Catastrophe Risk Management:
Addressing the challenge of non-modelled perils

Without doubt, the widespread industry adoption of catastrophe risk modelling has played an important role in enabling the global insurance and reinsurance industry to absorb over US$100 billion of insured losses from the natural disasters in 2011. However, in spite of the advances in CAT risk modelling tools[1] over the last 20 years, there are gaps in global coverage and some material limitations of the current suite of risk models. **Mr Paul Nunn** of **SCOR Global P&C** discusses the challenges that remain in terms of quantifying these non-modelled risks.

Major natural disasters represent existential risks to non-life (re)insurers, triggering thousands of claims simultaneously and constitute tail events beyond the historical claim experience of insurance companies in the modern era.

Catastrophe risk models have developed to help the industry to better understand the shape of the tail of the risk distribution and draw on scientific and engineering knowledge, calibrated with actual damage and claim information wherever possible. Using simulation techniques the mathematical models build up a probabilistic picture that describes the loss potential of extreme events and this helps insurers structure appropriate risk transfer mechanisms such as reinsurance, to manage risk and protect the balance sheets.

Model blind spots

While peril coverage is generally good for large mature markets representing peak global risks (in the US for example there are commercially available models for earthquake, hurricane, tornado/hail and winter storms), there are gaps, particularly in developing economies where industrialisation and an emerging middle class are drivers of increasing demand for insurance, creating new concentrations of risk exposed to natural hazards.

The economic success story of Thailand in attracting the foreign direct investment in the manufacturing sector, gave rise to a number of huge industrial parks that was clearly not matched by the development of catastrophe models to adequately quantify the flood risk.

Even within the current suite of models we must be mindful of certain limitations in terms of completeness. The March 2011 Tohoku earthquake serves as a stark example of the aggravated loss potential from so-called secondary perils such as tsunami, which accounted for between 15% and 30% of cedant losses; tsunami damage is not explicitly considered in any of the current generation of CAT models used by the industry. The Tohoku events also serve as a reminder of the inherent uncertainties when trying to model extreme events since the magnitude of the earthquake fell outside the expectations of the wider scientific community and the parameterisation of the mathematical models. Similarly, the series of earthquakes in the Canterbury region of New Zealand provides new insight into the local seismic setting and a better understanding of liquefaction that needs to be incorporated in future model updates.

Bridging the gaps

The gaps and limitations in the CAT modelling toolkits that the industry uses present a serious challenge, particularly for reinsurers with a globally diversified portfolio of natural catastrophe risks. It is clear from the events of 2011 that the gaps are not *de-minimis* and the expectations of key external stakeholders, including regulators, rating agencies

Figure 1: Contribution to TVaR by return period from 'non-model' perils

Source: SCOR

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1 There are 3 major specialist suppliers of global 'CAT' models to the industry: AIR, RMS & EQECAT

and investors are for a comprehensive catastrophe risk management framework to ensure appropriate capital is in place to support the risk profile.

To achieve completeness in its modelling of global perils, SCOR supplements its use of external catastrophe models with a statistical representation of the risk in each region/peril where scientific hazard based models do not yet exist. Key to supporting this is the detailed segmentation of expected catastrophe losses by peril/territory maintained in our pricing tool coupled with careful tracking of our natural catastrophe liability. This data is then used to parameterise a Pareto distribution of gross loss for each non-modelled peril which feeds into the global All Perils CAT risk profile. We have also developed an internal approach to supplement our modelling framework to reflect the missing tsunami component of loss.

Figure 1 (see page 92) shows that the CAT model based peril losses constitute an increasing proportion of loss outcomes at the risk beyond higher return periods, while the Pareto based, *non-model* perils play a more significant role for shorter return periods.

This follows from the fact that higher frequency/lower severity perils, such as flood, hail and bushfire are not well covered in the modelling tools. Flood in particular is technically very challenging to model insurance losses robustly, requiring complex interactions between precipitation, run-off/absorption, river flow modelling with topographical effects and the highly localised event damage footprints demands very detailed data related to the location of insured assets. Furthermore, losses are sensitive to flood defence performance (Thailand, New Orleans), and trying to modelling defence failure certainly adds to the complexity.

