

**Abstracts of Current Programs and Projects
(PP07)**

- PP07-01 **Development of Performance Measures for Evaluation of State Public Health Emergency Preparedness**
Patricia Bolton and Davis Patterson
- PP07-02 **Post-Disaster Redevelopment Planning in Florida**
Allison Boyd
- PP07-03 **Disaster Risk Reduction in the United Nations System**
Sálvano Briceño
- PP07-04 **Nebraska Disaster Behavioral Health Project**
Denise Bulling and Sarah Michaels
- PP07-05 **Testing Protocol and Certification Standards for Temporary Flood Fighting/Flood Proofing Products**
Larry S. Buss
- PP07-06 **Open Source Mobile Technology for Screening Potential Seismic Hazards**
Cathleen M. Carlisle
- PP07-07 **Disaster Management Improvement and Innovation on Natural Disasters in Taipei City**
Liang-Chun Chen and Wei-Sen Li
- PP07-08 **Building a Hazard-Resilient Community: Challenges and Strategies**
Liang-Chun Chen and Yi-Chung Liu
- PP07-09 **Project PREP: Promoting Disaster Preparedness in Latinos**
David Eisenman, Steve Asch, and Deborah Glik
- PP07-10 **OpenSHA: Open Source Seismic Hazard Analysis Software**
Ned Field
- PP07-11 **Breaking Tradition: Penetrating the Disaster Communications Safety Net**
Suzanne L. Frew
- PP07-12 **METASIM: A Simulation Framework to Support Technology testing in Crisis Response**
Shubharoop Ghosh, Charles Huyck, Vidhya Balasubramanian, and Sharad Mehrotra

- PP07-13 **Consortium for Emergency Response (CER)**
Letta Gorman
- PP07-14 **Tap Runs Dry: Managing Urban Water Supply Now and in the Future in
Canada**
Grace Koshida
- PP07-15 **The International Early Warning Program: A Multi-Agency Partnership for
Development and Implementation of Operational Early Warning Systems
with a Multi-Hazard Approach**
Douglas Pattie
- PP07-16 **OpenRisk: Open Source Risk Estimation Software**
Keith Porter
- PP07-17 **Guidelines for Assessing Planning Policy and Consent Requirements for
Landslide-Prone Land**
Wendy Saunders
- PP07-18 **Open Risk Analysis**
Charles Scawthorn
- PP07-19 **Developing Disaster Risk Management National Action Plans for Pacific
Island Countries**
Moses Sikivou
- PP07-20 **Pre-Disaster Planning for Post-Disaster Recovery in Beaufort County,
South Carolina**
Nathan Slaughter
- PP07-21 **Reducing Risk from Natural Hazards: A Progress Report from Natural
Resources Canada**
Christopher Tucker

Patricia Bolton
Davis Patterson
Battelle Centers for Public Health, Research, and Evaluation
1100 Dexter Avenue North
Seattle, WA 98109
(206) 528-3310
(206) 528-3209
bolton@battelle.org
pattersond@battelle.org

Development of Performance Measures for Evaluation of State Public Health Emergency Preparedness

Following the September 11, 2001, attacks on the World Trade Center and the Pentagon, Congress appropriated bioterrorism preparedness funds, supplemental to bioterrorism preparedness funding begun in 1999, to go to all state public health departments. The Centers for Disease Control and Prevention (CDC) is responsible for preparing guidance and awarding funds to all state public health departments through a cooperative agreement.

Since 2002 the CDC's Division of State and Local Readiness (DSLRL) has grappled with how to develop appropriate performance measures. During the early years of the cooperative agreement, the guidance for the applicants was to address the critical capacities and achieve critical benchmarks for preparedness activities around seven focus areas:

- 1) Preparedness Planning and Readiness Assessment
- 2) Surveillance and Epidemiology Capacity
- 3) Laboratory Capacity, Biologic Agents
- 4) Laboratory Capacity, Chemical Agents
- 5) Health Alert Network/Communications and Information Technology
- 6) Risk Communication and Health Information Dissemination
- 7) Education and Training

During Budget Year 6, the CDC guidance transitioned from an emphasis on developing critical capacities in the focus areas to evidence-based performance goals and measures. The preparedness goals are to prevent, detect and report, investigate, control, recover, and improve. The focus on bioterrorism preparedness has broadened to all-hazards preparedness.

Beginning in FY2002 we have had a contract to assist the CDC/DSLRL in developing an evaluation approach for the public health emergency preparedness program. This has included assistance in crafting measures and field testing them with selected states. The development of performance measures that have a meaningful metric and are applicable across all states has proven to be very challenging.

Allison Boyd
CSA International Inc.
759 Parkway Street
Jupiter, FL 33477
(561) 629-4636
aboyd@conshelf.com

Post-Disaster Redevelopment Planning in Florida

All of Florida's coastal counties and municipalities, a total of 203 communities, have comprehensive plan language indicating their intent to adopt a postdisaster redevelopment plan (PDRP) and/or ordinance. The state statutes recommend that "these plans should, at a minimum, establish long-term policies regarding redevelopment, infrastructure, densities, nonconforming uses, and future land use patterns (§163.3177(7)(l) *F.S.*). In addition, noncoastal local governments are also encouraged under Florida statutes to prepare PDRPs. However, little guidance exists to guide the content of such plans and they are not required to be reviewed or approved by the state. The Florida Department of Community Affairs, through funding from the Florida Department of Environmental Protection and National Oceanic and Atmospheric Administration, has contracted with CSA International, Inc., to remedy this issue. The project's goal is to develop sound and feasible guidance to assist Florida's communities in drafting effective PDRPs thereby increasing the resiliency of the state and its local jurisdictions.

