Natural Hazards Observer

NATURAL HAZARDS CENTER

Volume XXXIV · Number 5 May 2010

Tsunami Survivors Tell Their Tales

Learning From the Neighbors

An Invited Comment by Walter Dudley, Jeanne Johnston, and Cindi Preller

Mack and Bob Eads are brothers who ran a small business in Lowell Point outside of Seward, Alaska in 1964. A magnitude 9.2 quake struck in Prince William Sound on Good Friday that year, the largest experienced in North America. It generated a tsunami wave of 30 feet in some areas, killing 122 people in Alaska, Oregon, and California.

The Eads brothers tried to escape the approaching tsunami in two trucks they hoped to save. Mack was in the rear, driving a loaded logging truck. He had to dodge logs thrust through the cab of the truck when the wave struck. He nearly drowned when the truck filled up with water. He escaped by swimming through water he described as being "like swimming through cement." Bob, in the first truck, never even got his feet wet, but went back to rescue his brother. Both said next time they wouldn't try to escape in trucks, but rather would run uphill quickly.

To design effective tsunami education and mitigation, the natural hazards community must understand how individuals perceive a tsunami threat prior to the event, how they react at the moment of crisis, and how they view, participate in, and react to the recovery process in the short, medium, and long term.

The stories of individual tsunami survivors provide information on how to best communicate our message. These narratives tell the story as seen by individuals in the communities affected by these devastating natural hazards.

Personal histories offer insight into differences in various cultures, religious beliefs, ages, genders, occupations, and levels of education.

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INSIDE ...

The cost-benefit of health

Does Ethics Require the Elimination of Diseases?

Control diseases or eliminate them? It depends.

The global eradication of polio is within reach, and is an ethical imperative, according to research published in *The Lancet*.

But another paper, this one in the *Proceedings of the Royal Society B* argues that controlling diseases among the most vulnerable populations is more cost-effective than eliminating them altogether.

Once a scourge in the developed world until the widespread use of vaccines to prevent it, polio is now endemic in only four countries—India, Pakistan, Afghanistan, and Nigeria. Polio eradication strategies have in recent years focused on economic and technical feasibility issues, not ethical ones. But a control strategy—as opposed to eradication—would mean that four million children would contract the disease over the next 20 years.

The authors of *The Lancet* piece ask, "How can we ethically justify this course of action when the opportunity and means to rescue are available?" Examining only economic aspects of eradication overlooks "an important moral calculation: the human cost of failing to eradicate," they say. "This is the cost of lives not saved, the lives afflicted by polio (including those family members who care for paralyzed children), and the impact of those lives on the future of the broader community."

But McGill University biologist Jonathan Davies says that in the case of most diseases, it's cheaper and more effective to control them in vulnerable populations. Reducing the prevalence of diseases in areas most affected by them is a far more effective and efficient strategy than trying to eradicate them altogether, which is extremely difficult and costs billions of dollars. What's more, he says, new research shows that the most at-risk populations can be identified using just three variables.

Claudia Emerson, the program leader in ethics at the University of Toronto's McLaughlin-Rotman Centre for Global Health, says that the two approaches discussed in these apparently dissonant papers are not so different. Of Davies work, Emerson says, "I thought it was an interesting analysis. It doesn't undermine our claims at all. In my understanding of the paper, they are advocating for a reduction in the prevalence of disease under the assumption that eradication is not possible."

Emerson says that polio is very close to eradication worldwide. There were 350,000 cases of the disease in 1988 when the Global Polio Eradication Initiative was launched. Only 1,600 cases were reported in 2009. "It's really running a marathon," Emerson says. "We're close to the finish line and it doesn't make much sense to stop short of the finish line. We have a moral duty to do that."

Only one disease has ever been eradicated worldwide—smallpox. "Polio is next in line," Emerson says. "When it's possible to eradicate it, from an ethical perspective, it's clear. But what they presented is not incompatible with what we presented. Reduction makes sense where eradication is not possible … There's no ethical obligation to do something that it's not clear you can achieve."

Davies says of the Emerson et al. paper, "It's a very interesting argument because obviously you don't want

to ever say that you shouldn't try to save lives, no matter how you go about it. The ethical argument is, I suppose, 'Whose lives do you want to save?' If your aim is maximize the number of lives, or human years of life, globally, or is your aim to keep local populations within critical areas as healthy as possible, especially if they are paying for healthcare through taxpayers dollars. Should that money be put back to the taxpayers, or have you got a moral or ethical argument for spending it elsewhere, where the benefits are more diffuse?

"So the ethical argument for spending large amounts of money to eradicate one particular disease, it's not simple, I'd say."

Davies says that for most diseases, though, eradication is probably not possible, would be very expensive, and may not even be desirable. "If you want to just save lives, a cheap way to do it, if that's your aim, would be to treat people for dysentery, for example—very low costs. There are several millions of people a year—children—dying from dysentery. It's very easily treatable. One solution is access to clean water. Compared to the efforts required to vaccinate and treat people for infectious diseases, which are transmitted between people directly, that's a really cheap way to save lives," he says.

And, for some diseases, eradication is probably impossible regardless of how much is spent, "Basically, we haven't got a hope in hell of eradicating malaria. There are several strains going around. There are animal reservoir hosts. Even if we removed it from the human population, it might then re-infect us in the future, through an animal host. We'd have to not only treat humans, we might have to also remove the vector mosquitoes. You might have to make another species extinct. There's also the risk of it just coming back in from a wild animal pool."

He adds, "With polio, the difference is that we have it within our grasp. We could actually eliminate this disease. At the moment, it's really not feasible for malaria. Even within the United States, there have been huge efforts to remove the vector, there's still malaria present in the U.S., just at a very low level, a low prevalence."

"Global drivers of human pathogen richness and prevalence" by Robert Dunn, Jonathan Davies, et al. was published in the *Proceedings of the Royal Society B: Biological Sciences* online on April 14, 2010 (rspb.royalsocietypublishing.org). "The art of medicine: Is there an ethical obligation to complete polio eradication?" was published in *The Lancet* on April 17, 2010 (www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)60565-X/fulltext).

God Is 100-to-One Against

You can bet on it.

Paddy Power is at it again. In the last issue we reported Ireland's self-described "largest bookmaker" was offering wagers on the next big earthquake. Now they're taking on the Almighty.

Coinciding with the resumption of the Large Hadron Collider at CERN in Switzerland, Paddy Power is taking bets on what the physicists there will discover first. The odds they'll discover: dark matter, 11-to-10; black holes,

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They Said It ...

"While Haitian resilience has been duly recognized around the world, few appear to be interested in talking to Haitians about how to rebuild their communities and how the billions likely to be pledged to their country will be used."— *Loune Viaud of Zanmi Lasante/Partners in Health in Haiti and Monika Kalra Varma of the Robert F. Kennedy Center for Human Rights, writing in the* **Boston Globe**.

"I have heard the president say that based on what the engineers tell him, it will take 1,000 dump trucks working for 1,000 days to clear away the debris, and I am not sure even the experts know how big is the pile." —*Leslie Voltaire, an architect and diplomat who is leading the effort to plan Haiti's reconstruction, quoted in* **The Washington Post.**

"I think that the tsunami detection and warning operation that we saw over the weekend worked spectacularly well. Especially in comparison to 2004, when the Indian Ocean tsunami hit, there's a world of difference." —*National Oceanic and Atmospheric Administration administrator Jane Lubchenko, interviewed in* **The Washington Post,** *speaking about tsunami warnings after the Chilean earthquake.*

"The disaster of Haiti is not the earthquake. What we are seeing here is what happens when an extreme natural event occurs in the lives of people who are already frighteningly vulnerable." —*International Federation of the Red Cross and Red Crescent Societies in the report* **Haiti: From Tragedy to Opportunity.**

"We are facing some urgency now. We are one million people living in the street."—*Haitian President René Préval, quoted in* **The Washington Post.**

"As a neuroscientist, I remain interested in learning how these phenomena may help us to better-understand how individuals process information so as to become resilient to such horrible events, which could easily include pandemics, famine and war. As a human being, I am in awe of the will, strength and desire to overcome that are all manifested by the people subjected to such horrors." —*Noah Gray, editor of Nature, writing in* **Haiti Rewired** *(http://haitirewired.wired.com/profiles/blogs/senior-editor-of-nature-on).*

"Many women who do not dress modestly ... lead young men astray, corrupt their chastity and spread adultery in society, which increases earthquakes." —*Senior Iranian cleric Hojatoleslam Kazem Sedighi, quoted by Iranian media, reported by* **Huffington Post** *(http://www.huffingtonpost.com/2010/04/19/iranian-cleric-promiscuou_n_543100.html).*

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eight-to-one; dark energy, 12-to-one; or God, 100-to-one.

Odds that Thomas Aquinas is spinning in his grave: eight-to-five.

Poor Design, Poor Construction in Haiti

Poverty and density led to devastation

Haiti's buildings were particularly vulnerable to damage from the recent 7.0 magnitude earthquake because of a lack of attention to earthquake hazards in design and construction, and poor construction practices, according to a joint February 18, 2010 U.S. Geological Survey and Earthquake Engineering Research Institute Reconnaissance Team Report (tinyurl.com/yl7gtwb).

The five-member team studied buildings in Port-au-Prince and communities to the west of the city between January 26 and February 3, 2010. "A damage survey of 107 buildings in downtown Port-au-Prince indicated that 28 percent had collapsed and another 33 percent were damaged enough to require repairs. A similar survey of 52 buildings in Léogâne found that 62 percent had collapsed and another 31 percent required repairs," the report said.

One member of the team, University of Washington civil and environmental engineering professor Marc Eberhard was quoted in a news release saying, "Usually when I go to earthquakes, I find that the amount of damage is less than what appears on the television, In this case it was much more." The poverty of the people combined with the density of population and lack of building codes resulted in the widespread devastation, he said.

According to the USGS/EERI report, "Reinforced concrete frames with concrete block masonry infill appeared to perform particularly poorly."

Patrick Paultre, a Haitian architect who now teaches at Canada's University of Sherbrooke, agreed. Paultre said in an interview, "One big, big problem in Haiti is all of the slabs of the buildings are made by putting concrete blocks in the slabs to reduce the amount of concrete you would pour. These blocks are just hanging there and retained by the concrete around them. A little shaking and they will fall off. Just one will kill a person. You might have forty or fifty of them in a room. That's a major problem."

The USGS/EERI report added, "Structures with light (timber or sheet metal) roofs performed better compared with structures with concrete roofs and slabs. The seismic performance of some buildings was adequate, and some of the damaged buildings appeared to have had low deformation demands. These observations suggest that structures designed and constructed with adequate stiffness and reinforcing details would have resisted the earthquake without being damaged severely."

In another assessment of damage from the Haiti quake, teams of scientists from around the world have examined very high resolution aerial imagery of the earthquake region to learn how many buildings have collapsed or are heavily damaged. This new initiative is called operation GEO-CAN, which stands for Global Earth Observation Catastrophe Assessment Network. It is being coordinated worldwide by ImageCat, Inc. in Los Angeles and its London-based operation, ImageCat Ltd.

According to ImageCat's description of the process, "An area of some 300 square kilometers has been divided up into squares, and numbers of squares allocated for damage assessment to each GEO-CAN expert. The aerial imagery they are studying shows high resolution images of houses, public buildings, cars, and vegetation with detail that even shows the folds in tents in the temporary encampments. This is compared to imagery taken before the earthquake and buildings that have collapsed, or are heavily damaged are mapped."

The results will be used to inform the reconstruction program in Haiti.

Getting Old Is Not for Wimps

Falls, drowning, traffic all pose hazards

Older Americans are at increasing risk of dying from injuries, according to a study by the Johns Hopkins Bloomberg School of Public Health.

Researchers found that Americans aged 65 and over had increased death rates between 2000 and 2006 from falls (42% increase), motorcycle crashes (145%), machinery accidents (46%), accidental poisoning (34%), and drowning (19%). Curiously, the researchers—Guoqung Hu and Susan Parker—found that death from falls increased among older people, but the incidence of falls did not.

"Alcohol is another contributing risk factor worthy of consideration," added senior author Guoqing Hu. "Given the association between alcohol and injury, recent documented increases in alcohol problems among the elderly may be another partial explanation for the increase in severe falls."

"Our findings reveal significant increases in death rates from several different injury causes," said study co-author Susan P. Baker. "While the overall change in injury mortality among persons 65 and older was small, this study identifies important causes worthy of further investigation."

The research appeared in the February 2010 issue of *Injury Prevention* (injuryprevention.bmj.com/content/16/1/26.abstract).

Motorcycle crashes?

Magnitude Seven Times Two

Haiti, Chile, Mexico, and Sumatra

The January 12, 2010 Haitian earthquake was more than twice as deadly as any previous magnitude 7.0 event, according to University of Colorado seismologist Roger Bilham.

Writing in the journal *Nature* (www.nature.com/nature/journal/v463/n7283/full/463878a.html). Bilham says that the reason for this enhanced damage is obvious: "The buildings had been doomed during their construction. Every possible mistake was evident: brittle steel, coarse non-angular aggregate, weak cement mixed with dirty or salty sand, and the widespread termination of steel reinforcement rods at the joints between columns and floors of buildings where earthquake stresses are highest."

There have been a rash of earthquakes around the globe in recent weeks, some as strong as Haiti's, but none as deadly. A 7.2 magnitude quake centered near Mexicali, Mexico killed two people and injured 233 (edition.cnn.com/2010/WORLD/americas/04/05/mexico.earthquake/). The Mexicali quake's epicenter was only six miles deep—quite shallow as these things go—and it opened fissures in the ground.

The Mexicali event was felt as far away as Los Angeles, and sparked calls for better preparation for Southern California to try to avert catastrophe. But emergency officials say that the state's budget crisis has already strained resources. "We know that there's going to be an earthquake, and we know it's going to be a major natural disaster," Lou Paulson, president of the California Professional Firefighters and a captain in the Contra Costa County fire protection district told the *Los Angeles Times*. "And I don't want to be one of the people who stands in front of the state of California and says, 'We told you so.'"

A Mw 7.7 quake hit northern Sumatra on April 7, but no loss of life was reported. A tsunami warning was initially issued, but then canceled when a hazardous wave failed to develop. People in some communities—still mindful of the catastrophic 2004 Indian Ocean tsunami—reportedly ran into the streets and immediately sought higher ground (www.huffingtonpost.com/2010/04/06/sumatra-earthquake-78-mag_n_527698.html).

An estimated 230,000 people were killed in Haiti. CU's Bilham added, "The death and injury of about 15 percent of more than 2.5 million people in Port-au-Prince and its urban agglomeration, and the roughly 1.5 million people now homeless, is a consequence of many decades of unsupervised construction permitted by a government oblivious to its plate boundary location."

