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Nuclear Power Makes A Comeback

Are the Risks Worth the Rewards?

An Invited Comment by Len Ackland

When President Barack Obama committed the United States in April 2009 to "take concrete steps towards a world without nuclear weapons," I was elated. The President noted in Prague that "the existence of thousands of nuclear weapons is the most dangerous legacy of the Cold War. No nuclear war was fought between the United States and the Soviet Union, but generations lived with the knowledge that their world could be erased in a single flash of light … Today, the Cold War has disappeared but thousands of those weapons have not."

As a journalistandeducator who has researched and written about the danger of nuclear weapons for more than 30 years, I was relieved to finally hear this accurate perspective coming from the nation's top elected official. The use of nuclear weapons is still humanity's fastest route to environmental catastrophe. The hazards exist and the risks are far too high, demonstrated by how close the world came to devastation during the 1962 Cuban Missile Crisis and given the anticipated consequences of a regional nuclear war or terrorist acquiring a bomb (Ackland 2007).

Then when President Obama endorsed nuclear power in his January 2010 State of the Union address, I was perplexed. Placed first in his list of tasks needed to promote clean energy, Mr. Obama said the United States must build "a new generation of safe, clean nuclear power plants in this country." Later in his speech he ignored the direct

(Please see "New Nukes" on page twelve)

INSIDE ...

The 'Slow Emergency' of Climate Change

One of the early and most noticeable impacts of climate change is likely to be on water—on its availability, timing, quantity, and quality. "It is a game changer in many regards," says Ken Topping of Topping Associates International. Climate change and its impact on water constitute a "slow emergency," and one that may require emergency managers to rethink their approach to, and even the very definition of, "emergency."

Scientists are usually reluctant to attribute any single weather event to climate change. And the techniques of developing climate forecasts on scales fine enough to allow regional planning are still in their infancy. But a lot of evidence points to changes in the water cycle that emergency managers will have to anticipate in their plans. Kevin Trenberth, head of the Climate Analysis Section at the National Center for Atmospheric Research, says, "Heavy rains and flooding are increasing around the nation, especially since the 1970s, at very high rates. There have been recent examples with the very heavy rains and flooding in New England, and before that a major snowstorm in Washington, D.C.

"The snowstorm is a symptom of global warming, actually," Trenberth says, "because the water vapor is coming from the tropical Atlantic, from over a thousand miles away, and there's a lot more water in the atmosphere."

Paradoxically, because there are more intense rainfall events, there are longer dry spells in between, raising the specter of more drought. "The past is no longer a good guide to the future," Trenberth says. "Especially if you're in the planning business, and you're planning any kind of infrastructure, the main basis for that has usually been the past climate. It's no longer a good guide. We know that. We can't, however, say with a lot of reliability exactly what the climate will be at any individual spot."

"If you don't want to believe what Al Gore is telling you, maybe you'll believe what Mother Earth is telling you … We're seeing more extremes in nature."

—David Mallory

So there will be heavier storms, longer dry periods, the paradox of increased flooding and increased drought, changes in atmospheric circulation, changes in the amount of regional precipitation, changes in water quality, all resulting in new burdens to water systems, and all in an unpredictable way. So what's an emergency manager to do?

Turning the Conversation

David Mallory is a senior project engineer in the floodplain management program with the Urban Drainage and Flood Control District in Denver. He says, "I'm a practitioner, and I work with local government on a daily basis. I can tell you that in talking with local governments, with elected officials, with staff folks, climate change is a hot issue. It's very controversial. There are folks out there who are vehemently opposed to recognizing any sort of climate change."

Mallory says he tries to turn the conversation: "If you don't want to believe what Al Gore is telling you, maybe you'll believe what Mother Earth is telling you … We're seeing more extremes in nature." Even now this has had effects on local government budgets in form of more snow emergencies and more water-borne disease emergencies.

To store water, Colorado relies heavily on mountain snowpack which melts over the warmer months, supplying water to reservoirs. But the changing climate has meant that melt starts sooner, creating new water management problems. The state had gone through several years of dry conditions. "The first year we saw heavy snowpack, we were elated," says Mallory. "Until we saw early runoff. Then a lot of it evaporated."

Cultural Issues

Adrienne Greve, a faculty member at California Polytechnic State University and a member of a California commission addressing local adaptation to climate change, says that California is looking at water shortages under climate change, perhaps in contrast to some other regions of the country, like the Northeast, which may have more problems like flooding. "The challenge in adapting to water scarcity," she says, "is how long it takes to implement and actually address this problem."

There are some potential solutions to water scarcity, like new reservoirs, but they are not implemented by local governments, they take a long time to implement, and they are very controversial. Coastal California communities that don't have access to more water are now actively considering desalinization plants, Greve says. These, too, take a long time to develop, are politically loaded, and use a lot of energy.

In the short term, Greve says, reducing end use volume provides the most immediate hope. "The difficulty here is that it's really hard to project from a supply planning perspective," she says. Many of these issues are social and cultural. Many people are aware of the scientific and environmental issues with lawns, for instance, but they continue to use chemicals and a lot of water on them because they offer social approval. "They are valuing the image of family and play area for children," she says.

"You're starting to see some traction for xeriscaping and drought tolerant plants in California," she says. "But there is a huge amount of resistance, too." She says gray water and rain capture may make sense for watering landscaping. Whatever planners try to do, they must "recognize local values and culture," Greve says. "It works differently in different places."

The individuals quoted in this story all spoke at various sessions at the Natural Hazards Center's 35th Annual Natural Hazards Research and Applications Workshop held July 10 to 13, 2010, in Broomfield, Colorado.

—Dan Whipple

They Said It ...

"The IPCC [Intergovernmental Panel on Climate Change] has already identified the influence of climate change in these disasters. That's clear. But the main trend we need to look at is increasing vulnerability, the fact we have more people living in the wrong places, doing the wrong things."—**Sálvano Briceño** *of the United Nations' International Strategy for Disaster Reduction, quoted by the Associated Press.*

"My brother tells me from our village near the town of Sharda in the Neelum Valley that the house we finished building just two years ago, after our old one was destroyed in the 2005 quake, has been badly damaged by the rains and torrents coming down from the hills."—**Rafiq Muhammad**, *a Pakistani who runs a tea kiosk in Islamabad, on the impact of the floods there, quoted by IRIN.*

"Tragically, we will see more deaths due to sickness. People are in a miserable state. In some places conditions are even worse than after the 2005 Kashmir quake, the aftermath of which I saw, and the lack of existing infrastructure to meet basic needs aggravates matters."—**Unidentified French aid worker**, *on the Pakistani floods, quoted in IRIN.*

"The response from the international community as a whole, however, I have to say, bluntly, has just been lamentable. It's been absolutely pitiful."—**United Kingdom Deputy Prime Minister Nick Clegg**, *on the Pakistan flooding, which has affected 20 million people, quoted at Bloomberg.com.*

"For the [2010] year-to-date, the global combined land and ocean surface temperature of 58.1°F (14.5°C) was the warmest January-July period on record. This value is 1.22°F (0.68°C) above the 20th century average … The combined global land and ocean average surface temperature for July 2010 was the second warmest on record at 61.6°F (16.5°C), which is 1.19°F (0.66°C) above the 20th century average of 60.4°F (15.8°C)."—**National Oceanic and Atmospheric Administration** *in an August 13, 2010 news release.*

Sometimes, Recovery Is the Real Disaster

Many insular communities—whether they be tribal, remote, or otherwise on the periphery of mainstream society—suffer from the application of one-size-fits-all disaster response frameworks. Although the assistance those regimes offer might be necessary in the short term, their long-term homogenizing effect can threaten a way of life.

"Any damn fool can get power restored or get a Wal-Mart reopened," Mervyn Tano, president of the International Institute for Indigenous Resource Management, told an audience gathered at the 35th Annual Natural Hazards Research and Applications Workshop session on rural and tribal vulnerability. "The hard part is reinvigorating traditional tribal practices."

Often, grand plans fail to understand that a concept as simple as a housing—shelter from the elements—can be very different from one group to another. For instance, Native families are configured differently from suburban families, and disaster plans need to take that into account, Tano said. A structure's use and what it means to people should be considered alongside its more basic functions. Tano pointed to the Cold Climate Housing Research Center in Alaska as an example of how community identity can be incorporated when working with traditional communities. The group understands that a house is more than a dwelling, he said, it is part of an identity.

Understanding that identity can be difficult for planners that aren't part of the community—often a

culture can't be defined from the outside looking in. Rosina Philippe, a spokesperson for Grand Bayou Families United, commented on the way Native people are seen by broader society. According to Philippe, her people understand themselves in context of their history and attachment to place, not by the vulnerabilities attached to them since Hurricane Katrina.

A Sense of Place

A strong sense of place—another concept cherished by traditional societies, but often dismissed by modern ones—can help make a society resistant to disaster. One of the biggest problems facing indigenous people today is being relocated from traditional lands, said Juan Pablo Sarmiento of Florida International University.

The Latin American communities Sarmiento works with have strong ties to environment and good mechanisms to cope with local weather conditions. This has allowed them to exist naturally where they are, but encroaching ideas of mainstream society can threaten that.

"Many minority rural populations are losing cultural and historical disaster management knowledge because they are adopting knowledge of the majority," he said.

As Sarmiento sees it, one contributor to vulnerability is people who have been moved from their ancestral land and relocated to areas that are less productive. People have been marginalized and labeled as a minority. In the short term, this status might provide opportunities but over time it can cause a uniformity that degrades customs, values, and attitudes.

To overcome these obstacles, disaster planners and others that aid indigenous people must work with groups beforehand to create plans that fit the needs and beliefs of members. As a community planner for the Federal Emergency Management Agency, Diana Coho works directly with U.S. tribes to create multihazard mitigation plans.

Reading from the Navajo Nation's mitigation plan, Coho illustrated the concept of disasters and disaster planning is not consistent across diverse groups:

> "The Navajo Nation and the Navajo People (Diné) find the subject of hazards mitigation hard to speak of and hard to prepare for. The idea of preparing for disaster from a traditional point of view is asking for disaster … One does not plan for the proverbial rainy day, because it may offend the rain. The elements in traditional belief are living beings, wind, rain, earth, and sky, live and breathe as we do … To plan for protection from the elements may bring more of a disaster or worse yet, cause the elements to leave … The Dinė in this plan strive to find a balance between living in the 21st Century (Western) and living in the traditional way. The Diné believe that balance must be found between the two in order to survive as a culture, for in the balance there is Hozho (beauty)."

In her experience, Coho said, there is no one approach to planning that works for all groups. Instead, each group's cultural and societal needs must be considered. This process can be more time consuming and labor intensive, but it allows tribes to receive federal assistance after a disaster while honoring traditional beliefs.

"You have to be committed to respecting cultures," she said.

Unfortunately, there is still a tendency to view various cultures through a Western lens. Once a group's identity and knowledge have been altered, it's often too late for tribal members to maintain traditional values and practices.

"It's very much like the French trying to fend off Hollywood," Tano said. "The pervasiveness of Western culture is difficult to overcome."

—Samantha Capps

"To plan for protection from the elements may bring more of a disaster or worse yet, cause the elements to leave … The Diné ... strive to find a balance between living in the 21st Century and living in the traditional way. The Diné believe that balance must be found between the two in order to survive as a culture, for in the balance there is Hozho (beauty)."

Corps of Engineers' Steven Stockton

Avoiding the Single Line of Defense

"Where are the visionaries for the future? [Congress'] focus is on a million different areas. It's not on water infrastructure or on disaster risk mitigation," says Steven Stockton, director of Civil Works for the U.S. Army Corps of Engineers.

In a frank and wide-ranging discussion at the 35th Annual Natural Hazards Research and Applications Workshop, Stockton described the many issues the Corps faces, including the overly optimistic expectations the public has for protection by engineered structures like dams and levees. "Building strong is kind of our tagline," Stockton says. "It's not just about structural solutions, it's about building strong collaborative relationships with sustainable resource futures … there is no absolute when it comes to levels of protection. There's a lot of controversy in New Orleans, where we're putting in $15 billion there over a three year period developing a very strong and robust and resilient system." The system includes the world's largest surge barrier and the world's largest pumping plant.

"But that provides about a 100-year level of protection, which is relatively low," Stockton says. "The public either doesn't want to or cannot grasp exactly what their portion of the risk is."

Nonetheless, said Waterloo University's Elizabeth English in a comment to Stockton, there is still in New Orleans a reliance on "single line of defense" technological solutions that promote catastrophic consequences, and an institutional resistance to nonstructural ideas. "It seems to be a question of politics, as much as anything else," she said.

In response, Stockton said, "I would love to see good land use planning, but a lot of that has to happen at the local level. We try to inform the political decision making process. We do a good job of evaluating the environmental, the technical, and economic aspects of those investment recommendations. But at the end of the day, we get political direction and authorization and funding from our masters in Congress and the administration."

He added, however, "We're providing a relatively low level of protection, but there is still a lot of work that needs to be done at the local level, within the community to understand the risks."

Asked why the Corps isn't promoting nonstructural solutions harder, Stockton said, "Everything we do requires and act of Congress … We've been given a mission to provide a hundred-year level of protection, which is relatively low, by June, 2011. We're going to do that. That's what we get paid to do … Now there's a lot of things that can be done beyond that—say if we can get support for wetlands restoration. But it takes resources, it takes money."

And that money has to come from Congress which, as he said, is not paying much attention to disaster risk mitigation.

—Dan Whipple

Oil and Uncertainty Plague the Gulf

The BP Deepwater Horizon oil spill in the Gulf of Mexico has been called the worst U.S. environmental disaster in history. There's no doubt that a lot of oil was spewed into the northern portion of the Gulf, but its impact on the environment is still hotly disputed.

In early August, after the leak had been contained, a panel of government and independent scientists put together by the National Oceanic and Atmospheric Administration concluded that three quarters of the oil expelled by the well was captured directly from the wellhead. The remainder "had mostly washed ashore or been collected [there], was buried in sand and sediment, or was still on or below the water surface as sheen or tar balls," according to a blog on the *New York Times.*

This pronouncement was met with considerable skepticism both by the scientific community and the public at large. A paper in the August 20, 2010, issue of the journal *Science* immediately called the finding into question. University of Georgia scientists sent the automated underwater vehicle Sentry on a ten-day zigzag cruise through the subsurface oil plume. They found, "roughly two months after the initial explosion, the plume was approximately 1,100 meters deep, over 35 kilometers long, 200 meters high and up to two kilometers wide. About six or seven percent of all the so-called BTEX hydrocarbons—benzene, toluene, ethylbenzene and xylenes—leaked from the well were in this plume, the authors estimate. These volatile hydrocarbons make up a small fraction of all the compounds in the oil but are relatively easy to measure.

"The researchers also report that the levels of dissolved oxygen within the plume had not dropped to levels that would suggest bacteria were breaking down the oil," they said.

"The idea that 75 percent of the oil is gone and is of no further concern to the environment is just incorrect," Samantha Joye, a professor of marine sciences at the University of Georgia, told the *Times*. She has not yet published her own study results.

Responding to the University of Georgia criticism, Jane Lubchenco, the NOAA administrator, said the government stood by its calculations. "Some of those numbers we can measure directly," she said. "The others are the best esti-

mates that are out there."

The ink was barely dry on these papers when one in press at *Geophysical Research Letters* was circulated, saying a simulation of oil and methane leaked in the Gulf could form deep hypoxic zones, or "dead zones" in the Gulf. Portions of the Gulf of Mexico already have extensive dead zones, areas in which oxygen has been so depleted by chemical runoff that marine life is virtually impossible.

