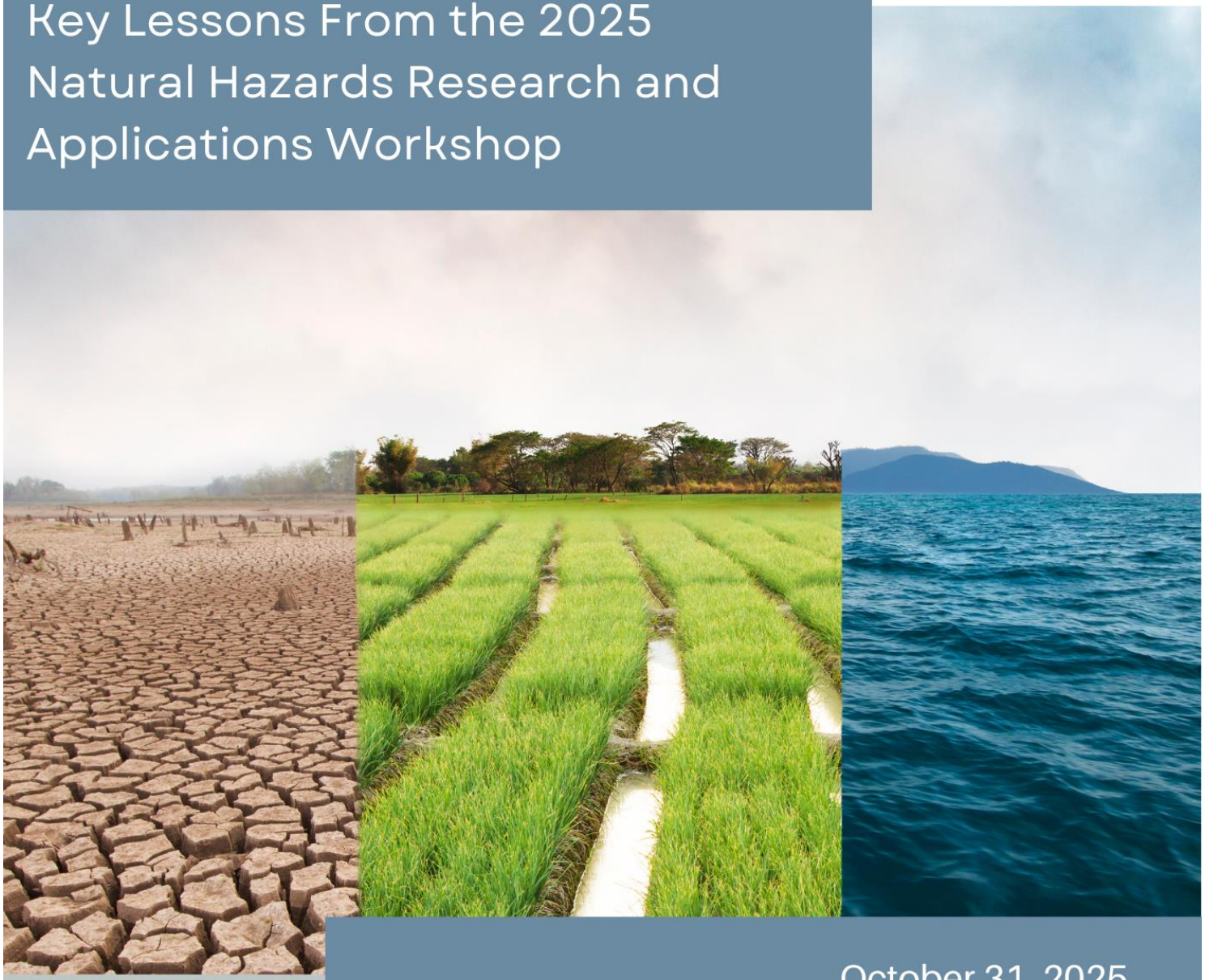
MOVING KNOWLEDGE TO ACTION

Key Lessons From the 2025 Natural Hazards Research and Applications Workshop



October 31, 2025

A Synthesis Report by the Natural Hazards Center
Submitted to the National Oceanic and Atmospheric Administration

NATURAL HAZARDS CENTER

University of Colorado Boulder

OVERVIEW

The **purpose** of this synthesis report is to highlight key findings and actionable recommendations shared during the 50th Annual Natural Hazards Research and Applications Workshop. This report emphasizes key takeaways that align with the National Oceanic and Atmospheric Administration's (NOAA) objectives of *advancing capabilities*, *strengthening partnerships*, and *expanding the generation and application of science for early warning systems, risk communication, and hazard assessments*. This report draws from a wide range of technical expertise from more than 700 Workshop participants that span multiple disciplines within academia, all levels of government, the private sector, and non-governmental organizations.

Background

Since 1976, the Natural Hazards Center at the University of Colorado Boulder has served as the National Science Foundation-designated information clearinghouse for the societal dimensions of hazards and disasters. The Center's mission encompasses four critical thrusts: building connections across sectors concerned with reducing hazard losses; translating and sharing information; advancing social science and interdisciplinary research; and training and mentoring next-generation hazards professionals.

In our capacity as the nation's clearinghouse, the Center has long assumed a role in linking federal agencies, such as NOAA, to other partners in the hazard risk reduction space. Over the past decade, the Center has worked closely with several offices within NOAA to advance weather ready research and improve capacity for drought risk communication. In addition, each summer since 1975, the Center has convened the Natural Hazards Workshop, which is designed to foster maximum engagement among participants and promote the transfer of knowledge across disciplines and sectors. This event serves as a critical stop on the pathway from knowledge creation to implementation. The Workshop and other initiatives support and help advance NOAA's mission areas. In this report, we summarize key takeaways and lessons learned from the Workshop and other programs that are of most immediate relevance to NOAA.

