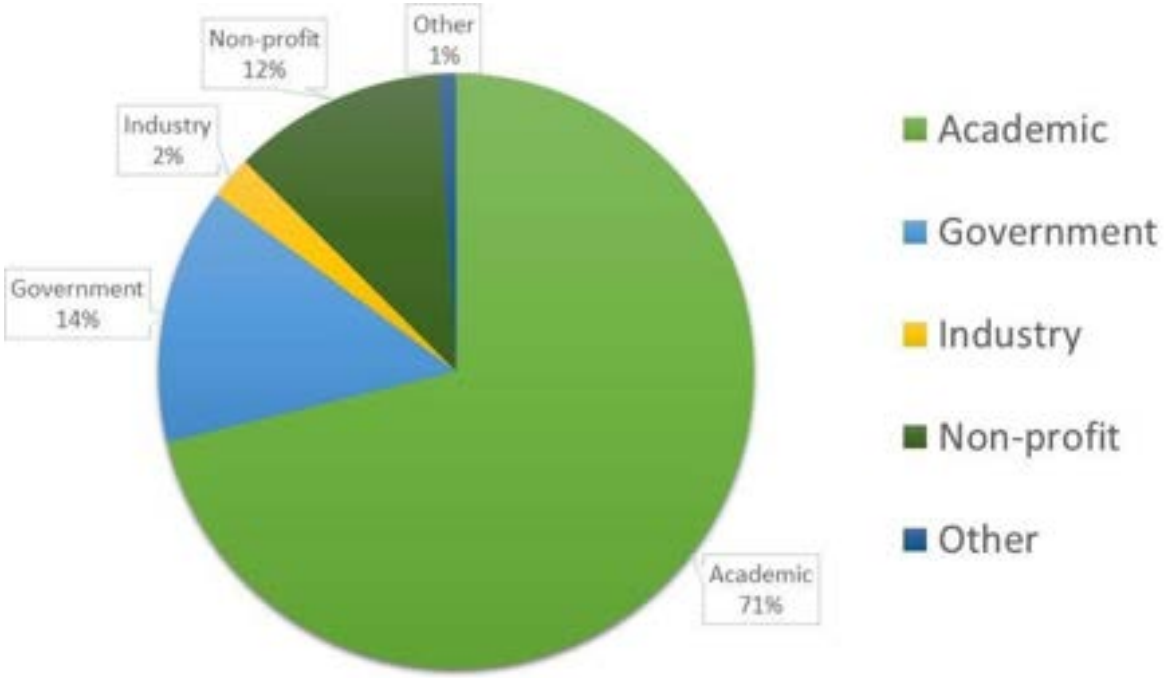

Figure 1. Workshop Participants

The workshop agenda featuring the above activities is presented below. The event webpage was frequently updated to reflect any changes, and this is the final agenda, also available at our event page: https://events.attend.com/f/1383794748. Note that speakers/panelists came from a variety of organizations, including universities, government, and nonprofit, as well as from a variety of disciplines. The goal was to enable cross-disciplinary interactions to help identify needs in the research community and at the intersection of research and practice.

Day 1 – Monday, May 09, 2022

9:00 a.m. Welcome and opening remarks, Bruce Hamilton (NSF)

9:10 a.m. Goals of Workshop and Overview of Agenda, Fernanda Leite (UT Austin)

9:20 a.m. Cross-disciplinary research as a mechanism to solve Grand Challenges, Jennifer Lyon Gardner (UT Austin)

9:45 a.m. Panel 01: Defining Resilience to Action

Moderator: Katherine Lieberknecht (UT Austin)

Panelists: Therese McAllister (NIST), Vincent Brown (LSU), and Cecilia Martinez (Bezos Earth Fund)

11:00 a.m. Breakout discussions

Facilitators: John Cooper (Assistant Vice President for Public Partnership & Outreach and acting Assistant Director of Institute for Sustainable Communities, Texas A&M University) and Jaimie Masterson (Director of Texas Target Communities, Texas A&M University)

12:15 p.m. Break

1:00 p.m. Lightning talks (nine, 6-minute talks and discussion)

Moderator: Michelle Meyer (TAMU)

Speakers: Kendall Valentine (Post-doc, Virginia Institute of Marine Sciences); Carol Friedland (LaHouse Director at Louisiana State University AgCenter); Carol Jeffers (Founder & CEO, JAQARDEN); Kassie Ernst (Gulf Scholars and Grand Challenges Scholars Program Director at the FAMU-FSU College of Engineering); Kevin Smiley (Assistant Professor, LSU); Mubarak Adesina (PhD student, Lamar University) and Nicholas Brake (Associate Professor, Lamar University); Stephanie Glenn (Houston Advanced Research Center); Ali Mostafavi (Associate Professor, TAMU) and Chao Fan (post-doc, TAMU); Will Hill (FAMU-FSU College of Engineering, RIDER Center)

2:10 p.m. Day 01 Wrap-up

2:15 p.m. Adjourn

Day 2 – Tuesday, May 10, 2022

9:00 a.m. Day 02 Welcome agenda and Day 01 recap, Fernanda Leite (UT Austin)

9:10 a.m. Panel 02: Community Challenges across the Gulf
Moderator: Maria Watson (University of Florida)
Panelists: Scott Hemmerling (Water Institute for the Gulf), Sally Ray (Center for Disaster Philanthropy), and Karena Mothershed (National Academies Gulf Education and Engagement Program)