"According to our simulations, these hypoxic areas will be peaking in October," says study coauthor Robert Hallberg of the NOAA Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey. "We're estimating a couple of years" before the dead zone has dissipated.

And then *Science* published a paper online on Tuesday, August 24 that found that the deepoil plume was being degraded pretty rapidly by microbes. "Our findings, which provide the first data ever on microbial activity from a deepwater dispersed oil plume, suggest that a great potential for intrinsic bioremediation of oil plumes exists in the deep-sea," Terry Hazen, a microbial ecologist with Berkeley Lab's Earth Sciences Division, said. "These findings also show that psychrophilic oil-degrading microbial populations and their associated microbial communities play a significant role in controlling the ultimate fates and consequences of deep-sea oil plumes in the Gulf of Mexico."

The paper concludes, "The oil biodegradation rates reported here at 5°C are explained in part by the relatively light nature of this crude (which contains a large volatile component that is more readily degraded), the dispersed nature of the deep plume (small oil particle size), the low overall concentrations of oil in the deep plume, and the frequent episodic oil leaks from natural seeps in this area that the deep-sea microbial community may have adapted to over long periods of time."

Meanwhile, Indiana University professor Christopher Craft says it is far to soon to know what impact the spill will have on the coastal wetlands. "At this point, the effects of the oil probably are limited to the aboveground vegetation," Craft said. "The roots that contain food reserves that enable the shoots to re-sprout seem to be unaffected. With chronic and repeated exposure to oil, though, the roots could die and the marsh surface collapse."

But the spill is only the latest insult the region's environment, Craft said. "Coastal Louisiana's wetlands have been under siege for a century or more," he said. "The Mississippi River delta is sinking as a result of natural and human-caused activities ... The landscape is stable as long as fresh sediment is deposited by the annual river floods. However, human activities ... that separate the river channel from its wetlands starve the marshes of sediment needed to maintain their elevation, and the land sinks."

In congressional testimony reported by the *Times*, Florida State University oceanographer Ian MacDonald said, "I expect the hydrocarbon imprint of the BP discharge will be detectable in the marine environment for the rest of my life. The oil is not gone and is not going away anytime soon."

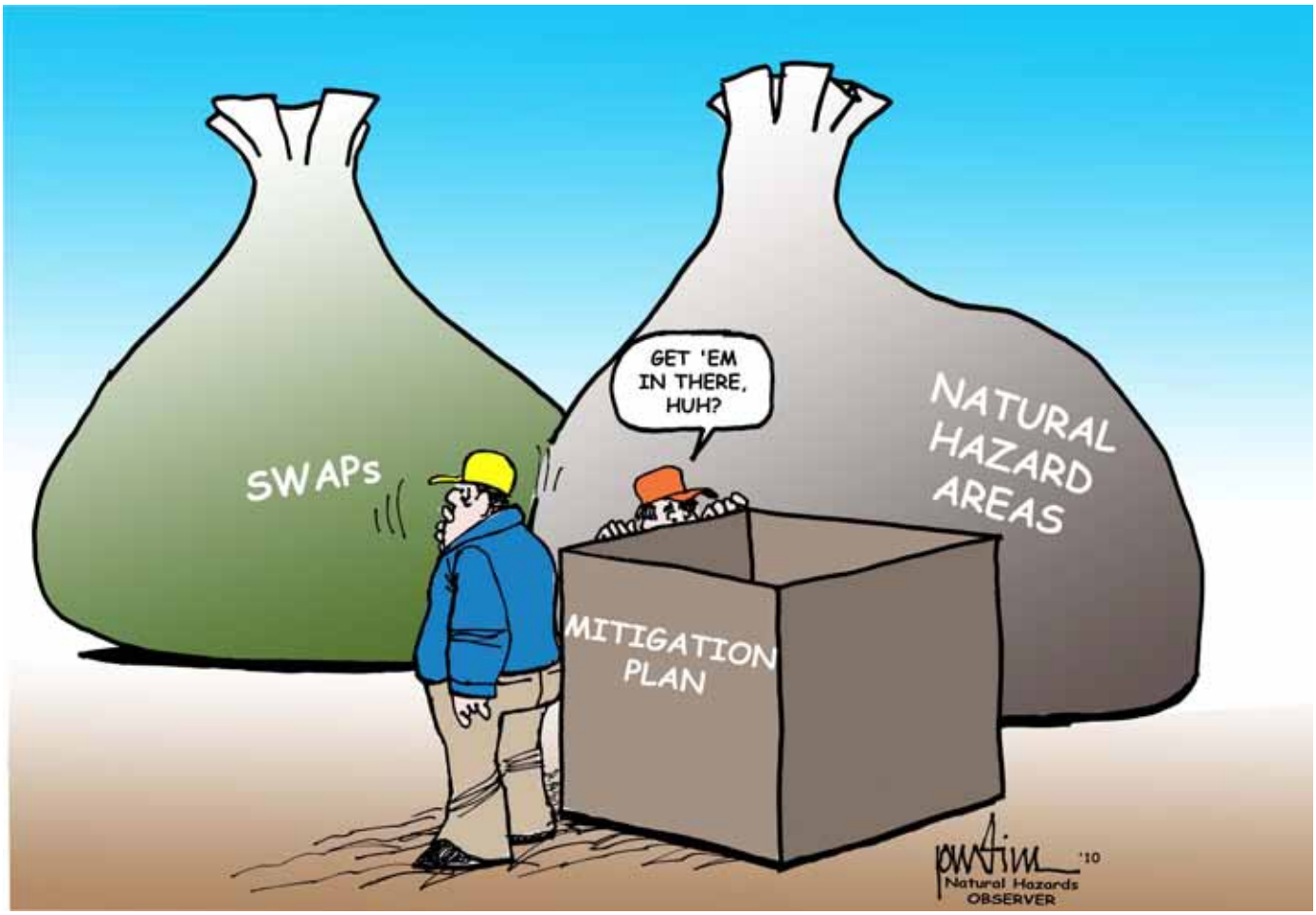
From a human perspective, this uncertainty is simply an added stressor. Natural Hazards Center sociologist Liesel Ritchie, who was recently on the Gulf Coast doing spill research, said, "Lack of consensus regarding the nature and extent of physical damage resulting from technological disasters leads to individual and collective uncertainty … Because there is no collective definition of reality—as evidenced by discrepancies in scientific reports released by various parties—people are forced to construct and reconstruct their own realities. One result of this process is social disruption.

"Beyond the directly affected communities, perceptions about the safety of seafood harvested from the Gulf of Mexico extend across the U.S. Although this does not cause social disruption in areas beyond the coast, these perceptions are one major cause of concern among coastal residents involved in the seafood industry. These perceptions—and confusion fostered by differing scientific accounts—generate further stress associated with uncertainty over the economic futures of shrimpers, oystermen, crabbers, fishermen, and others who rely on the Gulf for their livelihoods."

One Alabama shrimper Ritchie spoke with said, "For weeks they've been telling us they don't know exactly how much oil is leaking. Now they are telling us they have 75 percent of it cleaned up. How does that work?"

Room for All:

Collaboration Between Emergency Management and Wildlife Conservation



An Invited Comment by David Salvesen, Rebecca Kihslinger, Peter Zambito, Ryan Winterberg-Lipp, and Tessa Lee

The connection between environmental protection and hazards is real, but not always clear. Emergency managers and wildlife conservationists typically operate in separate universes, yet there are reasons why they should collaborate. A recent study conducted by the University of North Carolina and the Environmental Law Institute identified opportunities for wildlife conservation in areas where people and property are at risk from natural hazards. The study considered places where priority habitats—as identified in state wildlife action plans (SWAPs)—overlap with natural hazard zones and highlighted potential points of collaboration among land use planners, hazard mitigation planners, and wildlife habitat managers.

The study is relevant to hazard mitigation planners because it identifies many potential conservation resources that aren't often used in disaster risk mitigation. We found that, while opportunities exist to coordinate planning and leverage funding, numerous obstacles must be overcome, including the hazard planning community's lack of awareness about SWAPs and other conservation plans. Most local planners interviewed had never heard of these wildlife plans. A central conclusion of the study is that SWAPs offer a useful tool for coordinating habitat conservation and hazard mitigation efforts in ways that increase the successful outcomes of both.

More broadly, the study considered how compensatory mitigation funding and other incentive-based programs could enhance efforts of emergency management officials and local planners, as well as conservationists.

State Wildlife Action Plans: A Brief Review

In 2000, Congress enacted the State Wildlife Grants Program, funding state conservation planning to prevent wildlife species from becoming endangered. To be eligible for the program, every state and territory was required to develop a state wildlife action plan. The plans provide a strategic framework for wildlife and habitat conservation. Although states have flexibility in developing their plans, they are required to address eight elements, including the distribution and abundance of species; extent and condition

Figure 1.

of habitats; problems that may affect species or their habitats; conservation actions to protect certain species; plans to monitor species and their habitats; periodic review of the SWAP; coordination among federal, state, and local agencies and Indian tribes; and public participation (Association of Fish and Wildlife Agencies 2010).

All 50 states submitted their SWAPs to the U.S. Fish and Wildlife Service by October 1, 2005. Of these, 32 states set clear priorities for habitat conservation. Moreover, at least 31 states developed spatially explicit maps identifying the location of priority habitats (Wilkinson 2009). As our study showed, these priority habitat zones frequently overlap with high-risk disaster zones. Thus, the existing data and maps contained in the SWAPs can be used to target hazard mitigation efforts to areas that also benefit wildlife.

Implementation of state wildlife action plans occurs within a broad institutional framework of federal, state, and local planning for biodiversity, land use, natural hazards, and coastal management. For example, in addition to SWAPs, many states have adopted plans for hazard mitigation, special area management, forestry management, waterfowl and fish management, conservation and open space, and—in coastal states—coastal zone management. These plans can guide conservation-minded hazard mitigation decisions. For our analysis, we chose to focus on SWAPs because they have been adopted by all 50 states and provide information in a form that is relatively comparable across states.

The Study

The study contained five main parts: (1) identifying where priority habitats overlap with natural hazards; (2) interviewing state and local land use planners and hazard mitigation planners; (3) analyzing state and local policies and plans for land use and hazard mitigation; (4) analyzing federal mitigation funding opportunities to protect wildlife habitat; and (5) evaluating federal programs that govern floodplain and coastal management to determine if they address climate change. Recommendations were provided for improving implementation of the state wildlife action plans.

We selected three states—Florida, Washington, and Wisconsin—for our analysis. We were looking for states that had: (1) a large-scale ecosystem restoration effort already under way; (2) high-quality, recently updated hazard maps in GIS format; (3) detailed SWAP priority habitat maps in GIS format; and (4) statewide land use plans or goals. In each of the three states, we selected one site (encompassing two counties) to conduct our analysis of local plans and policies and to examine the level of coordination among local planners. The three sites (see Figure 1) included King and Snohomish counties in Washington, Jefferson and Waukesha counties in Wisconsin, and Osceola and Polk counties in Florida. The three sites offer a range of geographic habitats and a diversity of natural hazards.

Identifying Overlaps

We used GIS to prepare maps that identified areas where priority habitat overlapped with natural hazard areas. This analysis found considerable overlap between priority habitats and hazard zones at all three of our selected sites, representing places where state and local planning departments, wildlife agencies, and emergency management officials could collaborate to protect wildlife habitat while also reducing the impact of natural hazards on people and property.

For example, Figure 2 shows where priority habitat overlaps with wildfire prone areas in Florida's Osceola and Polk counties, just south of Orlando. Collectively, the two counties span over 3,500 square miles with over 800,000 people. The Southern Wildfire Risk Assessment rates the area as having one of the largest concentrations of elevated fire susceptibility in the entire South. These counties also contain one of the highest concentrations of priority wildlife habitat in the state, where there is considerable overlap with fire risk. In light of spatial overlap, the Florida Fish and Wildlife Commission's Upland Ecosystem

Restoration Project is already managing both habitat restoration and fire mitigation efforts in Osceola County.

Our study found that, in general, such agencies tends to operate in isolation, often failing to capitalize on opportunities to stretch their dollars by planning and funding of projects jointly—acquiring fire-prone land that also serves as prime wildlife habitat, for instance.

Evidence from Interviews

We conducted interviews with key informants at each of the three study sites to assess the level of awareness of, and commitment to, the goals and politics of SWAPs among hazard planners and to identify opportunities for collaboration with wildlife managers. A total of 27 interviews were conducted with 17 local land use planners and 10 hazard mitigation planners.

When asked whether preserving wildlife habitat or biodiversity was part of their agency's mission, only five of those interviewed said yes (Table 1). Only three of the land use planners and none of the hazard mitigation planners had ever heard of SWAPs (Table 2). Some respondents stated that they considered wildlife habitat in their work only if triggered by state or federal law, such as a permit to fill wetlands. Others reported that wildlife concerns were addressed indirectly, e.g., through policies to protect floodplains from development.

In general, hazard mitigation planners viewed their primary responsibilities as preventing loss of life and property from disasters, not protecting wildlife habitat. A hazard mitigation planning consultant from Wisconsin said the presence of wildlife is often viewed a hindrance because it can prevent or delay a project. Only eight of the 27 interviewees said they coordinated with the agency that implements the SWAP.

These interviews clearly show that preserving wildlife habitat is not a high priority among land use and hazard mitigation planners, at least at these three study sites. They also suggest coordination between wildlife professionals and local planners is almost nonexistent. In the future, it would be useful to interview wildlife professionals to see if they were familiar with hazard mitigation plans or viewed mitigation of natural hazards as part of their mission.

Evidence from Plan and Policy Analysis

We assessed whether state and local land use and hazard mitigation plans for the study sites supported or undermined the habitat conservation goals of SWAPs. Of the 24 local land use plans examined, none specifically mention SWAPs, though nearly all of the local plans were adopted or amended after the SWAP adoption date. This reflects a lack of awareness of SWAPs, as well as a lack of involvement on the part of wildlife agencies in preparing land use or hazard mitigation plans. Although SWAPs were not mentioned specifically, all 24 local land use plans examined contained policies to discourage development in floodplains, wetlands, or other natural hazard areas. They included specific implementation mechanisms, such as land acquisition or zoning regulations.

Only two of the eight hazard mitigation plans examined included policies to protect wildlife habitat. Yet most—five of eight—included policies to discourage development in natural hazard risk areas. Furthermore, analysis of statewide land use policies in the three states selected showed that each state either requires or encourages local jurisdictions to steer growth away from natural areas such as wetlands, forests, and floodplains.

The existence of such policies in land use and emergency management plans along with the data contained in the SWAPs shows that the groundwork is already in place for conservationists and hazard mitigation planners to work together to identify where their interests overlap and where they could achieve greater outcomes by coordinating their efforts. Local land use and hazard mitigation plans already include mechanisms to discourage development in priority habitat areas, but the connection between mitigating natural hazards and protecting wildlife habitat is not explicit.