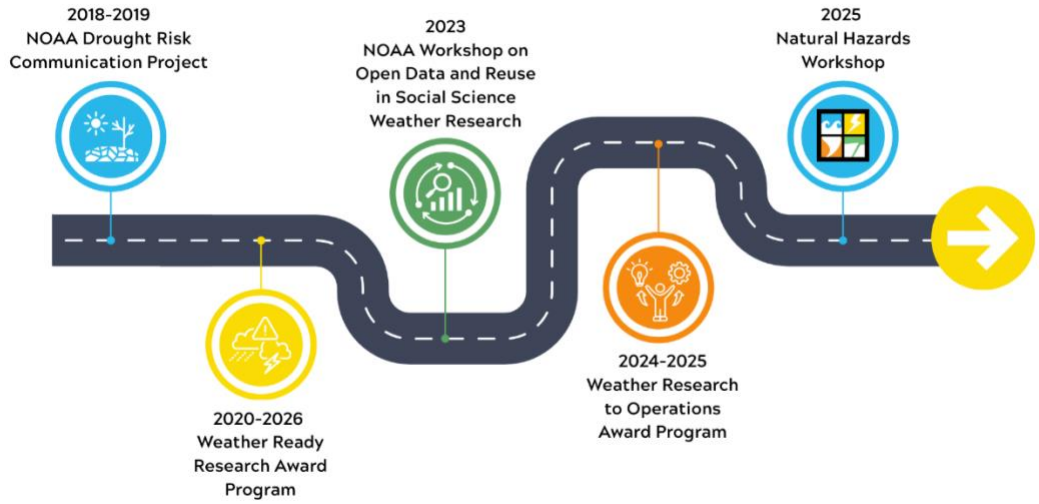


Figure 1. NOAA and Natural Hazards Center Knowledge to Action Partnerships

WORKSHOP SESSIONS

The Workshop schedule provides a robust set of program offerings that include:

- a keynote and plenary sessions,
- interactive breakout sessions,
- training sessions,
- film screenings,
- networking roundtables,
- TED-style talks, and
- poster sessions.

All Workshop sessions and activities provide rich substantive content related to hazards and disasters. Each year, the program is built around a theme statement that guides Workshop planning. This theme helps to focus the community's attention on pressing issues while also more broadly assessing the state of hazards and disaster research, practice, and policy.

Given that 2025 was the 50th anniversary of the Workshop, the theme statement was, appropriately, *The Next 50 Years: Charting a Course for the Hazards and Disaster Field*. Workshop plenaries and concurrent sessions were organized around the three major focal areas of the theme statement: (1) Looking Back and Assessing Current Conditions; (2) Envisioning Our Desired Future; and (3) Identifying What It Will Take to Achieve Our Goals.

As part of the Center's mission to train and mentor the next generation of hazards and disaster professionals, we invite graduate students to serve as recorders for each of the Workshop sessions. The goal is to have a written summary of each session that includes a brief *takeaway*, a *session summary*, *key points* made by the speakers, and a list of *resources* offered during the session. Students compiled written summaries for one keynote address, five plenaries, 24 concurrent sessions, and 12 new research, policy, and practice sessions. For a full review, please visit the 2025 Workshop Session Summaries page.

In addition, each year, the Natural Hazards Workshop is followed immediately by a 1.5-day Researchers Meeting, where both emerging and established scholars gather to present their in-progress as well as recently completed scholarship. In 2025, research presentations spanned seven topical tracks: hazard mitigation and preparedness; community health and well-being; emergency management; equity and empowerment; data-driven risk management; disaster reconstruction, recovery, and relief; and promoting resilience. Please see **Appendix A** of this report for Researchers Meeting abstracts relevant to NOAA's key mission areas.

Many of the topics in this year's Workshop sessions were cross-cutting and have relevant takeaways that align with NOAA's key mission areas. Specifically, the recommendations listed below can further strengthen NOAA's vital research, applications, and services

focused on improving early warnings, risk communication, and risk assessments for anticipating and reducing the impacts of weather and water-related hazards such as floods, droughts, and wildfires. These findings can support NOAA in building a stronger and more effective emergency management system to serve all Americans through translating knowledge to action.

General Session Takeaways for NOAA:

1. **Partnerships and Trust Matter**— A recurring message across sessions was the vital importance of building relationships between researchers, practitioners, policymakers, and communities during non-disaster times. These partnerships are foundational to effective risk communication and preparedness efforts.
2. **Data Should be Robust and Multiscalar**— Most data-focused sessions underscored that data should be collected across different time scales, geographic areas, hazard types, and resolutions. Quantitative data must be paired with qualitative insights—including historical narratives and local knowledge—to be meaningful and actionable. Further, it is important that qualitative data be coupled with larger-scale, geographically and demographically robust data to ensure broadly representative portraits of people and places. In addition, data should be standardized; data systems and infrastructure should be continuously improved; and data should be ethically collected and shared across agencies to strengthen emergency preparedness and response efforts.
3. **Integrate Social Science and Human-Centered Data Into Practice**— Disasters are fundamentally social phenomena affecting built, natural, social, and economic environments. Social science methods and data are therefore essential for understanding and addressing the human dimensions of disasters. Further, disaster data are most useful when they are both precise and human-centered. Such people-centered data allows for deeper understanding of contextual conditions that influence hazard risk and impacts. Those who gather data must consider its usability in terms of accessibility, completeness, and complexity. Making data accessible and actionable to decisionmakers, community residents, and others is critical for effective risk communication, planning, and resilience-building efforts.
4. **Improve Risk Communication**— Effective risk communication is community-centered, ongoing, and co-designed between scientists, community leaders, and other partners in risk reduction. Successful messaging requires communicators to consider three questions: (1) What do I want to achieve? (2) Who is my audience? and (3) How can I make my message clear, concise, consistent, trusted, and actionable? Investing in robust early warning systems that work across hazard types, while also supporting the people responsible for developing communication messages, is key to advancing the state of the art.
5. **Adopt Risk-Based Modeling**—When developing disaster models, it's essential to integrate hazard assessments with more complex understandings of risk—encompassing exposure and vulnerability of people and infrastructure as well as considerations of capacity to reduce risk. Risk-based models and approaches to understanding and acting on emerging threats helps communities define what

