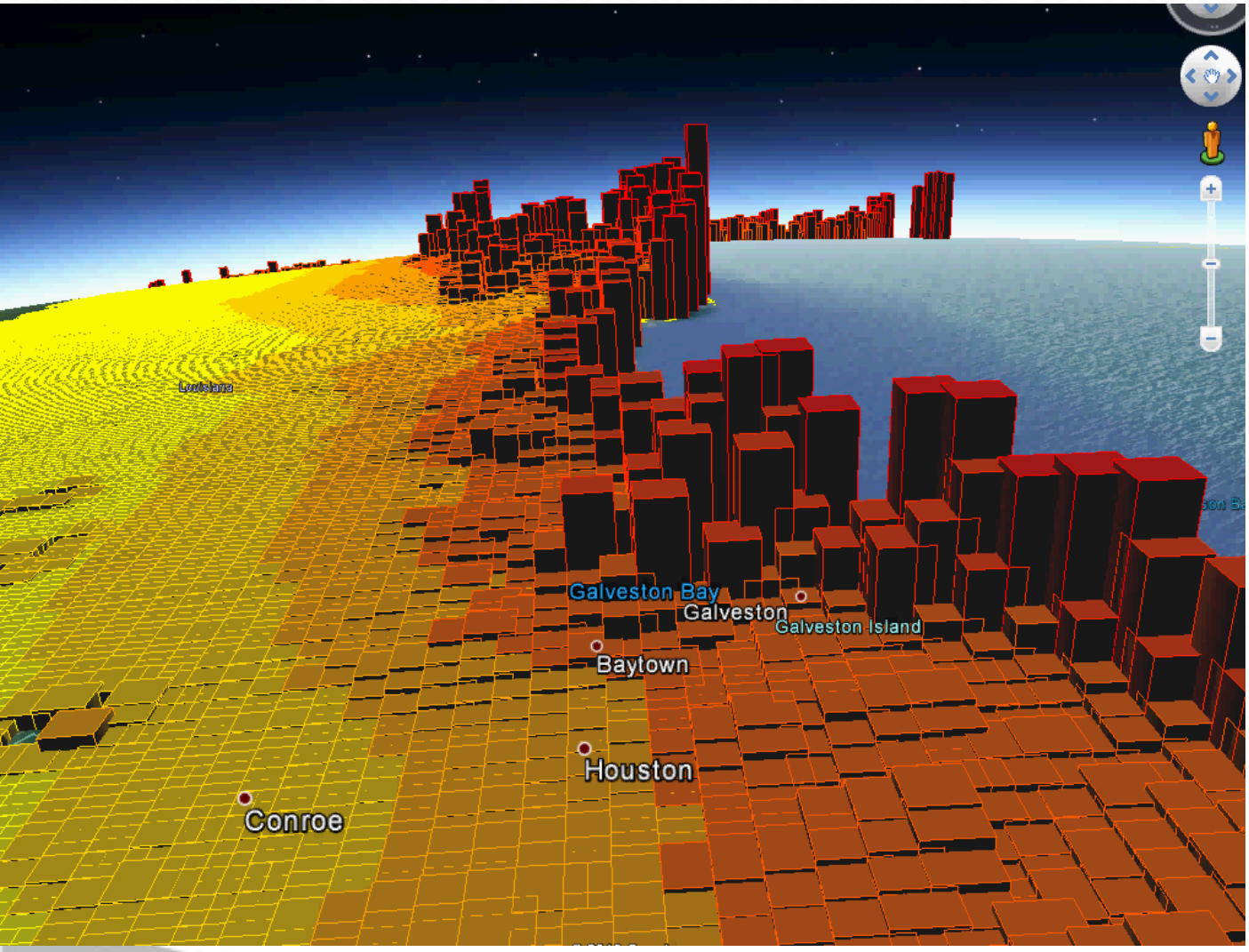
# Non-Modelled Risk: Navigating an Uncertain Landscape