10:30 a.m. Breakout discussions
Facilitators: John Cooper (Texas A&M University) and Jaimie Masterson (Texas A&M University)

11:30 a.m. Panel 02 & Breakout Summary

11:35 a.m. Set-up for Community-identified research needs Breakout Session

11:50 a.m. Break

1:00 p.m. Meet and Greet of Researchers in Breakouts

2:15 p.m. Adjourn

Day 3 – Wednesday, May 11, 2022

9:00 a.m. Day 03 Welcome agenda and Day 02 recap, Fernanda Leite (UT Austin)

9:10 a.m. Panel 03: What needs to change
Moderator: Maria Koliou (TAMU)
Panelists: Shirley Laska (Lowlander Center), Jeff Carney (UFL), and Suzanne Pierce (Texas Advanced Computing Center)

10:15 a.m. Breakout discussions
Facilitators: John Cooper (Texas A&M University) and Jaimie Masterson (Texas A&M University)

11:15 a.m. Summary of key takeaways, Fernanda Leite (UT Austin)

11:30 a.m. Adjourn

KEY TAKEAWAYS FROM THE WORKSHOP

Overarching Takeaways: What Does Resilience Planning Need?

There is a need for community-based research. A recurring theme throughout the workshop was the need for community-based research. Resilience work takes place along a transect of scopes, ranging from the national level to the individual household. For resilience research and planning to be effective, more work needs to be done at the small community/neighborhood level that allows researchers to meaningfully partner with communities, share resilience practice with those who will continue the work after the researchers are gone, and gather the local information that would otherwise be missed.

There is a need for flexibility both in project plans and in financing. For successful resilience research and planning, leaders need to have an openness to going where the facts on the ground lead and working across disciplines and institutions. Projects should allow the flexibility for change, if and when it is clear that the original scope was not the most apt or necessary or when a partner community communicates different needs. Similarly, grants and other funding sources need to work to include a variety of researchers and practitioners from different backgrounds and disparate skill sets.

The need to recognize our own and our communities' grief and fallibility. There is a need for humility and honesty in resilience work. Even the best resilience work cannot protect against the personal nature and reality of disaster (though it can improve disaster preparation and response), and may not be able to prevent irreparable changes due to climate change or other environmental issues. It is important to have self-awareness of one's own trauma, as well as show empathy towards the impacted population and recognize the pain and grief around disaster and climate change, including our inability to solve all problems or create a perfect system.

The need for resilience to be a "bounce forward" to a more just and resilient world, not a "bounce back" to the status quo. While the definition of resilience is all about an institution's ability to maintain itself in response to change, the world – as it is – is not perfect. Rather, resilience planning exists in the context of grave injustices. In the US, injustice and oppression along the fault lines of race, gender, and class should be addressed by resilience researchers and

practitioners, with the intention to “bounce forward” into a more just future rather than “bounce back” to an unjust status quo.

Day 1 – Defining Resilience to Action

The plenary talk by Jennifer Lyon Gardner (Deputy Vice President of Research, UT Austin) highlighted the importance of use-inspired, cross-disciplinary research, focused on societal impact, as well as the need to work collaboratively with communities on resilience research. This topic of working ***with*** communities from start to end was brought up throughout the workshop, underscoring the need for a two-way interaction and community-led co-production. This talk highlighted the flagship projects of Planet Texas 2050, focusing on species, ecosystems, frontline communities, equity, preparedness, and traditional knowledge – all related to the need for a multi-disciplinary and intersectoral approach to resilience that cannot intend to protect a baseline status quo but improve lives and ecosystems across the Gulf.

The plenary was followed by Panel 1, which focused on "Defining Resilience to Action". This panel was moderated by Katherine Lieberknecht (Assistant Professor, Community and Regional Planning, UT Austin) and was composed of the following panelists: Therese McAllister (National Institute of Standards and Technology), Vincent Brown (Louisiana State University), and Cecilia Martinez (Bezos Earth Fund). The panel highlighted the **need to build social and community networks** to enable stakeholder-driven research with real-world applications. The panelists discussed the **need to work with communities**, which aligns with the earlier conversation in the Plenary session. However, one challenge lies in the fact that, although trust-building is lengthy and sensitive, it is a necessary process. This challenge was also brought up across the breakout sessions, which highlighted the **need to fund organizations to continuously tackle trust-building with communities** to enable and sustain community-engaged research. Communities know best what impacts they suffer and what is needed to build resilience, since they are the ones dealing with the impacts and responsible for the long-term implementation of adaptation and resilience action. In addition, if science and models go against the lived experience of the community, trust is broken. Researchers were urged to work with communities to “research to life, not research to death,” taking into consideration the needs of the community first and using that to guide the research. A major takeaway was **the need to reflect on when and why to do research that engages with communities and what the benefits will be for these communities**.

One example of creating stronger connections and trust when working with communities is by using Memoranda of Understanding (MOUs) that clearly spell out the benefits to and responsibilities of both the communities and researchers. Other examples include establishing “community fellows” to gather information from communities about their needs and provide that two-way exchange of information, as well as having community stakeholders help formulate the research questions in a collaborative manner during the early stages of project development. The panel also highlighted the need for intergovernmental coordination so that resources are better allocated and efforts are complementary. The panel addressed the importance of the scale of resilience work and the importance of **research at the community-scale that considers local context**. Communities may have similar goals but varying resources,

so research should consider leveraging flexible methods that can be adapted to local contexts. There was then a discussion on **measuring progress**, or the lack of progress, in resilience research. The discussion around **metrics** returned across all three days of the workshop.

