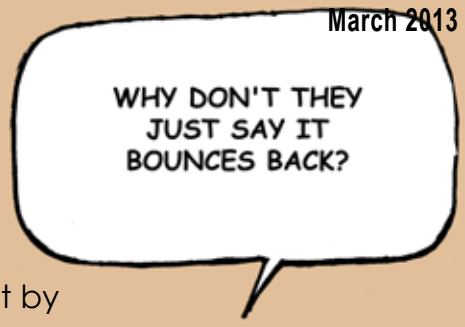
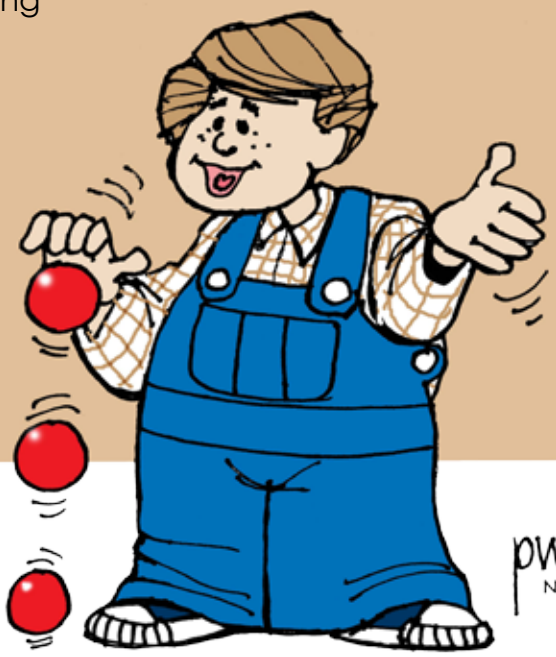
Natural Hazards Observer

Volume XXXVII · Number 4 March 2013

Clarifying resilience



An invited comment by Hugh Deeming



So, we all know what resilience is, don't we? The National Academies recently said building disaster resilience capacity in our communities should be a national imperative (National Academies 2012).So resilience must be a tangible thing, right?

A review of the literature reveals that resilience is a concept that has been applied, variously, to the ability of materials to withstand severe conditions, social-ecological systems, individual psychology, organizations and institutions, critical infrastructure, communities—and so on.

In his 2006 paper on the subject, Manyena (2006) discussed this multidisciplinary adoption of the term. He suggested that without a unifying definition, accurate, useful mapping of its attributes and a simplification of the conceptual target—is the focus on social structures or physical structures?—"Resilience is currently too vague a concept to be useful in informing the disaster risk reduction agenda."

However McAslan (2010), after a similar review, concluded that although the details varied, the many definitions contained a number of useful common characteristics. These include:

- The ability to absorb and then recover from an abnormal event.
- Readiness for facing threats and events which are abnormal in terms of their scale, form, or timing.
- An ability and willingness to adapt to a changing and sometimes threatening environment.
- A tenacity and commitment to survive.
- A willingness of communities and organizations to rally round a common cause and a shared set of values.

Common characteristics

So what is it about these common characteristics that make resilience an aspirational goal? Well, the use of the concept has certainly increased, and not only in the United States. Although there is no literal translation for the word resilience in many languages, in the United Kingdom the "resilience agenda" has become the foundation on which civil protection doctrine is now built.

Rob Hopkins, founder of the Transition Towns movement has even said, "Resilience is a more useful concept than the idea of sustainability." He says that's because resilience is all about "building surge breakers into how we organize the basic things that support us." Sustainability, he says, is more focused in the energy efficiency of our fridges. The definitions used are all slightly different from that used in the National Academies report, but there are hundreds of those definitions.

(Please see "Resilience," page fourteen)

INSIDE ...

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.

Observer cartoons are drawn by Rob Pudim.

Send items of interest to the Natural Hazards Center, University of Colorado at Boulder, 483 UCB, Boulder, CO 80309-0483; (303) 492-6818, (303) 492-2151 (fax); hazctr@colorado.edu. The deadline for the next *Observer* is **March 31, 2013**.

Notes and follow-up

Resilience ...

Gavin Smith, who wrote last issue's page one piece on the impact of Hurricane Sandy, reports that his article generated a invitation to speak in a conference call on January 25 with the Senate Homeland Security Committee. But he wanted to clarify one thing. Smith writes:

> The recent introduction of the Strengthening the Resiliency of Our Nation on the Ground (STRONG Act of 2012)—which emphasizes greater pre-event planning and the more effective use of existing federal agency resources to address episodic and slow onset hazards and the reauthorization of the Pre-Disaster Mitigation program—offers some hope that the nation is taking steps forward to confront the nexus between hazards management and climate change adaptation. The ability to clearly operationalize these ideas and programs already in place through a national climate change adaptation strategy remains to be seen.

So long, Zeke Peters

We're sorry to say that this issue bids farewell to NHC's Assistant Director for Programs and Outreach Ezekiel Peters. While many know Zeke for his forward-thinking partnerships and tireless promotion of the Center's offerings, he is probably less known for the deft editing that has shaped both our sister publication *DR* and the *Natural Hazards Observer* over the last five years.

Zeke will be pursuing his interests in emergency medical services and resilience. We're glad his formidable energy and problem-solving skills will still be working for the hazards community.

For ye have the flu always with you

Ten times more Americans die from influenza each year than from terrorist actions

Influenza came with a vengeance this past winter, according to the Centers for Disease Control and Prevention. During the last week in January especially, influenza deaths shot up "well above the epidemic threshold," CDC said.

Most deaths occurred among people aged 65 and older, but there were also 45 pediatric deaths nationwide by the end of January, the agency reported.

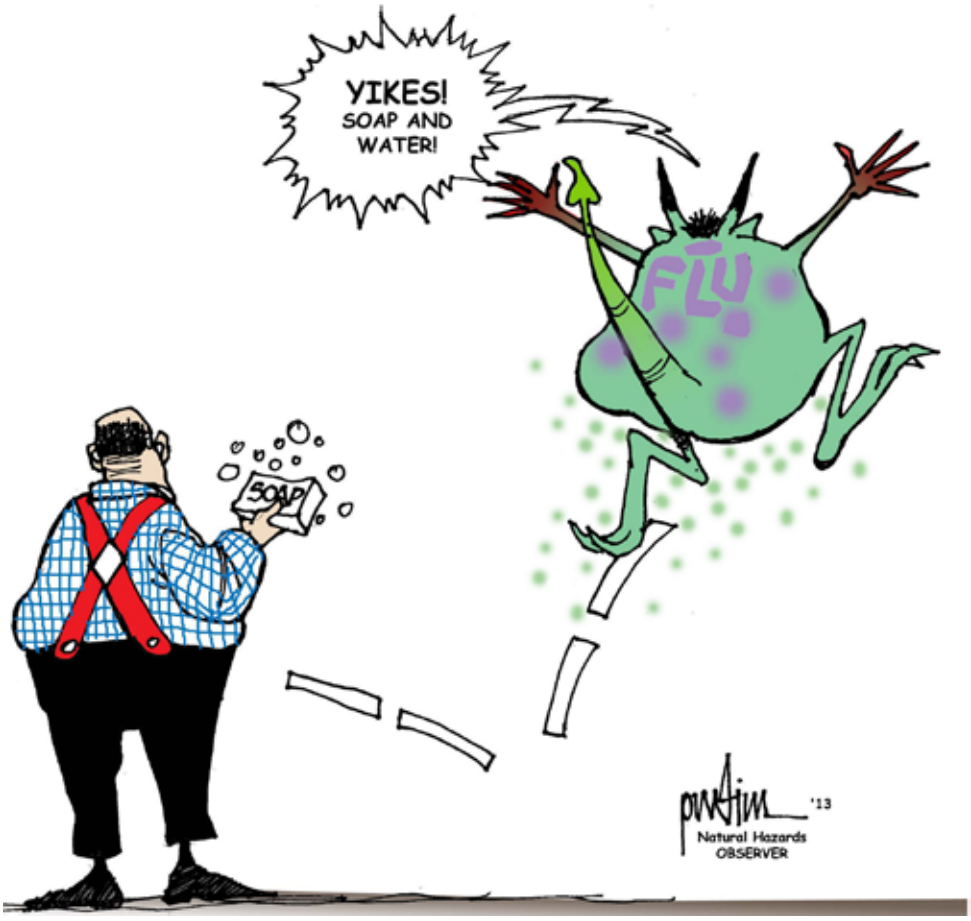
But new research indicates that the 2009 flu epidemic was harder on young people than older ones, at least globally. A study by Maria Van Kerkhove of the World Health Organization's Global Influenza Programme and colleagues, published in the January 2013 issue of the journal *Influenza and Other Respiratory Viruses*, found that 47 percent of those ages five to 19 from 19 countries showed signs of having caught the influenza virus. "Older people were affected less, with only 11 percent of people aged 65 or older becoming infected," according to a release about the study from Imperial College London.

Based on an estimate of about 200,000 deaths in the 2009 pandemic, they find the mortality ratio was less than 0.02 percent.

Because flu can be so devastating, many researchers are looking for ways to track and predict influenza outbreaks in real time. Google, for instance, has shown success using flu-related search terms to gauge the severity of influenza outbreaks in the United States. In the recent outbreak, this measure showed a very sharp increase in flu in early January, then a decline.

Meanwhile, scientists from Columbia University and the National Center for Atmospheric Research have applied the techniques used in weather prediction to generate local forecasts of seasonal influenza outbreaks. "In previous work, Jeffrey Shaman and colleagues had found that wintertime U.S. flu epidemics tended to occur following very dry weather," according to an NCAR release on the work. "Using a prediction model that incorporates this finding, Shaman and co-author Alicia Karspeck, an NCAR scientist, used Web-based estimates of flu-related sickness from the winters of 2003–04 to 2008–09 in New York City to retrospectively generate weekly flu forecasts. They found that the technique could predict the peak timing of the outbreak more than seven weeks in advance of the actual peak."

And Wake Forest University researchers have used game-based economic research to look at why some people take steps to avoid illness—like getting a flu shot—and why some don't. In an article on *PLoS One*, Frederick Chen and colleagues found, "People's behavior is responsive to the cost of self-protection, the reported prevalence of disease, and their experiences earlier in the epidemic. Specifically, decreasing the cost of self-protection increases the rate of safe behavior."



Chen said, "When it comes to policies for disease control, one size does not fit all. Some people are very risk tolerant and some are super risk averse. Our research shows that to prevent an epidemic, there is a need to tailor a menu of options for different kinds of people."

Not to be left out, mathematicians at the University of Warwick have developed tools to quantify the spread of epidemics. Using data from households where one members was identified as having the H1N1 virus in 2009, the model analyzed "how many people were living in the household, the number of symptomatic individuals, the number of individuals who were swabbed and the number of lab-confirmed cases within that household." This method allowed the mathematicians to directly estimate household infection rates—which were higher than

previously thought.

The findings are related specifically to the H1N1 outbreak in 2009, but the methods should be robust for future pandemics, including not only flu outbreaks, but any transmitted disease like chicken pox, gastrointestinal diseases, or measles.

A team from Kansas State University is looking at how social media can be used as a tool to influence behavior to reduce flu risks. A majority of study participants got their information from Facebook, and said they'd be willing to take preventive steps—hand washing, getting a flu shot and so on—if asked to do so by others in the social network.

Pandemics aren't just a health problem, but have serious economic consequences. An **article** in the online magazine *Slate* says, "A CDC study pegs the annual total economic damage [from flu] at about $87 billion. Some other estimates give higher figures. And the annual death toll calculated by the CDC is more than 10 times the number of U.S. citizens killed since 2001 by 'terrorist action.'"

Altruism shipwrecked

Women and children fare worst, crew members best

"Women and children first!"
"Every man for himself!"

We can't have it both ways, and it appears that, in shipwrecks, at least, the latter approach is the one favored. Mikael Elinder and Oscar Erixson, economists at Sweden's Uppsala University, analyzed 18 maritime disaster over 300 years, covering more than 15,000 people. Their findings were published in the July 31, 2102 **issue** of the *Proceedings of the National Academy of Sciences*.

