CONSTANT CATS
Understanding the influence of climate change

IN EQUAL MEASURE
Reducing the disproportionate impact of disasters

TOMORROW'S RISK
How risk management is evolving for an intangible world

EXPOSURE

ISSUE 06

THE FLAMES BURN HIGHER

IN THIS ISSUE

THE FLAMES BURN HIGHER

With California experiencing two of the most devastating seasons on record in consecutive years, should wildfire now be considered a peak peril?

PAGE 9

IN EQUAL MEASURE

A more inclusive approach to disaster risk reduction demands greater recognition of groups disproportionately affected by catastrophes

PAGE 6

LIVING IN A WORLD OF CONSTANT CATASTROPHES

How should (re)insurers prepare for a world in which their portfolios are bombarded with aggregate catastrophe losses each and every year?

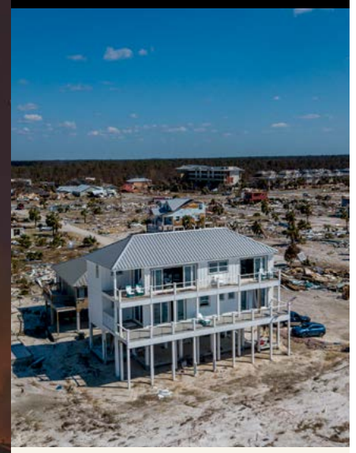
PAGE 12

THE FUTURE OF RISK MANAGEMENT

What does the future of risk management look like when so many new exposures are intangible and unexpected?

PAGE 15

OTHER STORIES



Underwriting with 20/20 vision

How is technology helping to bring granular exposure information and portfolio-level modeling to high-volume risks?

PAGE 18

Opening Pandora's box

With each new stride in hazard research and science comes the ability to better calculate and differentiate risk

PAGE 20

The art of empowerment

New technology offers access to deeper analytics by leveraging expansive model science in a more accessible way and at a more affordable price

PAGE 22

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FOREWORD

RISK AND REWARD

Welcome to the latest edition of EXPOSURE magazine. At this year's annual Exceedance conference, there is a real energy from the delegates here to both understand the issues that the risk management community face, and to move forward and embrace the changes, whether it is using new technology, science or disruptive thinking.

And the challenges continue to build. Our industry faces a seemingly never-ending barrage of sizable loss events, coming from across the world with increasing regularity, as we enter the era of constant catastrophes. As an example, wildfires in California that were regarded as attritional losses — two record-breaking seasons are forcing the industry to quickly re-evaluate what is now a tier-one peril. New categories of risk are growing, as the business world moves from having intangible assets instead of physical assets on the books. How can these intangible risks be quantified and protected?

Turning to technology, rather than focus on the technology itself, how will it help tackle these challenges? Getting the right insight to the people, to make informed decisions. And doing so to evaluate risks faster and in greater depth. Taking advantage of new risk data flows to understand these new intangible perils. This just scratches the surface of the potential.

With a greater understanding of the challenges we face, matched with an ability to deliver new and innovative solutions, we look forward to having you on our journey.

KAREN WHITE
CEO, RMS

NEWS ANALYSIS

FLOOD RISK

CLEAR LINK BETWEEN FLOOD LOSSES AND NORTH ATLANTIC OSCILLATION

RMS research proves relationship between NAO and catastrophic flood events in Europe

The correlation between the North Atlantic Oscillation (NAO) and European precipitation patterns is well known. However, a definitive link between phases of the NAO and catastrophic flood events and related losses had not previously been established — until now.

A study by RMS published in Geophysical Research Letters has revealed a direct correlation between the NAO and the occurrence of catastrophic floods across Europe and associated economic losses. The analysis not only extrapolated a statistically significant relationship between the events, but critically showed that average flood losses during opposite NAO states can differ by up to 50 percent.

A change in pressure

The NAO's impact on meteorological patterns is most pronounced in winter. Fluctuations in the atmospheric pressure between two semipermanent centers of low and high pressure in the North Atlantic influence wind direction and strength as well as storm tracks.

The two-pronged study combined extensive analysis of flood occurrence and peak water levels across Europe, coupled with extensive modeling of European flood events using the RMS Europe Inland Flood High-Definition (HD) Model.

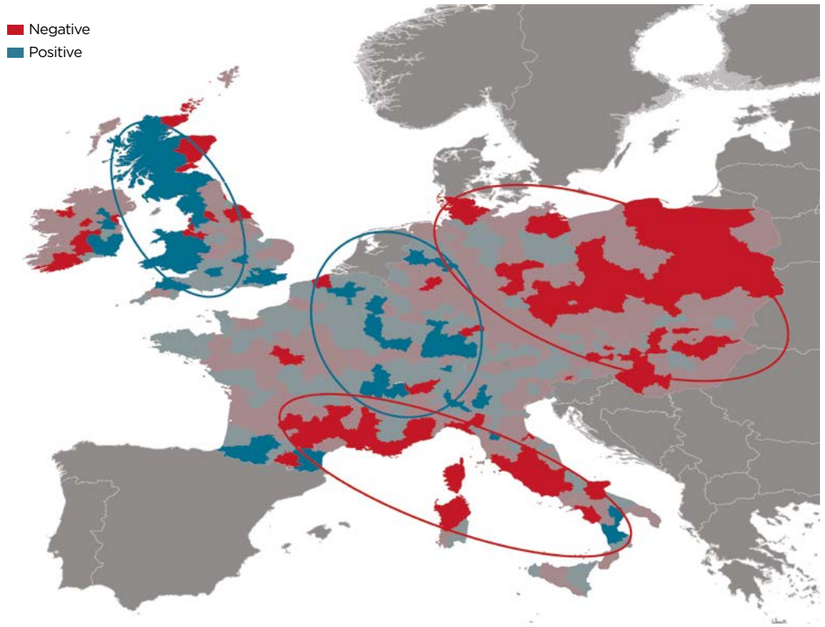
The data sets included HANZE-Events, a catalog of over 1,500 catastrophic European flood events between 1870 and 2016, and a recent database of the highest-recorded water levels based on data from over 4,200 weather stations.

"This analysis established a clear relationship between the occurrence of catastrophic flood events and the NAO phase,"

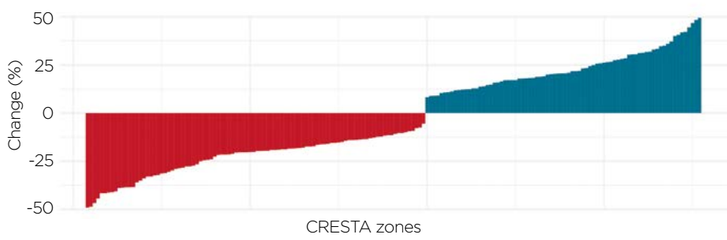
NAO flood loss correlation in winter

Pearson correlation coefficient

Source: RMS



Percentage loss change from negative to positive NAO phase



explains Stefano Zanardo, principal modeler at RMS, "and confirmed that a positive NAO increased catastrophic flooding in Northern Europe, with a negative phase influencing flooding in Southern Europe. However, to ascertain the impact on actual flood losses we turned to the model."

Modeling the loss

The HD model generated a large set of potential catastrophic flood events and quantified the associated losses. It not only factored in precipitation, but also rainfall runoff, river routing and inundation processes. Critically, the precipitation incorporated the impact of a simulated monthly NAO index as a driver for monthly rainfall.

THE HD MODEL GENERATED A LARGE SET OF POTENTIAL CATASTROPHIC FLOOD EVENTS AND QUANTIFIED THE ASSOCIATED LOSSES

"It showed that seasonal flood losses can increase or decrease by up to 50 percent between positive and negative NAOs, which is very significant," states Zanardo. "What it also revealed were distinct regional patterns. For example, a positive state resulted in increased flood activity in the U.K. and Germany. These loss patterns provide a spatial correlation of flood risk not previously detected."

Currently, NAO seasonal forecasting is limited to a few months. However, as this window expands, the potential for carriers to factor oscillation phases into flood-related renewal and capital allocation strategies will grow. Further, greater insight into spatial correlation could support more effective portfolio management.

"At this stage," he concludes, "we have confirmed the link between the NAO and flood-related losses. How this evolves to influence carriers' flood strategies is still to be seen, and a key factor will be advances in the NAO forecasting. What is clear is that oscillations such as the NAO must be included in model assumptions to truly understand flood risk."

EARTHQUAKE RISK

NEW ZEALAND INSURANCE SECTOR EXPERIENCES GROWING PAINS

Speed of change around homeowners insurance is gathering pace as insurers move to differential pricing models

New Zealand's insurance sector is undergoing fundamental change as the impact of the NZ$40 billion (US$27 billion) Canterbury Earthquake and more recent Kaikōura disaster spur efforts to create a more sustainable, risk-reflective marketplace.

In 2018, EXPOSURE examined risk-based pricing in the region following Tower Insurance's decision to adopt such an approach to achieve a "fairer and more equitable way of pricing risk." Since then, IAG, the country's largest general insurer, has followed suit, with properties in higher-risk areas forecast to see premium hikes, while it also adopts "a conservative approach" to providing insurance in peril-prone areas.

"Insurance, unsurprisingly, is now a mainstream topic across virtually every media channel in New Zealand," says Michael Drayton, a consultant at RMS. "There has been a huge shift in how homeowners insurance is viewed, and it will take time to adjust to the introduction of risk-based pricing."

