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The medium and message—making building warnings meaningful

An invited comment by Erica Kuligowski

Emergency communication in buildings can fail at several points. In addition to instances where communication systems are rendered inoperable as in World Trade Center One on September 11, 2001 (Averill et al. 2005), there are times when communication systems are used improperly.

Examination of disasters shows links between insufficient, excessive, inaccurate, conflicting, or uncertain information and occupant confusion in building emergencies. Simply providing alarms does not give people enough information to determine what is happening. As a result, people can't make appropriate response decisions (Proulx 2000).

There is a glaring disconnect between the adoption of new and emerging communication technology and the requirements established for the use of these systems in building emergencies. Emergency notification systems have been

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INSIDE ...

Quakes on the continental interiors are most deadly

Tsunamis outside, shaking inside

Earthquakes on the continental margins get all the attention, but the ones in the continental interior cause the most deaths, according to a paper published online on May 22 by *Nature Geoscience*.

"The 11 March 2011, Mw 9 Tohoku earthquake contains a remarkable story of resilience," write Philip England and James Jackson of the universities of Oxford and Cambridge, respectively. "Neither the continuing hazard posed by the aftereffects of the shaking and tsunami nor criticism of the methods for long-term forecasting of earthquakes in Japan should blind us to the fact that the death rate in this disaster was impressively low."

The quake exposed more than six million people to intense shaking, but only 25,000, or about 0.4 percent, died in the disaster, and most of those were from the resulting tsunami, not the direct shaking of the quake itself. "In striking contrast," the authors write, "death rates in earthquakes within continental interiors have often exceeded five percent, and can be as high as 30 percent."

During the past 120 years, there have been about 130 earthquakes that killed a thousand or more people. Of these, about 100 were in the continental interiors. The quakes in the interior have killed 1.4 million people, while quakes on the plate boundaries caused 800,000, about half of which were from resulting tsunamis.

Despite the fact that continental interior quakes are the most deadly, little is known about the web of faults on which they occur. On plate boundaries, the faults are well mapped. Interior continental quake zones may may be hundreds or thousands of kilometers wide and contain a web of many faults, most of which are unknown and unmapped.

"Devastating earthquakes in the continental interiors, such as those in Bam, Iran in 2003 (30,000 deaths), Muzzafarabad, Pakistan in 2005 (75,000 deaths) and Wenchuan, China in 2008 (70,000 deaths), frequently take place on faults that were either previously unknown, or whose threat had not been recognized. The severity of this threat is increasing rapidly as millions of people every year migrate into megacities in vulnerable locations, many of which were devastated by earthquakes in the past, when their populations were much smaller," they write.

The highest scientific priority should be to map these unknown seismic hazards," England and Jackson write.

Haiti death toll may be lower than original reports

Dueling data from U.S., UN

A U.S. government report says the death toll from the January 2010 Haiti earthquake was considerably lower than official Haitian government figures, according to the Associated Press.

The news agency obtained a draft U.S. government report that found the death toll to be about 60,000 people, not the 316,000 the Haitian government counted. In addition, the report concludes that no more than 375,000 people are still living in temporary settlements, not the 680,000 estimated by the United Nations International Organization for Migration.

Timothy Schwartz, an anthropologist, led 20 researchers to come up with the new estimates. Teams interviewed nearly 5,200 people in Port-au-Prince, asking them more than 100 questions each, including how many people were killed in area buildings, and what happened to the survivors.

"Intellectually, I really don't care how many people got killed in the earthquake," Schwartz wrote to AP. "But in terms of the tragedy, less is better. And at about 60,000 dead, it is still a huge tragedy."

A UN spokesman defended their estimates of those remaining in the displaced persons camps, however. "They have a powerful methodology," Leonard Doyle told AP. "But we are 100 percent confident that the people we counted are living in the camps."

How are species invasions like natural disasters?

Management lessons across disciplines

Three times in the fall of 2007, massive floating mats of algae on Lake Ontario clogged the coolant water intake filters of New York's James A. Fitzpatrick nuclear power plant, forcing it to shut down. The algae invasion was the result of the activities of two Eurasian freshwater mussel species which have invaded the Great Lakes since about 1990.

The zebra and quagga mussels are non-native invasive species which, according to the U.S. Geological Survey, "are notorious for their biofouling capabilities by colonizing water supply pipes of hydroelectric and nuclear power plants, public water supply plants, and industrial facilities. The shutdown at Fitzpatrick cost between $1.5 million and $2 million a day, according to U.S. government estimates.

Invasions of non-native biological species are not conventionally considered to be "natural disasters." But the invasion of alien species into new environments has many of the characteristics of natural disasters and could be managed in similar ways, according to Canadian researchers in the April 2011 issue of *Bioscience* (www.biosciencemag.org).

"Preventive management of invasions—like that of natural disasters—requires international coordination of early warning systems, immediate access to critical information, specialized training of personnel, and rapid-response strategies," write the University of Toronto's Anthony Ricciardi and colleagues.

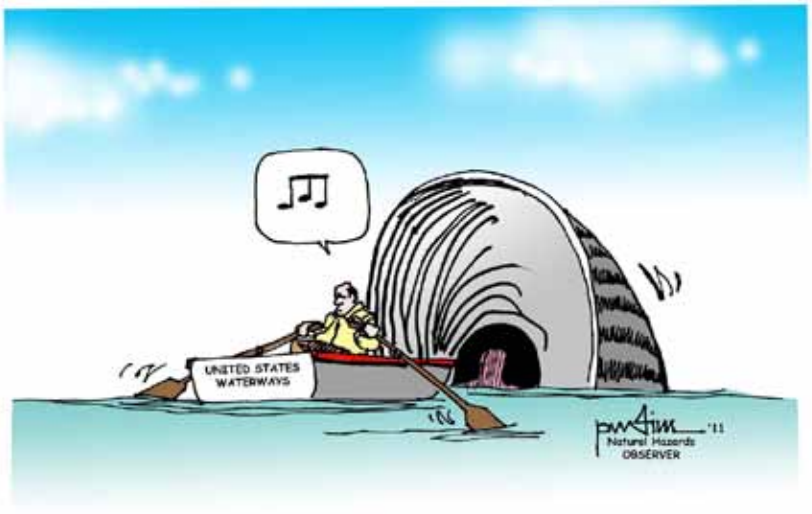
Alien species invasion have several similarities to events that are more typically thought of as natural disasters. They are difficult to control and predict. Their dynamics resemble other catastrophes. For instance, most species invasions have only minor impacts, while some are catastrophic. "For example," they write, "native population extinctions attributable to invasions are rare but of great concern to ecologists. In terms of their magnitude and frequency, invasion-mediated extinctions exhibit a negative power-law distribution like that found for natural disasters." A negative power law distribution means that small events are more likely than large ones, to some mathematical exponent (in this case −0.97).

Biological invasions also resemble disasters in high-tech industries like nuclear power, petrochemicals, and aerospace. The paper says that, like these high-tech catastrophes, invasions are generally inevitable, they are subject to hidden interactions, and their timing and magnitude are largely unpredictable because of the tight coupling anthropogenic and ecological systems.

The paper also attempted to compare large-scale disasters in five different criteria: predictability, human lethality, area affected, onset delay, and persistence of effects. Biological invasions were the most disastrous to humans in three of the five categories—human lethality (when pathogens are considered), area affected, and persistence of impact.

While the authors point out that not all invasive species are undesirable, damaging ones can be very expensive. A single invasive insect, the emerald ash borer, "is projected to cost the United States $10 billion during the next decade," the authors write. Globally, the cost of invasive species has been estimated as high as $1.4 trillion.

The essential elements of disaster preparedness should be applied to biosecurity issues, the authors say. These include vulnerability reduction, rapid response and assessment, access to reliable information, and coordination among authorities.



They Said It ...

"Cairo. I've been there. Trust me. Cairo … Have you been to Cairo? OK, then you know what I'm saying then."—*Missouri House Speaker Steve Tilley, when asked on April 28 whether he's rather see 130,000 acres of Missouri farmland flooded, or the small, mostly African-American town of Cairo, Ill., quoted on* ***Huffington Post****.*

"This court finds that the corps is committed to implementing the (floodway) plan only as absolutely essential to provide the authorized protection to all citizens. Furthermore, this court finds that no aspect of the corps' response to these historic floods suggests arbitrary or capricious decision-making is occurring."—*U.S. District Judge Stephen Limbaugh Jr., on April 29 allowing the U.S. Army Corps of Engineers to breach the levee that would flood 130,000 acres of Missouri farmland, protecting Cairo, Ill., quoted by the Associated Press.*

"We are experiencing the worst drought we have seen in decades; since the beginning of March, we have buried 54 people who died from the effects of the drought, seven of them today [20 April]."—*Ali Barow, leader of the small town of Guulane, 220 kilometers (137 miles) northeast of Mogadishu, Somalia, quoted by IRIN.*

"With up to 40 million pastoralists across the African region, each pastoralist has to be an innovator to some degree to adapt to climate variability."—*Fatema Rajabali, the climate editor of Eldis, an online knowledge service provided by the U.K.-based Institute of Development Studies.*

"According to climate reports, whose accuracy has been verified, European countries are using special equipment to force clouds to dump their water on their continent. They prevent rain clouds from reaching regional countries, including Iran."—*Iranian President Mahmoud Ahmadinejad, quoted by AFP.*

Disaster tolerance forms cultures

'Tight' nations face more threats

The risk of natural disasters is one factor that helps to determine whether a culture has strong behavioral norms and low tolerance of deviant behavior, or weak norms and a high tolerance for individualism, according to a paper in the May 27, 2011 issue of the journal Science.