The Role of Mitigation Funding

A majority of the state and local land use policies assessed included options for conserving natural resources,

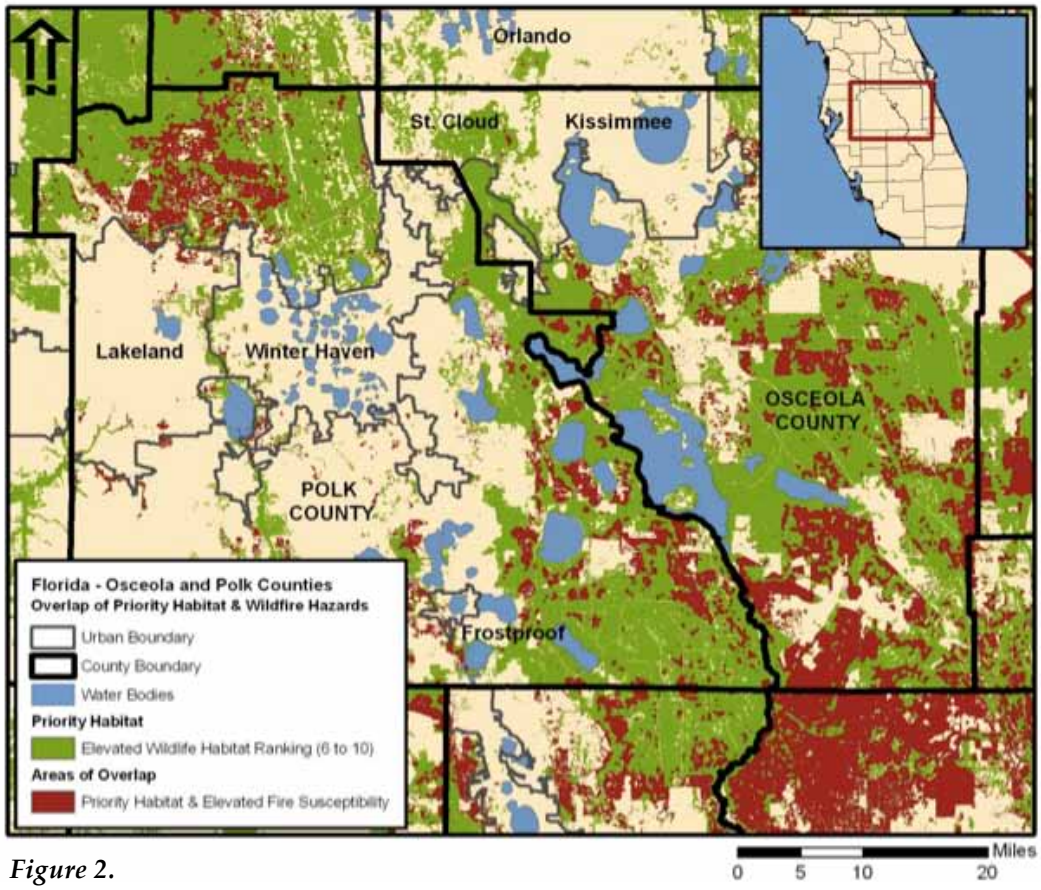


Figure 2.

***Table 1**: Agency Mission to Preserve Wildlife*

Is preserving wildlife habitat or biodiversity part of your agency or office's mission?			
	Land Use Planners	Hazard Mitigation Planners	Total
Yes	5	0	5
Per Laws / Regulations	9	2	11
Indirectly	3	5	8
No	0	3	3
Total	17	10	27

wildlife, and habitats. In addition, of the 11 federal compensatory mitigation and incentive-based programs our study analyzed, all could support efforts that provide disaster reduction as well as confer habitat conservation benefits. Several also contain guidelines or regulations that explicitly include wildlife conservation as a goal or required outcome of program activities (e.g., wetland compensation under the Clean Water Act).

Coordinating disaster risk reduction with conservation goals is not a difficult option. It doesn't require much deviation from current hazard management strategies. These already include acquiring or discouraging development in hazard-prone lands such as wetlands and floodplains. These lands serve as valuable wildlife habitat, demonstrating how conscientiously constructed land use plans and disaster mitigation policies could confer environmental benefits. For example, federal buyout projects, administered by the Federal Emergency Management Agency, have been used to remove flood-damaged homes from floodplains and to keep people and property from harm's way. Once the homes are removed, the buyout areas can become greenways and habitat corridors along rivers.

Climate Change

The final part of our study analyzed whether federal programs that govern floodplain and coastal management, as well as state-level hazard mitigation plans, address climate change. Despite evidence that climate change will likely increase the frequency and severity of disasters (Solomon et al. 2007), the five federal programs we assessed have not, in general, sufficiently incorporated climate change into their mapping, planning, or risk assessment efforts. The same was true for a large majority of the 48 state hazard mitigation plans we evaluated. Failure to integrate climate change into today's planning frameworks leaves municipalities inadequately prepared for disaster response. Current prediction models likely underestimate the risk of disaster, thus undervaluing disaster management services provided by undeveloped, healthy ecosystems.

Wetlands provide an example of the benefits greater collaboration can have in high-risk areas, where properly executed disaster plans could have a substantial impact on habitat preservation. Wetlands were identified as key habitat in 47 of the 50 SWAPs, and 37 SWAPs include wetland habitat maps. Furthermore, 40 SWAPs identify acquisition of wetlands and 46 identify restoration of wetlands as a method for achieving wildlife conservation goals (Environmental Law Institute 2007).

Wetlands play a crucial role in hazard mitigation, creating natural flood barriers, preventing erosion, and providing storm water storage, flood conveyance, and water purification. Wetlands can reduce the peak stream flow in major flood events, converting sharp storm peaks to slower discharges over a longer period of time (Mitsch 2007). On the coasts, wetlands help shelter coastal development from damage due to ocean storms by decreasing surges and maintaining shallow water depths.

Development in wetlands not only carries with it a high risk of damage from hazards, it degrades the ecosystem and its ability to shield surrounding areas from future hazards. For example, the loss of wetlands in the Midwest and on the Gulf Coast has left these regions more susceptible to flooding and storm damage. Wetlands along the Mississippi River once stored up to 60 days of river discharge. Now, the remaining wetlands store only 12 days (Mitsch 2007).

Economically, the value of wetlands is frequently overlooked. A recent United Nations report found that the "ecosystem services" provided by a certain coastal wetland left undeveloped was nearly thirteen times its value in extractable resources (United Nations Environmental Program 2010). In the United States, wetland services are worth $743 billion a year in natural flood and storm surge attenuation zones (Natural Hazards Observer 2010).

Hazard mitigation planners interested in reducing flood risk and the costs of damages could collaborate with wildlife agencies to achieve jointly what would be difficult to achieve working alone, coordinating funding to yield greater bang for the buck. Numerous funding mechanisms exist for wetlands preservation and restoration, which hazards planners could access in their pursuit of disaster mitigation. There is a need for heightened awareness in both the hazard mitigation and wildlife management communities of the rationale for and opportunities provided by working together.

In Washington and Wisconsin, activities already underway illustrate how certain mitigation and incentive programs can be used to fund the restoration of priority wetland habitats in floodplains and coastal areas while effectively reducing hazard risk. For example, the Wisconsin Department of Natural Resources recently

***Table 2:** Awareness of State Wildlife Action*

Are you familiar with your state's SWAP?			
	Land Use Planners	Hazard Mitigation Planners	Total
Yes	3	0	3
No	14	10	24
Total	17	10	27

developed a map of potentially restorable wetlands in the Rock River Basin to improve the basin to implement wetland management at the watershed scale. Many of these wetlands—which were tiled and drained decades ago for agriculture—are found in areas prone to severe flooding and overlap with priority habitats. Wetland restoration in the area has been funded by a variety of sources, including the Emergency Watershed Protection Program, the Floodplain Easement Program, and the Wetland Reserve Program.

Recommendations

Our recommendations include increasing awareness of state wildlife action plans, particularly among members of the hazards community; facilitating greater cooperation among wildlife and hazard mitigation professionals; revamping aspects of existing planning frameworks at the federal, state, and local level; and identifying innovative new funding sources as well as current federal programs to support the conservation of disaster-prone areas that provide high-quality wildlife habitat. Specifically:

- At the local level, land use and hazard mitigation planners should reach out to conservationists during their planning, preparation, and implementation processes. Hazard mitigation planners can work with wildlife managers to identify win-win opportunities for collaboration and coordination. This will require some rethinking of roles since many hazard mitigation planners do not currently perceive habitat conservation as part of their mandate. Changing this perception could make the hazard planner's job easier. In our study, local land use and hazard mitigation planners reported that they supported the goal of wildlife protection, but needed ready-to-use language (goals, objectives, and policies) that they could simply cut-and-paste into local plans. The disaster community can take the initiative in reaching out to conservation groups to make them aware of this need.
- At the state level, hazard mitigation planners should open a dialogue with the agencies responsible for SWAP administration to make sure they are aware of the influence disaster mitigation planning has on large-scale ecosystem restoration efforts. States could increase the effectiveness of their SWAPs by making them more user-friendly and requiring they be integrated into local land use and hazard mitigation plans. State wildlife agencies on the whole need to become more involved in the preparation of land use and hazard mitigation plans.
- At the federal level, agencies responsible for wildlife conservation and hazard mitigation could coordinate their planning and investments to prevent development in natural hazard areas while simultaneously preserving or restoring critical wildlife habitat.

Those responsible for protecting wildlife habitat should coordinate with those responsible for mitigating natural hazards to apply for federal funding, leverage local resources, match grants, and partner on projects of mutual benefit. Through such joint planning, the parties could achieve together more than they could by working on their own. State wildlife action plans are a useful but currently underutilized tool for maximizing the effectiveness of such partnerships. The hazards community should work internally to change the perception about the efficacy of protecting wildlife habitat and to raise an awareness of the need for collaboration with conservationists. Keeping people and property out of high hazard areas such as floodplains or wildfire-prone areas serves the dual goal of reducing damages from disasters while preserving priority habitats. Hazard mitigation professionals have a reservoir of untapped potential policy mechanisms, funding, and human allies in the habitat conservation field.

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New nukes...

(Continued from page one)

links between nuclear power and the technology's dark side when he stressed that "we're also confronting perhaps the greatest danger to the American people—the threat of nuclear weapons."

He singled out Iran and North Korea, criticizing "those nations that insist on violating international agreements in pursuit of nuclear weapons." Iran claims that its nuclear program is intended solely to produce nuclear power. While dubious, as documented by a recent article in Germany's *Der Spiegel,* Iran's claims do suggest the very real connections between nuclear weapons and power, which I'll come back to below (Follath 2010).

Climate Change and Nuclear Power

Nuclear power is enjoying a public relations renaissance lately, touted by many—including some former opponents—as a viable clean energy source to mitigate climate change. Nuclear power, so the argument goes, spews far less carbon dioxide (the major industrial contributor to greenhouse warming) into the atmosphere than competing fossil fuels like coal and oil. But climate change, while serious, isn't everything. This line of thinking ignores the even larger perils from a large increase in the use of reactors to boil water for electricity.

By choosing to treat nuclear power and nuclear weapons as completely discrete subjects, President Obama is following a long line of politicians, industry executives, scientists, and others who have promoted the benefits of nuclear power while either neglecting, minimizing, or dismissing the appreciable risks and unknowns involving this technology.

Tied to this approach, some nuclear power proponents fall back on their expertise and the complexity of the topic to claim a technical mandate for their positions. This reminds me of the "nuclear priesthood" that I encountered in the weapons field when I was editor during the Cold War's waning years of the *Bulletin of the Atomic Scientists*. The weapons priests employed an "if you knew what I know, then you would agree with me" strategy. The late physicist Edward Teller, "father of the H-Bomb," was the icon for this tactic. Variations of these appeals to authority occur in today's energy discussion, especially with regard to "educating" the public.

"Governments should communicate with stakeholders and the public to explain the role of nuclear energy in the national energy strategy, seeking to build public support through involvement in the policy-making process," the pro-nuclear International Energy Agency and Nuclear Energy Agency recommend in their joint July 2010 report, *Technology Roadmap: Nuclear Energy*. While noting some continuing public concerns about nuclear power, the report says worries about "security of energy supply and the threat of global climate change have tended in recent years to increase public recognition of the benefits of nuclear energy" (IEA/NEA 2010, p. 39).

Climate change mitigation is the latest argument for some nuclear proponents in recent years—including a few prominent environmentalists—who say the risks from nuclear reactors are simply outweighed by the risks of human-induced rapid climate change. Global warming is "the greatest danger that civilization has faced so far," writes James Lovelock, the well-known creator of the Gaia hypothesis that the earth is a self-regulating organism, in a May 2004 article. He concludes, "only one immediately available source does not cause global warming and that is nuclear energy" (Lovelock 2004).

Relatively rapid climate change poses risks thoroughly documented by the Intergovernmental Panel on Climate Change reports and elsewhere—reports that have withstood full-throated attacks from climate change skeptics, despite minor errors and some scientists' shoot-self-in-foot e-mails. I won't deal much with climate change, which environmental writer Dianne Dumanoski describes in her book *The End of the Long Summer (*Dumanoski 2009).

But you needn't accept dire climate change scenarios to appreciate the extremely high risks posed by nuclear power. Indeed, Wall Street's skepticism about the safety of nuclear investments is a large part of the reason the Bush and Obama administrations have backed loan guarantees, now pushed up to $54 billion, for new nuclear plant construction in the United States. If nuclear technology is as good as advocates say, why does the industry still require huge subsidies after decades of such support? From 1943 through 1999, the nuclear industry received 95 percent of the $150 billion (in 1999 dollars) in federal subsidies that went to wind, solar, and nuclear power (Goldberg 2000).

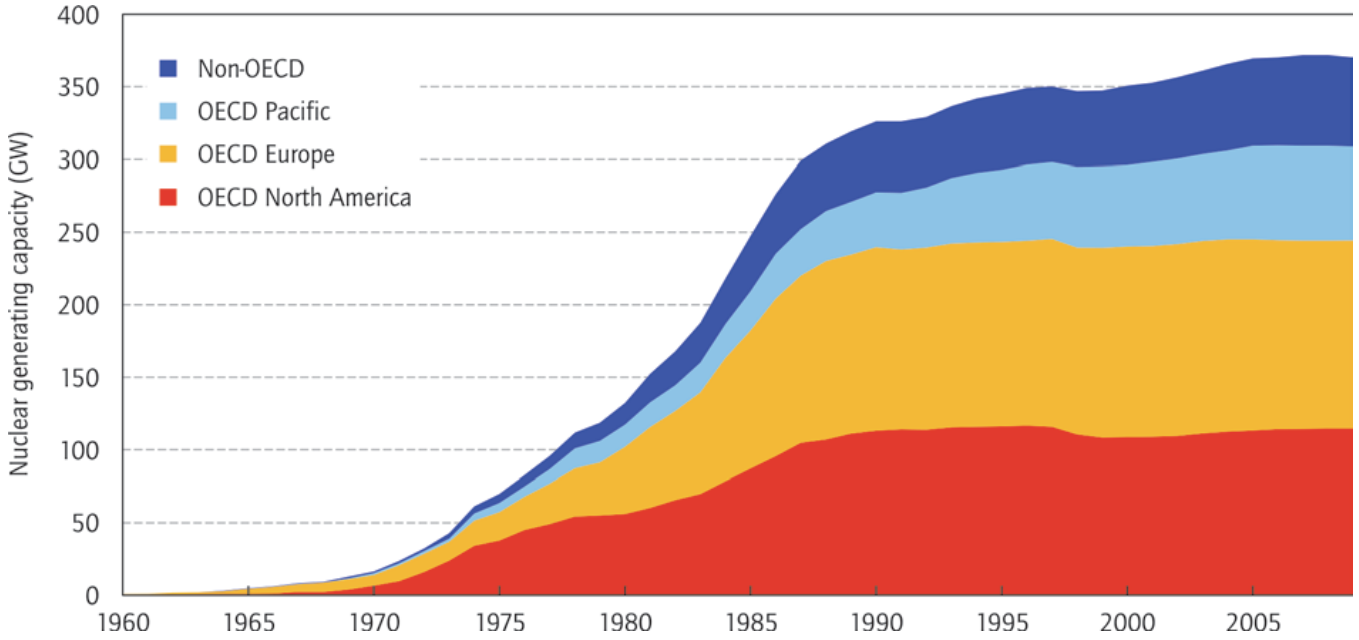
A point frequently lost in the arguments regarding solutions to rapid climate change is that nuclear power relates to the question of *electricity* production, not total primary *energy*, which includes oil and other sources of greenhouse gases. The single largest source of global greenhouse gases—electricity and heat production—accounts for some 41 percent of carbon dioxide emissions, primarily due to coal-fired power plants (IEA 2008). Thus, while the world's 439 operating commercial nuclear power plants, with a capacity of 373 gigawatts (billion watts), provide 14 percent of the world's electricity, they account for about six percent of primary energy (IEA/NEA 2010). That means that nuclear plants—which are relatively "clean" atmospherically given their lack of carbon dioxide emissions and even counting in the emissions from processes used to build the facilities—currently play a minor role in reducing overall greenhouse gases.