Another market-changing development is the move by the country's Earthquake Commission (EQC) to increase the first layer of buildings' insurance cover it provides from NZ$100,000 to NZ$150,000 (US$68,000 to US$101,000), while lowering contents cover from NZ$20,000 (US$13,500) to zero. These changes come into force in July 2019.

Modeling the average annual loss (AAL) impact of these changes based on the updated RMS New Zealand Earthquake Industry Exposure Database shows the private sector will see a marginal increase in the amount of risk it takes on as the AAL increase from the contents exit outweighs the decrease from the buildings cover hike.

These findings have contributed greatly to the debate around the relationship between buildings and contents cover. One major issue the market has been addressing

Road cracks appeared during the 2016 Kaikoura Earthquake in New Zealand

is its ability to accurately estimate sums insured. According to Drayton, recent events have seen three separate spikes around exposure estimates.

"The first spike occurred in the aftermath of the Christchurch Earthquake," he explains, "when there was much debate about commercial building values and limits, and confusion relating to sums insured and replacement values.

"The second occurred with the move away from open-ended replacement policies in favor of sums insured for residential properties.

"Now that the EQC has removed contents cover, we are seeing another spike as the private market broaches uncertainty around content-related replacement values.

"There is very much an education process taking place across New Zealand's insurance industry," Drayton concludes. "There are multiple lessons being learned in a very short period of time. Evolution at this pace inevitably results in growing pains, but if it is to achieve a sustainable insurance market it must push on through."

VULNERABILITY

IN EQUAL MEASURE

As international efforts grow to minimize the disproportionate impact of disasters on specific parts of society, EXPOSURE looks at how close public/private collaboration will be critical to moving forward

There is a widely held and understandable belief that large-scale disasters are indiscriminate events. They weigh out devastation in equal measure, irrespective of the gender, age, social standing or physical ability of those impacted.

The reality, however, is very different. Catastrophic events expose the various inequalities within society in horrific fashion. Women, children, the elderly, people with disabilities and those living in economically deprived areas are at much greater risk than other parts of society both during the initial disaster phase and the recovery process.

Cyclone Gorky, for example, which struck Bangladesh in 1991, caused in the region of 140,000 deaths — women made up 93 percent of that colossal death toll. Similarly, in the 2004 Indian Ocean Tsunami some 70 percent of the 250,000 fatalities were women.

Looking at the disparity from an age-banded perspective, during the 2005 Kashmir Earthquake 10,000 schools collapsed resulting in the deaths of 19,000 children. Children also remain particularly vulnerable well after disasters have subsided. In 2014, a study by the University of San Francisco of death rates in the Philippines found that delayed deaths among female infants outnumbered reported typhoon deaths by 15-to-1 following an average typhoon season — a statistic widely attributed to parents prioritizing their male infants at a time of extreme financial difficulty.

And this disaster disparity is not limited to developing nations as some may assume. Societal groups in developed nations can be just as exposed to a disproportionate level of risk.

During the recent Camp Fire in California, figures revealed that residents in the town of Paradise aged 75 or over were 8 times more likely to die than the average for all other age bands. This age-related disparity was only marginally smaller for Hurricane Katrina in 2005.

The scale of the problem

These alarming statistics are now resonating at the highest levels. Growing recognition of the inequalities in disaster-related fatality ratios is now influencing global thinking on disaster response and management strategies. Most importantly, it is a central tenet of the Sendai Framework for Disaster Risk Reduction 2015–2030, which demands an "all-of-society engagement and partnership" to reduce risk that encompasses those "disproportionately affected by disasters."

Yet a fundamental problem is that disaggregated data for specific vulnerable groups is not being captured for the majority of disasters.

"There is a growing acknowledgment across many nations that certain groupings within society are disproportionately impacted by disasters," explains Alison Dobbin, principal catastrophe risk modeler at RMS. "Yet the data required to get a true sense of the scale of the problem simply isn't being utilized and disaggregated in an effective manner post-disaster. And without exploiting and building on the data that is available, we cannot gain a working understanding of how best to tackle the multiple issues that contribute to it."

A woman carries items through Port-au-Prince, Haiti, after the 2010 earthquake destroyed the city

"WE CAN GO BEYOND STATISTICS COLLECTION, AND MODEL THOSE FACTORS WHICH LEAD TO DISCRIMINATIVE OUTCOMES"

— NICOLA HOWE, RMS

The criticality of capturing disaster datasets specific to particular groups and age bands is clearly flagged in the Sendai Framework. Under the "Guiding Principles," the document states: "Disaster risk reduction requires a multi-hazard approach and inclusive risk-informed decision-making based on the open exchange and dissemination of disaggregated data, including by sex, age and disability, as well as on easily accessible, up-to-date, comprehensible, science-based, non-sensitive risk information, complemented by traditional knowledge."

Gathering the data

Effective data capture, however, requires a consistent approach to the collection of disaggregated information across all groups — first, to understand the specific impacts of particular perils on distinct groups, and second, to generate guidance, policies and standards for preparedness and resilience that reflect the unique sensitivities.

While efforts to collect and analyze aggregated data are increasing, the complexities involved in ascertaining differentiated vulnerabilities to specific groups are becoming increasingly apparent, as Nicola Howe, lead catastrophe risk modeler at RMS, explains.

"You have to remember that social vulnerability varies from place to place and is often in a state of flux," she says. "People move, levels of equality change, lifestyles evolve and the economic conditions in specific regions fluctuate. Take gender-based vulnerabilities for example. They tend not to be as evident in societies that demonstrate stronger levels of sexual equality.

"Experiences during disasters are also highly localized and specific to the particular event or peril," she continues. "There are multiple variables that can influence the impact on specific groups. Cultural, political and economic factors are strong influencers, but other aspects such as the time of day or the particular season can also have a significant effect on outcomes."

This creates challenges, not only for attributing specific vulnerabilities to particular groups and establishing policies designed to reduce those vulnerabilities, but also for assessing the extent to which the measures are having the desired outcomes.

Establishing data consistency and overcoming the complexities posed by this universal problem will require the close collaboration of all key participants.

"It is imperative that governments and NGOs recognize the important part that the private sector can play in working together and converting relevant data into the targeted insight required to support effective decision-making in this area," says Dobbin.

A collective response

At time of writing, Dobbin and Howe were preparing to join a diverse panel of speakers at the UN's 2019 Global Platform for Disaster Risk Reduction in Switzerland. This year's convening marks the third consecutive conference at which RMS has participated. Previous events have seen Robert Muir-Wood, chief research officer, and Daniel Stander, global managing director, present on the resilience dividend andrisk finance.

The title of this year's discussion is "Using Gender, Age and Disability-Responsive Data to Empower Those Left Furthest Behind."

"One of our primary aims at the event," says Howe, "will be to demonstrate the central role that the private sector, and in our case the risk modeling community, can play in helping to bridge the data gap that exists and help promote the meaningful way in which we can contribute."

The data does, in some cases, exist and is maintained primarily by governments and NGOs in the form of census data, death certificates, survey results and general studies.

"Companies such as RMS provide the capabilities to convert this raw data

Vulnerability in numbers

CYCLONE GORKY
Bangladesh, 1991

140,000
deaths

93%
were women

INDIAN OCEAN TSUNAMI
2004

250,000
fatalities

70%
were women

KASHMIR EARTHQUAKE
Pakistan, 2005

10,000
schools collapsed

19,000
children died

CAMP FIRE CALIFORNIA
2018

Residents aged 75 or over were

8 times
more likely to die than the average for all age bands

into actionable insight," Dobbin says. "We model from hazard, through vulnerability and exposure, all the way to the financial loss. That means we can take the data and turn it into outputs that governments and NGOs can use to better integrate disadvantaged groups into resilience planning."

But it's not simply about getting access to the data. It is also about working closely with these bodies to establish the questions that they need answers to. "We need to understand the specific outputs required. To this end, we are regularly having conversations with many diverse stakeholders," adds Dobbin.

While to date the analytical capabilities of the risk modeling community have not been directed at the social vulnerability issue in any significant way, RMS has worked with organizations to model human exposure levels for perils. Collaborating with the Workers' Compensation Insurance Rating Bureau of California (WCIRB), a private, nonprofit association, RMS conducted probabilistic earthquake analysis on exposure data for more than 11 million employees. This included information about the occupation of each employee to establish potential exposure levels for workers' compensation cover in the state.

"We were able to combine human exposure data to model the impact of an earthquake, ascertaining vulnerability based on where employees were likely to be, their locations, their specific jobs, the buildings they worked in and the time of day that the event occurred," says Howe. "We have already established that we can incorporate age and gender data into the model, so we know that our technology is capable of supporting detailed analyses of this nature on a huge scale."

She continues: "We must show where the modeling community can make a tangible difference. We bring the ability to go beyond the collection of statistics post-disaster and to model those factors that lead to such strong differences in outcomes, so that we can identify where discrimination and selective outcomes are anticipated before they actually happen in disasters. This could be through identifying where people are situated in buildings at different times of day, by gender, age, disability, etc. It could be by modeling how different people by age, gender or disability will respond to a warning of a tsunami or a storm surge. It could be by modeling evacuation protocols to demonstrate how inclusive they are."

Strengthening the synergies

A critical aspect of reducing the vulnerability of specific groups is to ensure disadvantaged elements of society become more prominent components of mitigation and response planning efforts. A more people-centered approach to disaster management was a key aspect of the forerunner to the Sendai Framework, the Hyogo Framework for Action 2005–2015. The plan called for risk reduction practices to be more inclusive and engage a broader scope of stakeholders, including those viewed as being at higher risk.