During Panel 1, workshop participants were asked to type "one word that captures your understanding of resilience" in the chat. The following were some of the contributions: commitment, flexibility, adaptation, hope, fortitude, preparation, accountability, recovery, and collectivity. These terms came up again and again during breakout discussions and in subsequent days of the workshops.

After Panel 1, workshop participants were invited to join breakout groups, which were split by regional area. The intent was to connect individuals with interest in these areas in the hope of developing long-term, regional networks. The following lists the number of participants in each of the breakout rooms:

- Texas-Coastal Bend & Valley – 8 participants
- Texas-Houston MSA – 6 participants
- Texas-Southeast – 4 participants
- Louisiana – 14 participants
- Mississippi/Alabama – no participants
- Florida-North A – 6 participants
- Florida-North B – 6 participants
- Florida-Central & South – 6 participants

Within the breakout rooms, participants were asked to discuss what was missing from the resilience definitions proposed by earlier speakers. The discussions in the Breakouts included the following key themes.

Resilience has many definitions, and sometimes it is not the right term. As researchers and practitioners, we need to understand that the term may, in some instances, imply that only some populations (particularly marginalized ones) are asked to be “resilient,” while more privileged populations have access to the physical and social infrastructure needed to mitigate damage from shocks and stressors.

Bouncing forward is preferable to bouncing back. Resilience should not just be a return to the status quo. Sometimes “bouncing back” to the status quo is not attainable, appropriate, necessary, or desirable. Thus, transformation is another key aspect of resilience in order for communities to be able to “bounce forward” to a state where vulnerability is low and resilience is high. It is key to give people alternatives and better options to choose from so that they can make informed choices that build resilience and reject choices that increase or perpetuate risk and vulnerability.

There is no "one size fits all" approach – researchers need to understand local contexts. Resilience comes from the ground up and is rooted in local knowledge and experiences. Local cultures need to be centered if communities are going to be resilient over the long term, particularly as researchers, as well as state and national governments, come and go. Each community has different levels of resources and capacity, and resilience-building must be tailored to what is feasible and can be effectively done at the local level.

There is a need for relevant metrics. It is rare to see metrics that capture the dynamic process of resilience-building at fine spatial and temporal scales. Where meaningful information exists, it is often inaccessible to everyday practitioners and community members. New metrics and access systems need to be developed. The following quotes seemed particularly relevant:

"Resilience is felt before the disaster hits. Like a financial downturn, we are/should be prepared for hazard events. The majority of the literature is about [the period] during the disaster and recovery, but less is on what happens before and how we prepare for the hazard."

"Resilience isn't a point in time, but must be considered across a span of time [as a] combination of preparedness, hazard mitigation, impacts, historical processes."

"Resilience is so local. What works for one community may not work for another."

"Working at the local level, you can engage with the complexities of actual decisions, such as why it might make sense that a community wants to develop or remain in a floodplain. On a wider scale, you might see research that shows that community won't be there in the long term. So, different data/metrics [are needed] for different purposes."

Establishing redundancy in systems is key to long-term adaptability. As resilience researchers and practitioners, we must ask ourselves: Is creating redundancy a more efficient part of resilience? By reducing redundancy, global markets and large governments may accidentally make their constituent parts less shock resistant, imposing higher costs over the long term.

Scientists do (and should be funded to undertake) the difficult work of conducting community-engaged research. Building off of the panel discussions, the multiple breakout groups had deep discussions about the need for community-engaged research. This included the idea of creating community advisory committees for research projects, which should reflect the community and serve as a way to get people involved from the beginning. These groups do not only serve to empower local leaders, they also help to improve the breadth and depth of questions posed and metrics generated by the researchers. When research is done in coordination with a community advisory committee, there is also a natural and healthy push for implementation and action-based outcomes, producing more useful and applicable studies. Community buy-in is an essential component of a successful project, and community members should be paid for their time and expertise. Projects should pursue actionable and measurable objectives.

The last session of Day 1, moderated by Michelle Meyer (Associate Professor and Director, Hazard Reduction & Recovery Center, TAMU), was composed of nine Lightning Talks:

- Kendall Valentine (Post-doc, Virginia Institute of Marine Sciences) and Giulio Mariotti (LSU) "Harnessing the power of simple models to develop best practices";
- Carol Friedland (LaHouse Director at Louisiana State University AgCenter) "Floodsafe home";
- Carol Jeffers (Founder & CEO, JAQARDEN) "Dynamic partnerships and resilience";
- Kassie Ernst (Gulf Scholars and Grand Challenges Scholars Program Director at the FAMU-FSU College of Engineering) "How can we shape the research enterprise to undertake co-design and co-development of research and research translation so that the needs of non-academic stakeholders are centered and prioritized?";
- Kevin Smiley (Assistant Professor, LSU) "Social inequalities in climate change attributed flood impacts from Hurricane Harvey";
- Mubarak Adesina (PhD student, Lamar University) and Nicholas Brake (Associate Professor, Lamar University) "Deployment of low-cost sensors in Southeast Texas";
- Stephanie Glenn (Houston Advanced Research Center) "A sustainable vision: Building resilience for a changing climate";
- Ali Mostafavi (Associate Professor, TAMU) and Chao Fan (Post-doc, TAMU) "Smart resilience: Harnessing big data and AI to augment disaster resilience";
- Will Hill (FAMU-FSU College of Engineering, RIDER Center) "Northwest Florida sentinel landscape".