The international research group, led by the University of Maryland's Michele Gelfand, collected data from 33 nations to find out which factors influence whether a society is more open or more closed. One of the findings—among many factors—is that "tightness-looseness is afforded by ecological and human-made societal threats (or lack thereof) that nations have encountered.

"Ecological and human-made threats increase the need for strong norms and punishment of deviant behavior in the service of social coordination for survival—whether it is to reduce chaos in nations that have high population density, deal with resource scarcity, coordinate in the face of national disasters, defend against territorial threats of contain the spread of disease," the authors write.

Between the years 1500 and 2000, "tight" nations faced "more disasters such as floods, tropical cyclones and droughts and have had more territorial threats from their neighbors."

Past studies have looked whether natural disasters can contribute to civil unrest in nations (*Natural Hazards Observer* March 2009). There has been increasing concern that the changing climate will add to the existing pressures in societies. In The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change from the Center for Strategic and International Studies, the authors write that even under the lowest expectations for climate change by 2040, an average global temperature increase of 1.3 degrees Celsius, "National security implications include: heightened internal and cross-border tensions caused by large-scale migrations; conflict sparked by resource scarcity, particularly in the weak and failing states of Africa; increased disease proliferation, which will have economic consequences; and some geopolitical reordering as nations adjust to shifts in resources and prevalence of disease. Across the board, the ways in which societies react to climate change will refract through underlying social, political, and economic factors."

The recent research indicates that "tight and loose cultures may be, at least in part, functional in their own ecological and historical contexts."

Two hats, one hazard

An invited comment by Joseph Scanlon

I first encountered one version of what I call the "two hat phenomenon" when some students and I were studying a train derailment, toxic spill, and fire that led to a partial evacuation of Petawawa, Ontario, a small town a few hours' drive up the Ottawa Valley from where I live in Canada's capital, Ottawa.

The local volunteer fire department found dealing with the incident too much to handle alone, so they called for assistance. Among the departments that responded was the one from Canadian Forces Base Petawawa. However, many of the professional firefighters at Base Petawawa are also volunteer firefighters in the town. Some found themselves doing a 12-hour shift for the base fire department, then changing hats and doing another 12-hour shift as town volunteers.

I soon became aware that what I saw in Petawawa occurred in other places. There's also another, even more significant, two hat problem—when partners in a relationship both have emergency-related responsibilities.

Once I became aware of the phenomenon, I noticed other examples.

For example, when an ice storm struck eastern Canada in January 1998, it left one-seventh of Canadians without power—and 65 communities in my region declaring a state of emergency at the same time. Some city firefighters were also leaders of volunteer departments in the small nearby communities where they lived. Those volunteer departments were a key resource in those communities because they were usually the only agency with a portable generator. The firefighters found themselves trying to do two jobs at the same time.

People cope

Usually those with two hats find a way to handle the dual demands. However, in one community, a police officer—with the permission of his sergeant—had become a volunteer firefighter. Since the officer was also an arson investigator, his involvement with the fire department was seen as a way of making contacts that would enhance his police assignment. But when an emergency struck that called for both agencies to be involved, his sergeant told him that he had to stick to police work until the emergency was over. Fortunately other volunteers were available, but clearly emergency agencies can run into trouble when their members have other high priority commitments.

This is not just a concern for those in frontline agencies such as police, fire, ambulance, and hospital. When scores of commercial flights were diverted to Newfoundland after the September 11 terrorist attacks on the United States, there were no fires, no crimes, and few medical problems. But many organizations were involved in the emergency response—church groups, school teachers, school bus drivers, the Salvation Army, the Red Cross, the military, the local fire department, the Royal Canadian Mounted Police, community social services, the telephone company, airport staff, and even the staff at the local hockey rink (which was used as a cool place to store perishables). Inevitably, some people belonged to more than one of these organizations.

While the conflict that occurs when one person has two emergency roles can usually be sorted out, the conflict that occurs when both partners in a relationship are called to respond to an emergency is more difficult to resolve.

There was a time when many women in the workforce were single, largely because most single women stopped working when they married. So when there was a desperate need for volunteers during the 1918-20 influenza pandemic, some volunteers were married women who had important positions before they were married. Many others were teachers. The woman who ran the emergency hospital in the library in Kenora in Northern Ontario, for example, was the former superintendent of the Kenora's Jubilee Hospital. The volunteers who assisted her were mainly single women, including teachers.

Once the town ordered all public facilities such as churches, theaters, and schools closed, they were free to assist.

The current situation is different—for two reasons. First,

married women often work. Second, the number of women in many emergency agencies is increasing. My eldest daughter, for example, is a school teacher with two children. If the schools were closed she would not be available as a volunteer unless her husband or someone else was able to look after her children.

As these situations become more prevalent, agencies preparing emergency plans need to start determining what other responsibilities their personnel have and how they might affect the demands of the organization. They also need to know if a staff member shares care giving responsibilities with someone who is also in the emergency field.

But neither my daughter nor her husband belongs to an emergency agency. What happens when life partners have both child or family responsibilities as well as emergency responsibilities? What if, for example, one partner is a firefighter and the other a nurse? What if one is a police officer and the other a paramedic? What happens in an ice storm when there are massive power outages and one partner works for the power utility and another is employed by the local transportation agency responsible for salting and sanding the roads?

I've found numerous examples:

- A nurse on emergency duty was called in to deal with wounded police officers while her husband, a police officer, was responding to the same incident;
- A woman who was assistant to the chief medical officer in a community where several hundred persons had died in an air crash was married to a police officer who was dealing with body recovery and identification;
- A nurse who was administrator of a nursing home which had been partly evacuated during a flood was married to a man who, as a coordinator of community social services, was responsible for finding shelter for evacuees.

Couples like these usually have arranged child care to cover their normal working hours, perhaps making sure they are on opposite shifts. But these arrangements may not be sufficient for the extended demands of an emergency.

Agencies can prepare

As these situations become more prevalent, agencies preparing emergency plans need to start determining what other responsibilities their personnel have and how they might affect the demands of the organization. They also need to know if a staff member shares care giving responsibilities with someone who is also in the emergency field.

Child care isn't the only issue. There are those who have responsibility, for instance, for elderly parents. In an isolated mill town, the elementary school principal was supervising a school evacuation while he was also trying to assist his elderly parents, who happened to be visiting and were also being evacuated. They had no other community contacts and were bewildered by what was happening.

If we are going to face up to the changing nature of society we need to take several steps.

First, individuals need to assess their ability to participate in an organization during an emergency and communicate that to those concerned. A nurse might enjoy being a scoutmaster, but he can't guarantee he'll be available if the scouts are asked to assist in an emergency (which happened in a catastrophe we studied). A firefighter can take part in a church group, but should say she won't be available if the church becomes a shelter for evacuees.

Second, individuals should be asked to work out arrangements allowing both partners to respond should that become necessary. That may mean finding others who will look after children or elderly parents and having a clear understanding how they will do that during an extended emergency. It will mean checking to make sure those who agree to do that do not have other commitments of their own.

Third, emergency agencies may have to start doing personnel planning together. It is possible that in certain types of emergencies, some agencies will be more involved than others. For example, incidents with significant injuries require medically trained personnel, while those with mainly dead victims, such as some air crashes, won't. An attempt to discuss such situations could lead to closer liaison among the various agencies. Perhaps they can agree on which agency will get priority for critical personnel under certain conditions. Perhaps they can cooperate in establishing special child care facilities in a crisis.

My guess is that some agencies assume their needs will get priority in an emergency—and that they do so without considering priorities. We all know that different types of emergencies create different demands. Police, for example, assume their presence in an emergency is critical for public safety. Yet we know that such resources are often deployed to deal with issues such as looting that are not a problem. Often, the real demand is not for police, but for social service support.

My guess as well is that most agencies assume that women will take care of family responsibilities, while the men will be available. This kind of male chauvinism must disappear. In the modern era, more women are involved in agencies such as police departments while more men are taking up child-care responsibilities.

Reducing impacts

While I don't have clear-cut solutions for the two hat problems, I do have some thoughts about what must be done to reduce their impact during an emergency.

First, all adults in the household should assess their emergency responsibilities and discuss them with their employers. They also must make sure they understand their partner's responsibilities and how these might affect their own situation—and they must call any issues to the attention of their employers.

Second, emergency agencies must start paying more attention to the personal concerns of their staff. It is no longer sufficient for each agency to assume its needs will take priority.

I suspect that when individuals and agencies start exam-

ining the two-hat problem they will learn things that had not occurred to them. For example, when SARS struck, it called attention to the fact that some part-time nurses were working shifts in two hospitals—some where SARS patients were being treated, and others that were disease-free. There is nothing prohibiting nurses from doing work at more than one hospital. During a disease outbreak, though, the arrangement could lead to the possibility of disease transmission.

