NSF Convergence Accelerator Workshop Report

Societal Shock Resilience

Executive Summary

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Track topic. Our society regularly faces extreme stressing events or "shocks" such as hurricanes, earthquakes, floods, pandemics, and wildfires. Yet, resilience and adaptation tools that can help us face the consequences of such impacts are not fully developed. The premise of our Convergence Accelerator (C-Accel) Track concept is that significantly better societal decisions and resilience will result if they are informed by a broad understanding and improved quantification and visualization of the hazard, exposure, vulnerability, response to, and recovery from such events. We refer to this set of activities as the "societal shock resilience" framework.

Workshop outcomes. During the week of June 6, 2021, more than 250 experts and stakeholders from across the globe gathered at the Societal Shock Resilience Workshop in order to help craft a framework by which NSF might fund future projects in this space. We invited participants that spanned expertises such as hazard assessment (e.g., geoscience, climate science); ecologic, biological, and environmental science; engineering disciplines (civil, mechanical, electrical); architecture; mathematics and statistics modeling; computer science and software engineering, data science; social sciences (communication, education, urban planning, public policy, disaster management, public health, emergency response, and network analysis); economics and financial stress modeling. Experts from these disciplines also work in a wide range of sectors including academia, government at all levels, and the private sector (for- and not-for-profit). All these categories of experts and sectors were represented at the workshop. The three-day workshop focused on interactions among all the participants as opposed to gathering insight from only a few presenters. It included various means to virtually connect, discuss, and engage within and across disciplines to foster discussions. We collected extensive notes on the discussions, which were summarized by our team at the end of each day. The first two days consisted of a mix of plenary and breakout sessions, and were open to all participants. The third and last day was focused on synthesis activities conducted in four groups of ~15-20 people. Summaries collected from all those activities were condensed into three main groups of priorities deemed essential to making progress in Societal Shock Resilience within the next 3-5 years. We use the terms modeling, education and engagement to group these priorities. If the Track is to be selected, we recommend that all three aspects *ideally be* addressed by individual projects and *absolutely be* addressed by a cohort of projects and teams as a whole.

Broader Impacts. The topic of societal resilience to shocks will generate broad impacts for a large, diverse, dynamic society. The workshop, organized to foster interaction both within and among diverse systems, facilitated the identification of several convergence opportunities. We made efforts to have students and early-career participants in every session and especially to include them in the focus-group discussions on the last day of the workshop, the session in which the integration of input was performed. Moreover, based on the feedback received after the workshop, we believe we achieved the goal of making participants more aware of the need for true collaboration and more interested in pursuing convergence activities in their own projects.

1.INTRODUCTION

Communities across the country are facing extreme stressing events ("shocks") such as hurricanes, earthquakes, floods, wildfires, and pandemics. Although some specific shocks may be more regional in nature, the entire nation faces the possibility of extreme events disrupting normal societal functions. Across the broad spectrum of professions that engage in resilience research and its implementation, many examples of effective technologies for risk characterization and adaptation have been developed. However, broad consensus on best practices and effective public policies remains elusive, and as a consequence, mitigation strategies are still not implemented at large scales and their architecture is not yet fully developed. This situation is partially due to the lack of bridges between the different communities involved and the socio-cultural-economical barriers associated with the absence of interdisciplinary applied science on these issues.

During the week of June 6, 2021, more than 200 experts and stakeholders from across the globe gathered at the Societal Shock Resilience Workshop in order to help craft a framework by which NSF might fund future projects in this space. The three-day workshop included various means to virtually connect, discuss, and engage within and across disciplines to foster discussions.

Framing the Societal Shock Resilience Topic

For the purpose of the workshop, we adopted the National Academies (2012) definition of resilience: "*the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events*." We are interested in societal resilience and define society as people, the natural environments, the built systems, and the societal systems that surround them. We define shocks as rapid-onset, extreme stressing events.

We developed a framework diagram to describe the problem and facilitate the organization of the workshop (Figure 1). Figure 1 is not meant to include a description of all the interactions within the framework, and is instead focused on highlighting its key elements and examples of associated disciplines with a simplified set of connections between the elements. At the center, we represent society as a system of systems in which people live.

We present examples of how resilience can be affected by each element of the framework (Figure 1):

Shocks: shocks themselves may not be prevented, but a better quantification of key metrics (e.g., ground shaking from earthquakes, inundation levels for tsunamis) and their appropriate forecasting is critical to plan for exposure and vulnerability (proper regulatory guidance and policy). Resilience can therefore be improved through better shock hazard quantification and the reduction of their uncertainty.

Exposure: reducing exposure through environmental and regulatory policies can also improve resilience. This would involve, for example, preventing construction in areas most prone to floods and wildfires, and designating them instead for other purposes.

Vulnerability: improvements to construction and upgrade ("retrofit") designs can also improve resilience by reducing the impact of shocks to the built environment, which affect housing, infrastructure, industries and overall economic and public health. Social improvements, for example, to public health and community well-being along with environmental health and sustainability policies can also reduce vulnerabilities.