"Taken together," the authors conclude, "our findings show that human behavior in life-and-death situations is best captured by the expression 'every man for himself.'"

The researchers also demolish another cherished myth—that the captain goes down with the ship. Quite the contrary. "Captains and crew survive at a significantly higher rate than passengers" in shipwrecks, they write. Elinder told the online magazine *Slate*, "What we can see clearly is that the crew were more likely to survive than passengers, with 61 percent surviving compared to around 37 percent of male passengers. On average, the captain was more likely to survive than the passengers."

The data were limited for children in shipwrecks, but such data as were available indicated a very poor survival rate, about 15 percent.

But other recent research indicates that disasters can prompt children—at least older children—to be more willing to share. Younger children, alas, become more selfish.

Researchers at the University of Toronto, the University of Chicago, and Liaoning Normal University made this finding in a rare natural experiment after the 2008 Sichuan Earthquake in China, which killed about 87,000 people.

"The study provides the first evidence to suggest that experiencing a natural disaster affects children's altruistic giving significantly," said Kang Lee, a professor at the University of Toronto, in a news release.

"The immediate negative effect of the earthquake on six–year-olds suggests that altruism at that age is still fragile," Lee said.

But there's hope. Older children—a group of nine-year-olds—were more altruistic, had higher empathy scores, and donated more than the younger ones.

"As they grow older, children become able to better regulate their own vicarious emotions and understand better what they feel, and they are more inclined to act pro-socially," said University of Chicago psychology professor Jean Decety.

The journal *Psychological Science* will publish the study in an upcoming issue.

They Said It ...

"We will respond to the threat of climate change, knowing that failure to do so would betray our children and future generations. Some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires, and crippling drought, and more powerful storms."

—U.S. President Barack Obama in his second inaugural address, quoted in the *New York Times*.

"Looking back, I underestimated the risks. The planet and the atmosphere seem to be absorbing less carbon than we expected, and emissions are rising pretty strongly. Some of the effects are coming through more quickly than we thought then … I think I would have been a bit more blunt. I would have been much more strong about the risks of a four- or five-degree rise."

—British economist Nicholas Stern in an interview with the *Guardian*. Stern was the lead author of a 2006 British government report on climate change that has become a benchmark.

"There are some places where people may choose not to build back. I've talked to home owners who have dealt with serious floods three, four, five times over the past few years. Many of them are saying, 'I don't want to have to do it again. I'd rather buy out the parcel and move on.' There are some parcels that Mother Nature owns. She may only visit once every few years, but she owns the parcel and when she comes to visit, she visits. We want to run a program that will provide the funds to buy out those homeowners who don't want to rebuild and want to move on to higher ground.

—New York Gov. Andrew Cuomo in his January 9, 2013 State-of-the-State speech, urging a $400 million purchase program for homes located in flood plains which were destroyed by Hurricane Sandy, quoted in the *New York Times*.

AG: Why do you think we bought into the "women and children first" belief?

ME: The Titanic has been so extensively studied, and it confirmed the myth. There was little empirical evidence against it. Lucy Delap of Cambridge University argues that this myth was spread by the British elite to prevent women from obtaining suffrage. They said, "Look at the Titanic. There is no reason to give women the vote because men, even when facing death, will put the interests of women first."

AG: In fact, you've found that, in general, women fare worse on British ships?

ME: Yes, it has been claimed that "women and children first" is just a British phenomenon. But we found a lower survival rate for women on British ships than on ships of other nations.

— From an interview in the online magazine *Slate* between Alison George (AG) and researcher Mikael Elinder (ME), August 5, 2012.

What's the next big social media thing?

Social media analysis may be able to predict 'triggering events'

In 2005, the Danish newspaper *Jyllands-Posten* published cartoons featuring the Muslim prophet Muhammed which many Muslims found offensive. They triggered widespread protests.

In September 2006, a lecture given by Pope Benedict XVI quoted controversial material about Islam. A brief controversy ensued, but dissipated with "essentially no violence."

Is it possible to predict via social media analysis which triggering events will result in a crisis, and which will pass? An "early warning analysis for social diffusion events" by scientists at Sandia National Laboratories indicates that it may be.

"This research offers evidence that, when individuals are influenced by the actions of others, it may not be possible to obtain reliable predictions using methods which focus on intrinsics alone; instead, it may be necessary to incorporate aspects of social influence into the prediction process. Very recently a handful of investigations have shown the value of considering even simple and indirect measures of social influence, such as early social media "buzz," when forming predictions. This work has produced useful prediction algorithms for an array of social phenomena, including markets, political and social movements, mobilization and protest behavior, epidemics, social media dynamics, and the evolution of cyber threats," write Sandia authors Richard Colbaugh and Kristin Glass (http://www.fas.org/irp/eprint/

proactive.pdf).

The difference between the Danish cartoons and the Pope's talk was that "blog entropy"—relevant discussions of the issue—increases dramatically a few weeks before any increase in violence. This didn't happen in the Pope's lecture case, where the "blog entropy" remained essentially flat. In the case of the Danish cartoons, volume of comment on blogs then increased—it "went viral"—and was followed by violence. The issues with the pope's lecture simply faded away after an brief initial period of controversy.

The authors say that their algorithm may be able to predict "meme propagation, large-scale protests events, and politically motivated cyber attacks" through analysis of social networking dynamics.

For emergency managers, effective use of social networking usually requires an "evangelist" who motivates an organization to adopt the tools. For example, research has "examined the role of the information manager who brought IT expertise and technological innovation into a crisis response context," write Mark Latonero and Irina Shklovski in a 2011 issue of the *International Journal of Information Systems for Crisis Response and Management*. "Results suggest that such information managers or brokers are necessary to serve as the human experts who mediate between the technological system, information, organization, and audience … From our initial informal conversations with emergency management professionals, it became clear that such evangelists are key to IT adoption, innovation, and use in crisis response and management."

Australia feels the heat and fire

Wildfires are an 'intrinsic part of the landscape'

The heat in Australia has gotten so bad that black on the weather map is no longer sufficient. The Australian Bureau of Meteorology has added dark purple and magenta to its color codes to indicate temperatures of 51 to 54 degrees Celsius (about 124 to 129 degrees Fahrenheit).

The town of Moomba in South Australia recorded a temperature of 49.6 degrees C (121 degrees F) in early January. Reuters news service reported that Australia's average maximum temperature exceeded 39 degrees C (102 degrees F) for a record-setting seven days in a row. The previous record was four consecutive days in 1973.

The Australian Climate Commission, in a report on the heat wave, says, "There has been a significant increase in the frequency of hot days (days over 35 degrees C) and hot nights over the last 50 years. The frequency of record hot days has been more than three times the frequency of record cold days during the past ten years."

"Australia's average temperature has already risen by 0.9 degrees C since 1910 . This is consistent with the global trend of increasing average temperature. Globally, the 10 hottest years on record have all occurred in the last 15 years."

In addition, eastern, southern, and southwestern Australia have become drier. "Although Australia has always had heat waves, hot days and bushfires, climate change has increased the risk of more intense heat waves and extreme hot days, as well as exacerbated bushfire conditions. Climate change is making extreme hot days, heat waves and bushfire weather worse," the report says.

The January heat melted road tar and set off hundreds of wildfires, according to Reuters. The *Guardian* reported that about 350,000 hectares of land (just under 1,400 square miles) burned in bushfires so far in the Australian summer fire season.

Thomas Duff of the University of Melbourne writes, "Fires are an inescapable part of life in Australia; they have been occurring for millennia, and regardless of our actions, they will continue." He says that Australians must "accept fire as an intrinsic part of the landscape … It cannot be considered an adversary that can be defeated."

Back in the United States, a team of scientists led by Carnegie Institution's Department of Global Ecology found that a "a recent widespread die-off of Colorado trembling aspen trees is a direct result of decreased precipitation exacerbated by high summer temperature," according to a release. The die-off, which was triggered by the 2000-2003 drought, has affected 17 percent of Colorado's aspen forests.

The strong upward trend in summer temperatures could tie the die-off to climate change, the researchers said.

Lots of landslides after Virginia earthquake

Earthquake? Reach for the cigarettes

The magnitude 5.8 earthquake in central Virginia struck about a year and half ago, on August 23, 2011, but lessons from the rare event are still being collected. The U.S. Geological Survey estimates that about one-third of the U.S. population could have felt the quake—more than any earthquake in American history.

Landslides triggered by the quake occurred at distances four times greater and over an area 20 times larger than any similar magnitude quake in the world. The 2011 quake was the largest in the in the area since 1897. None of the landslides produced were particularly damaging but, though small, they were numerous and widespread.

"For the eastern U.S., the documented landslides from the 2011 Virginia earthquake suggest that ground motion is stronger and travels farther parallel to the Appalachian Mountains than perpendicular to them, which is consistent with other sources of intensity information," according to a release from the Seismological Society of America.

One hundred and fifteen years of lack of experience with quakes led Easterners to do the wrong thing in the quake. "Treating the shaking as if it were a fire drill, millions of workers in Washington, D. C., New York City, and other eastern cities hurriedly exited their buildings, exposing themselves to potentially greater danger from falling bricks and glass," says a paper in the 14 August 2012 issue of *EOS*, published by the American Geophysical Union. "'Drop, cover, and hold' would have been a better response. Fortunately, the strong shaking stopped after about 5 seconds and did not cause widespread severe damage or serious injuries."

A little practice in the Great California Shakeout tradition might be advisable in the region. The *EOS* paper says, "Considerable scientific uncertainty remains about the nature and scope of the earthquake hazard associated with the [Central Virginia Seismic Zone] and similar zones in eastern North America. Research is under way to better understand the geological and geophysical setting of the August 2011 earthquake and the severity and distribution of seismic shaking, including the geologic characteristics of seismic recording sites, the characteristics of the earthquake source, and associated ground deformation and failures."

Meanwhile researchers have concluded that, except in the case of aftershocks, large earthquakes are not linked across the globe. An analysis by Tom Parsons and Eric Geist of the USGS conclude that apparent clusters of quakes could be just random chance. The two conclude, "this could be disappointing news for researchers who thought global communication between quakes might offer a way to predict the most severe seismic activity."

In other disturbing earthquake news, according to a study from the European Respiratory Society's Annual Congress in Vienna, the prevalence of smoking increased following the 2010 earthquake in Christchurch, New Zealand. Of a group of 319 people who weren't smoking at the time of the quake, 76 took up or resumed the habit after the 7.1 Mw quake—about 24 percent of the study population.

An invited comment
by Matthew Biddle
and David R. Legates

Helping at-risk people survive tornadoes

Better building preparation and public shelters will increase survival rates

After tornadoes ripped through Tuscaloosa, Alabama, and Joplin, Missouri, many called for enhancement of tornado forecast lead times to save lives.

Unfortunately, many people wait until they see or hear a tornado before taking action. Humans often underestimate both the possibility of disaster and its potential effects. Warnings are interpreted too optimistically—so any additional lead time will probably not be heeded.

The National Weather Service false alarm rate of 70 percent complicates matters. While tornado forecasting is an inexact science, and the NWS does the best it can, too many false alarms make people think any alert is probably another false alarm. Response time is reduced despite improved forecast lead times.

NWS offices in Kansas and Missouri recently changed their warnings to include phrases like "mass devastation," "unsurvivable," and "catastrophic." While intended to communicate approaching storm dangers more effectively, these terms will likely have an opposite effect. After several storms labeled "catastrophic and capable of mass devastation" fail to produce destructive tornadoes, faith in forecasts will be lost.

It is assumed that how the population utilizes this information is a matter for emergency preparedness teams. But there is no remedy for human behavior. Even educated people make bad and sometimes deadly decisions. No NWS terminology can "cut through" this clutter unless a disaster arrives—and then it's too late.

Additional lead time also does little for at-risk populations which cannot evacuate and must seek "shelter-in-place." The poor, the elderly, people with disabilities, and people without adequate shelter (travelers and those living in mobile homes or pre-fabricated housing) have disproportionate death rates in tornadoes. The alternative to "sheltering-in-place" often is being caught in a car while en route to a shelter.