matters to them most by deciding which consequences are acceptable and which are not. For example, integrating tools that communities can easily access and manage—such as smoke modeling and air sensors—can strengthen resilience to wildfire smoke.

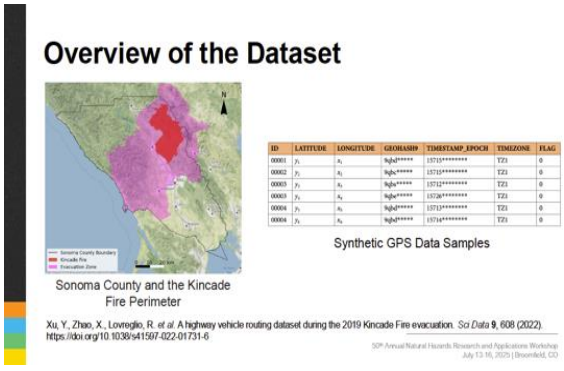
Weather Ready Presentations

On Wednesday, July 16, four recipients of the Weather Ready Research Award presented their findings to the Workshop audience. This program—administered by the Natural Hazards Center with funding from NOAA's Weather Program Office, National Weather Service, and Severe Storms Laboratory and the National Science Foundation—was established in 2020 to better understand how community members and other stakeholders receive, interpret, and respond to weather forecasts, watches, and warnings. The Center has funded 51 unique projects, with support provided to 146 researchers across 80 U.S.-based academic institutions and community partners. A full list of funded projects and published reports can be found on the Center's website.

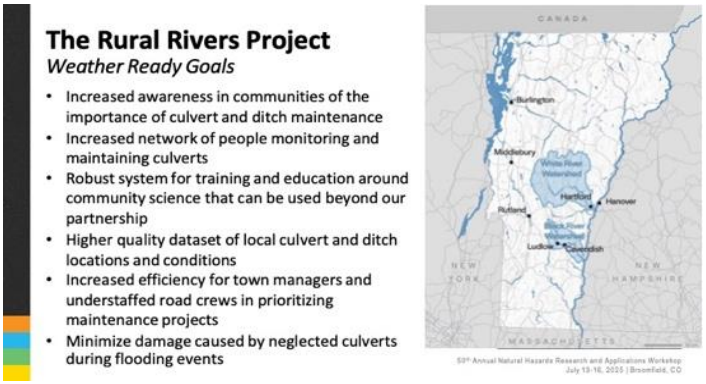
In the 2025 Weather Ready Research Workshop session, the speakers discussed how weather information can be better utilized and communicated to prevent the worst outcomes of extreme weather events. They also shared key findings and efforts to move **research to operations** in the context of wildfires, tornadoes, hurricanes, and other hazards. The four presentations focused on: (1) publishing a GPS dataset on evacuation behavior during California's 2019 Kincade Fire; (2) a mutual aid mapping effort after Vermont's 2023 floods; (3) a study on tornado resilience among older adults living in assisted care facilities in Texas; and (4) an analysis of land use strategies in wildfire recovery plans across several Western states in the U.S. These interdisciplinary, community-centered studies aim to improve preparedness and response to build a more weather ready nation.

Weather Ready Takeaways for NOAA:

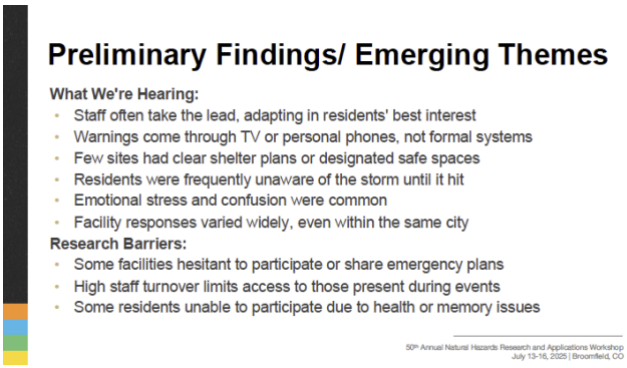
1. **Publishing Datasets Is Imperative for Moving Science Into Action**—Xilei Zhao and her team published the first dataset to analyze highway vehicle routing behavior during the 2019 Kincade Fire in Sonoma County, California. This anonymous dataset captured 22,215 highway trips over a one-month period that included the duration of the fire. This dataset can help validate existing evacuation models and serve as an educational tool to train future researchers who are interested in leveraging data analytics for weather ready research.