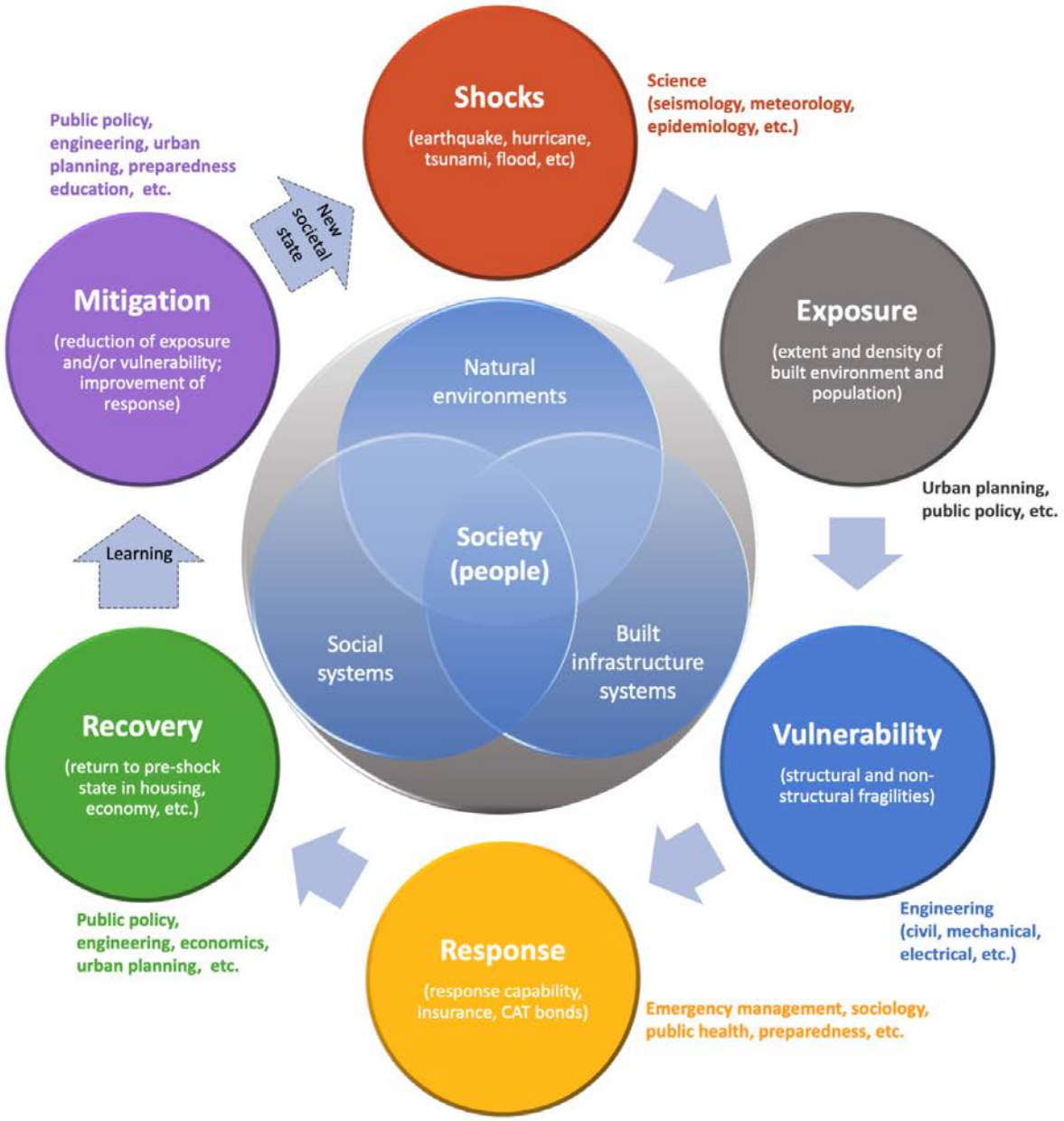


Figure 1. Simplified schematic representation of the *societal shock resilience framework* elements. Society (people) is represented in the center. Key elements of the framework are represented by the surrounding circles. In this simple cartoon, the framework starts with the shock and ends with resilience. Over time, lessons are learned and mitigation measures are implemented, with the goal to improve resilience. Learning and mitigation can happen at any time within the framework and impact resilience. Key disciplines are listed next to each of the framework element. Additional disciplines such as communication, mathematics and statistics, computer science and software engineering, education, economics and network analysis, for example, span all the elements. Stakeholders from different sectors (government from local to federal scales, private for-profit and not-for-profit entities) are also involved in all the elements. The schematic represents systems of systems converging to accelerate societal resilience to shocks.

Response: better training of emergency response teams can also improve resilience by, for example, efficient triage, rapid deployment of shelter, food banks, and emergency health-care facilities. Pre-emptive training of individuals affected by shocks can also make them more self-sufficient at the community level (neighborhood, church, hobby groups) and reduce the demand on organized response systems. Similarly, broad educational programs on hazards and preparedness can be very impactful.

Recovery: rapid recovery is a key element of resilience for both financial safety and quality of life reasons. Regulatory considerations can have major impacts on environmental performance and the design of new facilities to shorten the recovery time due to stresses. Programs tailored to specific communities can also be more effective than unfocused activities.

Mitigation: mitigation measures such as those listed as the examples above for the exposure, vulnerability and response components are great ways to improve societal shock resilience.

Over time, lessons are learned and mitigation measures are implemented, with the goal to improve resilience. Learning and mitigation can happen at any time within the framework and impact resilience. Key disciplines are listed next to each of the framework elements. Additional disciplines such as communication, mathematics and statistics, computer science and software engineering, education, economics and network analysis, for example, span all the elements. In order to be truly transformative, the improvement of resilience must be coordinated across the elements and involve a broad range of stakeholders representing different disciplines, environments, communities, industries and sectors. Convergence will accelerate the collective learning process in the community initiated by the shared experience of the shock to achieve a more informed, sustainable state of resilience to future hazards.

Goals of the Workshop

The workshop objective was to refine the C-Accel topic by gathering and synthesizing input from a broad community of stakeholders, and inform NSF's solicitation on a possible new Track. This was achieved through the following workshop goals:

G1. Define the problems and terminology. Establish clear definitions of hazard, risk and resilience that are applicable at the national scale and through disciplines and sectors to improve communication among the various stakeholders.

G2. Develop collaborations and partnerships. Foster collaboration and "system thinking" across the wide range of participants involved in different aspects of the societal shock resilience framework.

G3. Identify target needs and communities. Identify and prioritize specific problems and user communities that future C-Accel projects should address.

G4. Define convergence and partnership requirements. Define the requirements for cross-disciplines and trans-discipline convergence that involves the appropriate sectors and stakeholders for future C-Accel projects.

The first two goals were achieved directly during the workshop and all four goals are represented in the Outcomes Section statements (§3).

Organizing Team

The workshop was planned by a multidisciplinary Planning Committee (PC) under the guidance of an Executive Committee (ExCom). Several featured speakers were invited to participate by providing videos on specific topics selected to encourage discussions. These three groups of people are listed in Appendix, which includes a picture and a short bio for each person.

ExCom. The ExCom is composed of the four co-PIs (Goulet, Bozorgnia, Rathje and Tedesco). It is responsible to see the project completed in high-quality and to ensure its success, with support from the Planning Committee (PC). The members of the ExCom are also members of the Planning Committee.

PC. We have formed a multi-disciplinary Planning Committee (PC) to cover representation across the wide range of disciplines spanning the societal shock resilience framework. Because of the breadth of disciplines and the wide range of stakeholders that need to be included in the workshop, it is impossible to have each of the categories represented in the PC by an individual and have an effective committee. We opted to expand our original C-Accel team by carefully selecting influential stakeholders extremely well connected to complementary categories of disciplines and stakeholders.

2.WORKSHOP SUMMARY

The workshop included 1) large plenary sessions ; 2) parallel break-out sessions focused on current convergence challenges and opportunities; and 3) focus-group collaborative activities to synthesize the input. The workshop was organized across 3 days, each spanning 9 AM to 1 PM Pacific (12 PM to 4 PM Eastern) time frame. June 7 and 8 began with plenary sessions featuring broad visionary talks and large group discussions followed by break-out sessions spanning the elements of the Societal Shock Framework. These first two days were critical to set the tone for the workshops and to bring everyone up to speed with the concept of convergence. June 11 consisted of focus-group activities in virtual rooms that were filled through an application process at registration time. This third day was the time for synthesis of the whole workshop into a series of statements that became the core of our priorities recommendations.

