Vantage Risk

A History of Continuous Improvement

Introduction

Since its inception in the late 1980s, the catastrophe model industry has continued to improve by upgrading current models and introducing new ones. Some of the changes have been due to new scientific research and data or the availability of faster computing techniques, others due to market requirements. However, most of the model changes have occurred after a major catastrophic event, either because the models failed in some way or didn't exist at all.

A Historical Timeline

Figure 1 shows a non-comprehensive timeline of significant catastrophic events and the model reaction, or change in thinking, to those events. We can pick out several major themes:

- Wet tropical cyclones, i.e. those that drop a lot of rain and/or bring significant storm surge, have always caused problems for the models;
- Wildfires and flooding were issues long before models were built for these perils;
- Man-made perils (terrorism, cyber) required significant events before thought was given to modeling.

The general impression is that the catastrophe modeling industry is *reactive* rather than proactive, and events are constantly surprising the industry. In fact, in only one case (pandemic modeling) was modeling available, if not widely used, prior to a significant event occurring. The problem is a case of not knowing what we don't know – an event or behavior we haven't seen before is hard to model or even imagine. There are some events that are truly unimaginable, until they happen, the terror attacks of 9/11 being an example of this.

It is worth reading Richard Trubshaw's now widely seen comment in the MAP 2020 Managing Agent report[1]:

> *This brings me on to a perennial bugbear: the inadequate calibration of so-called proprietary rating models…. The problem is, what they are being fed (via the counterparty's intermediary) is risk-output from a severely under-cooked model. I find it particularly ironic that industry veterans will regularly opine on global warming and climate change, quite rightly pointing out the very real threats to the industry and societies around the World. Yet their organisations are still pricing to the same mis-calibrated metrics that were in place 5 years ago, despite the heightened catastrophic frequency since 2016, in both the Atlantic and Pacific, despite deterioration in loss estimates, despite the proliferation in wildfires in California and Australia – and that is observed reality, let alone whether the future will actually be even more extreme.*

[1] Syndicate 2791 Report and Financial Statements, 31 December 2020, page 10.

Trubshaw's comment has been read as a knock against cat modeling firms, which it is to some extent, but, reading the entire quote in context, he is also arguing that users of cat models often use them unmindfully, or perhaps cynically, and there should be a recognition that models are flawed, incomplete, and constantly evolving. The more we know, and the more events we see and analyse, the better the models get. But it does take some time to get there and we need to recognize that there is a lag between a problem being identified and the resolution appearing in a model.

Why Have Models At All?

The expectation that catastrophe models should provide 'correct' losses after an event is a prevalent one in the industry. There is widespread castigation of modelers when the losses are 'wrong' or when they react, or overreact, to major events. Given that models are seemingly wrong so often, why use them at all?

We should recognize what value catastrophe modeling provide in the first place and what they are meant to do. They are not meant to, nor have been built to, provide a loss estimate for real event. Some models do provide these estimates but that it not their primary purpose. It should be noted that it can take many years post-event to just understand the full nature of the hazard presented by a given event – the windfield for Hurricane Andrew has been reevaluated multiple times and it took over 10 years post-landfall for Andrew to be recategorized as a Cat 5 hurricane, having been initially pegged as a Cat 4[2].

Cat models are meant to answer these questions:

- What future events can occur?
- What frequency do we can expect from these events?
- What is the potential damage/loss from these events?

Note that we're asking what can occur and what potential loss may be, not what will occur or what the *actual* loss will be (if we knew that, no one would need insurance!).

Cat models, then, provide estimates based on evolving (and incomplete) science and data. It would be a mistake to take cat models as truth but at the same time it would be unfortunate not to use them as a tool to inform underwriting and risk management. Like any tool, they need to used mindfully and in full awareness of the flaws they possess.

[2] Landsea, C.W., et a, A Reanalysis of Hurricane Andrew's Intensity, Bulletin of the American Meteorological Society, Nov 2004, pp1699-1712.

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Catastrophic Events Timeline