This approach is a core part of the "Guiding Principles" that underpin the Sendai Framework. It states: "Disaster risk reduction requires an all-of-society engagement and partnership. It also requires empowerment and inclusive, accessible and non-discriminatory participation, paying special attention to people disproportionately affected by disasters, especially the poorest. A gender, age, disability and cultural perspective should be integrated in all policies and practices, and women and youth leadership should be promoted."

The Framework also calls for the empowerment of women and people with disabilities, stating that enabling them "to publicly lead and promote gender equitable and universally accessible response, recovery, rehabilitation and reconstruction approaches."

This is a main area of focus for the U.N. event, explains Howe. "The conference will explore how we can promote greater involvement among members of these disadvantaged groups in resilience-related discussions, because at present we are simply not capitalizing on the insight that they can provide.

"Take gender for instance. We need to get the views of those disproportionately impacted by disaster involved at every stage of the discussion process so that we can ensure that we are generating gender-sensitive risk reduction strategies, that we are factoring universal design components into how we build our shelters, so women feel welcome and supported. Only then can we say we are truly recognizing the principles of the Sendai Framework."

WILDFIRE

THE FLAMES BURN HIGHER

With California experiencing two of the most devastating seasons on record in consecutive years, EXPOSURE asks whether wildfire now needs to be considered a peak peril

Some of the statistics for the 2018 U.S. wildfire season appear normal. The season was a below-average year for the number of fires reported — 58,083 incidents represented only 84 percent of the 10-year average. The number of acres burned — 8,767,492 acres — was marginally above average at 132 percent.

Two factors, however, made it exceptional. First, for the second consecutive year, the Great Basin experienced intense wildfire activity, with some 2.1 million acres burned — 233 percent of the 10-year average. And second, the fires destroyed 25,790 structures, with California accounting for over 23,600 of the structures destroyed, compared to a 10-year U.S. annual average of 2,701 residences, according to the National Interagency Fire Center.

As of January 28, 2019, reported insured losses for the November 2018 California wildfires, which included the Camp and Woolsey Fires, were at US$11.4 billion, according to the California Department of Insurance. Add to this the insured losses of US$11.79 billion reported in January 2018 for the October and December 2017 California events, and these two consecutive wildfire seasons constitute the most devastating on record for the wildfire-exposed state.

Reaching its peak?

Such colossal losses in consecutive years have sent shockwaves through the (re)insurance industry and are forcing a reassessment of wildfire's secondary status in the peril hierarchy.

According to Mark Bove, natural catastrophe solutions manager at Munich Reinsurance America, wildfire's status needs to be elevated in highly exposed areas. "Wildfire should certainly be considered a peak peril in areas such as California and the Intermountain West," he states, "but not for the nation as a whole."

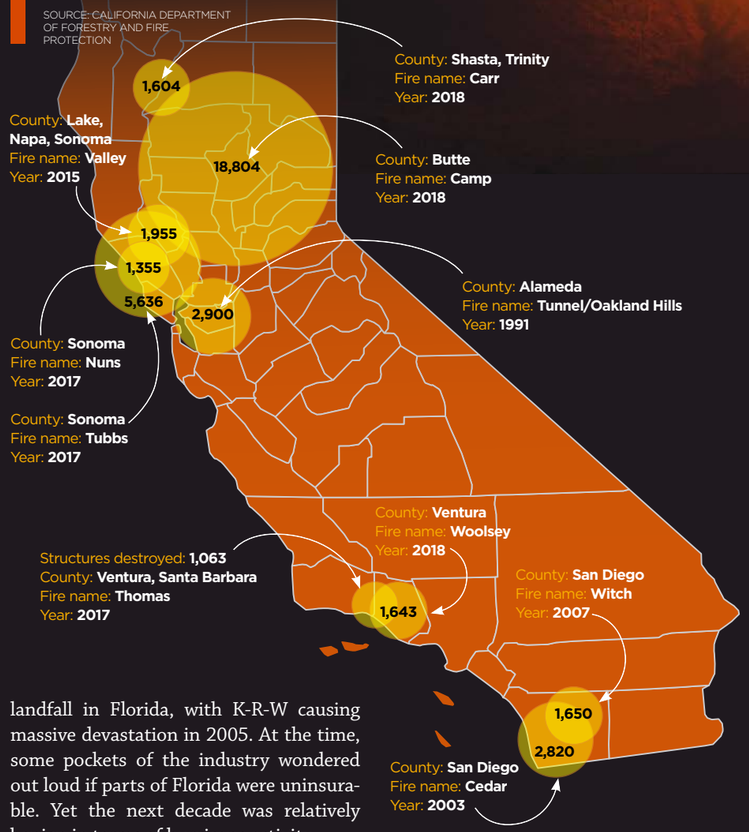
His views are echoed by Chris Folkman, senior director of product management at RMS. "Wildfire can no longer be viewed purely as a secondary peril in these exposed territories," he says. "Six of the top 10 fires for structural destruction have occurred in the last 10 years in the U.S., while seven of the top 10, and 10 of the top 20 most destructive wildfires in California history have occurred since 2015. The industry now needs to achieve a level of maturity with regard to wildfire that is on a par with that of hurricane or flood."

However, he is wary about potential knee-jerk reactions to this hike in wildfire-related losses. "There is a strong parallel between the 2017-18 wildfire seasons and the 2004-05 hurricane seasons in terms of people's gut instincts. 2004 saw four hurricanes make

Wildfires

Top 10 California fires by number of structures destroyed

SOURCE: CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION



landfall in Florida, with K-R-W causing massive devastation in 2005. At the time, some pockets of the industry wondered out loud if parts of Florida were uninsurable. Yet the next decade was relatively benign in terms of hurricane activity.

"The key is to adopt a balanced, long-term view," thinks Folkman. "At RMS, we think that fire severity is here to stay, while the frequency of big events may remain volatile from year-to-year."

A fundamental re-evaluation

The California losses are forcing (re)insurers to overhaul their approach to wildfire, both at the individual risk and portfolio management levels.

"The 2017 and 2018 California wildfires have forced one of the biggest re-evaluations of a natural peril since Hurricane Andrew in 1992," believes Bove. "For both California wildfire and Hurricane Andrew, the industry didn't fully comprehend the potential loss severities. Catastrophe models were relatively new and had not gained market-wide adoption, and many organizations were not systematically monitoring and limiting large accumulation exposure in high-risk areas. As a result, the shocks to the industry were similar."

For decades, approaches to underwriting have focused on the wildland-urban interface (WUI), which represents the area where exposure and vegetation meet. However, exposure levels in these areas are increasing sharply. Combined with excessive amounts of burnable vegetation, extended wildfire seasons, and climate-change-driven increases in temperature and extreme weather conditions, these factors are combining to cause a significant hike in exposure potential for the (re)insurance industry.

A recent report published in PNAS entitled "Rapid Growth of the U.S. Wildland-Urban Interface Raises Wildfire Risk" showed that between 1990 and 2010 the new WUI area increased by 72,973 square miles (189,000 square kilometers) — larger than Washington State. The report stated: "Even though the WUI occupies less than one-tenth of the land area of the conterminous United States, 43 percent of all new houses were built there, and 61 percent of all new WUI houses were built in areas that were already in the WUI in 1990 (and remain in the WUI in 2010)."

"The WUI has formed a central component of how wildfire risk has been underwritten," explains Folkman, "but you cannot simply adopt a black-and-white approach to risk selection based on properties within or outside of the zone. As recent losses, and in particular the 2017 Northern California wildfires, have shown, regions outside of the WUI zone considered low risk can still experience devastating losses."

For Bove, while focus on the WUI is appropriate, particularly given the Coffey Park disaster during the 2017 Tubbs Fire, there is not enough focus on the intermix areas. This is the area where properties are interspersed with vegetation.

"In some ways, the wildfire risk to intermix communities is worse than that at the interface," he explains. "In an intermix fire, you have both a wildfire and an urban conflagration impacting the town at the same time, while in interface locations the fire has largely transitioned to an urban fire.

"In an intermix community," he continues, "the terrain is often more challenging and limits firefighter access to the fire as well as evacuation routes for local residents. Also, many intermix locations are far from large urban centers, limiting the amount of firefighting resources immediately available to start combatting the blaze, and this increases the potential for a fire in high-wind conditions to become a significant threat. Most likely we'll see more scrutiny and investigation of risk in intermix towns across the nation after the Camp Fire's decimation of Paradise, California."

Rethinking wildfire analysis

According to Folkman, the need for greater market maturity around wildfire will require a rethink of how the industry currently analyzes the exposure and the tools it uses.

"Historically, the industry has relied primarily upon deterministic tools to quantify U.S. wildfire risk," he says, "which relate overall frequency and severity of events to the presence of fuel and climate conditions, such as high winds, low moisture and high temperatures."

While such tools can prove valuable for addressing "typical" wildland fire events, such as the 2017 Thomas Fire in Southern California, their flaws have been exposed by other recent losses.

"Such tools insufficiently address major catastrophic events that occur beyond the WUI into areas of dense exposure," explains Folkman, "such as the Tubbs Fire in Northern California in 2017. Further, the unprecedented severity of recent wildfire events has exposed the weaknesses in maintaining a historically based deterministic approach."