Pre-recorded talks were used strategically in the plenary sessions (3-4 minutes) to set the stage for the workshop, and during some of the breakout sessions (1-2 minutes) to stimulate discussions. The focus was on gathering input from the wide range of participants as opposed to presenting only a subset of views. In that sense, talks were used as nucleators to get the discussions going. Pre-recording the talks presented two main advantages: 1) it ensured that talks would not go over time, and 2) it allowed those presenters who were not available to participate to the live workshop to still contribute. The following subsections provide an overview of the daily workshop activities including the schedule and agenda, followed by a summary of attendance characteristics.

Day 1: Monday, June 6, 2021

The workshop launched with a plenary session that included an introduction to the societal shock framework and the purpose of the NSF Convergence Accelerator program. With lightning talk presentations to set the stage, the group was taken through considerations that are essential to fostering resilience. After the prepared presentations and an acknowledgement that the definition to define resilience would be the one used by the National Academies, an ideal end-user and potential collaborator joined for a "fireside chat": LA County Fire Chief Daryl Osby. The chief explained how he thought of resilience, what are key requirements, and how he hopes to work with experts who can help him create a safer, more resilient community in Southern California.

Following a short break, attendees were directed to parallel breakout sessions. The purpose of breakout Session 1 was to explore convergence within each of the resilience elements defined. Attendees were divided into five groups focused on issues within the elements of the societal shock framework:

1. Shocks,
2. Exposure and Vulnerability,
3. Response,
4. Recovery,
5. Mitigation.

Each element was the focus of discussions by a breakout group within a separate Zoom room. Participants addressed the same 4 questions within the context of their group's element:

- Q1. What are key aspects of collaboration outside of your field that made it successful within [Element]?
- Q2. What are the challenges of working across disciplines that remain?
- Q3 NSF's stated purpose for a C-Accel Track is to make use of the "best research results and practices" that can be applied to the real world in [Element]. What are the "best research results" that are ready for implementation within your discipline relative to [Element]?
- Q4. What is done well with regard to resilience with the hazard(s) you deal with that can be applied broadly to [Element]? What can we learn from people that deal with different hazards?

Each question was framed by a lightning presentation consisting in a 1-2 min(s) pre-recorded video. After the lightning presentation, each Zoom breakout room was further divided into groups of 4-5 people for small conversations to answer that question. Then, the small groups reconvened with their breakout group and shared answers to look for commonalities and gaps. This was repeated four times to allow for the most input in this session and gathering of ideas. At the close of Day 1, attendees had come together to collaborate on foundational understandings of what it takes to tackle their assigned element.

MONDAY, JUNE 7, 2021

Time (Pacific)	Item (hosts / presenters) (Plenary room in blue; breakout rooms (5) in green)
09:00 - 09:15	Workshop Check-In, Logistics (J. Bwarie)
09:15 - 10:00	**Plenary Session: Setting the Stage**
	What is resilience?
	Welcome, Objectives, Definition of Societal Shock Framework and Elements as the thread to this Workshop (C. Goulet)
	Introduction to the NSF Convergence Accelerator (C-Accel) Program (L. Campbell)
	Why are we having this conversation? Haiti: issues and lessons learned (M. Comerio) What we can learn from small businesses and Katrina (R. Barnes) Equity and justice in resilience (C. Willis) Emergency response perspective (E. Stanley)
	Recap of workshop goals. Q&A
10:00 - 10:20	Q&A with Los Angeles County Fire Chief, Daryll Osby
10:20 - 10:30	Introduction and instructions for break-out 1
10:30 - 10:45	Break
10:45 - 11:45	**Concurrent Break-out Sessions: Convergence "Within" Elements, Questions 1 and 2**
	1. Shocks (J. Stewart, M. Tedesco, R. Loft) D. Wald (USGS) C. Bruyere (NCAR)
	2. Exposure and Vulnerability (E. Stanley, P. Uriz) C. Speranza (DC HSEMA) M. Berkwitz (RCC)
	3. Response (L. Comfort, D. Asimaki) B. Nowell (NC State) D. Bonowitz (Structural Engineering Consultant)
	4. Recovery (D. Chandrasekhar, R. Olshansky) S. Miles (Univ. Washington) S. Van Zandt (TAMU)
	5. Mitigation (C. Davis, S. McCabe) J. Mitrani-Reiser (NIST) and S. Chang (UBC) L. Arendt (St. Norbert) and R. Little (RPI)
11:45 - 12:00	**Break**
12:00 - 13:00	**Concurrent Break-out Sessions: convergence "within" elements (continued), Questions 3 and 4**
	1. Shocks (J. Stewart, M. Tedesco, R. Loft) D. Ezekoye (U. of Texas) G. Schmidt (Goddard Institute, NASA)
	2. Exposure and Vulnerability (E. Stanley, P. Uriz) M. Walton (Datacast) R. Muir-Wood (RMS)
	3. Response (L. Comfort, D. Asimaki) C. Ansell (UC Berkeley) L. Anderson (FEMA)
	4. Recovery (D. Chandrasekhar, R. Olshansky) J. Santos Hernández (UPR) R. Olshansky (Univ. Illinois)
	5. Mitigation (C. Davis, S. McCabe) F. Masters (Univ. Florida) and T. Nabatchi (Syracuse Univ.) S. Nikolaou (NIST)

Day 2: Tuesday, June 8, 2021

The day started with a brief recap from each of the five breakout groups from Day 1, highlighting overlaps and key concepts that emerged from each breakout session. The entire plenary was then engaged in a discussion via Zoom chat about what was missing or notable from these discussions to highlight what the Day 2 session might focus on. Through the online Mentimeter tool, the group was also polled in real-time about their insights about resilience and key issues to be resolved, followed by a discussion.

After the plenary, the attendees were sent to ten different breakout sessions for an hour to have a more intimate discussion using a combination of short presentations, Mentimeter surveys, chat and voice discussions in zoom. These small groups were able to elicit outcomes of what could be done related to eight topics, each designed and led by champions from the PC. Group size ranged from 10-20 participants, and each was able to generate unique answers to questions on that topic.

This smaller group discussion began to create deeper connections between workshop participants, and was followed by a structured interactive session where participants were able to choose virtual breakout rooms to visit and connect with others. There was even a lobby where people were mingling and connecting before reconnecting to one of the six “networking” rooms. Engagement remained high in this structured informal session with nearly 100 attendees participating in it.