An often forgotten component of the mitigation cycle, planning for post-disaster recovery is essential for furthering the sustainability of a community. As is now realized along the Gulf Coast, making decisions for redevelopment after a catastrophe without any preconceived strategies for rebuilding a resilient and successful community is a difficult process. The aftermath of a disaster is always challenging, even if a community has planned for the worst-case scenario; however, by proactively creating a process for making smart post-disaster decisions and preparing for long-term recovery needs as much as possible, the community can do more than simply react. A disaster, while tragic, can also create opportunity. With a PDRP, a local government has a better chance of using the window of opportunity to move the community farther down the road to resiliency.

All communities in Florida, whether individually or through countywide initiatives, have already begun planning for pre-disaster mitigation and the immediate response in the post-disaster period. The next step is to plan for what happens after rescue and response operations have been completed and how to prepare for a rapid recovery and possible redevelopment due to the impacts of a disaster situation. Post-disaster redevelopment planning identifies policies, operational strategies, and roles and responsibilities for the implementation of the community's previously-identified growth management and hazard mitigation goals within the process of long-term recovery and reconstruction.

Program and Project Abstracts – PP07-02

In response to numerous costly disasters, a wealth of literature and sources have been created in recent years that examine communities' experiences with long-term recovery and theorize on how to better prepare for these situations. A literature review and survey of local governments in Florida will be completed this summer that will be the basis for a preliminary set of guidelines for developing a PDRP. Understanding the constraints of Florida's communities to prepare and adopt PDRPs is a critical step in accomplishing planning requirements that have been in place for 22 years. The draft guidelines will be tested on pilot communities later this year and the project will conclude in 2009 with a final best practices guidebook for post-disaster redevelopment planning.

Sálvano Briceño
United Nations Secretariat of the
International Strategy for Disaster Reduction
International Environment House II
7-9 Chemin de Balexert, CH 1219 Chatelaine
Geneva 10, Switzerland
briceno@un.org

Disaster Risk Reduction in the United Nations System

In recent years, disaster risk reduction has grown in importance on the international agenda. Natural hazards, such as floods, drought, earthquakes, tsunamis, as well as epidemics, have had an increasing impact on humans due to population growth, urbanization, rising poverty, and the onset of global environmental changes, including climate change, land degradation, and deforestation. Practitioners and researchers widely acknowledge that poor planning, poverty, and a range of other underlying factors create conditions of vulnerability that result in insufficient capacity or measures to reduce hazards' potentially negative consequences. Thus, vulnerability contributes as much to the magnitude of the disaster risk, if not more, as the natural hazards themselves. Many experts consider that action to reduce risk is now essential to safeguard sustainable development efforts and for achieving the Millennium Development Goals (MDGs).

An increase in human casualties and property damage in the 1980s motivated the UN General Assembly in 1989 to declare the 1990s the International Decade for Natural Disaster Reduction (IDNDR). The aim of the IDNDR was to address disaster prevention in the context of a range of hazards. One of the main outcomes of the IDNDR was the Yokohama Strategy for a Safer World and its Plan of Action, adopted in 1994 at the World Conference on Natural Disaster Reduction held in Yokohama, Japan. The Yokohama Strategy set guidelines for action on prevention, preparedness, and mitigation of disaster risk. These guidelines were based on a set of principles that stress the importance of risk assessment; disaster prevention and preparedness; the capacity to prevent, reduce and mitigate disasters; and early warning.

In 1999, the UN General Assembly decided to continue the activities on disaster prevention and vulnerability reduction and established the International Strategy for Disaster Reduction (ISDR), to be supported by the scientific and technical expertise and knowledge accumulated during the IDNDR. The World Conference on Disaster Reduction (WCDR) was held in January 2005 in Kobe, Japan. The WCDR aimed to increase the international profile of disaster risk reduction, promote its integration into development planning and practice, and strengthen local and national capacities to address the causes of disasters that hamper development. The 168 states attending the conference adopted the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Hyogo Framework for Action committed governments to five priorities for action: ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation; identify,

Program and Project Abstracts – PP07-03

assess, and monitor disaster risks and enhance early warning; use knowledge, innovation, and education to build a culture of safety and resilience at all levels; reduce the underlying risk factors; and strengthen disaster preparedness for effective response at all levels.

In 2006, the UN Under-Secretary-General for Humanitarian Affairs launched a consultative process to consider practical ways of strengthening the ISDR system to support governments in meeting their Hyogo Framework implementation commitments. The main aims were to extend participation of governments and organizations, raise the profile of disaster reduction, and construct a more coherent international effort to support national disaster reduction activities. A Global Platform for Disaster Risk Reduction was established by the UN General Assembly. The Global Platform serves as the primary multi-stakeholder forum for parties involved in disaster risk reduction in order to raise urgency and awareness on reducing disaster risk, share experiences, and guide the ISDR system. The platform met for the first time in Geneva, on June 5-7, 2007.

Denise Bulling
Sarah Michaels
University of Nebraska Public Policy Center
121 S. 13th Street, Suite 303
Lincoln, NE 68588-0228
(402) 472-21509
dbulling@nebraska.edu

Nebraska Disaster Behavioral Health Project

There is a gap between practice and research in disaster behavioral health (mental health and substance abuse). An innovative university-state government partnership has resulted in development of flexible capacity for the state of Nebraska that spans this gap.

The disaster behavioral health project focuses on planning efforts when there is not an active disaster in the state. Ongoing involvement of stakeholders (e.g., policy makers, professionals, academicians, community members) in planning efforts has resulted in development of state and regional all-hazard disaster behavioral health response and recovery plans, psychological first aid curriculum to boost resiliency and response capabilities of local communities, behavioral health guidelines for medical isolation, formation of a model program that includes chaplains as part of an overall behavioral health response to disaster, centralized oversight of the state's critical incident stress management team, and formation of a cadre of mental health and public information officers experienced in risk communication.