Commercial nuclear reactors are located in 30 countries, including seven of the nine nations which also possess nuclear weapons. The United States operates the largest number, with 104 plants producing about 20 percent of the nation's electricity. Worldwide, 61 plants are listed as under construction. Some have had that status for decades while one-third were begun since 2008. It typically takes between seven to 10 years to plan, license, and build reactors. China, which operates 12 reactors, has 23 under construction and plans to double that number (IAEA 2010; IEA/NEA 2010).

The International Energy Agency/Nuclear Energy Agency July report calls for tripling nuclear power capacity to 1,200 gigawatts by 2050, which would then produce 24 percent of global electricity consumed by a world population topping nine billion. Assuming the construction of large reactors between one and 1.7 gigawatts each, the agencies conclude that at least 800 plants, or an average of 20 plants a year for the next 40 years, are needed. The price

World Nuclear Generating Capacity, 1960 to 2009

Source: International Atomic Energy Agency, Power Reactor Information System



tag is estimated at $4 trillion (IEA/NEA 2010). By 2050 most of the current plants will be decommissioned and added to the mounting volume of global nuclear waste. Along with the new plants, numerous other facilities necessary for the production of nuclear power will also need to be built, as noted below.

More than doubling the number of nuclear reactors in the world will multiply the already high risks associated with this technology. The major risks are weapons proliferation (because weapons and power production are fraternal twin technologies nurtured by the same uranium umbilical cord), reactor accidents (epitomized by Chernobyl), and the disposal of nuclear waste (to prevent radioactive inheritance by future generations).

List Your Risk, Take Your Pick

People prioritize those risks differently. In Germany a robust debate over nuclear power has been going on for decades and resulted in a 2002 law to phase out the country's 17 plants by 2022 and replace their output with renewable energy. Nuclear waste has been a rallying point (Ackland 2009). Felix Christian Matthes, an analyst at the Ecological Institute in Berlin, told me last year that the German public's opposition to nuclear power—now being tested by a new conservative coalition government elected in September 2009—stems first from waste issues, then accidents, and then, much farther down the scale, proliferation. "For me," he added, "it's accidents, proliferation, and then waste."

Nuclear waste is tangible and visible. Moreover, no country has yet opened a site to safely dispose of the long-term, high-level waste created in the core of reactors, so it's understandable that the public in Germany and other countries consider that the biggest problem. And Matthes's top ranking for accident risks is derived in part from the geography of densely populated Germany, where 82 million people live in an area the size of Montana. A major nuclear accident there could have devastating results.

The possibility and reach of accidents became clear when the 1986 Chernobyl accident in Ukraine spread radiation widely through the atmosphere—a warning to the world about the risks of using complex nuclear technology to boil water into steam to spin turbines to produce electricity. But nuclear proponents point to the industry's overall impressive safety record since the first commercial reactors went online in the late 1950s. Accidents like Chernobyl are relegated to the category of "low probability-high consequence" risks, the same category of risk that oil drilling was in until the Deepwater Horizon disaster in the Gulf of Mexico last April. More should question whether such risks, whether from oil drilling or nuclear power, are worth taking (Gimein 2010).

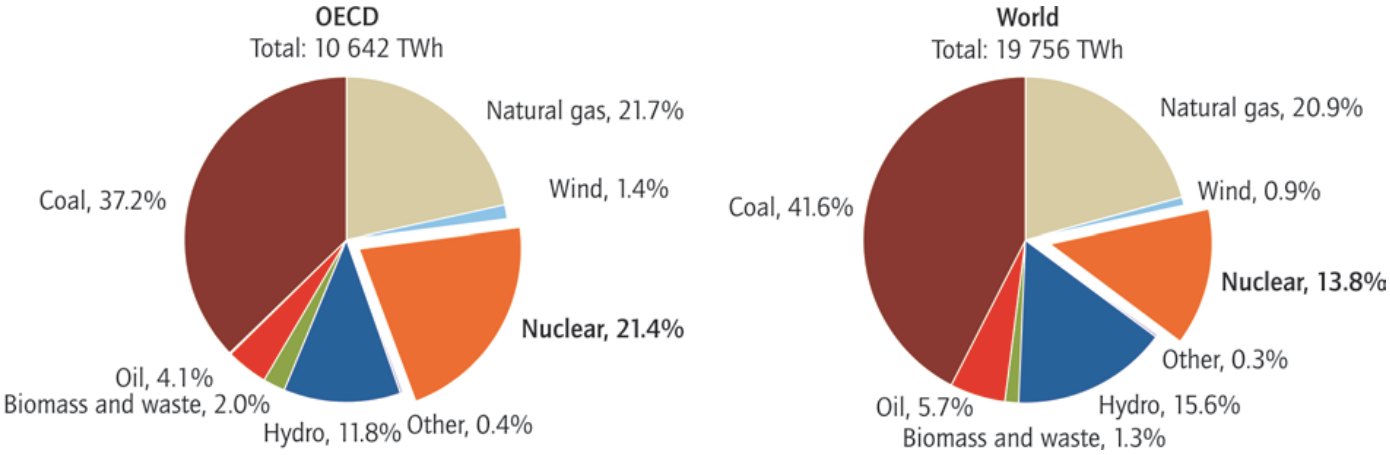
Accidents come second on my own list of nuclear risks. First place goes to weapons proliferation and its contemporary ally, nuclear terrorism. But I respect those who rank the issues differently. In taking on the powerful nuclear establishment, groups often don't converge their arguments in opposition. Aside from the big three nuclear risks of proliferation, accidents, and waste, many other risks are seen by specialists and from the local level. Some scholars worry, for example, about the security and sabotage of nuclear reactors or their destruction by terrorists or conventional war. On the local level, examples include a fight over renewed uranium mining in New Mexico in an Indian Country still suffering public health effects from more than 1,000 abandoned uranium mines causing contaminated water and housing (Paskus 2009). In western Colorado, a plan to build the nation's first uranium mill in 25 years has stirred a health vs. jobs debate (Rice 2010).

Uranium mines and mills are at the front end of the nuclear fuel cycle, the cradle-to-grave process for the materials used to produce (or "fuel") nuclear power or bombs. Details of the fuel cycle often make the subject seem impenetrable to laypeople, but the basics are straightforward. They help explain the two major points of intersection between nuclear power and nuclear weapons programs.

The production process begins with uranium, the heaviest naturally occurring element on Earth, with an atomic number of 92—the number of positively charged protons in the nucleus of each uranium atom, matched

Electricity Generation by Source, Worldwide and OECD, 2007

Source: International Energy Agency,



by an equal number of orbiting electrons. The nucleus also contains neutrons, which have no electric charge, but, like protons, have an atomic weight of 1, in contrast to the weightless electrons. Uranium, like other elements, can have different numbers of neutrons in its atoms' nuclei—resulting in different atomic weights and slightly different chemical characteristics. These variants are called isotopes. Thus, 99.3 percent of natural uranium consists of uranium-238 (146 neutrons plus 92 protons) and 0.7 percent uranium-235 (143 neutrons plus 92 protons).

Uranium-235 is the isotope needed for chain reactions because when its nucleus is hit with neutrons it splits, or fissions, into other elements while releasing the tremendous energy that holds nuclei together. To concentrate the amount of uranium-235 in order to create self-sustaining chain reactions in power plants or bombs, natural uranium is milled to refine the uranium into yellowcake. That is then converted into uranium hexafluoride gas and enriched by centrifuges or other means to separate the uranium-235 and uranium-238 isotopes.

Nuclear power reactors operate with controlled chain reactions fueled by uranium enriched to three to five percent uranium-235, while uranium bombs are uncontrolled, explosive chain reactions using about 90 percent uranium-235 as fuel. The United States proceeded directly to "highly enriched uranium" for the bomb it dropped on Hiroshima, Japan in 1945, which had an explosive force equivalent to 13,000 tons of TNT and instantly killed tens of thousands of people. It released radiation that increased the casualty count over time.

Uranium Enrichment Crossover Point

The current dispute over Iran's nuclear intentions vividly illustrates that uranium enrichment is the first potential crossover point between nuclear power and weapons. Iran insists that it only wants to create nuclear power, a claim greeted with skepticism by much of the international community. One challenge in determining a country's goals is that in enriching uranium-235 from 0.7 percent to about 4 percent requires about 70 percent of the total energy needed to enrich it to the weapons-grade 90 percent (Broad 2010). Also, centrifuge enrichment can be easily hidden. "A typical centrifuge plant has several thousand centrifuges, but the entire collection fits comfortably inside a space no larger than a movie theater," Berkeley physicist Richard A. Muller (2008) writes in the nuclear section of his clear, accessible book *Physics for Future Presidents*. "Such systems can produce enough enriched uranium for several nuclear bombs a year."

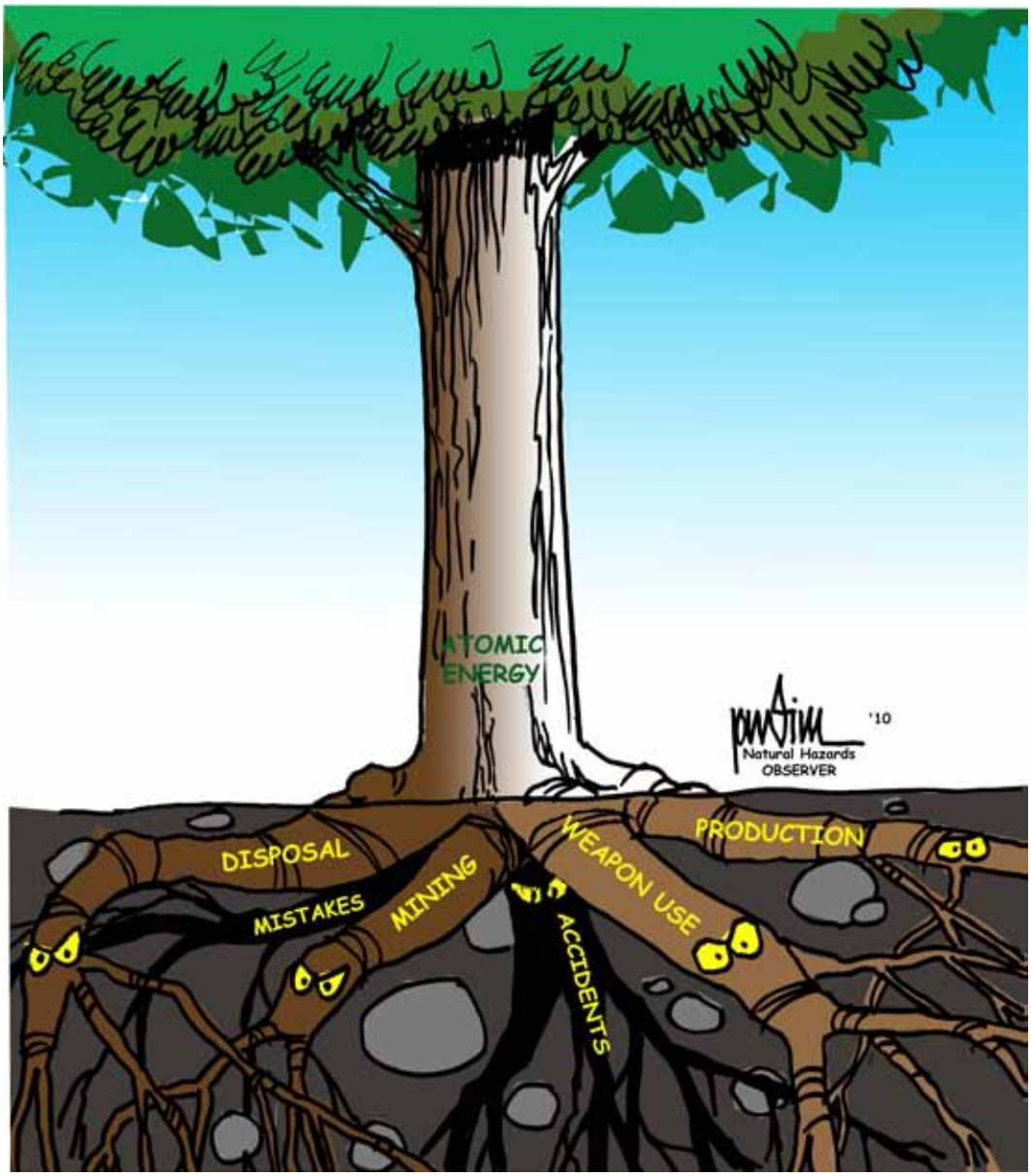
The second potential crossover point between power and weapons occurs because the vast majority of nuclear power reactors in the world also produce quantities of plutonium-239, the infamous fissionable element. Plutonium-239, used to make powerful nuclear bombs, is a byproduct of a chain reaction which essentially burns the uranium-235 fuel (concentrated to about four percent). The other 96 percent of the fuel, which has been pressed into pellets and then loaded into thin rods, is made up of uranium-238. Some of the neutrons from the fissioning uranium-235 in the reactors are absorbed by the uranium-238. Through a series of reactions plutonium-239 is produced. Plutonium comprises about one percent of the spent reactor fuel. After the spent fuel rods are removed from the reactor the plutonium must then be separated, or "reprocessed," from other elements before it can be fabricated for use in weapons. This is what North Korea did when it dropped out of the Nuclear Non-Proliferation Treaty. In October 2006, Nortyh Korea tested a plutonium bomb.

Plutonium-239, used by the United States for its first atom bomb test in New Mexico in 1945 and then the bomb dropped on Nagasaki, has long been the material of choice for nuclear weapons. Today it takes just 13 pounds of plutonium for a bomb compared with 33 pounds of uranium-235 (Muller 2008). Nations with nuclear weapons arsenals typically have dedicated military reactors to produce plutonium, but dual-use power and weapons reactors can also operate. Chernobyl was such a reactor. Sophisticated nuclear weapons nations use fission bombs to trigger hydrogen bombs with 1,000 times the explosive force of a fission bomb.

Scientists agree that acquiring the fissile materials plutonium-239 or uranium-235 is the most difficult part of making a nuclear bomb. Harvard's Matthew Bunn notes, "Making the needed nuclear material has always been the most challenging and costly element of national nuclear weapons programs, having consumed some 90 percent of the resources devoted to the Manhattan Project" (Bunn 2010). And Muller writes that once in possession of uranium-235, designing a Hiroshima-style bomb "is perhaps even within the means of small terrorist organizations." He argues that plutonium-239 is easier to acquire and extract from reactor waste "if you know enough about radiochemistry techniques." But terrorist groups, in contrast to nations with industrial capability, would be unlikely to try to

build a plutonium bomb, which requires sophisticated implosion techniques (Muller 2008).

Today, in addition to the nine nations with nuclear weapons (the United States, Russia, United Kingdom, France, China, Israel, India, Pakistan, and North Korea), 18 other countries possess enough plutonium or highly-enriched uranium "to require the highest international standards of security," writes Bunn in his report *Securing the Bomb 2010* (Bunn 2010). He notes that such security standards have not yet been achieved, although some progress is being made. Bunn's focus is the danger that terrorists could acquire and use a bomb, a risk that President Obama called "the most immediate and extreme threat to global security" in his 2009 speech in Prague.