Bilham wrote, "In recent earthquakes, buildings have acted as weapons of mass destruction. It is time to formulate plans for a new United Nations mission — teams of inspectors to ensure that people do not construct buildings designed to kill their occupants."

The February 27, 2010 earthquake that struck Chile was powerful enough to move the city of Concepcion at least 10 feet to the west, as well as shift the earth's axis enough to make each day 1.26 microseconds shorter, according to measurements by several university teams and the National Aeronautics and Space Administration (www.cnn.com/2010/WORLD/americas/03/09/chile.earth.shifts/index.html). But it was not as damaging as the less powerful Haitian quake, because of what the insurance company Swiss Re called "the highly advanced anti-seismic construction standards in Chile."

The company provided preliminary estimates in early March of insured losses from the Chile quake, ranging from $4 billion to $7 billion. The company said, "In Chile, it is common practice for owners of mortgaged residential property, commercial and industrial property to buy earthquake insurance from local and global private insurance companies. Accordingly, this latest earthquake will lead to significant insurance claims for property damage and business interruption which are designed to facilitate a swift economic recovery." (www.preventionweb.net/english/professional/news/v.php?id=13079)

In general, earthquakes are taking a higher toll of life worldwide. Over the past ten years, nearly 60 percent of the people killed in disasters have died in earthquakes, according to the Center for Research on Epidemiology of Disasters

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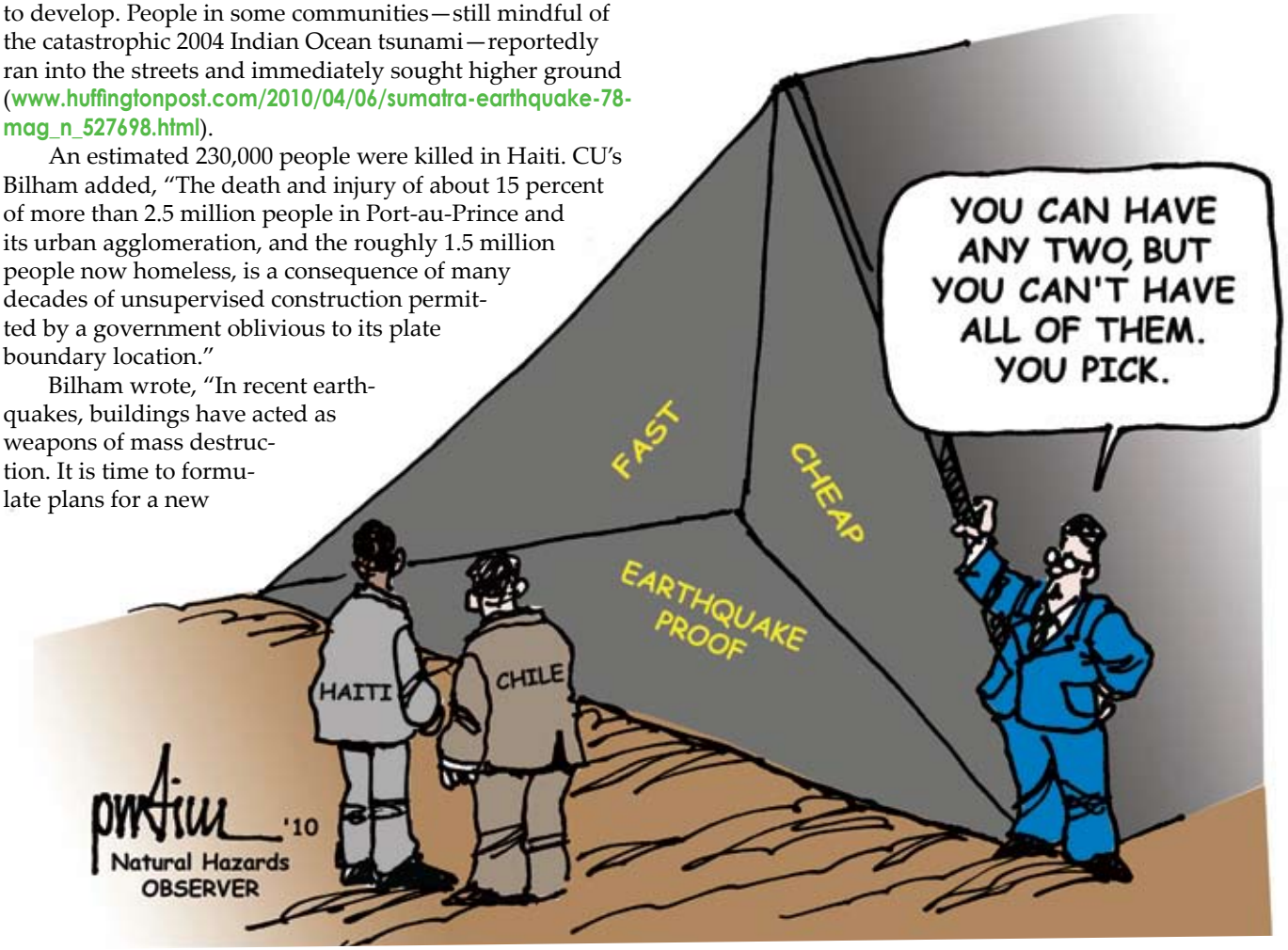

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(http://www.unisdr.org/news/v.php?id=12470).

According to the figures released by CRED at the end of January, 3,852 disasters have killed more than 780,000 people over the past ten years. Asian disasters account for 85 per cent of all fatalities.

"After earthquakes, storms (22%) and extreme temperatures (11%) were the most deadly disasters between 2000 and 2009," CRED reported. The other most deadly disasters of the decade of the 2000s were the 2004 Indian Ocean Tsunami, which left 226,408 dead in several Asian nations. Cyclone Nargis killed 138,366 people in Myanmar in 2008. The 2008 Sichuan earthquake in China killed 87,476.

In his *Nature* article, CU's Bilham said, "Since the turn of the century, earthquakes have directly or indirectly (including tsunami) claimed the lives of more than 640,000 people, four times more than in the preceding two decades, and proportionately more than the global increase in population would anticipate. If buildings are not made earthquake resistant, the toll is likely to continue to rise as cities grow in population."

The Early Recovery in Haiti

By Liesel Ritchie

By official declaration, as well as most media accounts, the emergency following the January 12, 2010 earthquake in Haiti is over. For several weeks, the Haitian government and humanitarians have been addressing "early recovery."

Whatever you call it, the situation in Haiti is a tragedy

According to the One*Response* website, "Early recovery in Haiti is a multi-dimensional process that establishes the foundations for longer-term reconstruction and development by supporting and generating self-sustaining processes for post-crisis recovery, planning and financing."

Whatever you call it, the situation in Haiti is a tragedy. More than a million people are displaced. Hundreds of thousands are without adequate shelter as the hurricane season looms. Nongovernmental organizations are struggling to provide food, water, and other services to survivors. Health issues—particularly for those living in camps or tent cities—are a growing concern. Almost four months after the quake, mental health matters are also demanding attention.

The list of earthquake-related concerns in Haiti is long, represented in part by the nine clusters established by the United Nations Inter-Agency Standing Committee in 2005: protection; camp coordination and management; water sanitation and hygiene; health; emergency shelter; nutrition; emergency telecommunications; logistics; and early recovery. These are in addition to the clusters specific to post-earthquake Haiti: agriculture; Dominican Republic response to Haiti; education; and protection. Add to this the necessity of addressing these topics in culturally appropriate and environmentally sustainable way. It makes for a daunting task for even the most seasoned NGO personnel.

Thankfully, the research with which I am involved is more focused—on issues regarding decision making and implementation of temporary housing in Haiti. I've travelled to Haiti three times since the earthquake, spending a total of about six weeks there. Most recently, we received word that the Natural Hazards Center has been awarded a National Science Foundation Grant for Rapid Response Research (RAPID). This will allow us to continue our efforts to understand how people on the ground in Haiti are dealing with the complexity of the post-earthquake housing situation and to address critical gaps in our knowledge of postdisaster housing.

After dozens of meetings, my initial observations concur with a number of findings from the limited previous studies on the temporary housing phase of disaster recovery. Among these are limited pre-planning efforts, ad hoc decision making, the challenge of providing housing following urban disasters, and the influence of predisaster inequities on postdisaster housing.

While in Haiti, particularly as I visited various camps, I have been in a position to witness challenges associated with postdisaster housing circumstances that are culturally inappropriate or that are disruptive to prior social arrangements. I've also observed situations in which culture and prior social networks are being examined as housing options are considered.

That there are common housing-related themes should not overshadow the fact that Haiti is a country with distinct regional characteristics. My experiences in populous Port-au-Prince have been different from those in Jacmel, with a pre-earthquake population of 49,000.

I liken the differences between these two locations to that of New York City and a smaller U.S. midwestern community. It's not just the scale of postdisaster issues that is different, but their nature. These qualities are based on local culture rather than on some homogeneous characterization of an entire nation. Generalizations should be made with caution prior to data collection and interpretation.

The Haitian people I've met are trying to move past the "*gwo bagay*"—Creole for the "big thing." It's a tough thing to do because reminders of the quake are everywhere. Yellow and red markers label hundreds of thousands of unsound homes, schools, and businesses awaiting repair or demolition. Rubble is piled on and along roads. Tent cities are crammed onto every available spot of land, spilling over into the countryside.

I'll return to Haiti later in May. I have been extremely fortunate to witness firsthand the efforts of many Haitians to survive, adapt, and move into what the world is calling early recovery following the earthquake. My concern now is not allowing a slide into complacency. More specifically, I hope that what is intended to be temporary postdisaster housing does not—as has happened in the past in other disaster settings—become permanent. I am anxious to see, as are many Haitians, the extent to which global support, interest, and early recovery activities evolve into long-term, sustainable recovery efforts that foster resilience.

Liesel Ritchie is the assistant director for research at the Natural Hazards Center.

Win, Lose, and Draw on the Climate Front

By Dan Whipple

There's good news, good news, bad news, bad news, and bad news on the climate change front. Which do you want first?

Okay, the good news.

People who rely on agricultural production in some countries may see a reduction in poverty from the changing climate, according to a study published by researchers from Purdue and Stanford universities. Parts of Asia and South America—notably Indonesia, the Philippines, Thailand, and Chile—may see up to a 50 percent reduction in poverty among some classes of worker as a result of changes in crop yields resulting from a climate change. Colombia, Mexico, Peru, and Venezuela will also see some positive outcomes from the changing climate, or at least break even.

In Africa, the study finds a generally unremitting dose of misery, with the percentage of people living in poverty increasing by from 10 to 50 percent, depending on the category of worker. In Malawi, Mozambique, Uganda, and Zambia especially, more urban and rural laborers will be poorer. There will be lesser impacts on the rural self-employed and urban diversified workers.

The study, *The Poverty Implications of Climate-Induced Crop Yield Changes by 2030,* was done by Purdue's Thomas Hertel and Stanford's Marshall Burke and David Lobell (http://foodsecurity.stanford.edu/publications/the_poverty_implications_of_climateinduced_crop_yield_changes_by_2030/). They conclude, "In our low productivity scenario, prices for major staples rise 10 percent to 60 percent by 2030. The poverty impacts of these price changes depend as much on where impoverished households earn their income as on the agricultural impacts themselves, with poverty rates in some non-agricultural household groups rising by 20 percent to 50 percent in parts of Africa and Asia under these price changes, and falling by equal amounts for agriculture-specialized households elsewhere in Asia and Latin America. The potential for such large distributional effects within and across countries emphasizes the importance of looking beyond central case climate shocks and beyond a simple focus on yields—or highly aggregated poverty impacts."

So, well, that wasn't unrelieved good news, was it? How about this, then?

Alaska's glaciers do not appear to melting as rapidly as originally thought. A team of international researchers says that previous studies have overestimated the rate at which Alaska's glaciers are disappearing, contributing about one-third less to sea level rise between 1962 and 2006.

The researchers, led by Northern Arizona University geographer Erik Schiefer, reported in *Nature Geoscience* that while Alaska's glaciers were thought to contribute .0067 inches to sea level rise per year, the actual figure is closer .0047 inches annually. The numbers sound small, but Schiefer says, "It adds up over the decades."

There were two reasons for the overestimation, he says. One is that thick rocks offer protection from solar radiation and slow the rate of melting. The paper says, "Our maps of ice elevation changes show that debris-covered glaciers experienced lower thinning rates. At low elevations on Bering Glacier, for example, we observe a twofold reduction of thinning rates under debris compared with debris-free ice. … Many Alaskan glaciers are partly debris-covered and the mass lost from these glaciers will be lower than for non-debris-covered ice."

Second, the ice is thinner along the edges of the glaciers, so when they melt, they contribute less water to the sea level rise.

Nonetheless, regardless which estimate you choose, other studies show the rate of ice loss has more than doubled in the last 20 years. "With current projections of climate change, we expect that acceleration to continue," Schiefer says in a release. This substantial increase in ice loss since the 1990s is now pushing up the rise in sea level to between .0098 inches and .0118 inches per year—more than double the average rate for the last 40 years.

So all that news wasn't entirely good, either. More of a "we've-stopped-beating-the-dog" variety.

Moving on …

Current international agreements to reduce carbon dioxide emissions are nowhere near stringent enough to

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Climate...

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keep the average global temperature below a two degree Celsius increase, argues an opinion piece in *Nature* published on April 21. The authors—Joeri Rogelj, Malte Meinshausen and colleagues—analyzed the pledges accompanying the Copenhagen Accord, taking into account major loopholes that are likely to make emissions worse.

First, they say, "It is more realistic that the lower ends of target ranges will be achieved. Second, many nations will bank surplus emissions allowances from 2008-2012 that they are likely to use. Third, some nations will probably be permitted extra allowances thanks to land use change, such as planting forests, that go beyond actual emissions savings" according to a *Nature* release.

All of this offers a pessimistic picture of future emissions. The team estimates that emissions will reach between 47.9 gigaton and 53.6 gigaton of CO_2 equivalents by 2020—10 percent to 20 percent higher than today's levels, and far higher than the 40 gigaton to 44 gigaton that the team estimates must be achieved to keep warming to below 2 degrees C.

The team concludes that even if nations halve their emissions by 2050, there is still a 50 percent chance that warming will exceed two degrees C. by 2100. It is crucial, they argue, that a better, binding agreement be established.

Diversity loss

Global warming will also alter plant diversity worldwide, according to a study from scientists at the universities of Bonn, Göttingen, and Yale. Jan Henning Sommer of Bonn University's Nees Institute for Biodiversity of Plants said in a release, "Climate change could bring great confusion to the existing pattern of plant diversity, with scarcely predictable consequences for our ecosystems and mankind."

The greatest diversity loss is expected in South America's Amazon rainforests, he says. Temperate zones like Europe and the United States may see habitat become available for a larger number of species. "But this can scarcely be described as a gain as the intensified redistribution of plant species will promote worldwide uniformity in the regional composition of species at the expense of unique species which have adapted to special habitat conditions," says Sommer.

