



think

When precision undermines pooling:
rethinking insurability in an age of
advanced risk modelling

by **David McNamara**

Independent thinking from the IFoA

Part of the IFoA's purpose is to promote debate within and beyond the profession, and to position our members as leading voices on the biggest public policy challenges of our time.

We aim to showcase the diverse range of expertise and critical thinking both within and outside the profession.

Our 'think' series seeks to promote debate on topics across the spectrum of actuarial work, providing a platform for members and stakeholders alike and sharing views that may differ from the IFoA's house view. In doing this, we hope to challenge the status quo, question the orthodoxy, and shine a light on complex or under-examined issues, thereby stimulating discussion and dialogue to help tackle issues in a different way.



David McNamara

Over the past two decades, David has developed a strong interest in natural hazards and how geophysical events translate into financial losses. This began during his time in Japan, where he experienced typhoons and a significant earthquake. He later completed an earth sciences degree at University College London and worked as a military aviation forecaster at the Met Office before completing a PhD in boundary layer meteorology at the University of Reading, where his research focused on atmospheric rivers and flooding.

He has held roles at Lloyds Banking Group and JBA Risk Management, working across catastrophe risk modelling, flood model validation and weather-related perils. He joined Flood Re within the actuarial team, contributing to its view of UK flood risk, and is now Head of Catastrophe and Climate Analytics, where he leads a team of scientists responsible for catastrophe risk modelling and model validation.

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Insurance to mitigate risk

Insurance redistributes uncertain losses from individuals to a broader community, enabling risks that cannot be borne alone to be shared collectively.

As knowledge and technology have increased, so has our ability to identify areas where risk is likely to accumulate. We can therefore target higher insurance premiums in those areas to compensate for the increased risk assumed by the wider risk pool. On the face of it, this appears to be a fair exchange: increased premiums in return for the ability of individual homeowners to transfer risk.

But what happens when we get too good at our jobs and utilise tools (such as flood mapping products) that tell us exactly where the highest-risk properties are? The relationship between the community and the individual may become strained. Why should the community as a whole pay for an insurance policy when we know that risk is likely to crystallise?

This creates a structural tension within insurance. As our ability to measure risk improves, our willingness to pool it diminishes. Increasing precision in risk assessment may therefore undermine the very principle on which insurance is built, contributing to the growth of the protection gap.

Insurance gaps

There are several reasons why an insurance gap may form:

1. The risk becomes empirically demonstrable (not hypothetical)
2. Uncertainty is collapsed into point estimates
3. Future risk is priced into present-day decisions

The development of a protection gap can therefore be a consequence of the perception of risk, which is not always an accurate reflection of the real underlying risk.

In the insurance industry, we develop our perceptions not only from experience but from models used when experience is inadequate or incomplete. This is most pertinent to the science of catastrophe risk modelling, where we deal with events that lie outside the experience of most people alive today. It is therefore a challenge to validate these models, but it would also be a mistake to ignore the modelled results entirely. This is demonstrated by events such as the Thai floods in 2011 and Hurricane Andrew in 1992, both of which resulted in insurer insolvencies.

On a broad scale, the development of modelling techniques has created a situation whereby aggregate-level risk is better understood. This in turn allows more people to insure their properties with confidence that insurers will be able to pay claims should major losses occur.

On the flip side, the development of very detailed flood mapping products, which feed into catastrophic risk models, has allowed insurers to discriminate between properties within their risk appetite and those perceived too expensive to insure (therefore effectively uninsurable). Climate change is currently increasing the gap between insurable and uninsurable properties.

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Climate change and its impact on the perception of risk

Catastrophe risk models are based on historical events from the region being modelled. Ensuring that the historical record is sufficiently long to capture a representative distribution of events is always challenging.

One solution is to attempt to use a longer historical record to create the model. In recent years, the validity of this approach has also been challenged by the recognition that historical events represent only one version of what might have occurred, as well as by the possibility that, due to climate change, the past is no longer an accurate representation of current risk within the system.

The uncertainty created by climate change, combined with the perception that 'everything will worsen' due to rising temperatures, means that the perception of risk globally is growing at a rate not necessarily aligned with the underlying science of climate change.

In the case of UK flood risk science, it is far from certain which regions have already been affected by climate change and which have changed due to the natural variability inherent in the Earth's atmospheric systems.

This is not to suggest that climate change is not altering risk, but rather that the translation of this change into precise, location-level insurance decisions remains highly uncertain.

In addition to changes in the underlying geophysical risk, significant advances have been made over the last 50 years in reducing the vulnerability of individual properties to flooding and improving the defence infrastructure that protects entire communities. Changes in land use, which affect the flow of rivers and thus the propensity for them to flood, can also affect the

amount of damage that may occur during any one event relative to historical records.

Some of these factors can counter the effects of climate change but are not always reflected in the models, due to the reliance on historical claims data for calibration. As a result, models may suggest that risk is increasing significantly, even where this does not fully reflect the underlying reality.

The uncertainties in modelling are well understood by model developers, but often less so by users. These misunderstandings can lead to model misinterpretation and to risk being assigned to individual locations when it should, in fact, be spread across multiple locations in accordance with alternative model views.

The protection gap can therefore grow as much through risk perception as through actual increases in risk. This in turn can exacerbate the insurance gap, affecting not only locations at risk today but also those that will be – or are perceived to be – at risk in the future.

