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ASHK Newsletter

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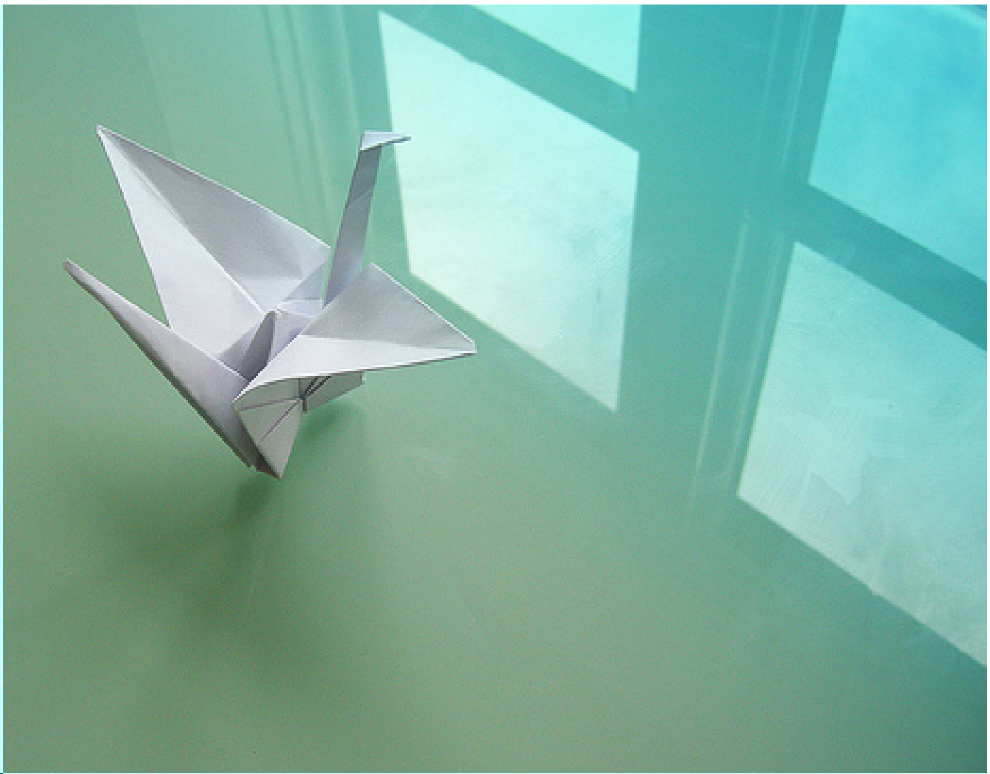

Managing Catastrophe Risk

EDITORIAL

Dear Readers,

Welcome to the second newsletter for 2011!

In this issue, we have adopted the theme of managing catastrophe risk. Although people are aware of this risk for a long time, it has only attracted more attention over the last few years as several severe catastrophic events have occurred with significant human and financial losses. We started the newsletter with a general discussion on catastrophe modeling from a reinsurance broker and an introductory article from representatives of the Casualty Actuarial Society. Then we provided a few contributory articles from reinsurance companies. Astute readers will notice that these articles all deal with managing catastrophe risk from a reinsurance angle. Inevitably there are some overlaps among these articles. However, we also notice that there are significant differences among these articles in terms of depth and approach. Finally we conclude by an interview with a consulting actuary discussing the implications of catastrophe risks.

It is my opinion that the newsletter, in addition to being a vehicle to disseminate news to the members, is a platform for members to discuss actuarial issues at various levels. We welcome all members, whether they are veteran actuaries with many years of experience or young and aspiring actuaries, to contribute articles for publication in the newsletter.

Happy Reading…

Dr. Louis Ng
EDITOR

The Need for Robustness in Catastrophe Modeling

John A. Major and Micah G. Woolstenhulme, Guy Carpenter & Company, LLC

People talk about black swans but they don't talk about robustness, which is the real lesson of the black swans.
Nassim Taleb, author of The Black Swan, in a 4/13/2011 interview at the Wharton School

Computerized simulation modeling of the potential impact and risk of natural disasters – from multiple perils – was pioneered by Dr. Don G. Friedman at the Travelers Insurance Company in the 1960s[1]. In 1987, Karen Clark founded the first cat modeling firm, AIR, and three more firms, RMS, EQECAT, and ARA, came on the scene in 1988, 1994 and 1999, respectively. Since then, there have been about 10 generations of change in the major U.S. catastrophe models, or about one every two years.

After an initial focus on natural peril risk in North America, modeling firms expanded their products to other parts of the globe. RMS was the first company to release a model in Asia, when it released earthquake models for Australia and New Zealand along with an Australian cyclone and Japan typhoon model in 1995. Within the next five years AIR and EQECAT also had models for these countries.

EQECAT was the first company to release a model in China and Hong Kong, with its typhoon and earthquake models in 1998 and 2000, respectively. However, they were not detailed models, in the sense that property exposure for China needed to be input at Province level. The first detailed location model for China became available in 2005 with the introduction of RMS' earthquake model, followed two years later by AIR's typhoon model. By the end of 2011, all three companies will have detailed earthquake and windstorm models for China and Hong Kong.

Early cat model users were distressed to discover that models from different vendors were likely to produce materially different risk estimates for the same set of insured exposures. As model builders' experience – and data – increased over time, the models have tended to converge…somewhat. There are still material, sometimes dramatic, differences between models, especially when examined at a geographically localized level.

Despite advances in knowledge and technique, there is still a fundamental uncertainty underlying catastrophe models. This uncertainty is widely recognized within the modeling community and has long been a prominent topic at modeling conferences.

In 1999 Guy Carpenter's David Miller published a study[2] that determined lower bounds on the amount of uncertainty that *had to be present* in U.S. hurricane risk models. A white paper entitled *Uncertainty in Catastrophe Models*[3] was then issued expanding on these results. This study concluded that, for a national portfolio of exposures and a typical return period of interest, a 90 percent confidence interval for a probable maximum loss (PML) goes from 30 percent to 400 percent of the PML estimate produced by the model. Undoubtedly, similarly large uncertainties hold for Asian typhoon modeling.

In 1974, Dr. Friedman described his work as "providing an order of magnitude measure of overall loss potential associated with natural hazards." By that measure, the uncertainty in state-of-the-art cat modeling has only improved modestly over time.

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[1] Friedman, Don G. (1984) *Natural Hazard Risk Assessment for an Insurance Program*, The Geneva Papers on Risk and Insurance, Proceedings of the First Meeting of the International Working Group on Natural Disasters and Insurance (I), Vol. 9, No. 30, January.

[2] Miller, David (1999) *Uncertainty in Hurricane Risk Modeling and Implications for Securitization*, Casualty Actuarial Society Discussion Paper Program.

[3] Major, John A. (1999) *Uncertainty in Catastrophe Models Part I: What is It and Where Does It Come From?* (February); *Uncertainty in Catastrophe Models Part II: How Bad is It?* (March), Financing Risk & Reinsurance, International Risk Management Institute.

If model results are so uncertain, why bother using them? Mainly, because the alternative methods of estimating extreme risk are inferior. Historical statistics on losses, for example, quickly become irrelevant the further back in time they go, limiting their usefulness. More qualitative assessments, such as scenario analysis, are very helpful in understanding the factors driving (or mitigating) the risk but do not lend themselves to quantitative measures of that risk. Cat models, therefore, have earned their place among risk assessment tools.

Nonetheless, the material uncertainty present in catastrophe models needs to be addressed by users. It is not enough to shrug and accept a model as given, allowing full credibility to ten significant digits in the outputs, or worse, to blindly use the model as the basis for "portfolio optimization."

The risk of uncritical acceptance of model results is illustrated by the case of a Florida homeowners carrier. This particular carrier perceived an opportunity to increase profitability through portfolio optimization. Through the lens of a commercial cat model, management looked at the strengths and weaknesses of its portfolio, identified changes it could make and developed an aggressive plan to improve the performance of the book of business. This plan was implemented and carefully monitored on a monthly basis. About a year later, the company had "optimized" its portfolio and reduced the model-calculated PML to premium ratio by approximately 25 percent.

Shortly thereafter, the company was advised by the model vendor that upcoming changes to the model would show significant increases in annual average loss costs in precisely those locations the carrier had targeted for growth. The changes it had implemented went directly against what the new version of the model indicated.

Yet these model changes were well within fundamental uncertainty bands; they were not indicative of error on the vendors' part.

Recently, cat model users have become more sensitive to these issues. One approach to the assessment of uncertainty is to consider the results from multiple models.

Suppose a client writes property insurance in three territories and wants to initiate growth plans based on expected return on capital, which is inversely proportional to territory PML:

Territory	Model X PML	Model Y PML	Ave. PML	Worst PML
A	50	150	100	150
B	100	120	110	120
C	150	50	100	150

Assuming equivalent exposure bases and the same basic price adequacy across the territories, if the client relies on model X, then territory A is preferred. In contrast, if Y is the model of choice, then territory C is superior. This was the industry status quo: choose a model and trust it.

A client with access to multiple model results should consider the fact that the models disagree. One approach would be to average the PMLs, in which case territories A and C appear equally attractive and superior to territory B. A second form of analysis is to bracket the model results from lowest to highest within each territory. This reveals that despite nearly equal average PMLs, territories A and C possess more "model risk" than territory B. In light of the averaging analysis, some judgment call is necessary to determine which is preferred.

We propose a "robust" approach to the use of models.

The theory of "robust control" began in the late 1970s and early 1980s. It is an engineering discipline aiming to design control systems that perform well in the real world, where mathematical assumptions used in the design may not hold exactly or at all times. Robust control typically borrows a key concept from game theory: the minimax principle. In a two-person game where one's winnings are equal to the other's losses, the minimax principle asserts that the best strategy is one where you act to minimize your worst-case (maximum) losses with respect to the other player's strategies. That is, you assume your opponent will always act to his best advantage, so you choose the best you can do under that assumption.

In using the minimax principle, robust control assumes a bounded set of alternative mathematical models and a malevolent nature that will choose the most disadvantageous model to apply in reality. Control design then works to do the "best possible" under this circumstance.

A robust approach to the above cat modeling problem could be to target the territory whose worst-case outcome across the modeled PMLs is the best. The worst-estimated PML for territory A is 150 (Model Y); 120 for territory B (Model Y again) and 150 for territory C (Model X). The robust choice is territory B.

We therefore propose the concept of robustness as an essential analysis paradigm for problems where decisions and their consequences are exposed to significant model risk. A "robust" decision is one that is relatively immune to potential errors in model specification or para-meterization. Robust analysis does not replace typical inferential analysis on a risk process, but it can improve decisions made with respect to the risk.

Robust analysis is also an alternative to Bayesian analysis. When the relative likelihood of potential models can be quantified, a Bayesian analysis can calculate the optimum decision relative to a performance criterion. However, this approach can be difficult or impossible to apply in some contexts. We may have access to two or three catastrophe models, but there is an infinite array of "models that might have been" and no sensible way to construct a "prior distribution" over them.

Robust analysis, however, steers its focus to the *most adverse models* and does not require the full Bayesian machinery. A more complete robust analysis of the above problem would compute statistical bounds on the PMLs in each territory, in effect expanding the set of alternative models to be considered. Then the best-performing territory over the entire set of models could be identified.

Stress testing and risk loading can be used to deal with the same question – "what if the model is wrong?" – but they often rely on arbitrary assumptions that can be obviated in a robust framework. Robust analysis is not so much a strict algorithm as it is a set of principles accompanied by mathematical tools for measuring decisions with respect to the values of the decision maker. The focus moves beyond the question of "what are we missing?" to address the question of "how should we act, now, before we find out?"

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EVALUATING AND PRICING NATURAL CATASTROPHE RISKS – AN INTRODUCTION

Co-authored by Rade Musulin, COO of Aon Benfield Analytics APAC and Carole Ho, Executive Director of Aon Benfield Analytics China, on behalf of the Casualty Actuarial Society.