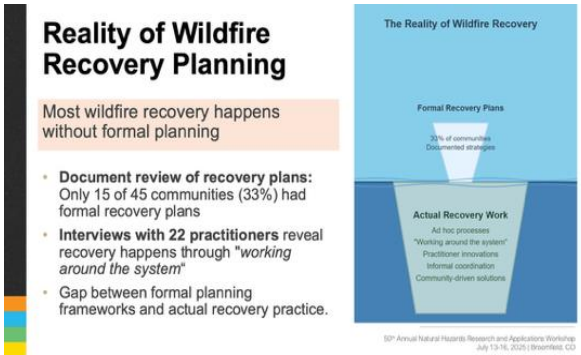
2. **Local Partnerships Should Enhance Local Capacity and Generate Needs-Based Data**—In 2023, Charis Boke and her research team studied response, recovery, and mitigation work following major flooding in the Black River Valley of Vermont. Their key findings highlight: "(a) the importance of scientific collaboration with community partners; (b) the role of researchers in empowering residents in small scale flood mitigation work; and (c) the need to acknowledge and address barriers to technology access for useful, accessible data visualization about flooding response, recovery, and mitigation efforts." When scientists work with community partners to generate the flood risk and other data types that communities need, those data are more likely to be used to inform decision-making at all levels (Boke et al., 2025).



3. **Assisted Living Facilities Need More Support to Effectively Prepare for Extreme Weather Events**—Breiana DeGrate and colleagues found that assisted living facilities in Dallas and Houston, Texas were underprepared for two severe storm events in 2024. Recommendations include offering technical support to develop and maintain location specific disaster plans; more robust workforce training and support as facilities are often understaffed by employees who do not have proper emergency management training; and targeted storm warnings and communication for both staff and residents, who are often the last to know when a storm is approaching.



4. **Wildfire Recovery Planning Requires Formalization**—Tasnim Isaba and colleagues studied the potential of incorporating land use strategies into wildfire recovery, finding that wildfire recovery is largely an informal, invisible process that prioritizes immediacy over long-term planning. The researchers call for specific actions to improve this process, including formalizing recovery planning at the federal level with



funding and uniform standards; standardizing recovery practices at the state level and providing training for practitioners; and documenting local inventories of best practices to "build institutional memory of recovery processes" (Isaba et al., 2025).

POSTER SESSIONS

Each year, participants are invited to submit posters on new programs, projects, or recent research. In 2025, the Center accepted 116 posters for presentation at the meeting. The edited and published abstracts can be viewed on the Workshop website, and full posters can be downloaded as PDF files.

Key Poster Session Takeaways for NOAA:

1. **Interagency Partnerships are Critical to Pre-Event Coordination and Monitoring**—

As wildfires threaten larger areas within the wildland-urban interface, emergency management professionals face more challenges related to population density and the built environment. Researcher Caerwyn Hartten interviewed officials responsible for emergency alerts in the Western United States, finding that strong relationships with federal agencies—including the National Weather Service, the National Park Service, and the U.S. Forest Service—are essential to pre-fire coordination and monitoring during the event. Cultivating these interagency and community-based partnerships is essential to effective risk communication with the public prior to and during an extreme event. It also can help ensure practitioners have critical information and context as they plan for mitigation.

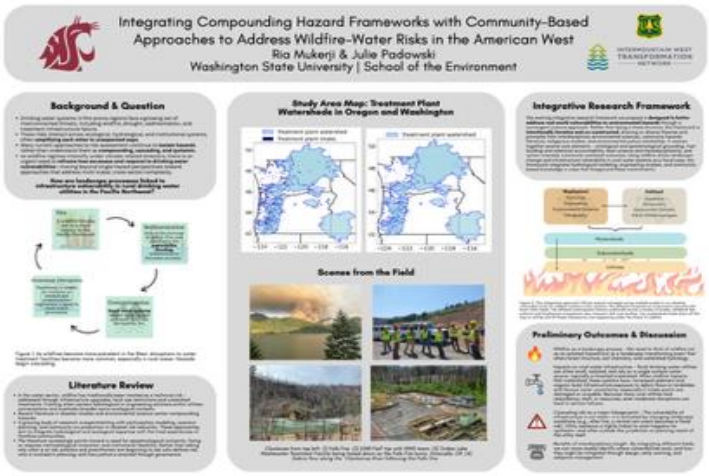
2. **Use Both Unofficial and Official Warning Systems to Tailor Risk Communication**—

Anutosh Das and colleagues uncovered significant disparities in hurricane risk communication between local emergency management agencies (LEMAs) and households regarding communication methods and trust in warning sources. In practice, this mismatch influences evacuation decision-making, resulting in delayed protective action. This poster highlights the need for LEMAs to develop strategies for region-specific risk communication, incorporating both official warning systems and unofficial sources—such as social networks—that residents often rely on when deciding whether to evacuate.

3. **University-Government Partnerships Help Fill Research to Practice Gaps**—

Partnering with the U.S. Army Corps of Engineers, a Natural Hazards Center team led by Carson MacPherson-Krutsky developed a suite of resources empowering practitioners to translate risk communication research to practice. Products include an annotated bibliography focused on populations at elevated risk to floods and other hazards; a practitioner-oriented guidebook; a worksheet booklet; and a collection of case studies and group activities to complement a series on online and in person practitioner trainings. To date, the Center has trained more than 60 flood risk managers and other professionals from the U.S. Army Corps who are now working with communities to reduce their flood risk.

4. **Combine Existing Frameworks With Participatory, Local Approaches—**



Washington State University researchers Ria Mukerji and Julie Padowski combined existing compounding hazard research frameworks with community knowledge to understand the relationship between environmental risk and infrastructure vulnerability. Specifically, they demonstrated how collaboration between researchers and practitioners—through exercises such as participatory scenario planning and co-development of risk assessment tools—enables the exploration of questions such as "who defines risk, who is involved in planning, and how [is] justice enacted through governance?" (Mukerji and Padowski, 2025).

