

Raising the rules

Colorado's route to tougher floodplain regulations

An invited comment by Kevin Houck

Kevin Houck '12
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INSIDE

RECENT LARGE FLOODS AROUND THE COUNTRY HAVE RAISED QUESTIONS about the effectiveness of current regulations, asking whether they provide enough protection against injuries and severe property loss. The balance between regulations that are too strict and those that are too relaxed is being revisited in many places. Colorado recently undertook a rulemaking that looked at this very issue. The process stirred controversy, eventually encouraged cooperation, and brought the state strong new regulations that will allow it to deal with its flood risk. Along the way, we learned a number of lessons useful to other jurisdictions.

THE DISCUSSION OF COLORADO'S STATEWIDE FLOODPLAIN REGULATIONS began with an analysis of the National Flood Insurance Program. NFIP was established with passage of the National Flood Insurance Act of 1968. Following a period of a large number of costly flood disasters, the federal program attempted to mitigate future disasters by shifting the burden of flood risk from the taxpayer to those who live and do business in floodplains. NFIP es-

(Please see "Colorado flood rules," page eleven)



Russian heatwave: The lady or the tiger?

in damages, according to the [EM-DAT International Disaster Database](#).

But of those heat wave-related deaths, nearly 124,000 have occurred within the last ten years, 56,000 in Russia during that nation's infamous 2010 heat event, and the rest in Europe.

BETWEEN 1900 AND 2012, 151,127 people died in heat waves around the world—disasters that cost an estimated \$22.4 billion

In the United States, a 1995 Chicago heat wave resulted in about 750 excess deaths. A heat event in 2006 killed about 225 people in the United States and Canada.

And it's not over yet. Exceptionally long heat waves in the United States could be common by 2039, according to a study by Stanford University researchers published in *Geophysical Research Letters*. These heat waves will occur at relatively small increases in global temperatures—considerably below an average increase of two degrees Celsius, which is the current mitigation target for global warming. “The possibility

They Said It ...

“More than any other major wildfire in Australia, Black Saturday [February 7, 2009] provided an unprecedented opportunity to learn about the effects of land management on house loss. Clearing trees and shrubs within 40 meters of houses was the most effective form of fuel reduction on Black Saturday. However, there was less risk to houses from vegetation in planted gardens compared with vegetation in remnant native bushland.”—**Philip Gibbons of the Australian National University, senior author of PLoS One paper [Land Management Practices Associated](#)**

with House Loss in Wildfires, quoted in a news release.

“In many regions, future climate change is predicted to put crops under temperature stress, reducing yields. This stress is alleviated by geoengineering. At the same time, the beneficial effects that a higher CO₂ concentration has on plant productivity remain active.”—**Julia Pongratz, Carnegie Mellon University researcher, quoted in a news release about geoengineering research published in [Nature Climate Change](#).**

that intensification of hot extremes could result from relatively small increases in greenhouse gas concentrations suggests that constraining warming to two degrees C may not be sufficient to avoid dangerous climate change,” write Stanford’s Noah Diffenbaugh and Moestasim Ashfaq.

In addition to the health issues involved in extreme heat events, they “put enormous stress on major crops like corn, soybean, cotton, and wine grapes, causing a significant reduction in yields,” Diffenbaugh says.

In another study, researchers at the Johns Hopkins Bloomberg School of Public Health found that the city of Chicago alone could see between 166 and 2,217 excess deaths attributable to heat waves by the end of this century. “Our study looks to quantify the impact of increased heat waves on human mortality. For a major U.S. city like Chicago, the impact will likely be profound and potentially devastating,” said Roger Peng, lead author of the study, which appeared in the journal [Environmental Health Perspectives](#). “We would expect the impact to be less severe with mitigation efforts including lowering CO₂ emissions.”

The issue of whether climate is already affecting the frequency and severity of heat waves is still a matter of contention. National Oceanic and Atmospheric Administration researchers examined the 2010 Moscow heat wave and found it was “due to natural atmospheric phenomena often associated with weather extremes.” However, “while the scientists could not attribute the intensity of this particular heat wave to climate change, they found that extreme heat waves are likely to become increasingly frequent in the region in coming decades.”

“Knowledge of prior regional climate trends and current levels of greenhouse gas concentrations would not have helped us anticipate the 2010 summer heat wave in Russia,” said lead author Randall Dole, deputy director of research at NOAA’s Earth System Research Laboratory. “Nor did ocean temperatures or sea ice status in early summer of 2010 suggest what was to come in Russia.”

Other researchers reached the opposite conclusion, however. Stefan Rahmstorf and Dim Coumou of the Potsdam Institute for Climate Impact Research, in a paper in the [Proceedings of the National Academy of Sciences](#), concluded, “For July temperature in Moscow, we estimate that the local warming trend has increased the number of records expected in the past decade fivefold, which implies an approximate 80 percent probability that the 2010 July heat record would not have occurred without climate warming.”

In what undoubtedly won’t be the last word on this topic, a paper to be published in an upcoming [Geophysical Research](#)

[Letters](#) finds that the Russian heat wave was influenced both by natural variation and climate change. High temperatures were within the natural range for a Russian summer, conclude Friederike Otto of Oxford University’s Environmental Change Institute and colleagues. But because of human-induced climate change, the chance of an extreme heat wave has tripled over the past several decades.

The GRL paper specifically reconciled the dueling conclusions of the NOAA and Rahmstorf papers. Otto and her colleagues used thousands of computer simulation runs to look at the Russian heat wave event. They found that in pre-warming scenarios, 2010 temperatures were reached only every 99 years or so. Under the existing climate regime, however—global warming—the temperature extremes occurred every 33 years.

“These results show that the same weather event can be both ‘mostly natural’ in terms of magnitude and ‘mostly human-induced’ in terms of probability,” explained Oxford University’s Neil Massey, who was also an author of the study. “Thinking in these terms makes it possible to calculate, for instance, how much human-induced climate change cost the Russian economy in the summer of 2010.”

The abstract of the GRL paper says, “Here we use the results from a large ensemble simulation experiment with an atmospheric general circulation model to show that there is no substantive contradiction between these two papers, in that the same event can be both mostly internally-generated in terms of magnitude and mostly externally-driven in terms of occurrence-probability.”

“The difference in conclusion between these two papers illustrates the importance of specifying precisely what question is being asked in addressing the issue of attribution of individual weather events to external drivers of climate.”





It kills more people
than previously
believed

TO GIVE YOU THE BAD NEWS first, malaria kills 1.2 million people worldwide annually, about twice the previous estimates from the World Health Organization. Re-

search from University of Washington's Christopher Murray and colleagues published in *The Lancet*, found that, in addition to the higher death toll, more teens and adults are victims than was previously believed.

But while total deaths are higher, there has been a 32 percent decline in malaria deaths since 2004. The rate of decline is the about same whether using the WHO lower estimate or the new higher one.

It has been generally believed among health professionals that the most at-risk population for malaria is children age five and below. Murray, director of the Institute for Health Metrics and Evaluation at the University of Washington, said in a news release "You learn in medical school that people exposed to malaria as children develop immunity and rarely die from malaria as adults. What we have found in hospital records, death records, surveys and other sources shows that just is not the case."

The paper's authors collected global mortality data between 1980 and 2010. They found twice as many deaths for the 30 year period as reported in the WHO's *World Malaria Report 2011*. The peak of death totals was in 2004, when 1.8 million died, the result both of increasing population and higher infection rates. By 2004, about one million children died. In 2010, the figure had fallen to about 700,000.

"Although malaria deaths in children account for most malaria deaths, the number of deaths in adults is high," the authors said. "Malaria deaths in individuals aged 15 years, 50 years, and 70 years or older account for 20 percent, 9 percent, and 6 percent of malaria deaths in 2010, respectively (thus over a third of all deaths occur in adults). With few exceptions, the proportion of malaria deaths in adults in each country

examined was almost always more than 40 percent. The exceptions are sub-Saharan African countries, which have the highest malaria transmission."

"Our research shows a strong and consistent downward trend in malaria deaths in nearly all of the 105 countries we studied," says Dr. Stephen Lim, associate professor of global health at IHME and one of *The Lancet* paper coauthors. "Malaria deaths climbed pretty steadily from 1980 and then peaked in 2004 at about 1.8 million. Earlier estimates also have shown a decline since 2004."

The reasons for the decline in malaria deaths appear to be complex. Many sources, including the University of Washington group, generally attribute the decrease to international health-based interventions. "An expansion in health aid targeted towards malaria suggests that the investments made by major funders such as the Global Fund to Fight AIDS, Tuberculosis and Malaria have rapidly decreased the burden of malaria," *The Lancet* piece says.

But a paper published in July 2011 in *Malaria Journal* by Danish, Tanzania, and U.S. researchers says that the decline in sub-Saharan malaria incidence, at least, is the result of a decline in mosquito populations. The authors results "indicated that the indoor density of the two main vectors of *P. falciparum* malaria, *An. gambiae* and *An. funestus*, declined considerably during both study periods, which covered a total time span of more than nine years. The overall decline in the number of Anopheline mosquitoes was within the range of 55 percent to 77 percent over the first study period (1998-2001), whereas the trend continued and became more pronounced over the subsequent period (2003-2009). Hence, during the last year of mosquito collection in Kirare [Tanzania], the annual numbers of collected *An. gambiae* and *An. funestus*, as compared to 2004, had declined by more than 99 percent."

So, this would be the good news implied by "bad news first" lead of this story. But even this is not entirely good news, the authors report. This 99 percent decline in mosquito populations is probably the result of declining rainfall, which

is occurring in areas already subject to periodic drought and famine.

"Many of our fellow malaria researchers think that the fall in countries such as Tanzania, Eritrea, Rwanda, Kenya and Zambia shows that all the control programs are working, particularly the use of mosquito nets," says Associate Professor Dan Meyrowitsch from the Department of Health Services Research at the University of Copenhagen.

"That just isn't the whole story," he says. "For more than ten years we have been collecting and counting the number of mosquitoes in Tanzanian villages. The number in our traps fell from 5,300 in 2004 to just 14 in 2009, and these were from villages without mosquito nets."

Meyrowitsch says the decline in malaria mosquito population during the end of the 1990s seems to be connected to a decrease in precipitation. This may be due to global climate changes. "From 2003 to 2009 the volume of precipitation was more stable, but the rain was more chaotic and fell outside the rainy season. And this may have disturbed the natural cycle of mosquito development," he says.

Climate and rainfall may also be having an effect, agrees

one of the authors of *The Lancet* paper. "Our statistical models for estimating deaths from malaria take into account a range of factors, which include rainfall," IHME's Lim says. "We factored in, for example, the effect of chloroquine resistance, the scale-up of artemisinin-combination treatment, the scale-up of insecticide-treated bed nets, and broader socioeconomic determinants. We agree that decreased rainfall has an impact on mosquito populations and, in turn, has an impact on malaria prevalence."

This decline in malaria incidence appears to be region-wide. In a 2009 study in *BMC Medicine*, researchers found that **pediatric admissions to hospitals** in Kenya for malaria declined by 49 percent between 1999 and 2008.

The WHO's *World Malaria Report 2011* holds out the ambitious goals of reducing malaria deaths to near zero by the end of 2015, reducing global malaria cases by 75 percent by the same date, and eliminating malaria in 10 new countries since 2008. But *The Lancet* paper's reassessment of the frequency of malaria infection and deaths calls into question the feasibility of achieving these objectives.