In the past 6 months, the world has witnessed devastating destruction brought about by natural catastrophes. 2011 began with heavy flooding in Queensland, Australia, which turned out to be the costliest natural disaster to the country to-date. Then a magnitude-6.3 earthquake hit Christchurch, New Zealand, claiming the lives of more than 170 people and caused widespread damage. At almost the same time, Cyclone Yasi made landfall in the flood-struck Queensland, producing serious economic and agricultural losses. On March 11, 2011 a mega-earthquake occurred near the northeastern coast of Japan and spawned tsunami that swept across the coastlines of 3 prefectures. More than 15,000 people were killed and the Japanese government estimated total economic losses ranging between JPY16.2 to 25.3 trillion Yen. Then the United States was hit by consecutive severe weather outbreaks in April and May, where a number of deadly tornadoes caused catastrophic damages to both human lives and properties, producing economic and insurance losses that are estimated to reach billions of USD.

Catastrophe Event	Catastrophe Losses in USD Billion Est. Insured Losses	Est. Reinsurance Loss	Economic Loss	Reference
Maule Earthquake Chile	8.5	8.0	30	AB Analytics 25 Feb 2011
Melbourne Storm VIC	1.06	0.5	?	ICA – Insurer reported reserve value
Perth Storm WA	1.1	0.5	?	ICA – Insurer reported reserve value
Darfield Earthquake NZ	~5.0	3.0 - 4.0	~30 USDB NZ Earthquake combined	Reported loss data + Aon Benfield NZ expert Estimate
Dec Central Queensland Floods	1.3 - 1.4	0.9	Combined flood impact ~10 USDB	ICA Reported loss data
Jan – Feb Aus Storm and Flood Events	4.0	3.0		
Lyttelton Earthquake NZ	~10.0	7.0 – 8.5	30	Reported loss data + Aon Benfield NZ expert estimate
Tohoku Earthquake Japan	14.0 – 20.5	~8.7 – 10.0	150 – 300 USDB	RMS Insured loss estimate for P&C subj. to Reinsurance. RI Losses est. from AB Market Analysis as reported by reinsurers.
Total	45 – 51.6	31.6 – 35.4		

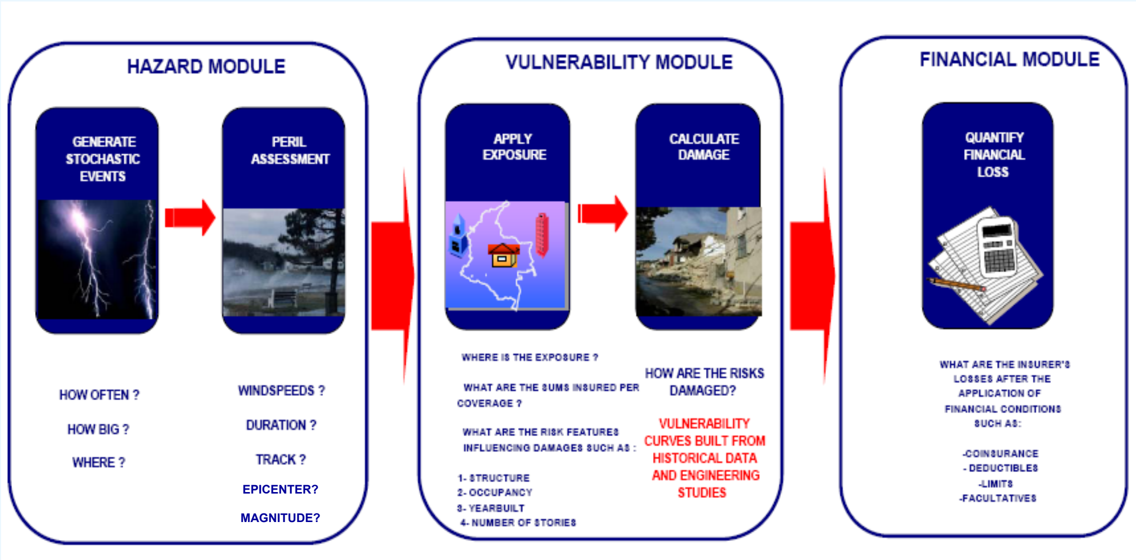
These catastrophic ("Cat") events produced high amounts of insurance and reinsurance losses. All of the recent events occurred in well-developed insurance markets where penetration would have been high (with the exclusion of residential EQ protection in Japan which is protected by a government pool and where losses caused by Tsunami were excluded from insurance coverage).Their financial impact on the insurance industry, while serious, was within the industry's ability to honor its financial commitments. From the above table, it can be observed that reinsurance as a means of risk transfer has been effectively utilized by insurers. And so far no reinsurer insolvencies have been reported. These losses caused a material impact in the reinsurers' earnings but to a lesser degree impairment of capital and capacity to write.

The ability of the industry to withstand consecutive catastrophes is a key to the mechanism of insurance. This ability is almost solely dependent on the insurers' and reinsurers' ability to evaluate and price natural catastrophic risks.

The Basics of evaluating natural catastrophic risks

Large scale natural catastrophes occur infrequently and historical data is an inadequate benchmark for its evaluation, especially when affected areas have experienced significant economic development and/or population growth between the time of the historical catastrophe and the present. Further complicating matters are changes in building practices over time or aggregate loss mitigation activities such as building dams, which may actually contribute to an increase of risk in some situations (upstream levees funneling water thereby increasing flooding risk downstream). Insurers today generally make use of the relatively new science of natural catastrophe modelling for the estimation of its natural catastrophe exposures.

Commercial Cat Models came into existence in the late 1980's and gained popularity in the USA after Hurricane Andrew in 1992. Andrew exposed severe limitations in past methods of catastrophe exposure measurement, in particular the problem of estimating catastrophe losses as a "loading" on "normal" perils such as fire or theft. Such methods failed to account for cyclical fluctuations in catastrophic activity due to phenomena like the Atlantic multi-decadal oscillation (AMO) or shifting demographics and geographic concentration. Currently the 3 major vendors of cat models are AIR, RMS and EQECAT. The basic premise of modern cat modelling is as follows:-



Source: AXA Group Risk Management 2008

A company's exposure to a natural catastrophic peril is comprised of many factors, including the value of the structure, its construction characteristics, its age, and a number of other parameters. This information is fed into a computer program that evaluates the loss potential based on the interaction of 3 components 1) Hazard; 2) Vulnerability 3) Financial Damage. The first component, Hazards, mimic the events that may happen to the geographic region being modelled, based on meteorological or seismic data reflecting past events. The Vulnerability component considers the relationship between the Hazards component and the company's actual exposure and estimates the amount of physical damage a particular event would bring to the structures comprising the company's book of business. Finally, the Financial Damage component translates the underlying economic loss for the policyholders derived using the first two components into insured losses (gross and net of reinsurance) by incorporating conditions of the underlying insurance policy. Tens of thousands of stochastic simulations are run in each cat modelling exercise and losses are estimated for each. This result forms the most fundamental piece of information for an insurer's evaluation of its exposure to natural catastrophe.

The outcomes from cat models are often presented in the form of an Exceedance Probability curve ("EP curve"), which is a graphical representation of the probability over a period of time, usually a year, that a certain loss amount will be equaled to or exceeded in a particular event (known as an Occurrence Exceedance Probability or OEP) or in the aggregate over a similar time period (known as the Aggregate Exceedance Probability or AEP).

Event	Annual Rate	Loss	Exceedance Probability	Return Period (Years)
1	0.0008	41,000,000	0.00080	1,250
2	0.0001	37,500,000	0.00090	1,111
3	0.00045	30,000,000	0.00135	741
4	0.0026	14,000,000	0.00395	253
5	0.0072	2,500,000	0.01112	90
6	0.0089	1,400,000	0.01992	50
7	0.0045	500,000	0.02433	41
8	0.0076	500,000	0.03174	32
9	0.002	200,000	0.03368	30
10	0.054	100,000	0.08586	12
11	0.032	50,000	0.11511	9

Probability (Event with $Loss_j$) = p_j

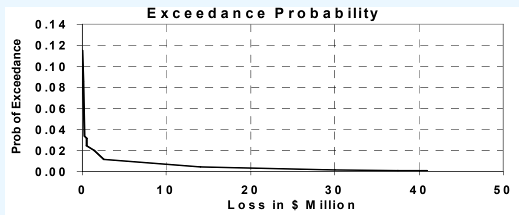
p_j = Annual rate of Event with $Loss_j$ for rates that are small

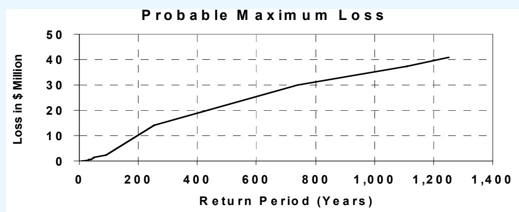
If we assume only one event occurs in a year → OEP

EP (Li) = Prob (Loss > Li) = 1 - Prob (Loss <= Li)

$= 1 - \Pi_1^{i}(1 - p_j)$

Return Period = 1 / Prob of Exceedance





The exceedance probability is sometimes quoted using “return periods”, e.g. a 1% exceedance probability in any given year is equivalent to a 1-in-100-year return period. Therefore when an event from a given peril is being referred to as a 1-in-100-year event, it does not mean that the event would not happen again for another 100 years, but that there is only a 1% chance for events caused by that peril to record the same or higher amount of losses to the portfolio within the same period.

Using the simulated output from cat models, two commonly used types of EP curves can be produced. The Occurrence Exeedance Probability (OEP) curve is one that represents the probability distribution from a single event in the year, and the Aggregate Exceedance Probability (AEP) curve is the probability distribution of all events that are simulated to occur in the same period. The information represented by these two curves will give an insurer useful reference to the natural catastrophic risk exposure in their portfolio. Whilst the OEP will be useful in assisting the insurer in determining the limit of their reinsurance for protecting against natural catastrophe for a single event (usually in the form of an Per Event Excess of Loss Treaty), the AEP provides information such as the expected loss from the modelled peril from one or more events in any given year (AAL, or Annual Average Loss) as well as the frequency of a certain size loss happening, thus assisting with the determination of the number of reinstatements needed for a particular reinsurance layer.

Bridging the Gaps

Whilst cat modelling outcomes greatly assist with a company’s evaluation of its natural catastrophic exposure, there are a number of limitations one must take into account when attempting to determine the actual natural catastrophe risks of a company’s portfolio. A list of the key limitations is outlined as follows:

- Unmodeled perils – Limitation in the Hazard module. Cat models do not cover all kinds of natural perils. In general, the currently modeled perils include Hurricanes (a.k.a Typhoons), Earthquake, Flooding, Bushfire, Winterstorm and Tornado/Hail but the models are not available in all territories around the world. In Hong Kong and China, for example, only cat models for Typhoon and Earthquake are available. Furthermore, perils not included such as Tsunami and Fire following Earthquake may be significant contributors to financial damage.
- Unmodeled exposures – Limitation in the Vulnerability and Financial modules. e.g. items such as offshore oil rigs, or lines of business such as workers’ compensation or commercial liability that are not included in the exposure that is being used for modeling.
- Model misses – either due to the Hazard module not capturing all kinds of possible peril or the Vulnerability and Financial component failing to model all exposures to a hazard. e.g. The recent Tohoku earthquake was of a larger magnitude that any cat model had contemplated.
- Inadequate or faulty data on the insured exposure, particularly inaccurate insurance to value and “unknown” construction or occupancy codes, limitation in the Vulnerability and Financial modules
- Demand surge inflation, whereby the increase in demand for construction materials and labor to repair the damage leads to an increase in repair costs. Limitation in the Financial module.
- Incomplete information in inuring reinsurance, such as surplus share programs with event limits. Limitation in the Financial module

Adjustments should be made to the modeling results to account for the above gaps for the derivation of a more realistic estimate of an insurer’s actual cat exposure.

Pricing the Cost of Cat into Policy Premium

Now that the insurance company has evaluated its cat exposure, the issue becomes one of managing the company’s risk appetite. Risk accumulation can be monitored by region and by line of business, decisions on risk transfer can be made based on the company’s risk tolerance level and the cost of the risk transfer mechanism, be it reinsurance or cat bonds. But how should it work on the other end of the equation where the cost of this exposure is built into the price of the underlying policy?