The callout box below illustrates the power of Workshop poster presentations and how these can be integrated into NOAA's ongoing continuous improvement efforts. The highlighted activities and initiatives are located at the University of South Carolina's Hazards Vulnerability and Resilience Institute (HVRI). Founded in 1995 as the Hazards Research Lab, the HVRI is a designated International Center of Excellence on Vulnerability and Resilience Metrics.

Current Activities and Transformations at the Hazards Vulnerability and Resilience Institute

Authors: Susan Cutter, Kirstin Dow, Brett Robertson, Margot Habets, Gwyneth Waddington, Suzan Edwards, Maddie Nordberg, Julie Salinas, and Katie Schreiber

Featured Initiatives and Activities: In partnership with the National Weather Service (NWS) and the Midlands Public Health Preparedness Coalition—and with funding from the NOAA Collaborative Science Technology and Applied Research Program—the Hazards Vulnerability and Resilience Institute (HVRI) leads the Addressing Geographical and Social Diversity in Heat Health Messaging project. Building on research finding that historically underserved and socially vulnerable communities (HUSVCs) are disproportionately susceptible to heat risks, the project's goals include "improving weather, water, and climate services to HUSVCs; enhancing NWS services for HUSVCs at greater risk to negative impacts of heat; and developing new messages and innovating communication processes to deliver forecasts and protective messages."

Linking Science to Service: HVRI's access to critical partners in communicating heat risk allowed them to conduct research to measure these stakeholders' knowledge, usage, and preferences surrounding weather information and heat advisory messaging.

Finding: Though stakeholders often use simple measures such as temperature to understand extreme heat, they may not accurately represent the potential extent of risk. ***Action***: Plain-language explanations regarding meaning and interpretation must accompany more complex weather metrics.

Finding: Respondents indicated a desire for actionable information during extreme heat events. ***Action:*** Forecasts should go beyond meteorological data to include information about concrete ways to cope with extreme heat and available resources such as cooling centers.

Finding: Logistics such as frequency of updates and modes of communication may vary between the public and stakeholders who work with them. ***Action***: Attention to risk communication preferences ensures that various populations receive timely information via channels they are familiar with.

Finding: Forecasters must prioritize communication that is both clear and accessible to a variety of audiences. ***Action***: Translating messages into other languages aids individuals with limited English proficiency, while adding descriptive text to online images assists individuals with visual impairments. Intuitive symbols increase the likelihood of recognizing the immediacy of the situation.

Betterment for Public Benefit: Understanding the needs of historically underserved and socially vulnerable communities is the first step to creating comprehensible, actionable communication regarding these communities' weather risk. Partners such as the Midlands Public Health Preparedness Coalition can provide valuable insight into the needs of the populations they serve.

CONCLUSION AND NEXT STEPS

This synthesis report summarized **actionable recommendations** advanced through NOAA-supported programs as well as at the 2025 Natural Hazards Research and Applications Workshop. The Center's longstanding leadership as the nation's clearinghouse for hazards information as well as the Workshop's standing as the flagship annual gathering for the hazards and disaster field make these useful avenues to feature initiatives at the nexus of research and practice. The cross-cutting insights generated at the Workshop and beyond support NOAA in building a more robust, effective emergency management system for the benefit of all Americans.

This report showed that Workshop participants and NOAA awardees highlighted that **partnerships** between researchers, government agencies, and community organizations are imperative to creating change rooted in local context. This is vital in, for example, tailoring extreme weather communication and warnings to the needs of the people receiving them. Recognizing the tension between universal theory and local realities, **participatory, co-designed research** can assist in this effort, in turn building community and government capacity for future endeavors. Grounding both research and practice in **social science** ensures that efforts remain **human-centered**, paving the way for more holistic and effective risk reduction. Finally, **data standardization and sharing** are critical steps in facilitating validation, learning, and knowledge-sharing across researchers, practitioners, and decisionmakers at all levels.

Indicators of improved performance surrounding extreme weather events may include more accurate early warnings issued and received by wider numbers of people, fewer deaths and injuries, less property damage, less population displacement, and increased uptake of resilience-building activities. To facilitate such goals, research should be grounded in interdisciplinary and social science theory while integrating local context to produce human-centered, actionable findings. Only in doing so can NOAA's laudable aim of reducing impacts of weather- and water-related hazards be realized.

In terms of next steps, the Natural Hazards Center is building on this foundational report to update several key initiatives for 2026. Specifically, as part of the 51st Annual Natural Hazards Workshop, we plan to update several of our submission and data gathering efforts—as informed by this important partnership with NOAA—to better capture the vital knowledge to action cycle at the center of disaster risk reduction. Examples of updates we plan to make in response to this academic-federal partnership include:

- Centering the 2026 theme on the topic of *coalition-building* and how we can grow the field to include a more robust set of local, state, and non-profit partners concerned with hazard risk reduction and effective communication.
- Involving NOAA leaders who have envisioned and led scientific coalitions—such as the Regional Integrated Sciences and Assessments, or RISAs—to share insights for how we bring researchers together across disciplines and in partnership with communities to assess and reduce risk.
- Including call out boxes on each of the 100+ posters at the Workshop to ensure that the broader implications and actionable recommendations of research findings are clear.
- Encouraging session presenters to share the key takeaways and lessons learned for practice and policy, and capturing those takeaways via the session summaries that recorders produce.
- Working with moderators of each session to ask standardized, solutions-oriented questions of each speaker so that key takeaways are clear and more consistent across sessions.

- Having report authors and other Center staff observe sessions and document key findings that are relevant to NOAA's mission so they can be included in future annual reports.
- Spotlighting research to operations publications, reports, and other activities via the Workshop as well as the Center's year around publication program.

We will continue to adjust and build upon this initial report, as we seek to achieve our goal of advancing and applying science to reduce the harm and suffering from disasters.