TUESDAY, JUNE 8, 2021

Time (Pacific)	**Item (hosts / presenters) (Plenary room in blue; breakout rooms (10) in green)**
09:00 - 09:10	Workshop Check-In, Logistics (J. Bwarie)
09:10 - 09:40	**Plenary Session: What We Learned**
	Lessons from Day 1 1. Shocks (J. Stewart, UCLA) 2. Exposure and Vulnerability (E. Stanley, Consultant) 3. Response (L. Comfort, U. of Pittsburgh) 4. Recovery (D. Chandrasekhar, U. of Utah) 5. Mitigation (C. Davis, Engineering Consultant) Group Discussion (J. Bwarie)
09:40 - 10:10	**Plenary Session: Thinking more broadly**
	Global Convergence for Resilience, Group Discussion (J. Bwarie)
10:10 - 10:15	Introduction and instructions for break-out 1
10:15 - 10:30	Break
10:30 - 11:30	**Concurrent Break-out Sessions: convergence “between” elements**
	1a. General Session on Convergence (Y. Bozorgnia, F. Zareian) 1b. General Session on Convergence (C. Goulet, S. McCabe) 2. Equity and Justice in Societal Resilience (N. Ganapati, S. Hamideh) 3. Education/Communication Focus (M. Benthien, B. Brand, C. MacPherson-Krutsky) 4a. Multi-Disciplinary Models and their Integration into Resilience (P. Uriz, R. Lee) 4b. Multi-Disciplinary Models and their Integration into Resilience (J. West, D. Asimaki) 5. Modeling, operationalization of the framework including cyberinfrastructure aspects (R. Loft, Y. Cui) Tom Gibbs (NVIDIA), Covid HPC Consortium Ilkay Altintas (SDSC), Wildfire in the Cloud Amy McGovern (U. of Oklahoma), Trustworthy AI and Natural Hazard Prediction 6. Economic, financial aspects of resilience (A. Rose, M. Tedesco) 7. Complex Time focus (L. Comfort, J. Carlson) 8. Translating resilience science into policy and practice (D. Finn, D. Chandrasekhar)
11:30 - 13:30	**Deepening the Convergence Session: Small Group Discussions & Networking in breakout rooms**

Day 3: Friday, June 11, 2021

For the final day of the workshop, a smaller, curated group was invited to participate in 4 focus-group sessions lasting nearly three hours. The groups were assembled to span the broadest range of disciplines and interests as possible. With a prescriptive process in place, each group was each asked the same questions on broad topics that emerged from the first two days of the workshop. After an introductory plenary to frame the purpose of the day, the attendees were dispersed into four groups to answer the following questions: What are the most important things that need to be achieved to improve resilience in 5 years? What do we need to know and what needs to be done?

The pair of questions was posed and answered for three topics (or themes):

1. Data, Models and their Infrastructures
2. Education & Communication, and/or Translation into Policy
3. Fostering Equity and Justice

The charge was to develop two statements for each topic that could be used to frame an NSF proposal. We used the Jamboard to simulate the use of “post-it” or “sticky notes” to organize ideas - an approach commonly used in collaborative in-person workshops. The tasks were to brainstorm ideas (task A), organize them in quadrants spanning short term-long-term to easy-difficult axes (task B), and to develop two statements summarizing key elements of ideas developed and organized (task C). The results revealed common themes across the topics and across the groups that inform the final output from the workshop.

FRIDAY, JUNE 11, 2021

Time (Pacific)	**Item (Plenary room in blue; Focus rooms (4) in yellow)**
09:00 - 09:05	People enter the room
09:05 - 09:10	Welcome, logistics, code of conduct (J. Bwarie)
09:10 - 09:27	NSF C-Accel program and goals (C. Goulet) The workshop so far Today’s charge & Themes/Topics Schedule and logistics (J. Bwarie) Q&A
09:27 - 09:35	Introduction to Jamboard (J. Bwarie) - Q&A
09:35 - 09:45	Intros: name, affiliation, & 3 words describing your expertise
09:45 - 10:00	**Task A (Topic 1)** Brainstorm
10:00 - 10:15	**Task B (Topic 1)** Organize
10:15 - 10:30	Plenary Review (J. Bwarie to lead). Each group shares an update of their Topic 1 work
10:30 - 10:40	Guidance for Task 3 (C. Goulet) - Q&A
10:40 - 10:50	Break
10:50 - 11:15	**Task C (Topic 1)** Summarize
11:15 - 11:25	**Task A (Topic 2)** Brainstorm
11:25 - 11:35	**Task B (Topic 2)** Organize
11:35 - 11:55	**Task C (Topic 2)** Summarize
11:55 - 12:00	Break
12:00 - 12:05	**Task A (Topic 3)** Brainstorm
12:10 - 12:20	**Task B (Topic 3)** Organize
12:20 - 12:40	**Task C (Topic 3)** Summarize
12:40 - 13:00	Plenary Review (C. Goulet to lead) Goulet and Bwarie share groups’ summary statements.

Registration and Attendance

We recorded 489 individual registrations representing more than 250 organizations. The plenary sessions included about half of the registered numbers with variable attendance in the different break-out sessions. Participants spanned a wide range of specialties as illustrated in the word cloud constructed from the self disclosure of their specialty collected at registration time (Figure 2). The most frequently cited words are in larger font sizes. Since many of the registrants spanned multidisciplinary specialties, it was difficult to associate them with any specific field. In addition, several words are used in different contexts, which we didn't attempt to reconcile when compiling the data. We instead opted for the word cloud as a true representation of how often words were listed.

Figure 2. Wordcloud constructed from the registration input to "Describe your relevant work expertise in a few words."

Figure 3 shows responses to a slightly different complementary question: "Which multidisciplinary element related to societal shock resilience best describes your interest?" and provides additional insight into people's interests. Registrants were asked to select a single choice among the six elements or "Other" for which they wrote their own answer. The distribution of interests was good across all sic elements, with the remaining 7% who selected "Other" all providing different answers that mostly covered the topics of technology and communication, or very specific topics relevant to one the six main elements.

Figure 3. Registration answers to "Which multidisciplinary element related to societal shock resilience best describes your interest?" The multiple-choice answers included the 6 elements listed in Figure 1 and the option to enter "Other" with descriptions entered manually.

Institutions represented are also presented as a word cloud (Figure 4). In this case, "university" stands as the most cited word, highlighting that a large portion of the attendees were from academia. We estimate that about 58% and 13% or entities were academic entities or a research center/institute, respectively, 16% for-profit entities, 7% not-for-profit organizations and 6% from various government levels. While a large proportion of participants spanned the US, participants from several countries joined the workshop, including Canada, France, Saudi, Greece, India, Italy, Nepal, the Netherlands and UK to name a few.

Figure 4. Wordcloud constructed from the registration input on affiliation.

3. OUTCOMES

In this section, we summarize the key outcomes from the workshop in aggregate form by listing the key attributes and priorities that should be addressed by projects targeting SSR. These statements have been assembled based on results of discussions throughout the workshop. We gathered several specific descriptions of priorities (e.g., mitigation-, hazard-, system-, or community-specific). Although specifics are easier to tackle, a synthesis is necessary to provide the overall attributes for potential projects targeting SSR. Recurring themes that were brought up in most discussions involved the need for clear terminology definition (as some terms have different definitions in the context of different specialties), cross-training, and improved interface communications (among people as well as through cyberinfrastructure), and that the consideration of interdependencies of systems at several scales was critical, as is the involvement of diverse communities and stakeholders. We present the synthesis of these key points in terms of recommendations.