Climate change has removed one source of regional conflict, however. In the Bay of Bengal, New Moore Island in the Sunderbans—claimed by both India and Bangladesh—has been completely submerged under rising seas. "What these two countries could not achieve from years of talking has been resolved by global warming," says oceanographer Sugata Hazra, a professor at Jadavpur University reported in the British newspaper *The Guardian*.

There were no permanent human settlements on New Moore—which is called South Talpatti in Bangladesh—but its submergence illustrates a large potential problem in the region over the coming century.

Scientists at the university in Kolkata have noted an alarming rate of sea level rise in the Bay of Bengal over the past ten years. Up until the year 2000, the rate of sea level rise in the bay was 3 millimeters (0.12 inches) a year. Since then, however, the rate has increased nearly 70 percent, to 5 mm annually (0.2 inches).

Officials estimate that 20 million in Bangladesh will be displaced 2050 and 18 percent of the country's coastal region will be underwater if sea level rises by the one meter projected by some climate models. The Intergovernmental Panel on Climate Change Fourth Assessment Report estimated a global rise in sea level of a maximum of only 59 centimeters (23 inches) by 2100. But revised estimates by some climate scientists (http://www.sciencemag.org/cgi/content/abstract/315/5810/368) say that they can't rule out a two-meter rise by 2100.

Lohachara, an island near New Moore, disappeared beneath the sea in 1996, forcing inhabitants to the mainland.

Meanwhile, data from the University of Alabama-Huntsville's tracking of satellite measurements show that the first three months of 2010 are all among the six warmest months on record since the satellite temperature record began to be compiled in 1978. Temperatures in the United States have not bee particularly warm, but Canada and the Canadian Arctic islands "saw March temperatures that were as much as 8.5 C. (15.3 degrees Fahrenheit) warmer than seasonal norms," according to according to John Christy, professor of atmospheric science and director of UAH's Earth System Science Center.

Christy attributes these records to "the most intense El Niño Pacific Ocean warming event since 1997-1998." But National Center for Atmospheric Research climatologist Kevin Trenberth argues that this El Niño may in turn be powered by the same heat accumulation that is driving climate change.

In a "Perspectives" piece in the April 16, 2010 issue of the journal *Science*, Trenberth and coauthor John Fasullo

consider a scientific mystery. About half of the heat entering at the top of the earth's atmosphere doesn't radiate back into space, but it isn't accounted for by current observations, either. So what happens to it?

It must be stored somewhere that current measurements don't reach. The most obvious possible reservoir is the deep ocean. El Niño is a warming of the surface water of the tropical eastern Pacific Ocean, accompanied by increased convection of seawater. "Is the warming associated with the latest El Niño a manifestation of the missing energy reappearing?" the authors ask in their *Science* piece.

They don't answer this question, but caution instead that accounting for this missing heat is important in forecasting future climate change and in assessing which steps should be taken to deal with it. They write, "Proposals for addressing global warming now include geoengineering, whereby tiny particles are injected into the stratosphere to emulate the cooling effects of stratospheric aerosol of a volcanic eruption. Implicitly, such proposals assume understanding and control of the energy flow, which requires detailed tracking of energy within the climate system. How can we understand whether the strong cold outbreaks of December 2009 are simply a natural weather phenomenon, as they seem to be, or are part of some change in clouds or pollution, if we do not have adequate measurements?"

Malaria

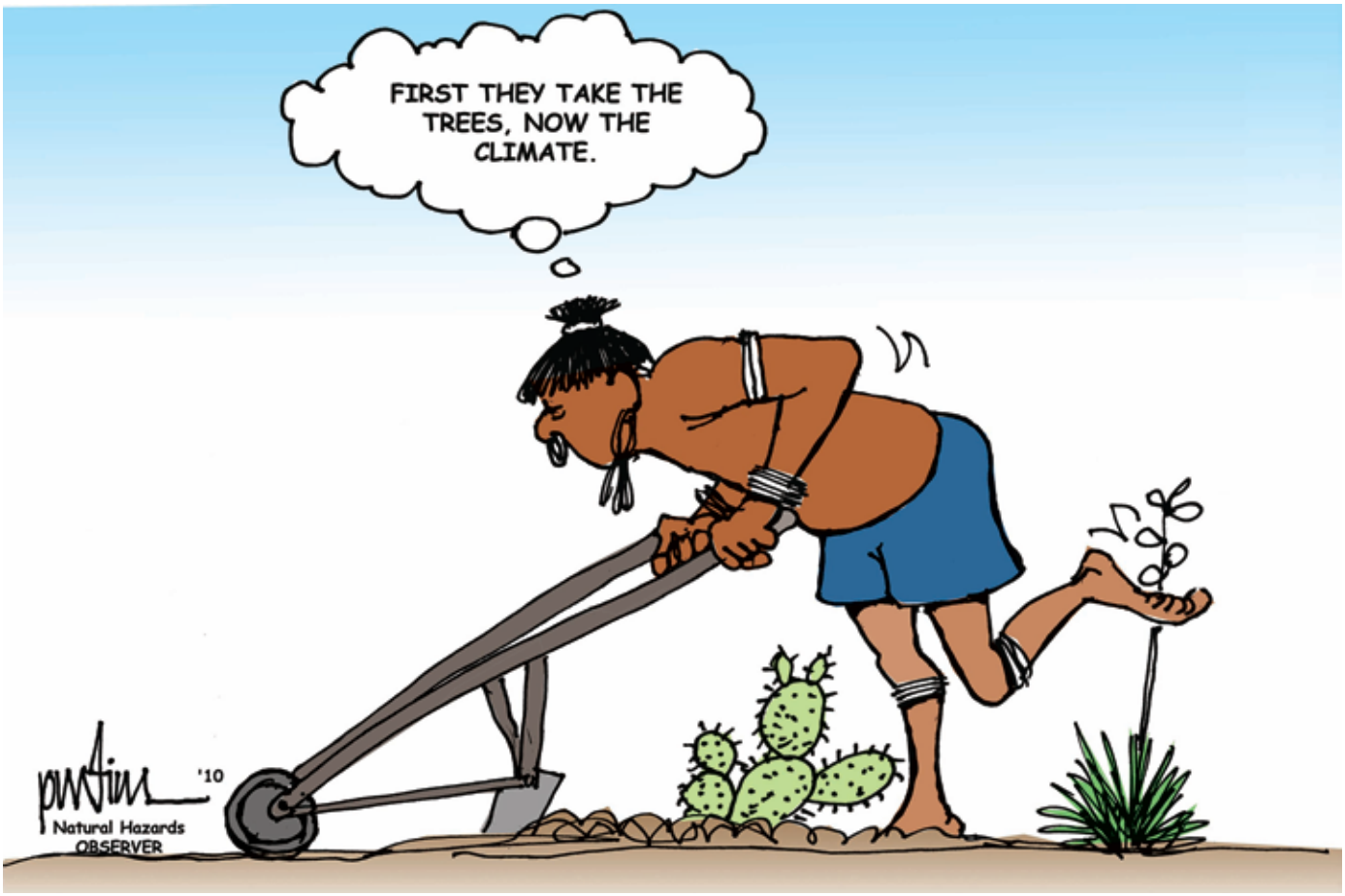
Climate change is one reason the incidence of malaria is increasing in parts of the world, according to the *Quarterly Review of Biology*. Highland areas in the tropics have generally been refuges from malaria-carrying mosquitoes. Authors Luis Fernando Chaves of Emory University and Constantianus J. M. Koenraadt of Wageningen University write, "Every 100 meter increase in altitude is associated with a 0.6 degrees C. decrease in temperature. Also, malaria parasites do not develop inside their mosquito host if temperatures fall below 15 degrees Celsius. Thus, malaria has been naturally excluded from these areas, most likely because they experience conditions that limit the biology of the parasite."

But as the globe warms, warmer temperatures move uphill. Malaria can follow: "Areas where malaria is not present because of climatic conditions (e.g., cities in the highlands of the developing world, especially in Africa) are at potential risk of having an increased burden of the disease if no concerted action is put forward to stop global warming."

None of the above

None of this news—bad or good—seems to make much of a dent in the world of climate skepticism. The South Dakota legislature, jumbling its promotion of poor science education into Concurrent Resolution 1009, encouraged teachers to present a "balanced and objective" presentation of global warming—echoing the language used in anti-evolution resolutions around the country.

The resolution (http://legis.state.sd.us/sessions/2010/Bill.aspx?File=HCR1009P.htm) as introduced does not inspire confidence in the authors' scientific expertise. It says there are "a variety of climatological, meteorological, astrological, thermological, cosmological, and ecological dynamics that can effect world weather phenomena and that the significance and interrelativity of these factors is largely speculative." Astrological? And thermology is a medical technique that uses high resolution temperature imaging of the human body from infrared cameras to make diagnoses.



Tsunami ...

(Continued from page one)

Tsunamis first-hand

The Pacific Tsunami Museum in Hilo, Hawai'i has pioneered techniques for conducting high-quality video interviews with tsunami survivors. The museum's archives now contain over 400 interviews representing first-hand survivor accounts from a dozen different tsunami events in the Pacific and Indian oceans between 1923 and 2009. The accounts of tsunamis prior to 1998 were recorded many years afterward, so memories may have faded. But those collected from survivors of the 2004 Indian Ocean tsunami and the 2006 Java tsunami were recorded as soon thereafter as was feasible (allowing time for recovery from immediate post-event trauma). Interviews with survivors of the 2009 South Pacific tsunami in Samoa and American Samoa were collected within three weeks of the event.

We were concerned about the emotional impact on survivors of reliving a painful experience. Though often very emotional, it has proven to be a catharsis for most interviewees, none of whom had received any form of post-traumatic stress disorder counseling.

> *From Salaevalu Ulberg at Aleipata, Samoa, we learned that the waves of the 2009 tsunami had wrapped around an offshore island, come back together and "leaped up" at the village "like a monster ... hurling stones."*

Critics have argued that interviewees might embellish their stories to make them more interesting or exciting. For most survivors this is not the telling of a story but a reliving of the most traumatic experience of their lives. We always allow survivors to tell their story without interruption and never interrogate subjects with closed questions.

> *On the island of Koh Phra Thong off the coast of Thailand, a survivor of the 2004 Indian Ocean tsunami saw a German engineer stand and watch the waves until he was killed. The engineer recognized that it was a tsunami, but was so fascinated by the phenomenon that he was frozen in awe and could not tear himself away.*

After the initial narrative, however, the interviewee may be gently prodded for additional information, overlooked details, and other useful information. Our experience has been that details of the tsunami event provided by survivors closely match physical data collected about it. In fact, a recent paper by Karlsson et al. (2009) strongly supports eyewitness interviews as a way to collect information of value to physical scientists studying tsunamis.

> *Prior to an interview with former Naval Petty Officer Lee Edtl, no information existed about the impact of the 1946 tsunami at French Frigate Shoals, a group of small islands in the leeward chain of the Hawaiian Islands. Edtl provided data concerning wave height and timing. He also talked about his fear of being washed off the low-lying island (Edtl 2001).*

> *Avis Kompkoff, an Aleut from Chenega, Alaska, told us of the strange abundance of sea cucumbers the morning prior to the 1964 earthquake and the "thousands of red snappers" floating on the surface with distended eyes and bellies following the 1964 event.*

> *At the village of Fagasa on Tutuila in American Samoa in 2009, we learned from Fasifua Fuimanono that large boulders sitting on the road at the front of the village had not come directly from the sea. Instead, the tsunami wave that transported them had come down the inter-reef channel then divided, depositing the boulders laterally along the shore.*

Video or audio?

The collection of oral histories has long been a valuable part of many disciplines including anthropology, history, psychology, and sociology. These have mostly been carried out with audio recording equipment. The prevailing view was that video was too intrusive. We were initially cautioned that people would be frightened by video cameras. But our experience has been that most people, regardless of culture, and including children as young as 10 years, are able to ignore the camera once they begin reliving the event. The successful protocol worked out during over a decade of interviews is explained in a recent article (Dudley et al. 2009).

> *Lori Hausman was 12 years old at the time of the 1964 Good Friday earthquake in Alaska that created a tsunami in Kodiak. Her story shows that the trauma stays with the survivors. She expressed "the importance of being able to share her story and grief" with others. "Each individual needs a chance to process their emotions."*

Interviews with tsunami survivors have also become a part of social science studies of tsunami events. The post-tsunami survey work carried out by the UNESCO-IOC International Tsunami Survey team following the September 29, 2009 event in Samoa was the first time that an integrated team of social and physical scientists has systematically carried out both video and oral interviews as part of an immediate post-tsunami survey (Dominey-Howes 2009). We have also begun interviewing first responders and government officials in order to gain insight into their role in the response to and recovery from tsunami events, along with an understanding of the level of preparedness for future tsunami events.

Research on disaster communication was carried out in a number of interviews with survivors of the 1946 and 1960 tsunamis in Hawai'i (Johnston 2003b). Among the facts that emerged was the distrust by local police of "high technology." On the island of Hawai'i in 1960, the Kau Police Station dispatched a fisherman with a walkie-talkie and a flashlight to the southernmost point of the island to watch for the tsunami. He was to call an officer stationed uphill when he saw the first wave. The officer in turn was to radio the information to the Kau Police Station. They were to call the Hilo Police Station to give them an early warning. The waves actually reached the easternmost point of the island, close to Hilo, first (Johnston 2003b).

At the medical center in Lalomanu, Samoa, Dr. Juinileti Chang Wai, told us that many wounds closed following the 2009 tsunami later become severely infected. They had to be reopened, cleaned, and resutured.

Tsunami education

One advantage of using video for survivor interviews is that, not only is physical and social science data collected, but it also provides powerful material for tsunami education. These stories can teach the public what to do, what not to do, and why. There is no messenger more credible for tsunami education than someone who has actually gone through the experience. And there is nothing like receiving the message in your own language and dialect, from someone your own age, who lives in a place similar to yours. It is like hearing the story from a family member or neighbor.

*Thelma Barnum, mother of five, was in Old Valdez in 1964. She was forced to evacuate her home knowing that her son Fred was in peril down at the harbor. Fred Christopherson fled the dock just before it was destroyed by the tsunami wave. He looked back to see the freighter **Chena** poised on its bow end, perpendicular in the water with its propeller exposed.*

An unexpected additional advantage of video interviews is that if high production criteria are applied to the interview procedure, the media can be leveraged for air time for tsunami education by effectively providing them with free news footage. We have gotten over 60 minutes of air time over the past few years, mostly in four-minute news segments. This keeps our message of tsunami preparedness before the public. It is essential the message be repeated often enough to integrate it into their memory, into the long-term potentiation of brain synapses, so that they will instinctively take the correct course of action during the next tsunami. Unlike hurricanes, whose progress we watch for days, giving us time to "educate" the public about the impending event, a tsunami may reach shore in hours or even minutes with little warning.