Appendix A: Selected Abstracts from the 2025 Researchers Meeting

Amer Hamad Issa Abukhalaf, Clemson University
Vaishnavi Chavan, Clemson University
Harshavardhan Kodela, Clemson University

Mental Health Effects of Severe Weather Events on Low-Income U.S. Communities

This study investigated the mental health impact of Ohio's 2024 tornadoes on socioeconomically disadvantaged populations in Franklin County, focusing on anxiety, depression, and post-traumatic stress disorder (PTSD). It explored how the tornadoes intensified existing mental health issues in vulnerable communities and examined coping mechanisms and resilience factors. Using a mixed-methods approach, the authors gathered data from surveys (N=521) and interviews (N=20) with adults from low-income households. Surveys assessed mental health outcomes (anxiety, depression, PTSD) and risk perceptions, while interviews provided qualitative insights into personal experiences, community challenges, and coping strategies. Findings revealed significant mental health disparities between individuals severely impacted by the tornadoes and those less affected. Those most impacted reported higher stress levels, compounded by financial hardship and limited access to mental health resources. Additionally, these individuals had heightened perceptions of risk severity and future weather events. Qualitative analysis identified themes of social isolation, dependence on family and social networks, and varied perceptions of local emergency communication. These results highlight the need for targeted mental health support, enhanced disaster preparedness, and culturally appropriate risk communication. The study emphasized the importance of policies focused on accessible mental health care, community resilience, and effective communication to reduce vulnerability and improve recovery in low-income populations, ensuring better preparedness for future disasters.

Amer Hamad Issa Abukhalaf, Clemson University
Abdallah Naser, Isra University

The Impact of Housing Conditions on Hurricane and Flood Evacuation Intentions

This study explored the relationship between housing conditions and risk perception, particularly how these factors influenced evacuation intentions during hurricanes and flooding in Florida. While research on risk perception in disasters has grown, there is limited exploration of how housing conditions affect risk perception, especially in the context of severe weather hazards. Existing studies have focused on specific housing types, such as mobile homes, with minimal attention to broader housing characteristics. This study aimed to bridge this gap by examining how housing conditions impacted evacuation decisions in Florida, where hurricanes and flooding pose frequent threats. A quantitative approach was used, involving a questionnaire distributed to 816 participants across five Florida cities: Miami, Tallahassee, Jacksonville, Gainesville, and Ocala. The questionnaire was validated by experts and pretested to ensure accuracy. Statistical analyses using Excel, DataTab, and SPSS revealed that two housing factors—required

dwelling repairs and whether the dwelling is on the ground floor—significantly influenced risk perception. However, risk perception did not significantly impact evacuation intentions based on logistic regression analysis. The findings suggest that emergency communication should not overly emphasize storm danger at the beginning of hurricane season, as it does not significantly influence preparation behavior when no storms are imminent. However, if a storm is approaching, communication should shift to highlight risk and prompt action. Additionally, efficacy and social norms were found to have a strong influence on evacuation intentions, suggesting that emergency messaging should focus on how to prepare and the importance of community participation in evacuation.

Samuel Adams, University of Rhode Island
Austin Becker, University of Rhode Island

Avoidable Consequences: Helping Emergency Managers Predict Outcomes of Major Ocean Storms

This presentation discusses emergency managers' use of simulation and modeling data to minimize avoidable consequences of major coastal storms (e.g., hurricanes, tropical storms.) Following an "implementation research" approach, findings are presented from interviews with emergency managers to better understand how better data supports pre-landfall decision-making. Climate change is increasing coastal populations' exposure to storm hazards while making it more challenging for emergency managers to anticipate the consequences of major storms in terms of community health, safety, and economic security. Despite decades of experience analyzing storm vulnerability, local communities continue to experience storm outcomes that decision makers either did not anticipate or did not prepare for, often with lasting and profound consequences for communities. Advancements in high resolution storm simulation and consequence modeling can help emergency managers make preparedness and response decisions. This research sought to better define "avoidable consequences" in the context of storm response and connect physical hazard impacts with human outcomes based on data gathered from interview subjects. The research described in this presentation leverages the Coastal Hazards Analysis, Modeling, and Prediction (CHAMP) project to explore practical application of decision support tools to improve local storm preparedness and response. Contributions include advancing understanding of emergency managers' community storm vulnerability assessment and informing further development of decision support tools like CHAMP.

Caroline Beckman, University of Michigan
Megan Czerwinski, University of Michigan
Sue Anne Bell, University of Michigan
Isabela Lovelace, University of Michigan
Francisca Santana, University of Washington
Alexandra Paige Fischer, University of Michigan

Navigating the Haze: Understanding Wildfire Smoke Decision-Making in Rural Communities

As wildfire smoke becomes an increasingly pervasive environmental hazard, understanding the cues that shape public decision-making and adaptive responses is critical. This study examines the interplay of environmental, social, and informational cues in influencing how individuals perceive and respond to wildfire smoke. In contrast to other hazards that may be more discrete, observable, and immediate, wildfire smoke can be difficult to perceive even as it is being experienced. Through qualitative interviews in rural Eastern Oregon (Baker and Harney Counties, both of which experienced heavy smoke from nearby fires in 2024), this study explores smoke experiences, decision-making processes, and behavioral responses during smoke events. In particular, this study demonstrates how direct environmental observations—such as visibility of smoke and personal health symptoms—interact with air quality data and social cues to form risk perceptions. Findings reveal that many individuals use personal observation and sensory cues rather than informational or social cues in shaping their protection strategies. Despite recognizing the health threats of smoke, interviewees noted that most protective behaviors were inaccessible due to the demands of a rural lifestyle and other sociocultural barriers. This research observes that while service providers acknowledged patterns and trends in smoke events, coordinated planning efforts remained minimal. The study highlights the need for targeted interventions and programs that address community-specific barriers and motivations to addressing environmental hazards.