Crush injuries kill in earthquakes

Quakes have become the most deadly natural hazard

EARTHQUAKES KILLED MORE than 780,000 people between 2001 and 2011, accounting for nearly 60 percent of all deaths from natural hazards, according to

a paper published in *The Lancet*.

But fatalities are only one measure of the damage quakes cause. They also cause many injuries, putting stress on local and regional medical response systems. Susan Bartels of Beth Israel Deaconess Medical Center and Michael VanRooyen of Brigham and Women's Hospital found that the injury-to-death ratio varies among earthquake disasters, but averages about three injuries to every fatality.

The biggest immediate problem is from crush injuries, often resulting in renal failure. "Crush syndrome ... is reported to have a frequency of 2 percent to 15 percent after major quakes," the authors say.

Most earthquake injuries are orthopedic, and most of those affect the lower limbs. "Overall the most common earthquake-related musculoskeletal injuries are lacerations (65%), fractures (22%), and soft-tissue contusions or sprains (6%)," the **paper** says. Multi-organ failure from sepsis in crush injuries is the most common reason for delayed deaths after a quake. There are numerous other health issues that arise after an earthquake, including heart problems in survivors, chest injuries, and the risk of infectious disease from disrupted water and sanitation services.

People aged 65 years or older have a three times higher risk of injury than younger people, and they are also most susceptible to renal failure. Among pediatric patients, "Most common complaints include respiratory, gastrointestinal, and genitourinary ... Incidence of renal failure in those aged less than 10 years [is] significantly lower than in older individuals."



Biodiversity loss attracts more international effort

A bigger problem than climate change?

when biodiversity loss will in itself begin to affect people. Researchers and policy experts meeting at the University of Copenhagen in January concluded that the challenges of preserving global species diversity is an even bigger problem than climate change—which most people consider a very big problem indeed.

The world is losing species at 10 to 100 times the background rate of extinction—that is, the ordinary evolutionary rate at which species go extinct. “The biodiversity crisis—the rapid loss of species and the rapid degradation of ecosystems – is probably a greater threat than global climate change to the stability and prosperous future of mankind on Earth. There is a need for scientists, politicians and government authorities to closely collaborate if we are to solve this crisis,” said University of Copenhagen’s Carsten Rahbek in a release. Rahbek is director of the Center for

MOST DEFINITIONS require some form of impact on humans to qualify as a “natural hazard.” One question that’s arising more often now is

Macroecology, Evolution and Climate.

The meeting was held to try to establish and organize a UN Intergovernmental Panel for Biodiversity and Ecosystem Services, IPBES—an equivalent to the UN Intergovernmental Panel on Climate Change.

A study in the journal *Science* found that preserving plant diversity is critical in countering the negative effects of climate change and desertification. In what the authors called the “most extensive study of the links between function and biodiversity ever undertaken,” the researchers found that species richness in plant communities performs multiple functions in ecosystems. The researchers analyzed soils from 224 dryland ecosystems around the world.

The paper, by Fernando Maestre and many other authors, says, “Climate change models predict increases in average annual temperature in drylands of up to 4 degrees C by the end of the 21st century. Our results suggest that such an increase will reduce the ability of dryland ecosystems to perform multiple functions related to [carbon], [nitrogen], and [phosphorus] cycling. Ongoing climate change is also likely to reduce local species richness and to increase the extent of areas affected by desertification, both of which will negatively affect ecosystem functioning.”

In a commentary on the findings, Guy Midgley of the South African National Biodiversity Institute said, “Indeed, only two abiotic variables, mean annual temperature and soil sand content, were more important than plant species richness in explaining ecosystem multifunctionality.”

In all disasters, it is better to be rich than poor. Another paper on conserving biodiversity, this time in the January 2012 issue of *Bioscience* by Will Turner of Conservation International, finds that “over half the global value of ecosystem services benefitting the world’s poorest people originates in areas that are a high priority for conservation. Moreover, the value of ecosystem services generated by the top quarter of biodiversity sites is more than triple the effective cost of conserving them.”

The problem is monetizing the value of those services to provide better livelihoods for the people who live nearby. Payments would total more than a dollar per person per day for about one-third of the 1.1 billion people now living in poverty. “The authors say their findings reinforce the idea that there is an important concordance between biodiversity, provision of ecosystem services, and poverty that policymakers could use in designing equitable payment schemes to address both poverty and loss of biodiversity,” according to a release on the study.



An invited comment by Vasileios Lamos
and Nello Cristianini



Diagnosing flu symptoms with social media

pn4im '12
Natural Hazards
OBSERVER

REAL-TIME MONITORING OF ENVIRONMENTAL AND SOCIAL conditions is an important part of developing early warnings for natural hazards like epidemics and floods. Rather than relying on dedicated infrastructure, such as sensor networks, it is possible to gather valuable information by monitoring public communications from people on the ground. A rich source of raw data is provided by social media—blogs, Twitter, or Facebook. Two experiments based on the use of Twitter content in the United Kingdom show it is possible to detect a flu epidemic and to assess rainfall levels by analyzing text data. These measurements can in turn be used as inputs of more complex systems, for example, for the prediction of floods or disease propagation.

Introduction

THE RAPID EXPANSION OF THE SOCIAL WEB means that large numbers of people can publish their thoughts at no cost. Current estimates put the number of Facebook users at 800 million and of active Twitter users at 100 million (Facebook Statistics 2011; Twitter blog 2011). The result is a massive

stream of digital text that has attracted the attention of marketers (Jansen et al. 2009), politicians (Diakopoulos and Shamma 2010), and social scientists (Huberman et al. 2009). By analyzing the stream of communications in an unmediated way, without relying on questionnaires or interviews, many scientists have direct access to people's opinions and observations for the first time. Perhaps equally important they have access—although indirectly—to situations on the ground that affect Web users, like extreme weather conditions, which are often mentioned in the published messages.

The analysis of social media content is a statistical game. There is no guarantee that a specific user will describe the weather state in her current location when it's needed. But by gathering a large number of messages from a given location, and by monitoring the right keywords and expressions, it is possible to obtain indirect statistical evidence in favor of a given weather state.

We conducted two experiments using Twitter content in the United Kingdom showing it can be used with significant

accuracy to infer the levels of rainfall or of influenza-like illness in a given location. The principle behind this is “statistical learning theory,” a branch of artificial intelligence concerned with the automatic detection of statistical patterns in data.

The use of data from Twitter is particularly convenient because its users can only exchange very short messages that are often geolocated, and because these data are freely available via an application programming interface (Twitter REST 2011). Furthermore, the use of these data do not raise the privacy concerns which surround the analysis—say—of e-mail or SMS messages (see sidebar, [page 10](#)). These are data that the users have willingly made public.

The signal we can extract from that textual stream can be of interest in its own right. It is a valuable input to more complex modeling software aimed at the prediction of epidemics, floods, or many other hazards.

The big idea

THE GOAL OF THIS WORK is to detect the occurrence and infer the magnitude of an event by exploiting unstructured, user-generated information posted on the social Web. The methodology is general and can be applied to different domains. We demonstrate it on rainfall and flu epidemics.

We will not be talking of forecasting or predicting. We use the term “nowcasting” to indicate that we are performing real-time measurements on the present state of the world, something that often takes many days using standard means. Think, for example, how many weeks it can take to measure

the state of a national economy at a given time.

The methodology can turn geotagged user posts on Twitter’s microblogging service to topic-specific geolocated signals by automatically selecting textual features capturing semantic notions of the inference target.

The fundamental idea is that our algorithm can compare a time series of Twitter messages from a given location with the time series of a quantity of interest in the same location (e.g., rainfall). By comparing the two time series, it is possible to automatically discover a function to map the textual signal of the first series into the numeric signal of the second series. At the same time, the method also selects the most relevant keywords and key phrases to monitor.

We investigate two case studies. The first is rainfall rates inference. This is a benchmark problem where actual precipitation quantities are inferred by the content of Twitter for several UK locations. Second is flu-like illness inference. We infer the influenza figures for several UK regions based on Twitter content. **Flu Defector** is a tool that implements our findings for the second case study.

Methods

THE TEXTUAL DATA ARE TRANSFORMED in the standard vector space representation used by all search engines and spam filters. Every document is represented by a set of words or two-word phrases, and we try to keep only those that are potentially relevant to the given application. This step is done by selecting a reference text (e.g., a discussion Web forum about flu, or about weather) to provide a list of words that are potentially useful. It need not be very accurate.

The main step is to discover a function that maps the vector representation of text to real values, a problem known as function regression in statistics. In simple words, we try to find a function of the word frequencies that can mimic the measurements on the ground. We achieve this by using the LASSO algorithm (Tibshirani 1996; Bach 2008) which can find this function automatically and at the same time indicate which words or phrases are most informative for prediction.

The majority of selected features (Fig. 1, left) is directly related with the target topic and inference performance has been significant (Fig. 2, next page). For the important task of nowcasting influenza, inferred flu rates reached an average correlation of 91.11 percent with the actual ones. The root mean squared error between inferences and ground truth shows an improvement of 10 percent compared to the method proposed in the Google flu trends paper (Ginsberg et al. 2008).

Future and related work

OTHER METHODS have been proposed for the nowcasting of

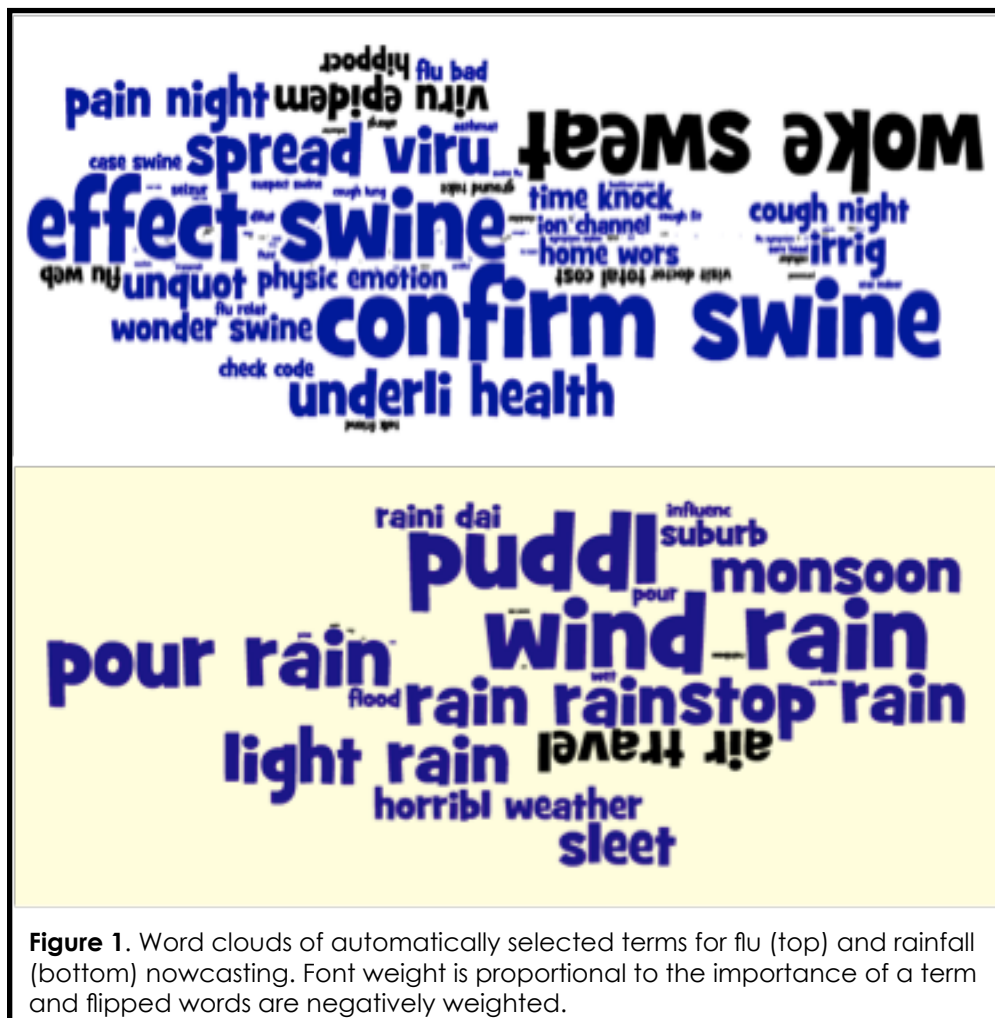


Figure 1. Word clouds of automatically selected terms for flu (top) and rainfall (bottom) nowcasting. Font weight is proportional to the importance of a term and flipped words are negatively weighted.