The state's capacity is extended by project personnel during and after times of disaster. The Public Policy Center has been able to immediately assist the state with data tracking, grant writing, and on-site consultation/coordination of disaster behavioral health resources. The project has provided oversight and evaluation services for two immediate and two regular FEMA crisis counseling projects in the state after presidential disaster declarations made the areas eligible for these services. The project activities have also led to research and evaluation opportunities, including research related to hospital readiness for psychosocial surge capacity, disaster cleanup volunteers' experiences, and the experience of first responders after a large disaster response. Practitioners have used formative and summative evaluations of the crisis counseling programs to make decisions affecting service delivery. Policy makers are now using research related to timing of psychological debriefing with emergency responders to inform decisions about the use of interventions in the state. Researchers are taking advantage of the opportunities the project has created to access real-world data related to disaster behavioral health.

Larry S. Buss
National Nonstructural Flood Proofing Committee
U.S. Army Corps of Engineers
106 South 15th Street
Omaha, NE 68102-1618
(402) 221-4417
larry.s.buss@usace.army.mil

Testing Protocol and Certification Standards for Temporary Flood Fighting/Flood Proofing Products

The U.S. Army Corps of Engineers National Nonstructural/Flood Proofing Committee, the Association of State Floodplain Managers, and Underwriters Laboratory have joined to implement a national program of testing and certifying flood fighting and flood proofing products. This program is currently envisioned to include flood fighting/flood proofing products in four broad categories—temporary barriers, semi-permanent barriers, closure devices, and sealants. This program is funded 100 percent by vendors/manufacturers of products who seek Underwriters Laboratory certification of their product to meet minimum standards. The product certification will be done by Underwriters Laboratory. The product testing leading to product certification will be done by Underwriters Laboratory and the U.S. Army Corps of Engineers. Underwriters Laboratory will perform evaluation and testing of materials used to assemble the product. The U.S. Army Corps of Engineers will perform all water-related testing of the product.

The testing protocol contained in this document has been developed for water-related testing of temporary barriers. The testing protocol is applicable to all flood situations, with the exception of storm surge situations that produce waves that are clearly in excess of those contained in this testing protocol. The water-related product testing will be performed at the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) located in Vicksburg, Mississippi. The testing will be performed in a laboratory setting with concrete floor and walls. This document also contains the standards that will be used for the water-related portion of the product testing conducted by ERDC as part of the overall certification program. These standards directly relate to pass/fail of the product and to general criteria of acceptable protection provided by the product. These standards, when combined with the standards for evaluation and testing of the materials used to assemble the product form the basis for the determination of product certification by Underwriters Laboratory.

Cathleen M. Carlisle
Department of Homeland Security - FEMA
500 C Street, Southwest
Washington, DC 20472
(202) 646-2810
Cathleen.Carlisle@dhs.gov

Open Source Mobile Technology for Screening Potential Seismic Hazards

Rapid Visual Screening (RVS) of Buildings for Potential Seismic Hazards (FEMA 154) is a methodology that has been used by engineers, building departments, and other technical and non-technical practitioners to screen a large number and variety of buildings using a “clipboard sidewalk survey” procedure. This procedure, first developed in 1988 by Charles Scawthorn and the Applied Technology Council, uses a simple numerical rating system to allow a non-engineer with a minimum amount of training to quickly divide a building population into two categories: those buildings that pose a very small or negligible risk to life safety, and those that may be seismically hazardous and require more detailed study. The resulting data, which are recorded using a paper-based system, can be entered in databases and used for loss estimation and other analyses, an important first step in earthquake mitigation planning.

In the course of revising the procedure in 2002, the FEMA 154 project team hosted a workshop and solicited recommendations from RVS users. The workshop participants suggested FEMA consider developing a digital version of RVS, noting the importance of quick data acquisition, retrieval, and storage. Given the increased use of mobile computing technology by building departments and other building design professionals over the past several years, FEMA saw this as an opportune time to automate RVS.

It is envisioned that the RVS software will enable a survey worker (inspector, firefighter, engineer, etc.) to enter summary building data and take a photograph, all within about 10 minutes. In addition, GPS technology will be incorporated to bring site-related hazard data and then calculate a seismic risk score for the building. Once developed and tested, it is possible that this tool could be adapted to screen for other hazards.

There are several challenges associated with the development of the RVS software. For example, the application should be adaptable for use with the most current mobile computing technology including PDAs, smartphones, and Tablet PCs. It is also important that the software be compatible with spreadsheet and database applications, as well as with loss estimation and post-earthquake evaluation software (e.g., HAZUS, ATC-20i). Flexibility is critical because jurisdictions will have differing needs based on hardware and software platforms and applications currently in use.

In an effort to provide this flexibility, FEMA is planning to implement an open source development approach for the RVS software, referred to as “Rapid Observation of Vulnerability

Program and Project Abstracts – PP07-06

and Estimation of Risk” (ROVER). The ROVER project will provide FEMA with new opportunities to test this approach in the open source environment, including the establishment of an open source business model and protocols for receiving, evaluating, and integrating software updates from outside programmers. The goal is to provide the public with low-cost, flexible tools and methods that will enable and encourage mitigation planning and action at the local level.

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Liang-Chun Chen
National Science and Technology Center for Disaster Reduction, Taiwan
Graduate Institute of Building and Planning
National Taiwan University
Taipei, Taiwan
lcchen@ccms.ntu.edu.tw

Wei-Sen Li
Associate Research Fellow
National Science and Technology Center for Disaster Reduction
Taipei, Taiwan
li.weisen@ncdr.nat.gov.tw

Disaster Management Improvement and Innovation on Natural Disasters in Taipei City

Taipei is challenged by many kinds of natural threats—including earthquakes, typhoons, and floods—that require major administrative commitment from local government to achieve the goal of comprehensive protection. In the past several decades, disastrous events have claimed huge property losses and life casualties. Among them, the 1999 Chi-Chi Earthquake and Typhoon Nari in 2001 brought horrible experience to all citizens in Taipei. The Chi-Chi Earthquake destroyed one residential building, causing 73 fatalities and leaving 14 missing. The number of the deceased is far beyond any single disaster-affected building in the whole island. Typhoon Nari inundated more than 80 percent of Taipei City and left the subway system submerged. In total, 4,171 buildings were flooded and 300,000 tons of waste required cleanup around the clock. The estimated economic loss reached hundreds of billion of dollars and 30 people died or were missing. For several weeks, the aftermath paralyzed the daily life of most citizens and surging criticism forced municipal governments to organize an inquiry commission for an investigation.