A large market-changing event

After the floods of 2007, the insurance industry concluded that the losses were closer to a 1-in-40 event than a very rare or extreme occurrence. Given the significant flood events that occurred before and after 2007, including those in 1998, 2013 and 2014, it is not surprising that the actuarial profession and the catastrophe modelling community positioned the 2007 event as having a relatively high probability of recurrence. But the losses from the summer of 2007 were far greater than anything seen in recent history, standing at around £3.9bn in today's money.

Actuaries and catastrophe risk modellers are, by nature, cautious people. If an event has occurred in the recent past, there is a tendency to adjust models in anticipation of a similar event recurring. Careers may depend on ensuring that organisations are protected against some of the worst natural catastrophes that can occur. But what if the 2007 flooding was nowhere near a 1-in-40-type event? What if it was closer to a 1-in-100-year event?

The average annual loss produced by a catastrophe risk model is primarily driven by higher-frequency, lower-severity events, although large events can materially influence the mean due to their scale. However, this influence diminishes with higher return periods. Removing the 2007 event from claims data would reduce average annual loss estimates by approximately £100 million. This is a significant amount, given that the modelled average annual losses are generally in the region of £600 million.

With the 20th anniversary of the 2007 floods approaching, a reassessment of where the event sits within the wider distribution of UK flood losses is not only appropriate but desperately needed. The classification of an event can materially alter perceptions of risk and thus influence the availability of insurance.

Following the floods of 2007 and the widespread flooding experienced during the winters of 2013–14, it became apparent that households were still finding it difficult to access flood insurance at a competitive price. Flood Re was established in 2016 to fill that gap in the market.

The purpose of Flood Re

Flood Re was formed to bridge the protection gap that emerged following the events of 2007 and the winter flooding in 2013-14 and 2015. At the time, it was considered necessary to bridge the gap between insurers and the international reinsurance industry. This has been achieved by allowing insurers to cede policies deemed uninsurable to Flood Re, with Flood Re then accessing reinsurance markets on their behalf. This structure enables Flood Re to fulfil its short-term purpose of increasing the affordability and availability of flood insurance. However, it may also reduce incentives to return the market to risk-reflective pricing.

A public – private partnership

The Flood Re Scheme was carefully structured to operate within the private insurance market while serving a clear public purpose: lowering insurance premiums for households located within flood-risk areas.

The Scheme is funded by the insurance industry but is also accountable to the Government for ensuring that both the affordability and availability of flood insurance remain high.

Primarily, the Flood Re Scheme exists to support the market in making insurance available to a wider pool of people. Over time, we hope to reduce the number of properties considered uninsurable, to the point where risk-reflective pricing can be implemented in a way that does not prevent households from purchasing cover.

However, significant challenges remain:

- The provision of insurance maps by independent private model providers can stifle collective innovation in products that more accurately represent underlying risk.
- The pricing of insurance policies remains largely deterministic when considering geographically derived risk factors.
- The insurance gap lacks a consistent definition. Many figures are used, but definitions are often obscured by differing descriptions of risk and varying insurer risk appetites.

- Data remains concentrated in private companies, limiting independent research.
- The nature of the Flood Re Scheme can inhibit both private individuals and insurers from tackling some of the problem's underlying causes.

The presence of a stabilising scheme like Flood Re may, under certain conditions, reduce incentives for innovation and reinforce existing perceptions of risk. As time progresses, it is becoming increasingly important for Flood Re to investigate the inherent uncertainty in flood modelling and demonstrate where increasing precision may be leading the industry astray.

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A need for better model scrutiny

Models increasingly shape our understanding of risks that lie beyond lived experience. Yet models are inherently influenced by the data and assumptions on which they are built. This can lead to systematic distortions: recent extreme events may inflate loss expectations, while structural changes such as climate variability may render historical relationships unreliable.

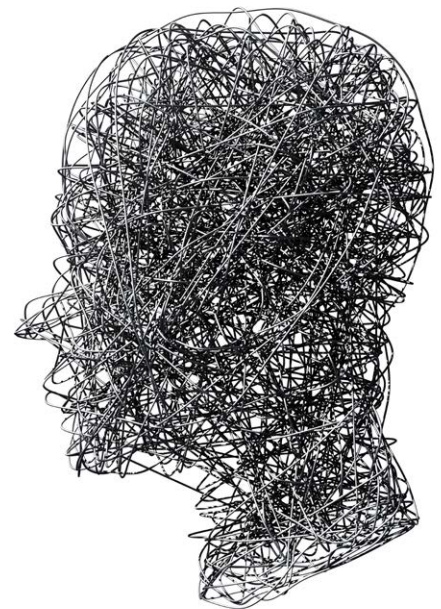
As a result, model users and validators are often required to make decisions that challenge both intuition and industry orthodoxy. This can be uncomfortable, particularly in an environment that prizes efficiency and rapid deployment over continual reassessment. However, greater scrutiny of models, rather than blind reliance on them, is essential if organisations are to navigate a world in which both risk and uncertainty are evolving.

Paradoxically, increasing uncertainty should not be viewed solely as a threat to the insurance industry. Rather, it reinforces the fundamental principle on which insurance is built: that uncertain losses can be pooled across a broad community. When uncertainty is properly acknowledged, rather than compressed into deterministic outputs, the conditions for effective risk sharing are strengthened.

The key challenge for actuaries and catastrophe risk modelling professionals is not only to refine the models but also to develop methodologies that incorporate uncertainty into their risk assessments in a way that is both robust and useful. In doing so, the industry can better balance precision with humility and preserve its ability to provide coverage in an increasingly uncertain world.

It should be recognised that uncertainty is not a failure of the modelling process - it is the foundation of insurability.

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