Natural Hazards Observer

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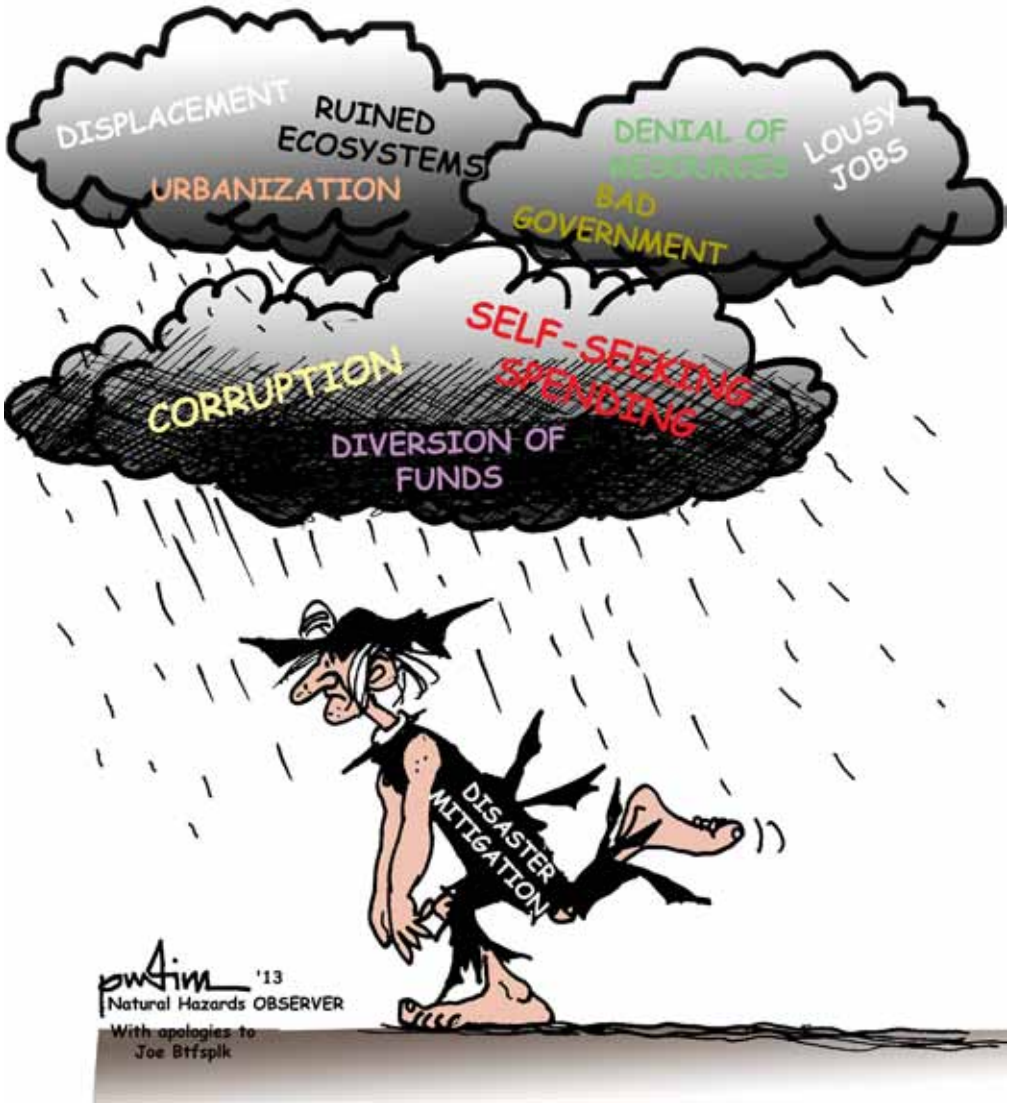
Creating disasters



An invited comment by James Lewis and Ilan Kelman

In the international arena of disaster risk reduction, vague connections are made associating poverty and other social blight to vulnerability, risk, and disaster. While this global social consciousness may be a welcome development, the top-down approach usually employed by international actors rarely explicitly articulates that vulnerability results from a wide variety of dynamic processes. This neglect encourages the creation of new disaster risks—not their reduction.

This vagueness covers up the extent to which greed, misuse of political and commercial power, mismanagement, incompetence, and poor governance drive vulnerability. Tackling these causes of "disaster risk creation"—instead of using the more passive style of disaster risk reduction—requires detailed investigation into contemporary and historical realities of the causes of vulnerability.

This is an effort to which the cooperative international bodies are poorly suited, because their members are often the root cause of the problems in their own jurisdictions.

Risk drivers

Profusely mapped and tabulated, the global, national, and local impacts of disasters are described as exacerbated by "'risk drivers' such as increasing urbanization, poor urban governance, vulnerable rural livelihoods and the decline of ecosystems" (UNISDR 2009). Although these drivers are cred-

(Please see "Creating disasters," page ten)

INSIDE ...

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

Observer cartoons are drawn by Rob Pudim.

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

Notes and follow-up

Mary Fran Myers winners

June and July here at the Hazards Center are usually consumed by preparations for the annual Natural Hazards Workshop, which is being held this year from July 13 to 16 at the Omni Interlocken Hotel and Resort in Broomfield, Colorado.

In addition to the NHC gathering, the International Sociological Association's International Research Committee on Disasters will hold its meeting. The rapidly growing Natural Hazards Mitigation Association will also hold its 2013 International Hazard Mitigation Practitioners Symposium.

Each year, the Gender and Disaster Network and NHC honor a recipient of the Mary Fran Myers Award. This year it is Zenaida Delica-Willison of the Philippines.

We'd also like to congratulate the Mary Fran Myers Scholarship winners: Mara Benadusi of Italy, Hari Krishna Nibanupudi of Nepal, and Barbara Ryan of the United States.

Mary Fran Myers was co-director of the Natural Hazards Center at the University of Colorado for 16 years until her untimely death in 2004. Reducing disaster losses, both nationally and internationally, was her life's work.

The Mary Fran Myers Award recognizes that vulnerability to disasters and mass emergencies is influenced by social, cultural, and economic structures that marginalize women and girls. The award was so named to recognize Mary Fran's sustained efforts to launch a worldwide network among disaster professionals for advancing women's careers and for promoting research on gender issues, disasters, emergency management, and higher education. A goal of both the GDN and the Natural Hazards Center is to promote and encourage such research and practice.

The Mary Fran Myers Scholarship recognizes outstanding individuals who share Mary Fran's commitment to disaster research and practice and who have the potential to make a lasting contribution to reducing disaster vulnerability.

Climate refugees?

Flooding in India and Nigeria sets people on the move

An estimated 32.4 million people in 82 countries were displaced by disasters in 2012—98 percent of them because of climate and weather-related hazards like floods, storms and wildfires, according to the Norwegian Refugee Council's Internal Displacement Monitoring Centre.

"Over five years from 2008 to 2012, around 144 million people were forced from their homes in 125 countries. Around three-quarters of these countries were affected by multiple disaster-induced displacement events over the period," says the IDMC's report *Global Estimates 2012: People Displaced by Disasters.*

About 41 percent of the people displaced in 2012 were put on the move by only two disasters, massive floods in northeast India and in Nigeria.

The report says, "The risk of displacement is expected to rise in line with related and interconnected global trends that increase the risk of disaster. These include population growth, rapid urbanization and the exposure of vulnerable communities, homes and livelihoods to hazards. Due to improved life-saving measures, mortality rates associated with major weather-related hazards are falling, yet increasing numbers of disaster survivors will still be displaced from their homes. In the longer term, human-made climate change is expected to increase the frequency and severity of weather-related hazards including floods and storms, which account for a high proportion of disaster-induced displacement each year."

Population movement occurs as a result of other disasters as well—earthquakes, volcanoes, and so on—but the prevalence of climate- and weather-related displacement is accelerating concerns about the impact of global warming. The United Nations currently does not recognize "climate migrants." But some people are urging that this be considered.

Christine Gibb of the University of Montreal and James Ford of McGill University wrote in the October 31, 2012 issue of *Environmental Research Letters* that the United Nations Framework Convention on Climate Change "can and should recognize climate migrants."

The first problem is finding out who a "climate migrant" is. It is relatively straightforward to say that someone's been displaced by a flood, but whether that flood was the result of climate change is harder to demonstrate. "This complexity, compounded by the impossibility of isolating climate change as a cause, is reflected in wide discrepancies in estimate of the number of affected persons," they write.

This lack of consensus on a definition needn't preclude international action. There isn't any uniform definition of terrorism, either, but that doesn't stop international policy discussions and directives on the topic.

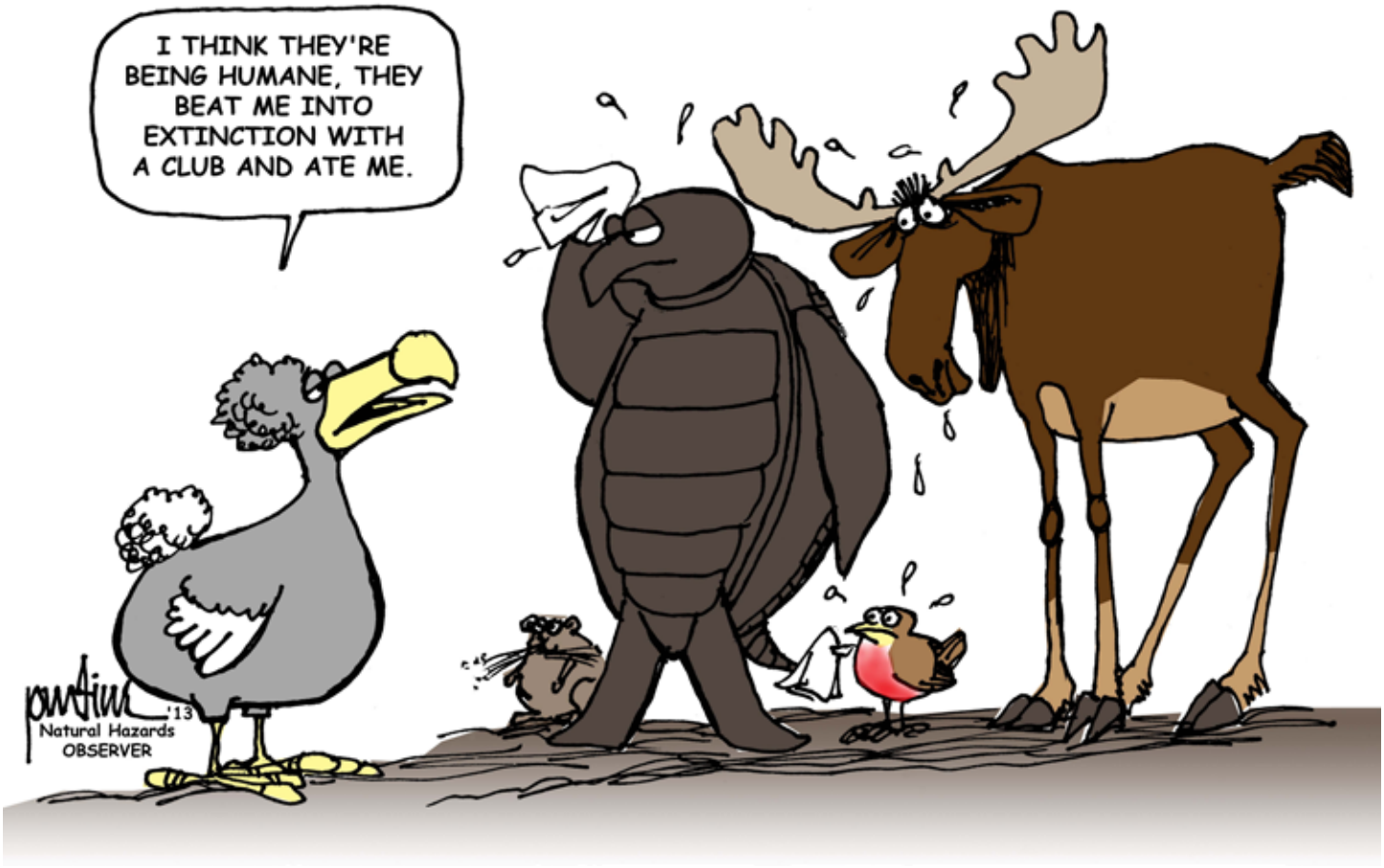
The United Nations *Human Development Report* says that worldwide there are 700 million internally displaced—people who are displaced within their own countries—and 214 million who are cross-border migrants. As many as 20 million people were displaced either permanently or temporarily in 2008 alone "because of rising sea level, desertification, and flooding," say Michael Werz and Laura Conley in the January 2012 report *Climate Change, Migration, and Conflict: Addressing Complex Crisis Scenarios in the 21st Century.* "One expert … predicts a tenfold increase in the current number of internally

displaced persons and international refugees by 2050."

