TO WHAT EXTENT DO CATASTROPHE MODELS REFLECT RECENT NAT-CAT LOSS TRENDS?

TIGERRISK PARTNERS

> *A series of above average years for nat-cat - can this be attributed to chance and volatility?*

There has been considerable and increasing debate during the last few years about the extent to which climate change exacerbates the volatility of insured losses arising from natural catastrophes. An excellent Howden report 'Climate in Peril'[1] articulates well the scientific evidence and its link to the recent empirical nat cat loss experience. Commentary and debate extends to whether nat cat models adequately capture the full range of nat cat risks they are intended to represent.

In light of 2022 likely representing another above average year for nat cat, we have reproduced and extended market loss studies into the recent two decades of global, insured natural catastrophe losses to address these questions.

1. NATURAL CATASTROPHE LOSSES

It is commonly accepted in the scientific and insurance communities that the last twenty years has seen an increase in insured losses from natural catastrophes. Figure 1 shows this split between 'weather' perils and all other.

For the purpose of this article, we have divided this period into two halves to show that over the most recent period (2012-2021) the average annual global insured nat-cat loss was $70bn, 23% higher than the average from the previous period (2002-2011), $57bn[2].

Two questions immediately arise. Firstly, to what extent can these increases be considered wholly or partly due to climate change? And secondly, are the causes of insured loss now adequately captured within the widely available natural catastrophe models such that (re)insurers with material exposure can use them with confidence?

Figure 1

***Figure 1: Total Global Insured Natural Catastrophe Losses** indexed to 2021 prices 'only'*

Source: Swiss Re, CRESTA, PCS. Man-made and COVID losses excluded. No indexation for wealth and other insurance market effects.

For example, in considering the first question does accounting for human economic and social influences wholly or partly explain the observable headline trend? Within the second question, is it reasonable to expect that (re)insurers should have sufficient familiarity with the models that they can apply their own adjustments in line with experience?

2. WHAT UNDERLIES THE OBSERVED TREND IN NATURAL CATASTROPHE LOSSES?

There are well-known methodological challenges in accounting for observed trends in nat cat losses.

For example, the reported loss trends commonly referenced across the insurance industry often simply inflate for changes in repair costs over time. Therefore, they do not account for the size of the underlying markets or any change in insurance penetration, terms and conditions.

Then, establishing the extent to which insurance and reinsurance deductibles or attachment points have kept pace with increased exposure trends may skew loss trends upward for those where the deductible or attachment point has remained fixed.

Looking for loss trends is also inherently challenging when considering both small and large events. Should larger events be discarded from any such analysis? When looking at large events is there sufficient data to be confident on loss trends? After all, that's one reason why models are used – to fill in the gaps where this is not enough historical data.

Finally, any visible trends may just be due to chance. Recent history is just one loss pick from many possible outcomes.

What we can say with reasonable confidence is that we would expect to see increases in losses with increased exposure and property values, partially offset by improvements in building codes over time, which catastrophe models can help us quantify.

We have, therefore, tested the hypothesis that trends may be an artefact of the indexation method assumed when 'on-levelling' losses from prior years.

TO DEMONSTRATE THE IMPORTANCE OF MAKING THE INDEXING PROCESS AS COMPREHENSIVE AS POSSIBLE, TIGERRISK UNDERTOOK A US TORNADO LOSS STUDY.

We chose a peril where (a) climate impacts can reasonably be expected to be relatively weak, so as to isolate the other possible indexing components; (b) exposure and insured loss data is of generally high quality across the period; and (c) data is available for associated 'social' factors.

We took as complete a record of events as possible back to 1950, small or large, and a measure of how severe these were at the time. We combined these with industry loss estimates from the time of each event, and different trending methods for just prices, then added exposure growth. Finally, we added changes in wealth and insurance penetration to produce an indexing method that could then be used to compare the results at today's levels.

The findings were that increases in population, migration and increased insurance penetration go a long way to explaining any headline trend

Figure 2 shows that no clear loss trend is visible using the comprehensive indexing method (the green line), whereas a 'price only' indexing (the yellow line) would – perhaps somewhat misleadingly – show an upward trend over the period.

