Andrew: Now & Then

Opinion/Analysis

Hurricane Andrew brought with it great devastation and loss a quarter-century ago, but also helped cement the value of well-informed catastrophe modelling. Fast forward 25 years and, once again, rethinking modelling is in order.

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Catastrophe models existed for several years before Hurricane Andrew, but it was this event that validated their credibility and led to their enhancement and widespread adoption. Now, 25 years after this industry-changing event, the models are again ripe for change.

CONVERGING CONTRIBUTORS

In the mid-1980s, computers and statistical techniques — such as Monte Carlo simulation — were becoming more accessible to scientists, engineers and other researchers. These are the tools that enabled the development of the first hurricane simulation model used to estimate the damages and insured losses from possible future storms. At the time, the first Cat model indicated that a Category 5 hurricane making a direct hit on Miami could cost the industry US$60 billion.

Loss misperception

Even though there were a handful of companies using the models at the time, no one could quite believe that number because the largest hurricane loss before Andrew had been US$4 billion caused by Hugo in 1989. A contemporaneous AIRAC (All Industry Research Advisory Council) study in 1986 of two US$7 billion hurricanes solidified in the minds of insurers that US$7 billion was a worst-case scenario.

The industry had severely underestimated the loss potential because in the decades prior to Andrew, there were no major landfalling hurricanes near populated areas.

During this same period, coastal property values were soaring. For example, Florida's population doubled between 1970 and 1990.

Move to probabilistic techniques

At about the same time, insurers in the United States had stopped tracking the locations and values of the properties they were insuring, instead using premiums to estimate how large hurricane losses could be. However, premium growth had not kept pace with exposure growth.

Most U.S. insurers were using the Maximum Foreseeable Loss (MFL), which was calculated by adding up premiums by region and then multiplying by factor. For example, Florida premiums would be multiplied by two and Northeast premiums would be multiplied by 1.5.

The maximum regional number was the MFL and this was the amount of reinsurance that insurers would purchase.

The Cat models used actual property values to estimate the losses and introduced the concept of simulating potential future events using probabilistic techniques. For this reason, the numbers were simply more reliable.

After Hurricane Andrew, reinsurers were the first to jump on this new technology, and the Bermuda class of 1993 was formed by investors and underwriters who embraced the models and understood how to use them to better price reinsurance treaties. In any case, the contraction of reinsurance capacity meant prices, terms and conditions were very favourable to the reinsurance market.

Each shock event — 9/11 and Hurricane Katrina — led to a new class of Bermuda reinsurers, ultimately resulting in the island becoming the centre of gravity for catastrophe reinsurance.

Catastrophe bonds and the insurance-linked securities (ILS) market also followed on the heels of Hurricane Andrew and supplied more capacity into the market. The Cat models were instrumental in pricing these transactions, and many would say this market could not have developed without the models.

DIFFERENCES, SIMILARITIES

Today, Cat models are well-established as the global standard methodology for catastrophe risk assessment, and are now used for rate-making, underwriting and reinsurance and risk transfer decision-making. Because of the models, the industry is much better prepared for catastrophe losses compared to the pre-Andrew days.

However, one thing that is similar to the pre-Andrew days is the tendency to focus on one number. Before Andrew, it was the MFL; today, it is the PML (Probable Maximum Loss).

In general, the insurance industry has gravitated to relying on single points from the model-generated exceedance probability (EP) curves. Typically, the 1-in-100, 1-in-200, and/or 1-in-250 year PML are used, depending on the peril and region. It is important to note, though, that these numbers are highly uncertain and can swing widely between model vendors and from model update to update.

More importantly, some major catastrophe events since Andrew have been surprises despite the widespread adoption of the models. For example, the models did not prepare the industry for Hurricane Katrina, the Tohoku earthquake or the Fort McMurray wildfire.

While the Cat models are based on sophisticated statistical and modelling techniques, their accuracy is limited by the data on historical events. In order to develop the underlying model assumptions, scientists use the data on past events to project future frequencies, locations and severities. The less data there is, the higher the uncertainty in the model and the model loss estimates.

In light of this, insurers are starting to look more deeply into the models to better understand the model assumptions and how changing those assumptions impact the loss estimates. The new generation of open Cat models is enabling insurers to dive into the model components and even customize the models to be more accurate and reflective of actual claims experience.

VIEW OF CANADA

Canada is fortunate to be vulnerable to perils with very low frequency, but this also means there is very little historical data to assess the probabilities of future events and, therefore, high uncertainty around the potential losses.

For example, Canada's highest exposure is to earthquakes generated by the Cascadia Subduction Zone (CSZ). Scientists believe the CSZ is capable of generating a magnitude 9 event, but cannot predict the exact location and return period of such a rupture. The ground motion that such an event would cause in and around Vancouver is also highly uncertain, along with the resulting damage and insured losses.

A 2014 report from the U.S. Geological Survey (USGS) notes that there are many possible rupture scenarios — magnitudes and locations — with a best estimate return period of 500 years. The USGS uses a logic tree to represent the scenarios and probabilities in the CSZ. Each branch of the logic tree is a plausible scenario, but the scenarios would result in widely differing losses.

Rather than collapsing all of that information into one number, insurers benefit from understanding the full range of potential scenarios and the resulting losses.

Catastrophes are like real estate — it is all about location. Insurers can see which scenarios adversely impact their books of business and can manage any exposure concentrations with which they are not comfortable. By not illustrating all potential scenarios, PMLs can give a false sense of security.

Insurers are also using the new open Cat models to build their own models, such as wildfire models for Canada. In essence, a Cat model is a set of events with intensity footprints and a set of damage functions. The damage functions link the intensities with exposures to estimate the losses. For a wildfire, for example, damage functions are straightforward because most of the area impacted will experience 100% loss.

Intensity footprints can be created or even obtained from outside sources. For example, the image to the left is a real-time footprint of the Fort McMurray fire from NASA's Fire Information for Resources Management System. This type of data can be directly downloaded into a modelling platform and used to calculate losses.

BUILDING ON EXPERIENCE

Technology has significantly advanced since Hurricane Andrew and the amount of data available now was unimaginable in 1992. With the right tools, insurers can leverage what has been learned about modelling over the past 25 years to develop more insightful information on their catastrophe exposure.

Especially for the types of perils impacting Canada, the models cannot give "answers." Rather, they provide a robust framework for better understanding the risk and potential losses. Modelling tools continue to evolve to accommodate more sophisticated model users and the trend of increasing catastrophe losses.

Editor's Picks

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