*Shane Latchman, CCM*

AIR WORLDWIDE®

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

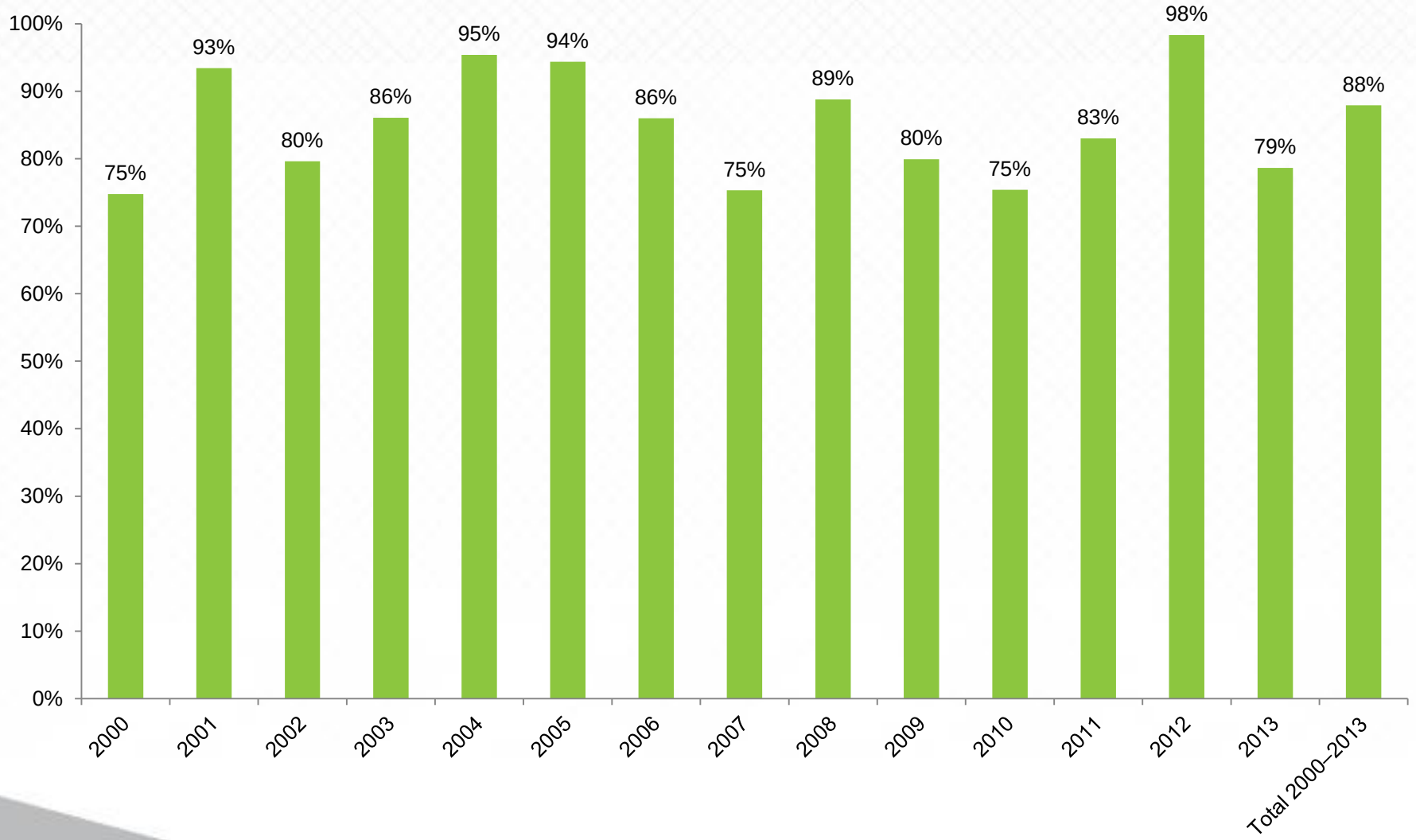



Low hurricane risk

High hurricane risk

*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**

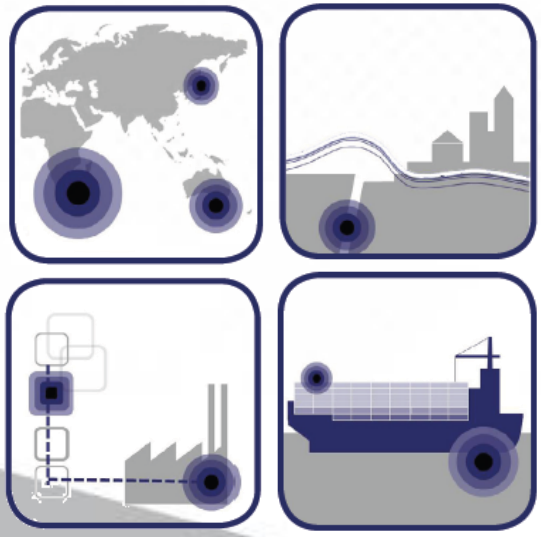
# 200-Year Industry Annual Aggregate Loss Across All Perils for Australia Consists of Large Modelled Risks but Non Modelled Risks Can Be Significant

| Event | Catastrophe Number if declared | Date dd/mm/yy | Location | State | Original Cost (AUD$) | 2011 Normalised Cost (AUD$) |
|---|---|---|---|---|---|---|
| Hail | CAT NSW 99/1 | 14/04/1999 | Sydney | NSW | 1,700,000,000 | 4,296,000,000 |
| Cyclone Tracy | CAT 88 | 24/12/1974 | Darwin | NT | 200,000,000 | 4,090,000,000 |
| Earthquake | Not available | 28/12/1989 | Newcastle | NSW | 862,000,000 | 3,240,000,000 |
| Cyclone, Wanda Flood | Not available | 25/01/1974 | Brisbane | QLD | 68,000,000 | 2,645,000,000 |
| Hail | Not available | 18/01/1985 | Brisbane | QLD | 180,000,000 | 2,063,000,000 |
| Severe Storm | CAT NSW 07/3 | 08/06/07-10/06/07 | Newcastle & Hunter Valley | NSW | 1,480,000,000 | 1,742,000,000 |
| Cyclone Leah | Not available | 04/03/1973 | Northern Australia | QLD/NT/WA | 30,000,000 | 1,492,000,000 |
| Bushfire Ash Wednesday | Not available | 16/02/1983 | Not available | VIC | 138,000,000 | 1,489,000,000 |
| Hail | Not available | 18/03/1990 | Sydney | NSW | 319,000,000 | 1,297,000,000 |
| Victorian fires | CAT 09/2 & 09/3 | 07/02/2009 | VIC | VIC | 1,070,000,000 | 1,266,000,000 |
| Melbourne Storm | CAT102 | 06/03/2010 | Melbourne | VIC | 1,044,000,000 | 1,160,000,000 |
| Perth Storm | CAT103 | 22/03/2010 | Perth | WA | 1,053,000,000 | 1,019,000,000 |
| Cyclone Ada | Not available | 18/01/1970 | Bowen & Mackay | QLD | 12,000,000 | 1,001,000,000 |

**Source: http://www.insurancecouncil.com.au/industry-statistics-data/disaster-statistics/historical-disaster-statistics**

# 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'**



ABI Association of British Insurers

**NON-MODELLED RISKS**

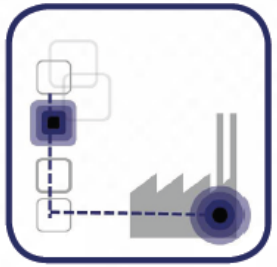
**A guide to more complete catastrophe risk assessment for (re)insurers**