The danger of terrorists acquiring a nuclear bomb is much different than the risk that nations will use a nuclear power program as a pretext for acquiring bomb materials, as North Korea did and Iran is suspected of planning. But international efforts to secure the nuclear fuel cycle to prevent countries from enriching uranium to weapons-grade levels or reprocessing plutonium for bombs have lagged. Ideas about ways to provide such security, such as creating international nuclear "fuel banks," are spelled out in publications such as the special fall 2009 and winter 2010 issues of *Daedalus,* the magazine of the American Academy of Arts and Sciences. However, little real progress has been made, for political reasons.

Unknowns and Optimism

"Will the growth of nuclear power lead to increased risks of nuclear weapons proliferation and nuclear terrorism? Will the nonproliferation regime be adequate to ensure safety and security in a world more widely and heavily invested in nuclear power?" analysts Steven Miller and Scott Sagan ask in the introduction to the *Daedalus* double issue. Their answer: "It depends."

"On what will it depend?" they continue. "Unfortunately, the answer to that question is not so simple and clear, for the technical, economic, and political factors that will determine whether future generations will have more nuclear power without more nuclear proliferation are both exceedingly complex and interrelated" (Miller and Sagan 2009).

Unknowns and a heavy dose of optimism dominate the July 2010 International Energy Agency/Nuclear Energy Agency report when it mentions potential solutions to proliferation as well as risks such as accidents and waste posed by nuclear power. A few examples:

- "Particularly if nuclear power is to play a greatly increased role, and is to be used in a wider range of countries, appropriate nonproliferation controls will need to be in place . . . Several international projects and proposals aimed at achieving this are being promoted by individual countries or groups of countries, and are being considered at the IAEA [International Atomic Energy Agency]."
- Existing reactors are called Generation II, with the "latest designs" known as Generation III or III+. "The designs offer improved performance and reliability, greater fuel efficiency, enhanced safety systems and produce less radioactive waste." On the following page, however, the report states that only one such reactor design is currently operating and when it describes the

new French reactors, under construction in Finland and France, it fails to mention the delays and big cost overruns for these projects.

- The report also notes that nuclear power programs "will need to be implemented in an increasing number of newly industrializing countries, where most of the increase in energy and electricity demand will occur" and that these nations will need to develop a "safety culture."

If something goes awry, however, the risk is that investments in nuclear power will end up being completely wasted. "A terrorist nuclear bomb, or a major sabotage of a nuclear facility—a 'security Chernobyl'—would doom any prospect for gaining the public, government, and utility support needed for large-scale growth of nuclear power, putting tens of billions of dollars in future revenue at risk," Bunn writes. "In some countries it might even lead to pressures to close major operating facilities" (Bunn 2010).

Proponents of nuclear power, and even some who are more skeptical, suggest that there is no viable alternative. Physicist Muller, summarizing the issue and giving advice to a future president, writes, "Despite the public opposition, nuclear power is likely to be an important part of our future energy needs. Somehow you need to convey to the public that their fear has come from ignorance, not from knowledge, and that you know what you are talking about" (Muller 2008).

It seems to me, however, that fear of nuclear power's risks is warranted, with few realistic solutions in sight—particularly for the dangers of proliferation, terrorist acquisition of bombs, and accidents. And the debate and emphasis on renewables in Germany, where the most profound public discussion of nuclear power has been occurring, suggests that an alternative path exists. The conservatively estimated $4 trillion needed to expand nuclear reactors around the world would go a long way to developing renewable and sustainable clean energy sources.

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Resources

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

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

ALL HAZARDS

Natural Disasters, Cultural Responses: Case Studies Toward a Global Environmental History. Christof Mauch and Christian Pfister, editors. 2009. ISBN: 978-0-7391-2416-1. 382 pp. $38.95 (softcover). Lexington Books. www.lexington-books.com.

Christof Mauch's introduction to this book points out something we've noticed around here: "Lately it seems that every Borders bookshop and Blockbuster video store is filled with titles such as *Nature on the Rampage, Killer Flood, Devil Winds, Tidal Wave: No Escape, Dante's Peak, Aftershock: Earthquake in New York,* and *Storm of the Century."* Our bookshelves too are filling with hazard and disaster titles, which has grown from a trickle to a flood. The titles on our shelves are little more prosaic than Mauch's selections—*Disaster Medicine*, for instance, or *Security Manager's Guide to Disasters*—but there's no denying that the volume has increased.

This book affirms, though, that while more attention may be paid to disasters these days, their impact has been felt through history. A series of case studies, the book takes a global historical look at natural disasters, how they've affected places, and how the responses to them have been organized.

In France in the 17th and 18th century, write René Favier and Anne-Marie Granet-Abisset, the citizenry became pretty fatalistic in the face of floods, freeze, and other hazards: "Everywhere disastrous events were brought within the framework of a religious ceremony; in certain cases the ceremony anticipated the event." The chief component of the mitigation plan, it seems, was prayer.

This book makes an admirable effort to direct the gaze of historians away from wars and warriors to the effects of natural disasters on the global patterns of development.

Disaster Management Handbook. Jack Pinkowski, editor. 2008. ISBN: 1-4200-5862-2. 595 pp. $99.95 (hardcover). CRC Press**.** www.taylorandfrancisgroup.com.

The collection of papers here covers a broad range of topics in handling disasters. An impressive collection of 44 authors contributed to the volume, dealing with topics from the Indian Ocean tsunami in theory and practice to intergovernmental relations.

Because Allan Boyce wrote so knowledgably about the issue in the July 2010 issue of the *Natural Hazards Observer,* we were particularly interested in the coverage this book gives to the role of the military in natural disasters. Two of the papers look the "necessity and impact" of the military's increasing role in disasters both domestically and internationally. Jay Levinson writes in his piece, "Calling in the military to assist in large civilian disaster should not be a natural reflex. It should be a calculated decision weighing both pros and cons. One of the basic issues to be considered is if the military has received the proper training to handle the civilian tasks involved."

Strengthening Care for the Injured: Success Stories and Lessons Learned from around the World. By the World Health Organization. 2010. ISBN: 978-92-4-1563963. 62 pp. Free (softcover). World Health Organization. www.who.int/violence_injury_prevention.

This book shares the lessons of trauma care from different countries around the world, offering case studies about improvements in health care access for the seriously injured in many different economic environments. In Ghana, for instance, many people died in the field without any hope of access to health care. "In response," the report says, "the government created the National Ambulance Service. This was created with a well-organized structure of administration, clearly defined standards for staff training and equipment carried in ambulances, well-defined operating procedures, accurate recording of data of cases handled, and use of that data for management and quality improvement."

The cases—from Cambodia, Iraq, Mexico, Colombia, Romania, Thailand, Qatar, Viet Nam, Brazil, India, Canada, and Sri Lanka, as well as Ghana—covers the spectrum from prehospital care to system-wide improvement.

Ideas From and Emerging Field: Teaching Emergency Management in Higher Education. Jessica A. Hubbard, editor. 2009. ISBN: 978-0-9793722-3-0. 220 pp. $40 (softcover). Public Entity Risk Institute. www.riskinstitute.org.

This book is a collection from the Federal Emergency Management Agency's 2008 11th Annual Emergency Management Higher Education Conference. It discusses the components of a university program in emergency management, but in a somewhat *ad hoc* manner. There are chapters on integrating disaster resilience into a university, about presidential authority during a catastrophe, about field research as graduate work, and much more.

Many of these chapters use experiences in Hurricane Katrina as examples, showing on one hand how much this disaster has influenced the American approach to emergency management, and on the other, how much this experience still needs to be integrated into our overall understanding.

CLIMATE CHANGE

Climate Change and Agriculture: An Economic Analysis of Global Impacts, Adaptation and Distributional Effects. By Robert Mendelsohn and Ariel Dinar. 2009. ISBN: 978-1-84720-670-1. 246 pp. $99.00 (hardcover). Edward Elgar. www.e-elgar.com.

The importance of agriculture to the well being—even the survival—of humanity isn't a matter of much debate. But the effect of climate change on agriculture is an extremely difficult topic. It's a glib conclusion of some climate

skeptics that carbon dioxide is good for plants, so our chief greenhouse gas will result in higher agricultural productivity.

A close look at this subject does not bubble with quite so much optimism, however. As the first chapter of this book points out, increased temperatures and carbon dioxide concentrations may be good for some crops—rice, for instance. But crops need nutrients besides CO_2, and these will not increase as CO_2 does. Furthermore, weeds and agricultural pests will also thrive as carbon dioxide levels go up and temperatures increase.

And even if climate change is good for some crops, there is a limited range of temperatures in which these benefits occur. If average temperatures get too high, global crop and animal production will suffer, regardless of carbon dioxide availability. Mendelsohn and Dinar conclude at the end of their opening chapter, "The exact magnitude of the impacts appears to depend on many local conditions including soils, nutrients, and water … The relationship between yields and temperature appears to be hill-shaped for every species, though the 'best' temperature for each species is different.

Furthermore, in a refrain that is echoing in more and more of the climate literature, the authors say, "Agriculture in developing countries is likely to be more vulnerable than agriculture in developed countries."

The discussion of the physical impacts of climate change on agriculture is only the opening of this book. They look in depth at the economic choices and adaptations that may (or may not) be made by farmers around the world in the face of the changing climate. Climate change will not only mean more CO_2, but changing rainfall patterns, different growing season lengths and a host of other impacts, some subtle, some not so subtle. In their conclusions, the authors write, "Farms in cooler locations are expected to benefit from warming, whereas farms in hotter locations will clearly be harmed."

The Political Economy of Hazards and Disasters. Eric C. Jones and Arthur D. Murphy, editors. ISBN: 978-0-7591-1309-1. 351 pp. $85.00 (hardcover). Altamira Press. www.altamirapress.com.

This book is densely packed with information, primarily from an anthropological perspective, on how the political classes relate among one another, and how those relationships increase vulnerability to disasters. "Generally speaking," writes Anthony Oliver-Smith in the first chapter, "from my perspective the public must be made aware of how implicated past human actions are in the occurrence of disaster; that is, how certain kinds of deeply embedded cultural predispositions combine with conscious decision making to further specific economic interests in society to produce specific kinds of vulnerabilities to disasters."

The *Political Economy of Hazards and Disasters* takes the readers on a tour of many disasters—Hurricane Katrina, the Johnstown Flood, the *Exxon Valdez* spill—from this perspective. Its study of power relationships may have a lot to say about the current vogue in the disaster research community for "resilience."

Assessing Vulnerability to Global Environmental Change: Making Research Useful for Adaptation Decision Making and Policy. Anthony G. Patt, Dagmar Schröter, Richard J.T. Klein and Anne Christina de la Vega-Leinert, editors. 2009. ISBN: 978-1-84407-697-0. 258 pp. $146 (hardcover). Earthscan. www.earthscan.co.uk.

What do policy makers have to know to deal with climate change among vulnerable populations? "The thesis of this book," write the editors, "is that, at least for now, the study of vulnerability to global climate change can and should fall with the domain of policy analysis—engineering practical solutions to pressing problems, rather that within the much broader discourse of natural, social, and systems science."

Much of the argument surrounding climate change concerns decision making in the face of uncertainty. Critics demand a high level of certainty before agreeing to investments in mitigation and adaptation, far higher than they do in, say, economic policy. This book may help point the way for decisions in an uncertain environment, at least insofar as it can identify vulnerable populations around the globe.

"Vulnerability is not a feature of how a system functions in the present," the editors write, "but rather of how it is likely to function in the future, and in particular of the ways in which it will not function as well in the future as it does today."

Global Environmental Change and Human Security. Richard A. Matthew, Jon Barnett, Bryan McDonald, and Karen L. Obrien, editors. 2010. ISBN: 978-0-262-51308-1. 327 pp. $25 (softcover). MIT Press. mitpress.mit.edu.

The definition of the term "security" has expanded in recent years. Its narrowest form, and the one most people probably think of, "refers to the security of the nation-state to attack from armed forces," say the editors in the introduction to this volume. But "human security" enlarges this view, asking "whose security?" The security of an individual within a state can be very different from the security of the state itself. Indeed, as the authors point out, in some nations "national security may mean very high levels of insecurity for people: If they are perceived to be risks to the state, they may be detained, forcibly removed, assaulted, or killed."

Furthermore, by designating an issue a security risk—whether it's drug use, climate change, energy, whatever—a nation may bring an entirely different set of strategies to bear on it, including the military. Some environmentalists have tried to present environmental issues and, lately, climate change as national security issues, a designation that might be used to circumvent democratic restraints on the solutions employed.

This book knowledgably deals with all of the subtleties of human security in an era when it is receiving increased attention. A few concurrences emerge. Democracy, the various authors say, tends to reduce the human security risks from environmental threats. Poverty is a powerful driver of human insecurity. And yet liberalized markets are an uncertain mechanism for increasing security. The authors conclude with a proposal for seven areas of further research.

FIRE

Awful Splendour: A Fire History of Canada. By Stephen J. Pyne. 2007. ISBN: 978-0-7748-1392-1. 549 pp. $38.95 (softcover). UBC Press. www.ubcpress.ca.

Stephen Pyne has probably written more about fire than anyone since Milton. This book is, as advertised by the

title, a fire history of Canada, but also "the story of Canada as viewed by fire, recasting Canadian history with fire as an organizing conceit," as Pyne writes in his introductory note.

Canada's history in this telling is a contest between fire and ice, between federal and provincial—a flammable analog of the equilibriums that govern Canada's political and cultural life.

HURRICANES

Pawprints of Katrina: Pets Saved and Lessons Learned. By Cathy Scott. 2008. ISBN: 978-0-470-22851-7. 244 pp. $19.99 (hardcover). Wiley Publishing. howellbookhouse.com.

Everyone loves their pets. This book will give you a pretty good idea of how much. It offers tales (or tails) of the many issues people dealt with during Hurricane Katrina to try to save their companion animals. It's filled with touching stories of people hoping to save their pets in the face of the enormous difficulties posed by the storm.

A subtitle of the book, promises "lessons learned," but there's relatively little of that beyond a pet preparedness checklist. Nonetheless, journalist Scott has produced a well-written and lively account of the animal disaster—among the many other disasters—of Katrina.

A.D. New Orleans After the Deluge. By Josh Neufeld. 2009. ISBN: 978-0-307-37814-9. 197 pp. $24.95 (hardcover). Pantheon Books. www.PantheonBooks.com.

It's hard to know even what to call this dramatic and affecting book. It's a graphic novel, sort of, although the stories are based on the real experiences of people living in New Orleans who were there when Katrina hit. Graphic nonfiction, perhaps.

Neufeld, a Brooklyn-based artist, follows the stories of eight New Orleanians. The stories are true, the author says, though some details have been changed for dramatic or privacy purposes.

The book offers a decidedly different take on the Katrina disaster, at least as far presentation is concerned. It brings the human costs home powerfully, in a way not accessible even in photographs.

Through the Eye of Katrina: Social Justice in the United States. Kristin A. Bates and Richelle S. Swan, editors. 2010. ISBN: 978-1-59460-735-6. 462 pp. $45.00 (softcover). Carolina Academic Press. www.cap-press.com.