I hope readers will be satisfied that I have raised legitimate concerns. They will also be aware that my suggestions for solutions are largely generalizations. One reason for the lack of specific solutions is that I believe the first step toward solving a problem is identifying it. I think two hat situations will become more and more common and it is time we started thinking about constructive ways of dealing with them.

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Warnings ...

(Continued from page one)

installed in many buildings and building campuses in the United States to allow building officials to communicate with occupants before, during, and after emergencies.

The 2010 *U.S. National Fire Alarm and Signaling Code* outlines requirements for the application, performance, and installation of emergency communication or mass notification technology (NFPA 2010), but these requirements only address message delivery, not content. Little guidance is available to ensure effective emergency communication, including message content and length, speaking tone and rate, and frequency of delivery.

Information transfer

Without guidance, messages might not be useful when a disaster is unfolding. Message providers are usually building managers or other safety personnel with busy schedules.

They might not have the time or institutional support to attend training sessions or to perform research on public warnings. In most instances, messages are "created" moments before dissemination with little or no understanding of effective public warning techniques.

Providing individuals with too much information can be confusing, as well, especially in this age of electronic media. Too much information can mislead individuals about which steps are most important to take and inaccurate or conflicting information is detrimental to public response. For instance, incidents have been reported of occupants receiving messages sending them to the building's floor that's on fire or telling them to stay and then immediately instructing them to evacuate (Kuligowski and Hoskins 2010).

In 2008, a fire broke out outside the first floor mezzanine walls of a 32-story U.S. office building populated by 4,400 people and more than 25 different companies. The emergency alarm system was a combination of voice and alarm with the capability of making live announcements to occupants. Because the building was so tall, a selective evacuation process that provided different pre-recorded voice messages to different floors was also incorporated. For instance, a specific "fire zone" message could be broadcast on the floor of alarm origin and to the floors immediately above and below. A simultaneous "safe zone" message would be broadcast to other floors.

"Shortly after the fire was detected, occupants below the fifth floor received the automatic, pre-recorded voice alarm message to evacuate the building," we wrote in our study of this incident. "Initially, occupants on the fifth through 32nd floors received the 'safe zone' message."

But less than five minutes later, "the fire alarm system received a second alarm initiated from a sixth floor fire alarm manual pull station which resulted in the fifth through seventh floor occupants consequently receiving a second automatic pre-recorded message. This message informed the occupants to evacuate down three floors and wait on that floor.

"In addition, occupants on the eighth floor and above also received a second automatic pre-recorded message that informed them that they were in a safe location and to wait for further instructions." About 15 minutes later a live voice announcement informed all the occupants to evacuate the building. In addition to the instructions, occupants received other environmental cues from the incident, including seeing smoke, especially below the eighth floor.

The right info, the right way

Messages like these can lead people into harm's way, rather than away from it. Warnings that contain unclear or uncertain information don't help. Alert colors and levels do not give enough information about what is going on and what steps must be taken (Drabek 2006). Warning systems have to provide the right information, the right way.

In 1990, more than 50 years of disaster-based social science research findings were synthesized to determine effective content of warning messages and dissemination during an emergency (Mileti and Sorensen 1990). Mileti and Sorensen—and research since then—demonstrate that the message is one of the most important factors in determining warning effectiveness (Mileti et al. 2006). A successful message should communicate the danger, what's to be done, the location of the hazard, a timeframe for action, and who is providing the information. The style of the message is also crucial. A successful message is one that is specific, consistent, certain, clear, and accurate. Messages delivered frequently through the correct channels (ones that broadcast content rather than sounding an alarm or initiating a strobe), are more likely to initiate an appropriate response.

Even with these important findings, there remains an emergency communication problem in buildings. It is important for the "right" information to be disseminated so that it reaches individuals of all needs and conditions in a timely manner.

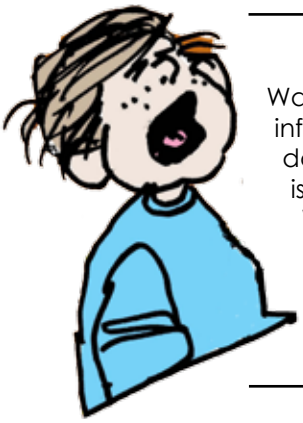
Populations receiving an emergency message can be a barrier to a successful emergency communication system. Distinct sections of any given population are likely to have difficulties perceiving, paying attention to, or comprehending a warning. In research on how to optimize fire alarm notification for high-risk groups, Gwynne identified various occupant types that could be vulnerable in emergencies, especially in message perception (2007). These occupants included individuals with sensory disabilities, such as hearing impairment or loss, visual impairment, or cognitive, thinking, or learning disabilities; the elderly; children; large groups; people who are alone; people who are asleep; intoxicated or sleep-deprived individuals; non-native speakers; and those engrossed in some particular activity when the alarm or warning begins.

Environmental distractions

Environmental distractions can also inhibit the effectiveness of emergency communication. In some cases, buildings have systems in place that regularly provide non-emergency information to occupants. Airports are an example. Occupants waiting at airline gates constantly receive audible and visual messages about departure information, seat changes, and delays. These regular messages can interfere with the ability to provide emergency messages and the ability of the message to grab occupants' attention because they might not differentiate the emergency message from regular messages.

The dynamic nature of hazards is another environmental concern. Changing disaster conditions inside or outside the warning area could require individuals to take safety actions other than those previously suggested. It could be complicated to change the message or update individuals on the latest appropriate action, especially if a previous message originally instructed them to perform a different action altogether.

Finally, the disaster can induce vulnerabilities for the gen-



Warnings that contain unclear or uncertain information don't help. Alert colors and levels do not give enough information about what is going on and what steps must be taken. Warning systems have to provide the right information, the right way.

eral population. Stress and anxiety during an emergency reduce the capacity for processing information (Chandler 2010; Keselman, Slaughter, and Patel 2005). When people spend a great deal of time in the same situation— their workplace, for example—and are accustomed to receiving the same information, sounds, smells, etc., they can sometimes neglect new information. In essence, people screen messages based on previous habits and conditioning (Chandler 2010).

Building codes and standards organizations need technically based guidance on message creation and dissemination for a full range of building emergencies. The Engineering Laboratory at the National Institute of Standards and Technology is currently working on a two-year project funded by the U.S. Department of Homeland Security to do just that for building emergencies likely to occur in the United States.

The project will include guidelines on structuring warning messages for different technologies, disseminating messages appropriately, and providing examples of the method with generic templates and canned messages for different emergency types. The first phase of this project is a literature review that outlines the current understanding of notification technology, dissemination approaches, and data on human response to warnings. The second phase will be the development of a best practices document.

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Resources

Below are brief descriptions of some of the resources on hazards and disasters that have recently come to the attention of the Natural Hazards Center. Web links are provided for items that are available free online. Other materials can be purchased through the publisher or local and online booksellers.

All of the material listed here is available at the Natural Hazards Center Library. For more information contact librarian Wanda Headley at wanda.headley@colorado.edu

ALL HAZARDS

Preparedness and Response to a Rural Mass Casualty Incident: Workshop Summary. By Kristin Viswanathan, Theresa Wizemann, and Bruce M. Altevogt, rapporteurs. 2011. ISBN: 0-309-17718-9. 144 pages. National Academies Press. Free download at www.nap.edu/catalog/13070.html.

Preparedness and Response starts out with a description of a 2008 Mexican Hat, Utah, bus accident in which nine people were killed and 43 injured that is especially chilling for its bloodless narrative tone. "About 8:02 p.m. … the motor coach departed the right side of the roadway … overturned … and came to rest on its wheels," it quotes from the National Transportation Safety Board report on the accident, which occurred after a ski trip to Telluride, Colorado.

The tragedy brought to a head need for an "integrated infrastructure capable of responding to mass casualty incidents that occur in rural settings," the report says. A workshop on the topic was organized, and this summary is the result.

Rural areas face unique challenges in mass casualty incidents, which are usually car wrecks, bad weather, or bus accidents. Even a relatively small number of victims can overwhelm facilities.

As with many emergency response scenarios, one central theme that emerged from this workshop was the lack of interoperability among communications systems. "Better communications and patient tracking can be a tremendous asset to everyone involved in a disaster response," the report says. "Interoperability with all responders, including across state lines, would be the ultimate resolution. Standardization for patient tracking systems would be another desirable outcome."

In addition to this theme, the participants addressed other issues and recommended areas for further research.

Crime and Criminal Justice in Disaster. Dee Wood Harper and Kelly Frailing, eds. 2010. ISBN: 978-1-59460-775-2. 356 pp. $38 (softcover). Carolina Academic Press. www.cap-press.com.

In the immediate aftermath of the 1906 San Francisco Earthquake, "those base wretches to whom plunder is always the first thought were as quickly engaged in seeking spoil in edifices laid open to their plundering hands by the shock," wrote observer Charles Morris. Some mine workers discovered a man robbing a corpse of its jewelry. They hanged the miscreant in a hotel entrance. Soldiers shot and killed another man who was cutting off the fingers of a dead woman to obtain her rings. Talk about the Wild West.

