The new Global Landscape of Catastrophe Risk, Re/insurance & Information in a Modeled World

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Rowan Douglas
CEO Global Analytics, Willis Re
Chairman, Willis Research Network
Grand Challenge for Global Society

- How populations share costs of extreme events & natural catastrophes
  - At local & international scales
  - Via Public (taxation) or Private (insurance) mechanisms

- Re/insurance is the ultimate community product

- Natural hazards drive majority of global risks & cat losses

- Sustainable sharing requires accurate evaluation; Frequency, Severity & Impact of extreme events within a dynamic climate environment

- Scientific research provides a robust approach for the assessment of risk
Grand Challenge for Asia and ICRM

• The Grand Challenge: Asian populations remain under prepared and under protected against the region’s natural catastrophes via public or private sector mechanisms.

• Greater risk evaluation, awareness and culture is required to underpin individual and collective decision-making & strengthen growth of public programmes and private markets.

• No shortage of potential risk capital from regional and global sources to support growing Asian demands for protection

• The enemy is the misunderstanding and uncertainty of risks

• The strategic key is new science, applied modelling and effective communication of regional risk to key audiences in and beyond Asia

• The creation of ICRM at this time, with its regional and global links, public/private partners and open ethos is a masterstroke.
Asian Cat Risk and Re/insurance in a Global Context: three Earthquakes

- The most costly in terms of human life and economic loss, the 2008 Sichuan EQ in China resulted in an insured loss of just USD 366m
- Only 3% of economic loss from Great Hanshin EQ, Japan in 1995 was recovered from the insurance market
- Northridge EQ of 1994 almost 35% of losses were insured, a reflection of the higher rates of penetration in the US

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>M7.9</td>
<td>M7.2</td>
<td>M7.3</td>
</tr>
<tr>
<td>Victims</td>
<td>87,449</td>
<td>6,425</td>
<td>61</td>
</tr>
<tr>
<td>Total Losses (USDm)</td>
<td>125,000</td>
<td>100,000*</td>
<td>44,000*</td>
</tr>
<tr>
<td>Insured Losses (USDm)</td>
<td>366</td>
<td>3,000*</td>
<td>15,300*</td>
</tr>
<tr>
<td>Insured Loss %</td>
<td>0.3%</td>
<td>3.0%</td>
<td>34.8%</td>
</tr>
</tbody>
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Asian Underprotection – A Consistent Picture

Asian Nat Cat: High numbers but low insured losses

- Nat Cats measured by frequency and insured losses paint a contrasting picture
  - On the one hand, Asia-based Nat Cat events contributed to 42% of the global total
  - While the number of Nat Cats taking place in US and Europe was relatively low (17% and 14% respectively)

2008 Nat Cats by Number

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>17%</td>
</tr>
<tr>
<td>Europe</td>
<td>14%</td>
</tr>
<tr>
<td>Asia</td>
<td>42%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>27%</td>
</tr>
</tbody>
</table>

2008 Nat Cats by Insured Losses

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>76%</td>
</tr>
<tr>
<td>Europe</td>
<td>11%</td>
</tr>
<tr>
<td>Asia</td>
<td>6%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>7%</td>
</tr>
</tbody>
</table>

- Asia's contribution by total insured loss from Nat Cats was only 6%
- This is due in part to the low penetration of insurance in the region
- This also reflects the potential, so far, for value losses (commercial and residential) of Cats in Asia
- The future development of these 2 charts will be compelling

Source: Swiss Re Sigma 2009
Asian countries top the table of nat cat human losses

**CAT Impact: Victims and Insured Losses; 1970 - 2008**

- Nat Cat events measured by the cost in human life are dominated by Asian territories
- Of the 30 largest historical losses, only three resulted in insured losses over USD 1bn
- Of these, one was the Great Hanshin Earthquake, another the Indonesian EQ / Tsunami which resulted in over 220,000 deaths

Source: Swiss Re Sigma
But Asia is under represented on the list of insurance recoveries

*Cat Impacts: Victims and Insured Losses; 1970 - 2008*

- In terms of insured losses, the US dominates the top 30
- No Asian cats outside Japan feature, while the highest number of victims is far below the likes of the Asian Tsunami or Sichuan EQ
Asia’s share of global premiums

Asia still pales into comparison with the U.S. and European markets, contributing 14%* of annual non-life premiums, compared to 41% and 40% respectively of the global market (*this figure includes Japan)

Asian reinsurance displays different trends arising principally from:

1. Reinsurance purchasing culture
2. Loss experience
3. Availability of Capacity
But things are changing: Fast!

- Within 5-10 years, assuming penetration rates rise as anticipated
  Beijing-Tainjin (quake) & Shanghai (wind/flood)
  join Florida (wind) California (quake) Japan (quake) and NW Europe
  (wind) as the global reinsurance natural catastrophe peak zones

- In 30 years, Chinese Typhoon/EQ could be single largest exposure.