# Potential Sources of Non-Modelled Risk

Non-modelled regions/perils

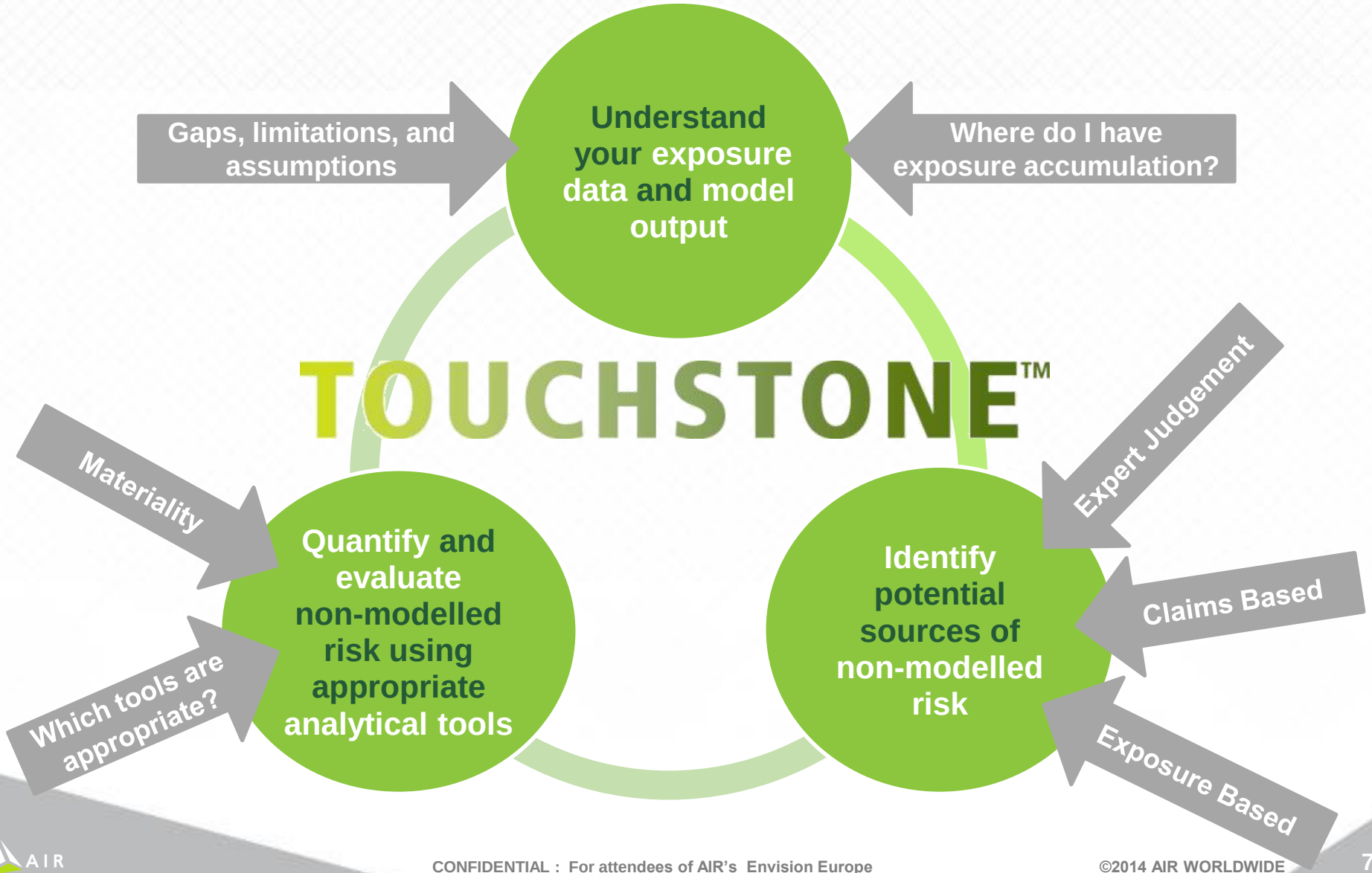
Secondary perils and effects not covered by catastrophe models

Classes/lines of business not covered by catastrophe models

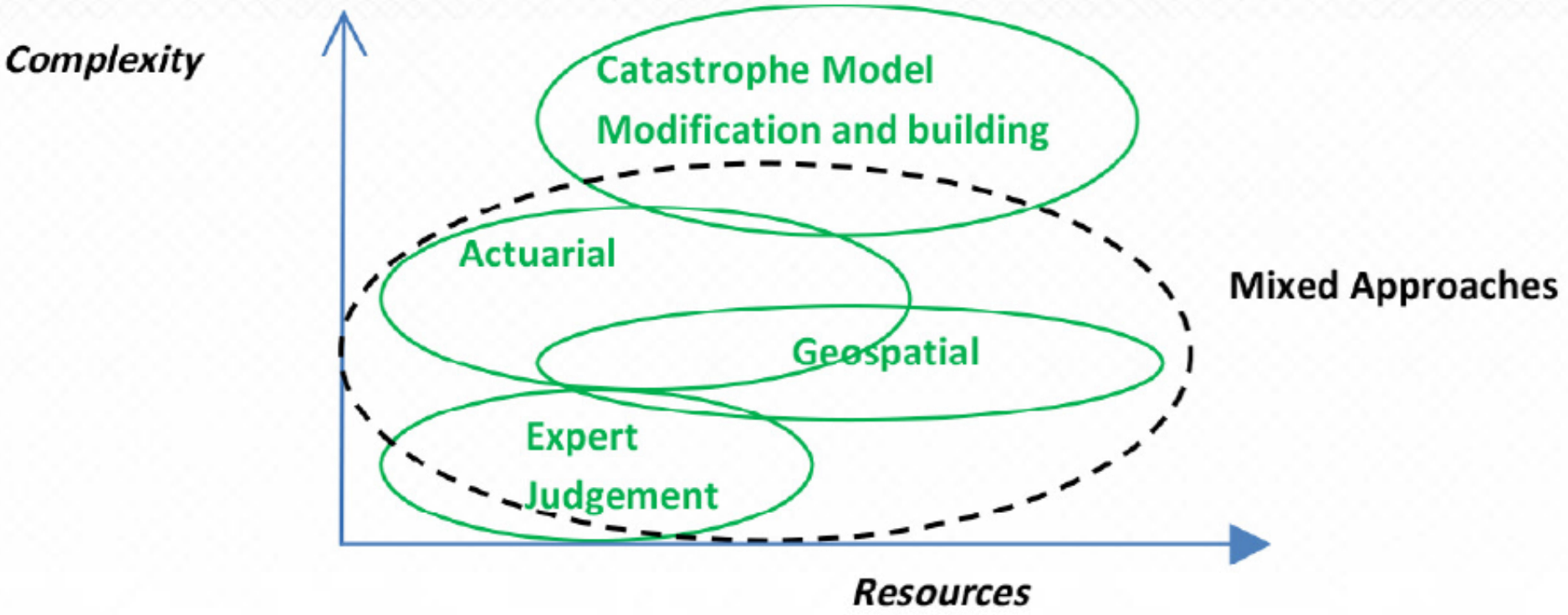


Coverages not considered by catastrophe models

# Managing Non-Modelled Risk in Touchstone



# 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:**

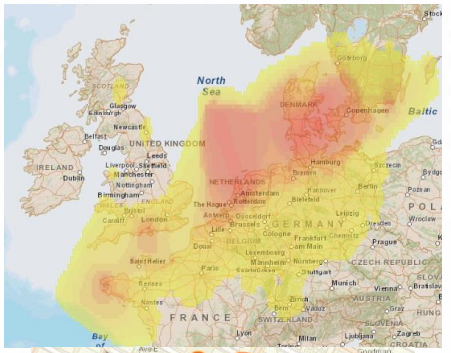
- Modify damage functions
- Modify event severity
- Modify event frequency

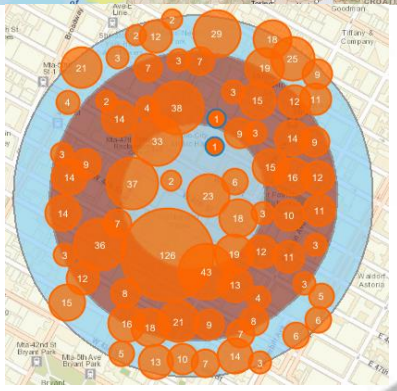
# Geospatial Methods to Quantify Risk Can Take Multiple Forms