For most primary insurance, coverage to natural catastrophe is part, and not all, of the policy coverage sold. For example, exposure to natural catastrophes such as typhoon and earthquake to a commercial property is only one kind of hazard that the risk will face, in addition to fire, burglary etc. The price of cat exposure therefore is one of components to a premium rate. The logic to pricing the risk of cat is to a large extent similar to pricing non-cat risks, with one complication.

An insurance premium is typically derived as follows:-

Policy Premium = Pure Premium + Net Cost of Reinsurance + Loadings for Expenses and Profit

The type of data collected on natural disaster perils may differ from that required for fire or theft, often requiring special data collection processes. For example, territories appropriate for fire insurance may be inappropriate for typhoon exposure.

It should be familiar to most P&C actuaries that the pure premium above accounts for the expected loss cost of the risk in question and the profit loading, with the intention of providing the insurer its required return on capital. Generally, lines such as motor liability have relatively low volatility, meaning that the premium is dominated by the expected loss and other underwriting or claims expenses. This exact same logic can be applied to pricing a policy with cat exposure except that the pricing of the loading for volatility is much more significant, given the low frequency high severity nature of cat risks and their potentially large downside. That is why this is usually treated as a separate item in the price and is referred to as the Cat Risk Load. The premium calculation formula is modified slightly as follows:-

Policy Premium = Non-cat Pure Premium + Cat Pure Premium + Loading for Expenses and Profit + Cat Risk Load

As discussed in the previous section, the Cat Pure Premium can be derived from the cat modeling outputs as the AAL plus any additional adjustments needed to account for model misses. As for the Cat Risk Load, standard deviation would not be an appropriate statistic to use due to the fact that it is always the tail risk that is of concern when it comes to cat and not the fluctuation around the mean. More recently there has been an increasing amount of literature advocating other risk metrics, such as VaR and TVaR, that provide insight into the risk at the tail of the loss distribution.

A simpler method that had been adopted is to base the cost of cat on the cost of Cat Excess of Loss Reinsurance, as follows:-

Policy Premium = Non-cat Pure Premium + Loading for Expenses and Profit + Cost of Cat Reinsurance

Whilst this method does reflect how much the reinsurer, as the risk-taker, wants for the risk, thereby inferring the actual cost of that risk, it is incomplete since not all cat exposure are covered by reinsurance. However this methodology would be an appropriate substitute for smaller companies whose cat pure premium and risk charge would be difficult to derive with reliability.

One final problem is that the pricing of risks subject to natural disasters is by definition dynamic, in that the correct risk load is a function of the risks in the portfolio and their concentration. In many other types of insurance the price required, being dominated by the expected loss is not significantly affected by the volume or concentration of risk in the portfolio. Thus, the marginal cost of an additional risk is similar to the average cost of risks already in the portfolio. This is not the case for risks subject to natural disasters, for the addition of a risk in an area of high concentration can change the needed price of the portfolio.

Regardless, the critical point of this discussion is that companies underwriting risks subject to natural disasters need to collect detailed information on their exposures, utilize complex catastrophe models, constantly monitor risk concentrations, and closely coordinate capital, reinsurance, and direct pricing strategies.

Summary

In summary, the proper evaluation and pricing of natural catastrophic risks are vital to insurers in managing their business. As the science on the subject matter evolves, the actuarial profession must play an active role in providing thought leadership in this relatively new area of risk quantification.

Rade Musulin
COO of Aon Benfield Analytics APAC

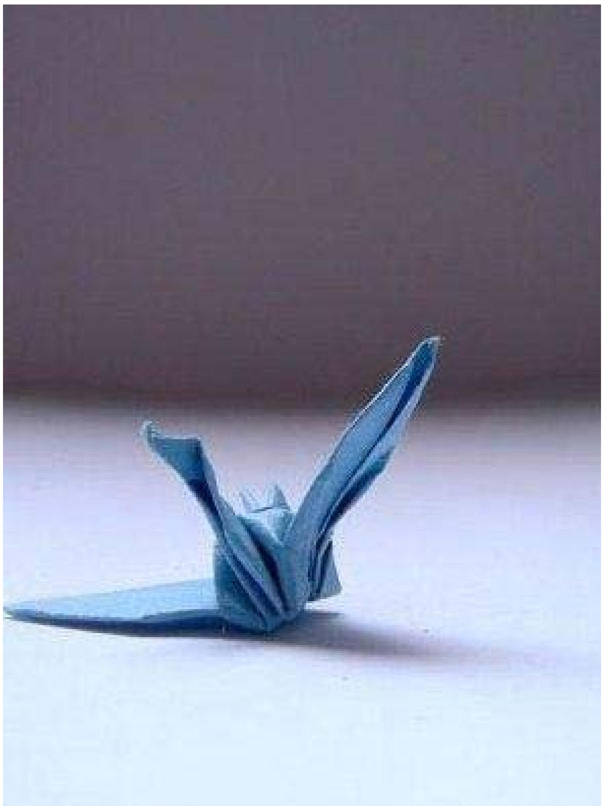
Carole Ho
Executive Director of Aon Benfield Analytics China
on behalf of the Casualty Actuarial Society

Natural Catastrophe Insurance and Risk Management

Catastrophe insurance provides pro-tection against natural disasters such as earthquakes, floods and cyclones, it sometimes also covers man-made dis-asters such as terrorist attacks. In the Asia Pacific region, because of low insurance penetration rates in many countries, even events with great loss of life often cause only limited financial detriment to insurers. However, Asia and Australasia have seen a spate of natural catastrophe events in the last couple of years, which have taken their toll on insurers' balance sheets: the Victoria Bushfires and numerous floods in Australia were only a harbinger portending events of a market-changing nature, namely the major earthquakes in Christchurch (New Zealand) and off the coast of Japan. Current estimates of insurance losses from these events are in the order of 12 bn USD (February Earth-quake in New Zealand) and, much worse, 30 bn USD in Japan. Reinsurers shoulder a large portion of the losses from these events and help their clients maintain their financial stability during such phases of turmoil, in which mounting repair and reconstruction costs aggravate losses of life and health.

A key element of success in any market is to offer products and reinsur-ance capacity that clients can fully rely on, even after "low frequency/high-severity" events such as those in Japan and New Zealand. The availability of this reliable risk capital is ensured by a sound enterprise risk management (ERM) framework which incorporates the following elements:

Underwriting Expertise: Naturally, the pivotal element of natural cata-strophe insurance is the underwriting, where risks of high severity are ex-changed for reinsurance premium pay-ments. Understanding the drivers of loss in any reinsurance contract calls for qualified expertise in the under-lying hazard, primary market terms, coverages and conditions, as well as familiarity with the overall downside effect on the reinsurer's capital position from a whole-of-portfolio perspective. The former can only be achieved by very strong interaction with clients and brokers, i.e. in-depth knowledge of the local markets; this is especially true of Japan, where the earthquake insurance sector is dominated by complex policy conditions unique to that country. Knowledge of loss potentials requires backup from sophisticated actuarial tools and methods such as those described below.



Natural Catastrophe Modelling: Today, natural catastrophe reinsurance would be unthinkable without the use of modeling techniques, usually in the form of complex software products. These combine a scientifically sound estimation of the natural hazard, e.g. when, where and how often earth-quakes tend to occur, with datasets about the portfolio of policies and property reinsured, known in the busi-ness as "exposure data." These usually contain a building inventory describing the geographic location, nature and value of the locales insured. Outputs from the models include a probability distribution of the financial losses arising from the hazards modeled and associated risk metrics such as the probable maximum loss in a rare "once in 250 years" event or the expected average annual loss that is fundamental to reinsurance pricing. Some companies use market -standard state-of-the-art models licensed from specialists for major perils such as earth-quakes but also employ a number of in-house models to expand coverage to take into account often-neglected perils such as Hail, Bushfire and Flood – each of which has caused turmoil in Australia recently.

Thinking outside the Model Box: The history of catastrophic events over the last ten years has shown that rely-ing on catastrophe model output alone would have left (re)insurers with an incomplete view of the financial risk latent in their portfolios, not just because of the aforesaid secondary perils, but also because a naive "black-box" usage of the cat models fails to capture potential drivers of losses in the perils they claim to model. These deficiencies come in the form of incomplete or inaccurate exposure data but also of side effects not even envisaged in the standard models: in Japan, the tsunami following the 9.0 earthquake caused tremendous damage covered by most insurance policies, but had not been allowed for in the calculations of vendor models. Likewise, the quake that devastated Christchurch in February was incom-pletely modelled because no allowance had been made for liquefaction effects due to the sandy soils on which the city it built. Some companies use sophisti-cated model validation and adjustment techniques to ensure that the output of its catastrophe models does not contain any surprise elements. These ap-proaches proved very sound during this year's two major events, so that even the huge losses sustained were not "off–scale high."

Accumulation Management and Internal Capital Model: Just as important as getting the price of reinsurance right is ensuring that the capacity offered does not breach prudent risk management thresholds and threaten a reinsurer's overall capital position. An internal capital model takes quantitative aspects of all potential risks into account and produces loss distributions that permit holistic and granular steering of business decisions, cascading down to the contract level.

Today, the quality of a company's ERM system and its Internal Model is an important element in the financial strength ratings awarded by rating agencies. It also comes under close scrutiny from regulatory bodies under schemes such as Solvency II, which impose a tight framework of organiza-tional, process and documentation requirements in order to verify the accuracy of an Internal Model and the overall efficacy of the overarching risk management framework.

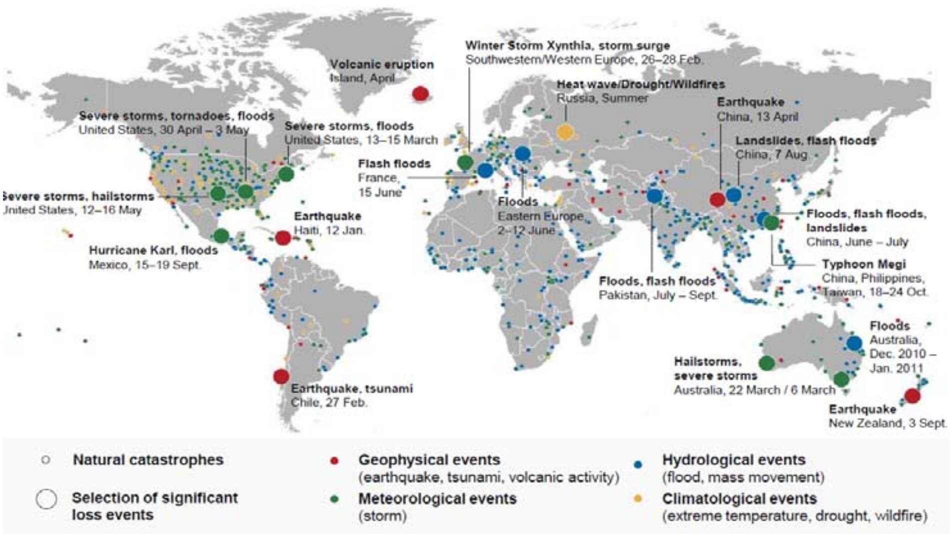
Dr Kai Haseloh
Senior Actuarial Analyst
Hannover Re

Catastrophe Risk Management

Catastrophic events are unique among insurance risks: while traditionally insurable risks occur with predictable frequency and relatively low losses, catastrophes occur infrequently but with high losses.

Altogether, a total of 960 natural catastrophes were recorded in 2010. These can be seen below.

Figure 1 – Natural catastrophes in 2010[1]



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Several of these major catastrophes resulted in substantial losses and an exceptionally high number of fatalities.