Climate is seldom the only cause of migration. It is usually coupled with social, economic, security, development, conflict, and other environmental factors. The effects can be subtle. Werz and Conley, for instance, says, "The Arab Spring can be at least partly credited to climate change. Rising food prices and efforts by authoritarian regimes to crush political protests were linked first to food and then to political repression—two important motivators in the Arab makeover this past year. To be sure, longstanding economic and social distress and lack of opportunity for so many Arab youth in the Middle East and across North Africa only needed a spark to ignite revolutions across the region. But environmental degradation and the movement of people from rural areas to already overcrowded cities, alongside rising food prices, enabled the cumulative effects of long-term economic and political failures to sweep across borders with remarkable agility."

An October 2012 report by the International Red Cross, *World Disaster Report 2012*, said, "Although forced displacement does not necessarily accompany disasters, the tendency for this to happen is increasing … Generally the hazard itself does not cause the crises of disaster and displacement but the lack of disaster risk reduction strategies, poor emergency preparedness, lack of adequate building codes, high levels of poverty, and similar weaknesses in local and national governance capacity."

Intense weather events threaten animals



Bad for birds, good for ratsnakes

Extreme weather from the warming climate will be tough enough on humans, but it will also cause problems for animals. A disaster map of likely droughts and cyclones under a warming regime—prepared by scientists from the Zoological Society of London—shows that mammals could be at a greater risk of extinction from more intense weather events.

The scientists looked at the ranges of 6,000 species of land mammals, finding that about a third of them are in areas highly susceptible to cyclones, droughts, or both. In particular primates, already among the world's most endangered animals, may be especially at risk. These species have shown some ability to adapt to the harsher conditions, however.

Climate change affects non-human animals in sometimes subtle ways.

For instance, drought in 2010 and 2011 in the Horn of Africa affected millions of people, but it also delayed the arrival of several songbird species to northern Europe. Several songbird species—like the thrush nightingale and red-backed shrike—migrate from southern Africa to northern Europe. They usually pause their migration in the Horn of Africa to refuel for the rest of the flight. In 2011, they had to stay longer in the area to take in their energy requirements, causing them to be late arriving in northern Europe. They missed their peak breeding season, although there was no sign of a failure of breeding success, according to Anders Tøttrup of the University of Copenhagen.

They Said It ...

"A study of injuries after a tornado in Marion, Illinois, showed that 50 percent of the tornado-related injuries were suffered during rescue attempts, cleanup, and other post-tornado activities. Nearly a third of the injuries resulted from stepping on nails. Other common causes of injury included falling objects and heavy, rolling objects. Because tornadoes often damage power lines, gas lines, or electrical systems, there is a risk of fire, electrocution, or an explosion."—**Centers for Disease Control and Prevention website.**

"Irresponsible reporting of that kind is unconscionable in my mind. You have the responsibility to give more than your off-the-cuff opinions."—**Ernst Kiesling, research professor at Texas Tech's National Wind Institute, on an Oklahoma weatherman's on-air advice that people who could leave South Oklahoma City in their cars to outrun an approaching tornado should do so.**

"The twister that tore through Oklahoma on Friday [May 31], which swelled from one mile to 2.6 miles wide in a 30-second span, is the widest ever recorded. For perspective, Manhattan is 2.3 miles wide at its widest point near 14th Street."—**Doyle Rice and Alia E. Dastagir writing in** *USA Today*, **June 5, 2013.**

But a study by York University in Canada found that purple martins migrating from the Amazon Basin to eastern North America had not adjusted their migration schedule to the earlier onset of spring that has been recorded in North America. This means the birds are missing their peak food supplies, which they need for breeding success. "Aerial insectivores like purple martins and other swallows, are experiencing strong population declines, particularly species migrating longer distances and populations breeding further north," said a York University news release. Some European species have been shown to decline because the birds are unable to readjust their migration schedule to the changing temperatures and earlier onset of spring.

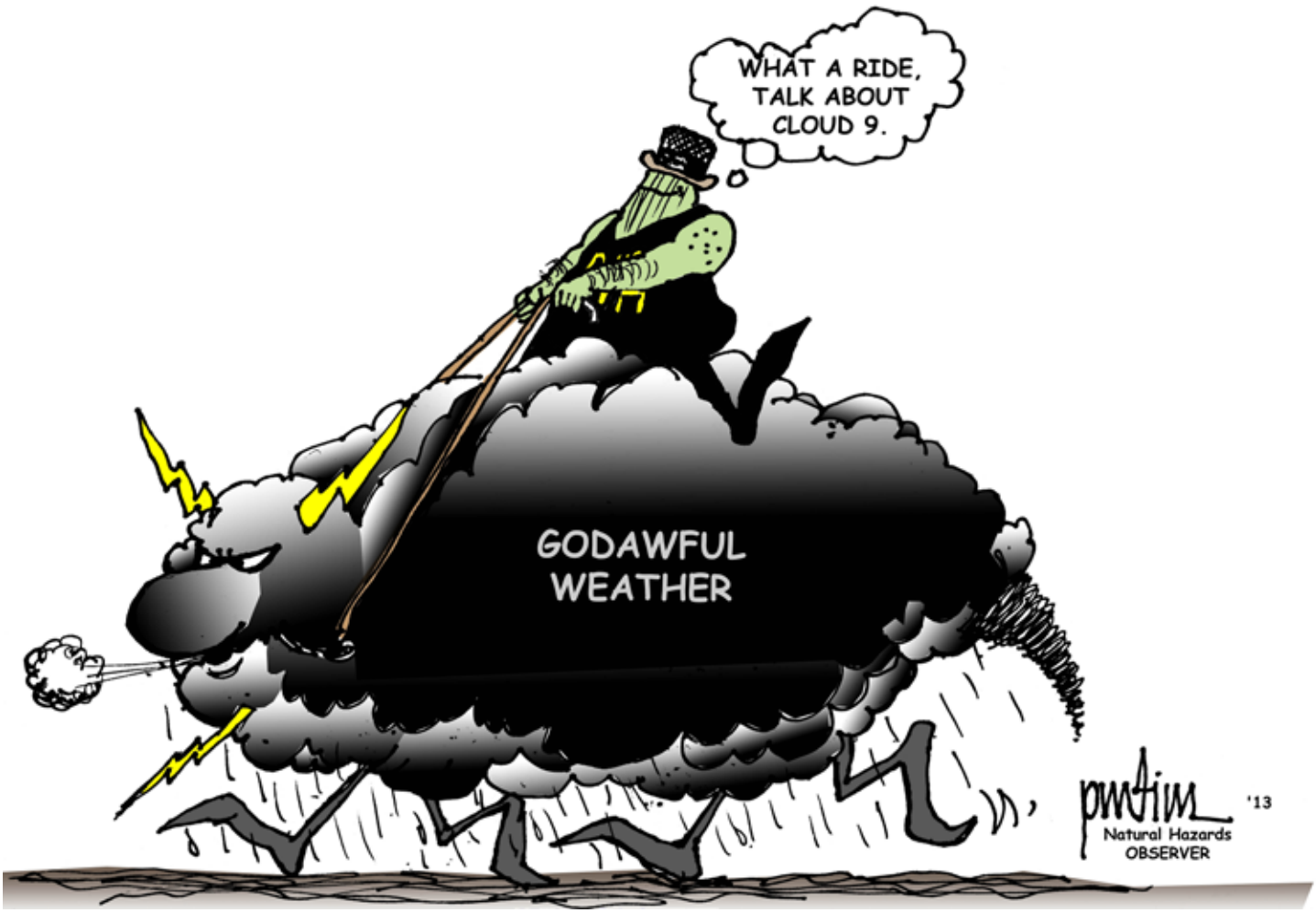
The warming climate will be good for ratsnakes, though. Ratsnakes are ectotherms, meaning that they use the environment to regulate their body temperatures, laying in the sun to warm up and retreating to shady places to cool. Global warming "would actually make the environment thermally better for them," says University of Illinois researcher Patrick Weatherford. "If we start with the premise that with a thermal increase snakes will do better, the snake population may increase." However, he adds that the nation is unlikely to be overrun by ratsnakes, "Snakes are also facing diminished habitat and have a high road mortality. They are not a universally well-loved group of animals."

And the 21st century might be your last chance to see a Pacific leatherback turtle, because climate change may be exacerbating existing threats to the species. Already critically endangered because of egg poaching at beaches and being caught in fishing operations, warming seas may affect their breeding success—but once again in indirect ways. They return to the Costa Rican beaches to nest when there are more jellyfish to eat. There are more jellyfish when the waters are cooler. If climate patterns follow the projections, "the eastern Pacific population of leatherback turtles will decline by 75 percent by the year 2100," says a study in Nature Climate Change by university and government research teams.

Yale University researcher Phoebe Zarnetske and colleagues warn that people interested in protecting biodiversity in the face of a changing climate have to pay attention species interactions. "Certain species impart particularly strong effects on others," they wrote in Science last year. "Consequently, climate impacts on these species could initiate cascading effects on other species. In effect, these species act as biotic multipliers of climate change."

For instance, on Isle Royale in Lake Superior, rising winter temperatures combined with canine parvovirus reduced wolf populations, which resulted in turn in an increase in moose populations and a decline in balsam fir.

"Species interactions are necessary for life on Earth. We rely on fisheries, timber, agriculture, medicine and a variety of other ecosystem services that result from intact species interactions," said Zarnetske. "Humans have already altered these important species interactions, and climate change is predicted to alter them further. Incorporating these interactions into models is crucial to informed management decisions that protect biodiversity and the services it provides."



The weather's even worse than we thought

Disasters are costing $400 per American household per year

It's worse than we thought—on several levels. Heavy weather continues to be the main culprit in natural disasters, and it's costing a lot more than anyone imagined previously.

There were 905 natural catastrophes worldwide in 2012, 93 percent of which were weather-related, according to a **report** from the Worldwatch Institute. "In terms of overall and insured losses ($170 billion and $70 billion, respectively), 2012 did not follow the records set in 2011 and could be defined as a moderate year on a global scale. But the United States was seriously affected by weather extremes, accounting for 69 percent of overall losses and 92 percent of insured losses due to natural catastrophes worldwide, writes Petra Löw, a geographer and consultant at Munich Reinsurance Company," the report says.

The cost of these disasters to the U.S. government, at least, is much greater than anyone has believed before, according to a report prepared by the Center for American Progress, and **reported** by the *Washington Post*. CAP says the federal government spent $136 billion in total from fiscal year 2011 to FY 2012 on disaster relief. "This adds up to an average of nearly $400 per household per year," the report says.

About 44 percent of this total was spent on one event—the "superstorm" Sandy—which got $60 billion in supplemental appropriations. "Nearly all of this disaster spending was for relief and recovery from these and other smaller natural disasters. Most of these disasters are symptomatic of the man-made climate change resulting from massive amounts of carbon emissions and other pollutants in the atmosphere, which warm the oceans and the Earth. As climate change accelerates, so will federal spending on disaster relief and recovery, which will ultimately be paid for by taxpayers," the report says.

In the wake of the devastating Oklahoma tornadoes, though, American taxpayers—usually a frugal bunch—say they're willing to pay up, to a point. A poll by the Pew Research Center for People and the Press found that 59 percent of Americans "say federal spending in response to natural disasters is emergency aid that does not need to be offset by cuts to other programs, while 29 percent say such spending must be offset by cuts to other programs." There were some partisan differences on the issue, with Democrats agreeing 69 percent of the time, independents 57 percent and Republicans 52 percent.