Noah Bezanson, Colorado School of Mines
Elizabeth Reddy, Colorado School of Mines
Charis Boke, Dartmouth College
Sarah Kelly, Dartmouth College
Paul Santi, Colorado School of Mines

Developing a New Interdisciplinary Model for Mapping Flood Risks and Impacts

In July 2023, the towns of Ludlow and Cavendish in rural Vermont were hit by severe flooding. Flood risk maps are an important tool that professionals and residents use to navigate flood recovery. This research project studied challenges related to the accessibility and accuracy of flood risk maps—specifically, the Federal Emergency Management Agency‘s National Flood Hazard Layer and the State of Vermont‘s River Corridors maps—in the aftermath of the July 2023 floods. It aimed to illuminate how local and state professionals, community organizers, and impacted residents used flood risk maps and the challenges that they encountered with finding, interpreting, or implementing them. The project also studied the accuracy, and perceived accuracy, of flood risk maps of Ludlow and Cavendish. Findings are contributing to efforts to make flood risk maps of rural areas more accessible to all users.This interdisciplinary, mixed-methods research project employed three primary data collection methods: qualitative interviews, participatory community mapping, and site visits. The research team conducted interviews with professionals and community organizers as well as impacted residents. Community

mapping events enabled residents to show where the floods impacted them in different ways. Finally, site visits to flooded properties with community organizers provided essential context to the data gathered elsewhere.

Katherine Cann, Rutgers University

Building a Community-Engaged Adaptation Plan: The Role of Community-Based Organizations

As communities experience more frequent and severe climate hazards, community-based organizations (CBOs) are emerging as leaders in adaptation efforts. How are CBOs engaging with their communities to understand emerging climate risks and develop local adaptation projects? This study comprised a two-part project jointly led by researchers at Rutgers University and two CBOs in the New York City metropolitan region, which served to build collective capacity to respond to climate risks in the region, in particular extreme precipitation events. Following a series of in-depth interviews with local adaptation partners, as well as two cross-community workshops, the research team developed a framework for CBO-led engagement and governance of adaptation. This framework informs a community-engaged research plan, including household surveys and targeted focus groups to understand local impacts of extreme rain events. The research project served two primary purposes: 1) to identify best practices of community engagement for adaptation planning and implementation for CBOs in the New York City metropolitan region, and 2) to build collective capacity for local governance of adaptation to climate risks, particularly extreme rainfall events. The project fostered relationships between CBOs, academic partners, and other local stakeholders to enable multidirectional knowledge transfer, build collective capacity, and shared strategies to support local adaptation practitioners. Data on community impacts of extreme rainfall in the region was used to inform ongoing and prospective flood mitigation and water quality improvement efforts, such as expanding urban tree canopy and implementing green infrastructure solutions.

Jess Downey, University of Oregon
Heidi Huber-Stearns, University of Oregon

Local Coordination for Smoke Communication and Preparedness: Oregon's Community Smoke Response Plans

This research focused on understanding how Oregon communities prepare for and respond to wildfire smoke, including identifying strategies to reduce smoke exposure, and related barriers. The researchers conducted a content analysis of community wildfire smoke response plans (SRPs) in all Smoke Sensitive Receptor Areas designated by the Oregon Department of Environmental Quality, outside the Portland Metro area (n = 9). The authors conducted interviews with the primary author(s) of each community wildfire smoke response plan (n = 10) to understand how they were being used, and specific challenges and opportunities communities have faced in implementation. Results show that SRPs can contribute to community preparedness and communication by being locally

branded and trusted online resource hubs for a range of wildfire, air quality, and public health preparedness. Communities used different definitions and data sources for identifying vulnerable or sensitive groups based on local conditions. SRP processes also considered translation needs and interconnected health effects of smoke and other extreme events. Community outreach surveys also informed the study on public behavior and communication and resource needs around fire and smoke. Implications include the need for ongoing involvement from public health practitioners and researchers in this developing area of public health research, and the opportunity to establish plans that also address other poor air quality events, extreme heat, and public safety power shut-offs.

Noah Hallisey, University of Rhode Island
Austin Becker, University of Rhode Island
Peter Stempel, Pennsylvania State University
Samuel Adams, University of Rhode Island

CHAMPioning Researcher-Practitioner Partnerships: A Decision Support Tool for Emergency Managers (Case Study)

The Coastal Hazards, Analysis, Modeling, and Prediction (CHAMP) system is a coastal storm early warning system that integrates improved storm models with actionable information regarding storm impacts to critical infrastructure for emergency management use. Decision support tools that visualize storm model outputs and contain analytical functions for assessing hurricane impacts, such as CHAMP, can aid in storm preparedness and response. However, barriers to technology adoption in emergency management, and lack of end-user participation in tool development hinder implementation of such into practice. Researcher-practitioner partnerships offer a solution, as practitioner needs and workflows can be directly integrated into the development of storm forecasting and decision support tools. Therefore, this exploratory research developed a framework to guide such collaboration using the CHAMP system as a case study. Results evaluated a decade-long interdisciplinary research project collaborating with emergency managers to develop and operationalize the system in Rhode Island, USA. Through interviews with researchers and emergency managers involved in the development of CHAMP, the framework highlighted challenges and best practices for researcher-practitioner partnerships and can guide future research collaborations, as well as support adoption of such decision support tools more broadly.