In the introductory chapter of this essay collection, the editors Frailing and Harper argue the mildly controversial conclusion that the data from history "counter the long held notion that looting only rarely occurs after natural disasters. In fact, crime of different types, from theft to murder, verifiably takes place in the wake of natural disasters."

But the book also observes that the immediate issue of looting and crime after a natural disaster is not the only impact. Existing criminal enterprises also get reorganized. There is a fascinating chapter on how illegal drug markets in New Orleans changed after Hurricane Katrina. They offer an example of "resilience" that perhaps most hazards researchers didn't have in mind.

The book concludes with a series of policy recommendations for a variety of subjects, including arranging for guarding cities before a disaster strikes if possible—as in a predicted hurricane landfall—preventing rape and fraud, and a number of other issues.

Geospatial Techniques in Urban Hazard and Disaster Analysis. Pamela S. Showalter and Yongmei Lu, eds. 2010. ISBN: 978-90-481-2237-0. 452 pp. $187 (hardcover). Springer. www. springer.com.

This volume is a compilation of research the use of geographic information systems in disasters. It looks at methods for creating models for sea level rise; studying atmospheric pollution, wildfire, and food security; applying GIS to management systems in response to earthquakes; using the technologies during hurricanes; and other disaster applications.

One of these studies concludes that geospatial techniques are not uniformly implemented during response and recovery to hurricanes, based on an analysis of Hurricane Katrina.

The editors note that the use of geospatial techniques in disasters has matured rapidly. As recently as 2002 "a book describing different methods applied to disaster research devoted one chapter to the use of a single type of geographic technology." And now we have this volume, with more than 450 pages, 151 illustrations and 21 chapters on the subject.

Institutions And Environmental Change: Principal Findings, Applications, and Research Frontiers. Oran R. Young, Leslie A. King, and Heike Schroeder, eds. 2008. ISBN: 978-0-262-74033-3. 373 pp. $28 (softcover). MIT Press. mitpress.mit.edu.

Institutions and their structures matter when dealing with environmental issues. Sometimes they cause problems; sometimes they solve them. This book addresses the issue of designing and sustaining institutions to deal with scientifically supported environmental goals, especially climate.

It won't come as any surprise that "there is a serious communications gap between science and policy in the global environmental change arena." the editors write. Science and policy should be better connected, through new institutions and institutional redesign. Obstacles to be overcome include "vastly different time horizons, lack of opportunity for scientists and policy makers to interact informally, and lack of knowledge about the policy making process and opportunities for scientific input."

The best way to design institutions to deal with complex environmental issues is via a "diagnostic approach," the book says. That is, identify the problems you want to deal with, assess the "overarching political setting," the major players, and the prevailing practices. Then build institutions that fit these criteria.

This is easily said, but difficult to accomplish. "Recommendations for institutional design must emphasize proposals that are realistic or feasible within the relevant sociopolitical setting. Yet changes that seem utopian under normal conditions may become feasible during 'windows of opportunity' brought about by economic, political, and social changes," the authors write.

Integrating Emergency Management Studies into Higher Education: Ideas, Programs, and Strategies. Jessica A. Hubbard, editor. 2010. ISBN: 978-0-9793722-4-7. 220 pp. $45. Public Entity Risk Institute. www.riskinstitute.org.

This is the conference proceedings of the Federal Emergency Management Agency's third annual Emergency Management Higher Education Conference. It covers a wide variety of topics important to educators, including curriculum, local strategies for disaster mitigation, long-term recovery, tribal emergency management and other topics.

One chapter of this book gives a snapshot of the emergency management community, including course enrollment and employment potential for graduates of university EM programs. The outlook is optimistic: "No longer is the community will to tolerate being put in the corner as it if is an afterthought or an aside. Its growing strength, identity, and momentum are both undeniable and seemingly unstoppable."

CLIMATE CHANGE

An Introduction to Climate Change Economics and Policy. By Felix R. FitzRoy and Elissaios Papyrakis. 2009. ISBN: 978-1-84407 –810-3. 224 pp. $33.30 (softcover). Earthscan. www.earthscan.co.uk.

The authors provide a sophisticated primer on the questions of economic growth and climate change, two issues that are often addressed in the popular debate as an "either-or" proposition.

"So how do our prospects for a sustainable future look so far?" the authors ask.

And they answer, "As every single dimension of global-level environmental health has deteriorated over the last few decades (from carbon emissions to water scarcity and deforestation), we are undoubtedly heading towards an environmental catastrophe. Without urgent and decisive policy measures targeting population levels, unsustainable consumerism and dirty technologies, there is no scope for optimism."

Sigh.

The authors attempt to address the issue not only of income and economic growth, but also wellbeing. "For those who are above the relative poverty line in any country," they write, "it is important to remember that income is far from the most important determinant of happiness or wellbeing. Unemployment and divorce are major causes of unhappiness, while family, health, social relationships and job satisfaction, together with largely inherited personality traits, are the most important factors influencing happiness."

It's probably no secret that being rich is good for you, as an individual. Whether it's good for the environment, or the planet, is another question, one which thinkers from Malthus onwards have considered with varying degrees of optimism. This book takes a more holistic approach to climate change and the economy than many, providing an excellent overview on the critical issues of climate, economics, and human welfare.

Cities And Climate Change: Policy Directions Global Report On Human Settlements 2011. By the United Nations Human Settlement Programme. 2011. ISBN: 978-92-1-132298-9. 62 pages (abridged edition). Earthscan. Free download at www.unhabitat.org/grhs/2011.

The robber Willie Sutton was once asked by a reporter why he robbed banks. Sutton allegedly responded, "Because that's where the money is." If someone asks why so many climate mitigation and adaptation studies focus on cities, the answer, *a la* Sutton, is "Because that's where the people are."

This UN publication explores little new ground in the climate debate. But it does make a compact and compelling summary of the challenges and promise of urban approaches to dealing with climate change. The refrain is familiar: reduce fossil fuel use; switch to lower carbon fuels; innovate in energy production. And of course, "The greatest responsibility for fighting climate change lies with developed countries."

Cities and Climate Change asserts uncontroversially that adaptation will have accompany mitigation in dealing with the world's new climate regime. It gently urges attention to land use activities, careful pricing of public services, infrastructure and resources, and cooperation among public and private entities to deal with urban issues.

Climate Change and Sea-Level Rise in Florida: An Update of the Effects of Climate Change on Florida's Ocean and Coastal Resources. By the Florida Oceans and Coastal Council. 2010. 36 pp. Free download at www.floridaoceanscouncil.org.

Floridians live literally and figuratively at the edge of the sea. Their environment includes not only the obvious ocean and Gulf vistas, but also a hidden edge, where the roads, waterworks, buildings, economy, and livelihoods interact with them. "Today, across the coastlines of the state, our infrastructure has extended as far out and as far down as we have been able to engineer," this report says.

With the changing global climate, however, the sea is making some unwelcome encroachments into these ecosystems and infrastructure. "For the past 20 years, the rate of global sea-level rise has been about 80 percent faster than the best estimate of the United Nations' Intergovernmental Panel on Climate Change Third Assessment Report released only a few years ago," the report acknowledges. "Recent estimates of melt-water contributions support a sea level in 2100 that is significantly than projected by the last IPCC, and the estimates indicate that sea level will continue to rise long after 2100."

This represents a significant issue for Florida. "Much of the current infrastructure of coastal Florida will need to be replaced or improved as sea level rises," the report says.

Florida's sea level rise probably presents unique problems in the United States, but it will be a bellwether for the rest of the country. The cutting edge of sea level rise might not be everyone's first choice of position. This report is worth looking at if only for the dramatic pictures of the changes in barrier islands and beach erosion that have followed major storms that made landfall in the state.

Engaging the Public with Climate Change: Behaviour Change and Communication. Lorraine Whitmarsh, Saffron

O'Neill, and Irene Lorenzoni, eds. 2011. ISBN: 978-1-84407-928-5. 320 pp. $81.96 (hardcover). Earthscan. www.earthscan.co.uk.

Are people "empty vessels," just awaiting the right information to change their behavior or suddenly support enlightened climate policies? Not likely, says this volume, and it's time to engage them on several fronts to deal with the pressing issues of climate change mitigation and adaptation.

The barriers between public understanding of the issue and scientific knowledge about it are regular topics on climate science Web sites. The consensus among scientists is nearly unanimous that global climate is changing and should be addressed. But in the United States, at least, polls regularly show only about 60 percent of the nonscientist public "believes in" climate change.

Part of the problem lies with the scientists themselves. While they regularly lament the ignorance of the public, they seldom include a portion of their grant funds to explain their eventual findings to the people at large. Funders would probably look askance at such puffery, anyway. And part lies with deliberate, self-interested confusion spread by advocacy groups.

This book addresses both the theoretical and practical frameworks for getting people to engage on this topic, understand it, and change their behavior. They urge a positive communication strategy rather than "fear messaging," delivered through trusted sources of information like neighbors and friends where possible.

"Whilst adaptation has been seen as a technical problem, requiring a technical solution, we echo the emerging climate resilience literature in viewing climate change as just one aspect of individuals' vulnerability," the editors write. "Instead of working from the top-down to quantify climate vulnerabilities, a bottom-up approach focusing on broader and more tangible goals … would provide a potent start."

Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change. Susanne Moser and Lisa Dilling, eds. 2008. ISBN: 978-0-52104-992-4. 576 pp. $62.20 (softcover). Cambridge University Press. www.cambridge.org

This volume is both comprehensive and eclectic. It includes academic studies of the public reaction to climate change stories, lessons from the atomic bomb era about communicating climate change, and the philosophical framework for dealing with the issue. The book's promotional material boasts that "the contributors come from a diverse range of disciplines, backgrounds, and experiences," which is true. But this is the second book I've reviewed about climate change communication in this issue of the *Observer* that doesn't include contributions from even one journalist who actually communicates scientific information to the public. There are 47 contributors to this volume about communicating climate change, but none is a working journalist. This seems odd. I don't want to pick on this book especially, though, because the same complaint can be leveled against *Engaging the Public with Climate Change: Behaviour Change and Communication* (above) though with a smaller number of contributors.

But once past this journalist's prejudice, *Creating a Climate for Change* offers a comprehensive and engaging look at the many issues surrounding the understanding of climate and the difficulty of changing people's habits. It's difficult to compress nearly 600 pages into a few paragraphs, but Anthony Leiserowitz in his essay offer four strategies for trying to get the problem through the thick heads of the public: highlight the local and regional impacts; emphasize that cliamte change is happening now; highlight health effects and extreme weather; and talk openly about remaining uncertainties.

There is a fairly large, well-funded public relations mill supported by the carbon-spewing industries that is dedicated to denying the human contribution to the changing climate, or downplaying its effects, or simply sewing confusion on the subject. But there isn't really any counterbalancing public relations mill on the other side. It costs money. While it talks a good game about reaching out to the public, the scientific, academic, and serious policy communities have not put their money into a public relations effort to counter this onslaught. Al Gore can't do the job alone.

Gender and Climate Change: An Introduction. Irene Dankelman, editor. 2010. ISBN: 978-1-84407-864-6. 312 pp. $32.75 (softcover). Earthscan. www.earthscan.co.uk.

Human endeavors interact with ecological processes. This runs in both directions, with humans working on the environment at the same time the environment works on humans. "Women and men have played diverse roles in this interface," writes Irene Dankelman. The authors in this volume explore these diverse roles.

"Gender mainstreaming in climate change is slowly taking shape in international climate change arenas," Dankelman writes in her introduction. "It is not only a question of having more women with different backgrounds participating and having a say in climate change negotiations and decisions at national and global levels, there is also a need for climate change policies and practices themselves to be sustainable and just. Or as Bella Abzug, former U.S. congresswoman and founder of the Women's Environment & Development Organization, once said: 'Women do not want to be mainstreamed into a polluted stream: they want the stream to be clear and healthy.'"

Global Climate Change Impacts in the United States: A State of Knowledge Report from the U.S. Global Climate Change Research Program. Thomas R. Karl, Jerry M. Melillo, Thomas C. Peterson, and Susan J. Hassol, eds. 2009. ISBN: 9780-52114-407-0. 192 pp. $52.45 (softcover). Cambridge University Press. www.cambridge.org.

Written for the public and policy makers, this report condenses what is known about the effects of climate change on the United States. Key findings—apart from the necessary but repetitive boilerplate that anthropogenic climate change is real and expected to increase—are that climate change will stress water resources as well as crop and livestock production. Coastal areas will be threatened by sea level rise, and energy transportation corridors in affected areas will see adverse impacts.

Human health impacts will result from heat stress, waterborne diseases, poor air quality, extreme weather events, and diseases transmitted by insects and rodents.

The report looks at impacts both by sector—water, health, society, ecosystems, and so on—as well as by geographic region. This latter reflects the latest trends in climate research, which is to try to make the effects of climate understood at the regional and local levels.

The report also attempts to point the way to future analysis. "A vision for future climate change assessments includes both sustained, extensive stakeholder involvement, and tar-

geted, scientifically rigorous reports that address concerns in a timely fashion,"the editors write. "The value of stakeholder involvement includes helping scientists understand what information society wants and needs. In addition, the problem-solving abilities of stakeholders will be essential to designing, initiating, and evaluating mitigation and adaptation strategies and their interactions. The best decisions about these strategies will come when there is widespread understanding of the complex issue of climate change—the science and its many implications for our nation."

RISK

Building Safer Communities: Risk Governance, Spatial Planning and Responses to Natural Hazards. Urbano Fra Paleo, editor. 2009. ISBN: 978-1-60750-046-9. 296 pp. $196 (hardcover). IOS Press. www.iospress.com.

Don't build in the floodplain. Build earthquake resistant buildings. Use your head.

Some of the simple rules of risk management are easy to outline, but hard to implement. This collection of seventeen papers from a variety of disciplines examines the issue of "spatial planning" in avoiding the accumulation of risk in the face of hazards. Natural hazards are unavoidable, the volume says, but the accumulation of risk is not.

In the opening essay, The University of North Carolina's Philip Berke and Gavin Smith note that while "knowledge about the causes and consequences of hazards is increasing … losses continue to rise dramatically." They present five sets of choices for communities to plan for mitigation to promote disaster resiliency.

This volume presents a thorough, balanced approach to community planning for disasters. It also steps a little outside the boundaries of the risk realm to discuss some of the philosophical approaches to environmental risk management, the precautionary principle, and the question of the human relationship with nature inherent in planning for hazard reduction.

HURRICANES

Culture after the Hurricanes: Rhetoric and Reinvention on the Gulf Coast. M. B. Hackler, editor. 2010. ISBN: 978-1-60473-491-1. 224 pp. $50 (hardcover). University Press of Mississippi. www.upress.state.ms.us/books/1285.

Whose culture is it? Or rather, which cultural rules obtain when rebuilding communities after a catastrophe like Hurricane Katrina?

"In envisioning a new New Orleans, the Urban Planning Committee produced a reasonably thought-out plan that nonetheless failed to take into account the values and interests of significant portions of New Orleans's population. The plan did not reckon with the willingness—indeed, eagerness—of those who wanted to return to their neighborhoods or with the suspicion of others that the new New Orleans of … [the] committee was not to their liking and was probably a well-packaged front for plans that would dispossess many people of their property and eject them from their neighborhoods," write Adelaide Villmoare and Peter Stillman in one essay in this volume.

Plans included reducing or prohibiting new building in flood plains that had suffered in Katrina. Some people's culture apparently includes living in floodplains, however, because they saw these plans as attempts to steal their land and their homes. On the other hand, as numerous hazards researchers have pointed out over a generation of research, the full cost of repopulating floodplains is not borne by those who live there, but by the society at large.

The survival and encouragement of "culture" necessarily demands an answer to the question of "whose culture?" The goals of white middle class residents in New Orleans may be very different from the African-American or Creole communities. "Contributors question the process of cultural planning by analyzing the language employed in decision making. They attempt to navigate between rhetoric and the actual experience of ordinary citizens, examining the long-term implications for those who call the Gulf Coast home," says promotional material for this book.

FIRE

Culture, Ecology and Economy of Fire Management in North Australian Savannas: Rekindling the WURRK Tradition. Jeremy Russell-Smith, Peter Whitehead, and Peter Cooke, eds. 2009. ISBN: 978-0-64309-402-4. 416 pp. $108.46 (softcover). CSIRO Publishing. www.publish.csiro.au.

Australia is becoming nearly as famous for its fires as its kangaroos, great white sharks, and the Sydney Opera House. This volume looks at fire management in the continent's tropical savannas, where about 18 percent of it is burned each year.

The book takes a multidisciplinary approach to fire management in northern Australia. The first part looks at the physical and historical makeup of the region, including the current economic situation and the relationship of the indigenous people to land and fire. The second section brings together "summaries of Western scientific understanding of fire regimes in the region's savannas and implications for regional and national goal in conservation."

One issue that the book addresses specifically is that the Australian approach to fire management has been shaped by experiences in the more populated areas of the nation, and in the urban-wildland interface. The savannas are sparsely populated, so some of this experience must be altered or discarded to enhance the cultural and ecological treasures of the north.

Fire, Chaparral, And Survival In Southern California. By Richard W. Halsey. 2008 (revised edition). ISBN: 0-932653-69-3. 232 pp. $19.95 (softcover). Sunbelt Publications. *www.sunbeltbook.com*.

This is an eminently readable book about one man's scientific and personal romance with California's chaparral ecosystem. Chaparral, says Richard Halsey, exists in every county in California. But there a number of misconceptions he wants to dispel. "Chaparral is not adapted to fire per se, nor is it a 'fire-dependent' ecosystem," he writes.

"Old-growth chaparral is a healthy, dynamic system and is not choking hillsides with 'decadent' or 'overgrown brush. Fire suppression has not led to an 'unnatural' accumulation of chaparral, leading to huge wildfires. Shrubs grow and big fires are unavoidable.

"Chaparral is not resilient to frequent fires," he writes.

And finally, "Wildland fires can not be extinguished by aerial drops of water or fire retardant alone."

All of these myth-busting assertions are carefully supported with scientific data, elegantly explained. This book is a must-read for everyone in California who has a chaparral ecosystem in her county—which is, I guess, everybody.