These larger cost and disaster figures may not make all the adjustments necessary to paint a complete picture of hazards losses. The United Nations' *Global Assessment Report on Disaster Risk Reduction 2013* **says** that "Direct disaster losses are at least 50 percent higher than internationally reported figures: Total direct losses in 40 low and middle income countries amount to $305 billion over the last 30 years; of these, more than 30 percent were not internationally reported."

What to do, what to do? It is generally recognized that

Sandy ...

A storm by any other name

So what was it? Hurricane Sandy? Superstorm (upper case "Super") Sandy? Super-storm Sandy? Or (lower case) superstorm Sandy?

You can find all of these designations in somebody's description of, uh, Sandy, the Category 1 hurricane that hit the East Coast on October 22, 2012. The most common designation seems to be "Hurricane Sandy," although the storm was not at hurricane force during the entire span of its fabled existence. Wikipedia says, "The severe and widespread damage the storm caused in the United States, as well as its unusual merge with a frontal system, resulted in the nicknaming of the hurricane by the media and several organizations of the U.S. government 'Superstorm Sandy.'"

The term "superstorm" seems—to us, at least—to imply that it is somehow superior to a hurricane. Faster, stronger, more horrifying, more deadly, more … something. So in what sense was storm Sandy "super?"

Well, it caused a super amount of damage, about $50 billion in property loss, second only to Katrina in U.S. history. It was the largest Atlantic hurricane ever recorded, with an 1,100 mile diameter at one time.

But its greatest claim to super-ness was simply where it hit, the New York-New Jersey-Connecticut population centers and media nexus. It's telling that Wikipedia credits the "super" appellation in large part to "the media."

In most other respects, Sandy was a pretty ordinary hurricane. By the time it hit the East Coast, it was a Category 1 hurricane, a serious but not awe-inspiring event. New York City has been hit by six more powerful storms since 1851.

Sandy killed 72 people in eight states. This makes it the deadliest hurricane to hit the East Coast since 1972, but it isn't within shouting distance of big killer storms like the 1970 Bangladesh cyclone that killed 300,000 people, according to Chris Landsea at the National Oceanic and Atmospheric Administration. In the United States, Sandy would be number 27 in fatalities caused by storms occurring since 1851.

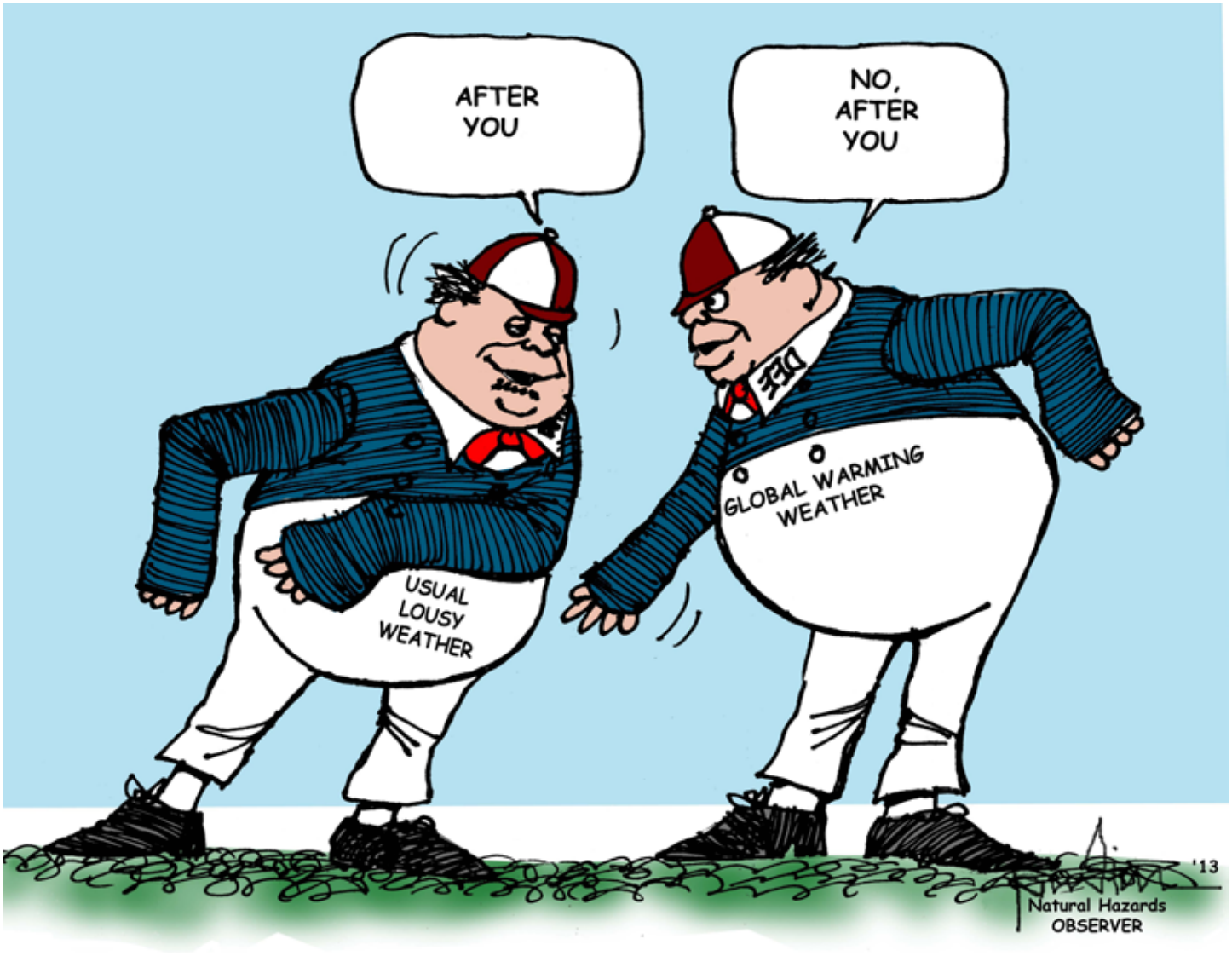
So, as a matter of editorial nomenclature, we prefer Hurricane Sandy and—if you simply must supersize everything—superstorm (l.c.) Sandy, using the superstorm as a description rather than a name.

money spent on mitigation reduces the ultimate cost of the disaster when it does occur. But some potential mitigation measures are too expensive. In the September 12, 2012 *EOS* from the American Geophysical Union, Northwestern University's Seth Stein and University of Tokyo's Robert Geller note, "Formulating effective mitigation strategies is both an economic and political challenge. In both spheres, explaining the uncertainties involved in hazard forecasts is crucial, even though they cannot be precisely estimated. From an economic viewpoint, they can be factored into analyses of the optimum mitigation level, i.e., that which minimizes the total cost to society, which is the sum of the cost of mitigation and the expected losses. Presenting the uncertainties is equally important for the public discussion needed to formulate policies."

"Another tough challenge, for which scientists do not yet have a good approach, involves extreme events that are so rare that their probabilities are hard to estimate. The 2011 Tohoku earthquake was much larger than considered in the Japanese government's hazard map and so caused a tsunami that overtopped seawalls, causing more than 18,000 deaths and $210 billion in damage. An immediate question is if and how coastal defenses that fared badly should be rebuilt, because building them to withstand tsunamis as large as 2011's is too expensive," Stein and Geller write.

Fifty-nine percent of Americans "say federal spending in response to natural disasters is emergency aid that does not need to be offset by cuts to other programs, while 29 percent say such spending must be offset by cuts to other programs."

An April 2013 paper in SIAM/ASA *Journal on Uncertainty Quantification* offers a model to attempt to formulate policies on natural hazard mitigation under uncertainty. "We present a general stochastic model in which the probabilities either are constant with time or depend on the previous history," the authors, father and son team Jerome and Seth Stein, write. "We then develop models for two hazard policy issues facing Japan. One uses a stochastic model to select an optimum mitigation strategy against future tsunamis by minimizing the sum of the expected present value of the damage, the costs of mitigation, and a risk premium reflecting the variance of the hazard. We also consider whether new nuclear power plants should be built, using a deterministic model that does not require estimating essentially unknown probabilities. These models can be generalized to mitigation policy situations involving other natural hazards."



Seth Stein is quoted in a news release, "Much of the problem comes from the fact that formulating effective natural hazard policy involves using a complicated combination of geoscience, mathematics, and economics to analyze the problem and explore the costs and benefits of different options. In general, mitigation policies are chosen without this kind of analysis. The challenge is deciding how much mitigation is enough. Although our first instinct might be to protect ourselves as well as possible, resources used for hazard mitigation are not available for other needs. For example, does it make sense to spend billions of dollars building buildings in the central U.S. to the same level of earthquake resistance as in California, or would these funds do more good if used otherwise?"

It's not the heat, it's the ...

Well, maybe it is the heat

And guess who's most likely to live in heat-prone areas?

The big disaster news out of Manhattan lately has been Hurricane Sandy, but the next headlines might be hollering about the heat instead of the wind. A study in the journal *Nature Climate Change* says increases in heat from a changing climate will increase the deaths by 20 percent by the 2020s and, in the worst case scenarios, by 90 percent or more in the 2080s.

Heat extremes are already responsible for about 20 percent of the natural hazard deaths in the United States, according to 2008 work done by Susan Cutter and Kevin Borden.

Higher winter temperatures may partially offset heat-related deaths by reducing cold-related mortality, but the net impact is that deaths may rise by a third over the rates from the 1980s, says a team from Columbia University's Earth Institute and the Mailman School of Public Health. The authors write, "Temperatures in the New York City region increased by 2 C between 1901 and 2000, substantially exceeding global and US national trends. Preparing for and preventing temperature-related health problems has been identified as a high priority topic by New York City's government."

The net effect of the increased heat would be up to 900

additional deaths in Manhattan per year in the 2080s from heat-related causes.

And guess who are more likely to be those extra death victims? A **study** by the researchers at the University of California, Berkeley, published online in Environmental Health Perspectives found that minorities were more likely to suffer and die from increased heat. The researchers looked at land cover, like whether an area was covered with heat absorbing surfaces like concrete or asphalt, or whether there tree canopies and such to provide shade.

African Americans were about 50 percent more likely than whites to live in "heat-prone" neighborhoods, while Hispanics were 37 percent and Asians a third more likely to live in them. "This study highlights a mechanism by which racial and ethnic minorities will likely suffer more from the effects of climate change," said study lead author Berkeley's Bill Jesdale. "It may not be surprising that minorities live in inner cities, but this is the first paper to assess what that means in terms of heat vulnerability at a national level."

Heat extremes are becoming more frequent in the United States. The Natural Resources Defense Council ranked "all 50 states for the percentage of weather stations reporting at least one monthly heat record broken in 2012. The ten states showing the highest percentage with new heat records are: Tennessee (36 percent), Wisconsin (31 percent), Minnesota (30 percent), Illinois (29 percent), Indiana (28 percent), Nevada (27 percent), West Virginia (26 percent), Maine (26 percent), Colorado (25 percent), and Maryland (24 percent). Especially hard-hit regions include the Upper Midwest, Northeast, northern Great Plains, and Rocky Mountain states.

"In 2012, Americans experienced the hottest March on record in the contiguous U.S., and July was the hottest single month ever recorded in the lower 48 states. As a whole, 2012 was the warmest year ever recorded in the U.S.," NRDC said.

The National Oceanic and Atmospheric Administration's *State of the Climate National Overview* **says** that in 2012 19 states recorded their record warm years. The fourth warmest winter, warmest spring and second warmest summer contributed to 2012 having an average temperature 3.2°F [1.8°C] above average and 1.0°F [0.6°C] above the previous record warm year of 1998."

Creating disasters ...

(Continued from page one)

ited with leading to "massive human misery and crippling economic losses" (UNISDR 2009), the political origins of poverty and disaster vulnerability are ignored. Greed, injustice and other problems perpetuated by decision makers remain in the background.