Day 2 – Community Challenges across the Gulf

The theme of Day 2 was community challenges across the Gulf. We began the day with a panel discussion, which was moderated by Maria Watson (Assistant Professor, Shimberg Center for Housing Studies, University of Florida). The panelists were Scott Hemmerling (Water Institute for the Gulf), Sally Ray (Center for Disaster Philanthropy), and Karena Mothershed (National Academies Gulf Education and Engagement program). The panel highlighted the following challenges observed in the Gulf region.

The existence of persistent/chronic hazards, along with acute/extreme weather events compounds underlying community problems. Many communities have interconnected challenges and compounding risks. This includes both acute and chronic risks and hazards. Of course, hazards always exist on top of systemic social and economic issues: for instance, extreme rain regularly causes flooding in low-lying areas inhabited by communities of color with low incomes. These short-term, acute events are made more difficult by the ongoing COVID-19 pandemic, as well as the lack of access to personal vehicles and lack of paid time-off for these households. Often, a community may be at a tipping point due to chronic stressors;

acute events can be the final straw that creates a tipping point for resilience in a community.

Hazard and resilience planning, research, and response are different in rural vs. urban communities. There is a tendency for an urban focus on resilience studies (e.g., Houston and New Orleans have resilience plans). This makes sense, both because most researchers are based in urban settings and because most people live in urban settings. However, there is a need for a deeper focus in rural areas. It is important to understand local contexts: for example, rural fishing communities have different needs than rural agricultural communities. Building a sense of place helps both researchers and locals better understand resilience-building needs.

Participant Scott Hemmerling raised an extremely poignant example from Louisiana: a community the Water Institute for the Gulf works with is not as concerned about being protected from the water as it is about losing their heritage in being connected to the water. A new levee, which will ostensibly protect the community from rising water levels, has made it impossible for most community members to see or access the water. When asked what resilience work was needed in the community, most community members pointed to the need for a new dock that would allow them to fish and connect with the water and maintain their culture. Therefore, researchers need to know the community stories so that research products inform the best resilience actions, which also take into account cultural and historical preservation.

Again, the conversation returned to the need for community-based research, as well as action for understanding and addressing systemic challenges. There is a need for flexible research methods. As previously mentioned, no "one size fits all" approach was a phrase used repeatedly. Researchers can and should use the knowledge of communities, or their learned experiences, to improve modeling data. It is important to meld traditional and scientific knowledge to integrate and work together. Data can and should be coupled with stories and context – storytelling is important mechanism, as well as the role of arts and culture, to inform resilience actions in a community. Communities' sense of place and learned experiences influence their ability to define a sustainable and resilient future. Funding and resources, political leadership, and competing priorities affect the capacity for resilience work across communities and over time. Researchers can and should work with local educators, teachers, and other outreach specialists (e.g., NOAA Sea Grants) to make their research more locally actionable.

There is a need to strengthen the connection between researchers and communities in order to generate new knowledge and solutions via participatory research and co-production. A lack of trust or of direct communication with local and state governments also hampers resilience planning and response. Communities that have a direct line of communication with local officials have better relationships with science and adaptation planning and are more successful in resilience building.

Resilience planning and research must recognize the grief associated with short-term disasters and the long-term changes associated with climate change. One participant wrote: *"The scale of loss is so huge that it's hard to grapple with: the loss of rural and native ways of life. The*

loss of access to the water. The loss of our small town or small city that's losing population every year and will be gone over the next century. The loss of the native habitats that we love. The loss of safety, or the homes where we thought we'd raise our grandchildren. It's hard to turn from "purpose" and "response" and "rebuilding" and grieve for a bit for all the things that just aren't coming back. I wonder if there's a place for the humanities and arts partners to record what is being lost and create art and ritual for grieving." This discussion highlights the critical role of arts and humanities in resilience research. Several examples were shared, including the following:

- The National Academies of Sciences, Engineering and Medicine, "In Times of Crisis: Stories from the Gulf of Mexico:
  - https://www.nationalacademies.org/our-work/in-times-of-crisis-stories-from-the-gulf-of-mexico
- The Collaborative for a Just Transition from the Gulf South to the Global South, "Another Gulf Is Possible":
  - https://anothergulf.com/
- The Louisiana Endowment for the Humanities:
  - https://leh.org/
- ArtSpot Productions and Mondo Bizarro, "Cry You One":
  - http://www.cryyouone.com
- Bessie Smith, "Backwater Blues":
  - https://www.loc.gov/programs/poetry-and-literature/audio-recordings/poetry-of-america/item/poetry-00001020/marilyn-chin-bessie-smith/

There is a large number of barriers to implementing resilience strategies. Foremost among these barriers is the lack of or unequal distribution of resources, including financial, human and technical resources. Funding often lacks flexibility, which, given the changing needs of communities, can end up limiting the usefulness of these funds. Notably, there is a lack of funding for necessary trust-building activities, including staff and time. In addition, valuing community participation is essential, and it should be, but rarely is, compensated.

Another significant barrier to disaster research and planning is shaped by factors outside of the local community's control, many of them limited to the realm of private enterprise. For instance, changing flood insurance rates might impact the community and cause population shifts more than the actual negative effects of climate change (i.e., more flooding). The work of researchers and local community members may be marginal compared to these larger market forces.