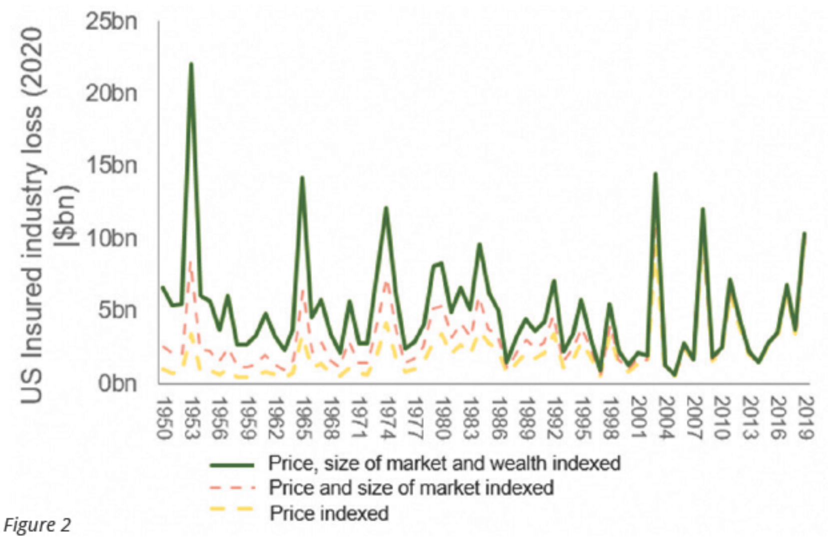

Figure 2

Figure 2: US tornado losses see no clear loss trend when full exposure and other factors are considered.

Source: PCS, NOAA NCDC dataset and TigerRisk research. Using Collins & Lower indexation method from NOAA NCDC Storm dataset

The above may feel somewhat incomplete since we can't adjust losses from events that never happened. To supplement that, we took a look at a shorter period, measuring the total growth of losses from severe storm events causing at least $250M in industry losses, and we have seen increases near a consistent 9% per year since 2000. Breaking down the growth, we measured an increase in both the frequency (number of events per year) and severity (loss per event). Nearly all can be explained by reviewing how the exposure landscape has changed. There exist several sets of compounding factors: building costs rose (4%), as did building size (0.6%); the population, and presumably the building stock, grew (0.8%), but we also sprawled out creating higher frequency (0.8%), and densified existing urban areas (0.9%). Aggregating all these sources of additional loss, a 9% loss trend looks like flat business as usual.

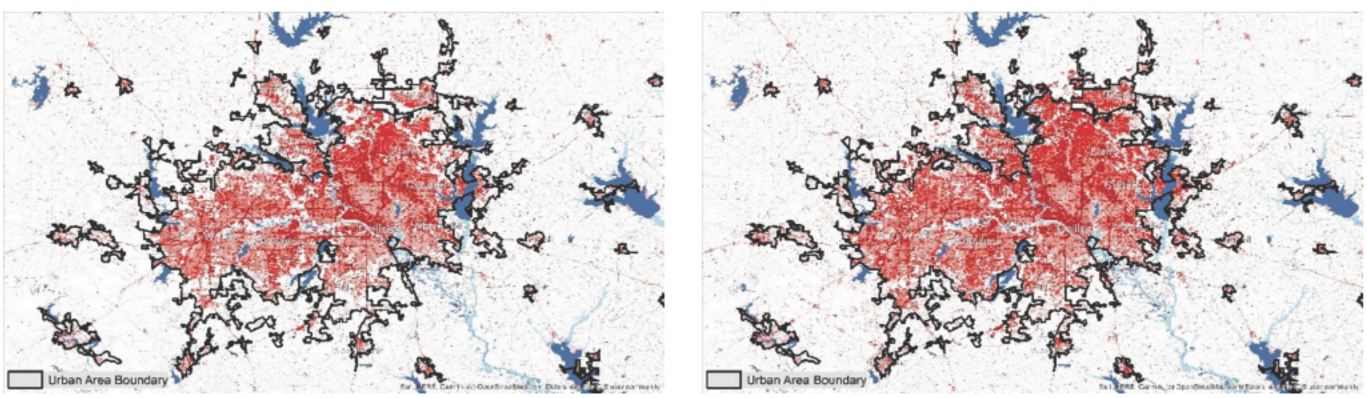

Figure 3

Cities in the US like Dallas, TX have both sprawled out (filling in the boundaries) and become more densely built (deeper red areas).