Eldon Gallear was on a tugboat hauling three barges in the Bering Sea off of Makushin in 1946. He contacted the Navy in Adak and asked them to warn Hawai'i, describing the timing of the waves.

The application of tsunami survivor interviews has far exceeded our expectations since we first began collecting

them on video in 1998. The interviews carried out for the Pacific Tsunami Museum have been routinely copied to videotape and made available for viewing by visitors to the museum (Pacific Tsunami Museum 2009). Several books and peer-reviewed papers have already been written as a result of access to the materials (Dudley 1999a, 1999b; Dudley and Stone 2000; Johnston 2003a; Goff et al. 2006). An interview with a tsunami survivor in Hawai'i was combined with stories about the 1960 tsunami in Chile and Japan to produce a circular by the U.S. Geological Survey (Atwater et al. 1999). Most recently the National Oceanic and Atmospheric Administration Science of a Sphere project (NOAA 2010) released an excellent tsunami education video, which both begins and ends with a poignant interview we carried out with a survivor of the December 26, 2004 tsunami in Banda Aceh, Indonesia. All of these have been helped increase public awareness of the tsunami hazard.

At the Thai village of Ban Talae Nok, we learned a school destroyed by the 2004 tsunamis was to be rebuilt on the same site. Villagers asked us to help them by interceding with officials. Ultimately the school was rebuilt on a safe site outside the tsunami hazard zone.

We learned in an interview with Ms. Irawati, in the village of Lampageu just outside Banda, Aceh, Indonesia, that rape was a constant danger for women in the tsunami relief camps following the 2004 tsunami.

Survivor interviews have become a key element in many of the major exhibits at the Pacific Tsunami Museum. Exhibits focusing on particular events use survivor stories chosen for their emotional power and the vital lessons they offer. The popularity of survivor interviews as museum exhibits ultimately led to the establishment in 2007 of community tsunami museums in Kamphuan, Thailand (USAID 2008) and Alappad, Kerala, India (Anon. 2008). In these small museums, computer kiosks offer the choice of hearing the interviews in the original language or dubbed into English, thereby serving both the local population and the majority of visitors. Museums using tsunami survivor interviews as key exhibits are also planned for Sri Lanka, Indonesia, and Alaska. Video interviews have also been incorporated into outreach education activities.

Duncan Fields of Kodiak said his father had gone to Larsen Bay to feed their cattle just before

{Please see "Tsunami," page twelve)

Tsunami ...

(Continued from page eleven)

the 1964 quake, but the cows had all run uphill. However, they returned before the tsunami arrived and many were killed by chunks of ice carried in by the wave.

It is not surprising that many of the initiatives discussed above are U.S.-based, because the archive is maintained and stored in Hawai'i. All archived data are available for educational activities and research. The Pacific Tsunami Museum is a non-profit organization and requires only a data management fee for the ongoing support of the archive. It seems likely that the value of the existing, and growing, dataset will become increasingly recognized over time and be used in more international venues. For example, a recent study carried out in Sri Lanka considered audio-visual means to be their most effective tool for disaster education (Kurita et al. 2006).

Peter Gurr of American Samoa said the training he received from the U.S. Department of Homeland Security only weeks before the 2009 tsunami "saved my life."

In our view, tsunami history is a powerful tool in preparing and warning coastal communities today. We can measure an earthquake and try to calculate its extent and energy. We can model potential tsunamis. We mostly hold our breath and hope the science holds up. It usually does. Tsunami history has shown us where to look and look again. Folklore has taught us that every coastline around the world has experienced this phenomenon. Stories can drive the science and the science validate the stories. When nothing else exists, we seek out human history for guidance. As Rudyard Kipling once said, "If history were taught as stories, it would never be forgotten." Our hope is that the stories of tsunami survivors will teach the life-saving lessons and these will never be forgotten.

Walter Dudley is chair of the Pacific Tsunami Museum's Scientific Advisory Council and an oceanographer with the University of Hawai'i at Hilo. Jeanne Johnston is president of Disaster Preparedness Solutions, Inc., in Kailua, Hawai'i. Cindi Preller is education and outreach coordinator at the West Coast and Alaska Tsunami Warning Center.

References

Anon., 2008. Tsunami documented. *Kerala Calling*, 28 (3): 46.

Atwater, B. F., V. M. Cisternas, J. Bourgeois, W.C. Dudley, J.W. Hendley II, and P.H. Stauffer, 1999. *Surviving a Tsunami—Lessons from Chile, Hawai'i, and Japan*. U.S. Geological Survey, Circular 1187. Washington, D.C.: U. S. Government Printing Office.

Dominey-Howes, Dale, Randy Thaman, Ausetalia Titimaea, Litea Biukoto, et al. 2009. The 2009 UNESCO-IOC ITST Samoa survey. Paper presented at the Fall Meeting of the American Geophysical Union, San Francisco.

Dudley, W. C., 1999a. The Pacific Tsunami Museum: A memorial to those lost to tsunamis, and an educational center to prevent further casualties. *Sci. Tsunami Haz.*, 17 (1): 127-134.

Dudley, W. C., 1999b. *Local Tsunamis in Hawai'i*. Hilo: Pacific Tsunami Museum Publications.

Dudley, W. C., 2007. Learning from the victims. Proceedings of the 1st International Tsunami Training Institute, University of Washington, Seattle.

Dudley, W. C., 2008a. Remembering the tsunami. Proc. report Post-Tsunami Sustainable Livelihoods and Integrated Ecosystem Management Workshop. Asian Institute of Technology, Bangkok.

Dudley, W. C., 2008b: Pacific Tsunami Museum and international community preparedness activities. In *Report of the North Pacific Tsunami Awareness Conference*, ed. T. Hendricks. Honolulu.

Dudley, W. C., and M. Lee. 1998. *Tsunami!* 2nd edition. Honolulu: University of Hawai'i Press.

Dudley, W., J. Goff, C. Chague-Goff, and J. Johnston. 2009. Capturing the next generation of cultural memories—video interviewing tsunami survivors. *Science of Tsunami Hazards* 28 (3): 154-170.

Dudley, W. C., and S.C. Stone. 2000. *The Tsunamis of 1946 and 1960*. Virginia Beach: Donning Press.

Edtl, L. 2001. *The tsunami of April 1, 1946 at French Frigate Shoals.* Event report submitted to the Pacific Tsunami Museum archive.

Johnston, J. B., 2003a. *Tsunamis in Maui County: Oral Histories*. Center for Oral History. Honolulu: University of Hawai'i Press.

Johnston, J. B., 2003b. *Personal Accounts From Survivors of the Hilo Tsunamis of 1946 and 1960: Toward a Disaster Communication Model*. Ann Arbor: ProQuest Company.

Karlsson, Johanna Mard, Alasdair Skelton, Michael Sanden, Mansour Loualalen, et al. 2009. Reconstruction of the coastal impact of the 2004 Indian Ocean tsunami in the Khao Lak area. *J. Geophys. Res.* 114, C10023, doi:10.1029/2009JC005516.

Kurita, T., A. Nakamura, M. Kodama, and S.R.N. Colombage. 2006. Tsunami public awareness and the disaster management system of Sri Lanka. *Disaster Prev. Management*, 15 (1): 92-110.

National Oceanic and Atmospheric Administration. 2010. **sos.noaa.gov/** (accessed March 20, 2010).

The Pacific Tsunami Museum, 2009. **www.tsunami.org/** (accessed March 22, 2009).

U. S. Agency for International Development. 2008. Kamphuan Memorial Tsunami Museum opens. *USAID Tsunami Reconstruction Update*, June, 2007.

What is the Chance of a Successful Earthquake Prediction?

Slim and Fat ...

By Dan Whipple

Maybe the toads know.

Ninety-six percent of the common toads (*Bufo bufo*) evacuated their breeding grounds five days before Italy's 2009 L'Aquila earthquake in 2009, according to research published in the Zoological Society of London's *Journal of Zoology*.

The number of paired toads dropped to zero three days before the quake at the site, which was located 75 kilometers (47 miles) from the quake's epicenter. "This shift in the toads' behavior coincided with disruptions in the ionosphere, the uppermost electromagnetic layer of the earth's atmosphere, which were detected using very low frequency radio sounding," according to a news release on the study.

Under ordinary circumstances, toads would stay at the breeding grounds until spawning is complete.

Toads are just the latest in a long list of animals that supposedly react to an impending earthquake. Cows, snakes, cockroaches, rodents, and Eeyore the clinically depressed donkey in A.A. Milne's *House at Pooh Corner* have all been credited with sensing something—what it might be is unclear—prior to earthquakes.

Animal sensitivity

But *Bufo bufo* is, alas, probably unreliable. There have been no reports of anomalous animal behavior before recent large quakes in Haiti, Chile, and Sumatra. "People have this notion that animals can sense things that we can't sense with scientific instrumentation," says Thomas Jordan, director of the Southern California Earthquake Center. "That's not true. There's no indication that animals are sensing anything that we can't sense ourselves."

So then, are animals sensing anything? Are there reliable indicators—"earthquake precursors," they're called in the trade—that can reliably predict earthquakes, which could then also be sensed by scientific instruments? Is science as smart as a cockroach?

Trying to predict the onset of earthquakes is a global cottage industry that both seismologists and interested lay people engage in. It has been called, in an oft-repeated cliché, "the holy grail of seismology." Prior to the L'Aquila quake, Giampaolo Giuliani, a physics researcher, claims to have seen anomalous radon gas releases from which he predicted the quake using his own techniques. He was allegedly silenced for spreading panic, later being vindicated somewhat when the quake occurred, killing more than 300 people. Giuliani was assured of his fifteen minutes of fame promised by Andy Warhol as the unappreciated maverick scientist.

In a paper at the American Geophysical Union in San Francisco in December 2009, Giuliani and colleagues wrote, "Our findings suggest that radon counts significantly increase in several hours up to two days in advance of the major earthquakes occurrence in the region. Based on our experimental results, we argue that rapid changes in the concentration of radon, measured from gamma detectors, could be considered as a potential earthquake precursor for the L'Aquila region."

With the L'Aquila toads, the researchers also noted, "The release of radon gas, or gravity waves prior to an earthquake have both been attributed to changes in atmospheric electric fields and currents."

Unfortunately, these methods don't offer much hope for prediction. In her book *Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction*, seismologist Susan Hough writes of Giuliani's prediction, "Following the 2009 L'Aquila earthquake in central Italy an Italian researcher pointed to his earlier prediction, which had been ignored. Close inspection revealed a familiar tale. Although in this case the prediction had apparently been borne out, it was based on observations—small earthquakes and anomalous radon release—that we know do not provide the basis for reliable earthquake prediction."

AGU had several sessions on techniques for forecasting earthquakes. In addition to radon anomalies, scientists have explored the predictive potential of earth-emitted radiation, siesmo-generated electrical fields, thermal anomalies, and

(Please see "Quakes." page thirteen)

"It's snowing still," said Eeyore gloomily.

"So it is."

"And freezing."

"Is it?"

"Yes," said Eeyore. "However," he said, brightening up a little, "we haven't had an earthquake lately."

—A.A. Milne, *The House at Pooh Corner*

Quakes ...

(Continued from page thirteen)

other possible techniques.

It is perhaps worth taking a step back to consider what a successful earthquake forecast might consist of. Scientists know pretty well, for instance, where large quakes are likely to occur. This is a prediction, is it not? With a few notable exceptions, they occur on long faults, most of which are located where the earth's tectonic plates grind against each other. Away from these areas, information is harder to get. "There are places where we're not nearly so sure," Jordan says. "In the interior of a continent like North America, or the eastern United States, we have a much harder time. There we have a hard time knowing how big earthquakes can be, how frequently they occur, where they're going to occur, and so forth."

But on well-mapped faults, much can be predicted. The probability of a large earthquake on California's San Andreas fault with 30 years or so is high. But this not a precise enough figure for most people.

"We can't predict when they occur. And without knowing when, you can't just say, 'Don't live there,'" Jordan says. "The types of forecasting that were done before Chile and Haiti said almost nothing about the timing of the earthquakes. Papers happened to be written about both of those just a couple of years before the event. But if you look at those papers, what they says is, 'sometime in the next fifty to a hundred years' or 'sometime in the next long period of time,' we're going to have an earthquake like this."

These long-term forecasts are useful in a scientific sense for understanding the hazards, but they are inadequate for some types of response. You don't want to order an evacuation of San Francisco based on so vague a prediction. "What we can't do," says Jordan, "is we can't predict earthquakes with high probability. We can't say there's a 70 percent chance of an earthquake happening next week … There is no method—including all the ones you talked about—that has proven to be a credible method for predicting earthquakes."

What about those prophetic toads, though? "Our findings suggest that toads are able to detect pre-seismic cues such as the release of gases and charged particles and use these as a form of earthquake early warning system," says Rachel Grant, lead author of the *Journal of Zoology* paper.

The trouble with this hypothesis is that seismologists are not sure these precursors exist, or if they do, that they would be consistent from one earthquake to the next. "People have been looking for diagnostic precursors for a hundred years," Jordan says. "There are many ideas out there about diagnostic precursors. But basically none of them have worked out. And most of them have been investigated."

How earthquakes work

The problem begins with how earthquakes work. As tectonic plates slide by each other, stresses accumulate. In *Predicting the Unpredictable*, Susan Hough describes it this way, "At their boundaries, plates generally lock up, unable to move smoothly past their neighbors. The crust thus warps at the boundaries, building up strain, or energy. Eventually this strain releases, abruptly, in an earthquake."

She adds, however, earthquakes "are unpredictable, or at least very difficult to predict, because faults teeter on the edge of failure for years, decades, maybe much longer. We don't understand what happens to finally push a fault over the edge."

The search for earthquake precursors is premised on the notion that prior to this abrupt release the earth will somehow "signal" that it's ready to rumble—by releasing radon gas, say, or rushing toads uphill.

Unfortunately, says Jordan, "That does not seem to be the way earthquakes work. Stresses do accumulate and a large-scale stress field does develop. But it appears that earthquakes begin all the same way. In other words, the difference between a magnitude two earthquake and a magnitude eight earthquake is what caused the earthquake to stop, not what caused it to start.

"So the conditions have to be right for a magnitude

eight to happen, but you get a lot more magnitude twos than you do magnitude eights, and randomly one of them will become a magnitude eight. That's the problem," he says.

This doesn't mean that useful things can't be said about earthquakes. You just have to change your expectations a little. There are things in the earthquake forecasting business that science can offer. "We do know the probability of having earthquakes varies in time," Jordan says. "And it varies in time quite bit, like by a factor of a thousand."