After Hurricane Andrew struck Florida in 1992, housing codes were changed to make homes withstand destructive hurricanes, thereby reducing insurance payouts. However, hurricanes offer substantial lead times, enabling those who choose to evacuate the chance to do so.

By contrast, tornadoes occur so suddenly that sheltering in homes is common—all the more reason why housing codes should be strengthened, especially for at-risk populations. While a direct hit from EF-4 or EF-5 tornadoes may not be survivable, deaths from even these extreme storms would be reduced if homes on the periphery provided more security through stiffer housing codes. Survivability would certainly be enhanced during less severe tornadoes—the vast majority of twisters.

A rapid assessment team supported by the National Science Foundation found that inadequate connections between trusses, roofs, and walls increase tornado damage. But even tougher building codes are not always followed or enforced. Although foundation anchor bolts and roof clips add less than $1,000 to the final cost of the home, tight construction budgets and timetables often trump safety.

This assessment team also found that mobile home residents accounted for two-thirds of tornado victims, and more than half did not have access to a basement, storm cellar, or "safe room." This figure is unchanged since the NWS Watch-Warning program began in the 1950s. It includes a

disproportionate number of the poor, elderly, and people with disabilities who are forced to "shelter-in-place." What are they supposed to do when a warning is issued? Doing nothing is not an option.

In some areas, even in "Tornado Alley," public shelters are closing because of staffing issues, Americans with Disabilities Act requirements, or underfunding for emergency management.

It is imperative, therefore, that modern building codes be followed and not undermined by competing interests. Trailer parks and apartment buildings must consider providing adequate and accessible shelters for their tenants.

Homes can be built more cheaply and quickly on a slab. For a generation now, we have built homes without basements, resulting in greatly decreased tornado survivability. More basements, storm cellars, and safe rooms simply must be built in more of "tornado country."

These measures were featured in Alabama's Tornado Recovery Action Council report. Unfortunately, the construction lobby largely opposes it, even as the insurance lobby is pushing for enhanced building codes. An independent consortium of engineers, architects, planners, emergency managers, meteorologists, geographers, and public safety directors must get involved, as they did after Hurricane Andrew, to argue for safer building codes.

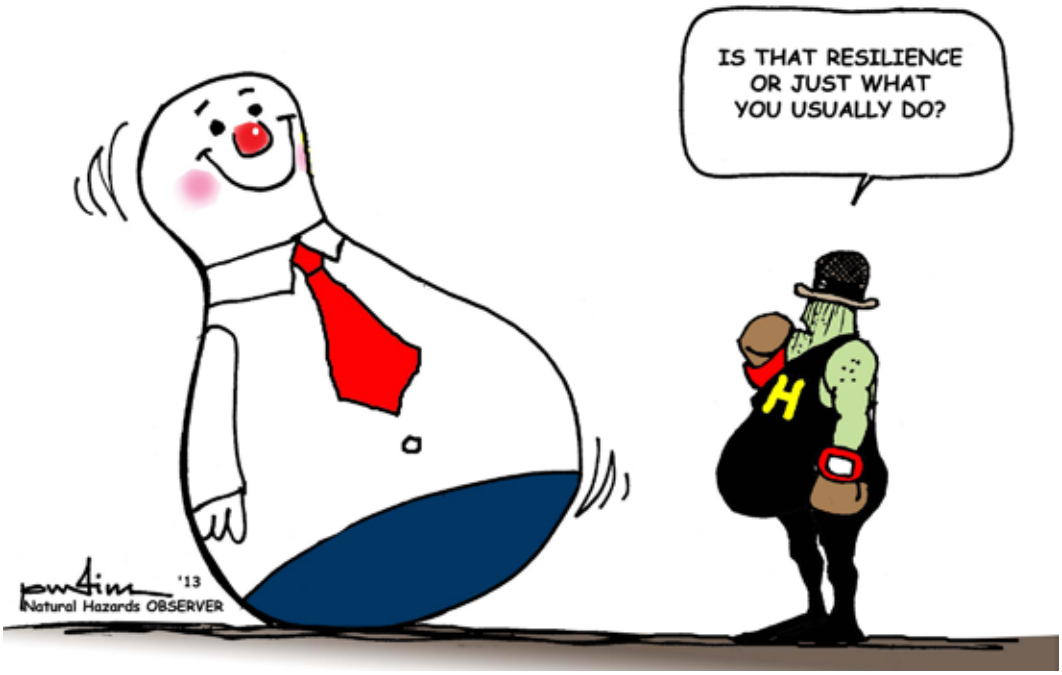
After a tornado strikes, the NWS assesses what could have been done better, but often avoids being critical of anyone, especially themselves. Third-party oversight is needed (akin to the National Transportation Safety Board), to review actions by federal, state, and local officials, and the general public and to suggest or mandate changes.

As devastated communities rebuild, now is the time to address improved construction standards and to discuss at-risk populations. We must also promote stronger building codes to protect all citizens, especially these at-risk populations, from tornadoes and other high wind events. But during a housing downturn and with many pre-existing homes, we need to ask what can be done to help people who now live in inadequate housing and will likely continue to live there.

We can no longer assume bad things only happen to others. Everyone in or near "Tornado Alley" is at risk.

Matthew Biddle serves as a community service officer at the University of Oklahoma Police Department and as an instructor at the University of Oklahoma. David R. Legates is a climatologist at the University of Delaware.

Q&A on resilience with Dan Lewis of UN-Habitat's Risk Reduction Unit



Reducing risk and building resilience in cities

UN-Habitat is in the business of sustainable development of cities, towns and other human settlements. A critical component of this goal is to promote urban resilience in the face of disasters. UN-Habitat is working on a new program, a systems model to measure urban resilience globally—the City Resilience Profiling Programme. In the clanking construction zone of the Village Market in Nairobi, Kenya, the ***Natural Hazards Observer*** *sat down with Dan Lewis, chief of UN-Habitat's Risk Reduction Unit, to learn more about the program.*

NHO: *First, can you describe the idea?*

Lewis: This program is in response to the demand we have from a range of cities that we have experience with who have understood the value of reducing risk to the citizens, to the businesses, to the government itself from the various hazards that potentially could affect them, or in some cases already have. And the demand is not about methodologies for reducing risk, the demand is about acquiring knowledge, acquiring tools, developing standards for building resilience and measuring it and calibrating it. This began maybe two years ago when the International Strategy for Disaster Reduction, the custodian agency for the Hyogo Framework, embarked on a global campaign to promote "resilience"—and I put that in quotes—in cities.

A month or two ago there were over 1,100 cities that had signed up and made a commitment to reducing risk and building resilience in their cities. Now that's a fairly large proportion of cities, covering a fairly large population around the world.

NHO: *Do you know how many people are covered?*

Lewis: No, but for instance, every city in Austria is involved. We've just done work with 31 cities in Pakistan. We've also just worked with seven counties, or districts, in Rwanda that cover the majority of the population of those two countries, certainly the majority of the population at risk. We've tried to introduce them to this advocacy machinery that the UNISDR has created. We do a lot of work in very close partnership with the UNISDR, part of which was developing their current methodology for assisting towns and cities. What they've done is create a local government self-assessment tool that created a set of targets, what they call the "ten essentials," which is fair enough and it's a very good start and its an excellent advocacy driver. But it is entirely perceptive, entirely subjective and not very reliable, lets say. It doesn't produce a very reliable baseline, because of those two things.

It really is an incredible advocacy tool as 1,100 plus cities would attest to. But those guys are coming to us and saying, "Okay, fair enough, we made the commitment, but how do we know?" If we plan for what the experts say is a six point four earthquake and we get a seven point four earthquake in our town, we're screwed. So how do we know?

NHO: *So how do they know?*

Lewis: Let me change tack here, and go back to the issue of resilience. So the cities are looking for more actually measurable means of, one, determining where they are against a range of different hazards and, two, being able to mark progress on whatever they do on the risk reduction side. That's one aspect.

The second aspect is that there are now probably as many different definitions of resilience as there are people who can actually say the word. For OCHA—which is the [UN] Office for Coordination Humanitarian Affairs—their view on resilience is entirely driven by a food security agenda. I look at a huge network organization like ICLEI, which is a global network of local authorities, their entire concept of resilience is hitched to climate change.

Even in our own climate change programs they're talking about resilience. But people will invest millions of dollars in a climate change adaptation program in a town or a city that's on a major earthquake fault line or on the coast. A tsunami will wipe out tens of thousands of people, but it has nothing

to do with the millions of dollars that are invested in climate change resilience.

These are the things that start to concern me a little bit. Other organizations, even countries, look at resilience from the point of view of critical infrastructure—energy, for example, or water—and will build a resilience agenda around protection of those resources. In the private sector, business continuity is the trunk of the resilience tree. But from a city point of view there does not exist any systemic approach to addressing resilience to multihazards, whether they're economic hazards or whether they're social hazards, whether they're so-called natural hazards or whether they're human-induced technological or industrial hazards.

Nothing exists in my estimation that is robust enough to be a bit more sure of how resilient a town or a city or a megacity might be.

NHO: *What components do you look at to define resilience?*

Lewis: The first challenge in this whole approach is to try to find a model that's applicable in any city, in any country, in any context, or in any culture—that's the first challenge. Going back to thinking some years back around urban systems models, what does every human settlement have in common?

It has in common essentially four key axes. All cities have physical attributes. There is a built environment there that consists of a certain level of infrastructure, a certain level of public and private built stock, a certain level of individual and public goods. All cities have this. All towns have this.

Second thing is they all have functions in common. They all have functions around urban management, systems to develop revenues. I'm not trying to say that everything is democratic, but they all have some system of governance in one way or the other, and all the different governance functions. That's in common—any human settlement.

The third thing is an organizational axis that starts at its lowest point with an individual and at its highest pint the state. When we're talking about hazards, we're often talking about what's extra-state. There's a kind of dotted line that goes out beyond the level of the state.

The final axis, which is common to any place, is that there is a spatial dimension. That spatial dimension is defined by the smallest discrete spatial unit and it also ends at the state level.

NHO: *When you say the smallest discrete spatial level, are you talking about a house?*

Lewis: No, I'm talking about a plot. A public plot that might consist only of a space to hold a stop sign somewhere, but it's a discrete spatial unit, and it's controlled by somebody. That's the key issue around the system model is that any way you shape these axes, there's a relationship between the function, the physicality, the spatial stuff, and the organizational stuff. You can take those three axes and move them around however you like and you'll discover that there's a relationship among those four things, and that exists. It doesn't matter if it's a hundred and fifty people in a rural village, or if it's downtown Manhattan. All those are in common—obviously with different attributes.

There's a fifth kind of dimension, the system model is not static so it changes over time. This makes it orders of magnitude more complex.

The first thing is the demand on the ability to measure. The second thing is organizing information and data that can be analyzed at the most empirical level. That's either observed or measured or some way calibrated. I have no illusions that everything is going to be empirical but I think statistically we can come up with quite a few more empirical, reliable data than is currently available.

The third principle is to use this as a means of turning the current popular dialog from one that focuses on risk reduction, which is a palliative, to turn it a hundred and eighty degrees and start talking about resilience as a future target.

The reason for that goes back to the first point, which is, "How do you measure it?" The corollary is, "Why do you measure it?" Because you want to be able to monitor the way in which your city develops in such a way that combines all of the elements of resilience to insure that you get a better, safer, more attractive city for investment and in-migration.

So that's flipping things around.