There is plenty of information about what, where, and how big disasters have occurred, but less focus on why. The realities of the status quo of vulnerability that creates disaster risk remain obscure and unexplored.

The inclusion of the four risk drivers—urbanization, poor governance, tenuous rural livelihoods, and ecosystem decline—is often taken to mean that we need look no further for the roots of vulnerability. This is not the case. Vulnerability accrues through a wide variety of dynamic, long-term processes. Neglecting them encourages "disaster risk creation."

A 2009 survey involving 7,000 people in 48 countries (GNCSODR 2009) indicated "a significant gap between national and local level action." Progress at the present rate "will not deliver the required reduction in disaster losses by 2015." Consequently, at its current pace of implementing change, the *Hyogo Framework for Action* (UNISDR 2005) cannot reach its stated goals, especially Priority Action 4: "Reduce the underlying risk factors."

These United Nations documents reflect the concerns of the organization and its member governments. They also embody a characteristic disadvantage: governments don't welcome exposure of their own shortcomings. How else could governments be expected to commit themselves to signing up to report content unless there are no indictments, no fault-finding, no blame, and no negatives reflecting on themselves?

Entire initiatives—such as the World Conference on Disaster Reduction, the Hyogo Framework for Action, and the Global Assessment Reports—trade on well-meaning optimism, positive drive, and honorable common good for the future of humankind. What such documents do not express—perhaps cannot express—is that governments, societies, and communities include functional as well as dysfunctional elements. They include the corrupt as well as the ethical, the weak and the apathetic alongside the powerful.

They reflect an assumed "equality of the good" that cannot represent or express society's inequalities and injustices that are themselves a principal cause of vulnerability. Sometimes "poverty" is referred to, yet causes of poverty are not always recognized in international documents—except through disasters themselves. Through vulnerability to disasters, poverty becomes not simply a static, immutable, and inconvenient fact. But in fact, it is the by-product of long-term, dynamic actions and inactions across economic and governance sectors.

Disaster risk reduction does not always acknowledge that societies inevitably include those with less admirable motives. Greed and self-indulgence exacerbate inequality and vulnerability. They operate pervasively, undermining DRR efforts at domestic, group, corporate, and institutional levels.

Good governance applies to the rural as well as to the urban, to the rich as well as the poor. It cannot be restricted to initiating or permitting favorable systems and procedures. It also must prevent and inhibit procedures that, while advantageous to a few, result in widespread deprivation for the many.

Vulnerability drivers

A population's vulnerability is the result of many factors. The actions of the political or economic power structure can endanger people, or impoverish them. For example:

Endangerment:
1. Environmental degradation;
2. Discrimination;
3. Displacement.

Impoverishment:
4. Self-seeking public expenditure;
5. Denial of access to resources;
6. Corruption;
7. Siphoning of public money.

Below are further explanations and a brief illustrative vignette of each item on these two lists.

Environmental degradation

Development affecting the environment may be initiated or permitted that places people in vulnerable situations when they occupy that development or changed environment. That may arise from environmental degradation or environmental modification that creates or augments hazards.

In Pakistan in the floods of 2010, hundreds of people were killed and millions displaced. Illegal logging was identified as a main culprit. In addition to deforestation contributing to flooding, landslides, and soil erosion, illegally felled trees hidden in ravines were dislodged by floodwaters and destroyed bridges providing access to flooded areas.

Discrimination

Ethnic, religious, gender, or disability-based discrimination may lead to deprivation, victimization, or forced movement into hazard-prone areas. Discrimination also reduces options for adopting DRR measures.

In South Africa, underdeveloped places like the South African townships are ghettos of discrimination, deprivation, and concentrated vulnerability. Most are overcrowded and prone to disease, fire, storms, and flooding. The inhabitants are sometimes forced to move without alternative accommodation.

Displacement

Removal of houses and people to make land available for other purposes—without compensation or alternative shelter—deprives families of livelihoods and exacerbates their vulnerability to hazards. When deprived of familiar environments without support for learning about their new location, already vulnerable people can be subject to hazards with which they are unfamiliar.

In the Philippines, government development projects—dams, irrigation, mining operations, plantations, recreation areas, and so on—are locally viewed as more disastrous than natural hazards. They all require conversion of prime agricultural land to industrial and commercial use. Local communities are often not consulted. They are displaced, losing their rights, livelihoods, and lands. Government or private compensation is far below the amount needed to start over elsewhere. Land alternatives are seldom available.

Self-seeking expenditure of public money

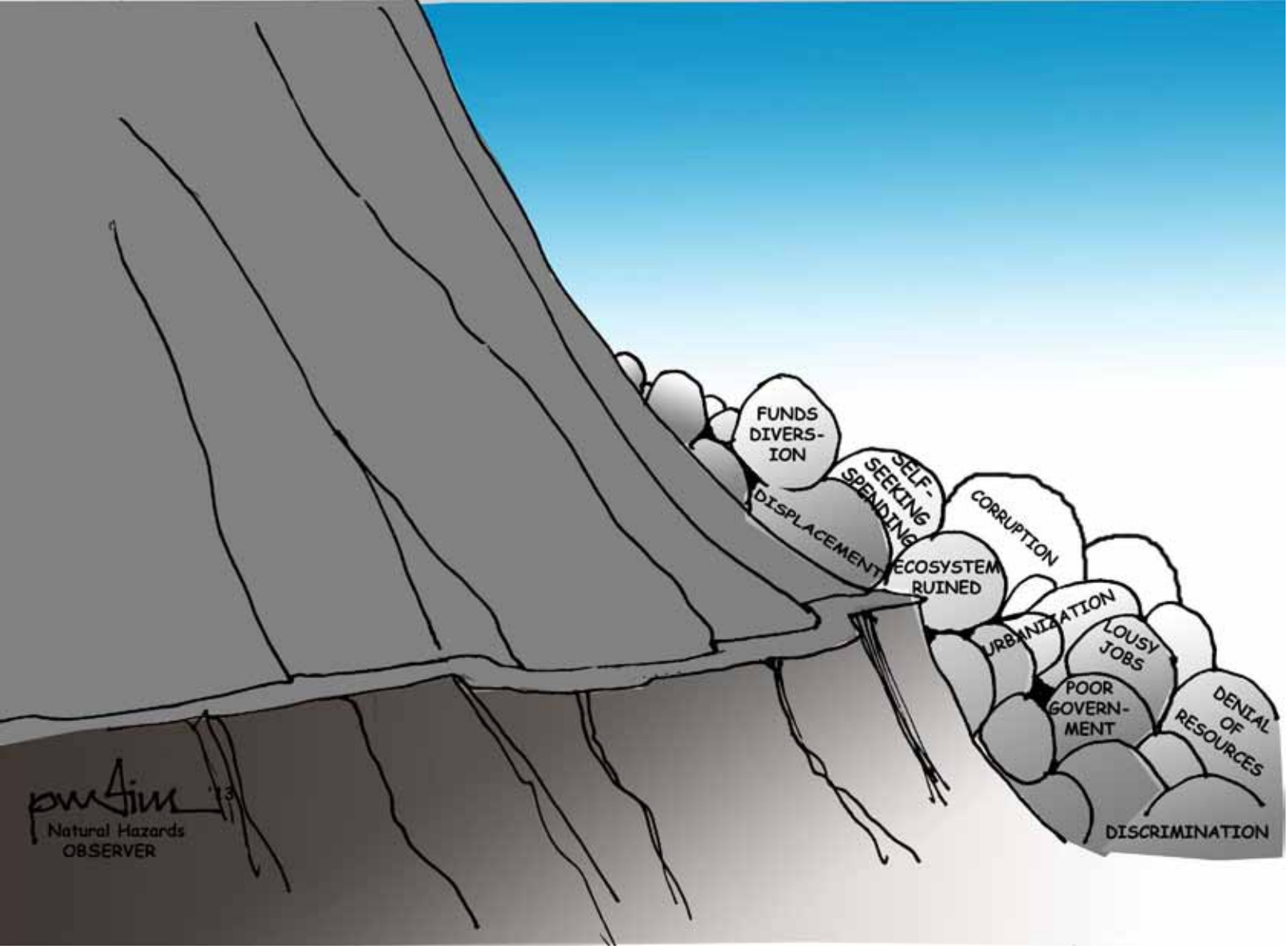
Self-seeking expenditure manipulates funds that otherwise could be applied to development, such as DRR work. Instead, these funds are put towards projects that benefit the manipulator. While no guarantee exists that unsiphoned funds would be used for DRR, the fundamental principle is that public money ought to be used for public good. Cases of abuse of entrusted power for personal gain leading to increased community vulnerability are discussed below as corruption (point 6) and siphoning of public funds (point 7).

In Vietnam, climate change adaptation influences vulnerability to hazards. Climate change adaptation is part of disaster risk reduction. In June 2012, three of four climate change research projects in Vietnam funded by the Danish International Development Agency, were stopped by the Danish Embassy because of fraudulent expenditure by participants. The projects were assessments of climate change impacts on land use and livelihoods, socioeconomic development, and estuarine ecosystems, along with the effects upon rice production of submergence and salinity. All these activities are part of DRR and link to social improvement, well-being, and poverty reduction.

Denial of access to resources

Some people's actions, inadvertent or deliberate, have caused others to be deprived of resources that either belonged to them or that were commonly available. The actions may have occurred in the past, but their long-lasting consequences continue to be a part of present-day conditions. Many current conditions have come to be regarded as permanent, normal, and acceptable, despite a step change in increased vulnerability from the past.

During World War II, an airfield was built on Funafuti atoll by American forces on the main island in what was then the Ellice Islands and is now Tuvalu. That land had been used for growing staple crops. The Tuvaluans were given food and amenities such as fuel, tobacco, and soap meaning that for decades afterwards many considered it to have been their time of plenty, despite the continuing loss of some of their most productive land. A similar story was told on the outer island of Nanumea where two-fifths of the island's coconut trees were destroyed to build an airfield—which no longer exists and which, due to the packing of the coral, no longer supports coconut trees to the extent previously. Reliable local food is reduced, decreasing self-sufficiency and augmenting vulnerability.



Corruption

At one time, corruption was typically condoned as "usefully functional" or as grease for the wheels of bureaucracy. It was more often ignored than investigated. That has been the case even though it deprives the poorest of what little money they have and keeps elites in power. Now, it is recognized that the spread, extent, and scale of corruption distorts economies, increasing costs of goods and services.

In fact, illegal transboundary movements of money and goods from developing countries are valued at an order of magnitude more than foreign aid to those countries. Much of the illegal profits from developing countries ends up in banks in the developed world.

Foreign aid includes DRR and other vulnerability reduction measures. If the "dirty money" were invested in the communities where the money came from, perhaps there would be no need for foreign aid to initiate and support DRR.

China's government promotes its uncovering of corrupt practices and subsequent punishing of those responsible. Yet corruption continues to take a large toll on the country's finances, environment, social services, and living conditions. In terms of disaster vulnerability, the destruction of so many schools in the 2008 Sichuan earthquake, which killed 75,000 people including 900 children in one school, was strongly suspected to have resulted from corruption in construction.

Siphoning of public money

Diversion and siphoning of public money into private bank accounts, wherever they are held, is an aspect of corruption, drawing money away from potential DRR activities. Inclusive of development funding, money is stolen and sent to private, offshore tax havens before it can be spent for other purposes, which could have included public goods such as vulnerability reduction. As a driver of vulnerability at national levels, the siphoning of public money has few rivals for the geographical extent and size of the sums involved. Washington, D.C. based Global Financial Integrity estimated that, during the past ten years, $6 trillion has been siphoned from developing countries alone.

From the military-industrial complex taking up approximately half of the U.S. discretionary spending each year to pork-barrel expenditures, whereby elected representatives direct money to their districts, the American political system is well-known for public money being siphoned to support special interests. The national budget crisis does not stop subsidies to the fossil fuel and defense industries. This occurs despite the vulnerability exacerbated by poverty in cities like Los Angeles (at risk for earthquakes), New Orleans (hurricanes), and New York (hurricanes).