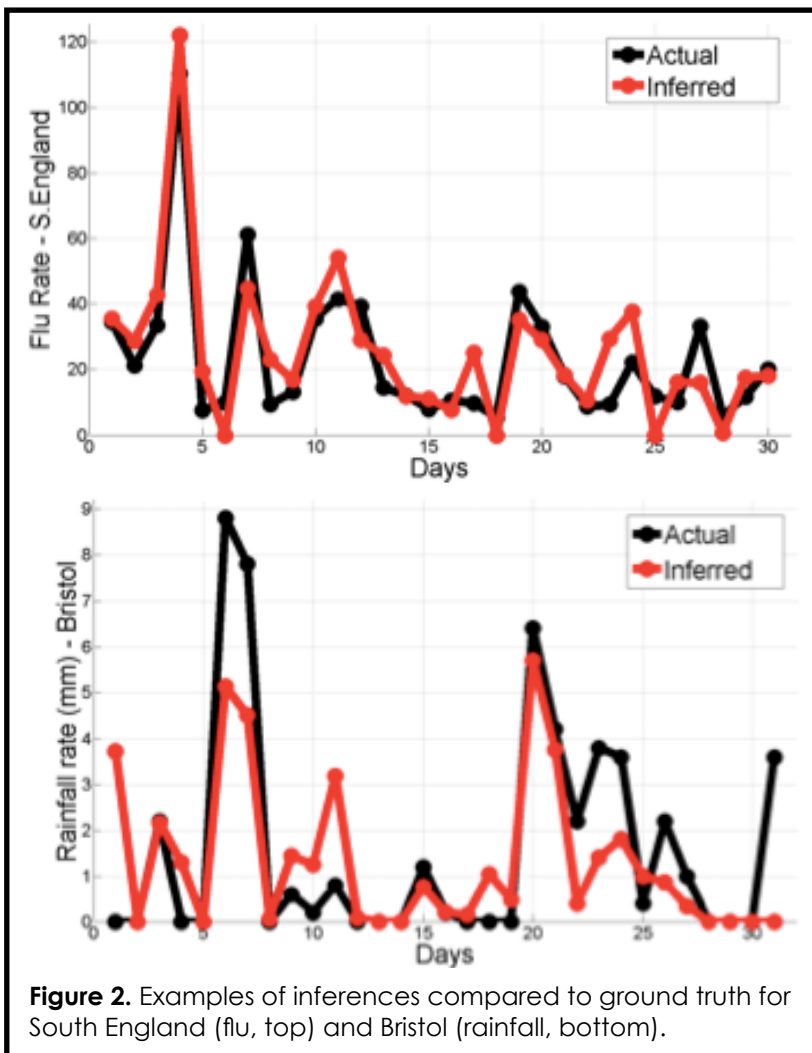


Figure 2. Examples of inferences compared to ground truth for South England (flu, top) and Bristol (rainfall, bottom).

flu levels. The best known was created by Google, based on search keywords. Our approach is complementary to that, since it makes use of entirely different input data, and it is possible to imagine a higher level model that can integrate multiple lines of evidence from search engines, social media, and perhaps sensors and hospital records too.

It is obvious that all these methods raise serious privacy issues. It is easy to imagine the possibility of applying them to data which have not been published by the authors. These concerns need to be taken very seriously and addressed, either by restricting all analysis only to public data, or by taking serious steps to anonymize all data before any analysis is undertaken. It is also important to realize the statistical nature of the information we can extract, and that this should probably be used by health authorities to prioritize their efforts, rather than by the general public.

Future work should involve the use of our models as part of larger systems that can integrate other sources of information, so to make more accurate and reliable inferences, and perhaps move from nowcasting to actual forecasting, as in the case of predicting flood risk or future evolution of an epidemic.

Vasileios Lampos is a PhD student in artificial intelligence and Nello Cristianini is a professor, both at the Intelligent Systems Laboratory at the University of Bristol.

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Social media and the intelligence from Facebook

By Dan Whipple

All that chatter on social media sites can be used to track flu trends, or rainfall, or earthquake activity, but the data mining can also have more sinister uses.

An Israeli professor says that terrorist groups are now using social media to recruit members. In what may give new meaning to the word “friend,” Gabriel Weimann of the University of Haifa **says**, “Today, about 90 percent of organized terrorism on the Internet is being carried out through the social media. By using these tools, the organizations are able to be active in recruiting new friends without geographical limitations.”

Furthermore, groups like Hezbollah are using social media sites like Facebook, Twitter, and so on to gather military intelligence by monitoring the social network activity of soldiers in the Middle East. Some countries—the United States, Canada, and the United Kingdom—have told soldiers to remove personal information to try to elude monitoring.

“Facebook has become a great place to obtain intelligence. Many users don’t even bother finding out who they are confirming as ‘friend’ and to whom they are providing access to a large amount of information on their personal life. The terrorists themselves, in parallel, are able to create false profiles that enable them to get into highly visible groups,” Weimann says.

It is hard to seize the moral high ground, though. The U.S Central Intelligence Agency has a group known as the “vengeful librarians”—or in one early report the “ninja librarians”—that is monitoring up to five million tweets and posts daily. The Associated Press **reports** that the agency’s Open Source Center gathers social media info, then cross-references it with newspapers or perhaps intercepted telephone calls.

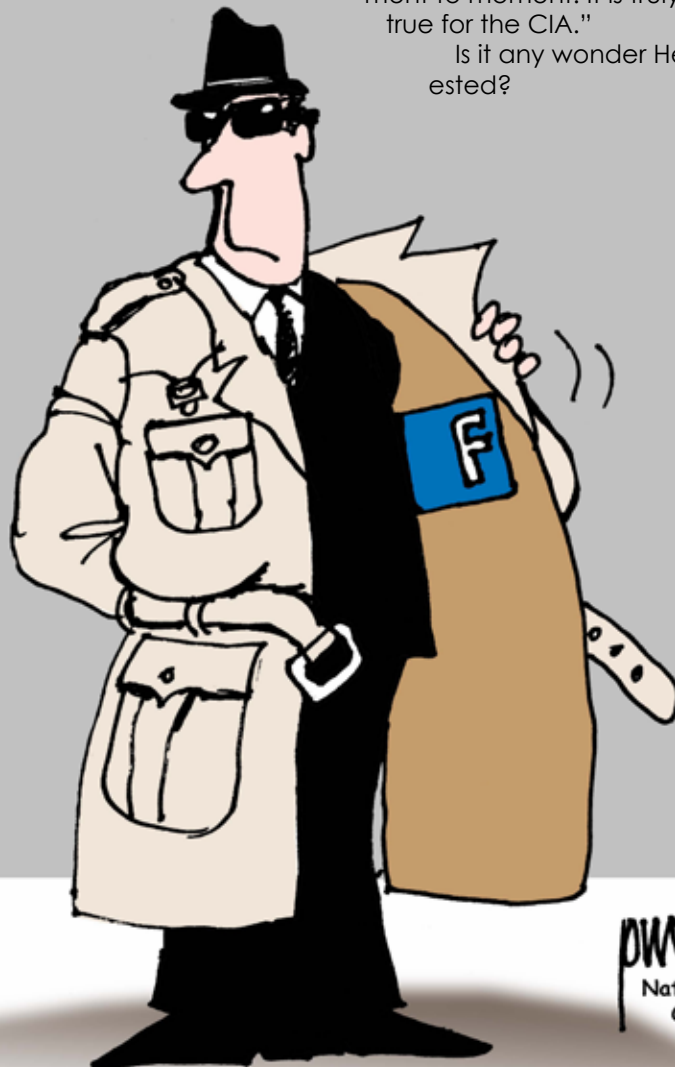
The center already had “predicted that social media in places like Egypt could be a game-changer and a threat to the regime,” center director Doug Naquin told the AP in a recent interview.

The Department of Homeland Security Media Monitoring Initiative authorizes DHS to retain personal data on users of social media and online networking. DHS’s Social Networking/Media Capability project was launched to help with the Haiti earthquake response and recovery, and with security for the 2010 Winter Olympics. “These limited purposes were expanded in June 2010 to meet the operational

needs of the department,” according to a November 15, 2011, Privacy Compliance Review of the NOC Media Monitoring Initiative. This report says that retaining “personal identifiable information” for publicly available websites meets the agency’s privacy protection criteria.

Perhaps there was some innocent long-ago time on the Internet when people believed that the things they published weren’t public information. But they should be long disabused of that idea by now. The humor newspaper **The Onion** posted a video that, while satirical, hits a little too close to home. The announcer opens saying that Congress has reauthorized Facebook, “the massive surveillance program run by the CIA.” Then the video has a congressional hearing witness saying, “After years of secretly monitoring the public, we were astounded that so many people would willingly publicize where they lived, their religious and political views, alphabetized lists of all their friends, personal email addresses, phone numbers, hundreds of photos of themselves, and even status updates about what they were doing moment to moment. It is truly a dream come true for the CIA.”

Is it any wonder Hezbollah is interested?



Colorado flood rules ...

(Continued from page one)

established a set of minimum standards for communities to follow in exchange for the availability of flood insurance within the community—among other incentives.

NFIP was intended to put an end to the ongoing cycle of build-flood-rebuild. By discouraging development in floodplains while guiding the development that does occur, flood losses should decrease. It has not, however, achieved this goal. Four decades of data show flood losses have actually been increasing. This has led both policy makers and the public to question whether the minimum regulations go far enough.

The list of recent disasters is large. While Hurricane Katrina became the poster child for elevated flood risk, it is not the only large flood of the past decade. According to the National Climatic Data Center, in 2011 alone, hurricanes Lee and Irene combined with substantial floods in the Upper Midwest and the Mississippi River Valley to cause more than \$12 billion in damages and more than 70 deaths. The NCDC reports that in 2010, flooding in Nashville, Tennessee, and in the U.S. Northeast (especially Rhode Island) caused over \$2.5 billion in damages and more than 40 deaths. 2009 was a relatively mild year for flooding nationally. But 2008 saw floods in the Midwest (especially Iowa) along with extensive damage from hurricanes Ike, Gustav, and Dolly. Recent deadly flood disasters around the United States have caused damages in the billions of dollars.

One state in the country has had the good fortune of largely missing these recent flood problems. Colorado is the only state in the country to go the entire period from 2000-2011 without recording a single flood disaster. So why would Colorado officials choose this period to implement tougher flood standards on a statewide basis?