Contracts and Grants

Below are descriptions of some recently awarded contracts and grants related to hazards and disasters.

A risk-based model to achieve sustainable solutions for bridge infrastructure subjected to multiple threats. National Science Foundation grant #1055301. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1055301. Five years. $149,991. Principal investigator Jamie Padgett, Rice University, jamie.padgett@rice.edu.

This research will develop a new approach to bridge infrastructure enhancement where risks posed by multiple threats are mitigated while balancing broader goals of sustainability. Threats result not only in physical damage, but cascading social, environmental, and economic impacts that impair sustainability. In the proposed model, "Sustainable Solutions for Bridge Infrastructure Subjected to Multiple Threats," performance goals are driven by sustainability metrics, such as energy usage, life-cycle cost, and downtime, while ensuring safety.

The risk assessment tools for SSIMT are derived through an analytical research approach supported by field data, with case studies conducted with stakeholder input. Vulnerability models will be developed to uncover the complex coupled effects of storm surge, earthquakes, aging and deterioration, and increased demands on bridge reliability. This physical vulnerability will then be related to metrics of sustainable performance for specific social, environmental, and economic impacts, ranging from safety to downtime, and from life-cycle cost to energy usage.

The outcome of this research will be an integrative model to determine sustainable solutions for bridges exposed to multiple threats, benefitting the civil engineering practice, public at large, and new generations of students. Its application will yield bridges that are safer, more cost-effective, and require less energy or emissions throughout their lifetime.

Extreme weather events and emergency medical services: A discrete optimization modeling framework. National Science Foundation grant #1054148. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1054148. Five years. $427,325. Principal investigator Laura McLay, Virginia Commonwealth University, lamclay@vcu.edu.

This research investigates how to reformulate and reframe important service system models that have considerable social relevance by considering the fundamental decision issues within their social context. There are important resource allocation problems in emergency medical service systems. These include how to provide a coordinated EMS response to medical emergencies during extreme weather events.

In particular, the project investigates how to optimally dispatch medical units to geographically dispersed patients, as well as how dispatching policies change during normal and extreme weather events. In general, little guidance exists for how dispatching protocols may change for systems operating under extreme weather conditions.

The discrete optimization models developed in this project provide novel formulations to reframe new classes of problems by investigating the particular demands of EMS systems. These new models and algorithms can be used to provide fundamental insights into the design and operation of EMS systems in response to medical emergencies that arise during extreme weather events. Integration between the research and educational components will be achieved by including the research models in the outreach and other educational activities and by using the outreach and educational component to better inform the research models.

Flood risk projections with climatic variation and human-induced shifts in hydrologic response. National Science Foundation grant #1053655. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1053655. Two years. $254,169. Principal investigator Veronica Griffis, Michigan Technological University, vgriffis@mtu.edu.

A large portion of the U.S. population, infrastructure, and industry is located in flood prone areas. However, structural and nonstructural strategies used to reduce the economic, social, and environmental impacts of floods continue to be based on static estimates of flood risk despite the influence of urbanization and climatic variation on flood peaks. The challenge is to create a statistical framework to project future flood risk accounting for natural climate variability, potential climate change, and impending land use changes.

The objectives of this research are: (1) to develop and test methods that extend traditional statistical flood risk models to project future flood risk, and; (2) to determine the relative impacts of climatic variation and anthropogenic activities on flood risk under future scenarios of climate change, land use, and emissions in the northeastern United States. This study region was chosen because it includes a range of flood generating mechanisms, and connections between flood peaks and oceanic-atmospheric patterns have been identified.

The benefits to society from this project will flow from the creation of a physical-causal based statistical framework for flood risk projection. This framework, combined with knowledge of the relative impacts of climatic variation and anthropogenic activities on flood risk under future scenarios, will provide the groundwork for new advances in water resources management.

Climate-to-humans: A study of urbanized coastal environments, their economics and vulnerability to climate change. National Science Foundation grant #1048912. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048912. Three yeares. $530,944. Julio Bacmeister, University Center for Atmospheric Research, juliob@ucar.edu.

A unified framework for studying global change in the Earth system allowing for scale interactions and explicitly modeled dynamic feedbacks between the sub-components will be developed. The investigator team will build an Earth system model that couples multi-scale ocean, atmosphere, watershed, biogeochemistry, and human system models. The projected variability of the coupled environmental and human systems, represented with bio-economic and social network models, will be used to study management and other socio-economic decisions affecting future sustainable practices and the long-term evolution of the Earth System. The

target for this study is the northeastern Uniter States, a highly urbanized and densely populated region with approximately 33 percent of the U.S. population hosting one of the world's largest economies. It is also a region where vulnerability to global change is heightened, experiencing significant climate and ecosystem changes, shifting land use, and a complex western boundary current oceanic regime with significant implications to the northern hemisphere climate. Since many of the global change issues can be attributed to anthropogenic perturbations (e.g., a warming climate, ecosystem stress, declining biodiversity) the interface of the physical environment with human systems is central to this project.

Volcanic earthquake swarms. National Science Foundation grant #1044930. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1044930. Three years. $268,491. Principal investigator Michael West, University of Alaska, mewest@alaska.edu.

This project is motivated by one simple, but inconvenient, reality: Almost all volcanic eruptions are preceded by earthquake swarms, but most earthquake swarms at volcanoes are not followed by eruptions. Though seismology remains one of the primary tools for tracking and understanding volcanic behavior, this fact is responsible for more false eruption forecasts than any other. Non-eruptive earthquake swarms at volcanoes have caused countless false alarms, economic impacts, and community responses. By addressing eruptive and non-eruptive earthquake swarm characteristics, this project attacks one of the fundamental challenges in volcano science.

The first objective is to quantify the defining characteristics of volcanic earthquake swarm mechanisms. Comparisons between volcanic swarms have historically been challenging because each swarm has been studied with a custom technique. We plan to reanalyze swarms from a wide suite of volcanoes using a uniform methodology. Beginning with the original continuous seismic records, automated techniques will be used to create new earthquake catalogs that span the swarms of interest. Using the new catalogs, a suite of quantitative parameters will be derived based on rates, magnitudes, and waveform characteristics.

The second objective is to assess the eruption forecasting potential of repeating earthquakes. Because these imply a long-lived non-destructive source, they are particularly promising for forecasting eruptive behavior. Building on swarm characteristics derived in the first phase, swarms with significant repeating sequences will be identified. From these, many of the same parameters derived for the swarms will be calculated. Additional measures are available for multiplets that exploit their waveform similarity for source migration inferred from high-precision travel times, coda wave interferometry, and precise relative magnitudes.

Informing climate-related decisions with earth systems models. National Science Foundation grant #1049208. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049208. Three years. $1.3 million. Principal investigator Robert Lempert, Rand Corporation, Robert_Lempert@rand.org.

This project will provide a deeper understanding of how best to use information from next-generation earth system models (EaSMs) to improve climate-related decisions. Itwill explore the use of climate information from two sources: high-resolution, dynamically downscaled, regional projections from atmospheric ocean general circulation models and estimates of extreme climate behaviors from ensembles of runs from earth system models of intermediate complexity. Decision-support applications in biodiversity and in water resource management will provide real-world experimental test beds to examine the value to decision makers of this climate information at alternative levels of spatial and temporal resolution and with alternative characterizations of uncertainty. Field evaluations and psychological experiments will formally measure the contributions of the alternative types of climate information towards better decisions. These three lines of research will combine to address two questions that are central to the effective production and use of information from EaSMs: (1) What is the value of climate information with increased spatial and temporal resolution? (2) What is the value of imprecise or deeply uncertain information about potentially extreme behaviors of the climate system?

The nation's investment in next-generation EaSMs will not only improve scientific understanding of the climate and related systems, but also to improve decision makers' abilities to plan for climate variability and change. Decades of research on decision making and decision support confirm that merely providing additional information in complicated situations such as those posed by climate change does not necessarily improve the quality of the decisions. The results from this research will be valuable in guiding those designing future EaSMs and the information systems that support them.

Environmental displacement and human resilience: New explanations using data from Central India. National Science Foundation grant #1062787. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1062787. One year. $51,770. Principal investigator Jeffrey Snodgrass, Colorado State University, Jeffrey.Snodgrass@colostate.edu.

This award supports new research on the interconnections between relocation, environmental change, culture, and human health. The researchers have developed an innovative combination of qualitative and quantitative measures of stress, health, and well-being to assess the impact of environmental shocks, particularly residential displacement. Displacement—whether due to development projects, natural disasters, conflict, or environmental protection programs—affects increasing numbers of people throughout the world. Findings from the research will help to more accurately conceptualize, measure, and plan for the human costs of environmental change.

The researchers will gather the data they need to explain these relationship through a focused study of the Sahariya peoples who have been displaced from their forest homes in the Kuno Wildlife Sanctuary in central India. Integrating biological and cultural measures, the researchers will compare stress and wellness among Sahariyas residing near the core of the sanctuary, who have maintained access to forests and their attendant economic and cultural resources, with Sahariya from nearly identical village settings, who have been displaced from the core because of a wildlife protection project designed to help rebuild an Asiatic population of lions.