Integrating disaster risk reduction

Why so many underdeveloped countries remain underdeveloped, or why the extent and levels of poverty and vulnerability prevail in all countries, are questions that cannot be answered without considering the colossal sums of money spent on tasks other than DRR and development. That covers the amounts accruing in private offshore bank accounts and the more than $1.5 trillion globally spent each year on the military. Corrupt practices offer incentives of personal profit of a magnitude far outweighing any, at a personal level, that might be achieved by DRR—and require less work for their installation.

Yet accepting that disasters happen is politically easier than professing to be able to prevent them and running the risk of backlash due to carrying the blame for failure. There also tends to be more political gain for responding competently to a disaster than for preventing one.

Current focus on climate change adaptation, often at the expense of other DRR and development work, may provide an opportunity to put the principles into practice to achieve ethical management. As money is directed toward climate change adaptation, irrespective of other DRR and development concerns, disciplined governance is required to ensure that funds are used for the purpose for which they have been disbursed.

The capital being appropriated by climate change work also includes intellectual capital, in terms of climate change knowledge. It is re-inventing what is known already, rather than embracing, building on, and learning from what other fields have long established. Separation from others is key to marking one's own territory.

In fact, perhaps the greatest failing of top-down, institutionalized DRR is that it has been separated from its contexts. But it is those contexts that actively contribute to vulnerability and disasters. DRR should not isolate itself. Moving beyond its presently perceived remit from the institutionalized perspective, DRR should be informed about, and prepared to deal with, all topics that have a bearing upon vulnerability, such as the seven discussed above.

Similarly, DRR should consider conflict, and consequent displacement and endangerment, due to the inherent links between disaster risk and different levels of violent and non-violent conflict. Corruption interacts with rebellion in complex ways, but can certainly feed grievances that lead to revolutions. Consequently, DRR must deal with corruption, conflict, and their interactions and consequences.

DRR has for too long institutionally and conceptually separated itself from its social, economic, and environmental contexts. DRR needs to integrate.

Taking on these recommendations and better integrating DRR with other process does not in itself guarantee a disaster-free world—although DRR in itself has never guaranteed a disaster-free world. Risks will always exist.

Without tackling all vulnerability drivers—the roots of disaster risk creation—the conditions of disaster risk creation will continue to prevail over attempts at DRR. In fact, DRR still has a long way to go before it can be recognized as containing the answers required for dealing with vulnerability, risk, and disaster. Meanwhile, DRC proceeds apace.

DRR should consider conflict, and consequent displacement and endangerment, due to the inherent links between disaster risk and different levels of violent and non-violent conflict.

This article is based on the paper by James Lewis and Ilan Kelman. 2012. The good, the bad and the ugly: disaster risk reduction versus disaster risk creation. *PLoS Currents: Disasters*, 21 June 2012, http://currents.plos.org/disasters/article/the-good-the-bad-and-the-ugly-disaster-risk-reduction-drr-versus-disaster-risk-creation-drc

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Resources

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

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

CLIMATE

Climate Change, Disaster Risk, and the Urban Poor: Cities Building Resilience for a Changing World. Judy L. Baker, editor. 2012. ISBN: 978-0-8213-8845-7. 322 pp., free download. https://openknowledge.worldbank.org/handle/10986/6018.

About a year ago, I was walking through Kibera, Nairobi's largest slum, with my brother-in-law, who is a physician. Kibera is a settlement of perhaps 600,000 people with open sewers, open burning, flying toilets (don't ask), mud shacks with tin roofs, and no running water, Tom looked around, said, "It's a wonder people aren't sick all the time here."

This study opens with the unexceptionable claim in its overview that, "People living in slums are at particularly high risk from the impacts of climate change and natural hazards … Residents are exposed to the impacts of landslides, sea-level rise, flooding, and other hazards."

While this might be true, it's far from clear that these are the biggest risks these folks face. Disease, crime, substandard housing, and hopelessness might be just as easily listed.

This book places quite bit of emphasis on good governance and finance to address these issues, two things that are often missing in slums. In its chapter on "Building Resilience for the Urban Poor," the report says, "City governments are the drivers for assessing risks, through the provision of public infrastructure, delivery of basic services, and mainstreaming climate adaptation and disaster-risk reduction into urban planning and management decisions." But these are precisely the things missing in slum governance. It might even be argued that this is why they remain slums.

Climate Adaptation and Flood Risk in Coastal Cities. Jeroen Aerts, Wouter Botzen, Malcolm J. Bowman, Philip J. Ward, and Piet Dircke, eds. 2012. ISBN: 978-1-84971-346-7. 332 pp., $80.80 (hardcover). Earthscan. http://www.routledge.com/books/details/9781849713467/.

This book takes a look at coastal climate issues through a high-powered socioeconomic lens. A major focus is on ports—New Orleans, Rotterdam, Miami, Houston—and the effect of severe weather disasters on them. Hurricane Katrina caused U.S. economic losses of $142 thousand million, the book says, with large—though not as large—economic costs from hurricanes Ike, Andrew, Ivan, and Wilma.

The third chapter of this book develops "socioeconomic scenarios" that map the "possibility space" to get an assessment of uncertainty and develop strategies for adaptation. "Socioeconomic scenarios are scenarios in which future population and human development, economic conditions, changes in land cover, water supply and demand, agricultural developments, energy consumption and biodiversity (or a selection of these trends) are systematically explored. General objectives underlying these assessments are to characterize the sensitivity, adaptive capacity and vulnerability of environmental, social, and economic systems."

The authors of the various essays then apply these principles to various situations, including the cities of Rotterdam, Jakarta, and New York, as well as flood models, and urban waterfronts generally.

The Hockey Stick and the Climate Wars: Dispatches from the Front Lines. By Michael E. Mann. 2012. ISBN: 978-0-2311-5254-9. 395 pp., $28.95 (hardcover) Columbia University Press. http://cup.columbia.edu/book/978-0-231-15254-9/the-hockey-stick-and-the-climate-wars

Michael Mann is responsible for the climate "hockey stick." Climate skeptics have been beating him with it ever since.

This book is Mann's story about the ways science can be abused by political interests. For scientists especially, it is a cautionary tale about science in the public arena.

Although every one with an interest in the subject certainly knows it by now, it's probably necessary to say the "hockey stick" is a graph in the 2001 *Summary for Policy Makers* of the Intergovernmental Panel on Climate Change climate report, showing the changes in the earth's temperature from A.D. 1000 to the present. The graph proceeds at a flat, leisurely pace for about 800 years, then spikes dramatically at the Industrial Revolution. The hockey stick's rise to prominence as the "bete noir for those who denied the importance or even existence of climate change" was the result of the fact that it was powerful and easy to understand. It's also correct—despite what you might hear to the contrary.

This is a very entertaining book that winds its way through the thicket of climate science and politics. The story is notoveryet. As an intellectual mater, the science of climate change was settled long ago—in favor, needless to say, of Mann and his colleagues. As a political and policy question in the United States, it's just getting under way.

Waking the Giant: How a Changing Climate Triggers Earthquakes, Tsunamis, and Volcanoes. By Bill McGuire. 2012. ISBN: 978-0-19-959226-5. 320 pp., $18.14 (softcover). Oxford University Press. http://ukcatalogue.oup.com/product/9780199678754.do#.UaMShWRKlpI.

Just when we thought that we'd worried about everything there is to worry about with the changing climate, along comes geophysical and climate hazards professor Bill McGuire to warn us that we have to worry about awakening earthquakes, tsunamis, and volcanoes, too. We thought those issues were off the table.

Not so, says McGuire. Taking lessons from the end of the last Ice Age, he writes that the rebound of the earth's surface from the declining weight of ice sheets can potentially trigger

all of these hazards. He writes in his final chapter, "That the extraordinary transformation in the Earth's climate between 20,000 and around 5,000 years ago drew a lively response from the solid Earth is incontrovertible. Only recently, however, has the possibility that anthropogenic climate change may evoke a response along the same lines begun to attract attention."

McGuire doesn't specifically lay any modern geophysical disasters at the feet of climate change. He does, however, take a close look at the melting of ice cover in Alaska to find the "canary in the cage" for these issues.

DROUGHT

Drought and Aquatic Ecosystems: Effects and Responses. By P. Sam Lake. 2011. ISBN: 978-1-4051-8560-8. 400 pp., $93 (softcover). Wiley-Blackwell. eu.wiley.com/WileyCDA/WileyTitle/productCd-1405185600.html.

Written by the aptly named Sam Lake, this book is a comprehensive look at the impact of drought on the environment. Little of it deals with the human impact, though naturally that figures into the overall picture.

Late in the book, Lake presents a chapter on "Human-induced exacerbation of drought effects on aquatic ecosystems." These are extensive, of course, ranging from the effects of land use change to groundwater mining to nonpoint pollutants to salinization and so on.

Lake makes the mandatory nod to the impact of climate change on freshwater ecosystems, though the cumulative effect of these changes is far from certain. "Basically," he writes, "in dealing with climate change, there are two courses of action—reactive and proactive. Reactive management means implementing measures in response to current impacts. Proactive management means the implementation of measures in response to current impacts—and much more importantly, it means acting in anticipation of future threats and impacts. In the case of droughts, management measures should be designed to aid the biota of aquatic ecosystems to resist, where feasible, the impacts of drought, and more importantly to recover after drought has broken. Reactive measures are usually short-term and, in the case of drought would involve such activities as the emergency release of water from dams, the pumping of groundwater to maintain streams and wetlands, facilitating the movement of aquatic fauna to refuges, the identification and protection of refuges and the destratification of lakes/reservoirs."

Droughts present an especially difficult problem to planners because it can be hard to recognize when they are occurring in the early stages, and it's nearly impossible to predict how long they'll last. While this book is oriented toward ecological understanding of the phenomenon, it provides a holistic understanding of the phenomenon.

ALL HAZARD

Natural Hazard Mitigation Policy: Implementation, Organizational Choice, and Contextual Dynamics. By Daniel J. Alesch, Lucy A. Arendt, and William J. Petak. 2012. ISBN: 978-94-007-2235-4. 238 pp., $128.35 (hardcover). Springer. http://www.springer.com/earth+sciences+and+geography/natural+hazards/book/978-94-007-2234-7.

The central idea of this book is that while good policies are good, good implementation of good policy is even better. Hard to argue with that.

"Few things are as simple as they first appear," the authors write in their first chapter. "Newcomers to government often assume that a policy, once adopted will be implemented faithfully in accord with the policy makers' intent and have the desired results. An increasingly rich body of research confirms what old hands already know: That is simply not the case."

The book takes an in-depth look at one case, California's regulatory effort to strengthen acute care hospital buildings against earthquake damage, known as SB 1953. The authors write ominously, "The case is a story of well-meaning seismic safety advocates attempting to require equally well-intentioned hospital owners and operators to retrofit acute care facilities built before 1973 to meet contemporary seismic standards, to replace them, or to remove them from service. The case is fraught with complexity. Nothing is simple. Neither the independent elements, nor the interdependent relationships, are easily understood."

The outcome of all this work might be surprising to some. "Some will read this book and conclude that we 'took the side of the bad guys,'" they write in their final chapter. Readers will have to decide that for themselves. But the authors explore what they call the "ecology of public policy implementation" in a thorough and detached manner, pointing out many ways in which good policy and good implementation can diverge in mitigating disasters.

Collaborative Resilience: Moving Through Crisis to Opportunity. Bruce Evan Goldstein, editor. 2011. ISBN: 978-0-262-01653-7. 424 pp. $27 (hardcover). The MIT Press.

The word of the year this year is "resilience." It hasn't overtaken "climate change" on the *Observer* bookshelf, but it's gaining ground. While the National Academies have made a yeoman's effort to corral the various meanings of the term, it remains a little like the old joke about the blind men describing an elephant. It depends on which part you examine.