Colorado's decade of floodlessness is a statistical fluke. Despite the recent respite, the state has a long history of disastrous floods. A 1965 flood through Denver caused nearly \$3 billion in damages (in current dollars). It was one of several events inspiring the initial implementation of the NFIP. A flood in Pueblo in 1921 caused over \$800 million in damages in today's dollars. Indeed, all but one decade in the 20th century featured at least one flood disaster somewhere in the state exceeding \$50 million in damages.

The most influential flood in Colorado was not the costliest, but the deadliest. The Big Thompson Flood of 1976, which caused 144 deaths, is one of the deadliest floods in U.S. history. It showcases the dangers of flash floods. Over a foot of rain fell in about four hours in the Front Range foothills north of Denver. A wall of water rushed down the Big Thompson Canyon. Many people didn't know it was coming.

With flood disasters nationally mounting in recent years, calls to the state by concerned public and the media began

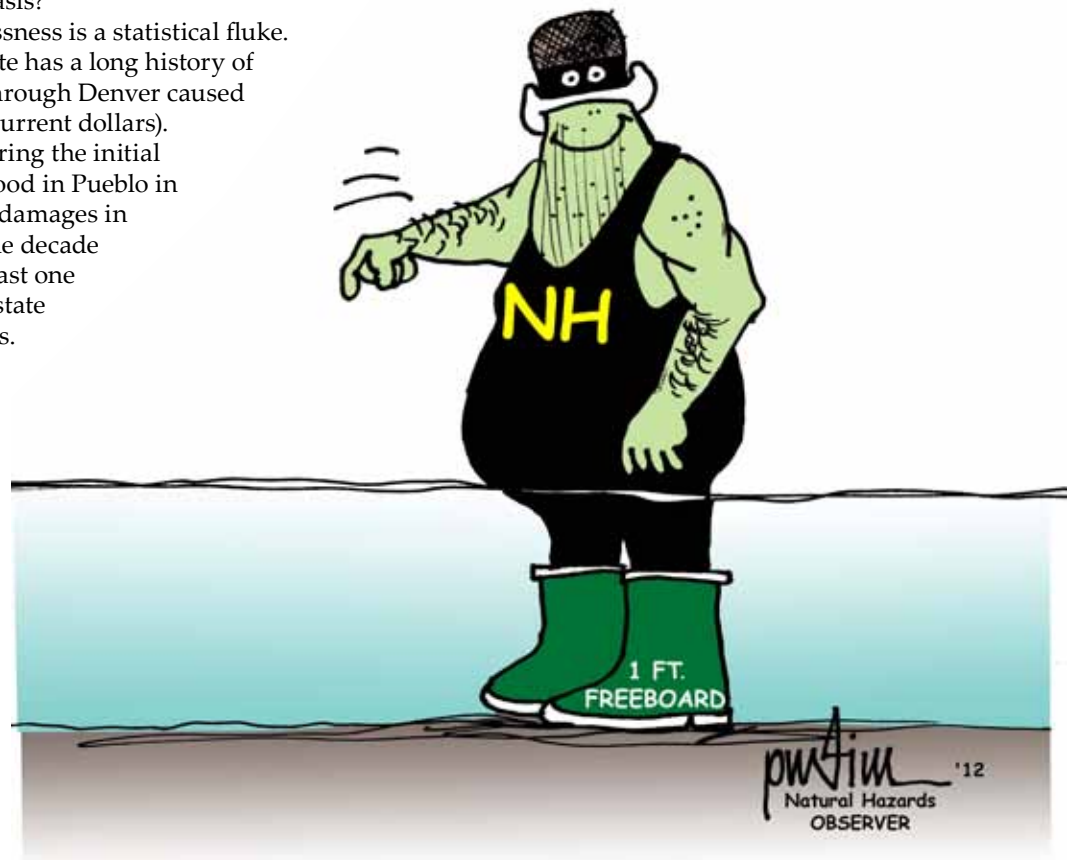
increasing. The question was always the same. Could an event like that which happened in New Orleans or Nashville or Rhode Island happen here? State officials were forced to answer, "Yes, it could." The right meteorological event falling in the right place could cause a disaster.

This led staff at the Colorado Water Conservation Board to consider higher standards. The CWCB, an agency within the Colorado Department of Natural Resources, is statutorily tasked with addressing flood hazards within Colorado. "We wanted to be proactive and ahead of the curve," says Tom Browning, assistant director for the CWCB. "We wanted to demonstrate to our citizens that we were watching out for their safety before something deadly happens."

Developing higher standards

WITH THIS IN MIND, CWCB STAFF BEGAN INVESTIGATING the implementation of statewide standards tougher than those of the NFIP, something never before done here. To complicate matters, while a number of other states had implemented higher standards previously, CWCB staff could not find any states that had done so in the past 20 years. While conversations with other states yielded much advice on how to regulate higher standards once they were in place, there was little guidance available for their implementation.

With guidance from its governing board, CWCB staff assembled a Technical Advisory Committee composed of professionals from the municipal, county, state, district, federal, and private sectors to assist with the development of the regulations. The TAC considered a number of standards and evaluated the effectiveness of each, along with an anticipated level of acceptance by the public. A number of specific standards were considered and subsequently discarded during



discussion. The standards that the TAC eventually proposed for consideration included:

- One-foot of freeboard for all new and substantially improved or damaged structures (NFIP minimum standards do not have freeboard);
- A 0.5-foot surcharge criteria for newly studied floodways (NFIP minimum allows a one-foot surcharge); and,
- Higher protection for structures identified as critical facilities.

NFIP minimum standards dictate that all new or substantially changed structures (defined as a modification due to upgrade or repair that exceeds 50 percent of the building's value) must be elevated (or floodproofed for non-residential structures) so that the building's lowest floor (including the basement) is at or above the 100-year flood elevation. "Freeboard" is the additional elevation above the base flood elevation.

By requiring one foot of freeboard, the lowest floor must be placed one foot above the 100-year flood elevation. This is a nationally common higher standard and at the time of consideration, 21 other states had implemented this requirement. Some required two feet of freeboard.

Floodways are an administrative tool to reserve flood carrying capacity in the center of the waterway—for the most dangerous area. Structures in the floodplain will raise the elevations of flood waters elsewhere in the floodplain. A floodway is the channel of a river and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Development within the floodplain fringe, but outside of the floodway, is permitted with allowable increases to flood heights.

The surcharge represents this allowable increase in flood elevations due to development in the floodplain. Put another way, the surcharge is a raising of flood levels that results from the flow area of a river being squeezed into a narrower space due to fill and development. Picture water flowing down a concrete channel five feet wide at a depth of six inches. Now imagine that the depth of that flowing water is blocked by dirt. The water would flow faster and deeper in the remainder of the channel due to the smaller flow area.

The NFP minimum one-foot surcharge allows development in the floodplain to the point where the 100-year flood elevation increases by one foot. This has the result of increasing flood heights on neighboring properties as well as inundating adjacent properties outside the historic floodplain.

By lowering the surcharge to 0.5 feet, the allowable rise in the flood is reduced by half. There are significant ramifications to this regulation, however. In order to achieve this allowable rise, a segment of the floodplain—the floodway—is reserved in which no allowable flood height increases are permitted. By reducing the allowable surcharge, the floodway—where development is very strictly regulated—increases, sometimes substantially.

At the time of consideration, seven other states were identified as having stricter floodway requirements as a statewide standard.

Critical facilities

CRITICAL FACILITIES PRESENTED AN EVEN TOUGHER ISSUE. There was a great deal of debate within the Technical Advisory Committee and,

as CWCB staff would later find out, much controversy during the public outreach phase. The issue of how to protect critical facilities required controversial decisions made on two fronts. First, how is a critical facility defined? Second, what higher regulations should be in place to provide a higher level of protection?

The concept of critical facilities is easy for most people to understand at the gut level. Most folks easily accept that hospitals and schools deserve more protection. But what about doctors' clinics (perhaps with surgical capabilities) or home-school settings? Nursing homes are often listed as being "obvious" critical facilities because of the fragility of their residents. But what about a small home that serves two or three of these same fragile inhabitants? These examples and many others showed CWCB staff and the Technical Advisory Committee that even developing a definition of a critical facility was not as easy as it first appeared.

The next issue dealt with what regulations to apply to critical facilities once they were defined. The initial proposal by the TAC was to substitute the 500-year floodplain for the 100-year floodplain in the standard regulations. The result would be that critical facilities must be elevated to one-foot above the 500-year elevation. The freeboard rule would still apply. Perhaps even more controversial than the elevation requirement was that floodplain regulations, which historically have been applied only within the identified 100-year floodplain, would be in effect in new areas outside of that traditional boundary.

Existing higher standards for critical facilities were identified at the statewide level in only eight other states.

Public Outreach

ONCE THE PROPOSED STATEWIDE REGULATIONS WERE DRAFTED, a public outreach campaign was developed to explain the proposed rules and to solicit public input. Although an initial draft of the rules had already been completed, determining



the final regulations would be a dynamic process incorporating public feedback. Seven workshops were scheduled for the public to hear the proposed rules and provide that feedback. In addition, CWCB staff offered to meet with any citizens or professional or industry groups to hear their comments.

It became evident quite early that a number of the proposed rules would be controversial. Many municipal and industry leaders expressed concern about using a 500-year floodplain standard for critical facilities. While few disputed the significance of critical facilities, CWCB staff heard repeatedly that a 500-year regulation was not the best way to deal with them. The extensive level of opposition caused CWCB staff and the TAC to reevaluate the critical facility regulation.

At issue were both the definition of critical facilities and the associated regulation. A number of industries pushed to be exempted from the new rule. Municipal leaders asked to have wastewater treatment plants exempted because of their necessary proximity to waterways. The oil and gas industry, the pharmaceutical industry, and sand and gravel operators are a few examples of industries that requested exemptions.

The Technical Advisory Committee carefully considered feedback from the early stages of the public outreach, refining the proposals to be more consistent with Colorado's lifestyle and economy. The definition of critical facilities was fine-tuned. Facilities were placed within four broad groups: essential services facilities (including, among other things, public safety facilities such as police and fire, and utilities); facilities storing hazardous materials; facilities housing at-risk populations; and facilities vital to restoring normal functions (continuity of government). Specific exemptions and definitions were provided. For example, wastewater treatment plants were excluded because of the economic hardship that could be placed on small communities by the higher standards.

Facilities housing at-risk people—including schools, day-care sites, and nursing homes—had to have a minimum population of 12 to be subject to the rules.

Finally, because of extensive opposition, the 500-year regulation was dropped and substituted with an additional foot of freeboard within the 100-year floodplain. The final proposed regulation called for two feet of freeboard for identified critical facilities in the 100-year floodplain only. This meant the lowest floor must be elevated or floodproofed to two feet above the 100-year floodplain. But we also included a recommendation that communities also consider protection of critical facilities in the 500-year floodplain as appropriate.

Cost and benefit

DURING THE LATER STAGES OF PUBLIC FEEDBACK, it became apparent that supporters and opponents could be quickly categorized into a few small groups. Supporters included: local governments that had already established higher standards and were concerned about being at a competitive disadvantage to their neighbors that had not done so; professional organizations and districts with missions to reduce flood damages; and the majority of the general public.

Opponents included: local governments that expressed concern about increased staff workload administering the new regulations, loss of property rights to constituents, or a reduced tax base; local governments that felt floodplain regulations were a local issue and did not welcome state involvement; and industries and utilities with significant operations close to rivers.

