Non-Modelled Risk: Navigating an Uncertain Landscape

Shane Latchman, CCM
Risk Can Be Thought of as a Landscape of Multiple Perils, Each Having Different Magnitudes and Spatial Locations

*the larger the height of the column, the larger the hurricane risk*
AIR Models Captured a Significant Percentage of the Total Insured Loss This Century

Source: Swiss Re Sigma Reports, AXCO Reports, and Munich Re NatCat Reports
## 200-Year Industry Annual Aggregate Loss Across All Perils for Australia Consists of Large Modelled Risks but Non Modelled Risks Can Be Significant

<table>
<thead>
<tr>
<th>Event</th>
<th>Catastrophe Number if declared</th>
<th>Date dd/mm/yy</th>
<th>Location</th>
<th>State</th>
<th>Original Cost (AUD$)</th>
<th>2011 Normalised Cost (AUD$)</th>
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</thead>
<tbody>
<tr>
<td>Hail</td>
<td>CAT NSW 99/1</td>
<td>14/04/1999</td>
<td>Sydney</td>
<td>NSW</td>
<td>1,700,000,000</td>
<td>4,296,000,000</td>
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<tr>
<td>Cyclone Tracy</td>
<td>CAT 88</td>
<td>24/12/1974</td>
<td>Darwin</td>
<td>NT</td>
<td>200,000,000</td>
<td>4,090,000,000</td>
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<tr>
<td>Earthquake</td>
<td>Not available</td>
<td>28/12/1989</td>
<td>Newcastle</td>
<td>NSW</td>
<td>862,000,000</td>
<td>3,240,000,000</td>
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<td>Cyclone, Wanda Flood</td>
<td>Not available</td>
<td>25/01/1974</td>
<td>Brisbane</td>
<td>QLD</td>
<td>68,000,000</td>
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<td>18/01/1985</td>
<td>Brisbane</td>
<td>QLD</td>
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<td>2,063,000,000</td>
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<tr>
<td>Severe Storm</td>
<td>CAT NSW 07/3</td>
<td>08/06/07-10/06/07</td>
<td>Newcastle &amp; Hunter Valley</td>
<td>NSW</td>
<td>1,480,000,000</td>
<td>1,742,000,000</td>
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<td>Cyclone Leah</td>
<td>Not available</td>
<td>04/03/1973</td>
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<td>QLD/NT/WA</td>
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<td>1,492,000,000</td>
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<td>16/02/1983</td>
<td>Not available</td>
<td>VIC</td>
<td>138,000,000</td>
<td>1,489,000,000</td>
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<tr>
<td>Hail</td>
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<td>18/03/1990</td>
<td>Sydney</td>
<td>NSW</td>
<td>319,000,000</td>
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<td>Victorian fires</td>
<td>CAT 09/2 &amp; 09/3</td>
<td>07/02/2009</td>
<td>VIC</td>
<td>VIC</td>
<td>1,070,000,000</td>
<td>1,266,000,000</td>
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<tr>
<td>Melbourne Storm</td>
<td>CAT102</td>
<td>06/03/2010</td>
<td>Melbourne</td>
<td>VIC</td>
<td>1,044,000,000</td>
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<td>CAT103</td>
<td>22/03/2010</td>
<td>Perth</td>
<td>WA</td>
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<td>1,019,000,000</td>
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<tr>
<td>Cyclone Ada</td>
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<td>18/01/1970</td>
<td>Bowen &amp; Mackay</td>
<td>QLD</td>
<td>12,000,000</td>
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</tbody>
</table>

The ABI Has Developed Explicit Guidance to Help Companies Understand and Manage Non-Modelled Risk

‘Any potential source of non-life insurance loss that may arise [from] catastrophe events, but which is not explicitly covered by a company’s use of existing catastrophe models’
Potential Sources of Non-Modelled Risk

- Non-modelled regions/perils
- Secondary perils and effects not covered by catastrophe models
- Classes/lines of business not covered by catastrophe models
- Coverages not considered by catastrophe models
Managing Non-Modelled Risk in Touchstone

Understand your exposure data and model output

Where do I have exposure accumulation?