For a megacity like Taipei, disaster management will be the hot issue. Citizens' concerns demand a well-planned strategy against upcoming hazards. As a consequence, newly developed technology and management are being introduced to assist city governments in building the capacity of disaster reduction. For the earthquake contingency, the Taiwan Earthquake Loss Estimation System has been broadly applied to explore possible earthquake damage and the simulated results supply sufficient information to pinpoint the seismically insufficient areas for further strengthening. Nowadays, the scenario- and performance-based methods are fully implanted in the regional plan for emergency response and preparedness for earthquakes. For flood control, both hardware installations and software implementations are being carried out by a string of projects. To identify the flooding potential for issuing warning and evacuation order, numerical analysis yielded inundation maps, which are publicized to citizens online. Especially after Typhoon Nari, the flood-proof standard had been reviewed and revised to amend glitches in the existing system. Since 2003, a project named "Collaborative Institute on Empowering Local Government for Disaster Prevention and Reduction" is bridging

the academic field with governmental sectors to build teamwork for updating the regional plans related to disasters. With participation from the local university, the interactions facilitated improvement in local government and brought the practical demand to researches and laboratories.

Liang-Chun Chen
Graduate Institute of Building and Planning
National Taiwan University
No. 1, Sec. 4, Roosevelt Road
Taipei, 10617 Taiwan
lcchen@ntu.edu.tw

Yi-Chung Liu
Management System and Policy Division
National Science & Technology Center for Disaster Reduction
9F, No. 200, Sec. 3, Beisin Road
Sindian City, Taipei County, 23143 Taiwan
ycl@ncdr.nat.gov.tw

Building a Hazard-Resilient Community: Challenges and Strategies

The recent devastation caused by natural disasters demonstrates that local emergency response could be overwhelmed during catastrophic events. In order to strengthen the emergency response capability of communities, various community-based projects have been promoted by governmental agencies, such as the Neighborhood Rescue Team and the Debris Flow Disaster Evacuation Plan. However, these projects are mostly targeted at effective disaster response and might be deficient in reducing community's vulnerability to hazard events.

With the increase in disasters and their resulting victimizations, the National Science & Technology Center for Disaster Reduction (NCDR) has recognized the need for enhancing community capability to disaster resilience. After the implementation of five pilot studies, a comprehensive Community-Based Disaster Management (CBDM) program was developed. Currently, governments, local executors, and communities are facing challenges while implementing the CBDM program throughout Taiwan. First, the policy makers and the local governments would rather address hazard mitigation constructions than promote community awareness to environmental risks. Additionally, local universities and NGOs, which are usually the major facilitators in the program, cannot offer enough support because of lacking experience and professional skills. In this case, it is believed that communities might receive poor support and resources while implementing the CBDM program.

Given these constraints, NCDR's main task is to develop comprehensive educational and outreach activities that address the concept of CBDM as well as practical skills and the operations. In order to effectively implement the CBDM program on a larger scale, different sectors—including public officers, community leaders, NGO members, and local universities—are also included in these education and outreach activities, which include the following:

1. propaganda and campaign
2. web-based information sharing
3. handbooks and manuals
4. "train the trainers" courses

David Eisenman
Steve Asch
Geffen School of Medicine at UCLA
Division of General Internal Medicine and Health Services Research
911 Broxton Plaza
Los Angeles, CA 90095-1736
(310) 794-2452
deisenman@mednet.ucla.edu

Deborah Glik
UCLA School of Public Health

Project PREP (Programa Para Responder a Emergencias con Preparación): Promoting Disaster Preparedness in Latinos

Project PREP is a community-based, participatory research program that aims to promote disaster preparedness among low-income, generally immigrant Latinos using culturally targeted intervention. Partners include the UCLA Schools of Medicine and Public Health, the Coalition for Community Health, and the Los Angeles Department of Public Health. Based on focus groups conducted with low-income, immigrant Latinos, a review of relevant literature, and health promotion theory, we developed a disaster preparedness program using lay health promoters (*promotoras de salud*). The program is being distributed and tested.

Focus Group Findings:

- Subjects reported significant concern about earthquakes and terrorism, though other disasters of concern in LA included hurricanes, tsunamis, floods, wildfires, tornados, gang violence (*maras*), home robberies, home fires, murder attempts, kidnapping, car accidents, and riots.
- Participants feared disasters would cause loss of life, property, and jobs, and difficulty with family reunification. Service disruption was rarely mentioned. Participants expressed anxiety over losing control and spoke frequently about remaining calm (*calma*).
- Only one-half of participants knew of the terms “disaster kit” or “emergency kit,” though most heard of “emergency supplies” or “disaster supplies.” Lack of space in crowded houses and apartments is an obstacle to kits.
- The concept of “communication plans” was poorly understood. It was often interpreted as having the means to receive communications in a disaster (e.g., walkie talkies and cell phones).
- Participants strongly preferred informal meetings (*platicas*) as a way to learn about disaster preparedness. They rated *promotoras de salud* highly as potential teachers.

Disaster Preparedness Program: We have designed a randomized, longitudinal cohort intervention with two arms: an experimental arm and a comparison arm. Participants in the experimental arm attend a small group discussion (*platica*) led by a trained *promotora* and supplemented by a small-group, community-building element. Participants in the comparison arm receive a mailed Spanish language booklet on disaster preparedness developed specifically

Program and Project Abstracts – PP07-09

for Project PREP. Low-income, generally immigrant Latinos were enrolled using respondent driven sampling (RDS) for recruitment of this difficult-to-reach population. RDS is a recruitment approach that uses research subjects to recruit their own peers to participate in a study. It relies on the knowledge that peers are better able to locate and recruit members of their own social groups than outreach workers and researchers. Two telephone assessments (pre-intervention and post-intervention) were conducted over a three-month period.