After Panel 2, workshop participants were invited to join breakout groups, which were split by regional area. The intent was to connect with individuals with interest in that area and continue to develop networks. The following lists participation in each of the breakout rooms:

- Texas-Coastal Bend & Valley, combined with Houston MSA – 8 participants
- Texas-Southeast – 6 participants

- Louisiana – 13 participants
- Florida-North – 13 participants

Within the breakout rooms, participants were asked to discuss what challenges their communities have faced, what keeps them going, what keeps them up at night. A summary of the breakout discussions follows.

What challenges have your communities faced? On the flip side, what's hopeful about your work…or what keeps you going?

A significant challenge is research silos, which prevent us from finding connections. It is important to come together as disciplines and out of our silos so solutions are more comprehensive. However, even as "multidisciplinary research" serves as a buzz phrase across academia, there are serious challenges to designing, funding, and executing cross-disciplinary research. Add to that a constant refrain throughout this workshop: **how to bring local people into resilience work**, as subjects, co-researchers, and practitioners? How to properly build trust and work with, not on, communities?

Unequal resources distributed across county/state levels is a challenge. Communities on the edge or outside of urban areas rarely have the same access to information or funding compared to large metro areas. In addition, even within communities, there is unequal resource distribution. Marginalized communities have many people without safety nets (e.g., no flood insurance or substantial rainy day funds), making it extremely difficult for the community, as a whole, to develop resiliency. These challenges should be addressed at all policy levels. There is a need for communities to have access to data and knowledge. Researchers and practitioners can help build knowledge at an institutional rather than individual level. Researchers and practitioners often feel the need to be protective of their data and expertise, and do not contribute to shared knowledge for the community. Data sharing and knowledge management should be a continuous process because losing knowledge due to turnover is a big issue that also impacts trust-building.

Positively, disaster work has evolved from disaster response and recovery alone to involve a more holistic approach that now includes preparation, mitigation, planning and holistic resilience. We have become more aware of the way compounding disasters make it difficult to be resilient. This includes both co-occurring disasters (e.g., pandemics and hurricanes) and consecutive disasters (e.g., two or more hurricanes in succession). These compounding disasters have always existed but are becoming more frequent due to climate change and other environmental issues, which is, in turn, a huge challenge.

What keeps you up at night?

There are deep concerns that it will not be possible to adequately address climate change itself before its effects have permanently, negatively altered communities, and resilience work will only be able to address symptoms in a reactive way. The reality is that many of the

consequences of climate change are now unavoidable, and resilience is about adapting to a new, relatively unknown – and possibly worse – reality. Resilience-building and adaptation need to take into account future climate change, but the work done today may not be enough to ensure a positive future.

Sea level rise in the Gulf is a significant issue. The Gulf water-level has already begun to rise and is forecast to rise a continued 14-18 inches between 2022 and 2050. This slow disaster will be responsible for significant loss of land and many related socioeconomic impacts. Despite various plans to reduce land loss and even recover land in some areas, there are rarely resources directed to communities to recover what has been lost. In addition, the disconnect between federal policies and marginalized communities and populations perpetuates inequalities.

There is a cultural resistance to storm-resistant structures. As mentioned before, many communities' cultures revolve around the water, and storm-resistant structures, such as levees and other barriers, prevent access to the water and also change culture and livelihoods. There is a need for greater consideration of each culture's vital role in connection and belonging. Resilience is only possible with sustained effort by local actors, and so resilience that does not take into account local practices and culture will not be effective long term. The arts and humanities are a means to better understand and include communities' values in resilience building.

Day 2 concluded with new breakouts where participants could informally connect with the steering committee. The following lists the five breakout rooms and which steering committee member led the discussion in each room:

- Equitable Community Adaptation Strategies – Katherine Lieberknecht & Maria Watson
- Resilience in the Built Environment – Eren Ozguven & Fernanda Leite
- Multi-hazards – Maria Koliou & Will Hill
- Data & Community Level Modeling – Paola Passalacqua
- Knowledge Exchange & Equity – Michelle Meyer & Jaimie Masterson

Day 3 – What Needs to Change

The theme of Day 3 was "What Needs to Change" and we began the day with a panel discussion, which was moderated by Maria Koliou (Assistant Professor, Civil and Environmental Engineering, Texas A&M University). Panelists were Shirley Laska (Lowlander Center), Jeff Carney (UFL), and Suzanne Pierce (Texas Advanced Computing Center). The panel highlighted the following needs for the Gulf region.

The varying scale of the challenge needs to be addressed. It is important to understand and undertake research at a variety of scales, both physical and temporal. Architecture professor Jeff Carney pointed out the need for resiliency from the individual home level during construction all the way up to larger scales, such as urban and regional planning. These various

scales relate to each other, so a theoretically perfect resilience plan would perfectly understand each level and their interactions. Even short of perfection, systems thinking is key.

Actionable research needs to include place-based sensemaking. As previously mentioned, each geographical location has different needs, resources, and capacity, and without the actual participation and input of the community, research can be meaningless and not actionable. Co-production is an essential piece of resilience building by adding to the social nature of shared experience.

There is a need for convergent thinking about transdisciplinary research. Suzanne Pierce spoke about the importance of using multidisciplinary approaches to tackle "wicked problems." This requires, but also enables, the development of shared vocabularies for problems and the protocols to address them.

Data and use cases and knowledge repositories can help. Currently, communities are overwhelmed by the plethora of tools and frameworks available. Yet a range of ideas during project development phases are needed to converge on general approaches. There must be ways to better facilitate the application and selection of tools and frameworks by communities while the development process is underway.