- 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



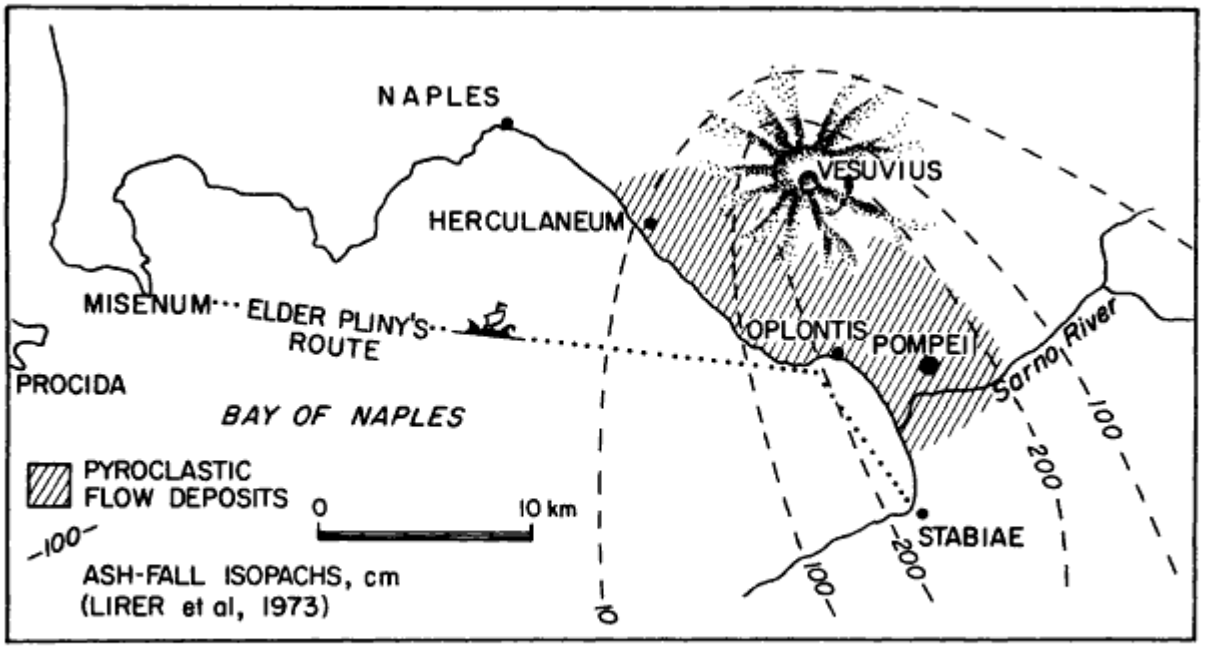
# What Is Accumulation?

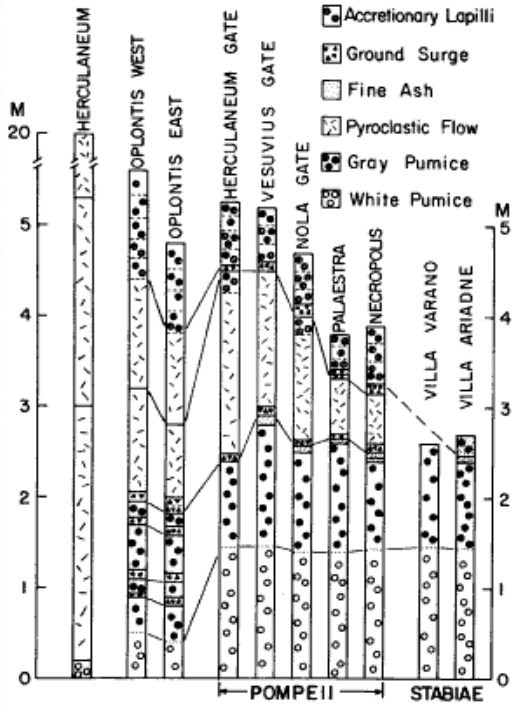
- Accumulation is the process whereby exposure is aggregated and a PML % is applied (this could be 100%) such that the total exposure within the aggregation region can be determined
- Sorting the total exposed limit by region/peril can give an idea of the materiality of non-modelled risks faced by an 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

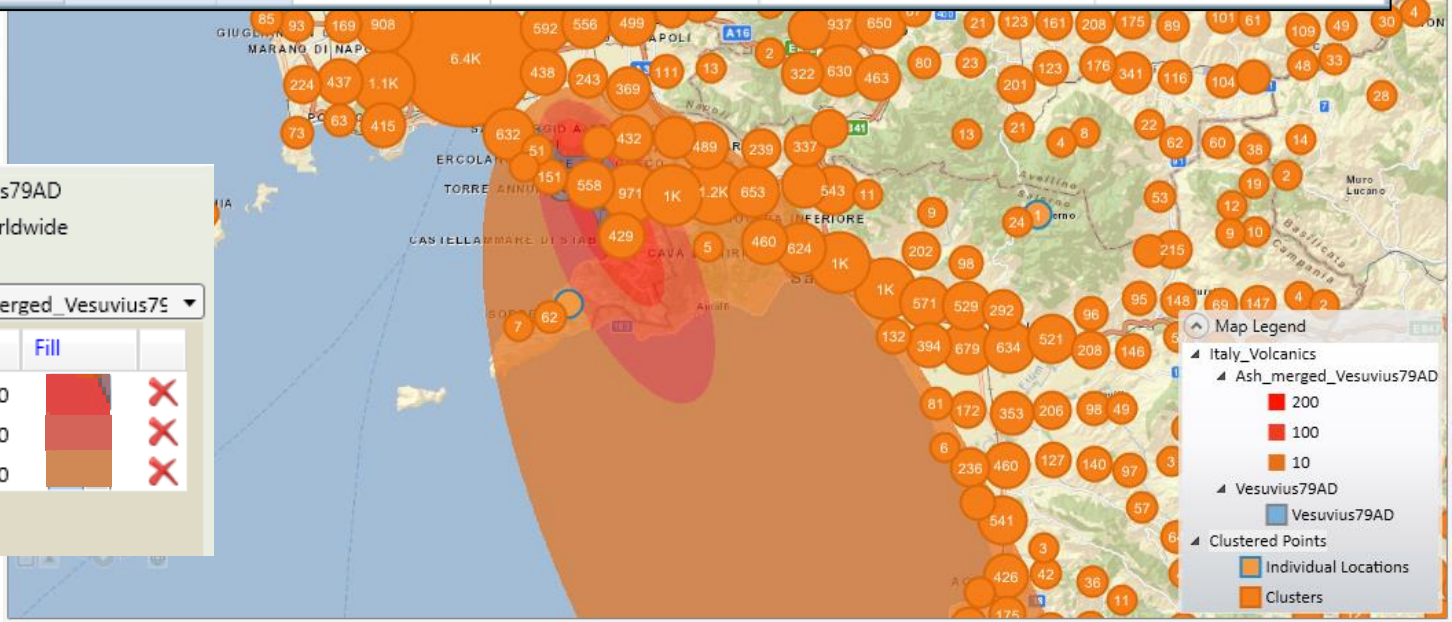
# Determine an Estimate of Loss for a Historical Scenario