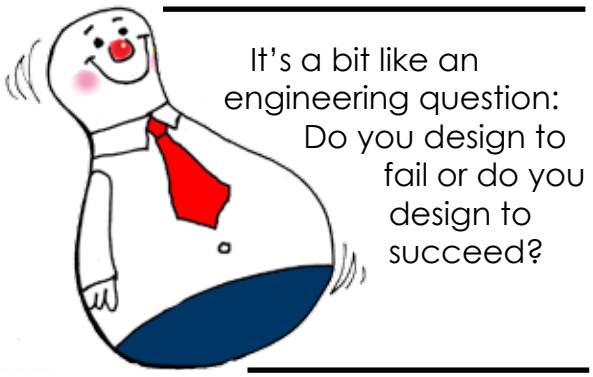
The fourth part of it is, if you do that, if we're successful in taking a systemic reliable means of measuring and monitoring hopefully the increase in resilience over time in a human settlement, then you need to set standards, you need to have targets. And that's where we go back to the model and we say okay we can use this model to create a baseline in any human settlement. If all of these attributes are common to any human settlement, then we can pull this thing apart, look down at discrete elements and determine what a baseline resilience might look like—for want of a better term, a "score."

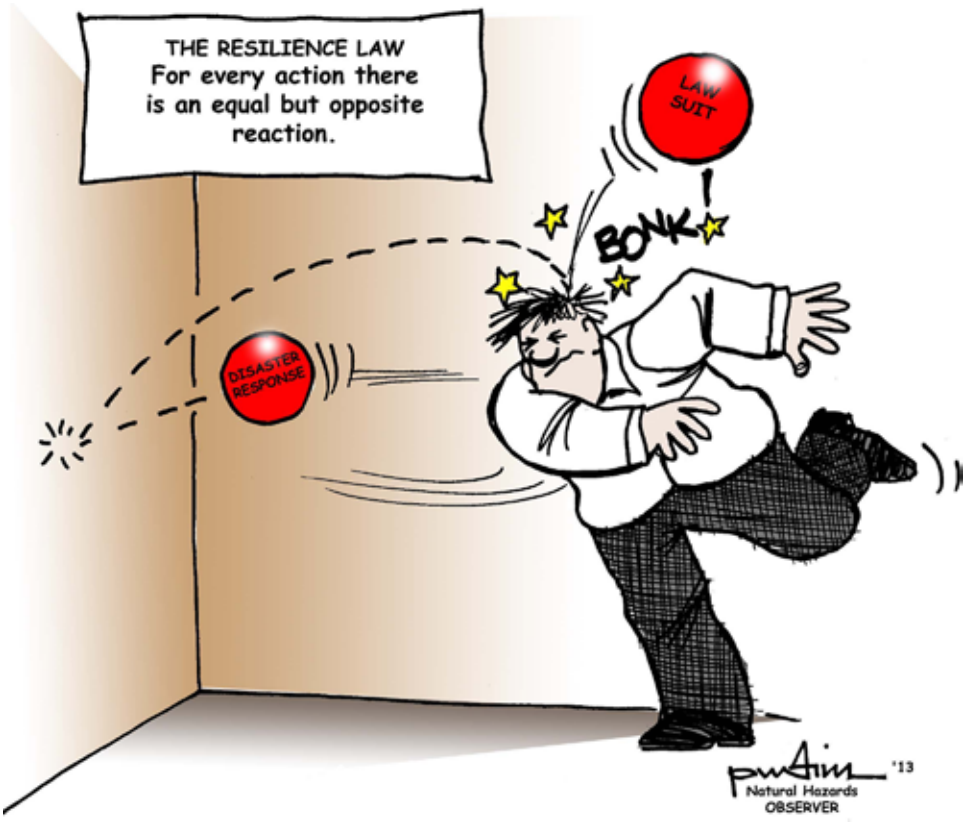
Which means that we have to create a set of indicators or indices across this urban systems model that give us a value that when analyzed and aggregated would give a score.

NHO: *Can you give me an example of what one of these might be?*

Lewis: Sure. Let me give you a real example of what we're doing right now. We're looking at a community level initiative in addressing two elements of the functional and physical axis. The physical element is solid waste and infrastructure plus water supply in 25 neighborhoods in Antanarivo in Madagascar. So it's the water and the solid waste management.

On the operational side, it's the management of those two critical infrastructure elements because the government is incapable—it doesn't have the capacity to do it. It has to be a community-driven thing. So the first thing we do is go around and map what's there. The second thing we do is to say in each one of these neighborhoods: What is the highest priority for protection the next time you get a cyclone that whacks Antanarivo? The communities know it because it gets





whacked every year, more or less.

At the beginning you have baseline that says the resilience of these two functions in these 25 communities is zero, because history shows us and we have evidence, they get obliterated every time. You end up having NGOs and all kinds of people running around and rebuilding this stuff every year or every other year.

The output of that is that the one water supply, the minimal solid waste supply might represent already 50 percent of what's there. If we invest a small amount of money in protecting these two things, the potential back end of this is that only 50 percent of it may have to be rebuilt. It's a very simplistic example, but this is a real project, this is something we're doing right now.

NHO: *But you can get it functional on the neighborhood level?*

Lewis: In the meantime, you have some human resilience being built in the 25 communities we're able to work in. The second thing that happens as a result of this is that the other 25 or 50 communities in Antanarivo are watching what's going on here. And this is not rocket science. What you're taking for an example, you take a community like this that has at the moment maybe five water standpipes spread throughout the community. And people rely on this stuff. In some cases, you have vendors that fill up and sell the water, in others people come and get the water. This is, call it, five thousand people. We say to them: In the past how many days have you been without water? Where have you had to go to get water? What do you think would be the minimum requirement you would need on the water side of things?

They'll say we need two taps here to maintain supply. Part of the problem is that these taps go under water. The end solution is very simple, you build a platform and extend the supply side up to beyond the highest possible flood range. Put a set of steps on it. Build it large enough so that it's protected in the event of a flood, and it's not under water.

The other thing you can do is to do work on the upstream side, the delivery system, to make sure that whatever trunk infrastructure that has a connection to these water standpipes is protected. You make sure that upstream the infrastructure is also protected.

This is a very simplistic example, but it shows where it sits within this urban systems model.

The other thing is, I can measure this, because I know there's going to be another cyclone either this year or next year. Every one or two years it hits the city, right? I can go and see. Did this work or not? And if it didn't work, why not? If it did work maybe you guys should go over to this community over here and show them how to do it.

The results that we have from Pakistan and Rwanda in applying this local government self-assessment tool tell us that even without the empirical data, the perception of people we've spoken to, their opinion, indicates that the level of resilience of the system that we're talking about is very low. Both countries. Which even if it's not true, is an indicator that the population themselves feel they're vulnerable and feel they're at risk.

One of the things about taking this kind of an approach is that there are things you can do that are not very expensive that can increase people's perception of the risk that they face, that can increase their confidence in their capacity to bounce back.

The last element of this is setting up the standards. That means introducing new elements driven from a resilience agenda into the legal regulatory and professional frameworks that local government, urban developers, urban planners, and the other technical fields—engineers, architects—can apply to achieve a better resilience profile, which you can measure using this particular system. It's creating the standards that are driven from a true resilience.

NHO: *This sounds like kind of a bottom-up approach. Am I misinterpreting?*

Lewis: It's a bit of both. For a couple of reasons. You work for a university publication, so I'm not afraid of talking in a very technical way to you. But if I go and I talk to a mayor, he doesn't give a rat's ass about how complex this model is. What he wants to know is what's the bottom line, what's the output on this thing.

I'm talking to mayors and donors, I'm talking to the political crowd. The degree to which I dive into the technical stuff increases as we go down through the governance and professional side of stuff. And then it decreases again when I talk to community people, because they don't care about the details.

When a politician asks me what does this produce, I say it produces four things, really. It produces a set of standards that you in your city can integrate into your regulations, your building codes, your planning regs, your urban development and land use regulations. That's number one.

The second thing it produces is a baseline that tells you in a convincing way the degree to which your town is able to withstand and recover from a range of different hazards. Plausible hazards.

The third thing it can produce—it should produce—is a vision plan, a ten-year or twenty-year plan for your urban development trajectory that you can actually measure because the tools for you to measure this are going to be available as part of this whole thing. As is an interface so your technical departments, your planning and engineering and public works can continually update on information that's forming the baseline.

And ultimately, the final thing it produces is a safer city that's more attractive to investment, that's more attractive to new residents and it will allow you to develop in a strategic to accommodate those people in a way that their investments are better guaranteed for the future. That ultimately is the objective.

NHO: *How do you build the model?*

Lewis: There are four key pillars involved. The first one is the research side of things. That's to really drill down and to work out the research to produce the systems model that we're gonna hang everything else on.

The second pillar is one that quantifies elements of this urban system model in some reasonably rational manner that reflects not the degree of risk, but the degree of resilience.

The third side is to create an interface that is usable—essentially what we're talking about is a computer program here.

There's also a political agenda. The introduction of new standards into industry is not an easy thing. It's more political than it is technical. That whole idea of creating and testing a new standard takes a lot of time and it's very political for all kinds of reasons. This is the policy side of things.

The important thing here is understanding what we actually mean by resilience. What's the difference between resilience and risk reduction. In this urban systems model, what we're talking about is whatever elements there are in a risk management scenario. One is understanding the hazards. What are the hazards, what are the plausible hazards and what degree do you give those to insure … It's a bit like an engineering question: Do you design to fail or do you design to succeed?

To a certain extent understanding risk that is mediated by an assessment of preparedness, an assessment of awareness, an assessment of planning and infrastructure, to certain extent an understanding of inherent vulnerability. If you're looking at multihazard thing, or you're looking at political and social risk, you can't use the old linear relationship between risk hazard and vulnerability. It becomes way more complex than that, because all of these issue around preparedness and exposure and all the rest are applied in a different way in economic and social risk than they are to natural hazards. That calculus has to change and it becomes a bit more complex.

The combination of all of those things applied against this urban system models can give you a profile, a city resilience baseline. That's the first output of the application of this stuff.

NHO: *It seems like a lot of data collection is required.*

Lewis: In today's world, data collection isn't the issue. You have all this crowd-sourcing stuff, you have lots of data that's already available. One of our key partners in this a major insurance company, Marsh & McClennan. The interesting thing is, with these guys, they're a retail agency. They're not the reinsurance dudes. Reinsurance guys have done a lot of work as well, but it's the retailers who are delivering insurance, not the reinsurance guys. And they're hungry. They're hungry for new markets, but they're also eager to protect the assets in the market that they have right now.

They totally got this. They completely understood what I was saying and they said, "We're in. We don't know how yet, but we're in." They understand that the value of this is targets for asset owners in the cities that can lower their premiums and ultimately lower the cost of payout. So they see the market value in this. They also like the concept of working in the developing world because these are undeveloped markets at the moment. They see the potential and they're willing to invest time and technology.

NHO: *In your project description, it says that there's been a lot of emphasis on climate change and hazards resulting from climate change but that has not emphasized a lot of the most dangerous hazards like earthquakes and tsunamis. Do you think that the emphasis on climate change has been a positive development on hazards awareness or a negative one?*

Lewis: Frankly I think it's a negative thing. That was a negotiated concession to one of our partners who wanted … I think the climate change stuff is a red herring that diverts huge resources away from actually making cities safe. Huge resources. You can invest millions and millions in climate change adaptation programs in many cities around the world that will get obliterated by an earthquake or tsunami. The damages to human life, the damages to property far exceed the impact of climate change so far.

Unfortunately, it creates more vulnerabilities than it resolves. I don't know who is sleeping better at night because the secretary general is looking for a trillion dollars to fund a climate change adaptation program. A tenth of that and you could do far, far more in terms of protecting lives and property from real hazards.

There are greater imperatives for addressing hazards associated with, for example, urbanization. The rate at which cities are growing right now, the rate at which they are paving over permeable soils, the rate at which cities are flooding as a result of this, has got bugger all to do with climate change. The ground can't absorb all of the runoff. A perfect example of this is Kampala [Uganda]. I've met a half dozen people who are flying the climate change impact flag about the increased flooding in Kampala over the last ten to 15 years.

You can't assume that the changes in the rain's intensity are the result of changes in the ozone level or global warming but in Kampala you can actually take look at the size of the city twenty years ago and look at the size of the city today, and put the floodplain on top of that and—guess what?—it's got only to do with the fact that the city is at a low elevation, close to the lake [Lake Victoria] and there's no place for that water to drain anymore.