So on any given day in Southern California, the odds of having an earthquake are very small, say, one-in-100,000. But, "sometimes the probability will go up by a factor of a thousand. So instead of being one-in-100,000, its one-in-100—a one percent possibility. I'm still probably going to be wrong if I say there's going to be an earthquake. I'll only be right one percent of the time.

"On the other hand, that factor of a thousand in what we call 'probability gain' is potentially useful to society. Not in terms of evacuating people, because the probabilities are too low. But in terms of allowing us to prepare for earthquakes and give some indication of where probabilities are higher, that may be useful information."

The best indicator of this probability gain is seismic activity itself. If there is lower-level earthquake activity near big faults, the chance of a major rupture goes way up. The San Andreas fault is "locked and loaded." If there are magnitude 5.0 quakes near the fault, the chances of having that big quake go way up.

L'Aquila forecasting

Something like this happened at the L'Aquila event, not in the prediction of the main shock, but forecasting the aftershocks. Warner Marocchi of the Institute di Geofisica e Vulcanologia in Rome, told the AGU meeting that his group monitored and forecast aftershocks from the L'Aquila quake with good success. "From the test of the first months, the forecast seems well calibrated," he said, "describing correctly the space-time evolution of the aftershock sequence. In practice, we have had some good skill in forecasting earthquakes during an aftershock sequence."

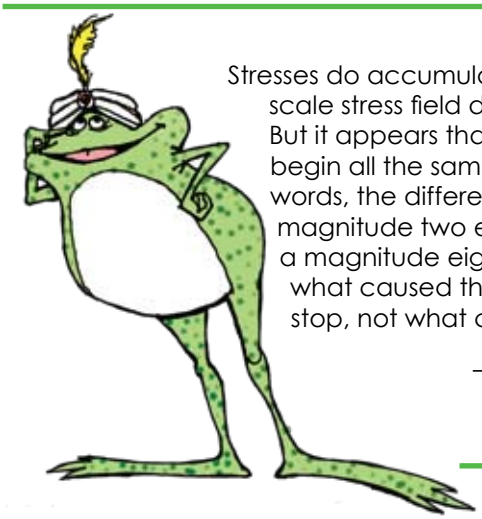
The model they used did detect a probability gain before the main event, though the daily probability never reached as high as one percent.

Forecasting the timing and intensity of aftershock swarms can have a practical function, especially in post-earthquake relief work. Rescue workers have been killed or injured when they entered unstable buildings that were then shaken by strong aftershocks. A reliable model could have warned them to wait a little while.

Meanwhile in California, the number of earthquakes of magnitude greater than 4.0 has increased significantly in 2010, the *Los Angeles Times* reports (http://www.latimes.com/news/la-me-quake13-2010apr13,0,4366518.story?track=ntothtml). "There have been 70 such quakes so far this year, the most of any year in the last decade. And it's only April. There were 30 in 2009 and 29 in 2008," the paper writes.

"The string of quakes this year raises the possibility that Southern California might again be entering a more active seismic period. Scientists said the increase does not mean the Big One is any more imminent, but it could mean more significant quakes are on the way," the *Times* says.

Officials noted that only one in six Californians is covered by earthquake insurance. "As we are building along the San Andreas fault, our exposure to the shaking hazard increases," says Mark Benthien, director of communication, education and outreach for the Southern California Earthquake Center. "And the losses we get in earthquakes increase as well. That's part of the equation."



Stresses do accumulate and a large-scale stress field does develop. But it appears that earthquakes begin all the same way. In other words, the difference between a magnitude two earthquake and a magnitude eight earthquake is what caused the earthquake to stop, not what caused it to start.

—Thomas Jordan

Resources

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

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

All Hazards

Self-Reliance During Natural Disasters and Civil Unrest: How to Handle Fires, Search and Rescue , and Other Emergency Response Situations on Your Own. By George R. Bradford. 2007. ISBN: 978-1-58160-628-7. 175 pp. $26 (softcover). Paladin Press. www.paladin-press.com.

This is the tough guy's and gal's guide to handling disaster. Bradford, a retired firefighter, wants to put the "I" back in self-reliance: "The government has screwed itself into the ground by convincing citizens that they are not qualified to perform simple emergency response tasks. Yet when a disaster occurs, government agencies quickly become overburdened with requests to handle simple emergencies, emergencies that every one of us should be able to handle as they occur."

Bradford urges preparedness first, then action. He deals with fighting small fires, controlling utilities, dealing with wildland fires, and providing first aid. There's even a handy illustrated lesson on knots in the back of the book.

Crisis Management in the Tourism Industry: Beating the Odds? Christof Pforr and Peter Hosie, editors. 2009. ISBN: 978-0-7546-7380-4. 249 pp. $114.95 (hardcover). Ashgate Publishing, Ltd. www.ashgate.com.

The tourism industry is as vulnerable as any to natural hazards—perhaps more so, since so much recreation occurs in areas like sea shores or mountains which can hit hard when disaster occurs. But the industry has been seen as reactive rather than proactive in dealing with these issues.

This collection of papers may begin to change that approach. The authors in the compendium look at preparation and recovery, including postdisaster marketing plans, terrorism, sustainability, and other disaster planning and management areas familiar to hazards professionals, but which here are placed in a tourism context.

Building an Enterprise-Wide Business Continuity Program. By Kelley Okolita. 2010. ISBN: 978-1-4200-8864-9. 324 pp. $79.95 (hardcover). CRC Press. www.crcpress.com.

The corporate risks for failing to plan for "the big one," writes Okalita, fall into three broad categories—"financial (how much money the corporation stands to lose), reputational (how badly the corporation will be perceived by its customers and its shareholders), and regulatory (fines or penalties incurred, lawsuits filed against them)."

The trouble is, "No one believes in the 'the big one.' Even after September 11, convincing leadership of the need for a plan is hard."

Okolita offers strategies for selling a business continuity plan to management, then provides the steps needed to get one in place that actually works. Considering how specialized much of the material is, the book is surprisingly easy to read as Okolita spices up the program with anecdotes from her own experience in corporate disaster planning.

The Law of Emergencies: Public Health and Disaster Management. By Nan D. Hunter. 2009. ISBN: 978-1-85617-547-0. 381 pp. $79.95 (hardcover). Butterworth-Heinemann. www.elsevierdirect.com.

This is a textbook to familiarize practicing professionals and students with the U.S. laws that govern emergencies as they impact public health. Though the book is heavy with excerpts from legal opinions and cases, it is not a traditional legal text.

It begins with an overview of federal legal authority in emergencies, then proceeds to state and federal public health laws, relating them specifically to public health, especially recent issues like AIDS and potential biological weapons from anthrax to tularemia. The book ends with an exercise based on a hypothetical dirty bomb explosion in Washington, D.C. to test readers on the application of the legal concepts presented earlier in the text.

Megadisasters: The Science of Predicting the Next Catastrophe. By Florin Diacu. 2010. ISBN: 978-0-691-13350-8. 195 pp. $24.95 (hardcover). Princeton University Press. press.princeton.edu.

Mathematician Florin Diacu begins his exploration of the science behind prediction with a quote that ought to be everyone's favorite, from physicist Niels Bohr: "Prediction is very difficult, especially about the future." In this entertaining book, Diacu explores the state of scientific forecasting of disasters—tsunamis, earthquakes, pandemics, economic disasters, hurricanes, and others.

Diacu devotes a chapter to each issue, describing briefly the history of the science behind it, occasionally including personal details about people who have been intimately involved.

As a mathematician, Diacu is interested in the models used to attempt to predict the behavior of natural systems, and of chaos theory. He concludes that for many systems, the models simply don't provide enough detail for reliable prediction. "Some recent research shows that chaos is less responsible for the errors of the current meteorological forecasts than are the models themselves … Nevertheless, chaos is still a factor of computational error for many classes of differential equations."

There has been quite a stir recently about the possibility of predicting earthquakes *(see our story beginning on page 13 of this issue)*, at least well enough to give a few moments warning. Diacu is less optimistic: "The most elusive predictions are those based on vague models, as it happens in seismology. Without knowing the exact position of tectonic plates and the way they move, we are unable to come up with precise models. So far, the best we can do is enforce building codes in unstable seismic zones."

Disaster and Development. By Andrew E. Collins. 2009. ISBN: 978-0-415-42668-8. 285 pp. $39.95 (softcover). Routledge. www.routledge.com.

In the developing world, sustainable development and disaster reduction go hand in hand, says Andrew Collins. "Sustainable environmental, social, and economic futures are dependent on applying the right risk reduction decisions, at the right time, in the right place, and with the right people," he writes.

This book looks at "neo-Malthusian" approaches to development governance and disaster prevention. It offers a hopeful messages in some senses: "People do more than just cope with disasters, they interact with them to build greater prosperity and a secure future, getting development out of disaster."

Disaster Management: Global Challenges and Local Solutions. Rajib Shaw and R.R. Krishnamurthy, editors. 2009. ISBN: 978-1-4398-1430-7. 648 pp. $99.95 (hardcover). CRC Press. www.taylorandfrancisgroup.com.

This is a comprehensive look at the many different disciplines involved in disaster management. Geographically, it concentrates primarily on Asia, where risks are serious and varied. Its essential principle is that for effective risk reduction, disaster risk reduction activities must be linked to human security. This, in turn, requires sustainable development, a "delicate balance between human security and environment."

The book is organized in a manner readily recognizable to disaster professionals, starting with descriptions of likely hazards, working through risk and vulnerability, then on to recovery, communication, and cooperation.

Disasters and Public Health: Planning and Response. By Bruce W. Clements. 2009. ISBN: 978-1-85617-612-5. 314 pp. $69.95. (hardcover). Butterworth-Heinemann. www.elsevierdirect.com/security.

"Personal and home preparedness is the bedrock of a resilient community," writes retired U.S. Air Force Public Health Officer Bruce Clements in this comprehensive guide to public health planning for disasters. Clements looks at likely hazards individually—and alphabetically—from bioterrorism to winter storms. He outlines a representative case studies for each chapter—the 1953 Beecher Tornado, the 2007 California wildfires—then extrapolates generalized preparation and response lessons from each.

If you can get through the first chapter—which is mostly lists and principles, essential but tedious—Clements has provided a readable and comprehensive look at dealing with the physical health threats posed by disasters.

Clements is also refreshingly clear about what he doesn't cover. "The mental aspect of some disasters may have a greater impact on long-term morbidity and mortality than the immediate effects on physical health," he writes in the preface. "While it is an extremely important consideration, it is not the focus of this book." Nor does he discuss animal issues.

In all, this is a well-presented, in-depth look at public health planning for and response to all types of disasters.

Disaster! A History of Earthquakes, Floods, Plagues, and Other Catastrophes. By John Withington. 2010. ISBN: 978-1-60239-749-1. 391 pp. $24.95 (hardcover). Skyhorse Publishing. www.skyhorsepublishing.com.

This readable history breaks a long lineup of disasters into digestible chunks. About half the book is "natural" disasters: volcanoes, famines, plagues, weather, and the like. Then it segues into the sort of catastrophe that is the result of humankind's cruelty to humankind (and vice versa), involving trains, planes, automobiles, warfare, explosions, and so on.

Hurricanes

Category 5: The 1935 Labor Day Hurricane. By Thomas Neil Knowles. 2009. ISBN: 978-0-8130-3310-5. 350 pp. $29.95 (hardcover). University Press of Florida. www.upf.com.

On Labor Day, 1935, a Category 5 hurricane hit southern Florida, with winds in some parts of the Florida Keys reaching 225 miles per hour. It was the first official Category 5 storm recorded in the United States. This account of that storm—which occurred before the custom of naming hurricanes after men and women came about—includes interviews with survivors, a survey of the meteorology of the day, and dramatic accounts of the storms effects. "In the hardest his area of the Florida Keys, three out of every five residents were killed, while hundreds of world War I veterans sent there by the federal government perished," the author writes. The American Red Cross estimated that 408 people died in the storm.

After Ike: Aerial Views from the No-Fly Zone. By Bryan Carlile. 2009. ISBN: 978-1-60344-150-6. 132 pp. $24.95 (softcover). Texas A&M University Press. www.tamupress.com.

This is a poignant and revealing picture book of the damage done by Hurricane Ike when it hit the Texas Gulf Coast on September 13, 2008. The author is a pilot who flew the area of devastation daily "shooting pictures while hanging over the skids of [the] helicopter." The pictures paint a vivid portrait of the damage from when "Ike was here." The book is introduced by a brief essay from Andrew Sansom.

Post-Rita Reflections: A Sociological Journey. By Stan Weeber. 2009. ISBN:978-0-7618-4374-0. 75 pp. $18.95 (soft-

(Please see "Resources" page eighteen)

Resources ...

(Continued from page seventeen)

cover). Hamilton Books. www.hamilton-books.com.

Stan Weeber joins the ranks of those who have produced vivid personal memoirs of their encounters with hurricanes Katrina and Rita. His efforts are strengthened by his insights as a sociologist. Six themes emerge from his experience. They are: "(1) displacement and attachment to place; (2) blasé attitudes of unattached 'host' communities; (3) protocol of bureaucratic agencies; (4) the masculine worker ideal and its relationship to emotional management, role conflict, and alienation; (5) spatial dynamics of disaster zones and its implication for gender and sexual rights; and (6) ongoing struggles with the above topics."

Weeber says "social capital"—the interweaving of people, place, and community—"might be an umbrella concept to guide future work on the transitions to postdisaster life."

Risk

At War With the Weather: Managing Large-Scale Risks in a New Era of Catastrophes. By Howard C. Kunreuther and Erwann O. Michel-Kerjan. 2009. ISBN: 978-0-262-01282-9. 416 pp. $55 (hardcover). The MIT Press. mitpress.mit.edu.

A nice thing about the work produced by Kunreuther and Michel-Kerjan is that while between them they know pretty much whatever there is to be known about risk and insurance, they write about this daunting subject gracefully. *At War With the Weather* is no exception.

Beginning in our "new era of catastrophes," the book explains gently what the problems are. They are also willing to think creatively about risk, money, and risk protection. "Empirical evidence reveals," they write, "that most individuals do not make cost-benefit trade-offs in their insurance purchase decisions … Homeowners' decisions related to the purchase of insurance are driven by a variety of goals other than financial protection. These many include reduction of anxiety (obtaining peace of mind), satisfying mortgage requirements, and satisfying social norms (e.g., purchasing insurance because one's friends and neighbors have coverage)."

The authors propose a "five-pillar strategy" to link risk assessment and management. Characterize the problem. Characterize the likelihood and consequences of extreme events. Recognize interdependencies. Understand biases. Address catastrophe risk management with expert assessment.

The approach is demonstrated through a study of several alternative insurance programs.

"One of the main reasons why the war against the weather has escalated is the desire of many people to reside in high-risk areas," Kunreuther and Michel-Kerjan write. "The economic development of Florida highlights this point: the population of the state by 2010 will have grown 600 percent since 1950 … The paradox in waging a war against the weather and other extreme events is that we might very well be our own worst enemy."