Risk Count Sum, Exposure Values Count, Total Replacement Value Sum and Exposed Ground Up Sum for Accumulator Name, Ash_merged_Vesuvius79AD_ashd

Risk Count Sum | Exposure Values Count | Measures

Accumulator Name (2) | Ash_merged_Vesu

| | | Risk Count Sum | Exposure Values Count | Total Replacement Value Sum | Exposed Ground Up Sum |
|---|---|---|---|---|---|
| Ash_merged_Vesuvius79AD | 200 | 77,891 | 1,704 | 17,815,335,904 | 17,815,335,904 |
| | 100 | 43,394 | 1,117 | 10,125,551,146 | 10,125,551,146 |
| | 10 | 218,942 | 7,890 | 53,901,918,905 | 53,901,918,905 |
| | Subtotal | 340,227 | 10,711 | 81,842,805,955 | 81,842,805,955 |
| Vesuvius79AD | | 82,637 | 1,777 | 18,819,771,917 | 18,819,771,917 |




**Name:** Vesuvius79AD
**Source:** AIR Worldwide
**Type:**
**Accumulation Ranges:** Ash_merged_Vesuvius7

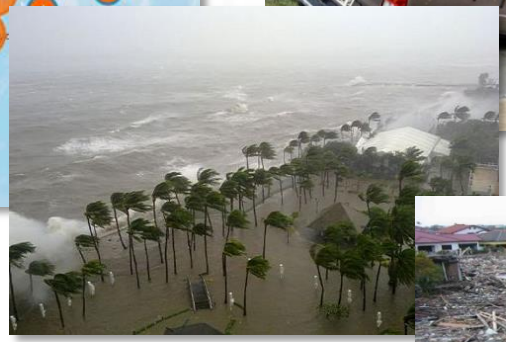
| Label | Damage% | Fill |
|---|---|---|
| 200 | 90.00 | |
| 100 | 70.00 | |
| 10 | 25.00 | |

Add New Range

# Asia Pacific Case Study







# Identify Aggregate Exposure by Geographic Zone

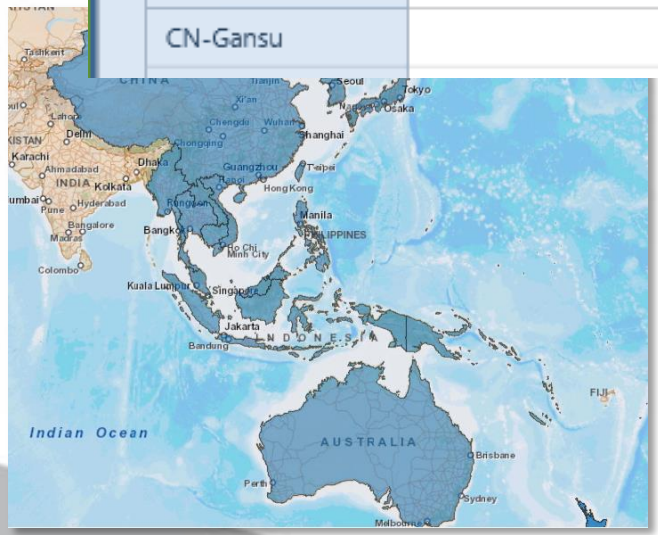
Use **AIR's Financial Module** to report on **Exposed Limits**

**Understand your exposure data**

**Identify exposure accumulation**

for Accumulat

| Accumulator | Total Replacement Value Sum | Exposed Gross Sum |
|---|---|---|
| CN-Qinghai | 1,084,716 | 108,472 |
| CN-Shanghai | 1,074,939 | 128,993 |
| CN-Anhui | 1,093,320 | 131,198 |
| CN-Xinjiang | 1,371,398 | 137,140 |
| CN-Fujian | 1,274,573 | 152,949 |
| CN-Gansu | 1,817,976 | 163,618 |