That's the wrong way to drive this, to look for climate change adaptation plans when it's the fact that the city has grown. It's the urbanization of that part of Uganda that is creating problems that are affecting people's lives.

Resilience ...

(Continued from page one)

With the common characteristics at least we know they mean the same basic thing. Don't we?

The National Academies say, "Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." This definition appears to agree in principle if not to the letter to that used by many other institutions around the world. I'd suggest that it's better than many. Importantly, this description communicates an integration that is absent from early "engineering" interpretations, which described a property's simple physical elasticity, i.e., its ability to bounce back into shape after severe loading.

Thinking in terms of the familiar disaster risk reduction cycle of mitigation, preparation, response, and recovery, the "resilience imperative" apparently imbued in this definition clearly relates to every stage of the cycle. Resilience becomes an encompassing capacity and capabilities issue. In effect, in order to be resilient there must be an element of anticipation. You should be able to see the threat you face, then plan and prepare. You must be able to "take your hits."

Because there will always be a wave that's higher than the levee, you must minimize damage potential as best you can. And you must be able—to use resilience parlance—to recover to an "acceptable level of functioning," which is a highly subjective condition.

Intuitively, these first components do reflect the old "bounce back" perspective, that comfortable, "You didn't get us this time!" interpretation. One critique leveled against the linearity of this approach lies in Wildavsky's (1988) differentiation between resilience and anticipation. He argued that unexpected trouble, rather than being knowable in a predictive sense, is actually ubiquitous and unpredictable.

This is not to say that floods do not happen on floodplains. But it points out that anticipation-based strategies—especially those based on limited and inevitably contingent data—are always likely to be confounded by surprises. One example that illustrates this point with clarity is the UK Government's biennial publication, The National Risk Register. The NRR, which first appeared in 2008, defines the risk levels associated with the principal hazards and threats faced by the UK. It provides the background context that underpins UK civil protection resourcing.

What makes the NRR interesting from this anticipation perspective is that volcanic hazards did not appear in its pages until its 3rd edition in 2012—after the 2010 Eyjaflallajökull eruption in Iceland brought European air traffic to a standstill for several days. In terms of national resilience this episode is doubly educational, because while the eruption's impacts weren't anticipated by the risk experts who had formulated the earlier drafts of the NRR, the knowledge that such risks should have been anticipated was available. It's just that it wasn't sought or that the risk assumptions were calculated too conservatively. Each interpretation bears a lesson regarding who decides what needs to be anticipated and planned for.

Ubiquitous and unpredictable?

So if trouble is "ubiquitous and unpredictable," does the final clause of the Academies definition help? Yes it does, because what the final clause reflects is something quite different from the linear disaster risk reduction cycle components. It articulates something that resonates with basic tenets of evolutionary thinking.

The introduction of the concept of adaptation transforms resilience into a dynamic process, rather than as a station to be arrived at. It becomes a process that involves the capacity to "successfully adapt to adverse events." In effect, to be resilient, we must second-guess our threats and we need to implement the lessons of our mistakes.

It has been proposed elsewhere that as a basic human instinct, resilience is second only to survival. This perspective is useful, because adopting it allows the easier understanding that the human capacity for adaptation in the face of threats has been a fundamental factor in our survival as a species. This is because one particularly crucial aspect of our ancestors' lives illustrates that they were resilient—and lucky. This is the fact that every single one of them attained reproductive age in the face of genuinely terrifying threats—I'm thinking of sabertooth tigers, bubonic plague, glaciations, and war. So, it could be suggested that there is something in us all that means that we too are resilient. We haven't just bounced back, we've kept moving forward … like we're climbing Escher's infinite staircase.

So if we're all resilient already, what's the problem? Well, one of the problems is that today, in many places in the world and for many individuals and communities wanting to plan, to absorb, or to adapt to challenges they are facing, the barriers confronting them are large or deep rooted. Every effort to shift them is thwarted. Resilience is a property that is not simply associated with positive outcomes.

Ben Wisner (2004), coauthor of the influential *At Risk*, recently suggested recently during a discussion on the Jiscmail Disaster_Resilience listserv, that resilience thinking requires us to consider an interesting dichotomy regarding "resilience to be sought" and "resilience to be fought." Wisner's point is that an aptitude for adaptation, adjustment, and recovery from stressor influences is not something that is purely confined to positive phenomena. Poverty appears, for example, to be highly resilient, as do despotic regimes. This raises an important warning flag for those who have moved so readily into the resilience camp. This dichotomy, between the "to be sought" aspirational resilience, which allows people to take informed and effective actions to mitigate threats, may not be easy to implement in the face of "to be fought" resilience, with its propensity toward persistence and its resistance to relinquishing dominion, or its own vested interests.

Dynamic pressures, dangerous conditions

Some authors point out that this new focus on resilience is inevitably limited, because it devalues or sidelines the decades of work that has identified the importance that vulnerability reduction plays in reducing socially inequitable disaster effects. Lewis and Kelman (2010), echo Wisner's *At Risk* work, by pointing out that the root causes, dynamic pressures, and dangerous conditions which preconfigure vulnerability over time and space must be taken into consideration in any resilience building initiative.

Vulnerable people living in unsafe buildings in hazardous locations will only ever possess finite amounts of resilience, meaning that "at best, resilience is fragile amelioration for those suffering from long-term permanent vulnerabilities perpetuated for the advantage and profit of others." Such arguments reveal the importance of acknowledging that an understanding of the key drivers of differential vulnerability

(i.e., susceptibility to harm) provides a critical backdrop for our developing understanding of how resilience operates. However, they also illustrate why resilience needs to be considered as a social justice issue, too.

As part of the Community and Regional Resilience (CARRI) project, Betty Hearn Morrow wrote a report on the social-justice issues surrounding resilience. She pointed out, "Resilience requires: (1) knowledge of the hazard; (2) accurate perception of the risk; (3) understanding of available alternatives; and (4) the resources and flexibility to respond successfully."

We can agree to this typology because it fits closely to our own working definition. However, Morrow goes on to point out that these factors are not spread equally through societies. Their distribution is largely determined by social and economic forces, many of which are outside the control of much of the population. This coupling of unequal exposure to risk with an unequal exposure to resources is, she says, what preconfigures social vulnerability. Social vulnerability has been identified as a principal reason poor households are often situated in high-risk locations, why they live in sub-standard accommodation, and why they are more likely to be tenants than owner-occupiers. All these factors are known to increase disaster risk.

However, social justice issues are not just related to poverty. Differential vulnerabilities can also result from socially ingrained negative attitudes toward gender, age, disability, minority status, and social disconnection or exclusion, with these factors rarely occurring in isolation. Buckle (2003) et al. point out that for vulnerable people, anxiety about feeding the children and paying the rent on time constitute the "overheads" of daily life. Expecting them to seek information about and take substantive action to mitigate what are low probability threats, is unrealistic. Buckle et al. clarify that this is not to say that vulnerable people do not appreciate the consequences for themselves if a disaster were to occur, it's just that they can't afford to expend resources considering them. To adopt Weber's (2006) phrase, people only have a finite pool of worry with which to get through their day.

Therapeutic communities

This raises an important point about how resilience framing influences our perceptions about the way in which vulnerable people cope with extreme events. The shocking images of post-tsunami Aceh, or post-Katrina New Orleans notwithstanding, many media portrayals of hazard aftermaths show resilient communities in action. Daring rescues of neighbors by neighbors are breathlessly reported. Television shows evacuation centers, staffed by volunteers, full of exhausted but philosophical survivors.

These images provide evidence of altruism. When circumstances get extreme, people often go out of their way to help each other. Both Allen Barton and Charles Fritz wrote of these therapeutic community effects many years ago and every year the compendium of stories expands. This is good. It is a substantiation of true social resilience.

However, because disaster effects must be endured long after the camera crews have packed up and gone, it is vital

that this therapeutic effect is understood as providing an important but insufficient indicator of encompassing community resilience. To explain, in research after serious flooding in the northeast England city of Hull in 2007, monitored the recovery of a core group of flood affected citizens for 18 months. Each group member kept a diary throughout this period, in which they recorded their day-to-day experiences. They also completed a weekly diary task, in which they rated their quality of life, relationships with family and friends, and health. What emerged from the research was striking if not truly surprising. What the diarists reported was that while the day of the flood had represented a traumatic experience, it was what came after that caused them equal or greater distress and which tested their resilience to the full.

In his ground-breaking work on psychological resilience, Bonanno (2002) discovered that spousal bereavement resulted in the extended dysfunction of only one-quarter of his subjects. All other subjects felt great sadness, but were able to adapt and even grow from the loss over time. Bonanno labelled as resilient the most effectively adapting group, who reported no debilitating grief at all. This group comprised 45.9 percent of the sample, almost half. Although the experiment was not disaster-related in the natural hazards sense, what this research confirms is the innate human aspect of resilience that allows most individuals to keep going even after a single momentous loss.

In Hull the problem was that the diarists kept being hit. Not by flood waves, but by the waves of bureaucracy and mismanagement and poor workmanship that flowed from insurers and builders and other organizations with whom they were forced to engage. The diarists recovered. They all eventually moved back into their homes. But doing so required a roller-coaster ride of intense emotional work. Ups and downs for months, to the extent that the experience was referred to as like playing Snakes and Ladders.

Their experiences illustrate the skills learned, as well as

the persistence and the sheer determination that saw the diarists navigate and negotiate their way through this process. The diaries effectively refute any perception that the path back to the new normality after a hazard impact can ever be visualized as a uniformly rising stroke drawn on an x-y plot. Yes, it takes resilience to prepare and to respond, but it also takes resilience to recover and even then, the knowledge that vulnerabilities may still exist subtly and irredeemably changes perceptions of home forever. The Hull study is not alone in identifying this issue. It is just one of many stories of personal disasters inflicted by a hazard but then perpetuated by very human actions or inactions. These cases have lessons to teach all resilience advocates.

It is looking increasingly clear that in the coming decades the challenges our communities and our descendants, are going to face may come quicker, harder, more often, and from different directions, from those that have educated and tempered us. To confront this gathering storm the imperative, we are told, is to build our resilience. This is good advice, it is constructive, it provides legitimacy to those seeking to think innovatively and to those wanting to build 'surge protectors' into our systems of protection and sustenance.

We must not forget that the personal capabilities, capacities, and resources needed to prepare and plan for, absorb, recover from, and more successfully adapt to any threat or challenge will, for some, be wickedly constrained by factors beyond their control. What we must understand that the imperative is to nurture types of resilience that go beyond ideas that busy soup kitchens and conviviality are sufficient indicators of success. The resilience we seek necessitates that we challenge the institutions that create vulnerabilities and perpetuate risks and it demands that the strategies we adopt are socially inclusive and socially just. We all have an inherited instinct for resilience, but that does not mean that safety nets aren't sometimes required.

Hugh Deeming is the Scientific Technical Officer for the EU FP7 Building Resilience Amongst Communities in Europe (emBRACE) Project (www.embrace-eu.org), based at Northumbria University, Newcastle upon Tyne, UK. He is a co-moderator of the Jiscmail Disaster_Resilience List (disaster-resilience@jiscmail.ac.uk)

References

Bonanno, G. A., C.B. Wortman, D.R. Lehman, R.G. Tweed, M. Haring, J. Sonnega, D. Carr, D., and R.M. Neese. 2002. Resilience to loss and chronic grief: A prospective study from pre-loss to 18 months post-loss. *Journal of Personality and Social Psychology*, 83: 1150-1164.

Buckle, P., G. Marsh, and S. Smale. 2003. Reframing risk, hazards, disasters, and daily life: A report of research into local appreciation of risks and threats. *The Australian Journal of Emergency Management* 18: 81-87.

Hopkins, R. 2009. http://www.ted.com/talks/rob_hopkins_transition_to_a_world_without_oil.html?quote=600.

Lewis, J., and I. Kelman. 2010. Places , people and perpetuity : Community capacities in ecologies of catastrophe. *ACME: An International E-Journal for Critical Geographies*, 9: 191-220.

Manyena, S. B. 2006. The concept of resilience revisited. *Disasters*, 30: 434-450.

