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NATURAL DISASTERS

A calculated risk

Scientists and engineers with an analytical bent are sought-after in natural-hazard risk assessment.

BY BRYN NELSON

Australian meteorologists introduced two new colours to their weather maps this January, during the country's hottest summer on record. Two years earlier, eastern Australia saw its worst flooding in decades following its wettest recorded December. Last autumn, Superstorm Sandy pummelled the US east coast, after devastating drought and wildfires scorched a huge swathe of the central states. Within the past three years, there have also been a catastrophic earthquake and tsunami in Japan, epic flooding in Thailand and East Africa's worst drought in 60 years. In a 2012 report, the Intergovernmental Panel on Climate Change concluded that climate change has already increased the frequency of some extreme weather events globally, and that more are on the way.

As these and other global threats weigh heavily on governments, corporations and charities, demand is spiking for scientists and engineers in the multidisciplinary field of natural-hazards risk analysis. Experts in the field, which focuses on how to predict, prevent and limit damage from natural disasters, are finding jobs in insurance, agriculture, finance, infrastructure, construction, humanitarian aid and public policy.

"There's a broad spectrum of the public and private sector that needs planning, that needs expertise, that needs a way of communicating the risks to effect policy," says Arthur Lerner-Lam, deputy-director of Columbia University's Lamont-Doherty Earth Observatory in Palisades, New York. "Good students, we're finding, are having no trouble finding positions in those areas." Particularly fruitful areas of study include Earth sciences, physical sciences and sustainable development, he says. "Some of our best PhD students are going to the insurance and finance sector, principally for modelling purposes."

Opportunities in risk analysis fall mainly into three overlapping categories: the natural and physical sciences; engineering; and social sciences. Engineers assess infrastructure and sometimes inform policy decisions; social scientists often study how best to communicate risk. Natural and physical scientists from geologists and meteorologists to mathematicians and physicists study the origins, movement and potential impacts of natural hazards. They often produce data-heavy models, maps, reports and briefs. The resulting visual presentations of risk may layer details such as a city's utility networks and roads onto a map of its flood-prone areas and a plot of the economic productivity of different zones as a function of their geography. These analyses help clients to estimate potential losses and to refine their prevention and mitigation measures.

BLURRING THE BOUNDARIES

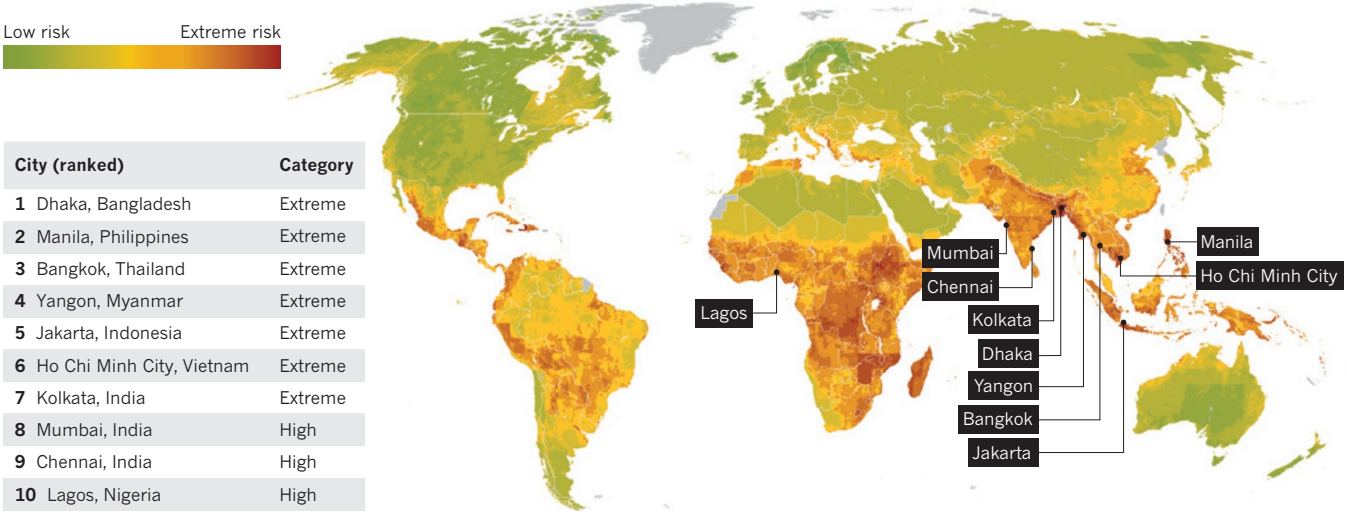
A career in natural-hazards management and mitigation often means collaborating on multidisciplinary teams that may include meteorologists, economists and civil engineers. Employers say that all roles require a solid foundation in statistics and good analytical and quantitative skills. Some firms build websites to help their clients to visualize risk, so software-development experience and familiarity with tools such as geographic information systems can come in handy. And candidates must be able to dispense with jargon and explain what a risk might mean to a lay audience. Employers are increasingly looking for analysts from all disciplines with at least basic skills in risk communication, a growing area of study among sociologists and behavioural psychologists (see 'Reaching out — carefully').