Science and Decisions: Advancing Risk Assessment. By the National Research Council of the National Academies. 2009. ISBN: 978-0-309-12046-3. 403 pp. $49.46 (softcover). Download $42.50 (.pdf). National Academies Press. www.nap.edu.

This book is advertised as "a complement to the widely used 1983 National Academies book, *Risk Assessment in the Federal Government* (also known as the Red Book)."

The report says that risk assessment is "at a crossroads," with its credibility challenged. The process has become bogged down, especially within the Environmental Protection Agency. The assessment of the chemical trichlorethylene, for instance, began in the 1980s and isn't expected to be completed until 2010—at the earliest.

The report makes eight major recommendations for improving the risk assessment process, including paying closer attention to the initial stages of the process and involving stakeholders earlier and more broadly.

The Tolerability of Risk: A New Framework for Risk Management. Frédéric Bouder, David Slavin, and Ragnar E Löfstedt, editors. 2009. ISBN: 978-1-84407-609-3. 146 pp. $49 (softcover). Earthscan. www.earthscan.co.uk.

"Risk assessment is confronted with three major challenges that can be best described using the terms 'complexity,' 'uncertainty,' and 'ambiguity,'" writes Ortwin Renn in part one of *The Tolerability of Risk*. "These three challenges are not related to the intrinsic characteristics of hazards or risks themselves but to the state and quality of knowledge available about both hazards and risks."

Assessing risk is, well, risky, because what counts as a risk is different depending on which actor in the play you inquire about. Duncan's murder was a hazard for Duncan, but a risk and an opportunity for Lady MacBeth.

The tolerability of risk, write the editors of this volume, "is an integral part of the wider and more sophisticated architecture of risk governance." The perception of risk, they argue, may be harder to quantify than the statistical probability of a hazard (which in Duncan's case was 100 percent, what with Shakespeare being Shakespeare).

Climate Change

The Economics of Climate Change Policy: International, National, and Regional Mitigation Strategies. By Adam Rose. 2009. ISBN: 978-1-84844-081-4. 599 pp. $195 (hardcover). Edward Elgar. www.e-elgar.com.

Adam Rose, now at the University of Southern California, has been examining the economics of climate change for nearly 20 years. This volume is a collection of the papers he's written on the subject. Rose is especially interested in issues of economic equity in climate mitigation solutions like cap-and-trade. It's a topic he's had a little trouble interesting policy makers in. The book charts a tidy arc of the discussions on climate and economic equity at many levels. One of his surprising conclusions—surprising to me, anyway—is that equity is of secondary importance both to stakeholders who want a deal on climate mitigation, and stakeholders who don't. Members of committees he sat on "suggested that my incursion into moral philosophy might bog down the policy process."

This book can be a little hard to read, though. Several of the papers here are simply reproduced from the journals they originally appeared in, reduced in size to fit the book's format. The type size is shrunk correspondingly, making you wish you had a magnifying glass for some of the pages.

Conferences and Training

May 5-7, 2010
Midwest Emergency Preparedness and Response Conference
Winnebago County Local Emergency Planning Committee
Rockford, Illinois
Cost and Registration: $125, open until filled

Focusing on an overview of changes in emergency management information and regulations, the conference features sessions hazardous materials response, forensic investigation and scene preservation, behavior-based safety applications, and lessons learned from H1N1.

www.winn-lepc.org/Registration.html

May 11-13, 2010
18th Annual Voluntary Organizations Active in Disaster Conference
National Voluntary Organizations Active in Disaster
Lake Buena Vista, Florida
Cost and Registration: $460

This year's conference, titled "United in Waves of Hope and Help," will offer expert presentations to improve VOAD members' skills, services, and organizational practices. Session topics include long-term recovery training, technology and holistic community readiness, and community emergency planning for special needs populations.

www.nvoad.org/Conference/2010/tabid/99/Default.aspx

May 16-19, 2010
Eighth UCLA Conference on Public Health and Disasters
University of California, Los Angeles, Center for Public Health and Disasters
Torrance, California
Cost and Registration: $475

This conference will promote dialog between local health departments and others to improve emergency public health preparedness, mitigation, response, and recovery. Topics address emergency public health issues, mass shelters, hospital and community clinics as partners in disaster response, and the escalation of response from emergency to disaster.

www.cphd.ucla.edu

May 16-21, 2010
ASFPM 34th Annual Conference
Association of State Floodplain Managers
Oklahoma City, Oklahoma
Cost and Registration: $650-$755

This conference discusses techniques, programs, and resources to reduce flood risk and to improve mitigation and watershed management. Topics include FEMA digital flood mapping products, floodplain management, adapting to climate change, mapping and engineering standards, coastal concerns, and building public support for floodplain management.

www.floods.org

May 19, 2010
Engineering Sustainability in the Face of Natural Hazards
University of Colorado College of Engineering and Applied Science
Boulder, Colorado
Cost and Registration: Free, no registration required

Much current engineering interest focuses on sustainable design. This symposium uses recent disasters to examine the creation of sustainable built environments. Topics include natural hazards and sustainability, lessons learned from Haiti, and development challenges.

engineering.colorado.edu/nae/Welcome.html

May 19-23, 2010
International Hazardous Materials Response Teams Conference
International Association of Fire Chiefs
Baltimore, Maryland
Cost and Registration: $365-$405

This conference prepares hazmat responders by examining the latest products and methods in hazmat responses. Session topics include first responders and terrorist attacks, the Hazmat IQ system, maritime hazmat response, hazardous materials in the flood environment, threat and vulnerability analysis, and the fundamentals of atmospheric monitoring.

www.iafc.org/hazmat

May 23-28, 2010
24th Annual Governor's Hurricane Conference
Florida Emergency Preparedness Association, National Weather Service, Florida State Emergency Response Team, and American Red Cross
Fort Lauderdale, Florida
Cost and Registration: $195

This conference will identify ways to improve hurricane preparedness, response, recovery, and mitigation by discussing all aspects of hurricane threats. Topics include lessons learned, new strategies, the availability of federal and private assistance to local governments, and the role of emergency management throughout the disaster cycle.

www.flghc.org

May 26, 2010
2010 Coastal Resilience Symposium
Rice University
Houston, Texas
Cost and Registration: $25 before May 15, $40 after

Hurricane Ike wasn't "the big one" for Houston. This symposium seeks a more resilient Houston region by discussing what to expect if a "massive Ike" makes landfall near the city, especially with new growth in low-lying areas. Sessions will discuss risks and vulnerabilities, structural and non-structural mitigation options, and coastal and public policy issues.

www.rpts.tamu.edu/coastalresilience

(Please see "Conferences," page twenty)

Conferences...

(Continued from page nineteen)

June 1-4, 2010
Understanding Risk: Innovation in Disaster Risk Assessment
The World Bank
Washington, D.C.
Cost and Registration: Not posted

What is risk? Can it be better managed and understood? These questions will be at the forefront of this meeting, examining innovations in disaster risk assessment with a focus on hazard and vulnerability modeling, geographic information systems, insurance and reinsurance, and climate change adaptation. The 2010 Outreach Meeting of the Global Earthquake Model Initiative and the Washington, D.C. Crisis Camp will take place in conjunction with this event.

www.understandrisk.org

June 4-5, 2010
Katrina Research Summit
University of Southern Mississippi Gulf Coast
Long Beach, Mississippi
Cost and Registration: $50, closes April 15

This conference will present research on the natural, social, political, and economic effects of Hurricane Katrina in hopes of making communities threatened by natural disasters become more resilient.

www.usm.edu/gulfcoast/cpr/summit.php

June 7-10, 2010
13th Annual Emergency Management Higher Education Conference
Federal Emergency Management Agency
Emmitsburg, Maryland
Cost and Registration: See website

This conference encourages and supports inter-school dialogue on a variety of issues and facilitates communication between the Emergency Management Higher Education Project and university and college representatives. Issues include challenges in developing new programs; international disaster management; imcreasing interest in hazards, disasters, and emergency management courses; and incorporating experiential and service learning in the classroom.

www.training.fema.gov/emiweb/edu

June 8-12, 2010
The International Emergency Management Society 17th Annual Conference
The International Emergency Management Society
Beijing, China
Cost and Registration: Not posted

Innovative methods to improve national and international mitigation of, response to, and recovery from emergencies and disasters are the focus of this annual gathering. Session topics include establishing emergency management systems; global earthquake catastrophe emergency response, rescue, and recovery; handling emergencies from a national point of view; a Nepalese perspective on the effects of climate change; and the application of spatial technology in emergency management.

www.tiems2010.org

June 10-11, 2010
First Hazardous Area Response Team (HART) Annual Conference
Ambulance Hazardous Area Response Team
Liverpool, England
Cost and Registration: $532, Open until filled

This conference highlights the work of hazardous area response teams and examines the fundamentals of national resilience and emergency preparedness. Session topics include the view from the front line, HART and its effects on the national ambulance service, Hurricane Katrina and other major events, and Haiti: the UK's response to an international tragedy.

www.healthcare-events.co.uk/conf/booking.php?action=home&id=445

June 13-26, 2010
Climate Change and Its Impacts: Resilience and Adaptation to Changes in Precipitation
Brown International Advanced Research Institute
Providence, Rhode Island
Cost and Registration: See Web site

This conference will examine hydrologic cycle changes; ecological, agricultural, economic, and social system resilience; and trans-regional adaptation policies. Session topics include expected patterns of climate change, extreme events, human disease and migration, biodiversity, and food security.

brown.edu/Administration/International_Affairs/initiative/2010climateandwater.html

June 18-20, 2010
2010 Rural Fire Service Association Conference
Rural Fire Service Association
Rydges Lakeside Canberra, Australia
Cost and Registration: $750 before May 7, 2010. $900 after

This conference looks at bushfire fighting, hazard reduction, emergency communications, community relations, firelines, and volunteer issues. Experts will share experiences and best practices in bushfire fighting.

www.rfsaconference.org.au

July 12-15, 2010
Rebuilding Sustainable Communities with the Elderly and Disabled People after Disasters
University of Massachusetts Boston
Boston, Massachusetts
Cost and Registration: $300, Open until filled

This conference examines long-term sustainable community recovery and rebuilding needs in postdisaster environments. Specific issues to be addressed include the status of elderly and disabled people after disasters; the participation of the elderly and disabled in local, regional, and national postdisaster reconstruction policies, plans, and programs; and the role of women with disabilities in formulating and implementing reconstruction policies.

www.mccormack.umb.edu/centers/crscad/RSCEPD.php

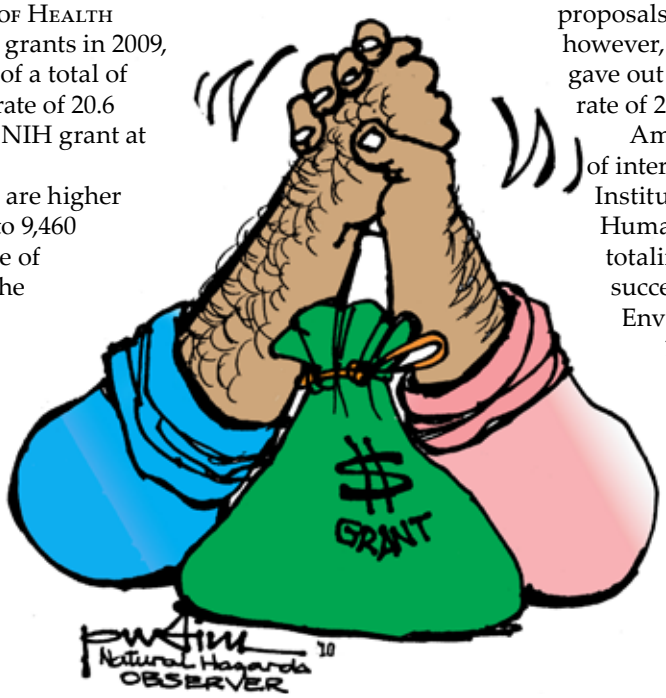
Below are descriptions of some recently awarded contracts and grants related to hazards and disasters.

NIH Grants Success Rate Down in 2009

The National Institutes of Health approved 8,881 research grants in 2009, totaling $3.7 billion, out of a total of 43,142 reviewed, for a success rate of 20.6 percent. This puts the average NIH grant at just over $418,000.

The 2009 financial awards are higher than the $3.6 billion awarded to 9,460 grantees in 2008, for an average of $379,300 per grant. However, the 2008 success rate was 21.8 percent, higher than 2009.

Among the NIH centers that might be of particular interest to hazards research, the National Institute of Allergy and Infectious Diseases awarded $442.2 million, the fourth highest total of NIH's 26 grant-making branches. The success rate for NIAID proposals was lower than average, however, at 18.7 percent. In 2008, NIAID gave out $438.7 million, with a success rate of 22.8 percent.



Among other NIH agencies of interest in 2009: the National Institute of Child Health and Human Development, 416 grants totaling $140.9 million, 14.9 percent success rate; National Institute for Environmental Health Science, 135 grants, $50.8 million, 17.7 percent; and Roadmap, cross-cutting NIH research grants, 225 grants, $177.5 million, 17 percent success.

These grant totals do not include funds distributed under federal economic recovery programs.

Observations and models of postseismic deformation: Constraints on the ductile strength of continental lithosphere. National Science Foundation grant #0944336. One year. $114,719. Principal investigator Yuri Fialko, University of California-San Diego, yfialko@ucsd.edu.

Large shallow earthquakes generate sudden stress perturbations in ambient rocks that may induce a ductile response of the lower crust and the uppermost mantle. Much improved global imaging of surface deformation from existing synthetic aperture radar satellites (in particular, the L-band ALOS mission) allows us to measure the delayed postseismic response of the crust and upper mantle to the induced stress changes. Measurements of postseismic transients bear on a long-standing debate on the effective rheology of the lithosphere below the brittle-ductile transition. Detailed observations of postseismic deformation in diverse tectonic settings will provide new constraints on the effective mechanical thickness and strength of the continental lithosphere. Such constraints will improve our understanding of continental tectonics. Physically based models of postseismic deformation might help forecast the evolution of stress and strain in the Earth's crust following large earthquakes, providing a useful input for seismic hazard estimates.

Studies of unusual earthquakes: Volcanoes and landslides. National Science Foundation grant #0944055. One year. $115,040. Principal investigator Goran Ekstrom, Columbia University, ekstrom@ldeo.columbia.edu.

The project will investigate anomalous seismic sources with a specific focus on slow earthquakes associated with volcanoes and landslides. It builds on discoveries from the systematic application of a long-period event detection algorithm to real-time and archived seismic data recorded on the Global Seismographic Network. For each year since 1991, more than 100 earthquakes of magnitude 5.0 or greater that are not reported in other catalogs have been detected and located using this algorithm. Many of these earthquakes are slow. A large number are associated with volcanoes and landslides. The first goal of the project is to discriminate volcano and landslide earthquakes from other earthquakes identified by the long-period detection algorithm. The second is to relate those earthquakes that occur in volcanic regions to eruptive activity and changes in the geometry and behavior of magmatic plumbing systems.