- Mirrored by growing exposures in India and across Asian Megacities

- Will be amplified and accelerated by macro forces and influences
  - Growing inter-governmental move toward nat cat management
  - National & Regional Cat Risk Financing (insurance) Schemes
  - Re/Insurance Regulation, demanding greater nat cat analysis
ASIAN REINSURANCE: SUPPLY AND DEMAND

Demand: Trends in insurance penetration

- The demand side is also experiencing growth as insurance penetration gradually increases.
- Insurance penetration as percentage of GDP shows somewhat limited growth, although this is as a function of rapid GDP growth in certain territories over the same period.
- The extent of this growth is seen more clearly on a year on year comparison basis.
- In contrast to this growth in developing markets, the mature market of Japan continues to stagnate as premium volumes decline.
- In USD terms, China and Vietnam saw exceptional growth of 33% and 36% respectively in 2008.
Meanwhile, the capital landscape is changing...

Reinsurance capacity in Asian based markets has grown from 13% to 19% of global capacity in last two years. Asian based capacity has now overtaken London...

Source: Willis Re
Why is it arriving and what is the effect?

• Attracted by current and projected growth in demand, local and global players seeking to establish regional position

• Global players also seeking to diversify portfolios away from traditional peak zones in Europe and North America

• Influx is creating critical mass of people, business and expertise in key hubs, such as Singapore and other centres

• Short to medium term this growth of regional capacity tends to flattening of pricing peaks and extension of softer pricing cycles

• Medium to longer term this is likely to change
  - Increased Asian exposures invoke entry to global pricing cycle
  - Regional re/insurers will diversify exposures outside region
  - Regional and global mergers and acquisitions will occur
Where is this capital coming from and where is it located?

- Local capacity in developing regional markets
  - Major centres based in Singapore, HK, Shanghai, and KL
- Inward capacity
  - Foreign / Global reinsurers with local Asia-based operations
  - Global reinsurers seeking to utilise regional presence
  - Lloyd’s syndicates expanding presence in the region (19 syndicates currently in operation)
- Intra-Asia capacity
  - Growing capacity from Asian reinsurers seeking non-domestic Asian growth
  - National reinsurers expanding beyond domestic markets
The Example of Singapore

Supply Side: Capacity growth

- Asian reinsurance capacity has grown steadily over recent years with markets such as Singapore now established players in the global reinsurance market
- Lloyd’s presence in Asia has also become more significant, with platforms now established in Singapore (1999), Japan and China (both 2007)
- Growth of Lloyd’s in Singapore has been notable:
  - 2002: 2 companies
  - 2005: 3 companies
  - 2008: 15 companies
  - 2009: 19 companies
- Similarly, written premium has increased
- Extensive growth in non-Lloyd’s capacity. E.g. approx 50 reinsurers in Singapore including 20 of 25 largest global groups
Public Nat Cat Schemes

- Growing interest in public nat cat financing arrangements by national and local governments and, occasionally regional consortia
- Inspired by internal drivers and also international dialogue and agencies such as UNISDR, World Bank, WFCP
- Climate Change and recent seismic events are maintaining nat cat as a high national and international agenda topic
- The growth of new media and improved communications heightens human awareness of nat cats, risk and suffering
- Well established schemes in Taiwan, New Zealand, Japan and Indonesia serious consideration being given by governments across the region.
The Pivotal Role of Regulation

- Financial & re/insurance regulations sets the rules and defines the operation and parameters of the risk landscape
- Emerging global ERM standards emerging via IAIC, European Solvency 2, US NAIC and national supervisors in Asia Pacific
- Amplified by complementary trends in credit rating agencies, corporate governance and investor analysis
- Strong and effective regulatory environments imply:
  Obliging insurers to price nat cat products to sustainable long-term margins & avoiding hidden subsidies.
  Imposing correct capital charges on re/insurers to reflect genuine natural catastrophe exposures
  Enforcing compliance with wider risk management legislation, such as building codes and adequate zoning of construction in higher risk locations.
Linking catastrophes with capital

Typical risk-split for an average European Property/Casualty insurance company under solvency II standard formula
Science, the key to solve Asian cat risk challenges.