This community participatory disaster preparedness program provides content and utilizes teaching methods culturally targeted to low-income, generally immigrant Latinos. To our knowledge, this is the first tested use of *promotoras* to improve disaster preparedness. Testing will determine its efficacy as well as predictors of disaster preparedness activities in this difficult-to-reach, vulnerable community.

Ned Field
U.S. Geological Survey
535 S Wilson Ave.
Pasadena, CA 91106
(626) 583-7814
field@usgs.gov

OpenSHA: Open Source Seismic Hazard Analysis Software

OpenSHA is a collaborative effort by the U.S. Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and others to develop object-oriented, Web- and GUI-enabled, open source, and freely available software applications for conducting seismic hazard analyses (SHA). It is relevant to the planning community in several ways, such as by allowing researchers who lack expertise in seismic hazard analysis to create shakemaps for realistic earthquake scenarios for emergency planning purposes. Another goal of OpenSHA is to allow international researchers who lack seismic hazard analysis software to add their own data to OpenSHA and more affordably develop domestic seismic hazard estimates.

Our ultimate goal is to provide a framework where any arbitrarily complex seismological model can “plug in” for analysis without having to change what’s being plugged in to. Although some software applications are stand alone, our goal is also to enable the various SHA components to be geographically distributed over the Internet in what we term a “community modeling environment,” all tied together with a user-friendly Web interface. This infrastructure should significantly reduce the gap between cutting-edge geophysics and state-of-the-art hazard and risk evaluations. We encourage participation from anyone in this development, and are actively collaborating with engineers involved in OpenRisk and elsewhere to create risk-oriented software. Software and other relevant information can be found at www.opensha.org.

Suzanne L. Frew
Senior Risk Communications Manager
CirclePoint
555 12th Street, Suite 290
Oakland, CA 94607
(510) 268-8400 x142
s.frew@circlepoint.com

Breaking Tradition: Penetrating the Disaster Communications Safety Net

The use of emerging technologies, alongside traditional and non-traditional outreach techniques, is critical to the development and application of effective strategies for non-native speakers. Innovative outreach techniques can include radio soap operas, such as those successfully used in flood-prone areas of Latin America; lively street theatre, like that used in Nepal; and SMS text messaging and art competitions, like those used in the United States. By better understanding how we can penetrate the population subcultures through appropriate cultural messaging, and by tapping into the most effective social networks available, risk communicators can reach our highly vulnerable community members—those who are shifting the cultural landscapes of our communities across the country.

The San Francisco Bay Area population grew by almost two percent between 2000 and 2006, bringing the population of a nine-county area to 7.2 million (U.S. Census, July 2006). The *San Jose Mercury News* reported that about 57 percent of that increase was due to international immigration, and pointed out that “within the next few years, more people will speak a foreign language at home than the number who speak English.” Thirty percent of the population of Santa Clara County, the heart of Silicone Valley, was born outside of the United States. Of all counties in the United States, this county ranks first in Vietnamese speakers, second in Hindi, third in Chinese, and fourth in Persian/Farsi. These sweeping demographic changes to the disaster-vulnerable Bay Area signal the critical need for emergency managers to address the psychological, social, and cultural needs of these growing populations by crafting appropriate risk communications campaigns and messages.

Utilizing Super Urban Area Security Initiative (SUASI) grant funding, efforts are underway to evaluate the region’s public information and warning capabilities, programs, resources, and technology solutions needed to effectively reach immigrant and other highly vulnerable populations of the Bay Area. This new case study will soon shed light on these challenging issues and potential regional solutions, resulting in the development of a five-year strategic plan, with its first phase of implementation focusing on special needs populations.

Shubharoop Ghosh
Charles Huyck
ImageCat, Inc.
400 Oceangate, Suite 1050
Long Beach, CA 90802
sg@imagecatinc.com

Vidhya Balasubramanian
Sharad Mehrotra
University of California, Irvine Calit2
4300 Calit2 Building (325)
Irvine, CA 92697

MetaSim: A Simulation Framework to Support Technology Testing in Crisis Response

While innovations in information technology (IT) are being made to support awareness in a crisis, a key issue that must be addressed is evaluating the effectiveness of the developed solutions in an actual response process. Simulation tools and techniques can help understand disasters, their evolution, and the potential impact of IT solutions on the outcome of the response. Extensive modeling of disaster and testing efficacy of IT solutions requires modeling activities like evacuation, disasters like earthquakes, and simulation support for technology integration. Different simulators model different aspects of the disaster activity and it is essential to bring them together in a single platform to execute a meta-simulation. We propose MetaSim as a platform to support integration of multiple simulations that coordinate together to execute a meta-simulation. This paper focuses on the concepts supporting the design and the architecture of MetaSim. MetaSim is envisioned as a Web-based collection of simulation tools developed to test the efficacy of new and emerging information technologies within the context of natural and human-induced disasters. The level of efficacy is measured by reduction in expected losses, evacuation times, and other impacts determined for each technology developed. The MetaSim framework, database structure, visualization interface, and results from various simulators are discussed in this overview paper.

Letta Gorman
FIND
102 E. Burch Street
Hartford, AL 36344
(334) 588-0799
lettag@comcast.net

Consortium for Emergency Response (CER)

In response to the need for collaboration at the grassroots level in preparing for, responding to, and recovering from emergencies, natural disasters, and terrorism, the Consortium for Emergency Response (CER) was established. Based in Bullock County, Alabama, in the heart of the Black Belt, the CER is composed of organizations whose missions target saving people and property (critical infrastructure), including faith-based organizations (churches and nonprofit organizations), public and private emergency responders (fire, medical, legal), public and private medical facilities, public and private schools, K-12 and higher education, and other for-profit and nonprofit organizations.