While the scale of the 2017-18 losses has focused (re)insurer attention on California, companies must also recognize the scope for potential catastrophic wildfire risk extends beyond the boundaries of the western U.S.

"While the frequency and severity of large, damaging fires is lower outside California," says Bove, "there are many areas where the risk is far from negligible." While acknowledging that the broader western U.S. is seeing increased risk due to WUI expansion, he adds: "Many may be surprised that similar wildfire risk exists across most of the southeastern U.S., as well as sections of the northeastern U.S., like in the Pine Barrens of southern New Jersey."

As well as addressing the geographical gaps in wildfire analysis, Folkman believes the industry must also recognize the data gaps limiting their understanding.

"There are a number of areas that are understated in underwriting practices currently, such as the far-ranging impacts of ember accumulations and their potential to ignite urban conflagrations, as well as vulnerability of particular structures and mitigation measures such as defensible space and fire-resistant roof coverings."

In generating its US$9 billion to US$13 billion loss estimate for the Camp and Woolsey Fires, RMS used its recently launched North America Wildfire High-Definition (HD) Models to simulate the ignition, fire spread, ember accumulations and smoke dispersion of the fires.

"In assessing the contribution of embers, for example," Folkman states, "we modeled the accumulation of embers, their wind-driven travel and their contribution to burn hazard both within and beyond the fire perimeter. Average ember contributions to structure damage and destruction is approximately 15 percent, but in a wind-driven event such as the Tubbs Fire this figure is much higher. This was a key factor in the urban conflagration in Coffey Park."

The model also provides full contiguous U.S. coverage, and includes other model innovations such as ignition and footprint simulations for 50,000 years, flexible occurrence definitions, smoke and evacuation loss across and beyond the fire perimeter, and vulnerability and mitigation measures on which RMS collaborated with the Insurance Institute for Business & Home Safety.

Smoke damage, which leads to loss from evacuation orders and contents replacement, is often overlooked in risk assessments, despite composing a tangible portion of the loss, says Folkman. "These are very high-frequency, medium-sized losses and must be considered. The Woolsey Fire saw 260,000 people evacuated, incurring hotel, meal and transport-related expenses. Add to this smoke damage, which often results in high-value contents replacement, and you have a potential sea of medium-sized claims that can contribute significantly to the overall loss."

A further data resolution challenge relates to property characteristics. While primary property attribute data is typically well captured, believes Bove, many secondary characteristics key to wildfire are either not captured or not consistently captured.

"This leaves the industry overly reliant on both average model weightings and risk scoring tools. For example, information about defensible spaces, roofing and siding materials, protecting vents and soffits from ember attacks, these are just a few of the additional fields that the industry will need to start capturing to better assess wildfire risk to a property."

A highly complex peril

Bove is, however, conscious of the simple fact that "wildfire behavior is extremely complex and non-linear." He continues: "While visiting Paradise, I saw properties that did everything correct with regard to wildfire mitigation but still burned and risks that did everything wrong and survived. However, mitigation efforts can improve the probability that a structure survives."

"With more data on historical fires," Folkman concludes, "more research into mitigation measures and increasing awareness of the risk, wildfire exposure can be addressed and managed. But it requires a team mentality, with all parties — (re)insurers, homeowners, communities, policymakers and land-use planners — all playing their part."

"AVERAGE EMBER CONTRIBUTIONS TO STRUCTURE DAMAGE AND DESTRUCTION IS APPROXIMATELY 15 PERCENT, BUT IN A WIND-DRIVEN EVENT SUCH AS THE TUBBS FIRE THIS FIGURE IS MUCH HIGHER" — CHRIS FOLKMAN, RMS

NATURAL CATASTROPHES

LIVING IN A WORLD OF CONSTANT CATASTROPHES

(Re)insurance companies are waking up to the reality that we are in a riskier world and the prospect of 'constant catastrophes' has arrived, with climate change a significant driver

In his hotly anticipated annual letter to shareholders in February 2019, Warren Buffett, the CEO of Berkshire Hathaway and acclaimed "Oracle of Omaha," warned about the prospect of "The Big One" — a major hurricane, earthquake or cyberattack that he predicted would "dwarf Hurricanes Katrina and Michael." He warned that "when such a mega-catastrophe strikes, we will get our share of the losses and they will be big — very big."

The question insurance and reinsurance companies need to ask themselves is whether they are prepared for the potential of an intense U.S. landfalling hurricane, a Tōhoku-size earthquake event and a major cyber incident if these types of combined losses hit their portfolio each and every year, says Mohsen Rahnama, chief risk modeling officer at RMS. "We are living in a world of constant catastrophes," he says. "The risk is changing, and carriers need to make an educated decision about managing the risk.

"So how are (re)insurers going to respond to that? The broader perspective should be on managing and diversifying the risk in order to balance your portfolio and survive major claims each year," he continues. "Technology, data and models can help balance a complex global portfolio across all perils while also finding the areas of opportunity."

A barrage of weather extremes

How often, for instance, should insurers and reinsurers expect an extreme weather loss year like 2017 or 2018? The combined insurance losses from natural disasters in 2017 and 2018 according to Swiss Re sigma were US$219 billion, which is the highest-ever total over a two-year period. Hurricanes Harvey, Irma and Maria delivered the costliest hurricane loss for one hurricane season in 2017.

Contributing to the total annual insurance loss in 2018 was a combination of natural hazard extremes, including Hurricanes Michael and Florence, Typhoons Jebi, Trami and Mangkhut, as well as heatwaves, droughts, wildfires, floods and convective storms.

While it is no surprise that weather extremes like hurricanes and floods occur every year, (re)insurers must remain diligent about how such risks are changing with respect to their unique portfolios.

Looking at the trend in U.S. insured losses from 1980–2018, the data clearly shows losses are increasing every year, with climate-related losses being the primary drivers of loss, especially in the last four decades (even allowing for the fact that the completeness of the loss data over the years has improved).

Measuring climate change

With many non-life insurers and reinsurers feeling bombarded by the aggregate losses hitting their portfolios each year, insurance and reinsurance companies have started looking more closely at the impact that climate change is having on their books of business, as the costs associated with weather-related disasters increase.

The ability to quantify the impact of climate change risk has improved considerably, both at a macro level and through attribution research, which considers the impact of climate change on the likelihood of individual events. The application of this research will help (re)insurers reserve appropriately and gain more insight as they build diversified books of business.

"THE USE OF NEW TECHNOLOGY, DATA AND ANALYTICS WILL HELP US PREPARE FOR UNPREDICTED 'BLACK SWAN' EVENTS AND MINIMIZE THE CATASTROPHIC LOSSES"

— MOHSEN RAHNAMA, RMS

Take Hurricane Harvey as an example. Two independent attribution studies agree that the anthropogenic warming of Earth's atmosphere made a substantial difference to the storm's record-breaking rainfall, which inundated Houston, Texas, in August 2017, leading to unprecedented flooding. In a warmer climate, such storms may hold more water volume and move more slowly, both of which lead to heavier rainfall accumulations over land.

Attribution studies can also be used to predict the impact of climate change on the return-period of such an event, explains Pete Dailey, vice president of model development at RMS. "You can look at a catastrophic event, like Hurricane Harvey, and estimate its likelihood of recurring from either a hazard or loss point of view. For example, we might estimate that an event like Harvey would recur on average say once every 250 years, but in today's climate, given the influence of climate change on tropical precipitation and slower moving storms, its likelihood has increased to say a 1-in-100-year event," he explains.

"This would mean the annual probability of a storm like Harvey recurring has increased more than twofold from 0.4 percent to 1 percent, which to an insurer can have a dramatic effect on their risk management strategy."

Climate change studies can help carriers understand its impact on the frequency and severity of various perils and throw light on correlations between perils and/or regions, explains Dailey. "For a global (re) insurance company with a book of business spanning diverse perils and regions, they want to get a handle on the overall effect of climate change, but they must also pay close attention to the potential impact on correlated events.

"For instance, consider the well-known correlation between the hurricane season in the North Atlantic and North Pacific," he continues. "Active Atlantic seasons are associated with quieter Pacific seasons and vice versa. So, as climate change affects an individual peril, is it also having an impact on activity levels for another peril? Maybe in the same direction or in the opposite direction?"

Understanding these "teleconnections" is just as important to an insurer as the more direct relationship of climate to hurricane activity in general, thinks Dailey.

"Even though it's hard to attribute the impact of climate change to a particular location, if we look at the impact on a large book of business, that's actually easier to do in a scientifically credible way," he adds. "We can quantify that and put uncertainty around that quantification, thus allowing our clients to develop a robust and objective view of those factors as a part of a holistic risk management approach."

