Abstract

NSF #1331463: *Hazards SEES Type 2: From Sensors to Tweeters: A Sustainable Sociotechnical Approach for Detecting, Mitigating, and Building Resilience to Hazards.*

Project Description:

This project addresses the national challenge of defining and building resilience to hazards that would engage the 'whole nation,' including scientists, governmental agencies at all levels of jurisdiction, private and nonprofit organizations, and communities. To meet this challenge, it is essential to **define, design, and demonstrate an interdisciplinary, dynamic process that will transform societal understanding of risk and enable self-organized, collective action to support the resilient management of hazards.** This study will identify and model the interactions among physical, engineered, and sociotechnical systems that occur in hazard emergence and response as *a complex, adaptive system of systems (CASoS) to enhance resiliency in practice and enable communities to manage the risk of hazards within existing resource and time constraints.* It will use the threat of *Near-Field Tsunamis* (NFTs; i.e., waves generated within 200 miles of shore) in a location prone to this risk, Padang, West Sumatra, Indonesia as a case study to investigate methods of assessing accurately and efficiently the dynamics of NFTs generated by undersea earthquakes or landslides as they impact human communities. This process is an iterative search for information under evolving conditions to inform decisions at multiple levels of action in response to shared risk.

Five basic research questions drive this project*:*

1. What instruments, metrics, media, tools, and technologies are most effective in enabling communities at risk to collect, access, and exchange information about risk?
2. What types of information and what forms of communication contribute most effectively to collective recognition of risk, creating public awareness of a shared threat to safety?
3. To what extent does investment in data collection, analysis, search, and exchange enable more informed decision making in community environments exposed to long-term risk, and reduce the potential for ecological, social, and economic losses from episodic catastrophes?
4. What causal models, based on combined real-time and stored data for social and physical systems, offer alternative strategies for collective action to protect community population, infrastructure, and resources?
5. How can the proposed resilience models, methods and tools for collective action be used to assess accurately and efficiently the dynamics of NFTs generated by undersea earthquakes or landslides and enable collective action to manage the impact of hazards on coastal communities?

Research Hypotheses: We test the following four hypotheses:

1. Computational modeling of complex adaptive relationships under uncertain conditions increases collective understanding of tsunami risk and increases collective problem solving capacity.
2. Multiple patterns of information dissemination regarding risk among community residents increase the efficiency of self-organized collective action.
3. Timely, accurate transmission of tsunami risk increases efficiency in targeting evacuation procedures to diverse community groups and areas with different degrees of exposure.
4. Detecting the temporal rate of seismic motion, or source slowness, discriminates tsunami earthquakes from non-tsunami earthquakes.

Project Significance and Broader Impact:

This study envisions communities that learn to assess hazards endemic to the environment and that have the capacity to make collective decisions informed by scientific knowledge, leading to timely, effective risk reduction. Findings from this project will redefine the science of community resilience and enable at-risk communities to create learning environments in which they collectively assess, respond, and recover from extreme events. Models for collective action demonstrated in this project will increase collective problem solving capacity for minimizing losses and maximizing actions for innovative, sustainable risk reduction. The most vulnerable groups in society--women, children, minorities, elderly—will benefit as communities initiate risk reduction measures, and as leaders trained in interdisciplinary skills guide citizens in responsible management of resources and risk assessment. Developing dynamic methods for managing sociotechnical systems will enhance SEES education. The CASoS prototype, deployed and tested in Indonesia, will benefit the global society.