Table 1 – The five largest natural catastrophes of 2010[2] *(Ranking by number of fatalities)*

Date	Country/ Region	Event	Fatalities
12 January 2010	Haiti	Earthquake	222,570
July to September 2010	Russia	Heat wave, forest fires	56,000
13 April 2010	China	Earthquake	2,700
July to September 2010	Pakistan	Floods	1,760
7 August 2010	China	Landslides, flash floods	1,470

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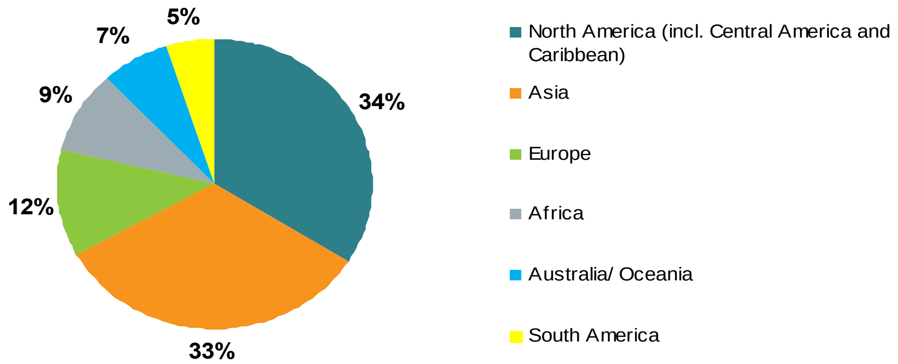
The global distribution of natural catastrophes in 2010 is comparable to that of previous years, with most catastrophes occurring on the American (365) and Asian (310) continents.

Figure 2 – Percentage distribution of natural catastrophes in 2010[3] *(by continent)*



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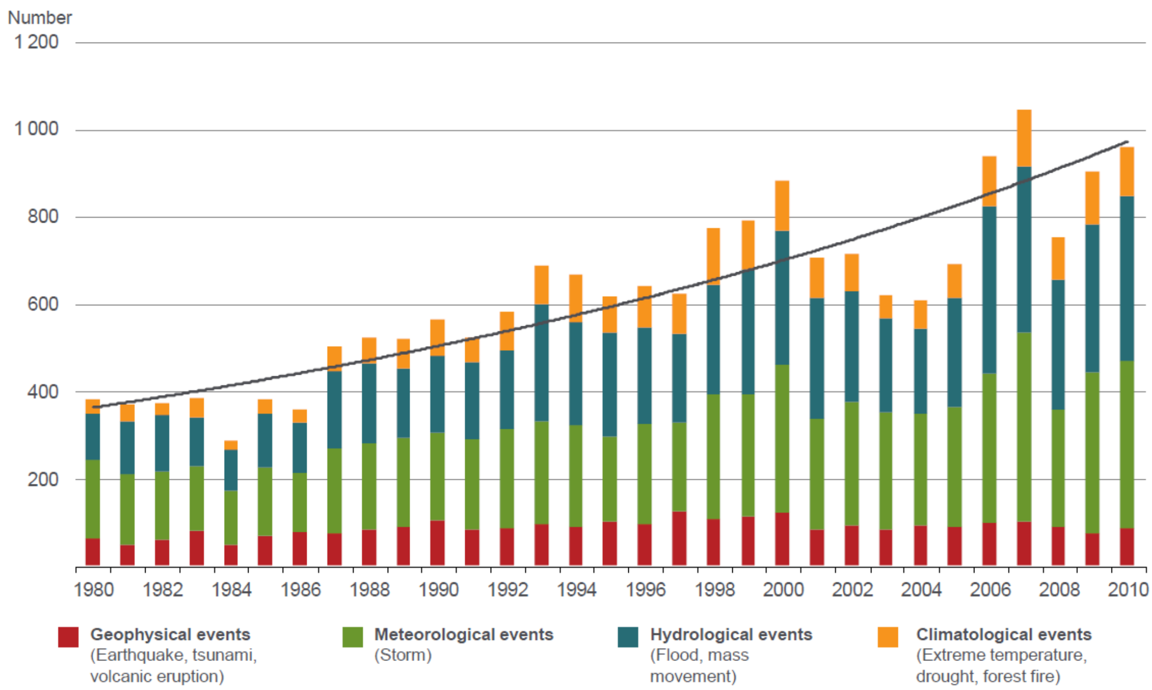
It is evident that the number of natural catastrophes worldwide is on the rise.

Figure 3 – Natural catastrophes worldwide from 1980 to 2010[4] (Number of events with trend)



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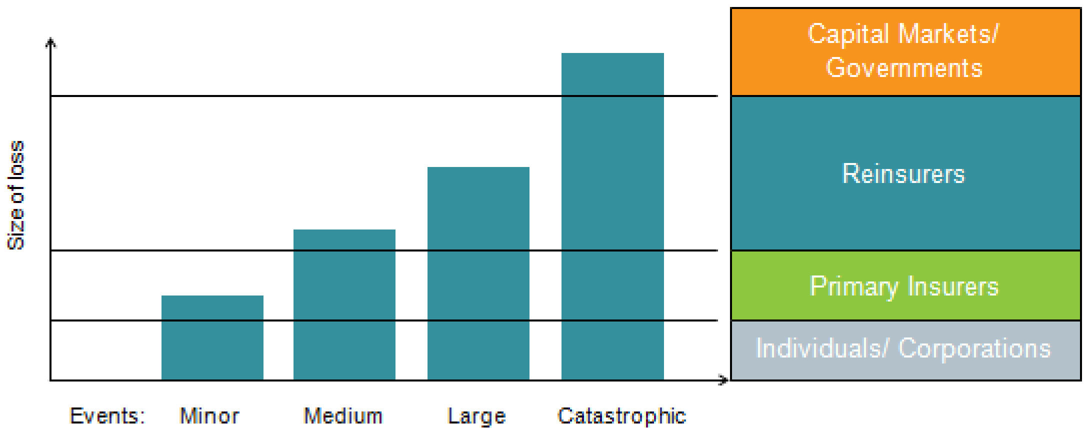
Catastrophe Insurance

In 2010, natural catastrophes claimed 295,000 lives and the first few months of 2011 have also resulted in significant catastrophic deaths. In Japan alone, there were 15, 400 fatalities[5] after the March 11 earthquake and tsunami.

To help absorb the financial burden created by natural catastrophic events, risks can be shared between individuals, corporations, insurers, global reinsurers, capital markets and governments. The rest of this article will focus on a particular tool - Catastrophe Excess of Loss Insurance - that can, with great efficiency, help to:

- Increase primary insurer capacity;
- Stabilize underwriting results;
- Protect against catastrophic losses; and
- Finance insurance company growth.

Figure 4 – Risk sharing shown graphically



Catastrophe Excess of Loss (Cat XL) Insurance provided by Reinsurers

Catastrophic events, that occur in an area where the primary insurer has a high concentration of policies (e.g. Hong Kong), could result in liabilities that place severe strain on a primary insurer's solvency. Cat XL cover allows the primary insurer to share the financial burden of these low frequency, high severity events in a cost effective way. Global reinsurers, in turn, diversify these risks across hundreds or thousands of similar policies worldwide.

In short, Cat XL cover is a non-proportional treaty with a short cover period (usually one year) and with a premium which is generally low in relation to the potential liability.

A 'loss occurrence' under a Cat XL treaty is the accumulation of individual claims arising directly from the same risk event covered (e.g. natural hazards, aviation and traffic).

In the context of life insurance, Cat XL cover can be obtained for that part of the directly written individual and / or group life business (death, accidental and disability) which the ceding company retains for its own account (after all other reinsurance). Cat XL covers the cost of accumulated claims of groups covered (after deduction of other reinsurance recoveries) in excess of a specific amount, up to a maximum.

For example, the treaty may cover losses in excess of HK$25million up to HK$125million, as a result of a single catastrophic event affecting the group shown below:

Table 2 – Example of total lives covered (group) under a Cat XL treaty

	Life Insurance	Accidental Death Benefits	Disability Benefits
Individual Business	40,000	10,000	5,000
Group Business	60,000	15,000	10,000

A minimum number of persons insured need to be affected by a single event for the cover to be triggered. For example, an event which results in less than 3 people being affected, is not considered a catastrophic event for Cat XL cover.

The probability that an individual company is affected by a second or even a third event within the same cover period is very low. However, it is common for reinsurers to set an overall maximum liability per year (say HK$150million in this example). As an alternative to setting a maximum liability per year, reinstatements may be granted.

Another important feature of Cat XL treaties is the 'hours clause'. In the case of natural catastrophes (e.g. earthquake, windstorm, hail, tornado and flood), the duration and extent of any 'loss occurrence' event are normally limited to 72 consecutive hours.

Due to the nature of the risks underwritten, exclusions are common. These include:

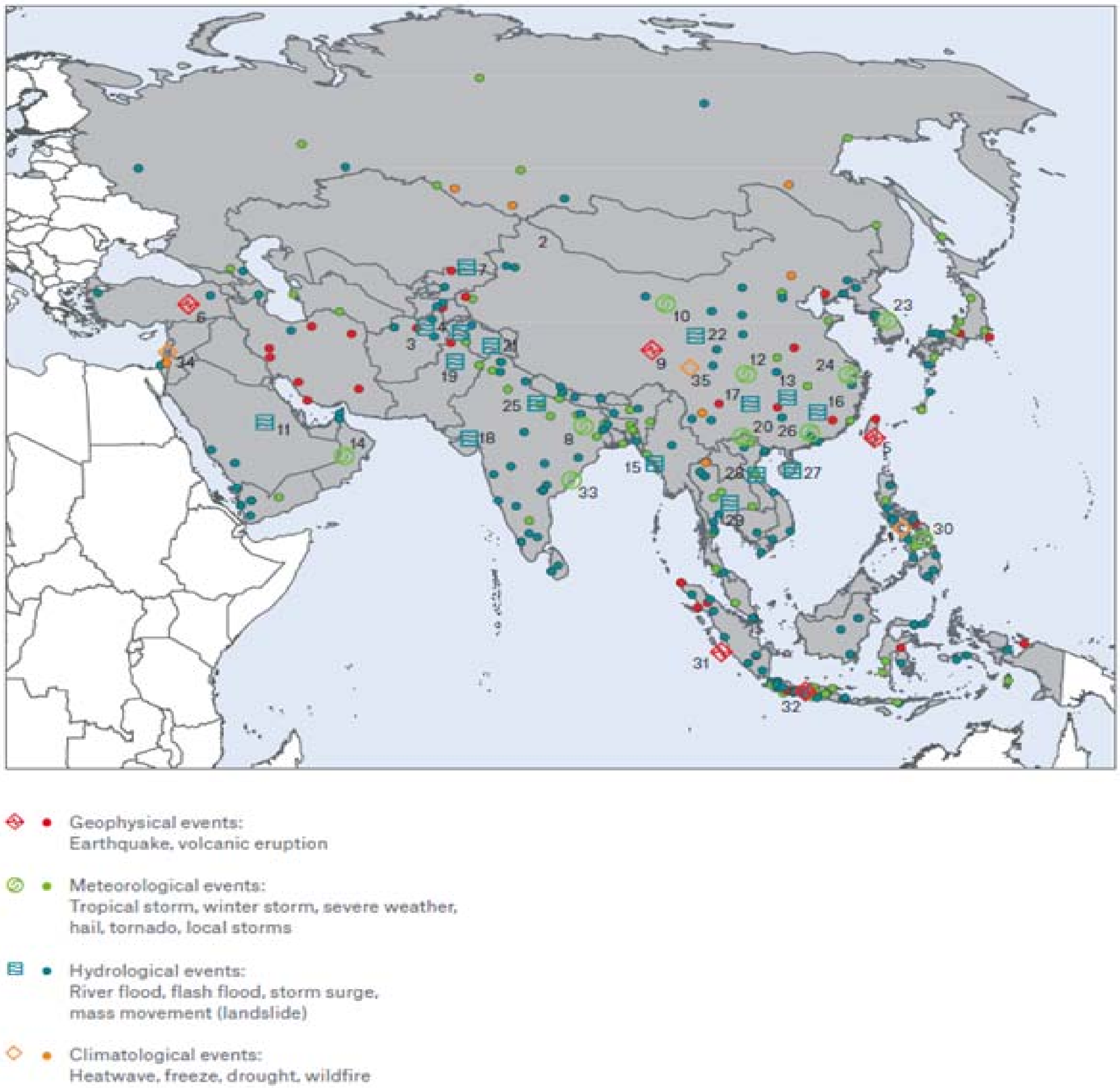
- Occupational and infectious diseases unless they are directly caused by a covered event;
- Accidents that are a direct or indirect consequence of the use of atomic, biological or chemical weapons as well as radioactive, biological or chemical substances.