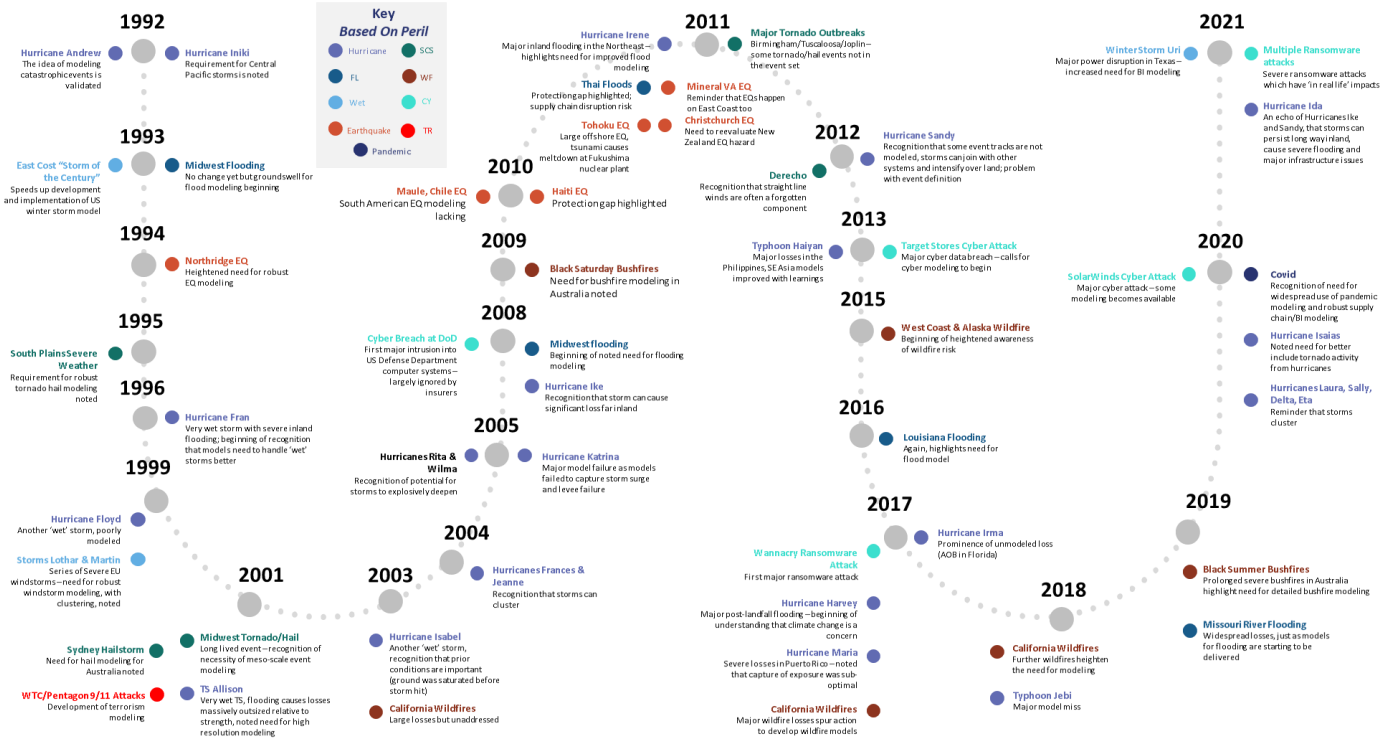

Figure 1: A selective timeline of catastrophic events.

What Can We See Coming?

Recent events can guide us to what some of the model changes we're likely to see over the next couple of years may be. Specifically, we can expect:

- Increased penetration and acceptance of high-resolution flood modeling.
- Improved modeling of business interruption and supply chain issues.
- Cyber modeling. Presently, there is little consensus on how to model cyber insurance losses. How does the cat modeling paradigm (which is based on the essential idea of overlaying events on a geospatial exposure) extend to cyber (which has non-geospatial exposure)? Further, the different attack types, from DDOS to ransomware, are all classified as 'cyber' but are very different perils. We expect the next few years to provide some clarity and consensus on how to consistently measure cyber exposure and then how to model cyber risk. We will be expanding on this topic in a future paper.

There are other model changes which we expect to see which don't explicitly fall out of recent events.

- Climate change. It probably goes without saying that many of the catastrophic events seen over the last 10 years (if not longer) have likely been enhanced by climate change. We are near the beginning of being able to attribute insured losses in part to climate change. Frequencies and severities of atmospheric perils have likely already begun to change, with more change to come. We expect the cat models to start explicitly accounting for this.
- Severe heat/drought. While not mentioned in the list of catastrophic events listed in this paper, severe heat and/or drought events have caused losses to agriculture and have led to a significant number of direct and indirect deaths on a regular basis for most of the last 40 years (and longer). Climate change is certain to increase the likelihood and length of these events. Drought/heat events regularly cause billions of dollars of economic loss and, historically, occur more frequently than winterstorms and wildfires, and cover a wider area. It is only a matter of time before this peril becomes an insurance issue.
- Infrastructure. Related to business interruption and loss amplification, the aging infrastructure in the G7 nations will start to cause increased losses from catastrophic events. Whether due to aging water infrastructure (sewers and water distribution), aging power infrastructure (notably national grids) or internet infrastructure, a failure in infrastructure could well be significant loss factor in future catastrophic events. One need only look at the Fukushima Daiichi nuclear plant failure during the Tohoku earthquake event to note this. We will return to the aging infrastructure issue in a future paper.

Conclusions

Models change, either due to new science or new observations. There will likely never be a situation where a cat model is 'finished.' The challenges to come – climate change, infrastructure issues, new perils – will all be incorporated into the models at some point but, in the meantime, at Vantage Risk, we are bridging the gap with our data and analytics skills so that we can serve our clients and partners better.

About the Author

Dr. Steve Smith is the Head of Research & Development at Vantage Risk.

Steve has spent over 20 years in re/insurance in analytic roles. He is a Fellow of the Royal Meteorological Society, a Certified Catastrophe Risk Management Professional, a Chartered Physicist, and holds a doctorate in atmospheric physics and a first class honours degree in physics, both from the University of Oxford. He was the 2007 recipient of The Review Worldwide Reinsurance Future Industry Leader award and a 2008 recipient of a Risk & Insurance Risk Innovator award