All members of the consortium maintain equal status and the consortium promotes whichever member is best qualified to take the lead on each individual activity. As a result of the expertise and experience of its member organizations, the CER is strategically postured to perform the following activities:

- Sponsor education and training events (for-credit and CLE units)
- Develop and disseminate information
- Apply for, acquire, and implement contracts and grants
- Conduct field research
- Develop effective processes, techniques, and products (intellectual property)
- Mobilize members
- Promote safe practices
- Facilitate implementation of state-of-the-art programs and products
- Promote formal research and development with educational institutions
- Facilitate the commercialization of technology developed at national laboratories
- Perform other activities

The initial director of the CER is Bill Roughton, hazards simulation specialist and marketing specialist, and his development committee consists of Jack Arrington, multi-media specialist and Faith Based Initiative Network Development (FIND) president; Letta Dillard Gorman, attorney, professional grant writer (retired from Auburn University), and instructor; Bill Karl, president of Emergency Management Assist, Inc.; David James, founder and headmaster of the Eastwood Christian School noted for its hazards prevention, mitigation, response, and recovery curriculum; John Painter, superintendent of the Lee County Schools, a leader in school safety; Miranda Townsend, president of a local faith-based organization; Joel Rodgers, medical hazards

Program and Project Abstracts – PP07-13

researcher at the University of Alabama-Birmingham (UAB); Paul Waggoner, program manager for homeland security programs at Auburn University, including the ACATS simulation exercise program and canine detection program; Lew Bomar, program director for homeland security programs at Chattahoochie Valley Community College; Ben Hand, attorney, and Patrick Aguiard, simulations specialist, of Emergency Response Training Systems (ERTS); and Rick Williams, Episcopal Priest and former Navy Chaplain.

Grace Koshida
Environment Canada
Adaptation and Impacts Research Division
4905 Dufferin Street
Toronto, ON M3H 5T4, Canada
grace.koshida@ec.gc.ca

Tap Runs Dry: Managing Urban Water Supply Now and in the Future in Canada

The recently released Intergovernmental Panel on Climate Change (IPCC) Working Group I report has concluded that increased risk of drought will likely occur under future climate change. Urban drought (a type of socioeconomic drought) occurs when there is an adverse change in the urban water balance between supply and use. Recent events, such as the water crisis that occurred in Tofino, British Columbia, in 2006, highlight how the viability of water supplies in normally water-rich Canadian communities can be negatively impacted by severe drought conditions.

The “Tap Runs Dry” project identifies and recommends some adaptive options that could be used to extend the coping range and decrease the vulnerability of Canadian municipalities to future droughts and water supply shortages under climate change. This project focuses on evaluating temporal changes in urban drought impacts and adaptive responses. Southern Ontario, which contains approximately one-third of Canada’s population of 32 million, was chosen as the study region. Responses taken by water management organizations in some of southern Ontario’s larger municipalities to deal with water shortages are documented for four severe droughts that occurred from 1988 to 2005.

An inventory of water-related adaptations was created to identify both planned and reactive, as well as short-term and long-term, measures that were used as the droughts progressed. Typical responses to urban drought are to either decrease water demand and/or increase water supply. The vulnerability of communities to urban drought is affected by the water source used (i.e., Great Lakes, groundwater, river, combination of water sources), and other factors such as population growth, suburban sprawl, local capacity, and changing water demands by all users.

Typical drought risk management and responses at the local level include monitoring of drought conditions and municipal water supplies, drought planning and preparedness (Ontario Low Water Response (OLWR)), and water conservation programs (components include staged non-essential water use, bylaw enforcement, and appropriate public education initiatives). Sustainable long-term water supply plans (e.g., 50 years) should include provisions for projected climate change impacts on hydrology, water supply, and drought. Several long-term water supply plans for southern Ontario are assessed.

Some challenges regarding the selection of appropriate indicators of urban drought impacts are identified. The utility of programs such as the OLWR, which uses specific thresholds of precipitation and streamflow deficits to help communities cope with drought-related municipal water supply impacts and urban drought conditions, are discussed.

Douglas Pattie
Platform for Promotion of Early Warning
United Nations International Strategy for Disaster Reduction
10 Herman-Ehlers Strasse
Bonn, Germany 53113
pattie@un.org

**The International Early Warning Program:
A Multi-Agency Partnership for Development and Implementation of Operational Early
Warning Systems with a Multi-Hazard Approach**

There is a range of different early warning systems in existence, fulfilling different functions and designed to fit different natural hazard threats. These include food security and famine, drought, avian flu, tsunamis, hurricanes, volcanoes, and wildland fire, among others. After the 2004 Indian Ocean tsunami, an international call for establishing a suitable framework for advancing a global multi-hazard early warning system as an essential risk management tool led to the establishment of the International Early Warning Programme (IEWP). The IEWP was formally launched at the World Conference on Disaster Reduction in January 2005 and is guided by the goals, objectives, and priority actions of the Hyogo Framework for Action (UN/ISDR 2005). The IEWP is dedicated to reducing the impact of natural hazards through establishing effective “people-centered,” multi-hazard early warning systems.

The IEWP aims to improve resilience of people to all types of natural hazards and to reduce disasters’ negative impact on human lives and livelihoods. The IEWP’s five areas of work are:

- 1) Better integration of early warning (and related disaster risk reduction and management) into development processes and public policies
- 2) Improved data availability for investigating, forecasting/predicting, and managing risks on different time scales
- 3) Improved capacities and strengthened early warning systems, particularly in developing countries
- 4) Development of people-centered warning systems
- 5) Mechanisms for sustaining the early warning dialogue and supporting the development and implementation of a program

To achieve a multi-hazard approach, the problems of fit, scale, and interplay of the systems must be considered, along with the over-arching issue of formal systems (technology-based, western) integrating with the informal (traditional indigenous knowledge) systems. The major challenge for the multi-hazard approach to early warning is how best to integrate systems operating at different points and at different scales in order to provide a better and more coordinated and comprehensive system, all while retaining the ability to address individual specific hazards.