In addition to having data repositories and shared vocabularies, it is necessary to get data that are useful to people and relay such data to communities. This will require the translation of data and strategies in formats that are geared towards non-expert audiences. Several suggestions and ideas were shared, including a social justice “Roofing Done Right” pamphlet example shared by Shirley Laska . More information on these pamphlets and other equitable resilience efforts – including resilient repair so as to stop the need to keep on repairing – out of the Lowlander Institute can be found in their website: disasterjusticenetwork.org/housing.

Figure 2. Roofing Done Right pamphlets

Figure 3. Rebuilding the Boot booth

There is also a role for for-profit companies in building resilience. For instance, construction companies could go to homeowners, showing them the potential savings of specific products that aid in resilience building. Often, universities cannot do the mitigation and sales work necessary to bring their insights to scale, but a private company could make a profit while contributing a meaningful public good. These projects can drive real change by providing job growth and on-the-job training on environmental building and infrastructure practices.

There has been, and continues to be, a posture of privilege in resilience research and planning. The history of engineering and of managing natural resources has often been a history of force and false rationalism that ignores ecosystem thinking. There are tradeoffs between hard, expert-led interventions and on-the-ground adaptations. To be successful, society must know that it is not possible to fix every problem, and that many hard adaptation efforts come with consequences. It is necessary to convey these difficult tradeoffs to communities, as they hold the ultimate decision-making power.

After Panel 3, workshop participants were invited to join breakout groups, which were split by regional area. The intent was to connect with individuals with interest in that area and continue to develop networks. The following lists participation in each of the breakout rooms:

- Texas – 14 participants
- Louisiana – 8 participants
- Florida – 17 participants

Within the breakout rooms, participants were asked to discuss what needs to change, who is doing good work in each region, and what lessons should be taken away from this conversation. A summary of the breakout discussions follows.

The necessity of data and/or models that are useful to communities. In particular, data coupled with stories can be powerful tools. Arts and humanities should be integrated into resilience building. Through cultural work, real messaging and understanding of issues can occur. The arts

speak in the language of lived experience, and in the case of climate disasters can aid in processing and channeling collective trauma. In turn, researchers can use the knowledge and lived experience of communities to improve modeling data.

There needs to be a review of the models for engagement with for-profit organizations. The standard model of funding and grants relies almost exclusively on the nonprofit ecosystem, both on the funding side (through foundations and other grant-making nonprofits) and on the practice side (through academic and practitioner nonprofits). However, many businesses are committed to the resilience of their community, engage in activities to support such endeavors, and can provide critical resources and a knowledge base on critical factors that impact the community. Additionally, if these businesses do not come back after a disaster, the community suffers or is lost, so it is to the advantage of both the owners themselves and the community, as a whole, that businesses invest in resilience.

Community-based research is needed to understand systemic challenges. For this to happen, the right people need to be in the room in order to implement change: community and business leaders, youth, elected officials, etc. The first steps of a community-based research project are geared to both understanding community needs and building trust. As one participant said, at this phase, the needed approach is "Go slow in order to go fast." Once trust is built, strengthening the connection between researchers and communities will generate new knowledge and solutions. For this to happen, researchers need to recognize and center the expertise of local leadership, undertake strategies such as recruiting community leaders to staff positions as fellow researchers/community fellows, and institute compensated "Community Advisory Committees" for research projects. Before starting a project, researchers should check to see if there are ongoing projects that can be tapped into or complemented, which do not require additional time commitments. In one small breakout group, a participant commented: "*I was struck by how many of the researchers are also disaster survivors and not just academics. The lived experience of resilience researchers during the conference added greatly to the sense of urgency and commitment to following communities' needs*." In many ways, researchers can and should use their own experiences to further resilience building and to highlight lived experiences and needs.

INTELLECTUAL MERIT

This workshop fostered exchanges and collaborations among scholars and stakeholders to build a community of practice focused on moving climate resilience research to action in the Gulf Region. These cross-disciplinary interactions helped identify needs in the research community and at the intersection of research and practice. There are many researchers in the STEM, arts, and humanities disciplines focused on questions relating to climate resilience in the Gulf Coast region. They are not, however, linked in region-specific interdisciplinary or research-to-action networks.

This means there is lack of awareness among researchers about work other researchers might be doing that is relevant to their own, and there is lack of coordination among research thrusts such that stakeholders might be able to more efficiently interact, influence, or use the knowledge outputs of resilience research. Moreover, the Gulf Coast Region is uniquely diverse in its interfaces between urban centers and rural areas, and resilience research must address these challenges, among other major gaps in our understanding of the interactions of human and natural systems, in this region.

BROADER IMPACT

The workshop sessions engendered meaningful communication and allowed for focused discussion of ideas presented by leaders in a range of relevant disciplines, resulting in a convergent prospectus of resilience research initiatives at the interface of environmental and urban systems. This workshop initiated transdisciplinary research relationships through:

1. Professional development of early-career faculty and city/state level and policy professionals in introductory socio-environmental modeling, as well as co-design of research-based socio-environmental interventions.
2. Meeting the increasing demand for workers with interdisciplinary training in navigating the complex interplay between rapid climate change and resulting stresses in ecosystem and engineered services.
3. Development of a network of scholars, government representatives, and community organizations focused on building resilience across the Gulf Region.