A common thread during outreach was the concern that costs to the public associated with the new rules would exceed any benefits realized from better public safety. While few disputed that the new rules would result in safer infrastructure, many questioned whether it was worth it. So CWCB commissioned ICON Engineering, a Denver area consultant, to perform an independent cost, benefit, and regulatory analysis to address this concern. A separate focus group was assembled to guide this effort. This group consisted of technical professionals from around the state representing GIS, economics, floodplain management, and engineering. Over five months, ICON analyzed the economic impacts of the proposed freeboard, floodway, and critical facilities regulations to see if they were cost effective.

ICON found that the one-foot freeboard criteria provided a benefit-cost ratio of between 1.4 and 3.6—for every dollar spent meeting this new criteria, the public realizes a return of between \$1.40 and \$3.60, depending on circumstances. This replicates results from other studies around the country.

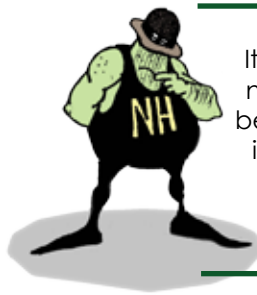
The critical facilities rule (two feet of freeboard within the 100-year floodplain) was calculated to provide a benefit-cost ratio between 0.9 and 2.9. This indicates that at the extreme low end, the cost-effectiveness of the regulation is questionable, perhaps costing slightly more than the benefits. However, on the high end, every dollar spent complying with this regulation results in nearly three dollars of public benefits.

The floodway regulation is much more difficult to quantify because it is so site specific. To address this, CWCB staff asked development officials from a community opposing the regulations for GIS files relating to past development and zoning, along with anticipated future development for use in a sample reach case study. Using this example, a benefit-cost ratio for the floodway regulation was calculated to be between 1.0 and 1.4.

The cost, benefit, and regulatory analysis helped considerably in addressing the opponents' concerns. "Although it didn't satisfy everyone, it certainly paved the way towards further acceptance and credibility of our proposal," says Penn Gildersleeve, president of ICON Engineering.

Rulemaking and implementation

A RULEMAKING HEARING WAS HELD ON November 15, 2010 in Berthoud, Colorado, to evaluate arguments by parties to the process, hear public testimony, and promulgate final rules, if appropriate. Supporters of the rules that filed for party status included: the Colorado Association of Stormwater and Floodplain Managers, a state professional organization dedicated to reducing flood damages in the state; the Urban Drainage and Flood Control District, a nationally recognized district dedi-



It became evident quite early that a number of the proposed rules would be controversial. Many municipal and industry leaders expressed concern about using a 500-year floodplain standard for critical facilities.

cated to reducing flood damages in the Denver metropolitan area; and two Colorado municipalities. Opponents that had filed for party status included three Colorado local governments, a utility operator, and an industry group.

After several hours of testimony and debate, the proposed rules were promulgated with minor revisions. The hearing was controversial, and the final decision was not unanimous. The rules passed by a vote of 7-3. They were officially adopted two days later on November 17, 2010 and became effective two months later on January 14, 2011.

Following passage, most of the direct opposition to the rules disappeared. The focus shifted to how to transition to the new regulations.

The TAC elected to provide a transition period of three years. During this period, the new rules and regulations, despite becoming effective in January 2011, will not be enforced at the state or federal level. Communities have three years to update their local ordinances to come into compliance. The rules are mandatory for all communities, regardless of whether or not they participate in the NFIP. If communities do not enact the new regulations by January 2014, sanctions will be put into place by both the state and the Federal Emergency Management Agency. Sanctions include public notices of non-compliance to a community's citizens, ineligibility for flood mitigation and other grants, and possible suspension from the NFIP. Colorado's enabling law requires state acceptance of a community's map in order for a community to be legally allowed to regulate their floodplain. The state will be able to reject floodplain maps from communities that do not include the required flood surcharge.

Concerns were expressed regarding the length of time it takes projects to come to completion following their creation. It can take years from conception to the completion of construction, and both communities and developers were concerned about having to develop to a moving target. For this reason, the rules allow "grandfathering." A community may allow any project that had received a floodplain development permit or has been issued a Conditional Letter of Map Revision from FEMA to be considered compliant.

As of January 2012, about 20 of Colorado's 240 NFIP participating communities have updated their local ordinances to meet the new regulations. This means nearly 90 percent of communities still must take action in the final two years of the transition period.

Lessons Learned

THIS PROCESS, WHICH LASTED NEARLY TWO YEARS, and consumed a large percentage of CWCB staff time, was not easy. A number of lessons were learned during the process. Any level of government considering rulemaking for safety regulations should consider the following:

- Any time regulations are developed, there will be those that are in favor of them and those that oppose them. Those that oppose will not always be congenial in their opposition. Knowing this prior to the process eases the sting of the resulting criticism.
- Those opposed to the regulations will generally be the loudest during the feedback phase. Be prepared to ask your supporters for overt and recordable support. This may be difficult for some. "Without the backing of our supporters during the rulemaking process, it is questionable whether our proposed rules would have made it through," Browning says.
- Start public outreach early in the process. In a transpar-

ent progression, there will undoubtedly be changes to the proposed regulations as a result of feedback received during the outreach phase. It is easier to address changes early in the process.

- Be prepared to compromise. During this process, some changes were made that both CWCB staff and the TAC were not in favor of. However, many of these changes eased the process and allowed many of the strongest critics to back off from their opposition.

- Be alert for misunderstandings. CWCB staff noticed that much of the opposition to the process resulted from mistaken perceptions. Once these misunderstandings were clarified, hard feelings toward the process often eased.

- Realize that any public safety regulations must carefully toe the line between increasing public safety and not excessively infringing on private property rights. Finding that line can be difficult. It depends on the makeup of your community and constituents.

- Although there is some honor in being the pioneer, take advantage of the experience of others. During our process, a number of other states that had already passed similar regulations drafted letters of support indicating their success with the regulations.

- Look to the past to justify the future. The best time to try to implement better regulations is immediately following a disaster, when public sentiment will be more in favor. Since Colorado had gone so long without a major flood, we couldn't count on this kind of sentiment. But since there had been numerous costly floods since 1900, we could spotlight examples of the mitigation offered by the new regulations. This was our most basic argument, without which it is doubtful any of these rules could have been approved.

For further reading, please visit the Flood Section page of the Colorado Water Conservation Board at www.cwcb.state.co.us or call CWCB staff at 303-866-3441. The website has a number of relevant documents, including the new regulations, the Cost, Benefit, and Regulatory Analysis, and hearing materials.

Kevin Houck is the section chief of the Watershed and Flood Protection Section of the Colorado Water Conservation Board.

Resources

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

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

ALL HAZARD

An Introduction to Emergency Exercise Design and Evaluation. By Robert McCreight. 2011. ISBN: 978-1-60590-760-4. 176 pp., \$50 (hardcover). The Scarecrow Press. <https://rowman.com/>.

Robert McCreight writes, "To simply assume that preparedness equates to readiness is a misguided notion." Readiness, he says, is the demonstration and execution of emergency functions effectively in realistic emergency exercise situations.

In other words, to be ready, one must practice.

An Introduction to Emergency Exercise Design and Evaluation provides the essentials for practicing to be ready. There are advantages and disadvantages to each of the many exercise options available. McCreight urges careful consideration of the goals and resources available when choosing the exercise. "The first and foremost issue in any exercise design is the objectives," he writes. "What do we want the exercise to reveal or demonstrate? Proving hazmat response capability is one thing, and testing emergency response team problem solving in a unique crisis is quite another."

In a table in the book, McCreight grades seven exercise types, from seminars (advantages—easy and cheap; disadvantages—limited test of readiness) to an full-scale exercise (advantages—every key function tested; disadvantages—never enough time).

The optimistic message of this book for emergency response managers is that exercises can be properly designed in communities to assess and test preparedness and readiness. Recent interest in earthquake preparedness in California and the Midwest, both of which have conducted large-scale exercises, have shown that these can be popular and important ways to bring communities together so that they're not caught flat-footed in emergencies. This book can help organize thinking about the issues that make the exercises successful.

Chernobyl: Crime Without Punishment. By Alla A. Yaroshinskaya. 2011. ISBN: 978-1-4128-4296-9. 409 pp., \$39.95 (hardcover). Transaction Publishers. <http://www.transactionpub.com>.

Originally published in Russian in 2006, this book is a writer's journey through the labyrinthine catastrophes of the Chernobyl nuclear plant meltdown. It explores not only the disaster itself, but the bureaucratic response to it and the difficulty of getting information out to the public. The author is outraged at the handling of the disaster, which shows in the book.

Yaroshinskaya writes, "The dramatic events at the Chernobyl nuclear power plant in 1986 were a practical demonstration of what global nuclear catastrophe can be, and of the utter impotence of the powers that be, of science and of society as a whole within the existing system of global nuclear safety and of the environmental and moral attitude toward it."

In the November 2010 *Natural Hazards Observer*, RoseMarie Perez-Foster wrote, "Our interim findings suggest that after Chernobyl the perception of radiation risk to both self and family in the Ukrainian population has not decreased since the immediate postdisaster period. The population has experienced a sustained and protracted concern about radiation-related disease for all 23 years of the postdisaster period."

This sustained psychological impact has proven to be the most severe, sustained impact of the meltdown, even more than the actual physical problems the exposed population endured. "The psychological impact is now considered to be Chernobyl's biggest health consequence," UN Development Program's Louisa Vinton told the *Chicago Tribune* in 2006, "People have been led to think of themselves as victims over the years, and are therefore more apt to take a passive approach toward their future rather than developing a system of self-sufficiency. There's a sense of waiting for rescue from a rescuer that never comes. It's a real impediment to people being able to take charge of their lives again."

Chernobyl: Crime Without Punishment echoes this. Yaroshinskaya says the psychological issues faced by the population include: a sense of the futility of life; a lack of empathy from the authorities; a feeling of isolation; fear for the health of oneself and one's descendants; and despair about changing things in the situation.

Changing Planet, Changing Health. By Paul R. Epstein and Dan Ferber. 2011. ISBN: 978-0-5202-7263-7. 368 pp., \$29.95 (hardcover). University of California Press. <http://www.ucpress.edu>.

Serious people have stopped arguing about whether the climate is changing and started arguing about what effects climate change will have. One of the many areas of uncertainty is what impact it will have on human health.

This book looks at this question through the eyes of real people. In the chapter "The mosquito's bite," the authors look at a case in the central Kenya highlands, which is seeing occasional malaria cases where none existed before. The authors examine the case of Elena Githeko, who suffered a life-threatening bout of malaria in 2002. "In Karatina and other villages in the foothills of Mount Kenya, malaria, once absent, has become commonplace as warmer temperatures have allowed malaria-carrying mosquitoes to live at high altitudes."

The up-gradient spread of malaria may be one of the most serious results of global warming. An estimated 655,000 worldwide died from malaria in 2010, which was actually a slight decrease from 2009. Most of the deaths are in sub-Saharan Africa, and 90 percent of them are children.

But Elena Githeko's story, dramatic as it is, does not "prove" that malaria is moving upslope. Madeleine Thompson, senior research scientist at the International Research Institute for Climate and Society of The Earth Institute at

Columbia University, told the *Natural Hazards Observer* last year, “That’s a bit too simple.” In a report on the question in the *Malaria Journal*, Thomson and colleagues analyzed daily temperatures in the Kericho region of Kenya. They found a warming trend of 0.2 degrees Celsius over the last 30 years, consistent with climate change. They concluded, “Climate should therefore not be dismissed as a potential driver of observed increases in malaria seen in the region during recent decades, however its relative importance compared to other factors needs further elaboration.”