McAslan, A. 2010. *The Concept of Resilience: Understanding its Origins, Meaning and Utility*. Adelaide, Australia: Torrens Resilience Institute.

The National Academies. 2012. *Disaster Resilience: A National Imperative*. Committee on Increasing National Resilience to Hazards and Disasters. Washington, D.C.: National Academies Press.

Weber, E. U. 2006. Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change*, Vol. 77: 103-120.

Wildavsky, A. 1988. *Searching for Safety*. Transaction Books, London.

Wisner, B., P Blaikie, T. Cannon, and I. Davis. 2004. *At Risk: Natural Hazards, People's Vulnerability and Disasters*. Routledge.

Rethinking hurricane risk communication

An invited comment by Tim. L. Tinker and Winnie Chao

Large-scale weather events in the United States, like hurricanes Isaac and Katrina, represent a unique class of risk situations that challenge traditional approaches to risk and crisis communications. Public communications messaging is often chaotic as the storm's narrative emerges and unfolds in the days, hours, and even minutes before landfall. For example, during Hurricane Isaac, CNN was forecasting potential financial losses if the Gulf Coast's oil refinery industry were to feel the full brunt of the storm.

Before Katrina became a full-fledged hurricane, Lieutenant General Russel Honoré was urging President George W. Bush to declare a state of emergency in Louisiana so that the public would take the threat seriously. While the President urged Gulf Coast residents to follow the instructions of local officials, then-U.S. Rep. Bobby Jindal was blaming the federal government for failing to declare a state of emergency.

As these examples illustrate, public communications messaging leading up to and during a hurricane is often disjointed and disordered, resulting in a failure to effectively reach intended audiences.

For public officials and commercial entities alike, delivering messages about risk, be it hurricanes, earthquakes, or other natural disasters, may appear to be straightforward—decide what they want to say, who they want to say it to, and then say it. The message that the public receives is not just a matter of language. Its meaning and impact is affected by the circumstances in which the message is delivered, including who delivers it (source) and how it is delivered (channel).

Moreover, communication can operate at different levels at the same time. The ostensible message may be clear and simple, but it may be interpreted differently depending upon the values, attitudes, and belief systems of the recipients and their relationship to the source.

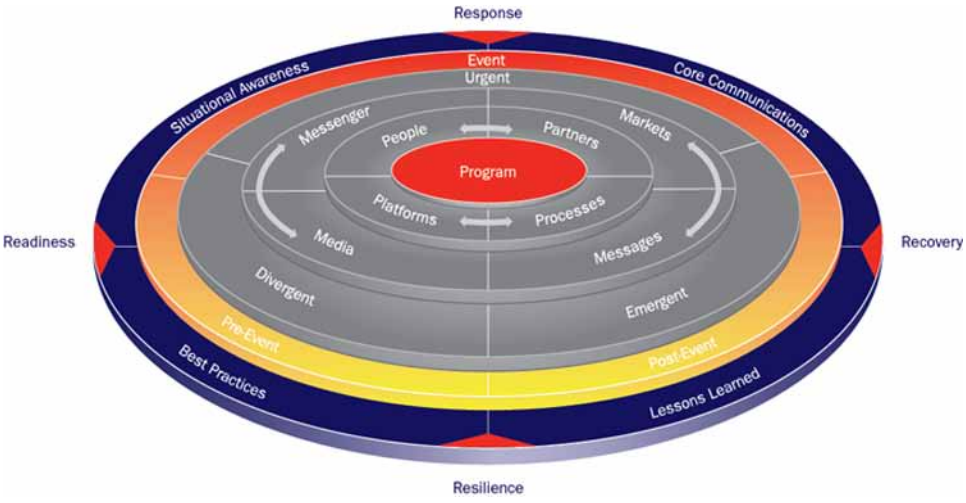
Benefits of Dynamic Communications Modeling

Dynamic Communications Modeling provides a robust but flexible approach for assessing and managing crises, responding to a range of urgent and emergent issues and threats, engaging key stakeholders in all phases of the response. DCM further provides a platform for examining the interactive effects of risk perceptions with the actual communications response before, during, and after an incident be it intentional, like a bioterrorism attack, or unintentional, like a hurricane. What emerges is increased situational awareness and a common operating picture reflecting the demands of the crisis as it unfolds, media coverage intensifies, and public trust and reaction fluctuates depending on how effectively (or poorly) the organization responds.

With many existing disaster communication approaches, it is assumed public trust only results from delivering the right information, in the right format, and through the right channels. Providing these communications will motivate individuals to adopt preparedness and response behaviors. However, this false assumption oversimplifies the risk communication process and the complexity of the target audience.

For example, in initial pronouncements, communications are aimed at providing the public with accurate information, improving their understanding of the risks. However, these communications ignore the audience's value judgments and the many different ways people receive, process, and make actual risk decisions. Even if the public understands the risks and accepts evidence about an impending threat, they typically value a "precautionary principle" approach to making decisions about such threats. Traditional messaging will not always be persuasive enough to motivate and sustain action.

As illustrated here, Dynamic Communications Modeling (DCM) provides a more holistic approach to assessing and managing communications before, during, and after hurricanes.



Integral to the model is the 4PMR enterprise methodology, which is comprised of the "4Ps"—people, processes, partners, and platforms as the foundation for effective urgent and emergent communications; "4Ms" which comprise an organization's spokesperson or messenger(s); the messages and how the messengers will address background information, threats, and challenges specific to an incident; the media; and markets; and the "4Rs"—readiness, response, recovery, and resilience—the phased approach to dynamic communications.

Dynamic Communications Modeling offers three major benefits.

- First, it incorporates a values-based approach for how decisions are made as large-scale natural disasters unfold and how information is processed by individuals or groups as they react to events with high levels of uncertainty and ambiguity.
- Second, DCM assesses hurricane risk as the event unfolds. Within the first few days and hours, as the hurricane approaches landfall, when risk perceptions and behaviors are in constant flux, people may change their perspectives in real time. Therefore, the decision to act quickly to mitigate impacts is not a one-time decision. In fact, there may be multiple opportunities for assessing and modifying decisions based on new and emerging information—such as changing news coverage and social media activity—that can shape and reinforce perceptions and opinions.
- Finally, DCM represents a more continuous, circular dynamic rather than a discrete and linear categorization, which does not consider changing circumstances within and outside impacted area. The model presents a "continuous dimension" involving a constant need to improve readiness and focusing on the relationship between the intensity of a crisis and the characteristics of the communications response.

DCM includes mechanisms to help maximize communication opportunities and minimize challenges. It also recognizes the value of other models, such as the Federal Emergency Management Agency's "Whole Community" approach. Whole Community is a philosophy of emergency management that encourages participation and engagement from all community stakeholders in order to effectively leverage available resources and relationships. DCM incorporates this philosophy as one of the model's key components, building on the notion that public trust relies on individuals personally identifying and connecting with the message. This, in turn, motivates them to act. During emergency situations, individuals are more likely to respond to messages from known community members.

Communicating with at-risk populations

DCM considers factors like emerging forces and trends in U.S. population demographics, that render traditional communications plans ineffective. These trends include an aging Baby Boom generation, the rising number of disabled individuals living outside institutions, increasing rates of obesity and asthma, and the rapid growth of immigrant populations. In a hurricane situation, these demographic groups are usually most at risk because of group-specific challenges to receiving and reacting to crisis communications. These audiences tend to place "greater trust in those people with similar characteristics, making it critical to develop communications strategies that incorporate cultural and economic diversity." DCM takes demographics-based behavior into account, understanding the necessity of using different information sources to reach diverse groups.

During Hurricane Isaac, despite calls for mandatory evacuations, many Plaquemines Parish residents chose to remain

in their homes. Plaquemines Parish has a "hardscrabble" reputation for residents hunkering down and bracing for rough weather, and even its elderly and sick residents are considered storm veterans. Those who stayed behind believed that if they "rode out Katrina," they could ride out Isaac. In these cases, DCM relies on local partners or community figures whom residents see as "one of their own" to convey hurricane risk messages in a way that motivates action, especially when circumstances change. In Plaquemines Parish, when Isaac unexpectedly stalled, threatening to flood inhabited areas, community leaders issued a mandatory evacuation. In the middle of the storm, they were able to move elderly residents to safety.

A recent survey revealed that while 57 percent of people believe their towns have well-developed hurricane plans, only 30 percent have faith in the federal government. Another study found that the largest determining factor for whether someone will pay attention to a hurricane message and take action, is the "degree to which message recipients trust the sender."In times of crisis, people place their trust in the communities and leaders they interact with every day. Trust-based communication ensure individuals respond appropriately.

By leveraging Whole Community methods and by partnering with community trust agents, DCM improves a hurricane communication plan's effectiveness in reaching different audiences and managing messaging. DCM links message immediacy and accuracy. Partners are kept informed of the objectives and message when asked to reach out to at-risk populations. Because partners understand these communities, they will adapt the message to address the particular concerns of those specific groups. Partners are also able to respond quickly to rumors and misinformation because of these open lines of communication. The engagement and inclusion of partners guarantees message consistency across groups, media outlets, and communication channels.

Conclusion

The United States has not experienced a major hurricane landfall (Category 3 or higher) since 2005. The 2009 and 2010 hurricane seasons both concluded with no hurricane affecting the nation. However, as Hurricane Isaac recently demonstrated, even a weak hurricane can still cause tremendous flood damage, and failure to properly communicate that threat can be devastating. The National Hurricane Center is currently devising a new prediction system that would include storm surge warnings with each hurricane forecast.

One of the most important stages of an effective hurricane risk communication plan is preparing before a threat is realized, especially if an unfamiliar message is being used for the first time (e.g., storm surge warnings and levels). With a new system, it will be critical for any hurricane communication plan to map out the message, including who delivers it, and how it is delivered.

Dynamic Communications Modeling prepares public officials and commercial entities to direct, guide, and inform the public during unpredictable crisis situations. The benefits of DCM—values-based approach, dynamic perspective, and continuous dimension—enable disaster communication plans to effectively deliver messages with the intended meaning and impact.

Tim L. Tinker and Winnie Chao both work at Booz Allen Hamilton, Inc. Tinker is director of the firm's Risk and Crisis Communications Capability. Chao is a strategic communications specialist working in the homeland security market.

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 HAZARD

Disaster Diplomacy: How Disasters Affect Peace and Conflict. By Ilan Kelman. 2011. ISBN: 978-0-415-67993-0. 184 pp., $144 (hardcover). Routledge. www.routledge.com.

Occasional *Natural Hazards Observer* contributor Ilan Kelman takes a hard look via theory and case studies at the diplomatic impact of disasters. Kelman tackles what we might call the "myths of disaster diplomacy" with a cold eye. Despite well-established benefits of humanitarian aid in the wake of catastrophe, the same disasters don't often result in long-term diplomatic success unless other political factors are favorable as well.

"The theme appears to be most popular in the media after a disaster hits a conflict zone or a country which has enemies," he writes. "An expectation is often implied that disaster should bring peace, whether or not any precedent or realism exists for that expectation. Policy—and decision-makers can be forced to respond to populist pushing for a disaster diplomacy process that they would rather avoid —legitimately or otherwise."

Kelman offers a sophisticated analysis of the successes and failures of disaster diplomacy since 2000. His case studies include China after the 2008 earthquake, Hurricane Katrina, the Indian Ocean tsunami and many other major disasters of the first part of this century.

He warns about "undue optimism" in the wake of disasters, but notes that hard negotiations can lead to positive results. He says, "The lessons examined here are: Be ready for assistance offers from enemies; All diplomacy tracks can be useful; Disaster diplomacy operates at many levels; Lessons should be implemented, not forgotten."

Disaster and the Politics of Intervention. Andrew Lakoff, editor. 2010. ISBN: 978-0-231-14696-8. 160 pp., $55 (softcover). Columbia University Press. cup.columbia.edu.

Disaster risk has been increasingly privatized in the Unit-

ed States, with market mechanisms often replacing regulation as the go-to strategy for mitigating vulnerability—think flood insurance or carbon emission trading. It's not particularly controversial to observe that the free market has not been good at incorporating the value of public assets—clean air, clean water, public health—by market mechanisms.