Overarching principles and desired attributes for projects on societal shock resilience

The following principles are recommended for the consideration of projects on SSR. These principles are consistent with the C-Accel Program, but are tailored to the specific needs of SSR.

- Perform activities under a co-development approach: Identify and engage community members, academia and the private sector meaningfully and continuously into a collaborative process for all research implementation tasks, so as to draw from diverse sources of knowledge and foster community capacity-building communication. Encourage the development of leadership in all the groups and incentivize omnidirectional communication and collaboration to increase trust in decision making processes.

- Generalize the concept of quantitative disaster resilience for key segments of society (e.g., infrastructure: water, power; schools; others) and/or specific communities. Use equity and justice in the development of performance measures and integrate social vulnerability into shock resilience decision-making.

- Integrate equity in all steps of the resilience research: designing, conducting, training, disseminating research as well as producing analyses/modeling results that are de-aggregated by a wide range of demographics (beyond income and race). Establish a process to involve disadvantaged and vulnerable communities in planning, communicating, mitigating risk and improving adaptive capacities.

- Include interactions of a wide range of participants spanning expertises such as hazard assessment (e.g., geoscience, climate science); ecologic, biological, and environmental science; engineering disciplines (civil, mechanical, electrical); architecture; mathematics and statistics modeling; computer science and software engineering, data science; social sciences (communication, education, urban planning, public policy, disaster management, public health, emergency response, and network analysis); economics and financial stress modeling. Experts from these disciplines also span a wide range of sectors including academia, government at all levels, and the private sector (for- and not-for-profit). In addition, stakeholders and communities depend on various entities for their resilience, which in turn span several sectors and at a minimum involve multiple

industries, the natural and built environments, energy and storage facilities, distributed infrastructure such as transportation and utilities, and communication systems.

- A project may be focused on a main principal shock and subsets of communities, but with the intent of being portable and scalable to other shocks, and should therefore involve relevant participants from other disciplines.

- Focus on implementation issues of previous research results and successful projects and their integration into the broad scope of SSR.

Recommended priorities

We have defined three priorities to be addressed by projects and cohorts of projects which we summarize with three words: modeling, education, and engagement. Progress in SSR requires that an appropriate modeling framework be developed to quantify resilience and the impact of decision making on outcomes; this is the first priority listed below. Education is also critical and is featured in the second priority, aimed at improving traditional training (i.e., school curricula) to cover the multidisciplinary aspects of resilience and engage future generations to think outside of their own specialty silo. The third priority is also education-based and involves a focus on deep community engagement with an aim to educate and enable communities to become part of the solution. We found that these three broad priorities were the best way to highlight the importance of these complementary sets of activities. All three require the multidisciplinary engagement of various stakeholders, yet they require different specific skill sets for implementation. A complete program on SSR should include activities from all three priorities to have the most impact. The statements for those three priorities are presented below along with specific objectives in bullet points.

Modeling: Develop an end-to-end institutionalized cyberinfrastructure modeling framework (or frameworks) to be used by decision makers for mitigation planning of shock resilience that accounts for equity and justice of served communities.

- Develop systematic multidisciplinary data collection schemas for the development and validation of tools and end-to-end models. Develop accessible, integrated, updatable, interdisciplinary knowledge bases and datasets.
- Develop institutional infrastructure to enhance multi-way information exchange for shocks, vulnerability, exposure, and model output for community stakeholders, industry, and researchers to improve societal shock resilience.
- Develop rapid data collection methods (post-event) with community-access capabilities (such as in tested visualization formats).
- The modeling framework should capture interdependencies among various infrastructures and people and integrate principles of uncertainty. Use of new yet proven technologies such as artificial intelligence and robust collaborative approaches are to be investigated so as to make a demonstrable impact on policy, practice and communities.
- Develop end-to-end scenario simulation narratives, with pre- & post-shock assessments to test the modeling framework and its ability to support community-based, practice-oriented and equity-focused approaches, as well as to quantify the societal cost-benefit analysis of alternate mitigation measures. Select subsets of communities to work with on this step to understand their disaster impacts and collaborate on mitigation approaches that would generate transferable and sustainable models for broader population groups.

- The framework(s) should be designed to allow the evaluation of disproportionate impact from hazards on disadvantaged communities, so as to support the implementation of equitable approaches to prepare for, mitigate, and recover from those impacts. The framework(s) should allow the testing of diverse mitigation measures regarding zoning, retrofit ordinances and incentives, and community preparedness, for example.
- Develop narratives from research results to spur policy changes that reduce exposure or mitigate risk over the long term.
- Develop cross-training tools and living documents to be used first by participants of funded projects and later disseminated through the broader community.

Education: Develop formal education programs focused on the needs of multidisciplinary collaborations for improving SSR.

- Train and develop researchers (all levels) in inclusive, interdisciplinary, innovative research methodologies, community partner engagement, and public policy making processes.
- Develop curricula for the broad range of expertise involved in resilience (physical, life, and social sciences plus other fields) for training them on justice, equity, diversity, and inclusion (JEDI), cognitive bias, and public risk communication. Develop disaster training curricula through dissemination of experiences and virtual platforms.

Engagement: Increase Public Education and Community Engagement.

- Increase public preparedness education and hazard awareness through co-development of educational and training material. Develop innovative communication techniques for public outreach that involve visualization, games, and advanced technologies such as cross-hazard platforms for communicating trustworthy actionable information for preparedness, response and recovery.
- Develop and train advocacy groups into an informed network for transmitting knowledge to communities that span diverse ranges of exposures and vulnerabilities.
- Develop tools and methods with community stakeholders that build on established knowledge for improved resilience. Identify sector-specific and broad society needs, with an aim to engage stakeholders in initiating and supporting policy changes that mitigate risk over the long term.

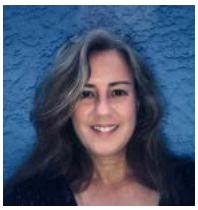
Broader Impacts

The topic of societal resilience to shocks will generate broad impacts for a large, diverse, dynamic society. The workshop, organized to foster interaction both within and among diverse systems, facilitated the identification of several convergence opportunities. We made efforts to have students and early-career participants in every session and especially to include them in the focus-group discussions on the last day of the workshop, the session in which the integration of input was performed. Moreover, based on the feedback received after the workshop, we believe we achieved the goal of making participants more aware of the need for true collaboration and more interested in pursuing convergence activities in their own projects.

APPENDIX - ORGANIZERS AND FEATURED SPEAKERS

This appendix presents short bios of the organizers (Executive Committee and Planning Committee) and featured presenters.

A.1 Executive Committee



Christine Goulet, Ph.D. is the SCEC Executive Director for Applied Science at the University of Southern California. She serves as the science lead and technical integrator for large-scale collaborative projects in earthquake hazard and risk. Her research interests are in the field of geotechnical earthquake engineering and applied seismology in the context of performance-based design.