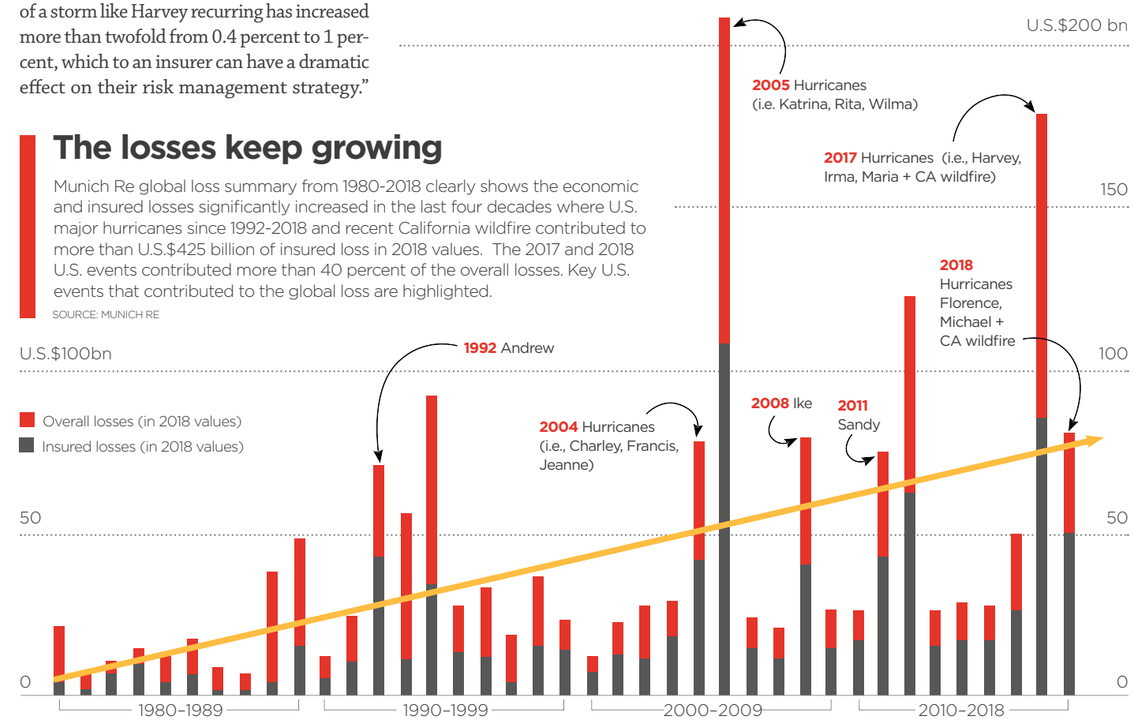
Of course, the influence of climate change is easier to understand and measure for some perils than others. "For example, we can observe an incremental rise in sea level annually — it's something that is happening right in front of our eyes," says Dailey. "So, sea-level rise is very tangible in that we can observe the change year over year. And we can also quantify how the rise of sea levels is accelerating over time and then combine that with our hurricane model, measuring the impact of sea-level rise on the risk of coastal storm surge, for instance."

Each peril has a unique risk signature with respect to climate change, explains Dailey. "When it comes to a peril like severe convective storms — tornadoes and hail storms for instance — they are so localized that it's difficult to attribute climate change to the future likelihood of such

The losses keep growing

Munich Re global loss summary from 1980-2018 clearly shows the economic and insured losses significantly increased in the last four decades where U.S. major hurricanes since 1992-2018 and recent California wildfire contributed to more than U.S.$425 billion of insured loss in 2018 values. The 2017 and 2018 U.S. events contributed more than 40 percent of the overall losses. Key U.S. events that contributed to the global loss are highlighted.

SOURCE: MUNICH RE



Inflation adjusted via country-specific consumer price index

PREPARING FOR A LOW-CARBON ECONOMY

Regulation also has an important role in pushing both (re)insurers and large corporates to map and report on the likely impact of climate change on their business, as well as explain what steps they have taken to become more resilient. In the U.K., the Prudential Regulation Authority (PRA) and Bank of England have set out their expectations regarding firms' approaches to managing the financial risks from climate change.

Meanwhile, a survey carried out by the PRA found that 70 percent of U.K. banks recognize the risk climate change poses to their business. Among their concerns are the immediate physical risks to their business models — such as the exposure to mortgages on properties at risk of flood and exposure to countries likely to be impacted by increasing weather extremes. Many have also started to assess how the transition to a low-carbon economy will impact their business models and, in many cases, their investment and growth strategy.

"Financial policymakers will not drive the transition to a low-carbon economy, but we will expect our regulated firms to anticipate and manage the risks associated with that transition," said Bank of England Governor Mark Carney, in a statement.

The transition to a low-carbon economy is a reality that (re)insurance industry players will need to prepare for, with the impact already being felt in some markets. In Australia, for instance, there is pressure on financial institutions to withdraw their support from major coal projects. In the aftermath of the Townsville floods in February and widespread drought across Queensland, there have been renewed calls to boycott plans for Australia's largest thermal coal mine.

To date, 10 of the world's largest (re)insurers have stated they will not provide property or construction cover for the US$15.5 billion Carmichael mine and rail project. And in its "Mining Risk Review 2018," broker Willis Towers Watson warned that finding insurance for coal "is likely to become increasingly challenging — especially if North American insurers begin to follow the European lead."

an event. But for wildfire risk, there's high correlation with climate change because the fuel for wildfires is dry vegetation, which in turn is highly influenced by the precipitation cycle." Satellite data from 1993 through to the present shows there is an upward trend in the rate of sea-level rise, for instance, with the current rate of change averaging about 3.2 millimeters per year. Sea-level rise, combined with increasing exposures at risk near the coastline, means that storm surge losses are likely to increase as sea levels rise more quickly.

"In 2010, we estimated the amount of exposure within 1 meter above the sea level, which was US$1 trillion, including power plants, ports, airports and so forth," says Rahnama. "Ten years later, the exact same exposure was US$2 trillion. This dramatic exposure change reflects the fact that every centimeter of sea-level rise is subjected to a US$2 billion loss due to coastal flooding and storm surge as a result of even small hurricanes.

"And it's not only the climate that is changing," he adds. "It's the fact that so much building is taking place along the high-risk coastline. As a result of that, we have created a built-up environment that is actually exposed to much of the risk."

Rahnama highlighted that because of an increase in the frequency and severity of events, it is essential to implement prevention measures by promoting mitigation credits to minimize the risk. He says: "How can the market respond to the significant losses year after year. It is essential to think holistically to manage and transfer the risk to the insurance chain from primary to reinsurance, capital market, ILS, etc.," he continues.

"The art of risk management, lessons learned from past events and use of new technology, data and analytics will help to prepare for responding to unpredicted 'black swan' type of events and being able to survive and minimize the catastrophic losses."

Strategically, risk carriers need to understand the influence of climate change whether they are global reinsurers or local primary insurers, particularly as they seek to grow their business and plan for the future. Mergers and acquisitions and/or organic growth into new regions and perils will require an understanding of the risks they are taking on and how these perils might evolve in the future.

"WE CAN OBSERVE AN INCREMENTAL RISE IN SEA LEVEL ANNUALLY — IT'S SOMETHING THAT IS HAPPENING RIGHT IN FRONT OF OUR EYES" — PETE DAILEY, RMS

There is potential for catastrophe models to be used on both sides of the balance sheet as the influence of climate change grows. Dailey points out that many insurance and reinsurance companies invest heavily in real estate assets. "You still need to account for the risk of climate change on the portfolio, whether you're insuring properties or whether you actually own them, there's no real difference." In fact, asset managers are more inclined to a longer-term view of risk when real estate is part of a long-term investment strategy. Here, climate change is becoming a critical part of that strategy.

"What we have found is that often the team that handles asset management within a (re)insurance company is an entirely different team to the one that handles catastrophe modeling," he continues. "But the same modeling tools that we develop at RMS can be applied to both of these problems of managing risk at the enterprise level.

"In some cases, a primary insurer may have a one-to-three-year plan, while a major reinsurer may have a five-to-10-year view because they're looking at a longer risk horizon," he adds. "Every time I go to speak to a client — whether it be about our new flood model or our North American hurricane model — the question of climate change inevitably comes up. So, it's become apparent this is no longer an academic question, it's actually playing into critical business decisions on a daily basis."

STRATEGY

THE FUTURE OF RISK MANAGEMENT

(Re)insuring new and emerging risks requires data and, ideally, a historical loss record upon which to manage an exposure. But what does the future of risk management look like when so many of these exposures are intangible or unexpected?

Sudden and dramatic breakdowns become more likely in a highly interconnected and increasingly polarized world, warns the "Global Risks Report 2019" from the World Economic Forum (WEF). "Firms should focus as much on risk response as on risk mitigation," advises John Drzik, president of global risk and digital at Marsh, one of the report sponsors. "There's an inevitability to having a certain number of shock events, and firms should focus on how to respond to fast-moving events with a high degree of uncertainty."

Macrotrends such as climate change, urbanization and digitization are all combining in a way that makes major claims more impactful when things go wrong. But are all low-probability/high-consequence events truly beyond our ability to identify and manage?

Dr. Gordon Woo, catastrophist at RMS, believes that in an age of big data and advanced analytics, information is available that can help corporates, insurers and reinsurers to understand the plethora of new and emerging risks they face. "The sources of emerging risk insight are out there," says Woo. "The challenge is understanding the significance of the information available and ensuring it is used to inform decision-makers."

However, it is not always possible to gain access to the insight needed. "Some of the near-miss data regarding new software and designs may be available online," says Woo. "For example, with the Boeing 737 Max 8, there were postings by pilots where control problems were discussed prior to the Lion Air disaster of October 2018. Equally, intelligence information on terrorist plots may be available from online terrorist chatter. But typically,

it is much harder for individuals to access this information, other than security agencies.

"Peter Drucker [consultant and author] was right when he said: 'If you can't measure it, you can't improve it,'" he adds. "And this is the issue for (re)insurers when it comes to emerging risks. There is currently not a lot of standardization between risk compliance systems and the way the information is gathered, and corporations are still very reluctant to give information away to insurers."

The intangibles protection gap

While traditional physical risks, such as fire and flood, are well understood, well modeled and widely insured, new and emerging risks facing businesses and communities are increasingly intangible and risk transfer solutions are less widely available.