From a reinsurer's perspective, because Cat XL only covers a small part of the risks borne by a primary insurer, often for a low premium, Cat XL is typically sold as a complement to other reinsurance (e.g. Proportional).

Conclusion

Catastrophic events appear to be on the increase worldwide and Asia is no exception. As the trend continues, catastrophe risk management from a reliable, financially sound and experienced global reinsurer is vital. Cat XL is a particular tool, that can, with great efficiency, help ensure the financial stability of an insurer in the event of a catastrophe.

Figure 5 – 2010 Natural catastrophes in Asia[6]



Lyndall Wilson, FIA
Munich Re, China

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[1] Munich Re's NatCatSERVICE
[2] Ibid.
[3] Ibid.
[4] Ibid.
[5] Munich Re, NatCatSERVICE, as at 9 June 2011
[6] Munich Re, Topics Geo 2010

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Catastrophe Reinsurance: Managing Extremes

Actuaries rely on the Law of Large Numbers for many of their actuarial methods to work. With extreme catastrophe events, which happen very rarely but cause severe losses, reinsurance actuaries need new tools to manage these extreme risks.

Television viewers on March 11 this year were shocked as they watched the dark waves of a devastating tsunami destroy the beautiful coastal town of Sendai in Japan, washing away houses, taking thousands of lives and causing widespread panic and commotion in its wake. Insurers around the world watched in horror too as initial loss estimates of up to US$34 billion (or around 15% Hong Kong's GDP) started coming in.

To avoid sleepless nights, insurance executives try to mitigate or transfer some of these catastrophic risks through measures such as monitoring their aggregate risk exposure, strengthening their underwriting and pricing disciplines, and buying reinsurance. In practice, reinsurance is by far the most efficient way to manage catastrophe risks by transferring some of these risks to the reinsurance market. Reinsurance covers protect not only the company balance sheet, but the executives' jobs. However, many insurers either buy too little cover to protect their exposures, or pay too much for reinsurance cover they don't necessarily need. This is where professional reinsurers and reinsurance brokers add value by crafting optimal catastrophe protection for insurance companies.

Catastrophe risk and capital

Partly driven by rating agencies' requirements and regulation, risk based capital assessment has generated considerable interest and controversy from boardrooms to frontline underwriting. For many insurers, a key challenge is managing extreme risks caused by the aggregation of losses and accumulation of exposures in a single event. Catastrophe risk is quite often the largest risk source affecting their balance sheets and earnings. Rating agencies and regulators usually focus on the risk in the tail of the distribution, which is primarily driven by catastrophe losses. If insurers can manage to reduce their catastrophe risk, they may need less regulatory capital for their business.

Reinsurance can do just that. Various kinds of reinsurance arrangements exist to protect insurance companies against the threat of catastrophe events. These products range from traditional proportional or excess-of-loss covers and risk pooling arrangements, to industry loss warranties, collateralized reinsurance and insurance securitizations. Often products are designed to tap into the market where cost of capital is the cheapest – be it the reinsurance or capital markets.

The question of what exact structures or products are needed to optimize an insurer's risk and capital mix depends on many factors. These include the state of the insurance and reinsurance markets, the financial strength of the company, the purpose of buying the protection, and how the company wants the catastrophe risk to be sliced and diced. Of course, the more protection a company buys the lower the risk of a single catastrophe event hurting the company. But this protection comes at a cost – and it also entails credit risk, because the insurer must rely on the reinsurance company to remain solvent after an extreme catastrophe. So how do reinsurance actuaries determine the "optimal" structure?

"Optimal" Structure

When structuring reinsurance protection for catastrophe risk, reinsurance buyers normally consider several aspects of an insurance company's business: underwriting, finance and risk management. Key factors include:

- Company risk appetite and risk tolerance
- The prospective underwriting plan, including the expected amount of aggregate catastrophe exposure and amount of diversification expected within the portfolio
- Quantitative assessments of the catastrophe risk
- Reinsurance budget
- Amount and cost of the capital that supports underwriting operations
- Price of buying the reinsurance covers
- Security of the reinsurance companies offering the covers

The relative importance of these factors will depend on the culture and strategy of the insurance company. Usually, reinsurance buying involves negotiations among various departments within a company, and the final structure is subject to approval from several committees or the executive board.

Quantitative risk assessment is the area where reinsurance actuaries can add the most value.

Actuarial toolkit

One of the most important aspects of designing an efficient catastrophe reinsurance arrangement is quantifying the catastrophe risks. In the olden days, a number of standard actuarial methodologies were used. All these methods have varying degrees of limitations when it comes to assessing catastrophe risk.

The "burning cost" method assesses risk by adjusting a few years' of historical observed losses on a relatively crude basis for changes in the business over time. This method may work reasonably well for higher frequency, lower severity events. For events which happen only once every few decades, it is difficult for actuaries to justify the idea that the few years of data they use are representative of everything that could happen to the portfolio.

With the advance of climatology, seismology and computing power, catastrophe models have overcome some of the shortfalls of the burning cost method by using historical events as a starting point and applying scientific theory to create other possible future events. Historical events used to build catastrophe models are generally taken from a much longer time horizon than company history would provide – usually decades or centuries.

Catastrophe models have been an integral part of the insurance business since the 80s. Global catastrophe modelling companies, such as Risk Management Solutions (RMS), Applied Insurance Research (AIR) and EQECAT, have over the years developed sophisticated probabilistic models to help the insurance industry to understand and assess natural catastrophe risk better.
These probabilistic catastrophe models rely on multi-disciplinary teams to ensure the physical sciences and financial implications of each event are properly understood. Wind speed of typhoons, intensity of earthquake and frequency of occurrence of each event are based on assessments by climatologists and seismologists; the degree of damage to particular structures after each event is based on assessment by structural engineers; and the insured losses are calculated by applying the right policy conditions. Very often these models will incorporate secondary effects of catastrophes such as the increasing cost of rebuilding due to a surge in demand for builders, and fires caused by damaged infrastructure following major earthquakes.

Such models enable actuaries to create not only a single point estimate, but a whole range of different outcomes. This means they can assess an insurer's potential catastrophe loss at different "return periods" – that is, the maximum amount of catastrophe loss that could be expected every X years, often called the "1-in-X value." Typically, insurers review their typhoon risk based on the 1-in-100 years return period loss, and earthquake risk using the 1-in-250 years return period loss.

Increasingly actuaries are also using dynamic financial analysis (DFA) models to take a holistic view of catastrophe exposure, combining risks caused by different perils. Using DFA allows actuaries to model correlations of different perils, as well as to quantify the impact of catastrophe risk on the whole company.

A new breed of actuary?

Even with all the new tools, being a reinsurance actuary is far from easy. First, reinsurance actuaries usually have to deal with lack of reliable data, it is therefore necessary to incorporate assumptions based on expert judgment. That's why reinsurance actuaries need a thorough understanding of the dynamics of the business. This includes in-depth knowledge about issues such as the changing mix of business, claims trends, inflation, the state of the insurance cycle, the effects of climate change and other emerging risks. Second, reinsurance actuaries need to understand the limitations of different methods and models in order to select the appropriate approaches for different situations models should be used intelligently. Third, reinsurance actuaries need to communicate effectively with underwriters, catastrophe modellers, finance directors, reinsurance managers and brokers about the underlying risk, the modelling approaches and the assumptions that have been incorporated in their analysis. For instance, a lot of reinsurance actuaries are now working alongside brokers or underwriters to present their solutions to a company's board. Good communication skills become crucial to convey technical messages to non-actuarial audiences.

More and more, we see reinsurance actuaries involved in many aspects of the catastrophe business. These include pricing catastrophe reinsurance contracts, managing their catastrophe exposure and aggregation, loss reserving, business planning and capital modelling. Perhaps instead of buying sleeping pills, insurance executives should hire more actuaries!

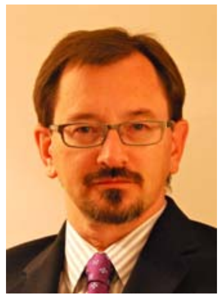
Chi Hang Wong
Actuarial Analyst, Willis Re

Michael Fung
Executive Director, Willis Re

Interview with an Actuary

Interview with ***Mr. Ronald T. Kozlowski*** by Mary Kwan, Ernst & Young

Mary: Hi Ron. First of all thank you so much for your time. Our theme for this newsletter is on general insurance. Recent catastrophes have had significant impact and they can have effects which spread worldwide. Lets start by looking at the catastrophes in Asia. What are the major catastrophe risks affecting Asia?



Ronald T. Kozlowski
FCAS, MAAA
Towers Watson

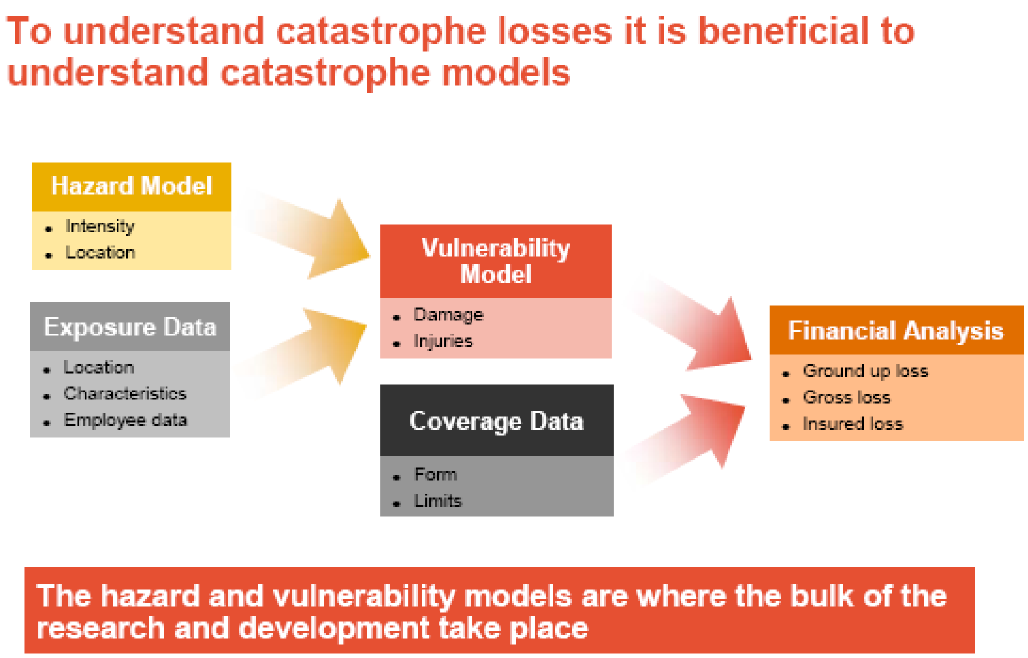
Ron: I almost think it would be easier to ask what catastrophe risks don't affect Asia. It seems like Asia has all the catastrophe risks.

From the recent earthquakes in New Zealand, Japan, and Indonesia, we are reminded that Asia's eastern coast sits in the Pacific Ring of Fire which is the most geologically active place on earth. We are also already into the 2011 Pacific typhoon season that runs from May through November. Probably the third catastrophe that comes to mind are floods. We also have everything from wild fires to mudslides, landslides, tsunamis, winter storms, volcanic eruptions, terrorism etc. And then there are other risks such as infectious diseases and industrial accidents.

(NATHAN World Map of Natural Hazards on next page)

Mary: What are catastrophe models? What are hazard modules and vulnerability modules? How do they work?