3. THE RISE OF 'NON-PEAK PERILS' AND THE LINK TO CLIMATE

Recent loss years have seen material contributions from so-called non-peak or 'secondary' perils and sub-perils.

Decomposing the global insured loss numbers, comprised the largest component of recent years (50% of the years saw 45 to 80% contribution) and there is an even larger 10-year non-peak peril loss growth (+55%) than the all-peril global insured loss trend of the past 10 years. North American Severe Convective Storm and European Floods have contributed 60% of these non-peak peril losses in total.

Some non-peak perils are certainly influenced by climate, such as increases in extreme rainfall driving potential changes in flood risk, which has then supported the view that human-influenced climate change has amplified natural catastrophe risk. However, there is less consensus on the climate influence on Severe Convective Storm given underlying competing physical mechanisms.

TigerRisk's study demonstrates that the empirical 'annual' contribution of losses from secondary classes of business or hazards associated with peak perils has been around 7% (see Figure 4). Examples include $12bn of flood damage from Hurricane Harvey in 2017 or the marine cargo losses from events such as Hurricanes Harvey, Irma, Maria and Michael, as well as Typhoons Jebi and Mangkhut.

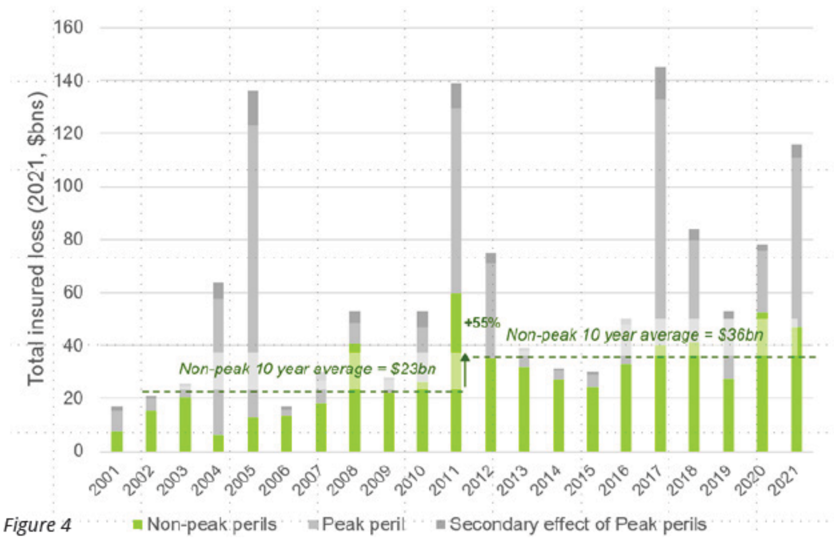

Figure 4

Figure 4: Non-peak peril losses show a larger increase than for peak perils. *Global Insured Natural Catastrophe Losses indexed to 2021 prices*

Source: Swiss Re, CRESTA, PCS

4. TO WHAT EXTENT ARE PERIL-REGIONS THAT DRIVE GLOBAL INSURED LOSSES APPROPRIATELY MODELLED?

Thirty-five years after the emergence of the first natural catastrophe models, three facts are universally understood throughout the (re)insurance community.

Firstly, as we continue to learn and grow our model ecosystem, more perils and sub-perils fall into the sphere of modellable risks.

Secondly, major events trigger changes to existing modelled views, although this may not always happen as quickly as the market (and regulators) would like. Sub-perils or classes of business that generate large cat losses tend to get more focus in model capture. For example, while tropical cyclone rainfall was not modelled well up to 2017, it is explicitly modelled to some extent now leveraging the insights gained from Hurricane Harvey.

Thirdly, while true 'model completeness' will continue to elude us no matter how quickly we advance, the universe of nat cat risk is increasingly well captured by models, albeit including models that are not always widely used and/or are heavily adjusted by cedants and markets alike. Meanwhile, the industry continues to learn from 'surprise' events, such as the power grid failure causing amplified loss in Texas from Winter Storm Uri, or the presence of debris and contamination increasing average claim sizes for the European flood 'Bernd' event.