- Reinsurance and the management of extremes is now undertaken inside a modelled world.
- A development of last 20 years, for example property catastrophe reinsurance. Immense benefits, with new challenges.
- A developing continuum – science, cat modelling, capital modelling, regulatory and credit modelling, public policy planning.
- Risk based modelling is creating new, unified, rules of the game.
- This is integrating of public science and re/insurance; driving the response to the current generation of modelling challenges.
- Public science also recognising the unique role of the re/insurance industry to both understand and confront some of our greatest challenges.
- The sector is at forefront of society confronting the normality of extremes.
## Scheduled/Possible Vendor Cat Model Asian New Releases, 2010-11

<table>
<thead>
<tr>
<th>Vendor</th>
<th>2010 Q3&amp;4</th>
<th>2011 Q1&amp;2</th>
<th>2011 Q3&amp;4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR</td>
<td>NW Pacific Typhoon</td>
<td>Indian Typhoon</td>
<td></td>
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<tr>
<td></td>
<td>SE Asia Typhoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SE Asia Earthquake</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Australia Bushfire</td>
</tr>
<tr>
<td>EQEcat</td>
<td>Japan EQ (phase 1)</td>
<td></td>
<td>Japan EQ (phase 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SE Asia Typhoon</td>
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<tr>
<td></td>
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<td></td>
<td>Oceania Quake</td>
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<tr>
<td>RMS</td>
<td>Australia Hailstorm</td>
<td></td>
<td>China Typhoon</td>
</tr>
</tbody>
</table>

Source: Willis Model Knowledge Centre
The Need for Public Science in Asian Cat Risk

- The sheer complexity and multiplicity of natural hazards in Asia Pacific generates major uncertainties
- Fast growing cities and industrial developments in coastal and flood plain regions create further uncertainties over risk exposures and vulnerabilities
- Hazard and exposure uncertainties exacerbated by patchy and incompatible historical observation data over the region and incomplete surveys of building stock
- Collection of risk data in industry systems has been limited
- While new vendor models will make a huge difference we also need revolutionary public science to overcome some fundamental limitations.
<table>
<thead>
<tr>
<th>Institution</th>
<th>Specializations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birkbeck University of London</td>
<td>Environmental modelling, GIS, Remote Sensing</td>
</tr>
<tr>
<td>University of Exeter</td>
<td>Seismic risk, uncertainty, clustering, statistical modelling</td>
</tr>
<tr>
<td>University of Bristol</td>
<td>Flood modelling and data</td>
</tr>
<tr>
<td>University of Cambridge</td>
<td>Risk assessment, seismic risks, earth observation</td>
</tr>
<tr>
<td>Imperial College London</td>
<td>Asia-Pacific geohazards</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>Seismic risk, risk appetite</td>
</tr>
<tr>
<td>City University of London</td>
<td>Climate risks, hail risk, vulnerability, seismic risk</td>
</tr>
<tr>
<td>Colorado University</td>
<td>Vulnerability, infrastructure</td>
</tr>
<tr>
<td>Durham University</td>
<td>Climate and extreme weather</td>
</tr>
<tr>
<td>National Center for Atmospheric Research</td>
<td>Remote sensing, satellite data</td>
</tr>
<tr>
<td>University of Oxford</td>
<td>Climate modelling, extreme weather</td>
</tr>
<tr>
<td>NUS National University of Singapore</td>
<td>Climate risks, flooding</td>
</tr>
<tr>
<td>Ordnance Survey</td>
<td>Geospatial data / systems</td>
</tr>
<tr>
<td>Princeton University</td>
<td>Catastrophe risk financing / public policy</td>
</tr>
<tr>
<td>University of Reading</td>
<td>Urban flooding, meteorology</td>
</tr>
<tr>
<td>University of Melbourne</td>
<td>Storm surge, sea level rise</td>
</tr>
<tr>
<td>Scripps Oceanography</td>
<td>Climate risks and modelling</td>
</tr>
<tr>
<td>University of California, Los Angeles</td>
<td>Climate risks, modelling</td>
</tr>
<tr>
<td>University of Colorado, Boulder</td>
<td>Financial modelling, cost of capital</td>
</tr>
<tr>
<td>Swarthmore University</td>
<td>Climate risks</td>
</tr>
<tr>
<td>Walker Institute</td>
<td>Tsunami</td>
</tr>
</tbody>
</table>
Modelling regional extremes – climate risks

Historical data is no longer sufficient

The industry is entering a new era of extreme climate & weather risk modelling

Simulation of planet’s climate system using high resolutions Global Climate Models

Improved evaluation of current risk levels

Global & regional teleconnections – diversification benefits
GCM track data – stochastic event generation input data

Experimental domain:
120°E – 160°E
4°N – 50°N

50 – year track set 1
50 – year track set 2
50 - year track set 3
Applying research to Client problems – storm clustering

Storms tend to cluster in time and space. A significant issue for reinsurance & capital requirements.

Manifested in historical storm statistics and explained by numerical climate modelling (GCMs).

WRN leads the development and application of storm clustering science to improve re/insurance risk assessment.