In particular, the project will involve a detailed comparative study of unusual earthquakes associated with the two greatest caldera collapses of basaltic volcanoes over the last century, Fernandina (Galapagos Islands) and Miyakejima (Japan). The third goal is to investigate anomalous earthquakes associated with large landslide events. A recently developed methodology for determining the trajectory of the sliding mass during a landslide directly from the radiated seismic waves will be refined, improved, and applied to several landslide events to estimate dynamic landslide parameters. The seismological analysis methods developed for these studies will contribute to improved monitoring capabilities for volcanoes and landslides.

(Pleaes see "Grants," page twenty-two)

Grants...

(Continued from page twenty-one)

Phenomenological and predictability studies of western North Pacific tropical cyclones in relation to the Pacific jet stream. National Science Foundation grant #0935830. Two years. $576,000. Principal investigator Lance Bosart, SUNY at Albany, bosart@atmos.albany.edu.

This project will investigate tropical cyclones over the western North Pacific with emphasis on TC life cycle, track, and structure; TC interaction with the North Pacific jet stream; and high-impact weather events over the eastern North Pacific and North America linked dynamically to western North Pacific cyclones. The project will analyze recurving and transitioning TCs, including those that undergo extratropical transition and subsequent reintensification over the western North Pacific from July through December. The analysis will address the ability of operational numerical weather prediction models to forecast episodes of western North Pacific cyclones and associated high-impact weather events occurring over the eastern North Pacific and North America; the behavior of large-scale flow regimes in which these episodes occur; and the transitions between large-scale flow regimes that take place in conjunction with these episodes. The research will increase understanding of the mechanisms that govern the predictive skill of high-impact weather events.

Glacier-climate-water mini-conference at Lamont. National Science Foundation grant #1007595. One year. $17,950. Principal investigator Joerg Schaefer, Columbia University, schaefer@ldeo.columbia.edu.

As the environmental stress on the planet's climate system increases, it creates novel societal problems too complex for traditional scientific approaches. This workshop seeks to address problems for societies created by changes in the regional hydrological cycle as a consequence of ongoing changes in glaciers associated with climate. Its goals are to: (1) review the sensitivity of glaciers to climate change on a near-global scale; (2) to identify key regions on earth where the potential for cross-cutting projects are highest; and (3) design strategies to work toward adaption and mitigation strategies.

The workshop will include experts from disciplines such as glacial geology, glaciology, climatology, hydrology, anthropology, human ecology, and international affairs, providing a forum to create modern approaches to pressing environmental problems.

Collaborative research: Causes and mechanisms of focused exhumation along the Denali Fault, Eastern Alaska Range. National Science Foundation grants #0952834, #0952800, and #0952793. Two years. Three grants, $144,489 to principal investigator Sarah Roeske, University of California-Davis, smroeske@ucdavis.edu; $139,856 to principal investigator Paul Fitzgerald, Syracuse University, pgfitzge@syr.edu; and $153,077 to principal investigator Paul Layer, University of Alaska-Fairbanks, player@gi.alaska.edu.

The 1,200-kilometer Alaskan Denali Fault system is a major intracontinental, right-lateral, strike-slip fault system. Since the 2002 Denali earthquake (magnitude 7.9), which initiated along a previously undescribed thrust fault in the eastern Alaska Range, scientists have increasingly focused on how much slip and convergence occurs along this fault system, and where deformation is being accommodated. Mountainous terrain and basins have formed along the Denali fault. The locations and age of formation of these features can be used to constrain the distribution of crustal deformation through time. The eastern Alaska Range, the topographic signature of the eastern Denali Fault, rises dramatically from the tundra to sharp glaciated peaks, forming a narrow but high-relief region immediately north of the fault.

This research will unlock the thermal history of rocks in the eastern Alaska Range, placing constraints on regional patterns of exhumation and uplift through time. This will allow evaluation of the relative importance of near-field boundary conditions versus far-field driving forces. It also has relevance to fundamental problems of major strike-slip fault systems, including what causes localized exhumation and how strike-slip deformation is transferred into the lower crust. Results will contribute to earthquake hazard prediction in this region by constraining locations of high neotectonic deformation, variations in Denali fault geometry and identification of reverse faults. A better understanding of contributing factors for seismic behavior along the Denali Fault will benefit seismic hazard maps. The Trans-Alaska oil pipeline and future $26 billion Alaska gas pipeline cross the eastern Alaska Range and Denali fault. The pipeline is designed to withstand strike-slip motion, but if there is a significant dip-slip component, the effects could be disastrous.

Geodetic and geologic field response to the January 12, 2010 magnitude 7.0 Haiti earthquake. National Science Foundation grant #1024990. One year. $133,804. Principal investigator Eric Calais, Purdue University, ecalais@purdue.edu.

A magnitude 7.0 earthquake struck Haiti on January 12, 2010, causing severe damage in Port-au-Prince. The event occurred on the Enriquillo-Plantain Garden fault zone, one of the main faults accommodating the relative motion between the Caribbean and North American plates. This project will map and measure the displacement on the fault, remeasure an existing network of 30 global positioning system benchmarks in Haiti and the Dominican Republic to determine co-seismic deformation, and install continuous GPS instruments in key locations to measure postseismic deformation. Available radar data for the area will be used to compute co-seismic interferograms. The information gathered in the field will be integrated to determine the co-seismic displacement during the main shock and to understand the nature and mechanism of the postseismic deformation that will follow this event for some years in the future. Geodetic measurements must be done as early as possible after the main shock in order to capture the early phases of postseismic deformation.

This project is an unprecedented opportunity to study a large, shallow-focus, strike-slip event in a tectonic environment similar to other plate boundaries that have not recently experienced such an event, such as the San Andreas Fault system. Indeed, this particular detailed study of the postseismic response of this event may prove most beneficial as the Enriquillo-Plantain Garden fault zone crosses thicker continental crust in Hispaniola and thinner ocean crust to the west toward Jamaica. Because Coulomb stress changes

from the January 12 event have loaded both extremities of the rupture, this work will help define the likelihood that other large earthquakes may be impending.

Near-trench deformation and tsunami runup from the January 3, 2010 Solomon Islands earthquake. National Science Foundation grant #1020239. One year. $24,420. Principal investigator Andrew Newman, Georgia Tech Research Corporation-Georgia Institute of Technology, anewman@gatech.edu

On January 3, 2010 an Mw 7.1 earthquake occurred in the Solomon Islands, causing strong shaking. It resulted in local landslides and a tsunami that impacted several of the islands, most notably Tetepare and Rendova. The event was likely triggered by, and occurred very near, the southeastern terminus of, the massive Mw 8.1 earthquake of April 1, 2007, which itself caused a substantial local tsunami that devastated many coastal areas. This most recent event was unique in that it caused a notable tsunami that was identifiable on two ocean-bottom pressure sensors nearly 1000 kilometers away, even though it was only a moderately large Mw 7.1 event. Such disproportionate tsunami excitation is observed with moderately large rare tsunami earthquakes, yet this exhibits only a modestly slow character.

Two main possibilities are proposed to explain the tsunami excitation of the 2010 event: (1) The earthquake was a "partial tsunami earthquake" in that it ruptured both a fast and slow component, giving it a mostly normal energy-moment; or (2) strong shaking from the event triggered a submarine landslide that generated the tsunami.

We will use the proximity of coastal environments to the rupture area and trench to conduct a postseismic tsunami inundation and near-source geodetic deformation survey along the two islands closest to the event to identify the magnitude and distribution of both parameters. We'll assess whether the coseismic slip alone was responsible for generating the observed tsunami. The tsunami run-up data will be modeled using the resultant coseismic interface slip model constrained from the combined geodetic techniques.

Cultural models of H1N1. National Science Foundation grant #1007842. One year. $30,325. Principal investigator Roberta Baer, University of South Florida, baer@cas.usf.edu.

This study will examine how the global pandemic of H1N1 influenza is understood in different cultural contexts—in this case, among laypeople and physicians in Mexico and the United States. Fears and anxieties, as well as vaccines, are dispersed around the globe. This study will contribute to the anthropological literature on how macro global forces play out in different cultural contexts. Epidemics provide the opportunity to investigate how people use cultural knowledge to react to new kinds of social experiences.

The researcher will employ a two-step process for data collection. The first step uses qualitative, open-ended interviews to collect descriptive information on explanatory models of H1N1 in the United States and Mexico. In the second step, themes from the descriptive interviews will be used to develop a structured interview, so that detailed comparisons can be made between laypeople and physicians, and across individuals, social classes, and cultural settings.

U.S.-Japan workshop on future directions for earthquake engineering research. National Science Foundation grant #0961320. One year. $43,175. Principal investigator James Wight, Univesrity of Michigan-Ann Arbor, jwight@umich.edu.

A United States-Japan workshop to explore future directions for earthquake engineering research was held March 6-7, 2010 in Tokyo. The workshop identified major challenges in earthquake engineering and defined research initiatives to mitigate the social and financial impact of future earthquakes in the Asian-Pacific region.

Support for a workshop on socioeconomic scenarios for climate change impact and response assessments. National Science Foundation grant #1003678. One Year. $52,000. Principal investigator Paul Stern, National Academy of Sciences, pstern@nas.edu.

The effects of climate change on society depend on changes in both the climate and in society over many decades. For example, the impacts of climate change on coastal communities in 2070 depend not only on changes in sea level and storm behavior but also on changes in population distributions and land uses over the period between now and then, including voluntary responses in anticipation of future threats. This international workshop will consider the current state of the science and will develop improved methods for describing the long-term social and economic future.

Projecting more than a few decades into the future is usually treated as beyond the capability of demographers and other social scientists working on socioeconomic and technological change. Global climate change challenges these communities to stretch beyond the usual limits to develop methods of integrated analysis to put decisions about how to respond on a better scientific foundation. The workshop will bring together several research communities working on parts of the problem, as well as researchers from both high- and low-income countries who have addressed the problem in different ways. It will encourage them to consider new analytical approaches, stimulating further collaboration to integrate: impact projections from physical models; scientifically credible descriptions of future demographic, economic, and social change; and potential mitigation and adaptation responses in anticipation of such impacts.

Earthquake source dynamics: Data and data-constrained numerical modeling. National Science Foundation grant #0944317. One year. $28,800. Principal investigator Ralph Archuleta, University of California-Santa Barbara, ralph@crustal.ucsb.edu.

This workshop will be held June 27-July 1, 2010 in Bratislava, Slovak Republic. Twenty U.S. scientists funded from this grant will attend. The meeting will bring together scientists from the Americas, Asia, and Europe to discuss investigations of earthquake dynamics using numerical simulations and earthquake observation. Participants will optimize strategies for improved modeling and testable predictions. Talks will focus on simulations of past earthquakes, fault zone structure and rheology, laboratory data on friction, energy budget for seismic activity, scaling laws, and other earthquake parameters.

(Pleaes see "Grants," page twenty-four)

Grants...

(Continued from page twenty-three)

RAPID: Supporting family reunification for the Haiti earthquake and future emergencies. National Science Foundation grant #1030002. One year. $50,000. Principal investigator Chen Li, University of California-Irvine, chenli@ics.uci.edu.

The UC-Irvine team is working on a website for family reunification for the Haiti earthquake. In addition to crawling and scraping data from Web pages for the repository at haiticrisis.appspot.com coordinated by Google and many other volunteers, the team has built a powerful search interface. The team has identified several research challenges to make the system more scalable. The project includes support of powerful keyword searches with efficient indexing structures and algorithms in a cloud-computing infrastructure that is increasingly popular for large-scale applications. The main challenge is using limited programming primitives in the cloud to implement index structures and search algorithms.

The techniques developed will have a broad impact on many information systems that are moving to the cloud-computing paradigm. The adoption of the techniques in the family-reunification domain will have a significant impact in our society by helping people find their loved ones in a disaster. The team plans to provide the techniques and source code in future releases for use in family reunification during future disasters.

For further information see the project web site at fr.ics.uci.edu/haiti/.

RAPID: Collaborative research: Offshore coseismic effects of the Port-au-Prince earthquake, Haiti. National Science Foundation grants #1028045 and #1028001. One year. $158,053 to principal investigator Cecilia Gonzalez-McHugh, Columbia University, cecilia@ldeo.columbia.edu and $40,954 to principal investigator Sean Gulick, University of Texas at Austin, sean@ig.utexas.edu.

In the aftermath of the earthquake in Haiti there is an urgent need to record aftershocks and capture ephemeral data that will help to assess both short-term and long-term earthquake risk in the region. Reliable models of strain accumulation and seismogenic release along the fault zone are needed.

A U.S. team is already installing additional seismometers and GPS stations as well as mapping features associated with the earthquake. A French team is preparing to deploy a suite of ocean bottom seismometers offshore. The January 12 main shock ruptured a relatively small segment of the Enriquillo-Plantain Garden fault zone, the southern of two parallel east-west sinistral transforms accommodating most of the motion between the North America and Caribbean plates. The fault zone follows the core of the southern peninsula and is associated with several large historic earthquakes, but its pre-1700's paleoseismicity is unknown.

A number of potentially active northwest-to-southeast trending faults and folds intersect the Enriquillo-Plantain. Many of these structures are unmapped, especially offshore, including a possible one in the Baie de Port-au-Prince. This survey of the offshore portion of the main rupture and the secondary structures associated with it will document the near surface effects of the earthquake offshore and characterize the seismogenic structures.

RAPID: Text message-based infrastructure for emergency response. National Science Foundation grant #1026763. One year. $75,000. Principal investigator John Yen, Pennsylvania State University, jyen@ist.psu.edu.

The Mw 7.0 earthquake in Haiti has mobilized the world to support the relief effort, including through novel uses of cyberspace. Even though the earthquake damaged much of the communication infrastructure, Haiti's Internet connectivity is robust. Most Haitian Internet service providers use satellite, rather than damaged undersea fiber optic cable. Consequently, relief workers, regular citizens, and non-governmental organizations have used tweets extensively to share information about needs, events, and relief operations. However, these tweets are not easily aggregated into meaningful topics for delivery to people who need the information.

This research project will develop and deploy, in collaboration with the NGO coordination body NetHope, a reusable text-message-based infrastructure that classifies and aggregates multilingual electronic communication about Haiti relief operations by topics and regions so that they can be easily subscribed by NGO's, survivors in Haiti, and their friends and families. The research project leverages existing software developed for entity extraction and topic classification so that the system can be developed and deployed to respond quickly. The evaluation of the system includes feedbacks from NetHope as well as quantitative metrics about the usage and performance of the system. For further information see the project web page www.emerse.ist.psu.edu.