WORKSHOP STEERING COMMITTEE

Fernanda Leite

Associate Professor in the Department of Civil, Architectural and Environmental Engineering

The University of Texas at Austin

Michelle Meyer

Associate Professor in the Landscape Architecture and Urban Planning Department & Director of the Hazard Reduction and Recovery Center

Texas A&M University

Maria Watson

Associate Professor in the M.E. Rinker, Sr. School of Construction Management and Shimberg Center for Housing Studies

The University of Florida

Paola Passalacqua

Associate Professor in the Department of Civil, Architectural and Environmental Engineering

The University of Texas at Austin

Katherine Lieberknecht

Assistant Professor in the Community and Regional Planning Program in the School of Architecture

The University of Texas at Austin

Maria Koliou

Assistant Professor in the Zachry Department of Civil and Environmental Engineering

Texas A&M University

Eren Erman Ozguven

Associate Professor of Civil and Environmental Engineering & Director of the Resilient Infrastructure and Disaster Response (RIDER) Center

Florida A&M University - Florida State University

Will Hill

Strategic Initiatives Manager of the Resilient Infrastructure and Disaster Response (RIDER) Center

Florida A&M University - Florida State University

The steering committee was responsible for all aspects of the planning and successful execution of the workshop. This committee consisted of the following members, representing institutions across the Gulf Region, and research expertise ranging from Natural Systems, Engineered Systems, Geosciences, Community and Regional Planning, and Social Sciences.

Fernanda Leite

Fernanda Leite is a Professor in the Civil, Architectural and Environmental Engineering (CAEE) Department at The University of Texas at Austin. She serves on the Executive Committee for the University-wide Grand Challenges effort called Planet Texas 2050, where she served as Chair in 2020-2021. Her built environment research program sits at the interface of engineering and computing. Most of her work has been in building and infrastructure systems information modeling, collaboration and coordination technologies, and circular economy in the built environment. At UT Austin, Dr. Leite teaches courses on Building Information Modeling, Project Management and Economics, Construction Safety, and Sustainable Systems Engineering.

Michelle Meyer

Michelle Meyer is an Associate Professor in the Landscape Architecture and Urban Planning Department at Texas A&M University. She is the Director of the Hazard Reduction and Recovery Center, an interdisciplinary research and engagement center focused on hazard mitigation and disaster recovery. Her research centers around social capital and collective capacity to increase hazard resilience. She specifically studies nonprofit and nongovernmental networks of organizations that address the disaster needs of underserved and socially vulnerable populations. She teaches courses on hazard mitigation, disaster recovery, disaster theory, and graduate and undergraduate social science research methods.

Maria Watson

Maria Watson is an Assistant Professor in the M.E. Rinker, Sr. School of Construction Management and Shimberg Center for Housing Studies at the University of Florida. Her research focuses on the factors impacting community recovery after disaster events, particularly interdependencies between infrastructure, housing, and businesses. She is particularly interested in the effectiveness of disaster programs and how these programs can be structured to better meet recovery needs. Watson has been a part of multiple interdisciplinary disaster recovery research efforts in Texas, Louisiana, and North Carolina.

Paola Passalacqua

Paola Passalacqua is an Associate Professor in the Department of Civil, Architectural and Environmental Engineering at The University of Texas at Austin. Her research interests are at the intersection of water resources engineering, hydrology, and geomorphology with particular focus on transport of water, solids, and solutes along river networks in both upstream watersheds and coastal environments with applications from flooding to coastal response to current and future climate. Passalacqua has worked on the Louisiana and Texas coast for the last 10 years with work that combines numerical modeling and the analysis of remotely sensed and field data.

Katherine Lieberknecht

Katherine Lieberknecht is an Assistant Professor in the Community and Regional Planning Program in the School of Architecture at The University of Texas at Austin. Her research area is equitable environmental planning, and her specific research interests include water resources planning, green infrastructure planning, and urban climate adaptation planning. Most of her recent research has been in partnership with municipal staff, community organizations, and local residents. She teaches courses on sustainable land use planning, urban ecology, water resources planning, and urban agriculture. Lieberknecht co-founded the UT Austin Planet Texas 2050 Grand Challenge and served as the inaugural chair for this effort (2018-2019).

Maria Koliou

Maria Koliou is an Assistant Professor in the Zachry Department of Civil and Environmental Engineering at Texas A&M University. Her research interests span the fields of structural dynamics, earthquake engineering, and multi-hazard performance-based design for system functionality and community resilience. She has a diverse research portfolio with projects on the performance and functional recovery of wood and cross-laminated timber (CLT) structures, moldable and wave tunable materials for application in complex freeform structures as well as community resilience framework development for decision making focusing on underrepresented populations along the Gulf Coast. She teaches courses on engineering mechanics, design of steel and wood structures and engineering risk analysis.

Eren Erman Ozguven

Eren Erman Ozguven is an Associate Professor of Civil and Environmental Engineering and Director of the Resilient Infrastructure and Disaster Response (RIDER) Center at the Florida A&M University-Florida State University (FAMU-FSU) College of Engineering. Dr. Ozguven focuses on investigating the relationships among different infrastructure networks in Florida, utilizing his academic research in transportation engineering, and background in industrial engineering and optimization. His work examines the simultaneous and interdependent movements of populations — including vulnerable groups and the commodities and services that meet their needs. During this process, he has established long-lasting, multi-disciplinary collaborations with researchers from psychology, sociology, public policy, communications, urban planning, geography, civil, electrical and industrial engineering. The research program he created draws from various engineering and scientific methods, including optimization, statistical analysis, human factors, machine learning, traffic and transportation engineering, and geography.