Bruce Evan Goldstein writes here about "collaborative resilience." A professor formerly at Virginia Tech University—now at the University of Colorado Denver—he was inspired to tackle the topic by the April 16, 2007 shootings there, which killed 27 students, five faculty members and injured more than a dozen more. "This book explores the meeting point of planning and natural resource management in their attempt to understand how to intervene to enhance community resilience. They must intervene while at the same time preserving the autonomy and agency that both energize collaboration," he writes.

The best part of the book is the case studies examining various recovery processes. "The eight case studies in the second part consider how collaboration can increase resilience to oppression, natural disasters, natural resource scarcity, and climate change," Goldstein writes. "The first four cases describe collaboratives that tend to be highly inclusive and that are intended to maintain system continuity and integrity by reorganizing in response to changing conditions. All of the collaboratives show adaptive resilience. In contrast, the collaboratives described in the next four cases tend to exclude certain stakeholders in their pursuit of transformative resilience. When ecological, economic, or social conditions make an existing system untenable, they seek to "create untried beginnings from which to evolve a new way of living."

Resilient systems, the book argues, arise from community debate and interaction, both the process and result of cooperation.

EARTHQUAKE

Tectonic Shifts: Haiti Since the Earthquake. Mark Schuller and Pablo Morales, eds. 2012. ISBN: 978-1-56549-511-1. 288 pp. $75 (hardcover). Kumarian Press. https://www.kpbooks.com/title/Tectonic_Shifts_Haiti_Since_the_Earthquake.

The volume covers the 2010 Haiti earthquake from the broadest context to the specific. The first essay here covers the political, social, and economic history of the nation, confirming—paraphrasing Gilbert White—"Disasters are not accidents or acts of God. They are deeply rooted in the social, economic, and environmental history of the societies where they occur." In this essay, Anthony Oliver-Smith offers a useful comparison between the earthquake in Haiti and the one that occurred a few weeks later in Chile—a quake that was 500 times more powerful, but the number of people killed numbers in the hundreds, not the hundreds of thousands.

Governance, development levels, building codes, and other factors separating the relatively rich nation of Chile from the poor one of Haiti provide insight into why destruction in Haiti reached such catastrophic levels.

Another essay, by Melinda Miles, looks at the way "the humanitarian response was colored above all by a series of assumptions about the Haitians whom the disaster most affected." In a sad episode of unacknowledged racism, Miles writes, "Pervasive stereotypes of Haiti—'poorest country in the Western Hemisphere,' chaotic, and wracked with political violence—created a fear not based on reality but rather on mainstream media depictions that frequently generalize, demonize, and sensationalize the Haitian people."

This attitude led to a top-down relief effort, in which many of the decisions that would affect the people were made behind high walls and barbed wire, without the participation of those same people.

The book also includes a moving "Diary of a Survivor in Haiti," by Carine Exantus, which brings the issues discussed here home at the individual level.

FLOOD

Flood Hazards: Impacts and Responses for the Built Environment. Jessica Lamond, Felix Hammond, Colin Booth, and David Proverbs, eds. 2012. ISBN: 978-1-4398-2625-6. 387 pp., $134.65 (hardcover). CRC Press. http://www.crcpress.com/product/isbn/9781439826256.

Flood Hazards is another in the long line of excellent technical books from CRC Press dealing with hazards and disasters. This one focuses on the many issues the built environment faces in the event of a flood. It's designed as a cross-disciplinary manual for anyone dealing with flooding and structure issues. Chapters cover flood forecasts, warnings, health effects, repairing water damaged buildings, and many other topics.

One of the later chapters in the book will be of particular interest to social scientists: "Why most 'at-risk' homeowners do not protect their homes from flooding." Surveys show that only eight percent of the people who have never experienced a flood take steps to protect their homes. Perhaps more surprising is that only 33 percent of people who have experienced flooding have taken steps to prevent a recurrence.

After surveys and substantial bivariate analysis, the researchers boiled their "statistically significant predictors" down to only two: "(1) the view that insurance is an adequate substitute for flood protection, a belief that is negatively correlated with protective behavior; and (2) the belief that flood protection will generate feelings of greater safety, a belief that is positively correlated with protective behavior."

Getting people to take protection against flooding means convincing them that there are added advantages over and above insurance, and appealing to their instinct for safety in their homes.

NUKES

Too Hot to Touch: The Problem of High-Level Nuclear Waste. By William M. Alley and Rosemary Alley. 2013. ISBN: 978-1-107-03011-4. 370 pp. $29.99 (hardcover). Cambridge University Press. http://www.cambridge.org/us/knowledge/isbn/item6893140/?site_locale=en_US.

The nuclear waste disposal problem has been with us for a long time—though not so long as the lifetime of the waste itself. The authors note, "One of the most important things to understand about radioactivity is that the half-life of a radionuclide is an inverse measure of the intensity of radiation it generates. The shorter the half-life, the more atoms that decay and emit radiation each second. Elements with a shorter half-lives, like thorium-234 at 24 days are more radioactive that those with longer half-lives, like uranium-238 at 4.5 billion years."

Too Hot to Touch gives a technical, historical, and political summary of the long-running issues with nuclear waste disposal. In 1948, the then-head of the Atomic Energy Committee's General Advisory Committee Robert Oppenheimer said the waste problem was "unimportant." Turns out, he was wrong. The problem of high-level waste disposal has proven to be very hard to solve and remains a major barrier to the responsible use of nuclear energy. This books offers a well-written, sober account of this sorry, continuing chapter in the development of the U.S. nuclear industry.

Contracts and Grants

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

Toward Improved Understanding of Rapid Intensification of Tropical Cyclones. National Science Foundation grant #1326524. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1326524. Three years. $96,468 to principal investigator Yuqing Wang, University of Hawaii, yuqing@hawaii.edu.

The rapid intensification, which involves interactions between the inner core dynamics and the large-scale environment and among different spatial and temporal scales, is still one of the least understood phases of a tropical cyclone. Previous studies have already shown that the rapid formation of a warm core in the upper troposphere is the key to the rapid intensification onset of a cyclone.

We will study processes that lead to the rapid formation of the upper-tropospheric warm core in tropical cyclones through idealized and actual case simulations and diagnostic and budget analyses using cloud-resolving models. In particular, three questions will be addressed: (1) Given favorable tropical ocean conditions, is the intensification rate of a cyclone externally or internally determined and can an environmental flow or synoptic-scale forcing increase the intensification rate that a cyclone could have without these forcing? (2) How do the three-dimensional structure (including the size) and intensity of a vortex determine the efficiency of the upper-tropospheric warming and thus the intensification rate of the cyclone itself? (3) How are convective bursts and hot towers triggered and how do they lead to the upper tropospheric warming over the storm core prior to and during the rapid intensification?

To answer these questions, we will use the tropical cyclone model TCM4 to conduct a series of idealized and real-case simulations and perform diagnostic and budget analyses to verify our hypotheses, identify the physical mechanisms responsible for the rapid intensification.

Fundamental Mechanics and Conditional Probabilities for Prediction of Hurricane Surge and Wave Loads on Elevated Coastal Structures. National Science Foundation grants #1301016 and #1266101. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1301016. Two grants. Three years. $210,000 to principal investigator Daniel Cox, Oregon State University, dan.cox@oregonstate.edu, and $140,000 to principal investigator John van de Lindt, Colorado State University, john.van_de_lindt@colostate.edu.

Damage to coastal structures as a result of combined surge and wave loading has been significant in recent events such as Hurricane Ivan (2004), Katrina (2005) and Ike (2008) and most recently Sandy (2012). There is over $3 trillion in built infrastructure along the U.S. East and Gulf coasts, and elevated structures along coastal areas are becoming more commonplace as building stakeholders seek to mitigate damage and risk of property and structure loss.

Currently, there are no accurate mechanics equations to compute the forces for combined surge and wave on these types of elevated structures and no comprehensive method to consistently account for the variability in the random nature of the incoming waves. This project will pursue research that focuses on the impact of hurricane surge and wave loads on elevated coastal structures. The goal is to understand and quantify surge and wave loads on buildings and structures that can be used to mitigate damage to the coastal structures.

A theoretical approach based on physics will be used to model the interaction between the water and coastal structure. The analytical formulation will be validated through small scale experimental testing in a wave tank. Storm surge and wave impacts will be formulated on a probabilistic basis. The results of the research can lead to performance based requirements in building standards.

The goal is to mitigate damages to shoreline infrastructures from extreme coastal storms. The analytical formulation will be built on Goda's method for calculating surge forces on elevated coastal structures and will be extended to incorporate wave forces. A probabilistic approach will be taken to combine surge and wave loads. Hydrodynamic hurricane wave and structure interaction will be used to formulate loading on these types of structures. The formulation will be validated with experiments on small scale structure models using a wave tank.

Analysis of Mobile Doppler Radar and Lidar Data of Severe Convective Storms. National Science Foundation grant #1262048. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1262048. Three years. $654,934 to principal investigator Howard Bluestein, University of Oklahoma Norman Campus, hblue@ou.edu.

This research project seeks to further our basic physical understanding of severe convective storms and tornadoes, with an emphasis on tornadoes produced by supercells. The overall goal will be accomplished through the analysis of data collected by state-of-the-art mobile Doppler radars and a mobile Doppler lidar (TWOLF: Truck-Mounted Wind Observing Lidar Facility). The former include: (1) a rapid-scan (mechanically scanning), polarimetric, X-band radar (RaXPol); (2) a rapid-scan, phasedarray, X-band radar (MWR-05XP); and (3) a high-resolution, W-band radar.

Some of the radar data to be analyzed includes datasets collected during VORTEX2 (The 2nd Verification of the Origin of Rotation in Tornadoes Experiment) in the springs of 2009 and 2010. The remainder of the radar data to be analyzed include RaXPol and MWR-05XP data collected a during a small, local, field program during the spring of 2011, RaXPol data collected during the spring of 2012, RaXPol and TWOLF/MWR 05XP data collected during the spring of 2013, and RaXPol data collected during the springs of 2014 and 2015.

Forecasts and warnings of tornadoes and other severe weather phenomena such as large hail and straight-line winds will improve with an increase in the understanding of them.

A Deep-AUV Magnetic and Seismic Study of the Hawaiian Jurassic Crust—The Global Significance of Jurassic Magnetic Anomalies. National Science Foundation grant #1341955. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1341955. One year. $85,083 to principal investigator William Sager, Uni-

versity of Houston, wsager@ocean.tamu.edu.

Funds are for a two-year study, initially involving a 42-day cruise to collect two high-resolution seismic profiles and near-bottom magnetic field data from the Hawaiian Lineation Jurassic Magnetic Quiet Zone using an autonomous underwater vehicle. We plan to obtain 800 kilometer long magnetic profiles and local seismic reflection and refraction data using a portable multichannel seismic system and sonobuoys. Seismic data will allow us to evaluate whether the Jurassic crust has been affected by later intra-plate Cretaceous volcanism.

This magnetic data will be compared to the previously studied JMQZ data from the Japanese Lineation. The latter reveals rapid reversal and decreasing field intensity as well as a period of apparently incoherent anomalies with short wave lengths and low amplitudes. If real and global, this low amplitude zone represents an very unusual field behavior in Earth's magnetic field history.

FEM-based Inverse Methods to Estimate Nonlinear Geometric Source Parameters of Volcano Deformation from Geodetic Data. National Science Foundation grant #1316082. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1316082. Three years. $113,420 to principal investigators Timothy Masterlark, and Kurt Katzenstein, South Dakota School of Mines and Technology, timothy.masterlark@sdsmt.edu.

The migration of magma within a volcano produces a deformation signature at the Earth's surface. The location, shape, and pressurization of the magma chamber, as well as the internal structure of the rocks surrounding the magma chamber, control the specific deformation pattern that can be observed at the surface of the volcano.

Quantifying the characteristics of magma migration is important, because the upward migration of magma is a precursor to volcanic eruptions. This project will develop finite element models, a type of numerical method to simulate volcanoes as a dynamic system that accounts for the interaction of migrating magma within the complex internal structure of an active volcano. These FEMs will be used in inverse methods that seek to quantify estimates and uncertainties of a few characteristic parameters that describe magma migration into, or out of, a magma chamber.