This book pokes at the corpus of social justice from virtually every angle—poverty, ethnicity, race, gender, communications, and so on. It also focuses on the modern political shift from collective to individual responsibility, bringing in careful warnings. "This fundamental shift has meant that while federal public policy used to spread extreme financial risk across all of society (thus ensuring that the burden was not carried by individuals) since the 1980s, this risk has been transferred to individuals … In both the short and long runs, it makes it the responsibility of the middle class and working poor to shoulder upheavals in the volatile U.S. economy, while leaving corporations and the upper class in the position to enjoy the upturns without having to take any responsibility for the downturns."

Law and Recovery from Disaster: Hurricane Katrina. Robin Paul Malloy, editor. 2009 ISBN: 978-0-7546-7500-6. 252 pp. $89.95 (hardcover). Ashgate Publishing Limited. www.ashgate.com.

In *Roughing It,* Mark Twain described "The Great Landslide Case," in which a landslide pushed Tom Morgan's ranch down a mountainside, completely covering the ranch below, owned for some years by Tom Hyde. As Twain describes it, "One of those hated and dreaded landslides had come and slid Morgan's ranch, fences, cabins, cattle, barns, and everything down on top of his [Hyde's] ranch and exactly covered up every single vestige of his property, to a depth of about thirty-eight feet. Morgan was in possession and refused to vacate the premises—said he was occupying his own cabin and not interfering with anybody else's—and said the cabin was standing on the same dirt and same ranch it had always stood on, and he would like to see anybody make him vacate."

Hyde complained to his lawyer, "'And when I reminded him … that it was on top of my ranch and that he was trespassing, he had the infernal meanness to ask me why didn't I stay on my ranch and hold possession when I see him a-coming!'"

The Great Landslide Case—like many sudden-onset disasters—posed serious legal issues for property owners. This case reaches a hilarious climax on the western frontier, but it isn't so different from some of the conundrums faced by the victims of Hurricane Katrina. Early in *Law and Recovery from Disaster,* John Lovett writes, "Most lawyers, judges, and legal academics think about property law as an institution that is designed to promote stability … But if stability is so important, what happens to property law and property relationships when stability is dramatically undermined, when the world seems to be turned upside down by events that take us by surprise?"

The book looks at how law and property rights responded—and how they might evolve—in the face of disasters like Hurricane Katrina. Though a book about law, it examines these issues with language many disaster professionals will recognize, like resiliency. "What accounts then for the city and region's recovery, incomplete as it still may be?" writes Lovett. "Perhaps more than anything … is the inherent 'stickiness' of so many New Orleans' residents attachment to their city and region. Their property relationships, like many types of relationships in this disaster, were bent, but not broken."

Conferences and Training

September 13-14, 2010
Social Media for Responders
Crisis Communications Network
Charlotte, North Carolina
Cost and Registration: $795, open until filled

This conference will discuss how first responders can use social media to improve public communication. Conference topics include overcoming social media challenges, the future of social media for emergency responders, and measuring the effectiveness of a social media presence.

www.crisiscommunicationsnetwork.com

September 14-17, 2010
CESA 2010 Annual Conference and Training
California Emergency Services Association
Monterey, California
Cost and Registration: $650, open until filled

This conference will tackle emergency management challenges, educate attendees on emerging technologies and best practices, and offer opportunities to cultivate professional relationships. Topics will include disaster recovery, potential issues in facility restoration, and social media in emergency management.

www.cesa2010.org

September 16, 2010
All-Hazards All-Stakeholders Summits
Emergency Management
Denver, Colorado
Cost and Registration: Not posted

Addressing natural and man-made hazards in the Denver area, this summit will discuss best practices for preparedness and mitigation. Specific topics include innovative solutions and technology for improving community preparedness, best practices on collaborative emergency management planning, the challenges to planning and preparedness integration, and the latest Department of Homeland Security and Federal Emergency Management Agency initiatives.

www.emergencymgmt.com/events/Denver-EM-Summit-2010-All-Hazards-All-Stakeholders-.html?elq=dd4d01ef97d4475fad8398f285f13fd0

September 19-22, 2010
Association of Minnesota Emergency Managers 50th Annual Conference
Association of Minnesota Emergency Managers
Breezy Point, Minnesota
Cost and Registration: $180, open until filled

This conference will develop emergency operations plans and provide disaster preparedness, response, and recovery instruction. Sessions topics include using of the incident command system in search and rescue, caring for responders and survivors, and the next generation 911 system.

www.amemminnesota.org

September 27-29, 2010
ConSec '10: A New Decade of Information Security
Texas Association of Contingency Planners, Texas Department of Information Resources, and others
Austin, Texas
Cost and Registration: $335 before September 9, open until filled

This conference will address information technology risks and solutions related to business continuity and disasters. A risk management track includes sessions on emergency management, completing risk assessments in five days or less, and tying business risk to security initiatives.

guest.cvent.com/EVENTS/Info/Summary.aspx?e=077ca879-d513-46d9-a8f1-173728af16ca

September 29-October 1, 2010
Deltas in Times of Climate Change
Climate Changes Spatial Planning, Knowledge for Climate, and the City of Rotterdam
Rotterdam, Netherlands
Cost and Registration: $504 before September 29, open until filled

The exchange of current scientific research on climate change and delta planning, the need to strengthen international cooperation between delta cities, and to explore the links between science, policy, and practiceare the subjects of "Deltas in Times of Climate Change." Conference themes include managing extreme weather risks, decision support instruments for climate adaptation policy, flood risk management, and resources and ecology.

www.climatedeltaconference.org/nl/25222734-Home.html

October 4-6, 2010
International Symposium on Benefiting from Earth Observation
International Centre for Integrated Mountain Development
Kathmandu, Nepal
Cost and Registration: $250, open until filled

This symposium will encourage regional and international cooperation on using earth observation to improve climate change adaptation. Symposium topics include using space-based information for disaster management and spatial data infrastructure for climate change adaptation.

geoportal.icimod.org/symposium2010

October 5-6, 2010
Asia-Oceania Resilience Conference
International Association of Emergency Managers
Singapore
Cost and Registration: $600, Open until filled

This conference will discuss public, private, and personal resilience through the exchange of experiences and best practices for mitigation, preparation, response, and recovery from disasters. Conference topics include water

emergencies of the 21st century, disaster resilient communities, crisis management and emergency response in Antarctica, and a road map from response to resilience.

www.iaem.com.sg/Asia-Oceania-Resilience-2010.htm

October 6-8, 2010
Federal Alliance for Safe Homes 2010 Annual Meeting

Federal Alliance for Safe Homes

Orlando, Florida

Cost and Registration: $200, open until filled

This conference will discuss best practices and technology emphasizing this year's theme: "Where safety and sustainability meet." Conference topics include severe weather education, green building and disaster safety, and the incorporation of mitigation, weatherization, and water conservation.

www.flash.org

October 7-9, 2010
Quake Summit 2010

Network for Earthquake Engineering Simulation and the Pacific Earthquake Engineering Research Center

San Francisco, California

Cost and Registration: Free, registration deadline September 1, 2010

This summit will enhance integration and synergy of researchers from various projects and disciplines, share practical applications of research results, and explore emerging research trends and opportunities. Session titles include ground motion hazards, tsunami research and performance-based tsunami engineering, transportation and lifeline systems, and research opportunities from the Chile earthquake.

quakesummit2010.org

October 8-9, 2010
Berlin Conference on the Human Dimensions of Global Environmental Change

Environmental Policy and Research Centre and Freie Universität Berlin

Berlin, Germany

Cost and Registration: $284 before August 31, open until filled

This conference will discuss ways to bridge the gap between mainstream economic analysis and efforts to conceptualize, analyze, and measure the social dimensions of environmental change.

www.berlinconference.org/2010

October 9, 2010
Third Tri-State Weather Conference

Western Connecticut State University

Danbury, Connecticut

Cost and Registration: $30 before October 3, open until filled

The Third Tri-State Weather Conference will enhance education, professional development, and communication among private and public sector stakeholders. Session topics include cause and effect of out of season snowstorms, hurricanes and climate change, and large-scale circulations during the Atlantic hurricane season.

www.wcsu.edu/weatherconference

October 17-21, 2010
National Emergency Management Association 2010 Annual Conference

National Emergency Management Association

Little Rock, Arkansas

Cost and Registration: $750, open until filled

This conference will addresses emergency management challenges and share NEMA's views on all-hazards emergency preparedness. Session topics include military support to civil authorities and lessons learned from the Deepwater Horizon oil spill and Tennessee floods.

www.nemaweb.org/home.aspx

October 18-19, 2010
2010 Business Survival and Recovery Conference

Contingency Planners of Ohio

Dublin, Ohio

Cost and Registration: Not posted

This conference will share expertise, education, and experiences to improve preparedness, response, mitigation, and recovery of businesses from disasters and emergencies. Conference topics include disaster response, resiliency analysis, critical infrastructure sector plans, and data center recovery.

www.cpohio.org/conference.asp

October 24-26, 2010
National Flood Workshop

Weather Research Center, National Weather Service, and others

Houston, Texas

Cost and Registration: $250 before September 1, open until filled

This workshop will encourage dialogue on meteorological and hydrological conditions before, during, and after flood events, as well as technological advancements, flood mitigation regulations, and floodplain management.

www.wxresearch.com/nfw

October 29 to November 4, 2010
IAEM 58th Annual Conference 2010

International Association of Emergency Managers

San Antonio, Texas

Cost and Registration: $530 before September 1, open until filled

This conference will be a forum for ideas on current trends, topics, and the latest emergency management tools and technology. Conference tracks include mitigation and recovery, vulnerable populations, communications and technology, and weather.

www.iaem.com/events/annual/intro.htm

November 2-5, 2010
Floodplain Management Association Annual Conference

Floodplain Management Association

Henderson, Nevada

Cost and Registration: $385, open until filled

This conference will discuss strategies to meet

changing floodplain regulations and make future policy recommendations. Session topics include tribal floodplain management, dam and reservoir operations in arid regions, levees, and flood risk.

www.floodplain.org/conference.php

November 23-24, 2010
Dealing with Disasters International Conference
Northumbria University
Newcastle, United Kingdom
Cost and Registration: $298 before October 15, open until filled

This conference examines disaster resilience, response, and recovery in the contexts of the environment, economy, and social impacts. Conference themes include rights-based approaches to disaster reduction, urban disaster planning and infrastructure, and community-to-community development.

www.dealing-with-disasters.org.uk

November 24-26, 2010
Commonwealth Climate Change Communication Conference
London Metropolitan University
London, United Kingdom
Cost and Registration: $473, open until filled

This conference will discuss methods of education and communication that increase climate change knowledge and identify solutions to reduce current and future impacts on Commonwealth nations. Conference topics include climate capacity building, communicating climate change to different audiences, and the international climate change information program.

www.commonwealth-climate-change-2010.net

Contracts and Grants

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

RAPID: Temporary housing planning and early implementation in the January 12, 2010, Haiti earthquake. National Science Foundation grant #1034861. www.nsf.gov/awardsearch/showAward.do?AwardNumber=103486. One year. $39,999. Principal investigator Kathleen Tierney, University of Colorado, tierneyk@colorado.edu.

This project looks at the provision of temporary housing to displaced victims of the January 2010 Haiti earthquake. Temporary housing is the phase during which victims move from short-term or improvised sheltering arrangements to more home-like living arrangements, so they can begin restoring household, employment, schooling, and other routines. With extensive damage to the capital and other population centers, providing temporary housing for homeless earthquake victims is a high priority.

This study will track the progress of temporary housing activities, with an emphasis on decision making and planning by international agencies, the Haitian government, and non-governmental organizations. These decisions are important because the projects that are undertaken will critically affect the ability of individuals, households, neighborhoods, and communities to recover. Mistakes are often made in housing disaster survivors, complicating the recovery process and negatively affecting recovery outcomes. The severity and scope of the Haiti quake make both planning and carrying out temporary housing projects challenging. New housing arrangements also must ensure victims' safety in light of the potential for aftershocks, hurricanes, flooding, and other hazards.

This project will determine how aid providers balance these potentially conflicting demands. Data for the study are obtained through direct observation of meetings at which decisions are made, interviews with decision makers and providers of housing, and documents related to housing and household recovery.

RAPID/Collaborative research: The forgotten aspects of evacuation: Mass evacuee processing and care by host communities following the Haiti earthquake. National Science Foundation grant #1034789. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1034789. One year. $19,090. Principal investigator James Kendra, University of North Texas, jmkendra@unt.edu.

This grant will focus on the integration of evacuees from the January 12, 2010, earthquake in Haiti into life in Florida. Researchers and policy makers have been concerned about how to manage hazards in large cities, but few have considered the likely effects of a catastrophe away from the impacted urban area.

Hurricane Katrina in New Orleans left hundreds of thousands of people displaced from their homes for months, years, or even permanently. The communities to which they fled or to which they were transported had no guidance to prepare for or respond to the mass influx of these evacuees. This situation was virtually unprecedented in U.S. history, leaving the emergency management community and the political systems it supports with no appropriate plans, legal instruments, or policies to deal with the magnitude of the situation. Apart from challenges to officials, the unpredictable and faltering housing and social service initiatives resulted in additional stress and anguish for evacuees. Now, the January 12, 2010, earthquake in Haiti resulted in tens of thousands of internally and internationally displaced refugees. This disaster foreshadows what could be experienced when large numbers of people are forced to travel far from their places of residence for assistance after a catastrophe.

In this project, focusing on the Haiti earthquake, researchers will study how organizations: (1) identified and prioritized evacuees' needs as they traveled to the United States for assistance; (2) assessed the availability of re-

sources to meet those needs; and (3) administered both public and private aid systems, including new or emergent ones. This research particularly focuses on the administrative impediments that arise from inconsistent regulations, disconnected or conflicting procedures between agencies, or pre-existing administrative structures that are tested by unusual requests. Findings from this study will inform policy makers who need to improve capacities for assisting people who have escaped disaster.

RAPID: Local health-related capacities in northern Haiti response. National Science Foundation grant #1034772. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1034772. One year. $39,967. Principal investigator Deborah Thomas, University of Colorado at Denver, deborah.thomas@ucdenver.edu.

This grant provides funds a case study of the two main hospitals that serve the northern region of Haiti, using semi-structured interviews and an analysis of organizational networks, the research will: (1) examine what local health-related resources were available in the northern region of Haiti; (2) examine how these were, or were not, used in response efforts; and (3) assess the level of coordination and collaboration among health delivery groups.

This research explicitly takes the view, however, that even in a place that is the "poorest in the Western Hemisphere," structures and resources exist through which international assistance and response could work to draw on capacities within the local system.

Through an assessment of what health-related Haitian and NGO resources were operating in this region and an articulation of the level of coordination and cooperation between them, the research will contribute to an understanding of local capacity, particularly in a developing country setting. The study also recognizes that any attempt at sustainable recovery planning and/or disaster mitigation necessitates directly incorporating the Haitian health sector as a building block and so the data collection will establish a baseline for future assessment of the recovery process.

A long record of earthquakes with timing displacements for the Dead-Sea Transform fault: A test of earthquake recurrence models. National Science Foundation grant #1019871. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1019871. Two years. $281,000. Principal investigator Thomas Rockwell, San Diego State University, trockwell@geology.sdsu.edu.

This project will test earthquake recurrence and slip models for a major plate boundary fault, the Dead Sea Transform in Israel. Through high-resolution, three-dimensional trenching and precise dating of past earthquakes, along with analysis of the long historical record of earthquakes in this region, this work will determine the timing and sizes of past earthquakes along this simple fault system. It will provide a test of the repeatability of large earthquakes and whether their occurrence in time is predictable or more random. This issue is at the core of earthquake forecast models, but there is no general agreement as to what direction or approach should be taken. There are very few long records of past earthquakes, and most lack information on displacement.