Serena Hoermann, Florida Atlantic University
Juliano Calil, Virtual Planet Technologies
John Renne, Tulane University
Anna Queiroz, University of Miami

Leveraging Immersive Technology to Communicate Flooding Risk and Adaptation

Planning for the impacts of sea level rise and storm surge depends on effectively communicating risks and potential adaptation strategies to stakeholders and decision

makers. However, engagement may be hampered by limitations in conceptualizing impacts or solutions using two-dimensional representations. Furthermore, planners seek to provide messaging that motivates action through a sense of agency rather than inaction due to a sense of anxiety. Finally, in the current moment, visualization strategies seek to engage a variety of audiences by finding common ground. The researchers partnered with the City of West Palm Beach, Florida, to create an immersive experience in virtual reality to present flooding risks in public parks along an intracoastal waterway. Participants also saw how adaptation infrastructure, including nature-based solutions, could be implemented. A survey collected data about the experience and preferred solutions. This presentation shares the methodology and results of the work. In VR, as opposed to a tablet/360 video experience, people found the adaptation strategies depicted to be more effective. In VR, the emotional response was higher. In VR, people were more receptive to being informed about future strategies to mitigate the impacts of flooding in their community. This presentation also shares preliminary results of a follow-up project. The research team is producing a VR experience that demonstrates flooding impacts around cultural and natural spaces and neighborhoods in Fort Lauderdale, Florida.

Jeffrey Lusk, U.S. Small Business Administration
Shannon Rhoten, U.S. Small Business Administration
Natacha Vacroux, U.S. Small Business Administration

PIVOT! Using Data and Trend Analysis to Provide More Effective Recovery

Since 1954, the Small Business Administration (SBA) has provided low-interest loans to disaster survivors to help them recover. Over time the profile of the loans and borrowers has changed and currently 80% of SBA disaster loans are actually made to homeowners. Recently the SBA started to see repeat disaster borrowers and decided to make a concerted effort to promote its "mitigation option" that provides funds to people to rebuild stronger. This panel will discuss longitudinal studies in the SBA disaster lending program and how they can inform future initiatives. The panel will be a facilitated discussion format with Jeff Lusk, Director of SBA's Field Operations Center West, serving as moderator and providing context. Shannon Rhoten, SBA Deputy Director for Data Analytics and IT, and Natacha Vacroux, SBA Program Analyst with the Policy, Planning, and Partnerships Division, will offer their perspectives and analysis, discussing how SBA has adapted its approach in response to emerging trends. Among the topics covered will be the results of a recent study examining 12 years of business disaster loan data that revealed SBA loans reduce bankruptcies and exits from a market after a disaster, increase employment and revenue, unlock private credit, and reduce delinquency. SBA will also share how it used a data-informed approach to encourage both business owners and homeowners to add mitigation funds to their disaster loans and how these funds can be a force multiplier when used as cost-share for state initiatives.

Elaina Sutley, University of Kansas
George Amariucai, Kansas State University

Elsie Asante, Wichita State University
Jason Bergtold, Kansas State University
Tonya Bronleewe, Wichita State University
John Colclazier, Wichita State University
Amin Enderami, University of Kansas
Alej Martinez, University of Kansas
Adaeze Okeukwu-Ogbonnaya, Kansas State University
Eliyasu Osman, Kansas State University

Using Stated Community Preferences to Inform Modeled Community Assets for Advancing Resilience

The Adaptive and Resilient Infrastructures driven by Social Equity (ARISE) project is developing computational decision-support tools for assisting communities in resilience planning. A stochastic heterofunctional graph is used for modeling physical, social, and economic functionalities in a community. A key research question has been on establishing how different functionalities contribute to a community's well-being and standard of living, given each community's uniqueness. To capture a community's characteristics, the ARISE team used seven community capitals, namely, built, social, cultural, human, natural, political, financial, as a framework for organizing community assets, and working with five partner counties in Kansas to gain depth, context, and detail through community engaged research. A key engagement approach has been hosting community studios, where representatives from the county participate in a structured half-day session. During the studios, participants list, categorize, and rate assets in their community that build equity and resilience. The findings from these studios provided quantitative relationships in the model, including capturing similarities and differences across geographies. The ARISE team formulated household surveys that established pair-wise rankings of functionality values, based on the community characteristics. The collection of pair-wise rankings is processed into a total order of functionality values, that is based solely on the perception of the communities' members, reflecting a bottom-up sense of fairness. Finally, outcomes can be used to inform operational and investment decision making. This presentation will share the methodology, comparative findings from the studios, and preview how the community data are integrated into the computational tools.

Douglas Wunneburger, Texas A&M University
Walt Peacock, Texas A&M University
Alexander Abuabara, Texas A&M University
David Bierling, Texas A&M University
Darrell Borchardt, Texas A&M University

Risk-Based Hurricane Evacuation Zone Planning for the Texas Gulf Coast

Tropical cyclones and their associated surge are major threats to the Gulf Coast of Texas. Mitigation of impact when conditions warrant evacuation requires extensive planning to develop prioritized zones to avoid exceeding evacuation route carrying capacity and

resulting traffic gridlock. Zone planning begins with storm surge models provided by the National Oceanic and Atmospheric Administration (NOAA) to identify areas and populations at physical risk. Based upon estimates of persons, households, and vehicles in areas of potential impact, zone boundaries are drafted through a collaborative process by the research team then reviewed and modified by local stakeholders and experts in community meetings. Important consideration is given to designing zones to facilitate orderly evacuations which work within the limits of available routes of egress. Further, zone limits are ideally delineated by recognizable boundaries easily described in radio communications. The Hazard Reduction and Recovery Center (HRRC) has developed such zones for the entirety of the Texas Coast. In this presentation, steps to draft and review these zones are described.