A TigerRisk loss study demonstrates that at the present time, 20% of historical nat cat losses come from peril-regions where a model is only partly adopted when setting catastrophe risk appetite through to pricing the risk. History strongly suggests that these 'partly adopted' models improve over time.

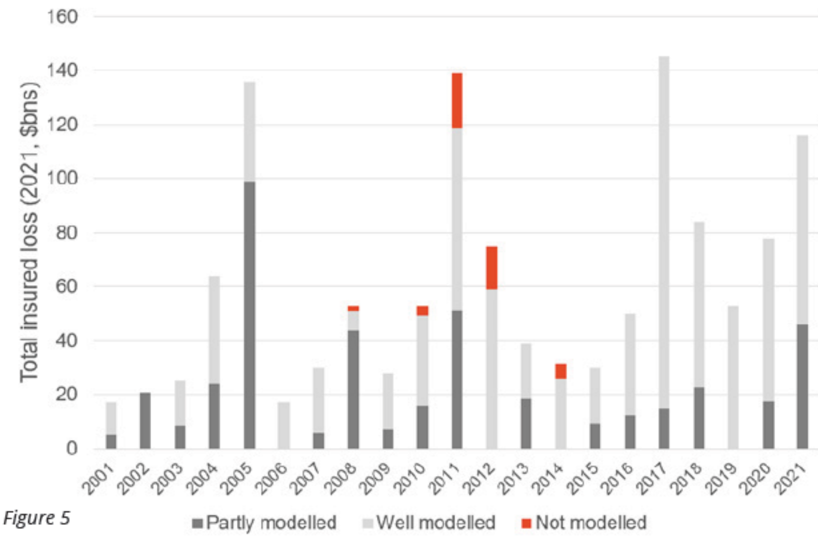

Figure 5

Figure 5: >90% of nat-cat losses from regions either well or partly modelled.
Global Insured Natural Catastrophe Losses indexed to 2021 prices

Source: Swiss Re, CRESTA, PCS

Finally, perils that are most affected by temperature (like wildfire burn area), rainfall extremes (such as flood, particularly urban flash flood), and sea level rise (for example, storm surge) remain by far the clearest and most actionable in an insurance modelling context.

While much research remains to be done, it seems reasonable to suggest firstly that climate change is indeed currently represented in the relevant widely-used cat models; secondly, that this representation will – like all other elements – improve over time in line with experience; and thirdly that (re)insurers with material exposure to natural catastrophe risk where climate change is (or will be) a clear contributor must take responsibility for understanding the extent of the current representation and making their own adjustments where this seems appropriate to their portfolios.

This viewpoint then challenges those who conclude that recent volatility from nat cat events is exclusively attributable to climate change and that this phenomenon is missing from today's catastrophe models.

5. CONCLUSION

This paper suggests that methods of indexing have a very material impact on how apparent high-level trends in nat cat losses can be explained. There are many underlying phenomena which need to be taken into account. 'Broad brush' indexing can lead to inconsistent conclusions.

A warming climate may increase the propensity for natural catastrophe losses for some contributors to the large category of 'secondary perils'. However, for perils like severe convective storm there is less consensus, and any reported loss trends should be treated with caution. An increased focus on understanding and attempting to quantify the impact of prior exposure changes is key.

It should be welcomed that nat cat models increasingly look to explicitly quantify all sources of risk that may correlate with peak perils in operation, such that 'non-modelled risk' reduces over time. Surprise losses, or 'unknown unknowns', will still occur, and these will continue to drive further understanding in the mechanisms impacting loss in the (re)insurance market. This particularly – and explicitly – includes the effects of climate change.

AUTHORS

TIM EDWARDS | TIGERRISK
EMEA, Head of Catastrophe Analytics

ANNA NEELY | TIGERRISK
Head of R&D and Event Response

DAVID CLOUSTON | CONSULTANT
Leading independent consultant on catastrophe risk and exposure-management in the London insurance market

DAVID FLANDRO | HOWDEN BROKING
Head of Analytics

SOURCES

[1] Howden, Climate in peril report, October 2021

[2] Approximately equivalent trends can be observed over different periods (for example annual, three-year and five-year).