These methods will be developed in the context of two volcanoes (Okmok, Alaska, and Tungurahua, Ecuador) that will serve as natural laboratories. Both of these active volcanoes have known internal structures in the form of tomography models estimated using data from ground-based seismic instruments, as well as surface deformation histories that were recorded with geodetic data over the past decade. More specifically, this project will use FEM-based inverse analyses of geodetic data to determine estimates and uncertainties for the location, shape, and pressurization of magma chambers embedded in the complex internal structures of these two active volcanoes.

Adjoint Tomography of Fault Zone Environments. National Science Foundation grant #1314875. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1314875. Two years. $74,320 to principal investigator Yehuda Ben-Zion, University of Southern California, benzion@usc.edu.

We are investigating the subsurface structure of fault zones using a variety of seismic phases: surface waves, body waves, fault zone head waves, and fault zone trapped waves. By using a larger portion of the recorded seismic wavefield, we should be able to better resolve the fault zone structures to which the waves are sensitive. We use an adjoint-based tomographic inversion technique that relies on highly accurate, three-dimensional seismic wavefield simulations. The study has the following three components: (1) simulations of synthetic seismograms in realistic, complex 3D fault zone models, including clarifying the allowable ranges of geometrical and material variations that produce the observed characteristics of recorded head and trapped waves; (2) analysis of volumetric sensitivities of various fault zone, body, and surface phases to key fault zone structures at depth; (3) iterative adjoint tomographic inversions for the structures of the San Andreas fault near Parkfield and different sections of the San Jacinto fault zone.

Large damaging earthquakes originate on faults kilometers below Earth's surface. A detailed characterization of the physical setting where earthquakes nucleate and rupture has not yet been achieved. By modeling seismic waves that are particularly sensitive to the structures of fault zones, we can image the subsurface structure of fault zones. The basic difficulty in imaging fault zones stems from their multi-scale and strong variations in structure, which are evident at the surface and within boreholes.

Understanding Changing ENSO Flavors in the Mid-Holocene Laboratory. National Science Foundation grant #1304910. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1304910. Three years. $439,605 to principal investigators Christina Karamperidou, Fei-Fei Jin, and Pedro Di Nezio, University of Hawaii, ckaramp@hawaii.edu.

El Niño/Southern Oscillation events can have profound impacts on regional climate in many parts of the world. Recent studies have shown that two primary "flavors" of El Niño exist, with distinct intensities and sea-surface temperature patterns: the Eastern Pacific El Niño, which is more intense, with warmer SSTs concentrated in the eastern Pacific; and the Central Pacific El Niño, which is more moderate, with warmer SSTs concentrated in the central Pacific.

Neither models nor observations conclusively indicate which of these ENSO flavors will be dominant as greenhouse gas warming progresses, creating uncertainty in projections of regional climate change throughout the Pacific basin. To help address this uncertainty, a team of scientists from the University of Hawaii will undertake a paleoclimate reconstruction study focusing on understanding the response of ENSO flavors to climate conditions in the mid-Holocene (approximately 5000-7000 years before present).

Through a synthesis of climate model results and paleoclimate proxies, the project will investigate the origin of ENSO flavors and their sensitivity to changes in tropical climate. In addition, modeling experiments will be performed to examine the role of stochastic noise in ENSO response to climate change.

Catching the Quake: Investigating Samples from the JFAST expedition of the 2011 Tohoku Earthquake. National Science Foundation grant #1260602 and #1260555. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1260555. Two years. Two grants. $153,729 to principal investigator James Kirkpatrick, Colorado State University, jkirkpat@rams.colostate.edu, and $176,072 to principal investigators Heather Savage and Pratigya Polissar, Columbia University, hsavage@ldeo.columbia.edu.

This research investigates how shallow slip occurred during the Tohoku earthquake by determining the frictional strength of the fault before the rupture initiated and during slip. Using samples collected from the fault during IODP exp 341 (JFast), the scientists will undertake:

(1) Organic thermal maturity measurements to identify the rupture plane and quantify the frictional temperature anomaly induced by coseismic slip.

(2) Microstructure observations to identify and characterize the fault that hosted the earthquake, including the identification of textures that indicate frictional weakening.

(3) Friction measurements to constrain the steady-state frictional stress of the faults.

These results are crucial for understanding tsunami genesis in shallow subduction zones and will provide critical information for tsunami prediction and hazard mitigation. Only direct observation and measurement of the fault physical properties can determine these parameters.

The Tohoku quake was a surprise. Previous work had indicated that such a quake was unlikely in region, especially one in which large amounts of slip occurred in "weak" shallow accretionary prism sediment. Understanding this quake requires understanding frictional characteristics of rocks in fault zone. There are three plausible scenarios:

First, the fault could have undergone frictional weakening during rapid slip resulting in very low stress coseismically. Alternatively, stress prior to the earthquake was low and changes on the fault were small coseismically, with slip driven by stress transferred from the deeper part of the fault. Finally, slip could have propagated through a velocity-strengthening region of the fault with little fault weakening on average.

Perceptions of and Intentions toward Tornado Sheltering Strategies of Mobile Home Residents. National Science Foundation grant #1301822. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1301822. One year. $13,756 to principal investigators Susan Cutter, and Kevin Ash, University of South Carolina at Columbia, sutter@sc.edu.

This project investigates the attitudes of mobile home residents about taking shelter from tornadoes. Mobile home residents are disproportionately affected by tornadoes. They make up about 6 percent of the population of the United States, but account for about 45 percent of tornado deaths.

Previous studies investigated what people knew about tornadoes or how they perceived danger from tornadoes. This project focuses on what people know about sheltering strategies and how they perceive the effectiveness of those actions in preventing harm.

For example, people who believe they are not able to carry out sufficient actions to protect themselves from a tornado may develop negative attitudes toward sheltering behavior. Such negative attitudes can lead them to ignore warnings and put themselves at greater risk from tornadoes.

The first goal is to identify a few common attitudes and beliefs about tornado sheltering within mobile home communities. This will be accomplished by a series of interviews with mobile home residents in South Carolina, where mobile homes are as prominent in the housing sector as any other state in the United States. After the interviews, a questionnaire will be mailed to random occupied mobile home units in South Carolina to provide data for the remaining goals of the project.

A second goal is to discover if certain types of attitudes and beliefs are more prevalent in different sectors of the population. For example, the study will investigate gender, age, race and ethnicity, family structure, education, mobility, and several other factors to determine how these relate to attitudes and beliefs about taking shelter from tornadoes.

We will also research whether mobile home residents living in different geographic situations have different tornado sheltering strategies. Many mobile homes are situated in or near urban areas within mobile home parks containing dozens of units. However, there are also large numbers of mobile homes in rural areas which are single-sited units situated in areas with fewer roads and nearby sturdy structures.

The final goal s to find out what mobile home residents intend to do when tornadoes threaten, and to understand which factors discussed above are most important in their decisions as to what to do. This will enable the building of a conceptual framework for how mobile home residents develop tornado sheltering plans and take action, or why they fail to do so.

Predicting Climate Change Impacts on Shallow Landslide Risk at Regional Scales. National Science Foundation grant #1336725. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1336725. Three years. $299,036 to principal investigators Erkan Istanbulluoglu and Jessica Lundquist, University ofWashington, erkani@u.washington.edu.

Landslides disrupt aquatic habitats and damage infrastructure. Landslide hazards in the West are expected to grow with climate change, but to date, geologic landslide research has been typically conducted independently from hydroclimate research.

Washington's Cascade Mountains experience landslides across a wide a range of climates, vegetation, and topography. Work done here is relevant to mountain areas across the globe.The project team will develop a regional scale, distributed numerical model in conjunction with 50-plus years of landslide observations across the Washington Cascades to answer the following research questions: (1) What are the relative roles of location (geology, topography, slope) vs. climate (precipitation, temperature, snowmelt, and recharge rates) on landslide frequencies? (2) How well does a new, transformative model combining the methods of geotechnology, geology, and hydroclimate prediction reproduce past spatial-temporal patterns and frequencies of landslides? (3) How will climate change likely impact landslide locations and frequencies?

While the effects of climate change on water resources and stream temperatures have been extensively studied using numerical models in recent decades, only limited studies focused on landslide sediment delivery. These studies either use empirical rainfall thresholds and geologic susceptibility maps at regional scales to identify landslides, or focus on detailed hydrology over several meters. The first method excludes essential physics, while the second cannot be used over large areas. This project will integrate these two lines of thought and potentially transform how regional landslide research is done.

Ecological Resistance of Multiply Stressed Populations: the Response of Tidal Marsh Birds and Plants to Hurricane Sandy. National Science Foundation grant #1340008. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1340008. One year. $199,976 to principal investigators Brian Olsen, Chris Elphick, and Greg Shriver, University of Maine, brian.olsen@maine.edu.

All animal and plant populations can weather change. However, the amount of environmental change a population can absorb is likely to depend upon other past and ongoing stresses that the population experiences. This project will test whether the ability of populations of native plants and animals in coastal marshes to withstand the recent, extreme storm Hurricane Sandy was greater or less in marshes more subject to past stresses.

Researchers will compare the abundance of marsh plants and animals before and after the storm and test whether vulnerability was greater in more specialized species or in marshes surrounded by development, invaded by introduced plants, or challenged by high rates of sea-level rise, and whether previous protection of areas from different kinds of development or use helped reduce vulnerability. By addressing these questions using current theories of ecosystem disturbance, the research will provide general insights on the effects of disturbance and stress on native species and habitats.

This research also will provide a specific assessment of Hurricane Sandy's impact on tidal marshes, a vital buffer against storm damage. This will help managers target specific marshes for conservation and restoration and improve the efficiency of planned federal restoration efforts. The work will also inform future coastal management planning by identifying which types of marshes are most vulnerable to future disturbances.

Structural Evolution Through the Lifecycle of Hurricane Sandy. National Science Foundation grant #1322532. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1322532. Three years. $166,958 to principal investigator Jenni-Louise Evans, Pennsylvania State University, jle7@psu.edu.

Hurricane Sandy wrought devastating impacts on tens of millions of U.S. citizens. Protection of the lives and property of residents along the path of such a system is imperative. This requires understanding the physics underlying the system and being equipped to act on that knowledge. Development of physical understanding of the evolution of Sandy provides the knowledge to underpin future forecasts of similar systems and appropriate societal responses to those events. Analysis of the sensitivity of the observed Sandy lifecycle to the characteristics of the various contributing systems and environmental factors helps to constrain and refine this understanding. Methodologies employed here will be cluster analysis of the ensemble forecasts and related sensitivity simulations.

This research hypothesizes that Hurricane Sandy underwent a warm seclusion near landfall, resulting in an atypical distribution of significant weather over the U.S. Northeast. The relative roles of Hurricane Sandy, the blocking high and upstream trough, the remnant Tropical Storm Tony, as well as surface fluxes and friction will be examined and the ensemble diagnostics and sensitivity simulations will be conducted. Point clustering will be used to evaluate the model skill in simulating the structural evolution of Sandy. Path clustering provides sub-groups from the ensembles whose evolution is similar over the entire forecast period.

Analyses of alternative storm evolutions within objectively-derived subgroups of the ensemble members provide insight into the relative importance of different storm and environment characteristics. These can be further tested through sensitivity studies using the Weather and Research Forecasting (WRF) model.

Materials Physics of Rapidly Sheared Faults and Consequences for Earthquake Rupture Dynamics. National Science Foundation grant #1315447. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1315447. Three years. $81,901 to principal investigator James Rice, Harvard University, rice@esag.harvard.edu.

Earthquakes on the well-established and highly slipped fault zones which host major events seem to occur at overall levels of shearing stress which are notably lower than "static friction" stress levels required to initiate slow frictional sliding between the fault walls. If those static friction stresses prevailed during earthquake slip, they would produce perceptible localized heat outflows along faults and leave abundant signs of melting and re-solidification, even at shallow crustal depths. Neither are generally found.