Gaps, limitations, and assumptions

Touchstone

Quantify and evaluate non-modelled risk using appropriate analytical tools

Identify potential sources of non-modelled risk

TOUCHSTONE™

Materiality

Expert Judgement

Claims Based

Exposure Based

Which tools are appropriate?
There Are a Range of Methods Available to Quantify Non-Modelled Risk

Pick the method that is most appropriate for the type and materiality of the non-modelled risk the portfolio is exposed to.
Tools Currently Available in Touchstone to Identify, Evaluate, and Manage Non-Modelled Risk

**Geospatial Module**

Aggregate accumulation by:
- Geographic Zones
- Event Footprints
- Hazard Footprints
- Concentric Ring

- Apply terms using the AIR Financial Model
- Apply damage ratios to ground-up calculations

**Loss Modification**

Apply ground-up loss modification by:
- Peril
- Geographic Region
- Coverage
- Line of Business
- Event Parameter

Future functionality:
- Modify damage functions
- Modify event severity
- Modify event frequency
Geospatial Methods to Quantify Risk Can Take Multiple Forms

- **Accumulation within hazard files**
  - Boundary files which approximate the extent of the hazard to compute *total exposed limit* within a boundary, *e.g.*, flood extents
  - Realistic hazard footprints, *e.g.*, estimating loss within wind footprints

- **Ring analyses**
  - Using ring analyses to estimate loss potential at specified locations, *e.g.*, terrorism rings
  - Using dynamic ring analyses to find regions with largest exposed limits

- Apply PMLs or damage ratios to exposure within a boundary to compute estimated loss, *e.g.*, flood depth return period maps
What Is Accumulation?

- Accumulation is the process whereby exposure is aggregated and a PML % is applied (this could be 100%) such that the total exposure within the aggregation region can be determined.

- Sorting the total exposed limit by region/peril can give an idea of the materiality of non-modelled risks faced by an entity.

- Touchstone®
  - Many examples in this presentation will use AIR’s next generation modelling platform, Touchstone due its geospatial abilities.
  - This is a catastrophe modelling software platform that can also import hazard data, do ring analyses and accumulate exposure.
Geological Evidence Can Be Used to Build Volcanic Footprints for Historical Events: A.D. 79 Vesuvius Eruption

The Eruption of Vesuvius in A.D. 79: Reconstruction from Historical and Volcanological Evidence*
HARALDUR SIGURDSSON, STANFORD CASHDOLLAR AND STEPHEN R.J. SPARKS

Ill. 1. Map of the Vesuvius region and Bay of Naples, showing the extent of the area affected by pyroclastic flows during the eruption of A.D. 79. Broken lines are isopachs of the pumice fall during the Plinian phase.
Applying User Defined PMLs can be done to determine an estimate of loss for a historical scenario.

<table>
<thead>
<tr>
<th>Accumulator Name (2)</th>
<th>Risk Count Sum</th>
<th>Exposure Values Count</th>
<th>Total Replacement Value Sum</th>
<th>Exposed Ground Up Sum</th>
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<tr>
<td>Ash_merged_Vesuvius79AD</td>
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<td>77,891</td>
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<td>10</td>
<td>218,942</td>
<td>7,890</td>
<td>53,901,918,905</td>
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<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>340,227</td>
<td>10,711</td>
<td>81,842,805,955</td>
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<td>82,637</td>
<td>1,777</td>
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**Name:** Vesuvius79AD  
**Source:** AIR Worldwide  
**Type:** Accumulation Ranges: Ash_merged_Vesuvius79AD  

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<th>Label</th>
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<th>Fill</th>
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<td>✓</td>
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<tr>
<td>10</td>
<td>25.00</td>
<td>✓</td>
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</table>

Add New Range
Asia Pacific Case Study
Identify Aggregate Exposure by Geographic Zone

Use AIR’s Financial Module to report on Exposed Limits

<table>
<thead>
<tr>
<th>Accumulator</th>
<th>Total Replacement Value Sum</th>
<th>Exposed Gross Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN-Qinghai</td>
<td>1,084,716</td>
<td>108,472</td>
</tr>
<tr>
<td>CN-Shanghai</td>
<td>1,074,939</td>
<td>128,993</td>
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<tr>
<td>CN-Anhui</td>
<td>1,093,320</td>
<td>131,198</td>
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<tr>
<td>CN-Xinjiang</td>
<td>1,371,398</td>
<td>137,140</td>
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<tr>
<td>CN-Fujian</td>
<td>1,274,573</td>
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<tr>
<td>CN-Gansu</td>
<td>1,817,976</td>
<td>163,618</td>
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</tbody>
</table>

Understand your exposure data

Identify exposure accumulation
Identify Localised Areas of Highest Accumulation

Global ring placement:

- User-specified
- Third-party provider (IHS)
- Portfolio TRV-based
- Grid-based
- Intelligent ‘highest accumulation’

Specify diameter of nested rings and damage ratio by peril

Understand your exposure data

Identify exposure accumulation
AIR-Provided Hazard Layers Can Be Used to Assess Non-Modelled Perils, Such as China Flood Risk

100-, 250-, and 500-year RP flood hazard layers available for Thailand and China
Third-Party Event Footprints and Hazard Layers Can Be Accumulated Against in Touchstone