So what are the implications for risk management when we replace public institutions with the market? This interesting question is at the heart of this short book, with five chapters examining the economic politics of disaster.

One curious result of this shift, explored in one chapter of this book, is the emergence of privatized military firms providing peacekeeping services and humanitarian aid. P.W. Singer argues in some ways "PMF clients, like humanitarian organizations, can better manage such tensions."

Benefits from privatizing these services—to existing humanitarian organizations, at least—include regularized security and "new possibilities for wholesale privatization of peacekeeping/enforcement operations." But problems include cultural clashes, quality of labor, contractual issues, and whether a private contractor can "scale up" to meet additional pressures in country.

The book doesn't decide public versus private intervention, examining benefits and pitfalls of the market approach.

Risk Modeling, Assessment, and Management. By Yakov Y. Haimes. 2009. ISBN: 978-0-470-28237-3. 1,040 pp., $165 (hardcover). John Wiley and Sons. eu.wiley.com/WileyCDA/Section/index.html.

This densely packed textbook brings the relatively new field of risk analysis into focus. "The ultimate utility of decision analysis, including risk-based decision making, is not necessarily to articulate the best policy option, but rather to avoid the extreme, the worst, and the most disastrous policies-those actions in which the cure is worse than the disease," the author notes.

"The ultimate aim of good risk assessment and management," Haimes writes, "is to suggest some theoretically sound and defensible foundations for regulatory agency guidelines for the selection of probability distributions."

This is a text for students of risk analysis, covering everything from the art of risk analysis to the statistics of extremes.

The Women of Katrina: How Gender, Race, and Class Matter in an American Disaster. Emmanuel David and Elaine Enarson, eds. 2012. ISBN: 978-0-8265-1798-2. 272 pp., $69.95 (softcover). Vanderbilt University Press. www.VanderbiltUniversityPress.com.

Gender indisputably played a role in the experiences people had in Hurricane Katrina. But in the analysis of the event, there was little systematic assessment. This books attempts to address that oversight. "Hurricane Katrina made landfall on a highly gendered terrain along the Gulf Coast: images flashed around the world of pregnant women in sweltering shelters, anguished mothers searching for their children, and exhausted older women wading through filthy waters," write the editors in their introduction to this volume of research essays. "Despite the undeniable presence of gender in these images, the dominant Katrina story that emerged did not see gender and instead emphasized the intersecting inequalities of race and class. When gender did get media coverage, it was often from pundits on the political right who were quick to blame unmarried women of color for their own suffering."

The book casts a wide net to capture the stories of women in the wake of Katrina, often relating it to other disasters in which women's issues were overlooked or underemphasized. The book includes what might be called case studies—but here are sometimes called "family stories"—that outline the isolation many women felt when displaced from their homes and given inadequate information about their own futures.

This work ranges so widely in its topic that it is difficult to summarize. It puts the stories of women in disasters in the forefront, through the lens of Hurricane Katrina—an event that has left its mark on the conscience of every American.

Disasters 2.0: The Application of Social Media Systems for Modern Emergency Management. By Adam Crowe. 2012. ISBN: 978-1-4398-7442-4. 321 pp., $71.35 (hardcover). CRC Press. www.crcpress.com.

There's probably no development in hazards work so promising, so anticipated, and so little understood as social media. A hot topic for research, a holy grail for disaster communication, it remains to be seen whether social networks can be seamlessly integrated into the emergency management framework.

The first issue is: What is it? "Social media and Web 2.0 technologies are both umbrella terms to cover the creation of online systems that allow facilitation of nearly instantaneous communications through shared networks and technological systems," writes Adam Crowe in this book. "One source estimated that nearly 4,000 different social media systems currently exist, with some of these networks containing thousands of additional subnetworks … Defining social media and Web 2.0 technologies can be difficult due to the wide spectrum of available systems and constant developments within this arena."

The third chapter talks about "citizen journalism" as a possible replacement for traditional media. There can be little doubt that "individuals throughout the world are beginning to utilize social media to report their surroundings, which includes emergency or disaster events that affect geographic locations 'upstream' of the event." There have been several successful examples of this, including fire and evacuation route maps for wildfires in several locations put together by local citizens or, sometimes, journalism students. During the 2007 Virginia Tech shootings, social media correctly identified the victims without a single error. "Although researchers found that no single online social media list contained all 32 victims' names, they were routinely accurate," and faster than the official sources.

However, there have been some less-than-successes. In the recent Newtown, Connecticut shootings, for instance, social media were used to misidentify the shooter, to incorrectly report that the shooter's mother was a former employee at the school where the shootings took place, that the shooter had been a student there … and so on. The information gleaned from social media was spread by conventional news outlets, everyone in a race to be the first with information, unwittingly illustrating Winston Churchill's mot, "A lie gets halfway around the world before the truth has a chance to get its pants on."

This book deals head on with the promise and problems in this very early stage of social media use in disasters. A problem for emergency managers is that they cannot control the release of information. Social media and citizen journalism are voracious and immediate.

Contracts and Grants

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

Federal disaster relief and the Stafford Act: Analyzing recovery outcomes in disaster declared and denied areas of the United States. National Science Foundation grant #1233352. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1233352. $15,618 to principal investigators, Jayajit Chakraborty, and Richard Salkowe, University of South Florida, jchakrab@usf.edu.

This project examines disaster recovery outcomes with respect to individual and community physiological and psychosocial well-being in federal disaster declared and denied counties of the U.S. federal disaster declarations are authorized by the president under the provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. This act created a mechanism for the distribution of various forms of individual and household assistance after disasters. Evidence of recurring problems associated with disparities in the recovery from disasters has led to a call for Stafford Act policy reformulation.

This research will provide clarity regarding questions pertaining to sufficient and equitable health-related recovery outcomes in communities that have differential access to the array of federal resources that are available under the provisions of a presidential disaster declaration. The theoretical context of the investigation utilizes Hobfoll's "conservation of resources" model as a framework for understanding the relationship between physiological and psychosocial well-being and the capacity to retain, protect, and rebuild individual and community resources in presidential disaster declared and denied areas.

The project uses encrypted empirical data, obtained from the Centers for Medicare and Medicaid Services, to support a multilevel longitudinal retrospective cohort study of individual and community health-related well-being in disaster declared and denied counties in Illinois. A mixed methods approach, utilizing quantitative archival analyses and qualitative open-ended interviews, will be employed to address the following fundamental question: Is there a significant difference in post-event disaster recovery between disaster declared or denied places that experienced similar types of natural disasters, as measured by changes in indicators of individual and community well-being?

Impact of Hurricane Sandy on the ecology of the New Jersey shorelines: Recovery and resilience. National Science Foundation grant #1313185. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1313185. One year. $100,000 to principal investigator, Michel Boufadel, New Jersey Institute of Technology, boufadel@njit.edu.

The ecological resilience of the North Jersey shorelines was evaluated following Hurricane Sandy. Three locations were selected each representing a different ecosystem: Sand beaches in Raritan Bay, a wetland system, and a site on the Passaic River a mile inland of Newark Bay. These systems were historically freshwater to brackish, and it was important to quantify the stress within them as a result of the intrusion of large volumes of seawater and sand onto them. Sampling transects were set across sand beaches whose inland areas where flooded, and the flooding persisted one week after the end of the storm. The hypothesis was that this residential flooding altered the ambient flux of chemicals in terms of quality and quantity. Measurements of pore water are being acquired, and they are analyzed for nutrients, metals, and salinity. The wetland system was brackish, and the hypothesis to test was that the behavior of the wetland switched from methanogenesis to sulfate reduction. Sediment samples are being analyzed for sulfide, nutrients, metals (iron, manganese, etc), and PAHs. The model MARUN, a finite element model for density-dependent flow in variably-saturated media will be used to interpret the results. The hypothesis being tested is that the impairment of the Passaic River due to Hurricane Sandy is more severe than that due to Hurricane Irene due to the large storm surge of the prior.

Coastal areas in urban centers are being stressed by increased population density and activity. While the quantification of this stress is challenging, it becomes extremely difficult in the presence of major but infrequent stressors such as hurricanes. In addition, urban coastlines consist of a mixture of anthropogenic structures, controlled (or regulated) estuaries, beach face morphology, and wetlands. Maintaining such a system whole requires various tools and measurements, each adapted to a particular ecosystem. In this project, site-specific measurements were made in three ecosystems: beach face, wetland, and estuary residential areas, and the goal of the project is to provide data that could be used to better construct a model for coastline sustainability.

Profiling of winter storms. National Science Foundation grants #1247473, 1247412, and 1247404. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1247473. Three years. Three grants. $22,251 to principal investigator, David Leon, University of Wyoming, leon@uwyo.edu, and $81,422 to principal investigator, Kevin Knupp, University of Alabama in Huntsville, Kevin@nsstc.uah.edu, and $234,296 to principal investigators, Robert Rauber, Greg McFarquhar, and Brian Jewett, University of Illinois at Urbana-Champaign, r-rauber@uiuc.edu.

Processes governing the spatial and temporal variability of precipitation within the "comma head" sector of extratropical cyclones remain poorly understood. This sector of baroclinic storm systems is often the focus of hazardous winter weather including heavy snowfall, blizzards and ice storms that markedly impact transportation and other human activities. This investigative team seeks to improve our understanding of precipitation substructures within this zone by addressing outstanding questions arising from the Profiling of Winter Storms (PLOWS) field campaign, which was carried out during the winters of 2008-09 and 2009-10. Observations collected during PLOWS included extensive in-situ microphysical data gathered by the NSF/NCAR C-130 aircraft, high-resolution remote sampling of precipitation structures by the University of Wyoming Cloud Radar and Lidar carried aboard the C-130, complementary views from ground-based

radars and profiling systems, and special serial rawinsonde launches. Additional insights will be gained through high-resolution simulations suitable for comparison with a wide range of observed precipitation substructures.

Planned investigations will center on: (1) the nature and source of instability creating cloud top generating cells, including determination of updraft magnitudes, origins and role supercooled water in the generation and growth of ice particles near cloud top, ice particle concentrations within generating cells and associated precipitation plumes, and processes leading to the rather ubiquitous generating-cell structures observed during PLOWS; (2) the means by which potential instability is generated within zones characterized by deep upright elevated convection on the warmer side of comma-head regions, the relationship between the "dry-slot" upper-tropospheric airstream moving over warm-frontal surfaces, and determination of the role of synoptic-scale vertical motions accompanying frontogenesis in triggering release of this instability; (3) the origins of linear precipitation bands and their potential creation by synoptic-scale deformation acting upon descending ice particle plumes issued by elevated generating cells, as well as differing ice particle characteristics within and outside these bands; (4) the relationship of polarization radar signatures to measured in situ microphysical properties, and in particular determination of whether supercooled water or its effects (e.g., rimed particles) can be dependably detected via remote sensing; and (5) the nature of stratiform- vs. convective-cloud region flows with attention to fine scale wave features, frontal interfaces, their effects on microphysical processes, and their relationship to isentropic surfaces, shearing instability, and low-level fronts in the production of locally-enhanced precipitation rates.

Dynamic linkages between the transition zone and surface plate motions in 3D models of subduction. National Science Foundation grant #1246864. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1246864. Two years. #89,903 to principal investigator, Magali Billen, University of California-Davis, mibillen@ucdavis.edu.

The motion of tectonic plates at the surface of the earth is caused by forces within the earth's mantle: the push of positive buoyancy at spreading ridges and the pull of sinking plates (slabs) at subduction zones. At the earth's surface these forces result in earthquakes where the two plates slide past one another (plate boundaries). The ability of the force from sinking slabs to effectively pull tectonic plates behind them depends on how the slab deforms within the earth's mantle, which in turn depends on how its material properties change as it deforms.