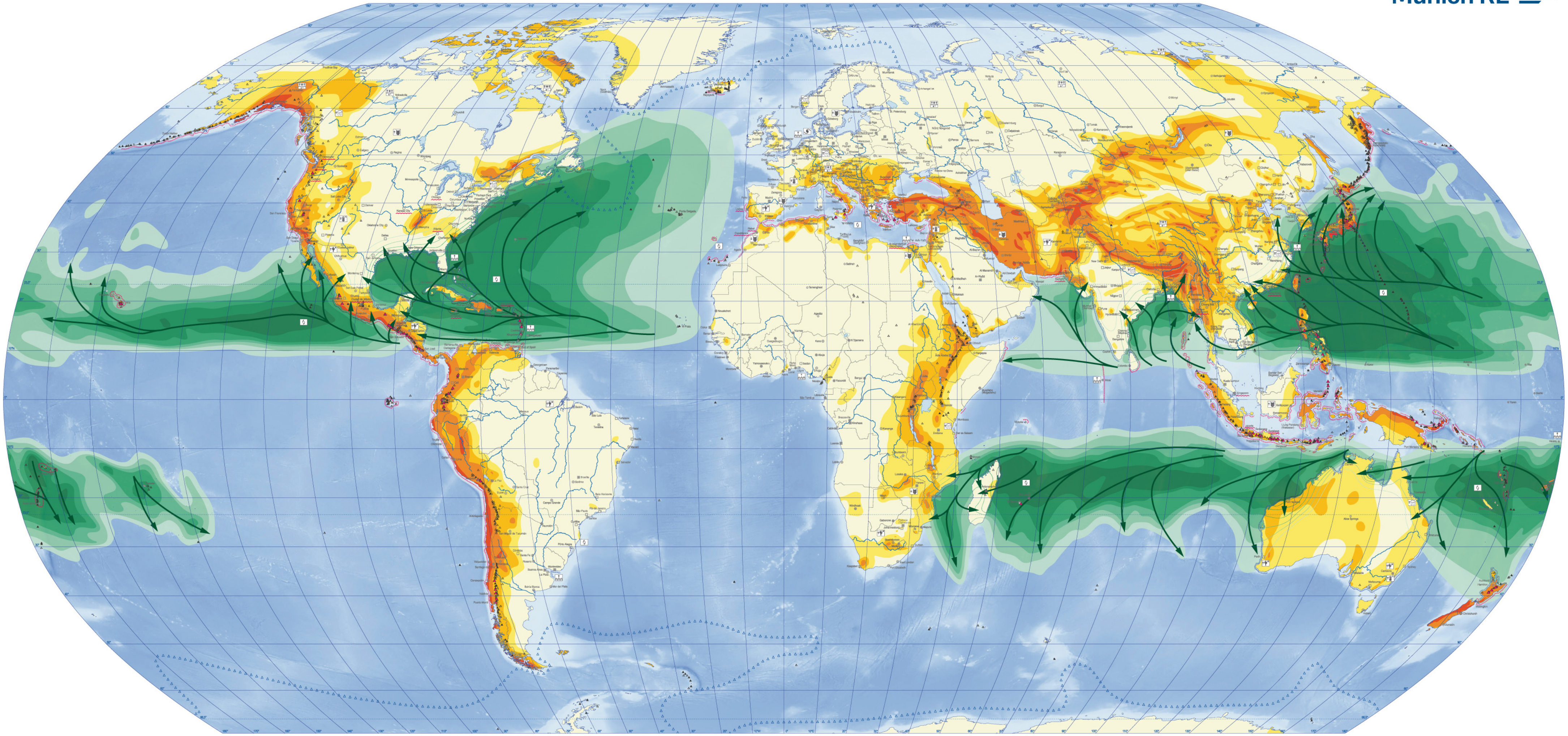
Ron: Catastrophe models are used by the insurance industry to assess the potential damage of natural or man-made catastrophes. There are normally three components – a hazard module, a vulnerability module and a financial analysis module. The hazard module takes the event parameters and determines the damaging forces. Think of the shaking intensity of an earthquake or the wind speeds of a typhoon. The vulnerability model takes the damaging forces and overlays it upon on the exposures to come up with the damage scale. The main component of this module is the damages, which translates the damaging forces to the actual damage. Using windstorms as an example, we might need to estimate the damage from a one minute sustained wind speed of say 120 miles/hour on a structure with certain characteristics. The financial analysis module takes the damaged exposure and overlays it with the insurance coverage (limits, deductibles, sublimits) to come up with the claims that will be paid by the insurance companies.



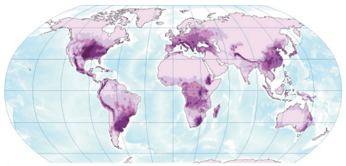
Hazard modules are generally developed by scientists. The vulnerability modules are usually developed by engineers and validated by using insurance company data. Financial analysis modules would be more the actuarial

NATHAN WORLD MAP OF NATURAL HAZARDS

Munich RE

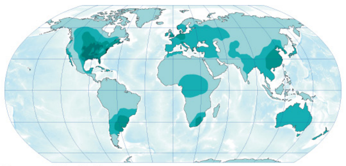


HAILSTORMS



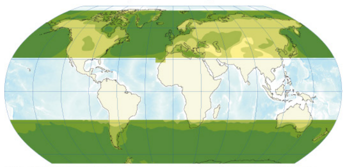
Frequency and intensity of hailstorms
Zone: 1 2 3 4 5 6
Low → High

TORNADOS



Frequency and intensity of tornados
Zone: 1 2 3 4
Low → High

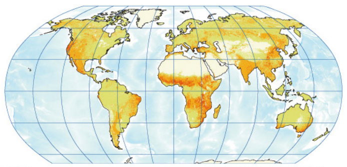
EXTRATROPICAL STORMS (WINTER STORMS)



Peak wind speeds (in km/h)*
- Zone 0: ≤80
- Zone 1: 81–120
- Zone 2: 121–160
- Zone 3: 161–200
- Zone 4: >200

Areas were examined in which there is a high frequency of extratropical storms (approx. 30°–70° north and south of the equator).
* See "Tropical cyclones"

WILDFIRES



Hazard
- No hazard for bodies of water, areas of urban development and areas without vegetation

Zone: 1 2 3 4
Low → High

The effects of wind, arson and fire-prevention measures are not considered.

EARTHQUAKES

- Zone 0: MM V and below
- Zone 1: MM VI
- Zone 2: MM VII
- Zone 3: MM VIII
- Zone 4: MM IX and above

Probable maximum intensity (MM: Modified Mercalli scale) with an exceedance probability of 10% in 50 years (equivalent to a "return period" of 475 years) for medium subsoil conditions.

Ōsaka – Large city with "Mexico City effect"

VOLCANOES

- Last eruption before 1800 AD
- Last eruption after 1800 AD
- Particularly hazardous volcanoes

TSUNAMIS AND STORM SURGES

- Tsunami hazard (seismic sea wave)
- Storm surge hazard
- Tsunami and storm surge hazard

ICEBERG DRIFTS

- Extent of observed iceberg drifts

TROPICAL CYCLONES

Peak wind speeds (in km/h)*

- Zone 0: 76–141
- Zone 1: 142–184
- Zone 2: 185–212
- Zone 3: 213–251
- Zone 4: 252–299
- Zone 5: ≥300

* Probable maximum intensity with an exceedance probability of 10% in 10 years (equivalent to a "return period" of 100 years).

- Typical track directions

CLIMATE IMPACTS

Main impacts of climate change already observed and/or expected to increase in the future

- Change in tropical cyclone activity
- Intensification of extratropical storms
- Increase in heavy rain
- Increase in heatwaves
- Increase in droughts
- Threat of sea level rise
- Permafrost thaw
- Improved agricultural conditions
- Unfavourable agricutural conditions

POLITICAL BORDERS

- State border
- State border controversial (political borders not binding)
- River
- Lake
- Previous extent of lake

CITIES

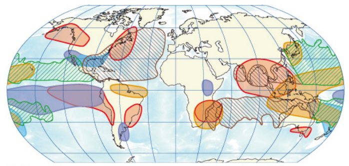
- Denver – >1 million inhabitants
- San Juan – 100,000 to 1 million inhabitants
- Maun – <100,000 inhabitants
- Berlin – Capital city

Data resources

Bathymetry: Amante, C. and B. W. Eakins, ETOPO1 1 Arc-Minute **Global Relief Model:** Procedures, Data Sources and Analysis, National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce, Boulder, CO, August 2008. **Extratropical storms:** KNMI (Royal Netherlands Meteorological Institute). **Temperature/Precipitation 1978–2007:** Climatic Research Unit, University of East Anglia, Norwich.

Order numbers
302-05912 NATHAN World Map of Natural Hazards (wall map)
302-05913 NATHAN Globe of Natural Hazards (DVD)
302-05972 NATHAN World Map of Natural Hazards (folding map)

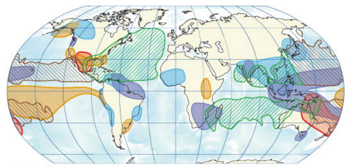
ANOMALIES DURING EL NIÑO



Weather conditions
- Wetter
- Drier
- Cooler
- Warmer

Tropical cyclone activity
- Fewer storms
- More storms

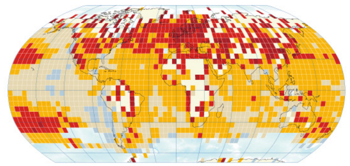
ANOMALIES DURING LA NIÑA



Weather conditions
- Wetter
- Drier
- Cooler
- Warmer

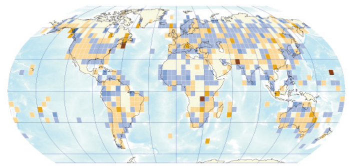
Tropical cyclone activity
- Fewer storms
- More storms

OBSERVED TREND IN MEAN TEMPERATURE IN THE PERIOD 1978–2007



-0.1 0.1 0.3 0.5 in °C per decade

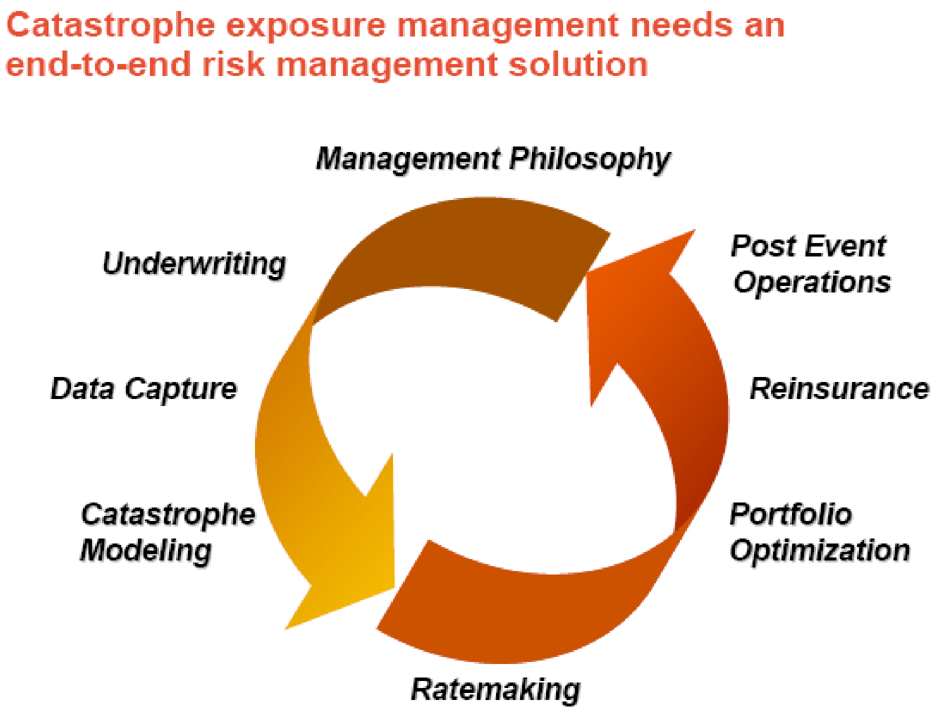
OBSERVED TREND IN PRECIPITATION IN THE PERIOD 1978–2007



-30 -15 0 15 30 in percentage per decade

Mary: How does the development of catastrophe models and their use by insurance companies in Asia compare to Europe and the US?