### Creating an open architecture for future CAT loss models

As discussed above, while the development of science/engineering based catastrophe models has served the industry well, the body of scientific understanding in wider academic and governmental research institutions continues to grow at a pace which is not matched by our ability to incorporate new knowledge quickly.

Recent examples include the findings of an expert panel commission by the Japanese Cabinet Office to look at tsunami risk[2], as well as an emerging scientific view of the effect of seismic stress transfer post-Tohoku on future earthquake probabilities. This will take time to integrate into future models. A major constraint on the industry's ability to embed the latest scientific knowledge into our risk management frameworks stems from the fact that it is largely mediated by just three specialist companies with limited resources.

To address this model development bottleneck, SCOR is supporting a new initiative called Oasis[3] to create an open architecture framework for catastrophe modelling. This will

enable a much wider community of technical experts to provide data or model components into a more modular plug-and-play framework.

In developing the framework, Oasis is currently working with a major meteorological office as well as specialist flood and earthquake consulting firms and taking advantage of the latest technology in terms of massively parallel processing, and scalable cluster/grid solutions. There is also engagement with other related initiatives such as GEM[4] and the EU ClimateKIC[5] to allow convergence of standardised data interfaces between the model components.

Figure 2: The Oasis Loss Modelling Framework

Source: Oasis
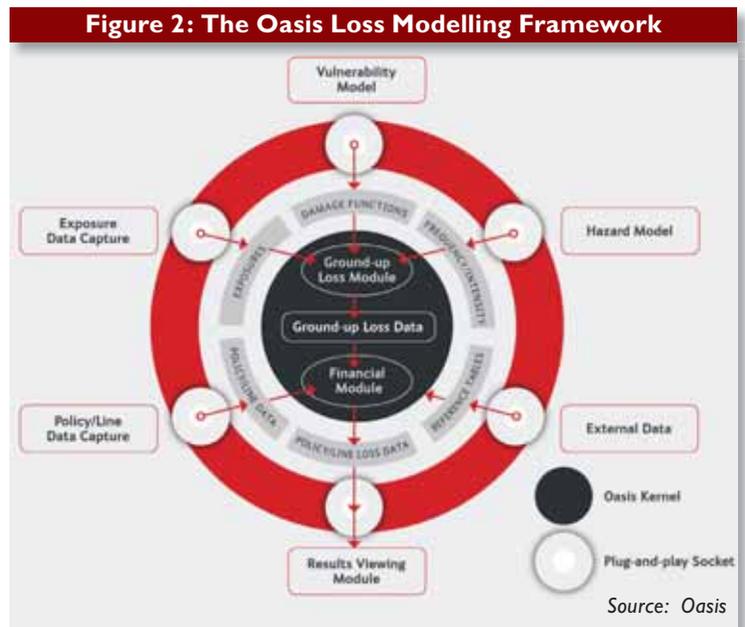
What the Oasis framework will do is enable model users to undertake full uncertainty calculations within a given model combination as well as testing a variety of models to illustrate the sensitivity of results to model choice. This will certainly support (re)insurers in demonstrating to regulators a detailed understanding of the models used by the business and their inherent uncertainties.

In conclusion, as an industry, we simply cannot afford to ignore non-modelled perils, and it is important that insurers and reinsurers develop approaches to bridge any gaps in their risk management and capital modelling frameworks. New initiatives such as Oasis will help support the creation of alternative models for existing perils and, new models for so-called un-modelled perils and territories.

Mr Paul Nunn is Head of Catastrophe Risk Modelling at SCOR Global P&C and will be a guest speaker at the Insurance Risk and Finance Research Centre's annual seminar that will be held in Singapore on 25 June 2012. He is also a director of the non-profit Oasis Loss Modelling Framework company.

2   Japanese Cabinet Office findings (ja): http://bousai.go.jp/jishin/chubou/nankai_trough/15/index.html/ Reporting of the findings (en): http://www.yomiuri.co.jp/dy/national/T120401002932.htm

3   Oasis is a non-for-profit organisation initially funded by subscribers from the insurance industry

4   GEM is the Global Earthquake Model initiative

5   ClimateKIC (Knowledge and Innovation Community) is an EU funded programme connecting a number of climate research institutions in Europe