An innovative feature of the work is the use of newly developed minimally-invasive measures of stress hormones (cortisol and oxytocin) that can be implemented in the field by the collection of salivary samples. For the Shariya case, the cultural measures will focus on the traditional religion-based ethnomedical system, which they hypothesize may protect villagers from stress and thus provide them with a source of health resiliency.

Assessing high-impact weather response to climate variability and change utilizing extreme value theory. National Science Foundation grants #1048716 and #1048841. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048716. Three years. Two grants: $144,066 to principal investigator Howard Kunreuther, University of Pennsylvania, kunreuther@wharton.upenn.edu; and $455,934 to principal investigator Gregory Holland, University Corporation for Atmospheric Research, gholland@ucar.edu.

Vulnerability to property loss and societal disruption is increasing as society becomes more complex and interconnected, and as private, industrial and commercial development expands in high risk areas.

Understanding and predicting changes in weather extremes is a major societal issue, encompassing urban, commercial and industrial planning, watershed maintenance, agricultural practices, and the development of insurance solutions to encourage investment in cost-effective adaptation measures. Current climate models do not have the capacity to resolve the intensity, damage potential, and other important characteristics of extreme weather.

This collaborative project will bring together an international group of regional climate, societal, statistical, risk analysis, and insurance experts. The group will examine the potential for using high-level extreme value statistics to assess weather extremes through a combination of pilot projects and expert workshops.

Broadband recording at the site of great earthquake rupture in the Alaska megathrust. National Science Foundation grant #1132343. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1132343. One year. $85,256. Principal investigator Kathleen Keranen, University of Oklahoma, kate.keranen@gmail.com.

The researches will deploy seismometers on land across one of the best-known examples of variability in seismogenic behavior—the Alaska Peninsula segment of the Aleutian megathrust—to record the active-source shots and extend imaging beyond the down-dip limit of seismicity. The funded active-source cruise will image the megathrust along five transects. The eastern part of the study area ruptured in a great (Mw=8.3) earthquake in 1938, and now shows nearly full geodetic locking. By contrast, the western part lies in the Shumagin Gap, a site of no clear seismicity larger than Mw=7.4, and where geodetic data suggest a creeping plate boundary.

Little else changes between the two segments. The incoming Pacific plate is similar in age and sediment accumulation. The upper plate is constructed of the same accreted terranes. Thus, the proposed array, combined with active-source shots, will test the deeper structure of megathrusts across the transition from locked to creeping faults. Because these two transitions will be sampled and imaged, these data will provide a strong test of the notion that structural properties of the megathrust control limits to seismogenesis. The work will deploy nine broadband onshore seismometers for two months during shooting of the active-source expedition in summer 2011.

Megathrust events pose significant seismic hazard to urban centers in Alaska, Cascadia, and elsewhere. Better knowledge of the geometry of seismogenic zones and their seismicity will reduce the inherent uncertainty in probabilistic seismic hazard maps around the Pacific Rim. The study area is also considered to pose the greatest tsunami risk to the west coast of the US because of its proximity and orientation. This work will also help public outreach on earthquake hazards.

Challenges in understanding tornadogenesis and related phenomena. National Science Foundation grant #1036237. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1036237. One year. $249,761. Principal investigator Jerry Straka, University of Oklahoma, jstraka@ou.edu.

Rear flank downdrafts (RFD), tornado cyclones (TC), and tornadoes are some of the most distinctive dynamic and kinematic phenomena associated with supercell thunderstorms. Little is known about the origins and evolution of the RFD and TC, and the possible role the RFD plays in the life cycle of the TC and tornado. The main objectives of this research are: (1) To examine the dynamic forces and thermodynamic processes governing the origins, and temporal and spatial evolution of the RFD; (2) To examine the dynamic forces and thermodynamic processes governing the origins, and temporal and spatial evolution of the TC; and (3) based on this examination, develop a conceptual model that elucidates the dynamical differences between mesocyclones, tornado cyclones, and tornadoes, if these differences exist.

Supercell RFDs, the genesis of TCs, and tornadoes are the result of a complex series of nonlinear processes. Evidence suggests that the vorticity in a tornado originates as horizontal vorticity between the supercell updraft and an associated RFD. The RFD, in turn, appears to be partially the result of small-scale precipitation structures unique to supercells: the hook echo and/or a narrow descending reflectivity core. In some supercells, the initially horizontal vortex lines generated between the major vertical drafts are drawn upward in the updraft, which leads to arched vortex lines and associated low-level counter-rotating vortices in the rear flank gust front convergence zone. Under certain conditions, this process appears to be governed by the degree of negative buoyancy in the RFD, and tornadogenesis can occur in the vicinity of the cyclonic member of the counter-rotating vortex pair. This research work, which utilizes state-of-the-art observations, observational analysis tool suites and cloud models, will help elucidate the physical and dynamical relationships between RFDs, TC genesis, and tornadogenesis.

Wildfire modeling and prevention initiative: Developing a technical framework for integrating research with public policy decision support. National Science Foundation grant #1126615. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1126615. One year. $262,439. Principal investigator Larry Smarr, University of California-San Diego, lsmarr@ucsd.edu.

Wildfires are increasing in both absolute number and severity in the American southwest. This trend is predicted to continue over decades to come. The need for descriptive and predictive simulation tools to support wildfire prevention, or suppression during future wildfire events, is critical. This project will develop a technical framework for integrating three-dimensional landscape models, real-time environmental data, and suite of simulation codes, and wildfire management protocols. This research will determine how to merge elevation and ground classification datasets, couple fire propagation, atmospheric, and hydrologic simulation codes, and verify the accuracy of the coupled computations against historical wildfire data. Key components in the development of the technical framework include: (1) identifying and obtain-

ing access permissions to the wide variety of datasets needed to create the high-resolution digital model of the topography and landscape of San Diego County; and (2) investigating how these datasets can be seamlessly "sewn together" using GIS software systems. The integration methodology being developed will be investigated using an unburned area of the San Diego County's Santa Margarita Ecological Reserve, which is an ideal rapid prototyping and validation site for this project.

Developing computational thinking through digital storytelling: Coping with the effects of the oil spill. National Science Foundation grant #1116427. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1116427. One year. $169,399. Principal investigator Shaundra Daily, G84 Consulting, shaundra.daily@g8four.com.

The dual motivations for this proposal are to address a nationally recognized need to prepare a computationally savvy 21st century workforce, and the immediate need to respond to the emotional impact of the Deepwater Horizon oil spill. Since the Deepwater Horizon rig exploded in April 2010 and oil began gushing into the Gulf of Mexico, individuals, families, and communities along the coast have been stressed by threats to their livelihoods, their health, and their immediate environment. Confronted with 206 million gallons of oil, the water, fishing and tourism industries took a downturn. Students in the region were not in school during much of the time of the disaster. When they returned, many may not have had the opportunity to share their personal experiences with their peer groups. Although the spill was stopped, the aftereffects still loom.

In this project, we with an urban elementary school site (> 98% minority population) in New Orleans, Louisiana, to develop, implement, and study new instructional materials that place the cultivation of computational thinking into the context of social and emotional learning. More specifically, the strategic aims are the following: (1) develop new instructional materials geared toward the cultivation of computational thinking in the context of social and emotional learning; and (2) study the potential of these materials to develop computational competencies and support emotional reflection when utilized with students in an informal setting.

Assessing decadal climate change impacts on urban populations in the southwestern United States. National Science Foundation grant #1049251. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049251. Three years. Two grants $750,000 to principal investigator Benjamin Ruddell, Arizona State University, bruddell@asu.edu, and $147,034 to principal investigator George Jenerette, Univesrity of California-Riverside, darrel.jenerette@ucr.edu.

In the cities of the southwestern United States, regional warming combined with increasing urban populations and the resulting urban heat effect are straining limited supplies of electricity and water. Cities can be designed that are more resilient, minimizing human impacts and energy and water stresses, under scenarios of decadal warming trends. However, improved micro-scale climate models that resolve urban landscape hydrology, vegetation dynamics and patch-scale water and energy balances are needed to support the design of these resilient urban systems. The tRIBS land surface hydrology model will be modified for urban environments and coupled with the vertically nested WRF 3.2 mesoscale and microclimate model. The combined model will be used to test the efficacy of different urban green-space and neighborhood designs under climate change scenarios with respect to the water and energy balance, demand for and optimal application of irrigation water, patch-scale air temperatures and humidities, and urban flooding responses. This newly coupled model will transform the design of urban neighborhoods to be quantifiably more adaptive and resilient to all types of decadal climate change.

The microclimate predictions of the model will be useful to predict neighborhood-level human health and social impacts, water and energy use, urban heat island effects, and urban flooding, in neighborhoods in cities around the world. The potential social benefits of this research include a research tool that can empirically validate, quantitative design of urban neighborhoods that are more resilient to climate change and other future challenges (i.e. water or energy shortages), allows the optimization of neighborhoods that minimize water and energy use, mitigate heat island impacts, and improve social and health outcomes. This modeling tool can change cities by making them adaptive by design.

Use of climate information in international negotiation for adaptation resources. National Science Foundation grant #1049100. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049100. Three years. Two grants. $225,499 to principal investigator David Lobell, Stanford University, dlobell@stanford.edu and $633,320 to principal investigator Michela Biasutti, Columbia University, biasutti@ldeo.columbia.edu.