100-year return period pluvial and fluvial extents for Malaysia

Fluvial 100-year Flood Extent for Brisbane
AIR-Provided ALERT Event Footprints Can Be Accumulated Against in Touchstone

Tohoku earthquake 2011 tsunami-inundation footprint
Accumulate exposure that falls within the earthquake and tsunami footprints

Typhoon Rammasun 2014
Accumulate exposure by user-specified damage ratio and wind speed band
Publicly Available Data Sets Can Be Used to Quantify Risk For Non-Modelled Regions and Perils
Seismicity and Intensity Information for Non-Modelled Regions Can Be Used for Simple Risk Quantification


Distributing Aggregate Exposure for Non-Modelled Risk Quantification Can Be Informed Using Night Lights Data

Source: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=79765
Using Ground-Up Loss Modification to Account for Non-Modelled Coverages and Secondary Perils

Non-Modelled Coverages

- Most catastrophe models routinely cover physical damage and business interruption
- Additional coverages and or sub-terms may not be explicitly modelled

Potential additional coverages for commercial/industrial risks

- Contingent business interruption
- Debris removal
- Pollution
- Machinery breakdown

Secondary Perils

- Primary event characteristics are captured in a catastrophe model
- Losses from resultant or secondary perils may not be represented

Potential secondary perils (varies by region and peril)

- Storm surge/tsunami
- Liquefaction
- Landslide/mudslide
- Loss adjustment expenses
- Demand surge
Applying a Ground-Up Loss Modification to Account for Storm Surge in Japan Typhoon Model

<table>
<thead>
<tr>
<th>Name:</th>
<th>Account for Japan Storm Surge Risk</th>
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<tr>
<td>Description:</td>
<td>Apply loss modification factor of 1.2 to all coastal Ku in Japan and only storms with a central pressure of less than 960mb</td>
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<td>Created:</td>
<td>08/31/2014 by air-worldwide\180895</td>
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<tr>
<td>Modified:</td>
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</table>

The following rules will apply to ground up numbers only.

- **Peril**
- **Admin Boundary**
- **Event Parameters**
- **Factor**

<table>
<thead>
<tr>
<th>Peril</th>
<th>Admin Boundary</th>
<th>Event Parameters</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Cyclone</td>
<td>Japan</td>
<td>Less than 960 mb</td>
<td>1.2000</td>
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Apply loss modification by:
- ✔ Peril
- ✔ Geographic Region
- ✔ Coverage
- ✔ Line of Business
- ✔ Event Parameter

### Summary EP Table

<table>
<thead>
<tr>
<th>Agg/Occ. Perspective</th>
<th>AIR/Mod</th>
<th>AAL(EV)</th>
<th>SD</th>
<th>20</th>
<th>50</th>
<th>100</th>
<th>250</th>
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<td>AGG</td>
<td>Ground Up</td>
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<td>72,268,041,644</td>
<td>233,928,810,052</td>
<td>485,020,111,172</td>
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<td>Gross</td>
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<td>51,388,027,537</td>
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<td>86,478,798,117</td>
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<td>4,208,707,961</td>
<td>13,492,041,214</td>
<td>27,257,027,499</td>
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</tbody>
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Review the AIR view and modified view side-by-side
Adjust Losses by Event Parameters - Turkey Earthquake

- Insurance company would like to account for liquefaction risk in Turkey

The engineering geology of İstanbul, Turkey

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² İstanbul University. (e-mail: tugrul@istanbul.edu.tr)

Figure 4. Seismicity of the Marmara Region (Ambraseys and Finkel, 1991)

Figure 2. Map showing geological units in İstanbul (Modified from Ketin, 1991)
Adjust Losses by Event Parameters - Turkey Earthquake

Loss Modification Template
Object Management > Loss Modification Template

<table>
<thead>
<tr>
<th>Name</th>
<th>Turkey EQ Adjusted</th>
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| Description                   | Adjustment for Events> M6.5 in Istanbul region
|                               | Adjusted 10% for PAN-EU_Earthquake Model |
| Created                       | 08/12/2014 by AIR-WORLDWIDE(i81029)    |
| Modified                      | 08/19/2014 by AIR-WORLDWIDE(i81029)    |

The following rules will apply to ground up numbers only.

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Risk Parameters:
- Event Parameters
- Turkey, Istanbul Region
- Mw 6.5

Factors:
- 1000
- 20

Locations:
- Turkey
- Istanbul Region

Countries:
- Turkey
- Istanbul Region

Use Selected Event Parameter Template
Cancel
Summary

• Understanding the exposure data and model output you are working with and its gaps and assumptions is critical to tackling non-modelled risk

• Touchstone allows users to identify, manage, and quantify non-modelled risk on a global basis using the Geospatial Analytics module and loss modification factors