While there is an important upside to many technological innovations, for example, there are also downsides that are not yet fully understood or even recognized, thinks Robert Muir-Wood, chief research officer of science and technology at RMS.

"Last year's Typhoon Jebi caused coastal flooding in the Kansai region of Japan," he says. "There were a lot of cars on the quayside close to where the storm made landfall and many of these just caught on fire. It burnt out a large number of cars that were heading for export.

"The reason for the fires was the improved capability of batteries in cars," he explains. "And when these batteries are immersed in water they burst into flames. So, with this technology you've created a whole new peril.

"As new technology emerges, new risks emerge," he concludes. "And it's not as though the old risks go away. They sort of morph and they always will. Clearly the more that software becomes a critical part of how things function, then there is more of an opportunity for things to go wrong."

From nonphysical-damage business interruption and reputational harm to the theft of intellectual property and a cyber data breach, the ability for underwriters to get a handle on these risks and potential losses is one of the industry's biggest modern-day challenges. The dearth of products and services for esoteric commercial risks is known as the "intangibles protection gap," explains Muir-Wood.

"There is this question within the whole span of risk management of organizations — of which an increasing amount is intangible — whether they will be able to buy insurance for those elements of their risk that they feel they do not have control over."

While the (re)insurance industry is responding with new products and services geared toward emerging risks, such as cyber, there are some organizational perils, such as reputational risk, that are best addressed by instilling the right risk management culture and setting the tone from the top within organizations, thinks Wayne Ratcliffe, head of risk management at SCOR.

"Enterprise risk management is about taking a holistic view of the company and having multidisciplinary teams brainstorming together," he says. "It's a tendency of human nature to work in silos in which everyone has their own domain to protect and to work on, but working across an organization is the only way to carry out proper risk management.

"There are many causes and consequences of reputational risk, for instance," he continues. "When I think of past examples where things have gone horribly wrong — and there are so many of them, from Deepwater Horizon to Enron — in certain cases there were questionable ethics and a failure in risk management culture. Companies have to set the tone at the top and then ensure it has spread across the whole organization. This requires constant checking and vigilance."

The best way of checking that risk management procedures are being adhered to is by being really close to the ground, thinks Ratcliffe. "We're moving too far into a world of emails and communication by Skype. What people need to be doing is talking to each other in person and cross-checking facts. Human contact is essential to understanding the risk."

"THERE IS CURRENTLY NOT A LOT OF STANDARDIZATION BETWEEN RISK COMPLIANCE SYSTEMS AND THE WAY THE INFORMATION IS GATHERED" — GORDON WOO, RMS

"NEW TECHNOLOGIES ARE CREATING MORE OPPORTUNITIES BUT THEY'RE ALSO MAKING SOCIETY MORE VULNERABLE TO SOPHISTICATED CYBERATTACKS"

— WAYNE RATCLIFFE, SCOR

Spotting the next "black swan"

What of future black swans? As per Donald Rumsfeld's "unknown unknowns," so called black swan events are typically those that come from left field. They take everyone by surprise (although are often explained away in hindsight) and have an impact that cascades through economic, political and social systems in ways that were previously unimagined, with severe and widespread consequences.

"As (re)insurers we can look at past data, but you have to be aware of the trends and forces at play," thinks Ratcliffe. "You have to be aware of the source of the risk. In 'The Big Short' by Michael Lewis, the only person who really understood the impending subprime collapse was the one who went house-to-house asking people if they were having trouble paying their mortgages, which they were.

"Sometimes you need to go out of the bounds of data analytics into a more intuition-based way of picking up signals where there is no data," he continues. "You need imagination and to come up with scenarios that can happen based on a group of experts talking together and debating how exposures can connect and interconnect.

"It's a little dangerous to base everything on big data measurement and statistics, and at SCOR we talk about the 'art and science of risk,'" he continues. "And science is more than statistics. We often need hard science behind what we are measuring. A single-point estimate of the measure is not sufficient. We also need confidence intervals corresponding to a range of probabilities."

In its "Global Risks Report 2019," the WEF examines a series of "what-if" future shocks and asks if its scenarios, while not predictions, are at least "a reminder of the need to think creatively about risk and to expect the unexpected?" The WEF believes future shocks could come about as a result of advances in technology, the depletion of global resources and other major macrotrends clashing in new and extreme ways.

"The world is becoming hyperconnected," says Ratcliffe. "People are becoming more dependent on social media, which is even shaping political decisions, and organizations are increasingly connected via technology and the internet of things. New technologies are creating more opportunities but they're also making society more vulnerable to sophisticated cyberattacks. We have to think about the systemic nature of it all."

As governments are pressured to manage the effects of climate change, for instance, will the use of weather manipulation tools — such as cloud seeding to induce or suppress rainfall — result in geopolitical conflict? Could biometrics and AI that recognize and respond to emotions be used to further polarize and/or control society? And will quantum computing render digital cryptography obsolete, leaving sensitive data exposed?

The risk of cyberattack was the No. 1 risk identified by business leaders in virtually all advanced economies in the WEF's "Global Risks Report 2019," with concern about both data breach and direct attacks on company infrastructure causing business interruption. The report found that cyberattacks continue to pose a risk to critical infrastructure, noting the attack in July 2018 that compromised many U.S. power suppliers.

In the attack, state-backed Russian hackers gained remote access to utility-company control rooms in order to carry out reconnaissance. However, in a more extreme scenario the attackers were in a position to trigger widespread blackouts across the U.S., according to the Department of Homeland Security.

Woo points to a cyberattack that impacted Norsk Hydro, the company that was responsible for a massive bauxite spill at an aluminum plant in Brazil last year, with a targeted strain of ransomware known as "LockerGoga." With an apparent motivation to wreak revenge for the environmental damage caused, hackers gained access to the company's IT infrastructure, including the control systems at its aluminum smelting plants. He thinks a similar type of attack by state-sponsored actors could cause significantly greater disruption if the attackers' motivation was simply to cause damage to industrial control systems.

Woo thinks cyber risk has significant potential to cause a major global shock due to the interconnected nature of global IT systems. "WannaCry was probably the closest we've come to a cyber 911," he explains. "If the malware had been released earlier, say January 2017 before the vulnerability was patched, losses would have been a magnitude higher as the malware would have spread like measles as there was no herd immunity. The release of a really dangerous cyber weapon with the right timing could be extremely powerful."

LOCATION INTELLIGENCE API

Risk data delivered to underwriting platforms via application programming interfaces (API) is bringing granular exposure information and model insights to high-volume risks

UNDERWRITING WITH 20/20 VISION

The insurance industry boasts some of the most sophisticated modeling capabilities in the world. And yet the average property underwriter does not have access to the kind of predictive tools that carriers use at a portfolio level to manage risk aggregation, streamline reinsurance buying and optimize capitalization.

Detailed probabilistic models are employed on large and complex corporate and industrial portfolios. But underwriters of high-volume business are usually left to rate risks with only a partial view of the risk characteristics at individual locations, and without the help of models and other tools.

"There is still an insufficient amount of data being gathered to enable the accurate assessment and pricing of risks [that] our industry has been covering for decades," says Talbir Bains, founder and CEO of managing general agent (MGA) platform Volante Global.

Access to insights from models used at the portfolio level would help underwriters make decisions faster and more accurately, improving everything from risk screening and selection to technical pricing. However, accessing this intellectual property (IP) has previously been difficult for higher-volume risks, where to be competitive there simply isn't the time available to liaise with cat modeling teams to configure full model runs and build a sophisticated profile of the risk.

Many insurers invest in modeling post-bind in order to understand risk aggregation in their portfolios, but Ross Franklin, senior director of data product management at RMS, suggests this is too late. "From an underwriting standpoint, that's after the horse has bolted — that insight is needed upfront when you are deciding whether to write and at what price."

By not seeing the full picture, he explains, underwriters are often making decisions with a completely different view of risk from the portfolio managers in their own company. "Right now, there is a disconnect in the analytics used when risks are being underwritten and those used downstream as these same risks move through to the portfolio."

Cut off from the insight

Historically, underwriters have struggled to access complete information that would allow them to better understand the risk characteristics at individual locations. They must manually gather what risk information they can from various public- and private-sector sources. This helps them make broad assessments of catastrophe exposures, such as FEMA flood zone or distance to coast. These solutions often deliver data via web portals or spreadsheets and reports — not into the underwriting systems they use every day. There has been little innovation to increase the breadth, and more importantly, the usability of data at the point of underwriting.

"We have used risk data tools but they are too broad at the hazard level to be competitive — we need more detail," notes one senior property underwriter, while another simply states: "When it comes to flood, honestly, we're gambling."

Misaligned and incomplete information prevents accurate risk selection and pricing, leaving the insurer open to negative surprises when underwritten risks make their way onto the balance sheet. Yet very few data providers burrow down into granular detail on individual risks by identifying what material a property is made of, how many stories it is, when it was built and what it is used for, for instance, all of which can make a significant difference to the risk rating of that individual property.

"Vulnerability is critical to accurate underwriting. Hazard alone is not enough. When you put building characteristics together with the hazard information, you form a deeper understanding of the vulnerability of a specific property to a particular hazard. For a given location, a five-story building built from reinforced concrete in the 1990s will naturally react very differently in a storm than a two-story wood-framed house built in 1964 — and yet current underwriting approaches often miss this distinction," says Franklin.