Will Hill

Will Hill is an Assistant Director in the RIDER Center. He is an M.S. student in the Department of Civil and Environmental Engineering at the FAMU-FSU College of Engineering. He earned a prior M.S. in Health Administration, a B.S. in Biological Sciences, and a B.S. in International Affairs. His current research interests involve the sustainable improvement of regional resiliency, disaster waste management, and disaster response. Currently, he studies under Dr. Juyeong Choi, helping to further establish the NSF-funded organization SUMMEER, which focuses on sustainable debris management and data collection.

WORKSHOP FACILITATION AND SUPPORT TEAM

Our facilitation team helped plan and coordinate sessions, as well as facilitate discussions. We also had event support from The University of Texas at Austin's Office of the Vice President of Research, Scholarship and Creative Endeavors via Planet Texas 2050, a research grand challenge initiative at UT Austin.

- **John Cooper**, Assistant VP in the Division of Academic and Strategic Collaborations, Texas A&M University
- **Jaimie Masterson**, Director of Texas Target Communities, Texas A&M University
- **Heidi Schmalbach**, Planet Texas 2050 Program Director, Office of the Vice President for Research, Scholarship and Creative Endeavors, The University of Texas at Austin
- **Alison Fiorenza**, Senior Events Coordinator, Office of the Vice President for Research, Scholarship and Creative Endeavors, The University of Texas at Austin

DISSEMINATION OF WORKSHOP OUTPUTS

The dissemination of the workshop results is achieved through collaboration with the academic institutions, federal agencies, and influential industry organizations. Specific outputs from the workshop include the following:

- Workshop e-Proceedings containing the presentations, materials from participants, and videos/summaries of the small group discussions. This material has been shared with all registered participants via Box. **Link:** https://utexas.box.com/s/l2rd5ew0wjov2bjs8ztg4i2i3m4zzv7m
- This Workshop Report/White paper, which will be shared with NSF as well as all registered participants.

ACKNOWLEDGEMENTS

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APPENDIX A: PRE-WORKSHOP QUESTIONNAIRE

Question 1: Full name

Question 2: Email

Question 3: Title

Question 4: Affiliation

Question 5: Area of expertise/discipline

Question 6: Provide one example of your recent work that supports co-learning between researchers and practitioners in support of resilience in the Gulf region.

Question 7: Define resilience from your perspective/context.

Question 8: What do you feel is the biggest challenge to improving resilience in the Gulf region?

Question 9: What ways can local communities and higher education work together to improve resilience in the Gulf region?

Question 10: What suggestions for workshop themes do you have?

Question 11: Which sub-themes/aspects of resilience are you most interested in? Based on interest, we'll select themes to be covered in the workshop (select up to five you are most interested in):

- Built environment/infrastructure systems
- Transportation systems
- Green infrastructure
- Equity
- Modeling of the Gulf region in response to future climate scenarios
- Sensors and observations of the Gulf region under change
- Housing stability (climate and disasters)

- Faith-based and nonprofit efforts
- Public policy
- Equitable economic opportunities
- Community adaptation strategies
- Community level modeling (data driven/empirical models vs analytical/detailed models)
- Multi-hazards
- Efforts with the arts, culture, and humanities
- Improving communications between universities and communities
- Migration and climate change
- Connect research with practice/implementation (i.e., what we need to present to stakeholders, communities, owners for decision making evaluation)
- Other

Question 12: What product would you like to see as a result of this workshop?

Question 13: If you are interested in presenting at the workshop, we ask you to share a project example or one page extended abstract of your relevant work related to resilience in the Gulf. Please let us know if you are able to upload that file now:

- Yes, I can upload now
- No, I would like to upload later
- No, I would not like to present at the workshop

Question 14: Please upload your project example or one page extended abstract here.

Note: Screenshots of the survey can be viewed on the following pages of this appendix.

Please fill out the following survey if you plan to join the National Science Foundation funded virtual workshop on **Moving Resilience Research to Action in the Gulf Region**, hosted May 9-11, 2022. More information about the workshop can be found on our webpage.

Full name

Email

Title

Affiliation

Area of expertise/discipline

Provide one example of your recent work that supports co-learning between researchers and practitioners in support of resilience in the Gulf region.

Define resilience from your perspective/context.

What do you feel is the biggest challenge to improving resilience in the Gulf region?

What ways can local communities and higher education work together to improve resilience in the Gulf region?

What suggestions for workshop themes do you have?

Which sub-themes/aspects of resilience are you most interested in? Based on interest, we'll select themes to be covered in the workshop (select up to five you are most interested in):

Built environment/infrastructure systems	Equitable economic opportunities
Transportation systems	Community adaption strategies
Green infrastructure	Community level modeling (data driven/empirical models vs analytical/detailed models)
Equity	Multi-hazards
Modeling of the Gulf region in response to future climate scenarios	Efforts with the arts, culture, and humanities
Sensors and observations of the Gulf region under change	Improving communications between universities and communities
Housing stability (climate and disasters)	Migration and climate change
Faith-based and nonprofit efforts	Connect research with practice/implementation (i.e., what we need to present to stakeholders, communities, owners for decision making evaluation)
Public policy	Other

What product would you like to see as a result of this workshop?

If you are interested in presenting at the workshop, we ask you to share a project example or one page extended abstract of your relevant work related to resilience in the Gulf. Please let us know if you are able to upload that file now:

- Yes, I can upload now
- No, I would like to upload later
- No, I would not like to present at the workshop