This project will advance understanding of how subseasonal variability in rainfall and temperature can affect agricultural production in the African Sahel in the current climate and under global warming conditions. The project also will identify best practice for how to convey such advanced knowledge to policy makers. The first task requires: (1) building the relevant datasets (for example, onset dates, frequency of dry spells, high rainfall events, and heat waves) for the Sahel from limited station data, satellites, reanalysis, and statistical weather generators; (2) analyzing the variability of these climate indices at the country and regional scale in observations and in climate model simulations; and (3) assessing their changes in 21st century projections. To identify if these climate indices have a significant effect on agricultural output, they will be used as input for crop models and as predictors in a regression analysis of agricultural and economic output.

The second task will be accomplished by a legal analysis of successfully concluded international agreements and of ongoing negotiations within the United Nations Framework Convention on Climate Change. The analysis will identify the nature of the information needed for the best allocation of resources, and the form in which such information should be framed in order for it to be most comprehensible and useful to negotiators. In particular, the analysis will identify how measures of uncertainty can be brought into the negotiation process as additional, valuable information.

This project will provide a template for how climate scientists and economists can frame and promulgate their findings in a way that will have the greatest policy impact.

Tropical cyclones in a warming climate: Lessons from model simulations of the last glacial maximum and Holocene. National Science Foundation grant #1064081. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1064081. One year. Three grants. $55,571 to principal investigator Suzana de

Camargo, Columbia University, suzana@ldeo.columbia.edu, $49,925 to principal investigator Joseph Galewsky, University of New Mexico, galewsky@unm.edu, and $811,448 to principal investigator Robert Korty, Texas A&M Research Foundation, korty@neo.tamu.edu.

This collaborative project uses numerical simulations to study the likely behavior of tropical cyclones—which include Atlantic hurricanes, Pacific typhoons, and cyclones in the Indian Ocean—at the height of the last ice age of about 21,000 years ago and during the mid-holocene warm period of about 6,000 years ago. Much attention has been devoted to understanding the impact on TCs of the warming of the world's oceans over recent decades and the likely response of TCs to future global warming. This study will address of the impact of climate change on TCs by looking backward to past climates. Four specific questions are addressed: (1) how do the factors that influence tropical cyclone genesis vary under last glacial maximum and mid-holocene forcings? (2) are there significant variations in how different models resolve these large-scale factors? Which changes appear attributable to model variability and which to variations in external forcing? (3) how do the TC-like vortices found in climate models change in LGM and mid-holocene simulations when compared to preindustrial or present-day conditions? and (4) How does a higher resolution, regional model's simulation of a paleoclimate environment handle genesis?

The work will inform research into the emerging science of "paleotempestology," the interdisciplinary study of the behavior of TCs and other storms in past climates. The work will also help understand the impact of global warming on landfalling TCs including hurricanes along the U.S. coastline.

Establishing radionuclide levels in the central Pacific Ocean in response to releases from the Fukushima Daiichi nuclear power plant. National Science Foundation grant #1137412. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1137412. 18 months. $94,637. Principal investigator Henrieta Dulaiova, University of Hawaii, hdulaiov@hawaii.edu.

The March 11, 2011 earthquake and tsunami in Japan did substantial damage to the Fukushima Daiichi nuclear power plant. There were significant releases of iodine, cesium, cobalt and other radioisotopes to the environment. Radionuclides were released to the atmosphere as well as the ocean. For atmospheric releases it was only a matter of days before they dispersed in the northern hemisphere. While the currently observed radiation levels do not pose a health risk for the U.S. Population, the releases are easily identified over the long-term background levels in the atmosphere. Releases so far have been episodic and highly variable, making predictions of spreading and deposition patterns difficult.

Researchers at the University of Hawaii at Manoa will monitor seawater near Hawaii in the central Pacific Ocean in order to establish a dataset of selected key isotopes. Its proximity to Japan makes Hawaii an important monitoring point. They will collect coastal and offshore water samples as well as particulates from ocean traps. Additionally, they will analyze samples provided to us by investigators from Midway and Guam. This dataset would become a part of a global effort initiated by colleagues at the Woods Hole Oceanographic Institution to establish an east to west network of sampling stations in the Pacific an Atlantic Oceans.

Conferences and Training

July 4-6, 2011
ACEM 2011: Emergency Medicine in Global Crises
Asian Conference on Emergency Medicine
Bangkok, Thailand
Cost: $400-$550

Emergency medicine providers from around the world will share best practices, identify challenges, and discuss ways to leverage funding opportunities to provide safe and seamless emergency medicine using the latest technical and medical advancements. Conference tracks include natural disasters; administration, management, and ethics; environmental poisoning; and EMT and paramedic.

www.acem2011.org

July 5-8, 2011
Geoinformatics Forum Salzburg
Centre for Geoinformatics and the Institute for GIScience
Salzburg, Austria
Cost: $442

The field of geographical information systems has has exploded over the last decade. This meeting brings together many of the leading lights in the field from academia, industry, and government to share information. Session range from curriculum development to cartography to "spatial citizenship." A vulnerability workshop held in conjunciotn with the meeting on July 4 to 6 will consider climate change and disaster risk reduction.

www.gi-forum.org

July 17-21, 2011
Coastal Zone 2011
U.S. Department of Interior, Illinois Department of Natural Resources, The Nature Conservancy, and others
Chicago, Illinois
Cost: $595

Themes for this meeting include: planning for resilient coasts; creating healthy coastal communities and habitat; conducting observation and modeling; and encouraging vibrant coastal economies. Sessions will focus on governance, implementation, evaluation, and outreach.

www.doi.gov/initiatives/CZ11/registration.htm

July 19-21, 2011
Indigenous Peoples, Marginalized Populations and Climate Change
United Nations University, Intergovernmental Panel on Climate Change, and others
Mexico City, Mexico

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www.colorado.edu/hazards/

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Cost: Unavailable

Indigenous peoples on islands, in the Arctic, at high latitudes, in the deserts are often on the front lines of climate change. This meeting provides a platform for sharing observations and adaptation strategies. Issue unders discussion will include food security, ritual and spirit, and other topics.

www.climatefrontlines.org

July 21-22, 2011
Third International Conference on Climate Change
Common Ground Publishing and University of Illinois at Urbana-Champaign
Rio De Janeiro, Brazil
Cost: $450 for non-presenters, $550 full conference

The themes for this meeting are global climate change and the implications for people, ethics, and equity. The conference is largely participant driven, with parallel, related streams on the scientific evidence, ecological impacts, hman impacts and technical, political and social responses of climate change.

on-climate.com/conference-2011

August 21-24, 2011
Conference on Coastal Engineering Practice
Coasts, Oceans, Ports, and Rivers Institute
San Diego, California
Cost: $425 for members, $795 for nonmembers

Practical experience and actual projects on sustainable coastal development will be covered at the Conference on Coastal Engineering Practice. The emphasis will be on case histories of technology as applied in the planning, design, permitting, and engineering of projects, as well as looking at "the realities of coastal construction, maintenance, and operations."

content.asce.org/conferences/copricoastal2011/index.html

August 21-27, 2011
World Water Week
Stockholm International Water Institute
Stockholm, Sweden
Cost and Registration: $1,081

World Water Week bills itself as "the annual focal point for the globe's water issues since 1991." The conference offers 55 seminars, 39 ancillary events, four field trips and two excursions, all highlighting the water challenges the world faces. The major theme this year is water issues in a rapidly urbanizing world. The conference offers "platform to build solutions and craft adaptive strategies to forge societies that are more resilient and can better balance the demands for water to produce food, energy, industrial goods and other uses.

www.worldwaterweek.org

August 30 - September 1
TCIP 2011
Technologies for Critical Incident Preparedness
U.S. departments of Defense, Justice, and Homeland Security
National Harbor, Maryland
Cost: Unavailable

The conference will bring together frontline responders and representatives from government, industry, the academy, states, local agencies and other interested parties to share knowledge about preventing and responding to critical incidents.

tcipexpo.com

September 4-13, 2011
13th International Conference on Landslides
International Landslide Research Group and the Japan Landslide Society
Kyoto, Japan
Cost and Registration: $3,053

Extensive field trips to look at landslide-prone areas in Japan are a major attraction for this meeting. Participants will examine earthquake-induced landslides, debris flows, faults and other representative areas.

landslide.dpri.kyoto-u.ac.jp/ICFL-2011/ICFL-2011.html

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Boost the Mary Fran Myers Scholarship Fund—Enable representatives from all sectors of the hazards community to attend the Center's Annual Workshop.

To find out more about these and other opportunities for giving, visit:
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The mission of the Natural Hazards Center is to advance and communicate knowledge on hazards mitigation and disaster preparedness, response, and recovery. Using an all-hazards and interdisciplinary framework, the Center fosters information sharing and integration of activities among researchers, practitioners, and policy makers from around the world; supports and conducts research; and provides educational opportunities for the next generation of hazards scholars and professionals. The Natural Hazards Center is funded through a National Science Foundation grant and supplemented by contributions from a consortium of federal agencies and nonprofit organizations dedicated to reducing vulnerability to disasters.

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Observer cartoons are drawn by Rob Pudim.

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