The trouble is that while climate change can affect the spread of malaria, other factors are probably more important, like poverty. As with most negative developments in disease or other disasters, the outcomes are worse for the poor, the elderly, children, and other disadvantaged people.

Malaria is an obvious worry with a changing climate, because mosquitoes do well in warm, wet weather. But it isn’t the only human health effect that can result from climate change. Also possible are harmful algal blooms in the oceans, contaminated seafood, an increase in the spread of dengue fever, higher mortality from heat waves, and so on.

This book provides a useful and interesting introduction to this still unsettled segment of the climate debate.

Environment, Forced Migration and Social Vulnerability. Tamer Afifi and Jill Jäger, eds. 2010. ISBN: 978-3-642-12415-0. 210 pp., \$127 (hardcover). Springer. <http://www.springer.com/>

Forced migration comes about for many reasons: flood, hurricane, war, civil unrest. To that long list, we may now be able to add environmental stressors and climate change. The simple fact that there are more people in the world means that more people may be affected by changes in their social, economic, political, or environmental situation.

The responses to “environmental refugees” are still emerging in the international community. Much research has been done recently on the question, but many issues are still unsettled. International law, for instance, generally does not recognize a category of environmental refugee.

Etienne Piguet writes in this volume, “In none of the disciplines of social sciences, ‘environmental conditions figure as salient determinants of migration decision-making’ while at the same time ‘many environmentalists take as an article of faith that population growth, environmental deterioration, and out-migration are fundamentally interrelated.’ What is true for the impact of the environment in general holds true for the impact of climate and led to important controversy among scholars during recent years.”

This book examines the emerging linkages between environmental stress migration, including case studies from such varied examples as Hurricane Katrina and sub-Saharan Africa.

One section is devoted to the potential of outmigration resulting from climate change, especially from hurricanes, floods, drought, and rising sea levels.

Whatever the cause of the migration, it can be either a second disaster or an opportunity for vulnerability reduction, according to Nisharo Fernando, Koko Warner, and Jörn Birkmann. “Relocation needs careful planning as it intends to build up new communities by moving part of the population from one place to another ... It is important to note that global and local studies underline that many risk factors which may be individual or family-specific, such as illness, debt, or lack of livelihood opportunities—are directly linked to natural

hazards and environmental conditions. The severity and extent of natural hazards affect migration,” they write.

Principles of Emergency Management and Emergency Operations Centers (EOC). Michael J. Fagel, editor. 2011. ISBN: 978-1-4398-3851-8. 585 pp., \$89.20 (hardcover). CRC Press. <http://www.crcpress.com>.

This is a thorough text on the disaster cycle planning and implementation—from assessing vulnerabilities to stress management to exercises to emergency operations center operations and management. The book opens on the “big picture” questions, then gradually narrows its focus to planning teams, exercise options, and response implementation, among many other topics.

One topic covered in detail here that may be unique to this book is a focus on the physical composition of an EOC. “It is a common mistake to confuse the emergency operations center with the tasks that are performed in the EOC and to forget that the EOC is a physical location that generates its own demands,” write Lucien Canton and Nicholas Staikos. “For the EOC team to perform effectively, the physical and organizational demands of the EOC as a facility must be met. This EOC management is distinct from the operational management of the incident.”

In this spirit, they look at the “facility management” aspects of EOC operations—things like ergonomics, environmental comfort, and the allocation of space to personnel. “By properly considering these as well as other requirements, the designers of the workplace environment will have a significant impact on the operational effectiveness, thus shaping the quality of an entity’s response,” they write.

But EOC facility management is only one aspect of this very thorough book. This is a comprehensive, on-the-ground operational text for emergency managers.

Creating Recovery: Values and Approaches in New York after 9/11. By David Mammen. 2011. ISBN: 978-4-9905343-1-8. 300 pp., \$25 (softcover). Fuji Technology Press. <http://www.fuji-press.jp>.

As David Mammen notes in his opening here, when a disaster strikes, the urge to do something is very strong. This is no doubt one of the impulses that makes untrained people near the site of a disaster among the earliest and most effective “first responders.” Mammen, former head of a New York-based urban planning research institute, took this impulse after 9/11 to educate himself and many others about the recovery of the city from the tragedy. This book is the result.

It wouldn’t be too far off base to call this a history of the recovery efforts in New York City, warts and all. Mammen has written a thorough and clear description of the recovery, blessedly free of hysteria. He weaves his way through the thicket of politicians, institutions, policies, and programs that emerged and evolved immediately after the event and through to the ten-year anniversary. The recovery process is winding down, but there are still important lessons to be learned from the disaster and its aftermath. Mammen’s book is good place to start learning them.

Contracts and Grants

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

Monitoring deep crustal earthquake sequence, Sierra Valley, California. National Science Foundation grant #1202664. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1202664>. One year. \$22,205 to principal investigator Kenneth Smith, University of Nevada Reno, ken@seismo.unr.edu.

The project is to establish a temporary telemetered broadband array to monitor an energetic and unique Moho-depth earthquake sequence that began in southern Sierra Valley, California, in August 2001. The sequence is confined to 30 to 36 kilometer depths and is remarkably similar to a sequence of earthquakes under North Lake Tahoe in 2003, about 45 km southeast of Sierra Valley.

To date, about a thousand earthquakes have been located in the 2011 Sierra Valley sequence. One long-period event has been identified along the structure, yet was not within either swarm location. The process, now observed in a second sequence, is interpreted to represent diking and weakening of a high strength upper mantle Moho cap by injection of a lower density melt defining a fundamental boundary between the Sierra Nevada microplate and the Basin and Range.

In both sequences, seismicity is confined to a five to six km depth range and magma progresses upward at very similar rates in both sequences. Periodic increases in activity are most likely related to enhanced injection within the overall diking process. The new data provides the most comprehensive measurements of Moho-depth earthquake swarms within the Sierran block. An October 26th Mw 4.7 earthquake, felt throughout the region, occurred at 15 km depth, the brittle-ductile transition depth, directly above the deep swarm. Based on upper crustal seismicity associated with the 2003 deep swarm, we could expect additional shallow seismicity. The shallow triggered seismicity is related either to fluids propagating from depth or deformation associated a Moho depth strain event.

Broadband instrumentation is in place to capture shallow crustal activity that may precede additional $M > 4.5$ earthquakes. High-density broadband data complement regional monitoring and local GPS measurements to address fundamental questions about and evolution of the Sierra Nevada microplate boundary in the northern Sierra region. No broadband stations were in place during the 2003 sequence, and increased station density and sensor bandwidth in 2011 provides the data to better observe Moho and lower crustal volcanic processes associated with the swarm. Several faults in the region are capable of M7 earthquakes.

The provenance of the excess sulfur released in arc volcanoes during Plinian eruptions. National Science Foundation grant #54239. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1144957>. Three years. \$54,239 to principal investigator Christian Huber, Georgia Tech Research Corporation, christian.huber@eas.gatech.edu.

Although it is commonly accepted that the behavior of volatile elements in magmas controls eruption dynamics, the depth and amount of vapor exsolved, as well as the distribu-

tion and transport of vapor bubbles in shallow magmatic systems remain poorly constrained. This project will develop a novel multidisciplinary methodology to quantify where and how much vapor degassing occurs, how fast vapor bubbles are transported in different magmatic environments, if they are expected to accumulate in the shallower portion of the system and how much effect this accumulation will have on eruption dynamics.

A fundamental observation to be explained is the discrepancy between emitted volatiles released during explosive eruptions and the amount of volatiles that can be dissolved in the melt prior to eruption. The clearest example of excess degassing is associated with S mass balance, because S release during and after eruptions can be measured accurately by spectroscopic methods. Several open questions will be addressed: (1) How much vapor can be present in magma prior to an eruption and what fraction was exsolved in-situ versus transported from deeper unerupted magma? (2) If ex-situ degassing is important, what controls the accumulation of bubbles in the shallowest part of the magma body and how does it affect the eruptive behavior of the magma?

The work will explore the poorly understood transport and storage of exsolved volatiles in magmatic systems with new numerical models. It will integrate geochemical data (trace elements in apatites and pyrrhotite) with thermodynamic modeling (expected vapor content as function of crystallinity) and fluid dynamics modeling into a novel approach to quantify the volatile budget in magmas.

Tornado-resilient structural retrofits for sustainable housing communities. National Science Foundation grant #1150975. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1150975>. Five years. \$400,000 to principal investigator, David Prevatt, University of Florida, dprev@ce.ufl.edu.

This award will characterize tornadic wind loads on a residential building and to compare the resultant structural response of traditional construction against a structurally enhanced one. Study variables include both tornado parameters, and the building parameters.

A three-dimensional "finite element analysis" model of a light-framed residential structural system will be used as the prototype to establish structural response. A database-assisted design methodology will analyze tornadic wind load time-histories from a model building shape and determine critical design loads and reactions for the structural system. Full-scale tests will be conducted on corner substructures of the prototype building for validating the numerical model and also to evaluate the structural and economic benefits of enhanced structural systems in houses. The effort will provide the basis for a tornado-resilient design methodology for houses.

The award facilitates knowledge generation that provides a better understanding of the structural behaviors and vulnerability of existing wood-framed houses, while identifying benefits to a community that incorporate tornado-resilient building structural systems.

Analysis of the shallow slip deficit using sub-pixel image correlation: Implications for fault evolution, slip rates, and seismic hazards. National Science Foundation grant #1147436. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1147436>. Two years. \$424,999 to principal investigator, James Dolan, University of Southern California, dolan@usc.edu.

This project is focused on understanding the distribution of fault slip near the Earth's surface during earthquakes through the use of a powerful new technology (COSI-corr sub-pixel image correlation), which facilitates tracking of the location and amount of surface deformation along and around faults in much more detail than was possible using previously available methods.

Previous studies suggest that the slip that occurs along faults during earthquakes is larger at depth than near the surface, leading to what has been termed a surface slip deficit. Using the COSI-corr image correlation technique, scientists from the University of Southern California and Caltech will examine the distribution of slip near the surface along more than a dozen large-magnitude earthquakes that occurred during the past few decades. The results will facilitate the mapping of on-fault versus off-fault deformation patterns in earthquakes, allowing correlation of these observations with basic features of the fault zone, such as the amount of total slip a fault has accommodated in its lifetime, which may prove to be good predictors of the percentage of slip that will occur on faults during future earthquakes.

Currently, forecasts of the probability of the future occurrence of earthquakes are based largely on the slip rate of the fault—that is, the rate at which the blocks on either side of the fault slide past each other over the course of many earthquakes.

These data will allow the researcher to test models of possible preferred propagation direction of seismic ruptures, which will be of profound importance for determining in advance the regional distribution of strong ground motions. The anticipated results will also allow assessment of models for the likelihood that seismic ruptures will (or will not) propagate through structural complexities along the fault, an issue of basic importance for estimating in advance the sizes of future earthquakes. The results will thus provide the basis for the development of statistical measures of on-fault versus off-fault slip and rupture behavior.

Spatio-temporal changes of earthquake and fault zone properties before and after the Mw7.1 Duzce event. National Science Foundation grant #1141944. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1141944>. One year. \$129,485 to principal investigator, Yehuda Ben-Zion, University of Southern California, benzion@usc.edu.