In response to demand for change, RMS developed a Location Intelligence application programming interface (API), which allows preformatted RMS risk information to be easily distributed from its cloud platform via the API into any third-party or in-house underwriting software. The technology gives underwriters access to key insights on their desktops, as well as informing fully automated risk screening and pricing algorithms.

> **"VULNERABILITY IS CRITICAL TO ACCURATE UNDERWRITING. HAZARD ALONE IS NOT ENOUGH"**
>
> — ROSS FRANKLIN, RMS

Understanding the vulnerability of a specific property to a particular hazard: This elevated house in Mexico Beach, Florida came through Hurricane Michael almost unscathed
PHOTO: JOHNNY MILANO

The API allows underwriters to systematically evaluate the profitability of submissions, triage referrals to cat modeling teams more efficiently and tailor decision-making based on individual property characteristics. It can also be overlaid with third-party risk information.

"The emphasis of our latest product development has been to put rigorous cat peril risk analysis in the hands of users at the right points in the underwriting workflow," says Franklin. "That's a capability that doesn't exist today on high-volume personal lines and SME business, for instance."

Historically, underwriters of high-volume business have relied on actuarial analysis to inform technical pricing and risk ratings. "This analysis is not usually backed up by probabilistic modeling of hazard or vulnerability and, for expediency, risks are grouped into broad classes. The result is a loss of risk specificity," says Franklin.

"As the data we are supplying derives from the same models that insurers use for their portfolio modeling, we are offering a fully connected-up, consistent view of risk across their property books, from inception through to reinsurance."

With additional layers of information at their disposal, underwriters can develop a more comprehensive risk profile for individual locations than before.

"In the traditional insurance model, the bad risks are subsidized by the good — but that does not have to be the case. We can now use data to get a lot more specific and generate much deeper insights," says Franklin.

And if poor risks are screened out early, insurers can be much more precise when it comes to taking on and pricing new business that fits their risk appetite. Once risks are accepted, there should be much greater clarity on expected costs should a loss occur. The implications for profitability are clear.

Harnessing automation

While improved data resolution should drive better loss ratios and underwriting performance, automation can attack the expense ratio by stripping out manual processes, says Franklin. "Insurers want to focus their expensive, scarce underwriting resources on the things they do best — making qualitative expert judgments on more complex risks."

This requires them to shift more decision-making to straight-through processing using sophisticated underwriting guidelines, driven by predictive data insight. Straight-through processing is already commonplace in personal lines and is expected to play a growing role in commercial property lines too.

"Technology has a critical role to play in overcoming this data deficiency through greatly enhancing our ability to gather and analyze granular information, and then to feed that insight back into the underwriting process almost instantaneously to support better decision-making," says Bains. "However, the infrastructure upon which much of the insurance model is built is in some instances decades old and making the fundamental changes required is a challenge."

Many insurers are already in the process of updating legacy IT systems, making it easier for underwriters to leverage information such as past policy information at the point of underwriting.

But technology is only part of the solution. The quality and granularity of the data being input is also a critical factor. Are brokers collecting sufficient levels of data to help underwriters assess the risk effectively?

That's where Franklin hopes RMS can make a real difference. "For the cat element of risk, we have far more predictive, higher-quality data than most insurers use right now," he says. "Insurers can now overlay that with other data they hold to give the underwriter a far more comprehensive view of the risk."

Bains thinks a cultural shift is needed across the entire insurance value chain when it comes to expectations of the quantity, quality and integrity of data. He calls on underwriters to demand more good quality data from their brokers, and for brokers to do the same of assureds. "Technology alone won't enable that; the shift is reliant upon everyone in the chain recognizing what is required of them."

RESEARCH

With each new stride in hazard research and science comes the ability to better calculate and differentiate risk

OPENING PANDORA'S BOX

Efforts by RMS scientists and engineers to better understand liquefaction vulnerability is shedding new light on the secondary earthquake hazard. However, this also makes it more likely that, unless they can charge for the risk, (re)insurance appetite will diminish for some locations while also increasing in other areas. A more differentiated approach to underwriting and pricing is an inevitable consequence of investment in academic research.

Once something has been learned, it cannot be unlearned, explains Robert Muir-Wood, chief research officer of science and technology at RMS. "In the old days, everybody paid the same for insurance because no one had the means to actually determine how risk varied from location to location, but once you learn how to differentiate risk well, there's just no going back. It's like Pandora's box has been opened.

"At RMS we are neutral on risk," he adds. "It's our job to work for all parties and provide the best neutral science-based perspective on risk, whether that's around climate change in California or earthquake risk in New Zealand. And we and our clients believe that by having the best science-based assessment of risk they can make effective decisions about their risk management."

Spotting a gap in the science

On September 28, 2018, a large and shallow M7.5 earthquake struck Central Sulawesi, Indonesia, triggering a tsunami over 2 meters in height. The shaking and tsunami caused widespread devastation in and around the provincial capital Palu, but according to a report published by the GEER Association, it was liquefaction and landslides that caused thousands of buildings to collapse in a catastrophe that claimed over 4,000 lives. It was the latest example of a major earthquake that showed that liquefaction — where the ground moves and behaves as if it is a liquid — can be a much bigger driver of loss than previously thought.

The Tōhoku Earthquake in Japan during 2011 and the New Zealand earthquakes in Christchurch in 2010 and 2011 were other high-profile examples. The earthquakes in New Zealand caused a combined insurance industry loss of US$22.8-US$26.2 billion, with widespread liquefaction undermining the structural integrity of hundreds of buildings. Liquefaction has been identified by a local engineer as causing 50 percent of the loss.

Now, research carried out by RMS scientists is helping insurers and other stakeholders to better understand the impact that liquefaction can have on earthquake-related losses. It is also helping to pinpoint other parts of the world that are highly vulnerable to liquefaction following earthquake.

"Before Christchurch we had not appreciated that you could have a situation where a midrise building may be completely undamaged by the earthquake shaking, but the liquefaction means that the building has suffered differential settlement leaving the floors with a slight tilt, sufficient to be declared a 100 percent loss," explains Muir-Wood.

"We realized for the first time that you actually have to model the damage separately," he continues. "Liquefaction is completely separate to the damage caused by shaking. But in the past we treated them as much of the same. Separating out the hazards has big implications for how we go about modeling the risk, or identifying other situations where you are likely to have extreme liquefaction at some point in the future."

The missing link

Tim Ancheta, a risk modeler for RMS based in Newark, California, is responsible for developing much of the understanding about the interaction between groundwater depth and liquefaction. Using data from the 2011 earthquake in Christchurch and boring data from numerous sites across California to calculate groundwater depth, he has been able to identify sites that are particularly prone to liquefaction.

"I was hired specifically for evaluating liquefaction and trying to develop a model," he explains. "That was one of the key goals for my position. Before I joined RMS about seven years back, I was a post-doctoral researcher at PEER — the Pacific Earthquake Engineering Research Center at Berkeley — working on ground motion research. And my doctoral thesis was on the spatial variability of ground motions."

Joining RMS soon after the earthquakes in Christchurch had occurred meant that Ancheta had access to a wealth of new data on the behavior of liquefaction. For the first time, it showed the significance of groundwater depth in determining where the hazard was likely to occur. Research, funded by the New Zealand government, included a survey of liquefaction observations, satellite imagery, a time series of groundwater levels as well as the building responses. It also included data collected from around 30,000 borings.

"All that had never existed on such a scale before," says Ancheta. "And the critical factor here was they investigated both liquefaction sites and non-liquefaction sites — prior surveys had only focused on the liquefaction sites."

Whereas the influence of soil type on liquefaction had been reasonably well understood prior to his research, previous studies had not adequately incorporated groundwater depth. "The key finding was that if you don't have a clear understanding of where the groundwater is shallow or where it is deep, or the transition — which is important — where you go from a shallow to deep groundwater depth, you can't turn on and off the liquefaction properly when an earthquake happens," reveals Ancheta.

Ancheta and his team have gone on to collect and digitize groundwater data, geology and boring data in California, Japan, Taiwan and India with a view to gaining a granular understanding of where liquefaction is most likely to occur. "Many researchers have said that liquefaction properties are not regionally dependent, so that if you know the geologic age or types of soils, then you know approximately how susceptible soils can be to liquefaction. So an important step for us is to validate that claim," he explains.

> **"THERE ARE TWO GENERAL TYPES OF LIQUEFACTION THAT ARE JUST SO SEVERE THAT NO ONE SHOULD BUILD ON THEM"**
>
> — TIM ANCHETA, RMS

The ability to use groundwater depth has been one of the factors in predicting potential losses that has significantly reduced uncertainty within the RMS suite of earthquake models, concentrating the losses in smaller areas rather than spreading them over an entire region. This has clear implications for (re)insurers and policymakers, particularly as they seek to determine whether there are any "no-go" areas within cities.

"There are two general types of liquefaction that are just so severe that no one should build on them," says Ancheta. "One is lateral spreading where the extensional strains are just too much for buildings. In New Zealand, lateral spreading was observed at numerous locations along the Avon River, for instance."

California is altogether more challenging, he explains. "If you think about all the rivers that flow through Los Angeles or the San Francisco Bay Area, you can try and model them in the same way as we did with the Avon River in Christchurch. We discovered that not all rivers have a similar lateral spreading on either side of the riverbank. Where the river courses have been reworked with armored slopes or concrete linings — essentially reinforcement — it can actually mitigate liquefaction-related displacements."