Yousef Bozorgnia is a professor of the UCLA Department of Civil & Environmental Engineering, and Faculty Director of the Natural Hazards Risk and Resiliency Research Center (NHR3). Dr. Bozorgnia's expertise includes multidisciplinary aspects of earthquake science and engineering. In 2019, he was awarded the Bruce Bolt Medal for his extensive contributions to seismic hazard analysis and earthquake engineering.

Ellen M. Rathje, Ph.D. is the Janet S. Cockrell Centennial Chair in the Department of Civil, Architectural, and Environmental Engineering at the University of Texas. Her main research interests include geotechnical hazards associated with earthquakes and other natural hazards, and the use of cyberinfrastructure to evaluate natural hazards. She is the Principal Investigator for the NSF-funded DesignSafe-ci.org cyberinfrastructure for natural hazards.

Marco Tedesco is a Lamont Research Professor at the Lamont-Doherty Earth Observatory of Columbia University and Adjunct Scientist at the NASA Goddard Institute for Space Studies (GISS). Dr. Tedesco's research focuses on the dynamics of seasonal snowpack, ice sheet surface properties, high latitude fieldwork, global climate change and its implications on the economy and real estate.

A.2 Planning Committee

Domniki Asimaki is a Professor of Mechanical and Civil Engineering at Caltech. Her research focuses on the understanding and simulation of 3D site effects and soil-structure interaction. She has served on the ASCE GeoInstitute Board of Governors since 2018; and is an associate editor for the ASCE Journal of Geotechnical and Geoenvironmental Engineering, for Earthquake Spectra, and for the Bulletin of Earthquake Engineering.

Yehuda Ben-Zion is the Director of the Southern California Earthquake Center and Professor of Earth Sciences at USC. His research is focused on physics of earthquakes and faults using theory, simulations and observations. He published over 275 papers and edited eight books. Ben-Zion is a Fellow of the American Geophysical Union and was awarded the Humboldt Research Prize in Geophysics.

Mark Benthien is Director for Communication, Education and Outreach for the Southern California Earthquake Center at the University of Southern California. In this role he serves as Executive Director of the Earthquake Country Alliance, and Global Coordinator of Great ShakeOut Earthquake Drills. Mark received his B.S. in Geophysics from UCLA and a Master's degree in Public Policy from USC.

John Bwarie, Stratiscope's CEO, has more than two decades experience engaging communities, leading conversations, and fostering resilience. John co-created the ShakeOut and Clean Air Day and has worked for the Los Angeles Mayor and City Council. He advises leaders in academia, transportation, elected office, and other high visibility individuals. John teaches university-level community engagement and leads strategic facilitation for government, nonprofit, and corporate entities.

Jean Carlson, Ph.D. is a Professor of Physics at the University of California Santa Barbara. Her research investigates robustness, tradeoffs, and feedback in complex, highly connected systems, and develops computational multiscale models to capture important small- scale interactions and predict large-scale behavior. Applications include dynamics of earthquake faults, wildfire propagation and disaster response, infectious disease, neuroscience, and collective decision making.

Divya Chandrasekhar is an Associate Professor in the Department of City & Metropolitan Planning at the University of Utah with expertise in community recovery from disasters. Her research has examined post-disaster community participation and capacity building, networking and coordination among recovery institutions, and disaster recovery policy in South and Southeast Asia, the Caribbean, and the U.S.

Louise K. Comfort is Professor and former Director, Center for Disaster Management, Graduate School of Public and International Affairs, University of Pittsburgh. She is a faculty affiliate with the Policy Lab, Center for Information Technology Research in the Interest of Society, University of California, Berkeley. She studies the dynamics of decision making in response to urgent events: earthquakes, tsunamis, wildfire, COVID-19.

Yifeng Cui, Ph.D. is a computational scientist at the San Diego Supercomputer Center, with educational backgrounds in meteorology and hydrology. His research interests are in high performance computing and extreme-scale end-to-end simulations. Cui co-developed the ACM Gordon Bell winning earthquake modeling AWP-ODC code, and received the NVIDIA Global Impact Award in 2015.

Craig A. Davis, Ph.D., PE, GE is a professional consultant on geotechnical, earthquake, and lifeline infrastructure system resilience engineering. In his three-decade long career at the Los Angeles Department of Water and Power, he worked as the Chief Resilience Officer, Seismic Manager, and Geotechnical Engineering Manager. He has developed infrastructure resilience frameworks and programs which have been implemented into practice.

Donovan Finn, PhD is Assistant Professor of Environmental Design, Policy and Planning in the School of Marine and Atmospheric Sciences at Stony Brook University. He is a member of the NCAR Early Career Faculty Innovators program studying the integration of climate science into local urban planning. His research focuses on community sustainability and resilience, long-term disaster recovery and environmental justice.

Dr. Ganapati is an Associate Professor of Public Policy and Administration and the Director of the Laboratory for Social Science Research, International Hurricane Research Center, Extreme Events Institute at Florida International University. She has served as the Principal Investigator (PI) or co-PI of several National Science Foundation projects related to disaster recovery and resilience in the U.S., Nepal and Haiti.

Sara Hamideh is an assistant professor at the School of Marine and Atmospheric Sciences' Sustainability Division at Stony Brook University. Her research interests are post-disaster housing recovery, community resilience planning and investments, public participation in recovery, and vulnerable populations in disasters. She is a Principal Investigator with the Center of Excellence for Community Resilience at Colorado State University funded by National Institute of Standards and Technology (NIST).

Richard Loft, Ph.D. is the Director of the Technology Development Division in the Computational and Information Systems Laboratory (CISL) at the National Center for Atmospheric Research (NCAR). In this capacity, he oversees CISL's R&D efforts in areas such as technology tracking, algorithmic research, and the development of useful computational tools and services.

Steven McCabe is a research structural engineer and is the Director of the National Earthquake Hazards Program (NEHRP), a statutory program initiated by Congress in 1977, consisting of FEMA, USGS, NSF and NIST, the lead agency. He works with the NEHRP agencies, other federal, state and public stakeholders and design practitioners to improve the earthquake performance of buildings and lifelines.

Adam Rose, Ph.D. is a Research Professor in the Price School of Public Policy and Director of the Center for Risk and Economic Analysis of Terrorism Events (CREATE) at USC. He was previously a faculty affiliate of the Multidisciplinary Center for Earthquake Engineering Research (MCEER). His major interests are modeling and measuring economic consequences of and resilience to disasters.

Sharon Sandow is Director for Strategic Partnerships of the Communication, Education and Outreach team at SCEC. Previously, she served as Los Angeles City Council Chief of Staff for two City Councilmembers, and Regional Director of Government and Community Relations at the American Red Cross. Currently, she serves as Deputy Director of Earthquake Country Alliance.