Understanding earthquake production along plate boundary faults is critical for seismic hazard assessment worldwide. Most studies on earthquake recurrence have been conducted along complex plate boundaries, such as in California where multiple parallel faults affect stress interaction, and on faults with high rates such that the production of large earthquakes is too frequent to precisely resolve unambiguous event ages without overlap in uncertainties. The Dead Sea Transform is a unique plate boundary fault with a very long historical record that slips at a moderate rate, and has a simple segmented geometry with no parallel interacting strands in Israel and Jordan. It is therefore uniquely set to address questions of earthquake recurrence and its variability. Thus, this project will provide much needed information to test the fundamental behavior of continental transform systems. It will lead to better methodology in the forecasting of future destructive earthquakes worldwide.

RAPID: Collaborative research: Deepwater Horizon: Simulating the three dimensional dispersal of aging oil with a Lagrangian approach. National Science Foundation grants #1048796 and #1048630. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048976. One year. $64,194 to principal investigator Elizabeth North, University of Maryland Center for Environmental Sciences, enorth@hpl.umces.edu; and $24,903 to principal investigator Edward Adams, Massachusetts Institute of Technology, eeadams@mit.edu.

Simulation of the subsurface and surface dispersal of oil in the Gulf of Mexico will be conducted with the objective of producing probabilistic envelopes of the spread of different size classes of oil as they age over time. The proposed model system is ready to respond. The SABGOM hydrodynamic model of the Gulf of Mexico and South Atlantic Bight has been successfully coupled with LTRANS, a fully three-dimensional Lagrangian particle tracking model capable of simulating subgrid scale turbulent motion as well as time-varying particle attributes like diameter, density, and rise/sinking velocities. At distances greater than a few hundred meters above the deepwater source (depending on ambient current speed and stratification), the dispersal of oil depends mainly on the behavior of oil droplets which are fractionated into different sizes. These oil droplets can have orders of magnitude differences in ascent rates (e.g., 6 mm/s and 0.06 mm/s for 300 micron and 30 micron diameter particles, respectively) and change in diameter as they age. Emulsification, interaction with suspended particulate matter, dissolution and other processes can also affect droplet behavior. The model results will be compared with available observations and will be made available to the oil spill response community.

In the near-term, a series of LTRANS simulations will be run using the existing flow field from recent SABGOM model simulations. The Lagrangian dispersion runs will be initialized with a continuous source of particles representing the near-field plume above the well. Each run will simulate the far-field dispersion of those particles based on a specific set of assumptions about particle behavior. As more complete information on the size and composition of gas bubbles and oil droplets emerge, the most realistic particle distributions from the LTRANS ensemble of runs will be selected. As part of this effort, an improved hindcast from the SABGOM model for use with LTRANS will be produced and the model skill will be quantified against physical oceanographic observations. In addition, Eulerian and La-

grangian predictions of oil dispersal will be quantitatively compared with observations in order to use the strengths of both approaches to provide the most realistic predictions for the oil response community.

RAPID: Rapid assessment of extent and photophysiological effects of the Deepwater Horizon oil spill. National Science Foundation grant #1048482. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048482. One year. $199,972. Principal investigator Alexander Chekalyuk, Columbia University, chekaluk@ldeo.columbia.edu.

The Deepwater Horizon accident in the Gulf of Mexico has created an oil spill of unprecedented magnitude. This spill is also unprecedented in that unlike most oil spills that occur due to shipping accidents and result in release of oil near the surface of the ocean, here oil is gushing out of the ocean from a depth of approximately 1500 meters. While there are several ongoing efforts to understand the impact of this catastrophe on the ecosystem of the Gulf of Mexico, much of the initial attention focused on the surface slick and on the potential for oil to wash up onshore. However, there is increasing evidence that there is substantial amount of oil subsurface, although there are no estimates of how much, its distribution in the water column, or the impact on ecosystem, including primary producers. In particular, it is unclear how physiological status, photosynthetic capacity and population structure of these organisms are affected by both oil itself as well as by dispersants such as Corexit. Given that the oil, the dispersants and their breakdown products are expected to have a long lasting presence in the Gulf and one of the current estimates of the amount of oil released already exceeds one million barrels, these changes may have significant and enduring affects on the microbial community and primary productivity of this region.

This award funds the investigators to contribute to the multidisciplinary team being formed by Montoya, Villareal, and Bracco in their upcoming cruises on the *R/V Oceanus* and *R/V Cape Hatteras* from mid August to mid September to study the distribution and spread of the bio-environmental oil impact on horizontal and vertical scales using state-of-the- art fluorescence and Lowered Acoustic Doppler Current Meter techniques. In addition to detecting oil itself through spectrofluorescence techniques, they will study the biomass, photosynthetic capacity and population composition of photosynthesizing organisms with regard to the potential effects of the oil spill using the Advanced Laser Fluorometer. They will detect subsurface plumes of oil using APEX floats and study vertical and horizontal velocities in the water column. Data from these instruments can also be used to validate numerical models being used to study the spread of the plume in the Gulf.

They will investigate fundamental questions about this event, to estimate the location and magnitude of the subsurface plumes, to map the spatial extent of the near surface plume, and to understand the effect of the plume on the Gulf of Mexico ecosystem by investigating its effect on photophysiology of phytoplankton, the base of the food chain.

RAPID: Evaluation of the near-term impact of the Deepwater Horizon blowout to the South Florida coast. National Science Foundation grant #1048697. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048697. One year. $170,267. Principal investigator Claire Paris, University of Miami Rosenstiel School of Marine and Atmospheric Sciences, cparis@rsmas.miami.edu.

This project will assess how, where, and when the oil products entrained in the Loop Current impact the South Florida coast. To this end, the integrated use of a series of nested ocean and coastal circulation models as a single application is critical in order to be able to identify pathways of the oil mixture from the deeper part of the Gulf of Mexico to the shallow areas of Florida Bay and the Florida coral reef track. Past work in nesting a high-resolution Florida Key model with the Gulf of Mexico real-time Hybrid Coordinate Ocean Model Ocean Predictions System using a multi-scale numerical modeling framework, the Connectivity Modeling System provides the framework for this study. This modeling framework, originally developed for larval transport and connectivity studies, is well suited for rapid assessment of the impact of the Deepwater Horizon blowout on the south Florida coast. The CMS has a hierarchy of embedded Lagrangian stochastic particle models allowing probabilistic dispersion of particles with individual attributes and behaviors and has the capability of tracking the three-dimensional movement of the particles across nested domains.

First, the formation of surface slicks, subsurface layers, and deep plumes and their pathways to the Loop Current will be simulated by conducting probabilistic runs of CMS with the highest resolution operational products available yet for the region (i.e., 1-4 km HYCOM-based Ocean Predictions System). In order to do this, we will adapt CMS to oil-gas mixture behavior (i.e., flow rate, density, viscosity, terminal velocity) and add processes of wind forcing, evaporation and weathering. The investigators will use an envelop of oil mixture behavior, varying the size of particles in the model and improve the "oil module" through systematic comparisons of model results with time series of Eulerian observations.

Second, the effect of hurricanes on the redistribution of the oil in the water column will be simulated. Given the large uncertainties inherent in the oil prediction problem, the proposed research will generate statistical estimates of the near-term impact of the oil-dispersant mixture to the South Florida coast.

This project will provide a new understanding of transport pathways and accumulating areas resulting from the interactions of the circulation with the oil mixed with huge quantities of dispersant.

RAPID: A double dunk: How the oil spill is affecting Katrina-impacted residents. National Science Foundation grant #1049048. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049048. One year. $35,023. Principal investigator Katherine Browne, Colorado State Univesrity, kate.browne@colostate.edu.

This research will examine how the Gulf of Mexico oil spill is impacting populations who are still recovering from the effects of Hurricane Katrina in 2005. The epicenters of both these disasters have occurred in the same New Orleans area of the Gulf Coast, affecting large numbers of the same people. Some of the impacts are indirect and unexpected. For example, contaminated fishing waters are affecting seafood supply which is linked to the maintenance of family networks and the resilience of the very family support systems that proved critical for dealing with the aftermath of Hurricane Katrina.

The award funds follow-up research on the post-Katrina recovery process of a large kin network of 150 African Americans. The research will advance science in three ways: 1) methodologically, by demonstrating the value of systematic, qualitative interviews with disaster-affected residents to collect data that is otherwise unobtainable; 2) theoretically, by modeling long-term disaster recovery as a volatile, non-linear process, rather than a defined episode or event; and 3) by demonstrating the value of communicating science findings to the public as well as to the scientific community.

RAPID: What counts as crude oil? Measuring the extent and effect of the Deepwater Horizon oil spill. National Science Foundation grant #1048569. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048569. One year. $7,424. Principal investigator Ann Stoler, New School University, StolerA@newschool.edu.

This research will examine the technical expansion of what counts as crude oil in deepwater drilling and the ability of regulators, scientists, and citizens to make informed decisions about that expansion. The researchers will investigate the daunting problems federal agencies face in measuring and combating this deepwater oil spill.

Through attending hearings, reading reports, interviewing key officials and marine scientists, and participating in research expeditions in the Gulf of Mexico, the research will provide an ethnographic account of this debate. Itwill focus on the scientific production and regulatory reception of new knowledge about deepwater oil spills. Particular attention will be paid to unfolding questions of evidence in order to: (1) describe the technical constraints of the existing regulatory structure in relation to the complexity of deepwater oil spills; (2) catalogue emerging sources of data on the deep sea movements of crude oil (and/or dispersants) and its effect on ocean ecology; (3) contribute to our understanding of how regimes of evidence are mobilized to define both urgent vulnerability and our responsibility to it.

RAPID: Proposal for systematic building data documentation following the February 27, 2010 Chile earthquake. National Science Foundation grant #1048314. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048314. One year. $68,896. Principal investigator Jack Moehle, University of California-Berkeley, moehle@berkeley.edu.

On Saturday, February 27, 2010, a Mw 8.8 earthquake struck the central south region of Chile, affecting an area with a population exceeding eight million people. This earthquake caused damage to buildings, highways, railroads, ports, airports, and other facilities due to ground shaking, liquefaction, and tsunami. Chile is a country that, in response to a history of frequent strong earthquakes, has developed and implemented building standards aimed at achieving earthquake safe construction. Many of the Chilean standards are adopted from standards in use in the United States. Although the majority of buildings performed well, an estimated 50 mid-rise concrete buildings sustained damage requiring extensive repair or demolition.

By studying these buildings, U.S. engineers can improve modeling, analysis, and design methodology for U.S. buildings. The researchers will travel to Chile to recover perishable data from a sample of heavily damaged or collapsed mid-rise concrete buildings. The results will be archived for academic researchers and practitioners for detailed study.

The field investigation will gather fundamental data from full-scale structures subjected to strong, long-duration shaking, and the results will be available to other researchers and practitioners to conduct detailed studies on aspects such as modeling, simulation including collapse, soil-foundation-structure interaction, and design methodology.

The BP Horizon oil disaster: Media accounts and community impacts. National Science Foundation grant #1045413. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1045413. One year. $57,306. Principal investigator Shirley Laska, University of New Orleans, slaska@uno.edu.

National and international media have reported the BP Deepwater Horizon oil disaster. This project explores the impact of the media accounting on the ways that communities come to understand the event, and identifies intervening factors that mitigate community adoption of the media accounting.

The environmental literature has long posited that problem identification is a construction process and a critical element of that construction is media accounts. The research team will make sense of the impact of the media stories by completing a content analysis of the media accounting and by designing and implementing a survey to measure residents' understanding of the event.

The survey includes measures of the respondents' vested economic interests, their stakeholder self-identification, the direct impact of the spill on them, and their understanding of the specifics concerning the event. The respondents are selected randomly within six communities spread across coastal Louisiana in order to "intercept" communities with different exposures. The study tests multiple theoretical models describing the likely outcome of the effect of the media accounting on communities' understanding of the event.

RAPID: Collaborative research: The political costs of natural disasters: Democratic support, authoritarian attitudes, and blame attribution after Chile's 2010 earthquake. National Science Foundation grants #1036414 and #1036411. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1036414. One year. Two grants: $41,084 to principal investigator Elizabeth Zechmeister, Vanderbilt University, liz.zechmeister@vanderbilt.edu and $10,076 to principal investigator Ryan Carlin , Georgia State University Research Foundation, rcarlin@gsu.edu.

On February 27, 2010, Chile was rocked by an Mw 8.8 earthquake registering 8.8, followed by a tsunami that ravaged the coast. While the capital, Santiago, experienced comparatively little damage, population centers closer to the epicenter, such as Concepción and Talca, as well as villages and towns along Chile's vast coastline, were devastated. Similar to concerns brought up in the wake of Hurricane Katrina in 2005, these events raise questions about the political aftershocks of the Chilean state's slow and fumbled response and the ensuing humanitarian crisis.

This project investigates the effects of the recent personal and community-level damage on Chileans' political perceptions and attitudes. Conditions of crisis affect politics, but the principal investigators argue that the breadth and depth of these costs to the system can be particularly

severe in less established democracies where support for democratic values and the system itself is less entrenched. Drawing on extant literature, the researchers hypothesize that as crisis-affected individuals cope they will express attitudes that are less favorable toward the incumbent, but in newer democracies like Chile, also democratic institutions. At the same time, the researchers expect blame attribution will differ among individuals and affect responses toward the system. Further, crisis-affected individuals will display lower levels of trust and tolerance.

To assess these expectations and uncover the ways in which the earthquake in Chile has affected public opinion and democratic attitudes, this project adds an oversample and a battery of questions to the AmericasBarometer survey (conducted by Vanderbilt University's Latin American Public Opinion Project in April 2010) that tap perceived personal and community damage and blame across key state actors and institutions (authoritarian attitudes are already on the questionnaire). In addition, the researchers add a geo-tagging feature, principally through GPS units, to the interview process, which will allow them to develop a dataset that includes contextual, objective data on damage to the area proximate to each interview. Finally, the researchers make use of both multilevel models and matching techniques (along with the 2008 AmericasBarometer survey of Chile) to assess variation in public opinion across those who were affected by the earthquake and those who were either less affected or not affected.

Collaborative research: A fundamental investigation of fire initiation and fire behavior in sparse vegetation. National Science Foundation grant #10499560. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049560. Two months. $91,840. Principal investigator Shankar Mahalingam, University of Alabama at Huntsville, shankar.mahalingam@ucr.edu.

This collaborative research project will develop advanced modeling technology for describing fire initiation and propagation in vegetation with low canopy bulk density. The ability to predict the spread of wildland fires is paramount in protecting life, property, and natural resources. Current operational models predict overall fire behavior well for the conditions for which the model was correlated (e.g., dead fuel beds), but they do not perform as well for live bushes or trees with high moisture content.

Detailed physical models, at either laboratory or landscape scale, require improved sub-grid scale models of combustion, especially to describe fire behavior in vegetation that does not act like a dense fuel bed due to the relative sparseness of the vegetation. This technology will be based on fundamental combustion measurements of live fuels, but it will apply to models of landscape-scale fires. The research objective will be achieved via four inter-related tasks: (1) flame propagation measurements in live leaves and small branches; (2) fire spread measurements in shrubs for varying bulk densities; (3) flame propagation models of bushes and trees; and (4) multi-bush fire behavior models.

The research will provide a cohesive picture of the phenomenon of fire spread starting from ignition of a single fuel element, such as a leaf, to a self-sustaining fire spreading through a larger fuel array such as a forest. The fundamental physical and chemical processes investigated are also relevant to the problem of surface fire propagation leading to ignition of crown fires. An improved fundamental understanding of fire behavior in sparse vegetation will be beneficial in promoting better predictive capability in other areas such as fire safety or arson investigation pertaining to identifying ignition sources.