This study focuses on detecting and quantifying evolutionary changes of earthquake and rock properties that precede and follow large seismic events. We use multiple techniques to examine evidence for accelerated faulting process before the Mw 7.1 Düzce earthquake on the North Anatolian fault, and to provide detailed results for postseismic effects following both the Düzce and the preceding Mw7.4 Izmit earthquakes.

The study employs extensive waveform data recorded by a tight fault zone array, with several stations located within the rupture zones of the İzmit and Düzce events, which oper-

ated from a few days after the İzmit mainshock until about three months after the Düzce event. Uncovering additional small events buried in the noise of the recorded waveforms can increase the available data significantly and offer unprecedented opportunities for tracking spatio-temporal changes of earthquake and fault properties.

To examine in detail evolutionary fault zone processes, the investigators perform research focusing on the following tasks: (1) Use the recently developed waveform matched filter technique to detect all possible additional earthquakes during the operation period of the network; (2) use the updated catalog with many previously undetected small events to search for patterns indicative of accelerated pre-earthquake activity around the hypocenter of the Düzce mainshock, as well as in the entire region covered by the data; and (3) identify clusters of repeating events in the complete updated data set, and use waveforms of the repeating event clusters to study temporal evolution of seismic velocities and earthquake source properties at various locations across the time of the Düzce mainshock.

Beyond the “classical” mantle plume concept: Upwelling dynamics, seismic structure, and partial melting of thermochemical plumes. National Science Foundation grant #1141938. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1141938>. Two years. \$82,834 to principal investigators Garret Apuzen-Ito and Cecily Wolfe, University of Hawaii, gito@hawaii.edu.

The classical concept of mantle plumes describes a thermally buoyant upwelling that rises through the entire mantle to feed a thin pancake of hot material ponding beneath the lithosphere and spawn hotspot volcanism. While this theory is elegant in its simplicity and its ability to explain a variety of observations, recent discoveries suggest that this idealization may no longer be tenable for all hotspots.

At the archetypal Hawaiian hotspot, for example, the seismic tomography results show compelling evidence for a plume-like body originating in the lower-mantle. However, they also reveal a low-velocity body in the upper mantle that appears far too thick and asymmetric to be consistent with a classical thermal pancake.

In the South Pacific, a cluster of hotspots populating the broad South Pacific Superswell each tend to be short-lived, show inconsistent age progressions, and are not connected to a large igneous province. Consequently, the classical plume theory has all but been discarded for these hotspots, giving way to the hypothesis that relatively small, short-lived plumelets rising from the roof of a giant superplume that is stagnating in the mid-mantle.

In recent numerical simulations, mantle upwellings that are thermally buoyant but compositionally dense show irregular and time-dependent forms with potential for explaining many of above observations.

The project has three main objectives: (1) explore the physics of thermochemical plumes in the mantle transition zone and upper mantle and characterize the different forms of upwellings as a function of properties such as plume radius excess temperature, and eclogite content; (2) establish relationships between the above properties and observables that can apply generally to hotspots worldwide such as the distribution, volume, and mafic content of magmatism, swell geometry, and mantle seismic structure; and (3) test the thermochemical plume hypothesis for hotspots in Hawaii, and the

South Pacific by comparing model predictions with geochemical and geophysical constraints.

Intermediate depth earthquakes: Investigations of the predominance and cause of subhorizontal faults. National Science Foundation grant #1141905. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1141905>. Three years. \$81,347 to principal investigator, Linda Warren, Saint Louis University, lwarren8@slu.edu.

Deep earthquakes were discovered nearly 100 years ago, but how they can occur outside the normal pressure-temperature conditions for brittle failure remains a mystery. Following up on recent observations that earthquakes from 75 to 300 kilometers depth often occur along subhorizontal faults, we have developed new hypotheses and tests to investigate the predominance and cause of these faults.

Do outer rise faults remain weak as the slab bends and subducts? Alternatively, are the fossil outer rise faults strong because they have healed? Does the stress field in the bending slab result in downward pumping of water that initiates earthquakes? Do sustained fault zones exist? Is rupture propagation an isobaric process?

Different seismic observations would support or refute each of these hypotheses, and we have selected two study areas, Japan and Colombia, with features and regional data sets ideal for answering these questions. In Japan, we are using the broadband records to analyze the directivity of about 500 earthquakes down to Mw 4.5. In Colombia, we are collaborating with Professor German Prieto of the Universidad de los Andes to analyze the Cauca cluster of about two thousand earthquakes through relocation and source characterization.

Partial melting at mantle conditions: Effect on elastic, anelastic, and plastic behavior. National Science Foundation grant #1141895. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1141895>. Three years. \$262,934 to principal investigators Donald Weidner and Li Li, SUNY at Stony Brook, donald.weidner@sunysb.edu.

The temperature within the Earth is high enough to melt rocks, as evidenced by volcanoes and volcanic rocks. Here we wish to address the question of how important partial melting is in defining the mechanical properties of regions within the mantle. The association of low shear wave velocity and low viscosity with partial melting has been part of the lore since the early days of plate tectonic theory. The strong rigid lithosphere defined the plates that were lubricated from below by the plastically weak asthenosphere.

The seismic verification came from the ubiquitous low velocity zone (at least under oceanic plates). The implicit assertions of this model are: (1) velocity and viscosity are both affected by small amounts of partial melting; (2) shear modulus is more affected than bulk modulus; and (3) the top of the low velocity zone marks the onset of melting and the bottom of the low velocity zone is thus defined by the disappearance of partial melting and the increase of both viscosity and velocity.

Our study will be the first that can analyze these properties at the conditions where the Earth phenomena are found. We will use the facilities at the National Synchrotron Light Source where we have developed high-pressure equipment capable of achieving these goals. The use of X-rays to probe the sample provides a piezometer to measure stress and images to measure strain.

Interferometric imaging of subduction zones. National Science Foundation grant #1141812. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1141812>. One year. \$120,001 to principal investigator Alison Malcolm, Massachusetts Institute of Technology, amalcolm@mit.edu.

Earthquakes and volcanism are phenomena directly affecting a large number of people in the United States and throughout the world. A major driving force for these mechanisms can be found deep down under the surface inside subduction zones—areas where two tectonic plates move towards each other, one sliding underneath the other.

Seismic imaging is a method of estimating rock properties, which in turn reveal physical processes in the subsurface. The quality of seismic images depend on many factors, the most important of which are the location of seismic sources (earthquakes) and recording devices (geophones) as well as signal distortions caused by the complicated nature of the Earth's interior. This project will develop a novel seismic signal processing algorithm that removes many of the problems associated with traditional imaging methods. This algorithm is based on seismic interferometry, a technique that allows to numerically turn sources such as earthquakes into virtual geophones capable of recording a signal at a location where no physical device can be placed. It is expected that the proposed algorithm will ultimately result in higher-quality and higher-fidelity images. Those images will provide additional clues about the important physical processes inside the subduction zones and their role in triggering earthquakes.

Seismic interferometry provides a method of redatuming (numerically moving) receivers located at the surface to be as if they were located at the source locations. Local earthquakes can then act as physical sources or, when desired, as virtual receivers. Our new technique, which combines classical seismic interferometry and source-receiver wavefield interferometry, uses teleseismic events as well as data produced by large local earthquakes and converts them into virtual data that we would have observed had we actually had physical receivers inside the subducting slab. The great benefit of this redatuming procedure is the construction of a virtual local seismic survey that can be used to produce an image of precisely the area that we are most interested in.

Stochastic optimization for water resources management. National Science Foundation grant #1151226. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1151226>. Five years. \$400,000 to principal investigator, Guzin Bayraksan, University of Arizona, guzinb@sie.arizona.edu.

The project investigates stochastic optimization models and methodologies to assist in managing and adapting water resources and infrastructures to ensure a sustainable future. The project will focus on two problems. The first is a large-scale multi-period water allocation problem under uncertainty in the Lower Colorado River Basin. The second is regional scale water reuse infrastructure design and operation problems. The research will address these issues by: (1) formulating mathematical optimization models under known and ambiguous uncertainties; (2) investigating decomposition-based solution methods that exploit the special structures of these models; and (3) advancing theory and methodology to evaluate the resulting solutions and other multi-period adaptation and mitigation policies.

The project will have a significant impact on the well-

being of the 25 million to 30 million people who reside in the southwestern United States. The models and methods developed can be applied wherever water is scarce.

Nineteenth century U.S. West Coast sea level and tidal properties. National Science Foundation grant #1155610. <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1155610>. One year. \$93,848 to principal investigators, Stefan Talke and David Jay, Portland State University, stefant@cecs.pdx.edu.

Tidal data are the oldest and longest records available from the ocean, but much of the 19th and early 20th century tidal record remains undigitized and unused. In this project, novel ways of recovering, digitizing, vetting and analyzing 19th century tide data from Astoria, Oregon (1853-1876) and San Diego, California (1853-1872) will be pioneered. These are two of the three oldest Pacific Ocean tidal records.

The products of this work and related metadata recovery will be used to improve estimates of 19th century mean sea level (MSL) in the north-eastern Pacific, assess the secular change in tidal properties, and estimate long-term changes in storminess. The data will be improved (by removing errors) and the tabulated data that has already been recovered for

Astoria and San Diego will be augmented by obtaining digital copies of selected marigrams (22 meter long scrolls that each contain one month of pencil tide tracings) from the U.S. National Archive.

One novel aspect is that recovered tide rolls will be digitized to six minute resolution using software, rather than the error-prone hand tabulations. Innovative analysis techniques will be used to find and correct errors.

To the extent possible, corrections for barometric pressure, river flow, and isostatic rebound will be applied. The analysis will address whether MSL at San Francisco is representative of the U.S. West Coast, and will, by comparison with the modern record, help constrain long-term trends in MSL variation. Secular shifts in the primary constituents and the shallow-water overtides will be assessed. Spectral analysis techniques and weather data collected at tide stations will be used to investigate secular changes to the non-tidal variance in the water level signal for San Francisco. Because overtides are produced by bathymetry, river flow, stratification, and other local processes, assessing their change over time can provide insight into locally forced changes to the functioning of estuaries.

Call for Nominations

Mary Fran Myers Award

THE MARY FRAN MYERS AWARD recognizes disaster professionals who continue Myers' goal of promoting research on gender issues in disasters and emergency management.

As co-director of the Natural Hazards Center, Myers recognized that disaster vulnerability is influenced by social, cultural, and economic structures that marginalize women and girls. The Natural Hazards Center and the Gender and Disaster Network established the award in 2002 to honor women and men whose advocacy, research, or management efforts have had a lasting, positive impact on reducing disaster vulnerability.

Individuals eligible for the award will have added to the body of knowledge on gender and disasters or furthered opportunities for women to succeed in the field. The selection committee is especially interested in nominations from outside the United States. Previously nominated individuals who have not won the Mary Fran Myers award are still eligible.

Award winners are invited to participate in the Natural Hazards Research and Applications Workshop and will be acknowledged in the Workshop program. Workshop fees will be covered. Travel to and accommodations at the Workshop are the winner's responsibility. The winner is also invited to serve on the Mary Fran Myers selection committee.

To Submit a Nomination:

WRITE A LETTER OF NOMINATION explaining how the nominee's work has furthered knowledge, created opportunities, or otherwise had a lasting impact in the field of gender-related disaster risk reduction. Nominations in English are preferred, but those in Spanish, French, or Italian can be accommodated.