Charles Scawthorn is internationally recognized as an authority for the analysis and mitigation of natural and technological hazards and is a Principal of SPA Risk LLC and a Visiting Researcher at UC Berkeley. He's retired from Professor of Infrastructure Risk Management from Kyoto University (Japan) and has been Visiting Professor at Stanford, Beijing Normal and Waseda (Tokyo) Universities.

Ellis Stanley is Managing Partner, Ellis Stanley Partners, LLC. Former General Manager of the City of Los Angeles Emergency Preparedness Department. Graduate of UNC at Chapel Hill. the Executive Leadership Program from the Post Naval Graduate School and John F. Kennedy School of Government's National Preparedness Leadership Initiative. Chairman Emeritus the Global Board of the International Association of Emergency Managers.

Jonathan P. Stewart is a Professor in the Samueli Engineering School at UCLA. His expertise is in geotechnical earthquake engineering and engineering seismology. He is a member of the EERI Board of Directors, UC Seismic Advisory Board, Steering Committee for the USGS National Seismic Hazards Mapping Program, Advisory Committee on Earthquake Hazards Reduction (NIST), and the SCEC Planning Committee.

Patxi Uriz, Ph.D. is a Vulnerability Modeler at RMS, specializing in wildfire ember transport modeling and vulnerability of structures subjected to radiant heat, direct flame contact, embers, and modeling the urban conflagration phenomena. Dr Uriz obtained his Ph.D. in structural engineering from the University of California, Berkeley where he studied earthquake resistant design of steel structures and has taught graduate courses at Stanford University.

Joshua West, Ph.D. is a Professor of Earth Sciences at the University of Southern California he works on understanding erosional and hydrological processes at Earth's surface including landslides and floods. Over the past decade, he has worked on catastrophic events and their impact on landscapes, such as the tens of thousands of landslides triggered by single large earthquakes and storms.

Farzin Zareian, Ph.D. is an Associate Professor at the University of California – Irvine where his teaching and research interest is in Performance Based Earthquake Engineering (PBEE). His research efforts have been focused on the development of new methodologies for enhancement of PBEE, implementation of PBEE for assessment of structures, and the development of tools for implementation of PBEE by engineering practice.

A.2 Featured Presenters

Rachel Adams is a research associate at the Natural Hazards Center and the National Science Foundation-funded CONVERGE initiative. Her research interests include building community resilience, reducing social vulnerability to disasters, and translating evidence-based practices in emergency preparedness and response. She earned her PhD in community health sciences from the University of California, Los Angeles Fielding School of Public Health and her Master of Public Health degree in epidemiology and biostatistics from the University of Southern California.

Dr. Ilkay Altintas, a research scientist at the University of California San Diego, is the Chief Data Science Officer of the San Diego Supercomputer Center, Founding Fellow of the Halıcıoğlu Data Science Institute, and the Founding Director of the WIFIRE Lab. The WIFIRE Lab focuses on AI methods for all-hazards knowledge CI and has achieved significant success in managing wildfires.

Lindsey Anderson serves as Deputy Director, Operational Coordination Division in FEMA's Field Operations Directorate where she oversees FEMA's field leadership programs. Prior to this role, Ms. Anderson was the Director, Strategy and Policy Division in FEMA's Office of Policy and Program Analysis. She has also served as Interim Director of the Center for Disaster Management at the University of Pittsburgh.

Christopher Ansell is Professor of Political Science at the University of California, Berkeley. His research focuses on understanding how organizations, institutions and communities can engage effectively in democratic governance in the face of conflict, uncertainty, and complexity. He is the co-author of the recently published Public Governance as Co-creation: A Strategy for Revitalizing the Public Sector and Rejuvenating Democracy.

Lucy Arendt, Ph.D. is a Professor of Management in the Donald J. Schneider School of Business and Economics at St. Norbert College. She received her Ph.D. in Management Science from the University of Wisconsin-Milwaukee. Her scholarship focuses on how leaders perceive and address risks associated with disasters and how organizations and communities engage in long-term recovery and resilience-building.

Robin A. Barnes, MPA, is an economic recovery and resilience expert with 35 years' experience helping communities, small businesses, and nonprofits recover from – and prepare for – natural, manmade, economic, and climate-based disasters. Also, she has worked closely with and within organizations on strategy, performance measurement & management, resource development, and nonprofit management.

Michael Berkowitz is a Founding Principal of Resilient Cities Catalyst, a global non-profit helping cities and their partners tackle their toughest challenges. Previously he joined the Rockefeller Foundation in August 2013 to shape and oversee the creation of 100 Resilient Cities (100RC). He served as the 100RC President from 2013 to 2019.

David Bonowitz is a structural engineer in San Francisco. He advises cities and government agencies on earthquake risk reduction and resilience. Bonowitz is EERI's 2020 Distinguished Lecturer, past chair of the NCSEA Existing Buildings and Resilience committees, and an appointed member of the FEMA-NIST working group on Functional Recovery of the Built Environment and Critical Infrastructure.

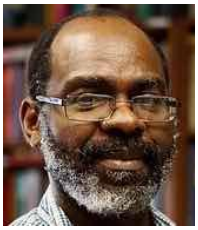
Brittany Brand, Ph.D., is the Director for the Boise State Hazard and Climate Resilience Institute (HCRI). The HCRI fosters interdisciplinary and cross-sector collaboration to build connected, thriving, resilient communities. We provide a platform to connect researchers, students, and community partners to collaboratively address community resilience research and practical needs, effectively translating research to practice.

Cindy Bruyere is the Director of NCAR's Capacity Center for Climate and Weather Extremes (C3WE). Her current research activities include understanding and predicting the impact of climate variability and change on extreme weather events. She focuses explicitly on the impact these extreme events have on industry and how science can help industry become more resilient.

Lara Campbell is a Program Director for the National Science Foundation's Convergence Accelerator Program which she helped launch in 2019. Lara's expertise is in managing large, collaborative, primarily international research efforts including in NSF's Office of International Science and Engineering and previously as Director of the nonprofit CUBRC Center for International Science and Technology Advancement. Her PhD is in chemistry.

Stephanie Chang is a professor at the University of British Columbia, Canada, with the School of Community and Regional Planning (SCARP) and the Institute for Resources, Environment, and Sustainability (IRES). She has published extensively on the socio-economic impact of natural disasters, modeling disaster losses, urban risk dynamics, critical infrastructure systems and interdependencies, economic evaluation of disaster mitigations, and disaster recovery.

Mary Comerio is an internationally recognized expert on housing, disaster resilience and recovery. She has been on the faculty at U. C. Berkeley for over 40 years. Her research includes seismic rehabilitation, post-disaster recovery and reconstruction, loss modeling and resilience-based design. She is the author of Disaster Hits Home: New Policy for Urban Housing Recovery, and hundreds of other books, reports, and scientific papers.