Also, recent field and lab observations show that the majority of deformation during rapid shear is generally localized to a remarkably thin principal shear zone along the fault, often less than a millimeter to a centimeter wide, with that feature forming within a much broader, say, one to a hundred meters wide, zone of granulated and damaged rock. Our study will understand the materials and thermal physics responsible for those features of fault zone response, and establish some of their consequences for the manner by which slip-ruptures propagate along faults in major earthquakes. This basic understanding of the physics of earthquakes may ultimately improve the predictability of seismic phenomena.

We have developed the concept that thermal heating of groundwater-saturated fault gouge during shear leads to strong localization of strain into realistically narrow zones. That focuses further heating and temperature rise, but rather than leading directly to melting, weakening mechanisms are triggered that sufficiently limit strength, and hence continued heating, so as to make bulk melting of the fault zone rare, at least at shallow crustal depths. A relatively universal form of weakening is that groundwater thermally expands much more than its mineral host, causing the mineral constituents to push less strongly against one another, and hence to have low frictional strength. A variant of this process is that thermal decomposition of common fault constituents such as carbonates and hydrated clays occurs, at temperatures far below melting, and creates a highly pressurized volatile product phase (CO_2 or H_2O, respectively) which similarly reduces strength.

Further weakening processes, of which the physical details are still unclear, relate to the nanometer size range of the solid decomposition and wear products. We will model how such weakening processes influence features of propagating earthquake ruptures (e.g., crack vs. slip pulse, rupture velocity, stress drop, total slip), how rupture relates to the fault mineralogy and depth, and how different dynamic weakening processes might be identified in seismic observations.

Hypotheses to be tested are that thermal decomposition combined with variation in fault mineralogy could explain how rupture stops at the base of the seismogenic zone, and that thermal decomposition could provide a mechanism for occasional extreme earthquakes on faults that generally experience smaller events. We will model the material lying outside the narrow highly deforming fault core as an elastic or an elastic-brittle-plastic solid, using our analyses of the localized shearing processes within the deforming fault core as the basis for imposing boundary conditions along the fault surfaces in the larger analysis.

The Role of Pore-Fluid Pressure on Fault Behavior at the Base of the Seismogenic Zone. National Science Foundation grant #1315784. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1315784. Three years. $104,856 to principal investigator J. Gregory Hirth, Brown University, Greg_Hirth@brown.edu.

To characterize earthquake rupture, localization of deformation, stress, and rheology at the base of the seismogenic zone we will conduct an experimental study on quartz-rich rocks. The project is focused on the mechanical role of pore fluids and how the mechanical properties of fluid-rock systems respond to variations in temperature and strain rate. Our study will provide new data relevant for understanding the evolution of seismic hazards, by concentrating on the links between long-term tectonic and earthquake processes. This unstudied area may be critical for applying geophysical data to constrain a wide range of fault zone processes that limit the depth extent of earthquake rupture.

The role of fluids on the processes responsible for the brittle-plastic transition in quartz-rich rocks has not been explored at experimental conditions where the kinetic competition between microcracking and viscous flow is similar to that expected in the Earth. Our initial analysis of this competition between these brittle and ductile processes suggests that the effective pressure law for fracture and sliding friction should not work as efficiently near the brittle-plastic transition (BPT) as it does at shallow conditions.

Experiments will be conducted on low porosity quartzite and sandstone at T = 700-1100oC, strain rates from 10-3/s to 5x10-7/s, and P = 100 MPa to 1 GPa. The results of our study will be directly relevant for understanding many critical scientific problems related to seismicity and the rheological behavior of plate-boundary faults. For example: (1) the long term strength of faults depends critically on pore-fluid pressure, thus investigating where the long-term strength faults is actually controlled by frictional properties rather than ductile creep - and how fault strength evolves during the seismic cycle - remains a key problem; (2) The presence of fluids (resulting in low effective stresses), and frictional properties near the fault slip stability transition and a fully effective pressure law are invoked in almost all models for the generation of non-volcanic tremor. However, the interactions between crystal plastic processes and pore-fluid pressure are not well constrained at these conditions; and (3) a key initial condition to understanding the evolution of fault resistance during seismic slip and the maximum depth of seismic faulting is the stress state and scale of strain localization at the base of the seismogenic zone during interseismic periods.

A Damage, Photogrammetry, and Radar Analysis of the Moore, Oklahoma Tornado. National Science Foundation grant #1343963. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1343963. One year. $13,705 to principal investigator Nolan Atkins, Lyndon State College, nolan.atkins@lyndonstate.edu.

This research will conduct a comprehensive analysis of the devastating Moore, Oklahoma tornado that occurred on 20 May, 2013. The focus of this study will be the integration of a comprehensive damage survey with high-resolution radar data from the nearby Twin Lakes, OK WSR-88D operational Doppler radar, as well as visual data of the tornado and attendant debris.

There are very few analyses of large, devastating tornadoes published in the referred literature. For the first time, the relationship between radar-detected features associated with the tornado and attendant debris, visual characteristics of the tornado and debris, and damage intensity and location will be examined. Such an integrated analysis has yet to be published in the refereed literature for a large, violent tornado.

Effects of Saharan Dust on African Easterly Waves and Tropical Cyclones. National Science Foundation grant #1321720. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1321720. Three years. $413,154 to principal investigators Shu-Hua Chen and Terrence Nathan, University of California-Davis, shachen@ucdavis.edu.

This research will advance understanding of the effects of Saharan mineral dust on the African easterly jet, African easterly waves, and tropical cyclones. A unified work plan is designed that combines theory, numerical experiments, data assimilation, and model verification. Standard analytical, numerical, and diagnostic methods will be used to execute the plan. A new theoretical framework will be developed whose goal is to illuminate causal relationships between Saharan dust, the African easterly jet, and African easterly waves. The theoretical framework will serve as a tool for interpreting results obtained from the Weather Research and Forecasting model, which will be used to carry out comprehensive simulations involving dust-radiative-microphysical interactions.

The intellectual merit of the research includes advancing understanding of how Saharan mineral dust operates over the synoptic scale environment to the tropical cyclone scale to affect the path and intensification of tropical cyclones. This research will assess the relative importance dust-radiation and dust-microphysical interactions on tropical cyclone activity, which will lead to improved prediction of tropical cyclones.

Conferences and Training

July 2-5, 2013
Geographic Information Forum 2013
University of Salzburg
Salzburg, Germany
Cost: $470

This forum will present GIS research with a focus on technology transfer. Topics include landslide susceptibility mapping, spatial modeling of climatic water balance indices, heat-related mortality in micro-urban heat islands, evacuating tsunami inundation zones, identifying and collecting geographical information with smartphones, and crime and hurricanes in Louisiana.

http://www.gi-forum.org/

July 8-10, 2013
Ninth International Conference on Earthquake Resistant Engineering Structures
Wessex Institute of Technology
A Coruña, Spain
Cost: $1,285

This conference will discuss basic and applied research for designing earthquake resistant structures. Topics include earthquake prediction, tsunamis, seismic hazards and vulnerability, building performance during earthquakes, performance-based design, material mechanics and characterization, and microzoning and seismic codes.

http://www.wessex.ac.uk/13-conferences/eres-2013.html

July 9-11, 2013
Third International Conference on Disaster Management and Human Health
Wessex Institute of Technology
A Coruña, Spain
Cost: $1,280

In coordination with the meeting listed immediately above, this conference will discuss the global health risks of disaster and how to reduce the human health impacts. Topics include disaster monitoring and mitigation, emergency preparedness, risk and security, socioeconomic issues, biological threats, lessons from disasters, risk mitigation, disaster analysis, and safety and resilience.

http://www.wessex.ac.uk/13-conferences/disaster-management-2013.html

July 13-16, 2013
38th Annual Natural Hazards Research and Applications Workshop
University of Colorado Natural Hazards Center
Broomfield, Colorado
Cost: $375

The Annual Natural Hazards Research and Applications Workshop is designed to bring researchers and practitioners from many disciplines together for face-to-face discussions on how society deals with hazards and disasters. The International Research Committee on Disasters Researchers Meeting and the Natural Hazard Mitigation Association Practitioners Meeting will immediately follow the main Workshop from Tuesday, July 16 through Wednesday, July 17.

http://www.colorado.edu/hazards/workshop/current.html

August 19-21, 2013
Maritime Security 2013 West
Homeland Security Outlook
Long Beach, California
Cost: $445

This conference will discuss using technology to mitigate maritime security threats. Topics include radiological and nuclear detection, waterborne terrorism, drug smuggling, submersible threats, sonar technology advances in port security, new types of coastal surveillance, the future of maritime security, maritime law enforcement training programs, and continuity of port operations.

http://www.maritimesecurity2013.com/west/

August 21-23, 2013
International Conference on Biodefense and Natural Disasters
OMICS Group
Orlando, Florida
Cost: $799

This conference will present new research in biological and environmental science. Topics include biological weapons, nuclear disasters, biodefense and emerging infectious diseases, applied biodefense research and technology, environmental hazards and natural disasters management, and catastrophic modeling.

http://www.omicsgroup.com/conferences/biodefense-natural-disasters-2013/index.php

August 27-29, 2013
Fourth International Conference on Risk Analysis and Crisis Response
Society for Risk Analysis and Istanbul Technical University
Istanbul, Turkey
Cost: $551

This conference will discuss decision making systems for risk analysis and crisis response. Topics include natural disasters and catastrophic accidents, public health, threats to social safety, debt crisis, terrorism, emergency risk, food safety, critical infrastructure protection, and experimental riskology.

http://www.racr2013.itu.edu.tr/

August 27-31, 2013
International Conference on Geomorphology
International Association of Geomorphologists
Paris, France
Cost: $695

This conference will present new research on landforms and the processes that shape them. Topics include human impacts on landscapes, geomorphic hazards, risk management and climate change, landslide risk assess-

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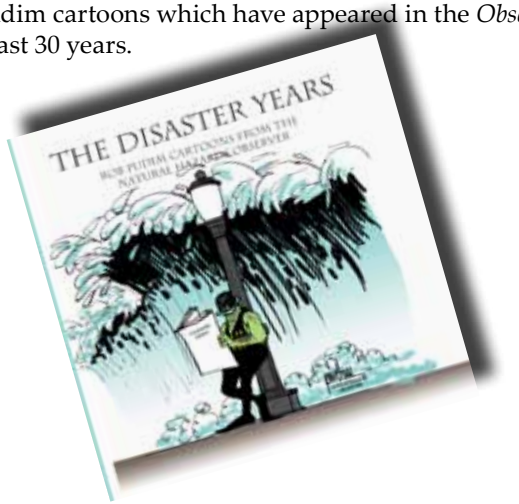

ment methods, mountain geomorphology, extreme events, and an assessment of volcanic landforms, processes, and hazards.

http://www.geomorphology-iag-paris2013.com/

September 2-5, 2013
AFAC13 Conference
Australasian Fire and Emergency Service Authorities Council and Bushfire Cooperative Research Centre
Melbourne, Australia
Cost: $1,495

This conference will promote partnerships that result in long-term community resilience. Topics include large-scale flood management through community engagement, maintaining effective teamwork during large-scale events, identifying under-prepared residents in the wildland urban interface, long-term and ongoing impacts of disasters, and the changing future of emergency management.

http://www.afac2013.org/

September 5-7, 2013
International Conference on Flood Resilience
University of Exeter
Exeter, United Kingdom
Cost: $421

This conference will discuss new research in flood management planning and resilience. Topics include flood impacts on human health, adaptive flood risk management plans, flood risk perception, the social impacts of urban floods, lessons learned in flood recovery, data collection and model calibration, weather radar technology in flood forecasting and analysis, urban development and flood risk, and the consideration of climate change and economic growth in future risk analysis.

http://icfr2013.ex.ac.uk/

September 8-12, 2013
Dam Safety 2013
Association of State Dam Safety Officials
Providence, Rhode Island
Cost: $800

This conference will explore dam safety engineering and technology. Topics include effective response to dam failures, new policies and guidelines for levee safety, the flood protection structure accreditation task force, blast damage experiments and simulations, tools for estimating flood impacts, and modernizing emergency action plans.

http://www.damsafety.org/conferences/?p=db47b764-cd84-4a17-a014-a96c6cebab34

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

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

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

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