Understanding the connections between strain transients and earthquake swarms. National Science Foundation grants #0952249 and #0952174. Three years. $118,700 to principal investigator Eliza Richardson, Pennsylvania State University, eur10@psu.edu, and $325,775 to principal investigator Jeffrey McGuire, Woods Hole Oceanographic Institution, jmcguire@whoi.edu.

The Plate Boundary Observatory instruments were installed to detect time periods when the deformation of the Earth's crust speeds up or slows down. These transient, predominantly aseismic deformation episodes have now been recognized worldwide. These strain transients often trigger swarms of small to moderate earthquakes. So far, the small number of examples with truly high-quality constraints on the space and time distribution of both the seismic and aseismic fault slip limits the mechanical understanding of earthquake triggering by strain transients.

This study combines geodetic inversions and earthquake triggering studies to improve the mechanical models that connect strain transients with increases in earthquake rate. Previous work shows that current mechanical models do not quantitatively predict the stochastic properties of earthquake swarms during transients. A GPS network filtering approach is being employed to detect new strain transients in the Salton Trough in southern California, the Cascadia subduction zone in Oregon and Washington, and the Alaskan subduction zone. The seismicity associated with any detected transients is then analyzed using a combination of stochastic and mechanical models of earthquake

triggering to estimate the temporal history of rate-changes associated with individual transients.

RAPID: Chilean earthquake rupture survey. National Science Foundation grant #1035121. One year. $191,238. Principal investigator C. David Chadwell, University of California-San Diego Scripps Institute of Oceanography, cchadwell@ucsd.edu.

In the aftermath of the February 27, 2010, Mw 8.8 earthquake in Chile,there is an urgent need to record aftershocks and capture ephemeral data that will help to assess both immediate and long-term earthquake risk. Reliable models of strain accumulation and seismogenic release along the fault zone, and improved tsunami models for the Pacific basin are urgently needed. U.S. teams are already on the ground onshore, and another team is preparing to deploy a suite of ocean bottom seismometers offshore. The February 27th main shock ruptured a 300-kilometer-long (180-mile) segment of the Peru-Chile subduction zone that borders South America, causing ground displacements of as much as seven meters. This bathymetric survey of the offshore portion of the main rupture zone and the deployment of four highly sensitive pressure gauges to record vertical motions will complement efforts to document the surface effects and possible earthquake hazards, such as tsunamis.

RAPID: Geotechnical engineering reconnaissance of the 2010 Haiti Earthquake. National Science Foundation grant #1025582. Six months. $25,200. Principal investigator Ellen Rathje, University of Texas at Austin, e.rathje@mail.utexas.edu.

On January 12, 2010 an Mw 7.0 earthquake struck the Port-au-Prince region of Haiti. The earthquake epicenter is located immediately west of the city of Port-au-Prince. It's estimated that there were 80 kilometers of fault rupture. A strike-slip Mw 7.0 event that affects ground near the margins of a bay represents a common earthquake scenario in the United States and around the world. This earthquake generated soil liquefaction and ground failure along the coastline and severely affected critical facilities, such as the country's main port. It is important to understand how soil and geologic conditions influenced the damage patterns across Port-au-Prince. Field reconnaissance will focus on capturing perishable data. We will also add some geotechnical characterization of the soils through: (1) examination of ejecta, (2) hand-held cone penetration tests, and (3) hand-carried equipment to measure shear wave velocities.

Surface wave triggering of earthquakes and non-volcanic tremor: Insights into the physics of rupture. National Science Foundation grant #0944257. One year. $122,861. Principal investigator Aaron Velasco, University of Texas at El Paso, velasco@geo.utep.edu.

This project will provide detailed analyses and modeling of surface waves in relation to triggering of both earthquakes and non-volcanic tremors. In particular, we have two main hypotheses that we will test: (1) the orientation of the local stress field and the orientation of the transient stresses induced by the surface waves combine to generate failure; and (2) triggered earthquakes and triggered non-volcanic tremor exhibit similar failure mechanisms caused by transient stress fluctuations. We will test these two hypotheses by analyzing numerous large—greater than Mw 7.0—earthquakes in regions with good local and regional network coverage, local and regional catalogs, and with documented triggered earthquakes and NVT. We will also develop a simple failure model that can explain our observations of triggered earthquakes and NVT. Our results will provide fundamental insight into stresses that trigger events, and whether these two seemingly different processes are indeed similar. Closely studying surface waves and triggering holds the key for understanding the physics of rupture.

A growing body of scientific studies has demonstrated that the passage of transient signals or seismic waves from large earthquakes can remotely trigger small earthquakes and non-volcanic tremors thousands of kilometers from the epicenter of a large earthquake. These two phenomena, at first glance, appear quite different, with the only common attribute being the triggering stress: surface waves. Triggered non-volcanic tremor is the radiation of non-impulsive seismic energy not associated with volcanic processes that occurs coincidentally with the passage of the surface waves of a larger earthquake. Similarly, dynamically triggered earthquakes are generally small earthquakes that trigger coincidentally or shortly after the arrival of surface waves from a larger earthquake. Given the fact that these two phenomena occur frequently, a detailed investigation into both the local and triggering, transient stress fields could provide fundamental insight into the physical mechanisms of rupture failure.

CAREER: Innovative seismic sensing for earthquake analysis and seismic hazard assessment. National Science Foundation grant #0952376. Four years. $390,919. Principal investigator Elizabeth Cochran, University of California-Riverside, cochran@ucr.edu.

The Quake-Catcher Network is a transformative approach to earthquake detection, science, and outreach. QCN is a distributed computing seismic network that links internal (no cost, built-in) or external (low-cost, USB-based) accelerometers connected to any participating computer for earthquake research. The objective of QCN is to dramatically increase the number of seismic observations by exploiting recent advances in sensing technologies and cyberinfrastructure. This approach will enable the creation of the world's largest and lowest-cost seismic network to explore earthquake fault rupture and the ground response to seismic wave passage by leveraging innovative cyber-enabled seismic data. This proposal will result in 375 QCN seismic stations at regional K-12 schools and an additional thousand public participants to enable groundbreaking discoveries in seismology. The work will address the following scientific questions: (1) Can MEMS technology and distributed computing produce transformative outcomes in real-time seismology applications by increasing the density of strong-motion observations, improved triggering algorithms and metadata generation, and innovative clustering algorithm development? (2) How do earthquake source properties, such as slip amplitudes and rupture velocity, vary at small spatial scales and how does increased density of observations improve the resolution and stability of source rupture modeling? (3) What is the variability in seismic amplification at a block-by-block scale and do increased seismic observations translate into improved prediction of ground motion estimates?

RAPID: Wind energy and rainwater harvesting solutions for sustainable recovery of Haiti. National Science Foundation grant #1036415. One year. $102,000. Principal investigator Catherine Peters, Princeton University, cap@princeton.edu.

Following the Haitian earthquake of January 12, 2010, two areas of importance are water and energy. Haiti is a country with abundant rainfall but inadequate water and sanitation systems, which now have been largely demolished by the earthquake. Furthermore Haiti, even before the quake, had low electric power production and distribution. To address these key areas, two novel technologies will be deployed and tested.

For water collection and treatment, a system has been designed for combined rainwater harvesting and treatment using porous clay ceramics. In addition to deploying and demonstrating this system in Jacmel, its effectiveness in terms of capacity, treatment rate, and resulting water quality will be tested.

For renewable energy production, a novel five-kilowatt wind turbine designed specifically for deployment in disaster relief will be deployed, demonstrated, and tested. A meteorological measurement station to characterize wind resources at the Jacmel location will be set up.

Finally, fine resolution numerical atmospheric simulations will be conducted, using the Weather Research and Forecasting model to map the wind resources and potential wind turbine placement sites around Port-au-Prince and other sites in Haiti.

RAPID: Supporting Haitian infrastructure reconstruction decisions with local knowledge. National Science Foundation grant #1032184. One year. $199,854. Principal investigator Franco Montalto, Drexel University, franco.montalto@drexel.edu.

In the wake of the January 12, 2010 earthquake in Haiti, we will test the hypothesis that infrastructure rehabilitation priorities based on local knowledge elicited through stakeholder driven processes will differ fundamentally from those developed by technical experts based outside the impacted area. Easterly, for example, contrasts the "planner's" approach to development aid with that of the "searcher." While "planners" make decisions about how to apply development aid assuming that they already know the answers, "searchers" admit not knowing the answer up front, finding solutions based on interaction with local population.

To test the hypothesis, the research will focus on water and sanitation issues in Leogane, a town of approximately 40,000 located about 30 kilometers (18 miles) west of the capital, near the quake's epicenter. The effort integrates education and outreach into the research plan, and will contribute critical information to the Haitian reconstruction effort. Participants in a local Leogane stakeholder committee will partake in cross-cutting discussions about key infrastructure issues, to enable them to participate in local decision making.

Assessment of current and potential uses of mobile technology for Haitian relief and development Effort. National Science Foundation grant #1034825. One year. $39,975. Kevin Meehan, University of Central Florida, kmeehan@mail.ucf.edu.

Following the earthquake of January 12, 2010, the situation in Haiti provides an important opportunity to perform a feasibility study of the potential for mobile communications to enhance coordination among stakeholders during and after the crisis. The research team combines technical expertise with effective ground-level liaison through higher education and community association networks in Haiti. The goals are to: (1) assess network accessibility during and after the crisis; (2) assess the level of interagency coordination; and (3) assess current use of mobile communication technology.

RAPID: Automated target detection tool for disaster response. National Science Foundation grant #1034639. One year. $39,644. Harvey Rhody, Rochester Institute of Technology, rhody@cis.rit.edu.

This project will develop and evaluate an automated target detection tool for disaster response. In the aftermath of the January 12, 2010 earthquake in Haiti, this tool will assist emergency response personnel in quickly identifying desired targets in a large collection of imagery. The tool will run on commonly available systems (supporting both desktops as well as laptops that might be used in the field), needing no more than recently collected images to process. A user will examine one typical image and identify targets based on simple matches of color and tolerance properties. The work will address the important question of how to provide useful information to onsite responders to disasters and emergencies, when the specific questions and the type of information that is useful are dependent upon local events and circumstances.

A prototype of the algorithm has already shown it can locate encampments of internally displaced persons. This automated tool can be provided to responders so that food, water, and medicine can be provided to survivors.

REU Site: Network for Earthquake Engineering Simulation: Reducing seismic vulnerability. National Science Foundation grant #1005054. One year. $99,775. Sean Brophy, Purdue University, sbrophy@purdue.edu.

This three-year program will provide an opportunity for eleven undergraduate students to be involved in the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) projects, using NEES advanced cyberinfrastructure. The students will have opportunities to work with world-class researchers and their graduate students in the areas of structures, geotechnical engineering, and tsunami mitigation. Those students interested in information technology development will develop tools that can become part of the network supporting the NEES community. Students will synthesize research outcomes into learning resources that can be shared on the cyberinfrastructure being developed by the NEEScomm IT team.

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

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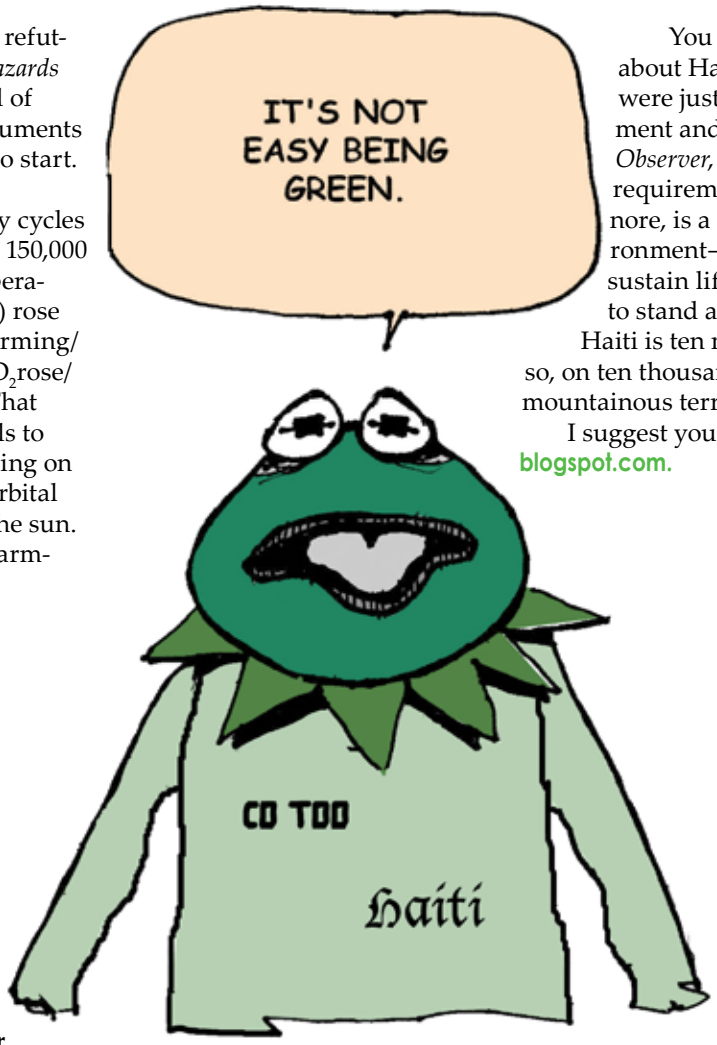
Letters

To the Editor,

The letter by Walter Barth refuting climate change (*Natural Hazards Observer*, March 2010) is so full of inaccuracies and spurious arguments that it is hard to know where to start. Let me deflate just one.

Mr. Barth asserts, ". . many cycles of warming/cooling in the last 150,000 years . . show that global temperatures and CO_2 (carbon dioxide) rose and fell in tandem. But the warming/cooling occurred first, then CO_2 rose/fell hundreds of years later." That is indeed true. But what he fails to state is that warming and cooling on that time frame is caused by orbital changes of the Earth around the sun. Increases in CO_2 come from warming the oceans which releases CO_2, and other processes. The important distinction is that in the cycle we see today, the increase in CO_2 is *leading* the warming—something which has not been observed in a million year record. This is a particularly disturbing trend because as the Earth warms, it will release even more CO_2 causing a feedback that will make it extremely difficult to arrest, unless we act quickly.

Tim Spangler
Nederland, Colorado



To the Editor,

You and virtually all others talk about Haiti's recovery as though it were just a matter of better government and housing (*Natural Hazards Observer*, March 2010). The very first requirement, which you totally ignore, is a sustaining and stable environment—a landscape that works to sustain life, a place for a government to stand and to build an economy.

Haiti is ten million people, or nearly so, on ten thousand square miles of largely mountainous terrain.

I suggest you look at thenatureofourhouse.blogspot.com.

George M. Woodwell
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