# Identify Localised Areas of Highest Accumulation

Understand your exposure data

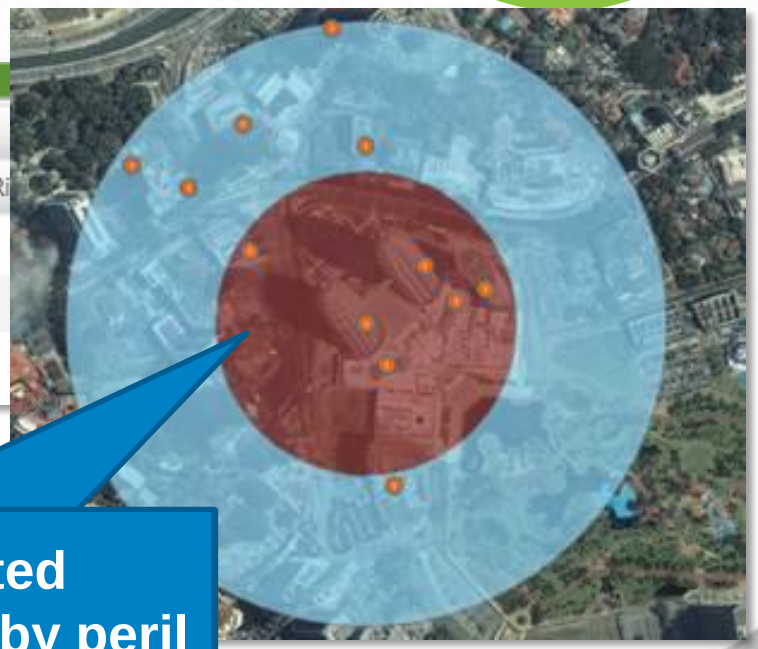
Identify exposure accumulation

## Global ring placement:

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

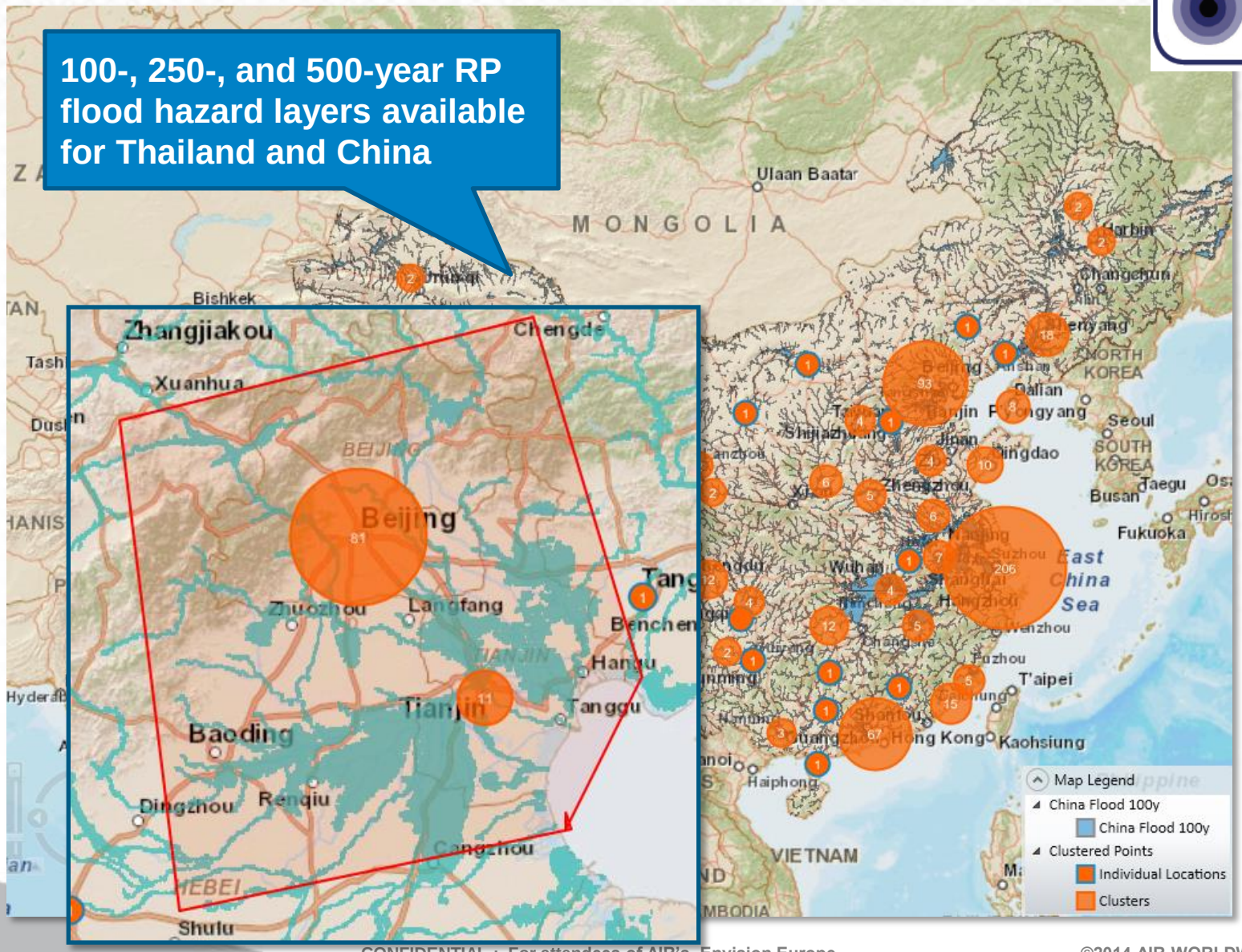
Damage Ranges

| Damage Band Info | | | Perspectives | | | |
|---|---|---|---|---|---|---|
| ID | Radius | Damage Ratio | Ground Up | Gross | Total Replacement \ | Ri |
| 1 | 200 Meters | 100 | 727,024,047 | 726,982,592 | 727,024,047 | |
| 2 | 400 Meters | 25 | 442,407,848 | 441,457,669 | 1,769,631,392 | |
| 3 | 500 Meters | 10 | 44,441,289 | 43,997,216 | 444,412,885 | |