Keith Porter
California Institute of Technology
1200 E California Blvd MC 104-44
Pasadena CA 91125-4400
(626) 233-9758
keith@cohen-porter.net

OpenRisk: Open Source Risk Estimation Software

Risk analysis is a critical link in the reduction of death and destruction due to earthquakes. Recognition of this has led to a rapid rise in demand for accurate, reliable, and credible risk analyses. A bottleneck exists, however, between the wealth of high-quality scientific data generated by researchers, and the demands of end-users; that bottleneck is the dearth of readily available, user-friendly transparent risk analysis software to meet the wide variety of end-user needs. This situation, of strong demand for user-adaptable software, has emerged in many fields and has been met by the open source movement, with solutions such as Linux, OpenOffice, Mozilla, and Wikipedia. This trend is also strong in the seismic arena, as evidenced by the emergence of OpenSHA and OpenSEES serving critical parts of the field. Open source risk (OSR) software meets this demand and also advances research and enhances training in a variety of catastrophe-related disciplines.

This presentation introduces *OpenRiskSM*, including two initial software applications. OpenRisk comprises a growing set of OSR applications for quantifying risk to individual facilities and portfolios of facilities in terms of probabilistic repair costs, human casualties, and loss of use (“dollars, deaths, and downtime”). OpenRisk’s initial development focuses on seismic risk to individual facilities via traditional loss-estimation algorithms, with subsequent developments addressing multi-hazard risk, risk to groups of two or more facilities (“portfolio risk”), and eventually PEER-style performance-based earthquake engineering analysis. Work to date has provided a development roadmap for OpenRisk, including a brief overview of the fields of loss estimation and performance-based earthquake engineering (PBEE), a review of existing loss-estimation and PBEE software, a mission statement for OpenRisk, and a proposed development approach. We have documented various risk algorithms—the mathematics needed to calculate risk—as a major next step towards programming. An initial list and summary specification of software objects employing these algorithms have been developed, along with draft development guidelines; initial data structures; and a seed database of structure types, seismic vulnerability functions, and damage probability matrices. OpenRisk is anticipated to develop dynamically, with releases and feedback requests available online at www.risk-agera.org.

Wendy Saunders
GNS Science
1 Fairway Drive
PO Box 30368
Lower Hutt 5010
New Zealand
+64 4 570 4802
w.saunders@gns.cri.nz

Guidelines for Assessing Planning Policy and Consent Requirements for Landslide-Prone Land

GNS Science has developed a guideline to assist land use planners with the development of landslide-prone land. The guideline was drafted over a two-year period, with both geotechnical and planning input. This joint approach ensured that technical landslide information required by planners to make sound decisions can be provided by the geotechnical community. This approach has ensured support for the guideline from both the planning and geotechnical professions.

The guideline emphasizes a risk-based approach, based on the joint Australia/New Zealand Risk Management Standard 4360:2004, common to both the planning and geotechnical communities. This common ground provides a framework that benefits both parties, and should, in turn, deliver safer communities. Planners are more aware of landslides and how they need to be considered in the development process. The geotechnical community will become aware of planning needs, and what information is required to follow the guidelines when undertaking planning project investigations.

The guidelines can be viewed at www.gns.cri.nz/news/release/lsp prone.html.

Charles Scawthorn
Kyoto University, Katsura Campus
Department of Urban Management, Room 137
Cluster C-1
Nishikyo-Ku Kyoto, 615-8540 Japan
+81-75-383-3249
cscawthorn@att.net

Open Risk Analysis

To manage risk from natural and technological disasters (earthquakes, hurricanes, industrial accidents, etc.) and to understand the potential impacts of new disaster science or policy, access to analytical and computer risk models is required. Risk models are constantly in flux as science, engineering, and disaster social science develop, and many researchers and practitioners lack the risk-integration tools and methods needed for an overall understanding of risk. As such, they must either re-develop existing integrative software or abandon potentially fruitful study. Current end-to-end risk models have been developed in a hierarchical paradigm and can't nimbly respond to emerging knowledge and data. In response, a new paradigm of open risk analysis (ORA) is emerging, fostered by an international *Alliance for Global Open Risk Analysis* (AGORA, www.risk-agera.org), which held an international workshop in February at the California Institute of Technology. This session describes the AGORA Framework and selected current ORA initiatives, and includes an open panel discussion on ORA needs and opportunities.

Mosese Sikivou
Pacific Islands Applied Geoscience Commission
Private Mail Bag
Suva, Fiji
(679) 330-2563
mosese@sopac.org
www.sopac.org

Developing Disaster Risk Management National Action Plans for Pacific Island Countries

In October 2005 the Pacific Islands Forum, comprising the Heads of Government of Pacific Islands Countries, endorsed the *Pacific Disaster Risk Reduction & Disaster Management Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disaster* (Regional DRM Framework). The Regional DRM Framework is the Pacific adaptation of the Hyogo Framework for Action, which was approved by world leaders that attended the Second World Conference on Disaster Reduction held in Kobe, Japan, in January 2005.

The challenge facing Pacific countries is to ensure the development and implementation of DRM National Action Plans that would facilitate the mainstreaming of disaster risk reduction and disaster management within countries at the national, local, and community level; thus effectively increasing the safety and resilience of Pacific countries and communities.

The work on developing the DRM National Action Plans has been assisted by the establishment in February 2006 of the Pacific Disaster Risk Management Partnership Network (Partnership Network). The Partnership Network is an open-ended partnership of about 30 regional and international organizations that are active in disaster risk management in the Pacific. The members of the Partnership Network have agreed that a major priority focus would be to provide technical assistance and resources to Pacific countries to help develop and implement DRM National Action Plans.

The Pacific Islands Applied Geoscience Commission, or SOPAC, is the lead facilitator of the Partnership Network. SOPAC would like to extend the membership of the Partnership Network to include U.S.-based organizations and agencies that may be able to assist Pacific countries in the development and/or implementation of DRM National Action Plans. To date, assistance in this regard from the Partnership Network has been provided to the Republic of Vanuatu (June 06–present) and to the Republic of the Marshall Islands (December 06–present). Other Pacific countries identified to receive support from the Partnership Network in the near future are Samoa, Cook Islands, Solomon Islands, and Papua New Guinea.