Jobs are particularly abundant at reinsurance companies, which insure other insurers to help them to limit their losses in the event of a disaster. Reto Schneider, head of emerging risk management at Swiss Re, a global reinsurance company based in Zurich, cites a long list of positions suitable for experts on disasters such as floods, droughts, windstorms and earthquakes, or for geographers and mathematicians who can do in-house modelling and mapping. For example, Swiss Re has hired several scientists from the Swiss Federal Institute for Snow and Avalanche Research in Davos to assist in risk analysis for landslides and avalanches. Consultancies that specialize in mapping or ▶

DANGER DEPICTED

Risk analysts develop visual representations of risk levels, such as this 2013 map from Maplecroft in Bath, UK, which shows the cities most vulnerable to the effects of climate-related natural disasters and rising sea levels.

SOURCE: MAPLECROFT



City (ranked)	Category
1 Dhaka, Bangladesh	Extreme
2 Manila, Philippines	Extreme
3 Bangkok, Thailand	Extreme
4 Yangon, Myanmar	Extreme
5 Jakarta, Indonesia	Extreme
6 Ho Chi Minh City, Vietnam	Extreme
7 Kolkata, India	Extreme
8 Mumbai, India	High
9 Chennai, India	High
10 Lagos, Nigeria	High

modelling a client's vulnerability to a range of catastrophes are also big employers.

Schneider earned a PhD in immunology and did two postdoctoral fellowships before his search for a stable, family-friendly career led him to Swiss Re 18 years ago. The company was searching for what it now calls high potentials: clever and motivated academics who can be trained in an internal graduate programme. Schneider's current work in analysing the financial impact of disasters is far removed from immunology, but he sees parallels between the immune system and the complex systems that he now studies, and says that his analytical skills are an asset. "Scientists might overlook it or ignore it because they have never heard about it or they can't imagine that the insurance industry is offering something to them," he says. "But after close to 20 years working in this industry, I must say that it's a great target."

Helen Hodge is head of maps and indices at Maplecroft, a consultancy in Bath, UK, that produces maps, indices, scorecards and other visual representations of risk in ten major categories (see 'Danger depicted'). She estimates that half of her firm's recent recruits have scientific backgrounds. She has a master's degree in geography and worked as an environmental scientist before she started modelling natural catastrophes in London's insurance industry and eventually joined Maplecroft.

At Maplecroft, scientists are particularly well represented in risk analysis for natural hazards, climate change and environment, areas in which the 90-employee firm is scaling up its work. The expansion, says Hodge, is the result of demand from clients such as banks, insurance companies, major corporations and national and international humanitarian groups. "We're growing at a good rate," she says.

Commercial clients are increasingly wary of major disruptions in their supply chains, especially as many boost their reliance on supplies and parts from Southeast Asia, a region prone to natural disasters. Thailand's catastrophic monsoon flooding in 2011, in particular, delivered a sobering wake-up call about the danger of concentrating resources in a single location. Car and computer-hardware manufacturers were inundated: Honda and Toyota paused production and hard-drive prices soared by nearly 30%. Analysis of a company's business practice to identify high-risk locations or methods may help it to avoid the most vulnerable sites or to safeguard against lengthy delays in re-establishing its supply chain.