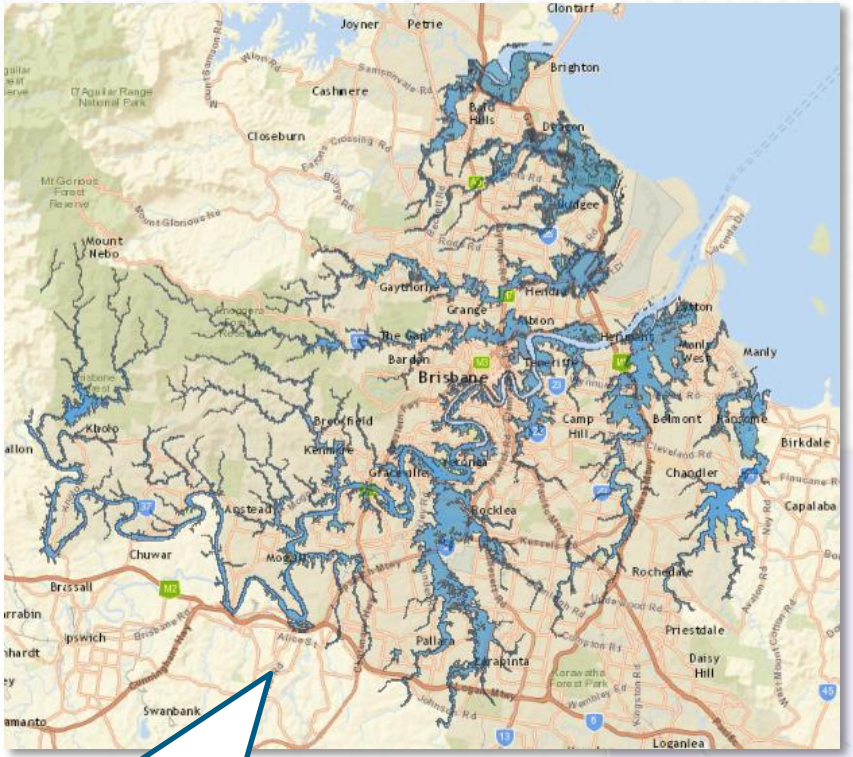


Specify **diameter of nested rings** and **damage ratio by peril**

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



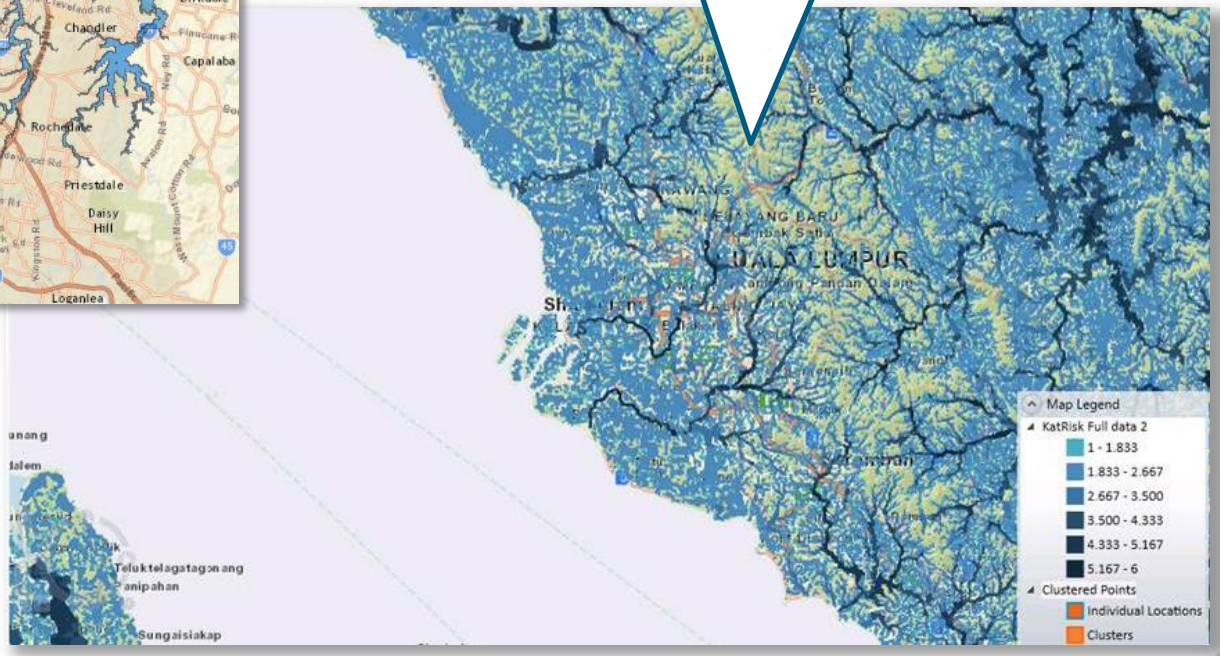
# Third-Party Event Footprints and Hazard Layers Can Be Accumulated Against in Touchstone



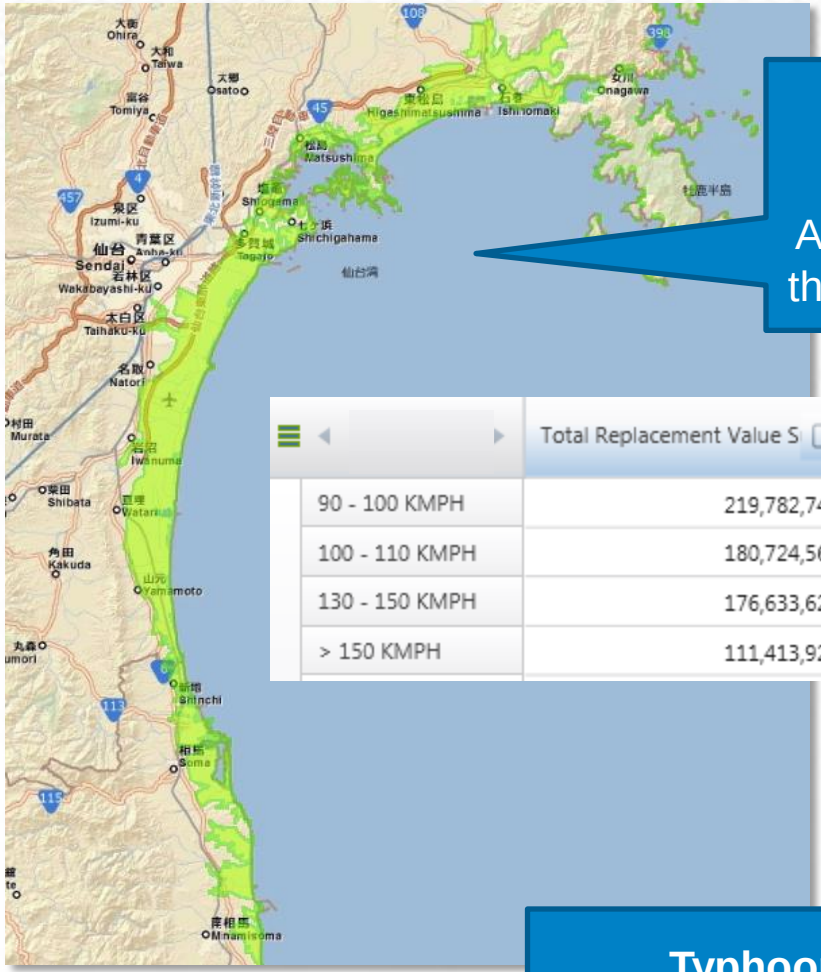

**Fluvial 100-year Flood Extent for Brisbane**

KatRisk

**100-year return period pluvial and fluvial extents for Malaysia**



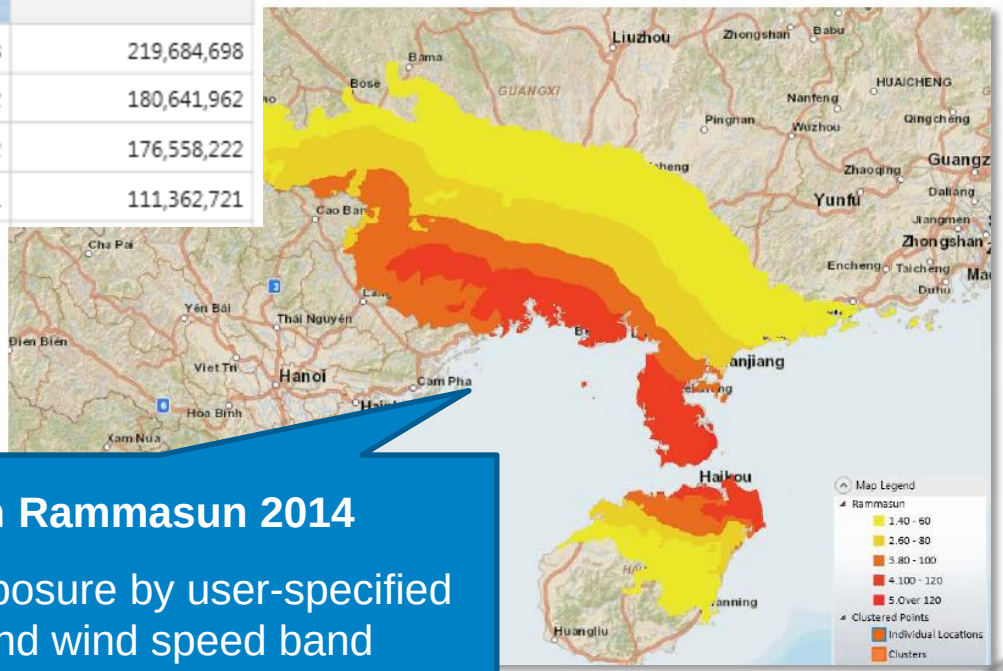
# AIR-Provided ALERT Event Footprints Can Be Accumulated Against in Touchstone