RAPID: Getting word out about the science being done to determine the true scope and impact of the Gulf oil spill. National Science Foundation grant #1048917. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048917. One year. $200,000. Principal investigator Lester Crystal, MacNeil Lehrer Productions, lcrystal@newshour.org.

The objective of this award is to inform the public about the science and engineering research that is being conducted to determine the scope and impact of the Gulf oil spill. In response to the this environmental disaster facing the United States, NSF has funded numerous RAPID awards to send scientists and engineers to the Gulf to research the impact of the spill. MacNeil Lehrer Productions, producer of the PBS NewsHour, will report on this research that is ongoing as a result of the unanticipated and disastrous oil spill in the Gulf of Mexico.

The PBS NewsHour team of experienced producers and correspondents will produce at least nine segments for broadcast, along with extensive material online. All the stories will revolve around scientists and engineers and the work they are doing in the Gulf in response to the spill. The online material will include blogs and additional web-only video reports that will deliver content to augment broadcast coverage. The NewsHour will encourage user engagement through regular posting of stores on social media outlets, including Facebook, Twitter, YouTube, UStream and Disqus, to help the reporting on the oil spill go viral. The NewsHour will coordinate efforts with PBS stations located in the Gulf to create a synergy and extend the usefulness and life of these efforts.

The reach of the PBS NewsHour is significant. The national daily broadcast delivers an audience of approximately 1.1 million viewers. The NewsHour public radio broadcasts reach an average of 63,000 listeners daily across the nation. Outside the United States, the PBS NewsHour television broadcast is available on the American Forces Television to more than 800,000 military and State Department personnel around the world. In addition, audiences across Canada, Australia, Japan and Europe, Asia, Africa, and Latin America tune into the service via various channels and satellite services.

RAPID: Measuring the ecological effects of the Deepwater Horizon oil spill on the Florida Coastal Everglades. National Science Foundation grant #1048458. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1048458. One year. $150,038. James Fourqurean, Florida International Univesrity, fourqure@fiu.edu.

As of June 2010, the Deepwater Horizon BP oil spill in the northern Gulf of Mexico continues to dump oil and dispersants into the sea, and the Gulf of Mexico Loop Current has picked up this oil and is transporting it south to the tropical/subtropical coastal ecosystems of south Florida. The Florida Coastal Everglades Long Term Ecological Research (FCE-LTER) program in south Florida includes open water, seagrass, and mangrove habitats that could receive oil. Mangrove forests and seagrass beds, and the faunal com-

munities they support, are exceedingly sensitive to damage from oil spills.

Oil is directly toxic to marine plants, and mangroves are sensitive to smothering and death when oil slicks wash ashore. The food webs of these coastal communities are highly sensitive to toxic compounds in oil, and seagrass animal communities can be altered for many years after a spill. Given the susceptibility of the ecosystems of the FCE to oil spills, significant oil reaching this well-studied system could drastically alter the distribution of the marine communities, the structure of the food web, and the cycling of organic matter for years or decades after the spill.

The investigators will measure hydrocarbon concentrations and food web structure at sites that may be directly impacted by the oil spill before the oil reaches them, and assess how these factors change following the arrival of oil. The researchers will test the hypotheses: (1) oil pollution shortens food chain length in coastal ecosystems; and (2) food web structure will be differentially affected in seagrass beds, where the primary producers are less sensitive to hydrocarbon pollution, compared to mangrove forests where the primary producers are killed by oil.

The ecological disaster playing out in the Gulf of Mexico as a result of the Deepwater Horizon BP oil spill is underscoring the importance that a sustainable costal ecosystem has in supporting the social and economic integrity of the human population in the region.

RAPID: Mitigating the deposition of oil on Gulf shores via oil anti-deposition strategies. National Science Foundation grant #1047662. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1047662. One year. $149,955. Robert Lochhead, University of Southern Mississippi, Robert.Lochhead@usm.edu.

The Deepwater Horizon oil spill is now threatening the Gulf Coastline and the wildlife and economies that depend upon this region. Mitigation of the effects of the oil on the land and wildlife could be achieved if the deposition of the oil onto these substrates could be prevented.

In this context, deposition of oil onto substrates is routinely achieved in laundry by the use of polymeric soil anti-redeposition agents. This project will investigate the propensity of these agents to mitigate the effects of oil deposition on the Gulf Coast. The project will identify effective oil anti-deposition aids that are nontoxic, biodegradable, and available commercially in amounts large enough to mitigate the effects of the Deepwater Horizon oil spill on the Gulf Coastline.

These agents are polymers that sterically-stabilize the oil droplets and prevent close approach at which attractive London dispersion forces would operate. However, the Gulf is much larger than a laundry load, the oil in the Gulf is overwhelming the system, and the water is seawater rather than freshwater. These are significant unknown variables.

Nevertheless, it is worthwhile exploring the use of oil anti-deposition agents for their possible effect in mitigating this disaster. The most commonly used soil anti-redeposition agents are cellulose ethers, which are available inexpensively in large commercial quantities. Carboxymethylcellulose ethers are listed on the EPA subinventory. These are not likely to accumulate in the food chain due to their water solubility and high molecular weight (bioconcentration potential is low). They are nontoxic to fish and aquatic organisms on an acute basis. They are expected to slowly biodegrade in the aquatic environment.

These compounds are already released into the environment in vast quantities as a consequence of their widespread use in laundry detergents. There are also marine proteins that are by-products of fisheries that will be investigated in the proposed research, for their ability to prevent oil from sticking to coastal substrates.

Grand challenges in earthquake engineering research: A vision for NEES experimental facilities and cyberinfrastructure tools. National Science Foundation grant #1047519. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1047519. One year. $251,052. Principal investigator David Feary, National Academy of Sciences, dfeary@nas.edu.

The George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) will complete ten years of National Science Foundation support for operations and research at the end of fiscal year 2014. To develop the next-generation earthquake engineering research agenda and research infrastructure needs beyond 2014, a National Research Council committee, convened by the NRC's Division on Earth and Life Studies Board on Earth Sciences and Resources, will organize a community workshop on the grand challenges for earthquake engineering research. This workshop will bring together experts to address: (1) the high-priority grand challenges in basic earthquake engineering research that require a network of earthquake engineering experimental facilities and cyberinfrastructure; and (2) the networked earthquake engineering experimental capabilities and cyberinfrastructure tools required to address these grand challenges.

Workshop attendees will be asked to describe the experimental infrastructure capabilities and cyberinfrastructure tools in terms of requirements, rather than by reference to any existing or anticipated located future facilities, and will consider emerging technical and conceptual advances with the potential to influence future earthquake engineering research directions, such as early warning systems, new materials, sustainability, high performance computing and networking, modeling and simulation, sensor and monitoring technologies, and other factors identified by the workshop steering committee.

The workshop will be held in fall 2010 at the National Academies Beckman Center in Irvine, California. The NRC committee will prepare a workshop report summarizing the Grand Challenges and the requirements for networked facilities and cyberinfrastructure. The workshop report will be completed in early 2011. The ultimate goal of the basic earthquake engineering research defined by this workshop is to mitigate the effects of future earthquakes and decrease societal risk.

Gulf oil spill disaster coverage. National Science Foundation grant #1045744. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1045744. One year. $198,843. Principal investigator Maryanne Culpepper, National Geographic Society, mculpepp@ngs.org.

National Geographic Television is creating multiplatform media to communicate the scientific and engineering stories unfolding in the Gulf region due to the oil spill there. The Deepwater Horizon spill is one of the worst environ-

mental disasters to occur in the United States. Though traditional news outlets continue to report on the spill, there is little discussion about the scientific factors at play. These include the technology and engineering skills needed to stop the leak and contain the oil; the scientific and engineering efforts to mitigate its effects; and the potential impacts on the Earth system. Communicating these scientific and engineering concepts to the public is both critical and urgent.

National Geographic is uniquely positioned to take the lead in reporting on the science and engineering behind the spill and its implications. Deliverables will include: a 60-minute "Explorer" documentary television program to air on the National Geographic Channels in September 2010; 16 weekly online "Science Journal" segments featuring interviews with scientists, engineers, and other experts, promoted through National Geographic's social media channels; ongoing online news coverage and blog reports from the Gulf region; and online content for children. Funding from the National Science Foundation will specifically support coverage of the yet-to-be-filmed science and engineering segments for the television program and digital content.

Workshops to identify research needs emerging from the 2010 Haiti and Chile earthquakes. National Science Foundation grant #1045037. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1045037. One year. $56,000. Principal investigator Jay Berger, Earthquake Engineering Research Institute, jberger@eeri.org.

This award provides support for two workshops to identify emerging themes and directions for potential research resulting from the magnitude 7.0 January 12, 2010, Haiti earthquake and the magnitude 8.8 February 27, 2010, Chile earthquake. These two earthquakes are among the top five earthquakes in recorded history in terms of number of fatalities and magnitude size.

The Earthquake Engineering Research Institute will organize these workshops to explore needed research and data gathering opportunities from these two major seismic events.

Both the Haiti and Chile earthquakes present major learning opportunities of different types for the U.S. engineering and scientific communities. The Haiti earthquake has research lessons emerging from the response and rebuilding. The complex and devastating nature of that disaster will shape these lessons across many disciplines.

A different set of research needs and lessons will emerge from Chile, which is one of the most significant earthquakes for the U.S. earthquake engineering community in the last several decades. Building codes in Chile are similar to those in the United States for concrete and steel buildings; there are strong motion records that provide important data; the geologic setting is similar to the Pacific Northwest; there are similarities and lessons from the transportation, lifelines, and critical facilities sectors; and there are similar social and public policy issues in the response and recovery.

The workshop on the Chilean earthquake will be held at the National Science Foundation in Arlington, Virginia, on August 19, 2010; the workshop on the Haitian earthquake will be held at NSF on September 30-October 1, 2010.

The objective of these two workshops is to identify major research themes and directions emerging from the 2010 earthquakes in Haiti and Chile. Workshop participants will identify these directions to guide NSF's programs for future research related to these events. Participants will define major lessons and opportunities for further research across a range of disciplines. Transformative and cross-cultural research areas will be identified, where appropriate.

RAPID: Environmental and social impacts of the 2010 Eyjafjallajökull eruption. National Science Foundation grant #1042951. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1042951. One year. $27,720. Principal investigator Andrew Dugmore, CUNY Graduate School University Center, Andrew.Dugmore@ed.ac.uk.

This project will use the once-in-a-generation opportunity provided by the 2010 eruption of Eyjafjallajökull to create a new model of volcanic ash layer formation within the geological record, and evaluate the ash fall's social and environmental impacts. This may transform our understanding of the environmental data preserved within volcanic ash layers, refine our knowledge of past eruptions, and enhance our understanding of their impacts on society and landscape. In order to achieve this goal, it is necessary to rapidly gather a suitable multinational interdisciplinary team of researchers, hold a workshop to establish appropriate and meaningful collaborations between both the academic and local community, and establish a rigorous sampling protocol that can be carried out over the next three to five years.

The eruption presents a unusual opportunity to understand more about thresholds of change related to volcanic ash-fall. Under what circumstances do tipping points occur in relation to vegetation, geomorphology, and land-use change? How does weather, vegetation, topography, and land use affect the transformation of the ash layer? What is the effect of deposition over snow? When do volcanic ash layers remain the same, acquire, or lose mass? What governs the timing of ash stabilization and redistribution across landscape? If the ways in which volcanic ash layers become transformed are better understood then this could achieve four important goals we will be able to know more about: (1) the nature of the landscape onto which the ash fell; (2) the post depositional environmental processes operating on it; (3) the nature of the initial ash fall; and (4) be able to better reconstruct the initial eruption.

In the aftermath of the 2010 eruption the social and environmental impacts can be tracked in detail as they happen and it will be possible to discuss unfolding events and their consequences with the affected community. How does volcanic ash affect vegetation, water quality and drainage? What are the impacts on livestock? How does the ash-fall affect grazing, soil erosion and soil fertility? Where the ash was cleared, how was this done? What other impact (negative and positive) has the eruption caused and how does this affect the viability of farming and other rural activities?

Breaking the high-frequency barrier in earthquake source imaging with a network of seismic antennas. National Science Foundation grant #1015704. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1015704. One year. $84,010. Principal investigator Jean-Paul Ampuero, California Institute of Technology, ampuero@gps.caltech.edu.

Seismological insight into the physics of earthquakes is hampered by the limited spatio-temporal resolution of

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conventional source imaging techniques which, due to the heterogeneity of the Earth's crust, are incapable of assimilating the high-frequency wavefield. This project aims at enabling the development of a new generation of seismic networks specially designed for high-resolution imaging of large earthquake ruptures.

Non-parametric source imaging can be achieved if an earthquake is recorded on a highly clustered strong motion network, composed of multiple small aperture arrays: processing array data with high resolution direction-of-arrival estimation techniques can provide the spatio-temporal distribution of "bright spots" of high-frequency source radiation, a direct insight on rupture complexity. This research encompasses aspects of the system design and specifications that can be addressed through computational modeling of realistic earthquake scenarios, numerical solution of optimal experiment design problems, developments in array signal processing techniques, and analysis of available datasets.

The researchers will generate source dynamics and wave propagation in earthquake scenarios with realistic source complexity, crustal heterogeneities, and topography to provide a proof of concept, and to assess the robustness and resolution of imaging complex source processes with multiple arrays. These synthetic scenarios will also guide the definition of practical guidelines for array site selection by quantifying the effect of scattering on waveform coherency as a function of frequency and inter-station distance and by identifying adequate geomorphological proxies for wavefield coherency.

Many large urban areas around the world are exposed to earthquake hazard in close proximity to active faults, where the effects of the earthquake source complexity dominate the amplitude and variability of ground shaking. Improving our understanding of earthquake dynamics will consolidate the emerging trend of physics-based approaches for earthquake hazard assessment. This project aims at a transformative development of our capabilities to image the details of the rupture propagation of large earthquakes through the design of a new generation of seismic networks made of multiple clusters of strong motion sensors near active faults. This development aims at an order-of-magnitude improvement in the spatio-temporal resolution of earthquake rupture processes that will allow testing of competing hypothesis about the physics of earthquakes, and hence will advance our quantitative understanding of earthquake hazards. The concept timely builds upon recent experience with single-array recordings of the 2004 Parkfield earthquake and takes advantage of recent technological developments, such as the increasing availability of low cost MEMS accelerometers and wireless communication.

RAPID: Oil optimized particle surfaces (OOPS). National Science Foundation grant #1049915. www.nsf.gov/awardsearch/showAward.do?AwardNumber=1049915. One year. $67,001. Principal investigator Sudipta Seal, University of Central Florida, sseal@mail.ucf.edu.

This project addresses the urgent national need of safe scavenging of oil from spills such as the recent disaster in the Gulf of Mexico. The researchers are using flyash, a waste material resulting from combustion of coal in electrical power plants, to absorb large volumes of oil from an oil-water mixture by a simple chemical alteration of the flyash surface in a cost effective manner. These materials then can be placed in a low-cost, oil-permeable mesh packaging material for practical use in oil cleanup. After the cleanup, the materials can be easily recycled by feeding them into a combustion process to recover the thermal value of the oil without decomposition of the flyash.

This project offers the opportunity to use low temperature chemical processing to tailor inorganic surfaces of complex amorphous aluminosilicates with high surface area at a molecular level. This provides the necessary hydrophobic groups to adsorb organic molecules including long chain hydrocarbons. The process leads to an end product that is a low cost means of absorbing large volumes of oil and is capable of recovering the energy value of the oil. This project potentially can lead to a general theory converting inorganic inert surfaces to a highly active hydrophobic surface without degrading the refractory characteristics of these inorganic complex silicates.

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