Focussing on most intense storms. Intense Extra-Tropical Storms seem to cluster more than mid storms.

Clustering results are being incorporated into cat model outputs and client DFA analyses.

Source: R Vitolo, Willis Research Fellow, Exeter University
Developing climate services for insurers

WCC-3
HIGH-LEVEL DECLARATION, Geneva Sept 2009

DO 1 We, Heads of State and Government, Ministers and Heads of Delegation present at the High-level Segment of the World Climate Conference-3 (WCC-3) in Geneva, noting the findings of the Expert Segment of the Conference;

OP 1 Decide to establish a Global Framework for Climate Services (hereafter referred to as “the Framework”) to strengthen production, availability, delivery and application of science-based climate prediction and services;

OP 2 Request the Secretary-General of WMO to convene within four months of the adoption of the Declaration an intergovernmental meeting of member states of the WMO to approve the terms of reference and to endorse the composition of a task force of high-level, independent advisors to be appointed by the Secretary-General of the WMO with due consideration to expertise, geographical and gender balance;

OP 3 Decide that the task force will, after wide consultation with governments, partner organizations and relevant stakeholders, prepare a report, including recommendations on proposed elements of the Framework, to the Secretary-General of WMO within 12 months of the task force being set up. The report should contain findings and proposed next steps for developing and implementing a Framework. In the development of their report, the taskforce will take into account the concepts outlined in the annexed Brief Note;

OP 4 Decide further that the report of the task force shall be circulated by the Secretary-General of WMO to Member States of the WMO for consideration at the next WMO Congress in 2011, with a view to the adoption of a Framework and a plan for its implementation; and

OP 5 Invite the Secretary-General of WMO to provide the report to relevant organizations, including the UN Secretary-General.
Developing global building inventories

Using a fusion of satellite imagery and other geospatial data to develop consistent, regional building stock inventories for cat risk applications.

Assess geographical distributions of buildings, infrastructure and other permanent assets at risk to catastrophe perils.

Characterise in relation to cat model modifiers:
- Construction
- Height
- Size
- Age
- Use

CORRELATION between the parameters for buildings in Pylos (N= 786)
Post earthquake event damage using remote sensing

- Developing rapid damage assessment toolset for post event loss estimation
- Combining multi-source data into a coherent estimation toolset
- Scale and extent of affected area – regional estimation – soil, land cover, population, built up areas
- Detailed damage assessments
- Remotely sensed images, UAVs, ground data
- Pre-post damage assessments (Google street view)
- Stereoscopic, image change analysis, image interpretation
- Fusion into a combined risk / damage assessment tool using appropriate loss functions
Tsunami

Asia-Pacific Tsunami risk model

• Develop new digital tsunami hazard map from numerical model outputs
• Incorporate into appropriate GIS based risk browser
• Undertake coastal risk assessment for Western Pacific
• Focus on urban centres, industrial sites, ports
• Stage 2 – develop probabilistic tsunami model for Asia Pacific region
Global landslide model

- Developing a global insurance risk model for landslide
- Generate a comprehensive quantitative risk assessment for high loss landslides
- Global scale analysis – hazard and insured risk
- Causes, triggers, high susceptibility sites
- Regional scale risk evaluations
- Frequency / severity assessments
- Consider landslide-induced tsunami risks – North Atlantic
Global Earthquake Model

OECD Global Earthquake Model

Standard models of earthquake risk worldwide: for insurance and public sector

5 year Euro 30m programme

Willis one of 4 founder private sponsors with Munch Re, Zurich and AIR

Singapore one of six country sponsors

WRN members and technology supporting GEM

GEM Exposure sets will become base for multi-hazard risk modelling
WRN Commitments to ICRM and Singapore

WRN Global Hub of Marine Cat Risk Research
Two Willis Research Fellowships at the School of Civil and Environmental Engineering
1. Marine Cargo Accumulation & Exposure Modelling
2. Marine Cargo Vulnerability to Natural Hazards

WRN Global Hub for WRN Credit Risk Research
Willis Research Fellowship at Risk Management Institute

WRN Regional Climate and Flood Risk Research
Willis Research Fellowship at Tropical Marine Science Institute
Conclusions

Plus ca Change…. Risk, Capital and Information

- Willis is Enhancing Re/Insurance Broking & Analytics through the *Intellectual Broking* of leading institutions and sectors

- *Modelling mediates the science, and unifies these groups*

- Leading to technical and strategic Convergence among The Commanding Heights of Science and Risk

- Reconfirm re/insurance as the ultimate ‘community product’ a mechanism for society to share risks at local and global scales through public and private mechanisms

- Singapore and the ICRM playing a leading role in helping the market and science sectors take this journey together and attain greater security and return in Asia Pacific and beyond