Ron: I would say that the catastrophe exposure management practices in Asia are 10 to 20 years behind Western practices.



Catastrophe management is one component of ERM (Enterprise Risk Management) and should reside throughout the company. It is not just the responsibility of one person or one department. It starts with setting out the management philosophy – whether it is to avoid risk or consider risks as an opportunity for writing an insurance product. In underwriting we decide what risks to write or reject.

Mary: Do Asian companies' underwriting guidelines specifically address the catastrophe exposure?

Ron: One of the areas for immediate improvement is in the capturing and validating of exposure information so that insurance companies can run the exposures through catastrophe models, be it simple deterministic events (like what would be insured damages if a magnitude 8.0 earthquake occurred within ten kilometers of Tokyo) or a probabilistic event dataset. We also need to think about the catastrophe loss, costs and risk loads in the rates.

Mary: Have Asian companies implicitly or explicitly quantified the catastrophe loss, costs and risk loads that they are charging for these risks?

Ron: Portfolio optimization helps companies to determine whether to stop writing or write more business. Reinsurance protection helps control the impacts of catastrophes on an insured's financials. As catastrophes occur companies can use the models to assess potential damage and to deploy claims adjusters to the right areas.

When I ask my colleagues what is the most important thing to focus on, they always say it starts with the data. Without data there is nothing to be modeled.

Mary: So what are the data inputs required for a catastrophe model?

Ron: The first data input will be exposure data. Exposure data will be what are you insuring, for example is it a home, office building, manufacturing plant or workers that are covered? Other details such as location and building characteristics (construction type, roof type, area of windows and doors, number of stories) are also included as exposure data. Exposure data quality will be dependent upon the information captured when the policies are first written and should be stored for future use.

A second type of data input is the insurance coverage data, which gives information of what insurance coverage is provided, including limits and deductibles.

We shouldn't forget about workers compensation, life or health information risks as well. Workers compensation, life and health risks can be modeled as well. These risks can be factored in as separate modules or by entirely different models. For example, earthquake damages will be very dependent on where the person is located and dependent upon the structural damage. However, other perils such as infectious diseases like influenza or industrial accidents could be dependent on climate and wind direction without damage to the structures.

Mary: Input data quality is crucial for any models. How can we collect better data and what are the alternative data sources?

Ron: Better recording and documentation of risks insured could help companies better understand and measure their catastrophe risk. For example if you are insuring a building but did not capture how many stories it has, you are missing an important data input into an earthquake damage model. An example for wind would be the number and area of windows and doors. Year of construction may also give information on building practices of the structure. Specialist underwriters should be encouraged to work closer with insurance companies to identify the building characteristics that might affect potential losses.

In some countries data may exist in the public record that describes the type of structure, year built, etc. You could even use Google maps to have a better understanding of the risk and the surrounding area. This is important for windstorms as airborne debris from surrounding properties can cause damage to the structure. You could also study topography and flood zone maps to better understand the potential for flooding, landslides or mudslides. Unfortunately catastrophe management in Asia isn't practiced the way it is in other insurance markets.

Mary: How do you think the actuarial profession in Asia can work better with catastrophe modeling experts and insurance companies?

Ron: I think the actuarial profession can help in two ways. First, the actuaries can help companies with improving their exposure information that is needed to be input into the catastrophe models. In order to have models of value, good quality exposure data is needed. So companies should develop processes to improve the data quality over time. The US industry has carried out work to improve data quality since the early 1990s. It took about ten years to significantly improve industry data. Even today companies blame the lack of good exposure data on why they didn't understand better the resulting losses from events. Second, actuaries can work with the engineers to improve damageability functions and improve underwriting. If an engineer comes up with a theoretical assessment of what the damage is, it should be tested with actual insurance company data. You'll need to understand the difference between structure damage and the insured damaged. The actuary can help with adjusting for the impacts of the coverage through the insurance policy. This is really important because sometimes the damage function created by engineers need to be tested and validated.

Actuaries should also assist in the development of catastrophe loss costs, mitigation/retrofitting credits, rating plans, etc. Actuaries can also help in understanding the concentration risks, portfolio optimization and assist in the understanding of reinsurance needs.

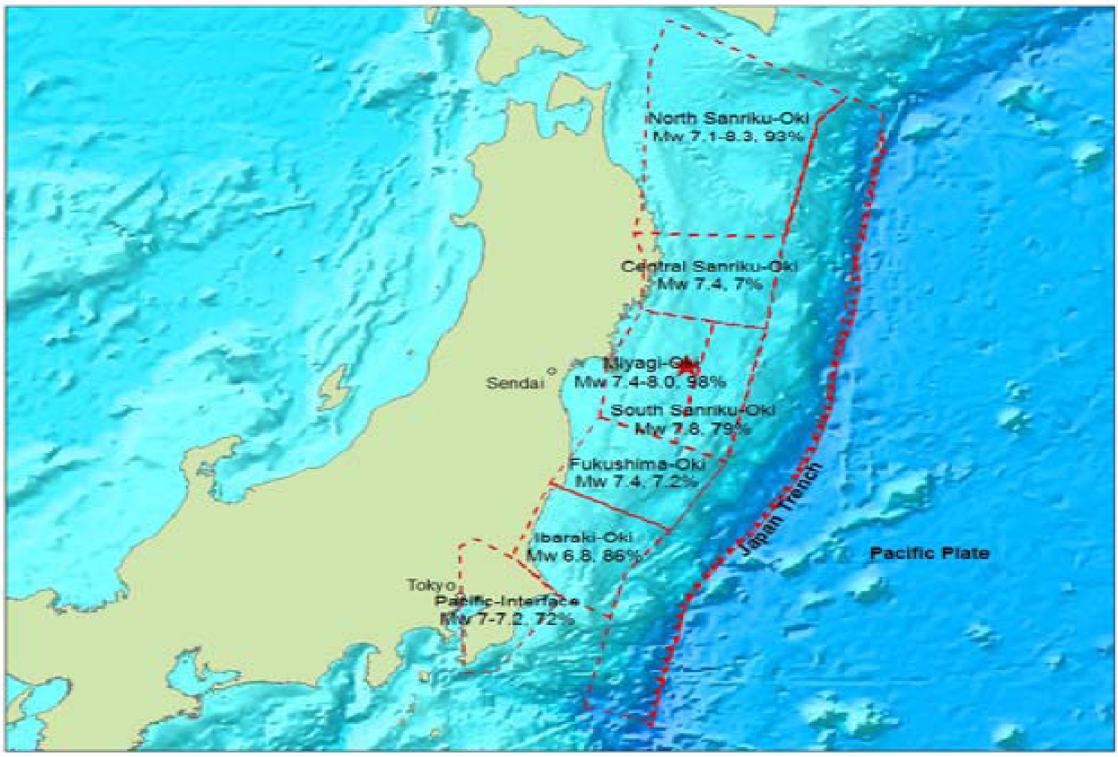
Mary: Japan is regarded as a country well prepared for earthquakes, for example in terms of construction standards against earthquakes. Yet the impact is still devastating. We have also seen other major catastrophes in recent years such as the New Zealand Christchurch Earthquake and the hurricanes in the States. What do you think the industry can learn from these events?

Ron:

(1) First for the Great Tohoku earthquake, we should consider what would have happened if the event occurred closer to Tokyo. The tsunami was a devastating event that caused lots of damage. If the earthquake happened in another area, even closer to a concentration of exposures, how much bigger could the losses have been? In 1992, Hurricane Andrew hit near Miami and caused USD19 billion worth of damage. At that time insurance company management was wondering what would have been the financial losses if the storm had directly hit Miami. Would it have been USD60 billion or USD100 billion? These questions helped start the reliance and use of catastrophe models on a wider basis.

(2) It is also worth looking into earthquake science from this event. Japan's Headquarters for Earthquake Research Production (HERP) breaks down the Japan Trench earthquake risk into eight source zones. The specific zone where this earthquake occurred had a 98% probability of rupture size 7.4 or greater in the next 30 years. The actual event was a 9.0 magnitude event. HERP did not expect an event so large. It appears they understood the probability but not the severity of the event. The difference between an 8.0 and a 9.0 is 30 times the energy. Therefore a second lesson learnt will be to improve our understanding of earthquake sciences:

Lessons learned from the Great Tohoku Earthquake



Source: From AIR Worldwide

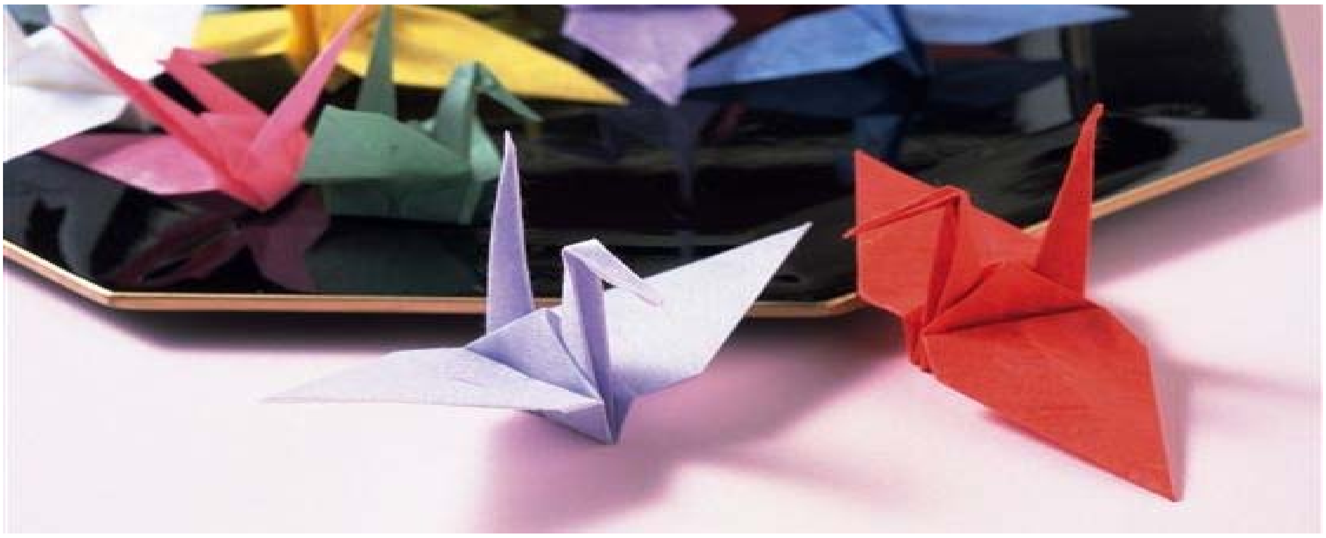
(a) Understanding the differences in the different methodologies: In determining earthquake size and probabilities, we use historic records, paleoseismic data (geological evidence) and geodetic data (GPS measurements). The differences in return periods and the size of events driven from the geological evidence and the geodetic data were large and the geodetic implications were ignored. This event may have shown us that the geodetic data was useful information and there was more potential for a more sizeable event. So the question today is are there differences between the different data sources or different models and what could be the implications? I think it is important that actuaries and insurance companies understand that the differences exist.

(b) Secondary events: It is also important to understand how earthquakes build up energy in the faults. For example in the Great Tohoku earthquake, in the six weeks after the event, there were more than a thousand aftershocks – half greater than 5.0 –which exceeded ten years of prior activity in the region. There are lots of questions on earthquake pressure release. The Christchurch New Zealand earthquakes were considered to be an aftershock of the Canterbury earthquake. We should look into the implications on the stress build-up or release in causing these secondary events. The larger the earthquake, the larger the aftershocks will be. For powerful events like the one in Canterbury, an aftershock can itself be a catastrophe.

(c) Implications on how plates of zones interact: This could potentially give information on how stresses are being created and released.

(d) Tsunami models: The recent Japan quake highlighted the need for a better understanding of the tsunami risk and the need for model development.