The second type of severe liquefaction is called "flow slides" triggered by liquefaction, which is where the soil behaves almost like a landslide. This was the type of liquefaction that occurred in Central Sulawesi when the village of Balaroa was entirely destroyed by rivers of soil, claiming entire neighborhoods.

"It's a type of liquefaction that is extremely rare," he adds. "but they can cause tens to hundreds of meters of displacement, which is why they are so devastating. But it's much harder to predict the soils that are going to be susceptible to them as well as you can for other types of liquefaction surface expressions."

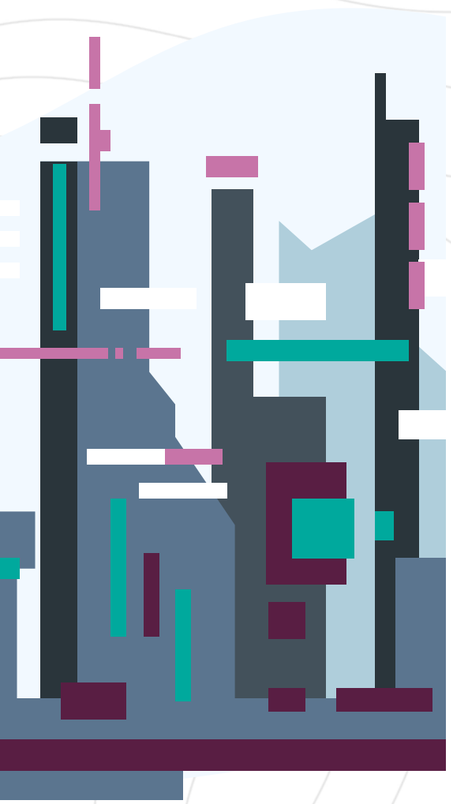
Ancheta is cognizant of the fact that a no-build zone in a major urban area is likely to be highly contentious from the perspective of homeowners, insurers and policymakers, but insists that now the understanding is there, it should be acted upon.

"The Pandora's box for us in the Canterbury Earthquake Sequence was the fact that the research told us where the lateral spreading would occur," he says. "We have five earthquakes that produced lateral spreading so we knew with some certainty where the lateral spreading would occur and where it wouldn't occur. With severe lateral spreading you just have to demolish the buildings affected because they have been extended so much."

TECH TALK

THE ART OF EMPOWERMENT

A new app from RMS intuitively synthesizes complex risk data for a single location, helping underwriters and coverholders to rate and select risks at the touch of a button



The more holistic view of risk a property underwriter can get, the better decisions they are likely to make. In order to build up a detailed picture of risk at an individual location, underwriters or agents at coverholders have, until now, had to request exposure analytics on single risks from their portfolio managers and brokers. Also, they had to gather supplementary risk data from a range of external resources, whether it is from Catastrophe Risk Evaluation and Standardizing Target Accumulations (CRESTA) zones to look-ups on Google Maps.

This takes valuable time, requires multiple user licenses and can generate information that is inconsistent with the underlying modeling data at the portfolio level. As the senior manager at one managing general agent (MGA) tells EXPOSURE, this misalignment of data means underwriting decisions are not always being made with confidence. This makes the buildup of unwanted risk aggregation in a particular area a very real possibility, invariably resulting in "senior management breathing down my neck."

With underwriters in desperate need of better multi-peril data at the point of underwriting, RMS has developed an app that leverages sophisticated modeling information, as well as a view of the portfolio of locations underwritten, to be easily understood and quickly actionable at the point of underwriting. But it also goes further as the app can integrate with a host of data providers so users can enter any address into the app and quickly see a detailed breakdown of the natural and human-made hazards that may put the property at risk.

In addition to synthesized RMS data, users can also harness third-party risk data to overlay responsive map layers such as, arson, burglary and fire-protection insights, and other indicators that can help the underwriter better understand the characteristics of a building and assess whether it is well maintained or at greater risk.

The app allows the underwriter to generate detailed risk scores for each location in a matter of seconds. It also assigns a simple color coding for each hazard, in line with the insurer's appetite: whether that's green for acceptable levels of risk all the way to red for risks that require more complex analysis. Crucially, users can view individual locations in the context of the wider portfolio, helping them avoid unwanted risk aggregation and write more consistently to the correct risk appetite.

The app goes a level further by allowing clients to use a sophisticated rules engine that takes into account the client's underwriting rules. This enables the app to recommend possible next steps for each location — whether that's to accept the risk, refer it for further investigation or reject it based on breaching certain criteria.

"We decided to build an app exclusively for underwriters to help them make quick decisions when assessing risks," explains Shaheen Razzaq, senior director at RMS. "The app provides a systematic method to identify locations that don't meet your risk strategy so you can focus on finding the risks that do.

"People are moving toward simple digital tools that synthesize information quickly," he adds. "Underwriters tell us they want access to science without having to rely on others and the ability to screen and understand risks within seconds."

And as the underlying data behind the application is based on the same RMS modeling information used at the portfolio level, this guarantees data consistency at all points in the chain. "Deep RMS science, including data from all of our high-definition models, is now being delivered to people upstream, building consistency and understanding," says Razzaq.

The app has made it simple to build in the customer's risk appetite and their view of risk. "One of the major advantages of the app is that it is completely configurable by the customer. This could be assigning red-amber-green to perils with certain scores, setting rules for when it should recommend rejecting a location, or integrating a customer's proprietary data that may have been developed using their underwriting and claims experience — which is unique to each company." Reporting to internal and external stakeholders is also managed by the app.

And above all, says Razzaq, it is simple to use, priced at an accessible level and requires no technical skill, allowing underwriters to make quick, informed decisions from their desktops and tablet devices — and soon their smartphones.

In complex cases where deeper analysis is required or when models should be run, working together with cat modelers will still be a necessity. But for most risks, underwriters will be able to quickly screen and filter risk factors, reducing the need to consult their portfolio managers or cat modeling teams. "With underwriting assistants a thing of the past, and the expertise the cat modelers offer being a valuable but finite resource, it's our responsibility to understand risk at the point of underwriting," one underwriter explains.

THE APP ALLOWS THE UNDERWRITER TO GENERATE DETAILED RISK SCORES FOR EACH LOCATION IN A MATTER OF SECONDS

"As a risk decision-maker, when I need to make an assessment on a particular location, I need access to insights in a timely and efficient manner, so that I can make the best possible decision based on my business," another underwriter adds.

The app is not intended to replace the deep analysis that portfolio management teams do, but instead reduce the number of times they are asked for information by their underwriters, giving them more time to focus on the job at hand — helping underwriters assess the most complex of risks.

Bringing coverholders on board

Similar efficiencies can be gained on coverholder/delegated-authority business. In the past, there have been issues with coverholders providing coverage that takes a completely different view of risk to the syndicate or managing agent that is providing the capacity.

RMS has ensured the app works for coverholders, to give them access to shared analytics, managing agent rules and an enhanced view of hazards. It is hoped this will both improve underwriting decision-making by the coverholders and strengthen delegated-authority relationships.

Coverholder business continues to grow in the Lloyd's and company markets, and delegating authorities often worry whether the risks underwritten on their behalf are done so with the best possible information available. A better scenario is when the coverholder contacts the delegating authority to ask for advice on a particular location, but receiving multiple referral calls each day from coverholders seeking decisions on individual risks can be a drain on these growing businesses' resources.

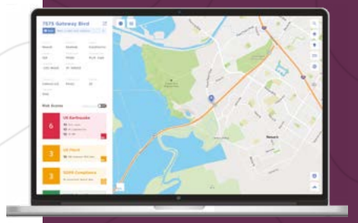
"Delegated authorities obviously want coverholders to write business doing the proper risk assessments, but on the other hand, if the coverholder is constantly pinging the managing agent for referrals, they aren't a good partner," says a senior manager at one MGA. "We can increase profitability if we improve our current workflow, and that can only be done with smart tools that make risk management simpler," he notes, adding that better risk information tools would allow his company to redeploy staff.

A recent Lloyd's survey found that 55 percent of managing agents are struggling with resources in their delegated-authority teams. And with the Lloyd's Corporation also seeking to cleanse the market of sub-par performers after swinging to a loss in 2018, any solution that drives efficiency and enables coverholders to make more informed decisions can only help drive up standards.

"It was actually an idea that stemmed from our clients' underwriting coverholder business. If we can equip coverholders with these tools, managing agents will receive fewer phone calls while being confident that the coverholder is writing good business in line with the agreed rules," says Razzaq. "Most coverholders lack the infrastructure, budget and human resources to run complex models. With this app, RMS can now offer them deeper analytics, by leveraging expansive model science, in a more accessible way and at a more affordable price."

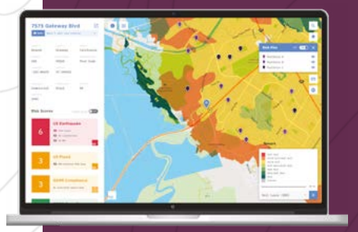
APP FEATURES

1 Enter an address and quickly understand which hazard may affect the location

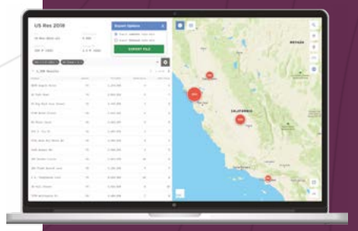


2 View high-resolution hazard maps within seconds

3 View other locations in context with the location being analyzed



4 Import multiple locations



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