ATTACH THE NOMINEES CURRENT RESUME OR CURRICULUM VITAE.

INCLUDE YOUR FULL NAME and contact information (mailing address, e-mail, telephone, and fax) on the nomination, as well as that of the nominee.

OPTIONAL: You may also include an additional one-page letter of support from another person or organization.

E-mail all materials to mfmawards2012@gdnonline.org by April 16, 2012. Nominations will be forwarded to the 2011 Selection Committee for review and selection.

Questions can be forwarded to Bethany Brown (bethanylbrown@gmail.com) or Maureen Fordham (maureen.fordham@northumbria.ac.uk)



Conferences and Training

March 5-7, 2012

Logistics of Natural Disaster Recovery
Chartered Institute of Logistics and Transport in New Zealand
Wellington and Christchurch, New Zealand

Cost: \$1,413

Using the 2011 Christchurch earthquake and Queensland floods as case studies, this conference will present recommendations for preparedness and response. Topics include civil defense training, early warning systems, rescue coordination, infrastructure challenges, and economic recovery planning.

<http://www.ciltconference.co.nz/>

March 5-7, 2012

International Crisis and Risk Communication Conference
University of Central Florida
Orlando, Florida

Cost: \$495

This conference will encourage international dialogue about ethics in crisis and risk communication. Topics include tourist perceptions of safety, best practices for managing a Web site during crises, business ethics of online social networking, and how to build trust among volunteers in a crisis.

<http://www.icrcommunication.com/>

March 9, 2012

The First Australian Conference on Natural Disasters and Family Violence
Australian Domestic and Family Violence Clearinghouse
Melbourne, Australia

Cost: \$267

This conference will look at relationship violence, child abuse, and domestic violence incidents following natural disasters in Australia. Topics include natural disaster impacts on family relationships, strategies for managing increased local government services during and after a natural disaster, and international trends in domestic violence following disasters.

<http://afmw.org.au/conferences/732-the-first-australian-conference-on-natural-disasters-and-family-violence>

March 14-16, 2012

The GLOBE Conference
The GLOBE Foundation
Vancouver, Canada

Cost: \$1,295

This conference looks at methods for achieving corporate sustainability and how it can ultimately enhance business performance. Topics include energy efficiency and alternative power, climate change adaptation strategies, environmental risk management, green infrastructure, waste-to-energy systems, and efficient water use.

www.globeseries.com/

March 18-21, 2012

Sustainable Water Management

American Water Works Association
Portland, Oregon

Cost: \$770

This conference will discuss potential changes to water utility regulations. Topics include water conflict management, residential water sustainability, aquifer storage and recovery, low-impact development, sustainable commercial and industrial use, and opportunities for water reuse.

<http://www.awwa.org/Conferences/SustainableManagement.cfm?ItemNumber=56511&navItemNumber=56514>

March 19-22, 2012

Analyzing Risk: Science, Assessment, and Management
Harvard School of Public Health
Boston, Massachusetts

Cost: \$1,595

This program teaches participants how to conduct and interpret complex risk analyses involving chemicals, radiation, and other environmental hazards. Topics include economic approaches to social decision-making, benefit-cost analysis, basic principles of toxicology, and the connections between epidemiology and environmental health research.

<https://ccpe.sph.harvard.edu/RISK>

March 20-21, 2012

Water and Environment
Chartered Institution of Water and Environmental Management
London, England

Cost: \$297

This conference will present innovations in sustainable water infrastructure around the world. Topics include global water security, flood management schemes, the economic value of regional water trading, and strategies for urban ecosystems.

<http://www.coastms.co.uk/conferences/448>

March 25-29, 2012

Wildland Urban Interface
International Association of Fire Chiefs
Reno, Nevada

Cost: \$425

This conference will discuss solutions to wildland-urban interface suppression, prevention, and mitigation challenges. Topics include assessing wildfire hazards, preventing accidental or intentional wildfires, and reducing wildfire risk while protecting environmental interests.

<http://s36.a2zinc.net/clients/iafc/wui12/public/MainHall.aspx?ID=3612&sortMenu=101000>

April 9-11, 2012

Hydrologic Engineering Center River Analysis System Workshop
Floodplain Management Association
San Diego, California

Cost: \$695

This workshop prepares water resources professionals to use the Hydrologic Engineering Center River Analysis System (HEC-RAS). Participants will learn to conduct water surface profiles, bridge/culvert hydraulics, and floodplain studies using HEC-RAS. Topics include developing hydraulic models, adding tributaries and junctions, creating plans, modeling bridges, and estimating floodway encroachment.

<http://www.cvent.com/events/hec-ras-april-9-11-2012/event-summary-de620a8c5d414555951039f454dfe120.aspx>

April 10-13, 2012
2012 EERI Annual Meeting and National Earthquake Conference
Earthquake Engineering Research Institute
Memphis, Tennessee

Cost: \$450

This conference will discuss lessons learned from recent and historic earthquakes. Topics include geotechnical engineering for seismic and tsunami events, lessons for today from the 1811-1812 New Madrid earthquakes, unreinforced masonry performance in recent quakes, and preparedness, response, and recovery operations. A one-day Earthquake Insight Field Trip looking at engineering designs that minimize earthquake risk will be held in conjunction with the conference.

<http://earthquakeconference.org/>

April 11-12, 2012
Emergency Preparedness Conference
The Joint Commission
Arlington, Virginia

Cost and registration: \$699 before March 11, closes April 6

This conference will look at how healthcare organizations can use accreditation standards to guide emergency management planning. Topics include hospital use of disaster medical assistance teams, crisis standards of care, standardization of hospital emergency codes, hurricane preparedness for inland healthcare facilities, and case studies from Joplin, Missouri, and the Vermont State Hospital.

http://www.jointcommission.org/jcr_annual_emergency_preparedness_conference_br_edu1112/

April 14-17, 2012
National Planning Conference
American Planning Association
Los Angeles, California
Cost: \$995

This conference offers sessions and workshops addressing issues in urban and environmental planning, regional planning, natural hazard risk reduction, and others. Topics include urban forestry, climate change, the cost of sea level rise, urban agriculture, Los Angeles River water quality, hazard mitigation, fire management and ecological restoration, and disaster risk reduction.

www.planning.org/conference/

April 16-18, 2012
Australian and New Zealand Disaster and Emergency Management Conference
Australian Institute of Emergency Services, Australian and New Zealand Mental Health Association, and the Association for

Sustainability in Business
Brisbane, Australia

Cost: \$950

This conference looks at a variety of issues surrounding natural and man-made hazards. Topics include post disaster psychological health in children, the role of systems theory in disaster response, the role of insurance in promoting flood resilience, and an all-hazards information management approach to managing disasters.

<http://anzdmc.com.au/>

April 17-19, 2012
Hazardous Materials Transportation Conference
Coastal Region Hazardous Materials Response Organization
Richmond, California

Cost: \$225

This conference will teach participants how to operate in a unified command system, enhance communications between public and private agencies, and build trusting work relationships. Topics include pipeline safety and security, the use of vacuum trucks at hazardous sites, maritime transportation incidents, and facts and fallacies about hazardous chemicals.

http://crhmro.org/index.php?option=com_content&view=article&id=8&Itemid=0

April 20-22, 2012
Wildland Fire Litigation Conference
Ken Roye
Sacramento, California

Cost: \$595

This conference discusses environmental, infrastructural, and subrogation issues in wildland fire litigation. Topics include technology in fire investigation, uses and limitations of fire behavior modeling software, conservation and environmental easement appraisals, tree damage valuation methods, and the use of game theory in conflict mediation.

<http://www.wildlandfirelitigation.com/>

April 22-25, 2012
Ninth International Conference on Information Systems for Crisis Response and Management
International Community on Information Systems for Crisis Response and Management
Vancouver, Canada

Cost: \$650

This conference looks at integrative approaches to emergency management information systems. Topics include planning and risk analysis, GIS technology for crisis response, healthcare crisis management systems, social media and collaborative systems, inter-organizational exercises, and wireless connectivity management.

<http://www.iscram.org/>

April 22-27, 2012
European Geosciences Union General Assembly
European Geosciences Union
Vienna, Austria

Cost: \$513

This conference presents research from geoscientists around the world. Topics include the uncertainty and variability of precipitation, landslides in volcanically active

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www.colorado.edu/hazards/

environments, flood risk uncertainty, large earthquakes and tsunami activity, and the economic costs of natural hazards.

<http://www.egu2012.eu/>

**April 25-27, 2012
Urban Water Conference
Wessex Institute of Technology
New Forest, United Kingdom**

Cost: \$1,903

This conference looks at the design, construction, maintenance, and control of urban water systems. Topics include pollution sources, water recycling systems, water supply networks, leakage and losses, storage tanks, and industrial wastewater.

<http://www.wessex.ac.uk/12-conferences/urban-water-2012.html>

**April 30 to May 2, 2012
Coastal Cities Summit
International Ocean Institute
St. Petersburg, Florida**

Cost: \$395

This conference examines managing coastal resources while addressing the pressures of coastal development, sea level rise, population growth, and ocean acidification. Topics include disaster resilience, coastal energy alternatives, food supply concerns, drought, and building smaller cities and towns.

<http://www.coastalcities-ioi.org/>

**May 7-9, 2012
Sustainable City 2012
Wessex Institute of Technology
Ancona, Italy**

Cost: \$1,855

This conference addresses environmental challenges facing cities. Topics include natural resources consumption, the generation of waste and pollution, social and economic imbalances, sustainable urban tourism, natural hazards planning, urbanization of rural areas, and sustainable energy resources.

<http://www.wessex.ac.uk/12-conferences/sustainable-city-2012.html>

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May 30 through June 22, 2012

Natural Disaster Management

University of Iceland Earthquake Engineering Research Centre
Selfoss, Iceland

Cost: \$2,037

This course provides an introductory overview of the disaster cycle, and examines local, national, and international roles in disaster management. Topics include multidisciplinary disaster cycle management, risk analysis, cost-benefit analyses of mitigation projects, and contingency planning for rescue, relief, and recovery. Following completion of the course, students will be able to lead or participate in multidisciplinary disaster management projects.

<http://www.earthquake.is/academic-program/natural-disaster-management-2012>

July 12-13, 2012

Fourth International Conference on Climate Change

University of Washington
Seattle, Washington

Cost: \$400

This conference will examine scientific and political perspectives on climate change. Topics include climate change and disaster management, the impact of climate change on water resources, climate change education for children, climate change vulnerability related to racial and income disparities, and national mitigation strategies.

<http://on-climate.com/conference-2012/>

August 26-30, 2012

International Disaster and Risk Conference

Global Risk Forum
Davos, Switzerland

Cost: \$1,061

This conference discusses integrative risk management approaches for mega-catastrophes, country risk management, environmental and ecological risk, urban risk, societal and political risk, and health risk. Topics include disaster recovery and reconstruction, ecosystem services, land use planning, and critical infrastructure protection.

http://idrc.info/pages_new.php/IDRC-Davos-2012/831/1/



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

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

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

To find out more about these and other opportunities for giving, visit:

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

Or contact Ezekiel Peters at ezekiel.peters@colorado.edu or (303) 492-2149 to discuss making a gift.

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

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Observer cartoons are drawn by Rob Pudim.

Send items of interest to the Natural Hazards Center, University of Colorado at Boulder, 483 UCB, Boulder, CO 80309-0483; (303) 492-6818, (303) 492-2151 (fax); hazctr@colorado.edu. The deadline for the next *Observer* is **March 30, 2012**.