Experts in sustainability and resiliency are also finding work. Resiliency refers to designing buildings, infrastructure, contingency plans and communication systems that allow companies or communities to withstand a disaster or bounce back quickly. Sustainability experts help clients to make durable and cost-effective decisions about infrastructure, development and other long-term investments in the face of changing economic, climatic and political conditions (see *Nature* **494,** 507–509; 2013).

Gauging the integrity of infrastructure threatened by weather and seismic events is providing another big opportunity for scientists and engineers. For example, many of the 3,000 levees and 700 dams overseen by the US Army Corps of Engineers are reaching the end

COMMUNICATION SKILLS

Reaching out — carefully

Demand is rising for scientists who can not only assess risk but also clearly communicate it. "A lot of risk communication is trying to understand how people make decisions about risks, how they should make decisions about risks, how you help them make better decisions about risks," says George Gray, president of the 2,000-member Society for Risk Analysis in McLean, Virginia, an international organization of academic, government and private-sector professionals.

The engineering and public-policy department at Carnegie Mellon University in Pittsburgh, Pennsylvania, includes experimental psychologists who focus on developing, testing and gauging the response to risk-related messages aimed at policy-makers and the public. "You can sit in your office until the cows come home, trying to dream up appropriate messages, and still be surprised the minute you actually take them out in the field and test them," says Granger Morgan, head of the department. Even the best risk analysis in the world may be useless, he says, if it is not communicated in a way that improves how people perceive and respond to risk, and that supports good decision-making.

There is particular demand for scientists who can distil sophisticated information into understandable advice that influences behaviour — the likelihood of a levee withstanding a storm surge and how that affects a city's evacuation routes, for example — says Eric Halpin, special assistant for dam and levee safety at the US Army Corps of Engineers in Washington DC. "It's a balance of being a good-enough communicator, saying, 'This is why you should care about the risk,' without throwing a whole community into panic." **B.N.**

of their typical 50-year life expectancy, and the costly process of shoring up or replacing them could take decades. "It's a long-term problem, so we need to make sure that we have the right people around 20 years from now to deal with this," says Eric Halpin, special assistant for dam and levee safety for the corps in Washington DC.

Halpin needs scientists and engineers who can assess more than just the logistics of building and maintaining dams and levees. They also need to understand how decisions about infrastructure may affect the long-term well-being of a local economy and population. "What we're finding out right now is that engineers tend to look at every problem as an opportunity to build something new, a structural solution, and many times the solutions are not structural," he says. "Maybe it's managing your consequences better through building codes, or smart economic development or evacuation plans rather than a bigger levee."

RISKY POLICIES

In the aftermath of devastating storms such as Sandy and 2005's Hurricane Katrina, and amid growing concern over the coastal impacts of global warming, government officials around the world are debating when to rebuild barriers and when to pursue other risk-reduction strategies (see D. Moynihan *Nature* **495,** 7; 2013). The increasingly urgent discussions are opening doors for scientists and engineers versed in public policy.

Frauke Hoss, who is doing a PhD in engineering and public policy at Carnegie Mellon University in Pittsburgh, Pennsylvania, is German but trained in political science and hydraulic engineering in the Netherlands. She hopes to pursue an advisory role with the European Union or the Dutch or German government, combining her expertise in public policy and flood-control engineering. Hoss says that infrastructure decisions are affected by geography in much of Europe. "We live so densely that you will be building in an area where there's flooding potential," she says. "And as your economy grows, you have more value that you have to keep drier."

In the Netherlands, where 35% of the population lives on flood-prone land, officials are supplementing flood barriers with new and larger spillways and reservoirs as more natural ways to control inundations. Although unsure of her own prospects in helping to formulate policies, Hoss thinks that she is on the right track with her dual focus. "There will always be demand, because there are very few engineers who are interested in policy," she says.