Ofodike A. Ezekoye is the WR Woolrich Professor of Engineering at University of Texas-Austin and Director of the UT Fire Research Group. His group investigates wildfire spread, community-scale fire data analysis, compartment fire evolution, fire forensics analysis, firefighter ventilation tactics, fireground acoustics, and lithium-ion battery hazards. His work has been recognized with awards from ASME, SFPE, NFPA, and NSF.

Tom Gibbs is currently responsible for strategy and implementation of SW development programs for NVIDIA's HPC Business Unit. The programs focus on solutions that utilize the convergence of advanced classical simulation methods with AI, experimental data acquisition, real-time control and most recently quantum computing systems. Most recently his focus has been on joint research targeted at HPC for Covid which resulted in the Gordon Bell for Covid Award at SC20.

Jenniffer Marie Santos-Hernández is an Assistant Research Professor at the Center for Social Research at the University of Puerto Rico-Río Piedras. She currently serves as co-lead for the city of San Juan in the NSF Urban Resilience to Extremes Sustainability Research Network (NSF UREx) and as the lead of the Helping Affected Communities Engage in Resilience (HACER) initiative.

Carson MacPherson-Krutsky, Ph.D., Co-Founder and Community Engagement Coordinator for the Boise State Hazard and Climate Resilience Institute (HCRI). She focuses on how scientists communicate effectively with the public, specifically on topics related to natural disasters, hazards, and risk. Carson also develops new and interactive methods for translating technical-scientific content into user-friendly formats.

Richard G. Little is a Visiting Research Scholar in disaster mitigation at Rensselaer Polytechnic Institute and Editor of Public Works Management & Policy. He was Director of the Keston Institute for Infrastructure at the University of Southern California (2004-2012) and Director of the Board on Infrastructure and the Constructed Environment of the National Research Council (1995-2004).

Forrest Masters, Ph.D. studies tropical cyclone wind and wind-driven rain effects on the built environment through field reconnaissance in landfalling hurricanes, destructive testing, and boundary layer wind tunnel modeling. At the University of Florida, he is a Professor of Civil and Coastal Engineering and serves as Associate Dean for Research in the Herbert Wertheim College of Engineering.

Amy McGovern, Ph.D. is a professor in the School of Computer Science and School of Meteorology at the University of Oklahoma. She is also the director of the NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography. Her research focuses on developing trustworthy AI/ML methods with a focus on severe weather.

Scott Miles, Ph.D is an expert on disaster risk reduction, community resilience, disaster recovery, simulation modeling, and human centered design. He is a senior research scientist in the Department of Human Centered Design and Engineering at University of Washington. He is Director of the Disaster Science as Design (DisSci:gn) Lab.

Judith Mitrani-Reiser, Ph.D. is the Associate Chief of the Materials and Structural Systems Division at the National Institute of Standards and Technology. She oversees the Disaster and Failure Studies Program, National Earthquake Hazards Reduction Program, and the National Windstorm Impact Reduction Program. She is the Vice President of EERI, on the Executive Committee of CROSS-US, and a member of ASCE.

Robert Muir-Wood. Natural Sciences MA & Earth Sciences PhD from Cambridge University. Chief Research Officer, RMS since 2003. IPCC Lead Author 4th Assessment Report and Special Report on Extremes. Chair of the OECD High Level Advisory Board on Large Catastrophes. Visiting Professor: Institute of Risk and Disaster Reduction UCL. Author of 2016 Book: 'The Cure for Catastrophe: how we can stop manufacturing natural disasters'.

Tina Nabatchi is the Joseph A. Strasser Endowed Professor in Public Administration and the Director of the Program for the Advancement of Research on Conflict and Collaboration (PARCC) at the Syracuse University Maxwell School of Citizenship and Public Affairs. An elected fellow of the National Academy of Public Administration, Nabatchi studies collaborative governance, public participation, and conflict resolution in public administration.

Sissy Nikolaou, Ph.D. leads the Earthquake Engineering Group of the National Institute of Standards and Technology. Her group develops, advances, and deploys measurement science to reduce seismic risks to the built environment, and supports the National Construction Safety Team and National Earthquake Hazards Reduction Program. Prior to joining NIST, she was a consulting engineer for 25 years with global projects involving critical facilities, lifelines, and high-rise buildings.

Branda Nowell is a professor in the department of public administration at North Carolina State University specializing in the design and governance of public networks. She is the director of the Firechasers research initiative (firechasers.ncsu.edu). Since 2008, this team has worked in collaboration with federal, state, and local jurisdictions on research aimed at improving inter-agency coordination and communication during large scale wildfire events.

Robert B. Olshansky is Professor Emeritus of Urban and Regional Planning, UIUC. He has studied recovery planning after numerous major disasters around the world, including the U.S., Japan, China, Taiwan, India, Indonesia, New Zealand, and Haiti. Now based in California, his current research focuses on community relocation in response to natural hazards, involving dozens of cases in North America and Asia.

Gavin Schmidt is a climatologist, climate modeler and Director of the NASA Goddard Institute for Space Studies (GISS). He is the Principal Investigator for the GISS ModelE Earth System Model. His technical interests include understanding past, present and future climate and the impacts of multiple drivers of climate change, including solar irradiance, atmospheric chemistry, aerosols, and greenhouse gases.

Carrie Speranza is the Deputy Director for the Homeland Security and Emergency Management Agency, where she manages internal operations of the organization. Carrie is also a member of FEMA's National Advisory Council. She's deployed for seven hurricane response efforts, and has worked as Executive Command Staff for multiple events: civil unrest, extreme weather, and over two dozen National Special Security Events.

Shannon Van Zandt, Ph.D., AICP, is Professor and Head of the Department of Landscape Architecture & Urban Planning at Texas A&M University. Her research focused on housing recovery and social vulnerability to disasters, emphasizing the way that urban development patterns characterized by racial segregation and concentrated poverty expose vulnerable populations to increased risk and longer paths to recovery.

David Wald is a Seismologist at the USGS National Earthquake Information Center (NEIC). His responsibilities include real time information systems including "ShakeMap" and the citizen-science "Did You Feel it?" system. His scientific interests include the earthquake rupture processes, ground motion analysis and site effects, and earthquake effects (landslides, liquefaction, shaking-based losses). He is the Editor-in-Chief of Earthquake Spectra.

Mr. Walton has founded and managed private, public and non-profit enterprises. His ventures have primarily focused on developing networked, interactive systems for healthcare, public safety, defense, intelligence and entertainment. As chairman of the EIC, he worked with the Homeland Security Agency and other international standards bodies to promote the use of the Common Alerting Protocol for global emergency communications.

Chauncia Willis is the Co-Founder and CEO of the Institute for Diversity and Inclusion in Emergency Management (I-DIEM). Ms. Willis is certified as an Emergency Manager, Professional Coach, and Cultural Diversity Professional with over 20 years of experience in disaster equity. She is the author of a new book called, “Stretching: The Race towards Diversity, Equity and Inclusion in America.”