Nathan Slaughter
PBS&J
1616 East Millbrook Road, Suite 310
Raleigh, NC 27609
nslaughter@pbsj.com

Pre-Disaster Planning for Post-Disaster Recovery in Beaufort County, South Carolina

While there are plenty of examples of successful planning for disaster recovery and reconstruction, these efforts have often taken place in the immediate aftermath of a destructive event. Beaufort County, South Carolina, is one of the few communities that has seriously engaged in such planning and decision making before disaster strikes.

Beaufort County, one of South Carolina's most rapidly developing counties with a population of 137,849 (2005), experienced a 40 percent increase in population from the 1990 to 2000 Census. With this growth comes development and increased exposure in one of the state's counties most vulnerable to hazards. The county is located on the Atlantic coast of South Carolina and is susceptible to flooding, erosion, and wind hazards associated with hurricanes, tropical storms, and nor'easters.

Following Hurricane Katrina, local officials in Beaufort County began asking tough questions about their own disaster recovery procedures. Have we thought through the temporary and long-term housing issues we might face? How will we get tourists back into the area after an event? Are we prepared to handle debris removal? How will we handle reconstruction issues and the massive permitting and inspection process following a disaster? The more questions they asked, the more strongly they felt that they needed to develop a disaster recovery plan to help them assemble and refine the policies and procedures that had already been adopted to address recovery issues, as well as to develop new ones that they had not previously considered.

Over a six month period, from May 2006 to November 2006, Beaufort County staff members and interested stakeholders organized a Disaster Recovery Planning Committee and held an intense series of meetings between key county departments, stakeholders, and each of the municipal jurisdictions within the county. The resulting disaster recovery plan outlines and addresses 24 short- and long-term recovery issues that the county felt could potentially be faced following a disaster.

The general purpose of the plan is to establish the mechanism to help Beaufort County return to pre-disaster conditions following a natural disaster. The vision statement developed for the plan was, "To guide local officials in coordinating and implementing successful short-term and long-term recovery activities following a natural or manmade disaster."

Program and Project Abstracts – PP07-20

Following completion of the plan, the county developed the Disaster Recovery and Reconstruction Ordinance. The ordinance captures and codifies the main procedures and policies identified throughout the plan, such as the county's recovery management structure and recovery procedures, including emergency permitting and zoning policy and procedures. By officially adopting the Disaster Recovery Plan and Disaster Recovery and Reconstruction Ordinance, the Beaufort County Council will be able to expedite the recovery process by authorizing certain extraordinary governmental actions to be taken during a declared local emergency or disaster.

With the time and effort spent on decision making up front and before disaster strikes, the county will have the ability to focus on meeting the needs of disaster victims in a much more timely and effective fashion following the next disaster.

Christopher Tucker
Reducing Risk from Natural Hazards
Natural Resources Canada
Earth Science Sector
Room 479 - 601 Booth Street
Ottawa, Ontario
CANADA, K1A 0E8
(613) 943-4245
cmtucker@nrcan.gc.ca

**Reducing Risk from Natural Hazards:
A Progress Report from Natural Resources Canada**

Natural Resources Canada (NRCan) has established a relatively new program within its Earth Science Sector (ESS): “Reducing Risk from Natural Hazards” (RRNH). Aimed at providing a framework for focusing our “traditional” science work (earthquakes, landslides, volcanoes, geomagnetic storms, etc.) with more user-based risk reduction methods and tools, the program uses this latter focus to further emphasize the importance of hazard information for informed decision making. Through work with other federal to community-based agencies and institutions, we are developing partnerships to transform the geohazard information core into knowledge used at the community and community-of-practice level for the creation of more sustainable and disaster-resilient communities. This is fundamental for sound decision making and policy development that resonates with local risk tolerances and economic realities. The RRNH program has five inter-related projects, each with numerous activities. They include the following: Western Canada Geohazards Assessment (WCGA), Eastern Canada Geohazards Assessment (ECGA), Space Weather Hazard Assessment (SWHA), Risk Assessment Methods (RAM), and Geohazard Awareness (GA).

A primary concern for the RRNH program is to identify and describe, in an accurate and integrated manner, the hazards that are principally located in areas of high urban density and/or critical infrastructure elements. To this end, we have developed activities that will address the understanding of high consequence and low frequency events. This work is essential for the refinement of national mitigation and risk reduction policies and programs. RRNH is also assessing geohazard events of lower national consequence, but higher frequency, in areas where we can successfully transfer knowledge to help address local and regional vulnerabilities. Our contribution will be increased understanding of hazard processes and intensity, in time and space.

Our Risk Assessment Methods project builds on the existing ESS project “Pathways,” where risk reduction methodologies and decision support tools are already being developed and implemented in cooperation with the U.S. Geological Survey. The process uses commercial, modified, and in-house designed software packages as mechanisms to help communities with risk reduction strategies. These decision support tools, along with direct geoscientist involvement in the process, provide effective ways of integrating and presenting complex, geological, and multi-hazard social and economic information. Compelling results, presented in graphical ways and incorporating geoscience

knowledge, help ensure that critical information is considered throughout the decision making process.

Presentation of integrated multi-hazard information in ways appropriate and useful for the various target user groups has been essential, particularly at the community level. But the overall approach presents a greater challenge for federal and regional agencies in Canada. Expanding lessons learned, refining the decision support toolkit, and developing processes that are applicable to a large number of communities, as well as on more regional scales with a broader range of hazards, adds significant complexity.

A third focus of our program is to enhance the current state of natural hazards awareness and to satisfy the requirements of emergency management professionals, community planners, decision makers and educators. We intend to broadly transmit our newly developed hazard assessments, risk methods, and tools to these end users, ensuring there is a fuller understanding and uptake of their utility.

This presentation will provide the audience with an overview and progress report of NRCan's risk reduction program, the results of pilot projects to date, as well as an introduction to the decision support toolkit and its applications.