That demand is relevant across Europe. The UK government's Foresight programme, for example, relied heavily on natural-sciences and public-policy expertise in crafting its 139-page report *Reducing Risks of Future Disasters*, released last November. The programme commissioned 18 independently peer-reviewed papers and workshop reports and enlisted a small army of academic, governmental and institutional experts to write and review the report, which calls for decision-makers worldwide to increase their reliance on science, technology and risk-assessment methods to help to reduce the impact of disasters.

SLOW GROWTH IN ACADEMIA

Because risk analysis often spans disciplines and tends to be highly applied, academic positions are the hardest to find. However, a modest corps of academic sites focuses at least in part on natural hazards; most, but not all, are in the United States and Europe. Some of the best known established sites include the Aon Benfield UCL Hazard Centre at University College London; the Disaster Prevention Research Institute at Kyoto University in Japan; the Center for Disaster Management and Risk Reduction Technology in Potsdam, Germany; and the Engineering and Public Policy department at Carnegie Mellon. That list is now expanding, with centres such as the Cabot Institute at the University of Bristol, UK, opened in 2010, and the Center for Risk Governance at Tsinghua University in Beijing, launched this year.

Despite the growing options for academics and students, employers tend to agree that few programmes prepare scientists for the multidisciplinary, holistic and hands-on responsibilities of applied risk analysis. Applicants may have to actively seek out practical experience on their own, as Hodge did in the insurance industry or as others have done in organizations that regularly assess disasters, such as one of the many national Red Cross and Red Crescent societies.

Depending on the employer, recruits may receive extensive in-house training that directs their expertise to applied ends — Swiss Re, for example, sometimes trains employees in financial modelling, and the US Army Corps of Engineers teaches them how to incorporate skills beyond their normal disciplines. "We hire some straight-up scientists in hydrology and geology and geomorphology; we hire some straight-up social scientists, particularly in the areas of life loss and vulnerability; and we hire some straight-up engineers," says Halpin. "And not one of them comes to the table with all of the skills. We build it in after they get on board."

The aim is to produce what Halpin calls a natural-hazards "super generalist" who is well versed in the application of multiple disciplines to real-world problem solving. "If you have the right foundation in one area and you're willing to learn about other areas, and you're willing to create some of the education in the workplace rather than in school, then that's the key," he says. ■

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AUSTRALIA

Foreign students wanted

Hoping to boost Australia's economy by bringing in more international students and researchers, the nation's government is adopting recommendations from its International Education Advisory Council. On 27 February, the council published *Australia — Educating Globally*, a report that outlines a 5-year plan for reaching Australia's international-enrolment goals. The number of international students at universities and other institutions in Australia could grow by some 30% by 2020, to 520,000 students, as a result of the council's plan, the report predicts; it estimates that this would add about Aus$19 billion (US$19.5 billion) to the country's economy and provide extra support for research positions. The recommendations include streamlining visa requirements and regulations for international academics and students; encouraging international research collaborations and partnerships; and offering incentives for top academics and doctoral students to come to Australia. Michael Chaney, chairman of the advisory council, says that the government is already implementing specific strategies to increase numbers of international scientists, such as establishing high-paying contracts for research posts.

UNITED STATES

Pay rise for presidents

US university presidents and academic officers, including deans, provosts and chancellors, saw their pay increase by a median of 2.3% in 2012, more than one-third above the inflation rate of 1.7%, according to a survey. The College and University Professional Association for Human Resources in Knoxville, Tennessee, polled 1,251 institutions for its 2012–13 *Administrators in Higher Education Salary Survey*, published on 25 February. The median pay for the president of an institution that grants doctorates rose by 2% for the year, to US$402,000. Deans of biological and life sciences at doctoral institutions also saw a pay rise: their median compensation climbed by 3% to $225,000 in 2012. Executive benefits included not only pay but also housing for 47.3% of university presidents, a car or car allowance for 51.6% and membership of a club such as a gym or airline for 31.6%, the survey says. More than one-quarter of presidents received deferred compensation such as pensions or stock options.