In addition, the total force associated with the sinking slab depends on changes in the crystal structure of the minerals (phase changes), which lead to changes in density within the slab. Most of these phase changes occur between 410 and 660 kilometers beneath the earth's surface, a region known as the transition zone. Ultimately, the deformation of the sinking slab inside the mantle is manifest in seismicity occurring within the slab to depths of 660 km beneath the earth's surface, and observables changes in plate motions at the earth's surface.

The purpose of this study is determine: (1) how surface plate motions and the state of stress within surface plates react to, and provide feedbacks for, slab dynamics in the transition; (2) what is the origin of deep slab seismicity; and (3) if the observed shape of slabs is related to intrinsic properties of the subducting plate and plate boundary, or is instead a reflection of the time-dependent evolution of the slab. While the focus of this study is on deformation within the earth's mantle, this deformation couples to the motions of plates at the earth's surface, which can cause destructive earthquakes and tsunamis.

To address these questions we will develop three-dimensional numerical models (simulations) of subduction dynamics. More specifically we will use the best laboratory and observational constraints on the mineral composition of the plate (the crust, the residual harzburgite and the mantle layers), phase transitions (including all major mineral components) and rheology of the plate and mantle. We will enable dynamically mobile plates and plate boundaries, which are essential for understanding the physical connection between slab deformation and surface plate motions.

These models eliminate several simplifying assumptions used in previous studies allowing us to make connections between slab deformation and surface plate motions and slab seismicity. Model results will be compared to global data sets on slab shape, plate characteristics and kinematics, as well as regional seismic observations on the state of stress within slabs and seismic discontinuities (which occur at phase transitions) across subducting lithosphere.

Collection of perishable Hurricane Sandy data on weather-related damage to urban power and transit infrastructure. National Science Foundation grants #1316335, 1316301, and 1316290. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1316335. One year. Three grants. $20,000 to principal investigator, Rae Zimmerman, New York University, rae.zimmerman@nyu.edu, and $20,000 to principal investigator, Carol Friedland, Louisiana State University & Agricultural and Mechanical College, friedland@lsu.edu, and $9,954 to principal investigator, Dorothy Reed, University of Washington, reed@u.washington.edu.

This project will collect perishable damage data caused by Hurricane Sandy, which made landfall on October 29, 2012. It was a very large storm (almost 800 miles in diameter according to National Oceanic and Atmospheric Administration) that affected large areas of coastlines of New York (Long Island and New York Metropolitan area) and New Jersey. The storm was judged to be Category 1 based on its wind speed. However, because of its size and coinciding with high lunar tide, it generated high storm surge. The New York Metropolitan area sustained severe damage to coastal structures due to surge and wave actions. Most of the New York Metropolitan area lost electrical power and the transportation system became inoperable because of flooding of tunnels and loss of power. The project will collect data on weather, storm surge and floods, power outage, transit stoppage, and interdependencies of infrastructures in New York Metropolitan area.

The project will identify, collect and disseminate weather-related hazard and damage data induced by Hurricane Sandy for power and transit infrastructure in New York Metropolitan area. The weather data will include measurements of storm surge, flooding, rainfall and wind speeds. The spatial extent of the data collection will be the transit region of New York Metropolitan area and the service areas of the power delivery systems responsible for the transit networks. The weather and damage data will be geo-coded and timelines at regular intervals over the duration of infrastructure recovery will be established.

Wave and surge structural damage to shorefront residential properties from Hurricane Sandy. National Science Foundation grants #1314648, and 1314612. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1314649. One year. Two grants. $14,994 to principal investigator, Ning Lin, Princeton University, nlin@princeton.edu, and $35,000 to principal investigator, Andrew Kennedy, University of Notre Dame, Andrew.B.Kennedy.117@nd.edu.

This project will collect perishable damage data caused by Hurricane Sandy that made landfall on October 29, 2012. It was a very large storm (almost 800 miles in diameter according to National Oceanic and Atmospheric Administration) that affected large areas of coastlines of New York (Long Island and New York Metropolitan area) and New Jersey.

The storm was judged to be Category 1 based on its wind speed. However, because of its size and coinciding with high lunar tide, it generated high storm surge. The coastline regions received serious damage by the flood due to surge and impact forces of waves. Residential structures along the coastlines sustained severe damage and destruction.

This collaborative project will collect field data of damaged residential buildings focusing on the New Jersey coastal area. Two major goals for collection of data are: (1) to collect perishable data on residential building damage levels, failure modes, and building characteristics (elevation, specific connections/members failed, age); and (2) to find damage gradients, and to identify and quantify their causes. Small teams will evaluate and record data for every residence in the selected region.

Data taken will include location, elevations, house type and size, approximate age, large scale storm erosion/accretion, local scale foundation scour, approximate waterlines, visible damage from wind/waves, damage levels, damage/failure modes, specific connection and member failures, and environmental exposure (sheltered behind buildings/dunes, open to sea). Numerous GPS-tagged pictures will be taken of each house from multiple angles. With three or four teams of two people each, 400 to 600 houses will be surveyed for the database.

Conferences and Training

March 4-5, 2013
Mass Fatality Management Symposium
Houston Regional Catastrophic Preparedness Initiative
Houston, Texas
Cost: $75

This conference will address ways in which to manage disaster deaths and mass fatality incidents. Topics include death certifications and remains disposition, communicating with families and the public, first responder mental health, creating temporary morgues, and victim identification.

houstonmfm.eventbrite.com

March 5-7, 2013
Missouri Community Forestry Council 20th Annual Conference
Missouri Community Forestry Council
Joplin, Missouri
Cost: $164

This conference will focus on the effects of natural disasters on community forests and basic preparedness, mitigation, and disaster response strategies. Topics include the wildland urban interface, utility disaster response strategies, Joplin's tornado recovery, flooding effects on trees along the Missouri River, and ways to leverage resources to restore trees after a disaster.

mocommunitytrees.com

March 10-12, 2013
National Tornado Summit
Oklahoma Insurance Department, Storm Prediction Center, and others
Oklahoma City, Oklahoma
Cost: $265

This conference will help insurance professionals and emergency managers work to find ways to better protect lives and property from extreme weather. Topics include disaster preparedness for special populations, bystander roles in disaster response, why people ignore tornado warnings, emergency plans for businesses, the impact of inadequate insurance coverage, social media and disaster response, and volunteer and faith-based organizational contributions to emergency management.

www.tornadosummit.org

March 12, 2013
Second Annual Forum for Disaster Victim Identification
The Royal College of Pathologists
London, UK
Cost: $273

This conference will discuss techniques and legislation related to the identification of disaster victims. Topics include the importance of culture in victim identification, roles and duties of coroners in disaster, academic programs for disaster victim identification, and age estimation from developing teeth.

www.regonline.co.uk/builder/site/default.aspx?EventID=1131018

March 13-15, 2013
Asia Water Week
Asian Development Bank
Manila, Philippines
Cost: Free

This conference will look at ways to strengthen and reform Asia's water sector in ways that will result in sustainability, private sector investment, and increased expertise.

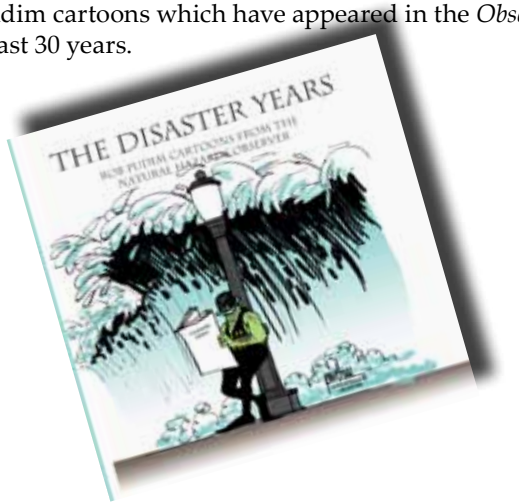
Natural Hazards Observer
ISSN 0737-5425
Printed in the USA.
Published bimonthly. Reproduction with acknowledgment is permitted and encouraged.

The *Observer* is available free online. A print subscription to the *Observer* is $15 a year to subscribers within the United States. Back issues of the *Observer* are available for $4.00 each, plus shipping and handling. Orders must be prepaid. Checks should be payable to the University of Colorado. Visa, MasterCard, and American Express cards are also accepted.

Subscribe to the *Observer* and the Natural Hazard Center's electronic newsletter, *DR-Disaster Research News You Can Use*, at:

http://ibs.colorado.edu/hazards/subscribe

Paid subscribers to the print version of the *Natural Hazards Observer,* will receive a free copy of *The Disaster Years*, a book of Rob Pudim cartoons which have appeared in the *Observer* over the last 30 years.



Topics include climate change; the intersection of water, food, and energy; disaster management; water supply and sanitation; water resources and environment; and agriculture and irrigation.
www.adb.org/news/events/asia-water-week-2013

March 19-23, 2013
Natural Resource Distribution and Development in the 21st Century
The Society for Applied Anthropology
Denver, Colorado
Cost: $150

This conference examines how equitable access to basic resources can be sustained. Topics include issues of water usage and distribution, the impact of disasters on cultures and livelihoods, current drought adaptations and how they apply to future climate variability, coastal community disaster resilience strategies, postdisaster community reconstruction and resettlement, and the gaps between disaster knowledge, policy, and practice.
www.sfaa.net/sfaa2013.html

March 19-21, 2013
Wildland Urban Interface
International Association of Fire Chiefs
Reno, Nevada
Cost: $375

This conference will discuss solutions to wildland-urban interface fire suppression, prevention, and mitigation challenges. Topics include creating fire-adapted communities, assessing wildfire hazards, preventing accidental or intentional wildfires, and reducing wildfire risk while protecting environmental interests.
www.iafc.org/WUI

March 20-22, 2013
Disaster Resistant University Workshop
The University of New Orleans CHART
New Orleans, Louisiana
Cost: $30

This conference will address the risk assessment and mitigation planning challenges facing universities. Topics include an introduction to multi-hazard mitigation planning, campus emergency management, the differences between disaster "resistance" and "resilience," faculty's role in building campus resilience, and how to conduct detailed vulnerability assessments of campus buildings.
crescentcityevents.com/lindyboggs/

March 25-28, 2013
National Hurricane Conference
National Hurricane Conference
Orlando, Florida
Cost: $350

This conference is focused on strengthening hurricane preparedness and response in the United States and Caribbean by exploring new ideas and lessons learned, as well as the basics. Topics include evacuation decision making, amateur radio communication, healthcare accessibility, fostering resilient communities, debris management, and utility damage assessments.
hurricanemeeting.com

May 20-22, 2013
Seventh National Seismic Conference on Bridges and Highways
Federal Highway Administration, Caltrans, and others
Oakland, California
Cost: $550

This conference will focus on teaching engineers best practices for mitigating earthquake damage to bridges and highways. Topics include the design and use of seismic isolation bearings, post-earthquake repair and recovery, performance-based seismic design, liquefaction, lateral spreading, and ground movement, tsunami loads and design, multi-hazard design, monitoring bridge performance in extreme events, and innovative technologies and materials for improved bridge resilience.
www.7nsc.info

Natural Hazards Center
Institute of Behavioral Science
University of Colorado at Boulder
483 UCB
Boulder, Colorado 80309-0483

Change Service Requested

Non-Profit Org.
U.S. Postage
PAID
Boulder, CO 80309
Permit No. 156

Printed on recycled paper

Support the Natural Hazards Center

The success of the Natural Hazards Center relies on the ongoing support and engagement of the entire hazards and disasters community. The Center welcomes and greatly appreciates all financial contributions. There are several ways you can help:

Support Center Operations—Provide support for core Center activities such as the *DR* e-newsletter, Annual Workshop, library, and the *Natural Hazards Observer*.

Build the Center Endowment—Leave a charitable legacy for future generations.

Help the Gilbert F. White Endowed Graduate Research Fellowship in Hazards Mitigation—Ensure that mitigation remains a central concern of academic scholarship.

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: www.colorado.edu/hazards/about/contribute.html

Or call (303) 492-2149 to discuss making a gift.

A U.S.-based organization, the Natural Hazards Center is a nonprofit, tax-exempt corporation under Section 501(c)(3) of the Internal Revenue Code.