(3) Potential implication on nuclear facilities and other hazardous materials is also one area that has raised concerns after the Great Tohoku earthquake. This includes nuclear plants and chemical facilities which could have environmental implications if damaged. Additional concerns are raised over where else should these facilities be built and what natural perils are they exposed to.



(4) Business interruption is an area that is under-modeled and could be a big risk world-wide. On a recent trip back to the US to help my parents buy a new car, we constantly heard that dealers stocks were depleted and this was affecting their business. It was interesting to see how the recent Japan quake had affected the south side of Chicago. In Asia, we sell less business interruption coverage and are therefore less concerned about this risk. I think it is better to understand how these policies work and the damages that could occur.

(5) Most people feel that Japan is well prepared for a catastrophe because of their earthquake preparation work and the mitigation strategies in place. What would have happened if a similar event hit somewhere else that is not as prepared? What would a similar event in Taiwan or Philippines have cost in terms of total damages and insured damages?

(6) Historically, insurance companies paid great attention to peak catastrophe zones which are areas with high risks. Insurance companies have been adapting a diversification strategy so that they are not undertaking too much risk in high risk areas such as the Southeast US, California and Japan. Companies started to diversify their portfolio by writing policies in Chile and New Zealand, which have recently been hit by some massive events. Companies might need to review their diversification strategies and make sure they are pricing the risks accurately for areas which are outside the territories they normally write. It is a common thought that the reinsurance costs for New Zealand were understated. Companies will need to re-examine their diversification strategies.

(7) Another lesson learnt from the recent catastrophes will be the potential failure of mitigation techniques such as sea walls and dykes. An example is the sea wall protecting the coast of Japan or the dykes that failed as a result of Hurricane Katrina.

(8) In building the economic capital models for the non-life industry, we try to calculate the amount of capital needed for, say a 1 in 100 year event, I think the catastrophe risk needs to be better understood in Asia and modeled before we as an industry start relying upon these economic capital models.

(9) Catastrophe risks can also affect the life insurance industry. One of the big concerns over the Great Tohoku earthquake is the possible increase of cancer risk resulting from events at the nuclear facilities. The long term impact on cancer rates and deaths, as well as potential medical costs could affect the life and health insurance industry. These can be tested by the sensitivity on mortality or morbidity assumptions of the life/health models.

Mary: To conclude, what areas do you think the industry should focus on regarding catastrophe exposure management?

Ron: There is a long way to go for Asian insurers to develop "best practice" catastrophe exposure management practices. Companies should start with improving their data and working to develop catastrophe exposure management practices throughout the company. This isn't just an issue to be solved by purchasing reinsurance. Mapping exposures and running deterministic events against an insurer's portfolio are easy ways to highlight risks to management. My view is that catastrophe insurance is underpriced and that catastrophe risks are not fully understood in Asia. Companies should be addressing this concern.

Dr Geraldine Kaye FIA FREC
will be visiting:
Bangkok, 18th - 23rd July
Hong Kong, 24th - 31st July

If you would like to make an appointment with Dr Geraldine Kaye whilst she is visiting the region, please email gkaye@gaaps.com. Only a limited number of slots are still available.

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MEMBERSHIP UPDATE & ACTUARIES ON THE MOVE

New Members

Fellow

William Youjun BU	HSBC Insurance, FSA (2008)
Nienh HO	PricewaterhouseCoopers, FSA (2010)
Jiang-Bin LAI	PwC Hong Kong, FIA (2010)
Paul LLYOD	AIA, FIA (1997)
Kwok-Hung LUI	AXA China Region, FIA (2005)
Cornelis Rene OLIJ	HSBC Insurance, AAG (1996)
Frank SCHNEEVOIGHT	AIA, FSA (2002), Actuary (DAV)
Michael Chi-San SHIH	Dah Sing Life, FSA (2010)
Dennis Ming-Kei TANG	Prudential, FSA (2009)
Timothy Chi-Fai YIU	Sun Life, FSA (2009), MAAA (2008)
Song ZHANG	Manulife Financial, FSA (2004), FCIA (2004)

Associate

Ka-Ming CHEN	AXA China Region, ASA (2010)
Paul Ka-Yuk LIM	HSBC Insurance, ASA (2009)

Student

Lawrence Lok-Sang CHENG	AON Benfield, IoA Student 2004
Patrick Hei-Yin CHOW	Sun Life, SOA Student
Helen Hoi-Lam KWAN	Manulife Financial, SOA Student
Iris Hiu-Yi LAM	Sun Life, SOA Student
Ivan Shu-Lung HUI	Sun Life, SOA Student

Reinstated Members

Fellow

Ka-Chun CHEUNG	Swiss Re, FSA (2005)
Robert Tak-Pun FOK	Swiss Re, FSA (1985), FCIA (1986)
Andy Man-Tai LIU	Barclays, FSA (2004)
Matsuta NG	Towers Watson, FSA (2009), CERA (2010)
Simon Min SHA	Sunshine Insurance, Actuary (DAV)
Kwong-Wing YEUNG	AIA, FSA (2008)

Associate

Anna Yee-Ching IEONG	Manulife (Int'l), AIAA (2003)
Bobby Chi-Kan LEUNG	Deutsche Bank, AIAA (2003)
Kin-Man YU	Swiss Re, ASA (2008)

Student

Peter King-Chun LO	Manulife (Int'l), SOA Student

Actuaries on the Move

Fellow

Tony CHAU
Aaron CHONG
Ivy CHIU
Mario LAI
Joanne TSE
Lawrence WAN
Frank J.G. VAN KEMPEN
Candy YUEN

Associate

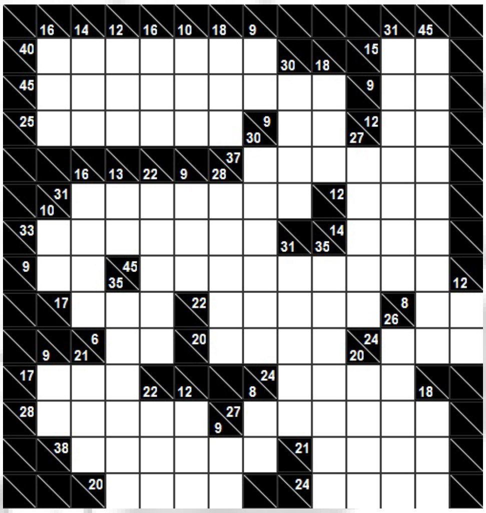
Bill CHEUNG
Victor CHEUNG

Student

Sharon KONG
Arthur LIM

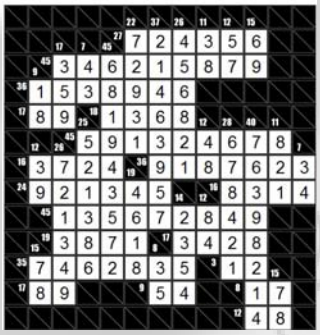
PRIZE TO GIVE AWAY!

A prize will be presented to the member who submits the first correct entry of **the Kakuro**.
Join the game and submit your entry to ASHK Office by email: actuaries@biznetvigator.com **NOW** !!!



How to play:

- Place the digits 1 to 9 into a grid of squares so that each horizontal or vertical run of white squares adds up to the clue printed either to the left of or above the run.
- Numbers below a diagonal line give the total of the white squares below; numbers to the right of a diagonal line give the total of the white squares to the right.
- **No digit can be repeated** within any single run. Runs end when you reach a non-white square.



Suggested solution for Apr 2011

UPCOMING EVENTS

July	19-29 (Tue - Fri)	• Joint Regional Seminar in Asia on Economic Capital
	26-28 (Tue-Thu)	• Joint Professionalism Course, Singapore
August	15 (Mon)	• ASHK & Macquarie Uni Seminar
	25 (Thu)	• SOA VA Seminar in China, Shanghai
	25-26 (Thu - Fri)	• SOA IFRS and US GAAP, Taipei
	29-31 (Mon - Wed)	• SOA IFRS and US GAAP, Hong Kong
September	23 (Fri)	• Society of Actuaries of Thailand Non-Life Forum, Bangkok
	27 (Tue)	• ASFA Asian Pensions Seminar, Hong Kong
October	3 (Mon)	• ASHK Luncheon Meeting
	10 – 13 (Mon - Thu)	• 16th East Asian Actuarial Conference (EAAC), Kuala Lumpur, Malaysia
	(tbc)	• SOA APC, China
	28 (Fri)	• SOA APC, Hong Kong
November	1 (Tue)	• SOA APC, Singapore
	2-4 (Wed - Fri)	• SOA FAC, Singapore
	7 (Mon)	• ASHK Annual Dinner
	8 (Tue)	• ASHK Appointed Actuaries Symposium
	10 (Thu)	• SOA CRC Senior Life Actuaries Forum, Beijing
December	8 (Thu) - tbc	• Global ERM Webcast, Asia Pacific
	12 (Mon)	• ASHK AGM

IAA Mini-Congress in Hong Kong

Please visit http://www.actuaries.org/hongkong2012/ for detail

News in the Circle

Happy moments with Jack Mak's (Towers Watson) loving family. The elder one is Alexander. He is almost three years old and his favorite toys are trains. The younger one is Antonia and she has just turned 5 months old.

ASHK Soft Skills Course (13 & 14 April 2011)

Speaker : Mr. Sebastian Bombaci

ASHK 1st Investment & Risk Management Symposium (19 April 2011)

Ms Ka-Man Wong (Chairperson) and
Mr. Patrick Jay (Guest of Honor)

Ms Woon-Khien Chia (RBS)

Mr. Duncan Mansfield (RBS)

Dr. Robert Waugh (Standard Chartered) and
Mr. Jeremy Porter (President of ASHK)

Mr. Alexander Bushel (URS) and
Mr. Jeremy Porter (President of ASHK)

Mr. Pierre Noel (KPMG) and
Mr. Jeremy Porter (President of ASHK)

Mr. Ranjit Jaswal (PWC) and
Mr. Jeremy Porter (President of ASHK)

Mr. Doug Caldwell (ING), Mr. Paul Headey (Ageas), Mr. Roddy Anderson (Dah Sing) & Mr. Stuart Leckie (Stirling Finance)

SOA EBIG, Hong Kong - Day 1 (30 - 31 May 2011)

Chair of the Meeting: Mr. Ravi Ravindran

Speaker : Mr. Michael Winkler (New Re)

Speaker : Mr. Alexis Zervoglos (Commerzbank)

Speaker : Mr. Marc Saffon (Societe General)

Speaker : Mr. Jeremy Porter (President of ASHK)

Speaker : Mr. Wade Matterson (Milliman)

Speaker : Mr. Philip Metcalf (Credit Suisse)

Speaker : Mr. Charles Firth (Credit Suisse)

SOA EBIG, Hong Kong - Day 2 (30 - 31 May 2011)

Chair of the Meeting: Mr. Ravi Ravindran

Speaker : Ms. Cornelia Spiegel (Deutsche Bank)

Speaker : Ms. Sally Yim (Moody's)

Speaker : Mr. Peter Philips (AON Benfield)

Speaker : Ms. Jackie Wai Chu (Ernst & Young)

Speaker : Mr. David Maloof (Towers Watson)

Speaker : Mr. Frank Zhang
(Actuarial Financial Risk Management Associates)

ASHK & HKRSA Joint luncheon Meeting (2 June 2011)

Panelists (from left to right): Mr. Peter Wong (Hong Kong Retirement Schemes Association), Mr. Michael Somerville (Business and Professionals Federation of Hong Kong), Ms. Christine Fang (Hong Kong Council for Social Services), Mr. Jack Mak (Actuarial Society of Hong Kong)

ASHK NEWSLETTER

Volume 02/2011

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Contributions to the ASHK Newsletter

We welcome members' contribution to the following sections of the ASHK Newsletter: Feature Article, Actuaries on the Move and Puzzle Corner.

Send correspondence to the ASHK Office at the address below. When sending in correspondence which has been created in a word processing program, when possible, email a copy of the file to either the editor's or the coordinators' e-mail address. Publication of contributions will be at the editor's discretion.

Corporate Advertisement

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