**Tohoku earthquake 2011 tsunami-inundation footprint**

Accumulate exposure that falls within the earthquake and tsunami footprints

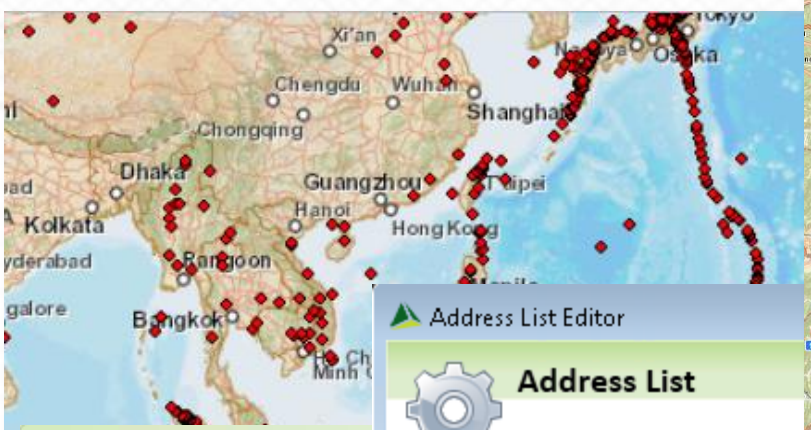
| | Total Replacement Value S | Exposed Gross Sum |
|---|---|---|
| 90 - 100 KMPH | 219,782,748 | 219,684,698 |
| 100 - 110 KMPH | 180,724,562 | 180,641,962 |
| 130 - 150 KMPH | 176,633,622 | 176,558,222 |
| > 150 KMPH | 111,413,921 | 111,362,721 |

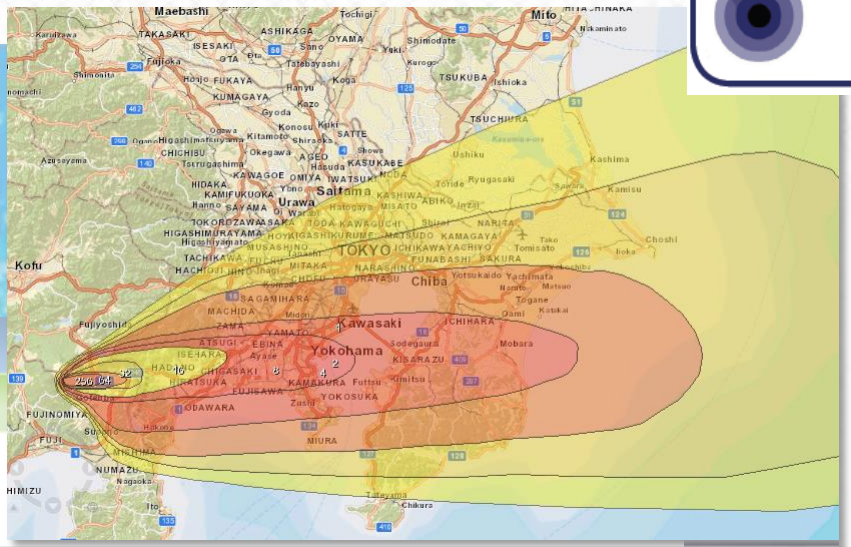



**Typhoon Rammasun 2014**

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




Address List Editor

**Address List**

Ring Definition

Accumulate Exposure using ring bound

**Ring placement criteria:** rings will be

Top 1,000 risks by total rep

AIR Landmarks Select Landma

Address List **4 locations lo**

Remove duplicates - Do not allow

**Ring Content:** Define peril and geoco

Peril:

Geocode Match Level:

| Ring Center Name * | Country (ISO Code) | Latitude * | Longitude * |
|---|---|---|---|
| Merapi | ID | -7.54 | 110.44 |
| Kelut | ID | -7.93 | 112.31 |
| Krakatau | ID | -6.1 | 105.42 |
| Tambora | ID | -8.25 | 118 |

**Ring Definition:** Define the ring radius and damage ratio for each concentric ring.

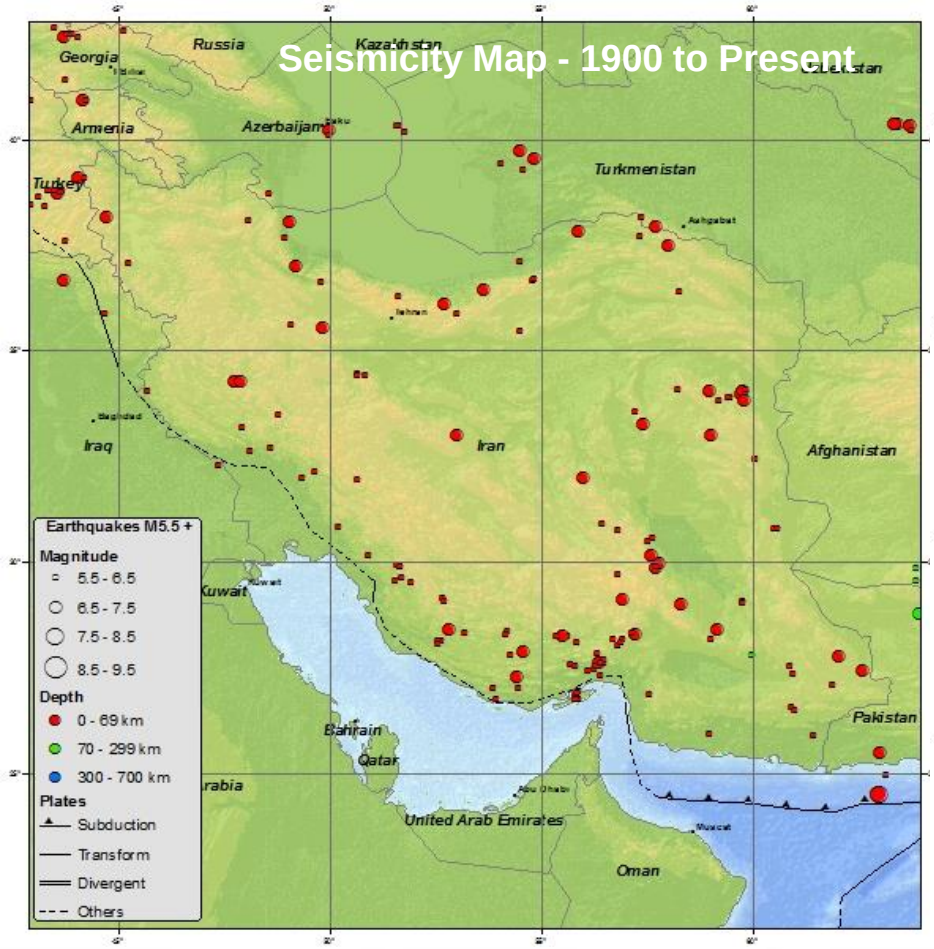
| Radius | Unit | Damage Ratio |
|---|---|---|
| 5,000 | Meters | 100.00% |

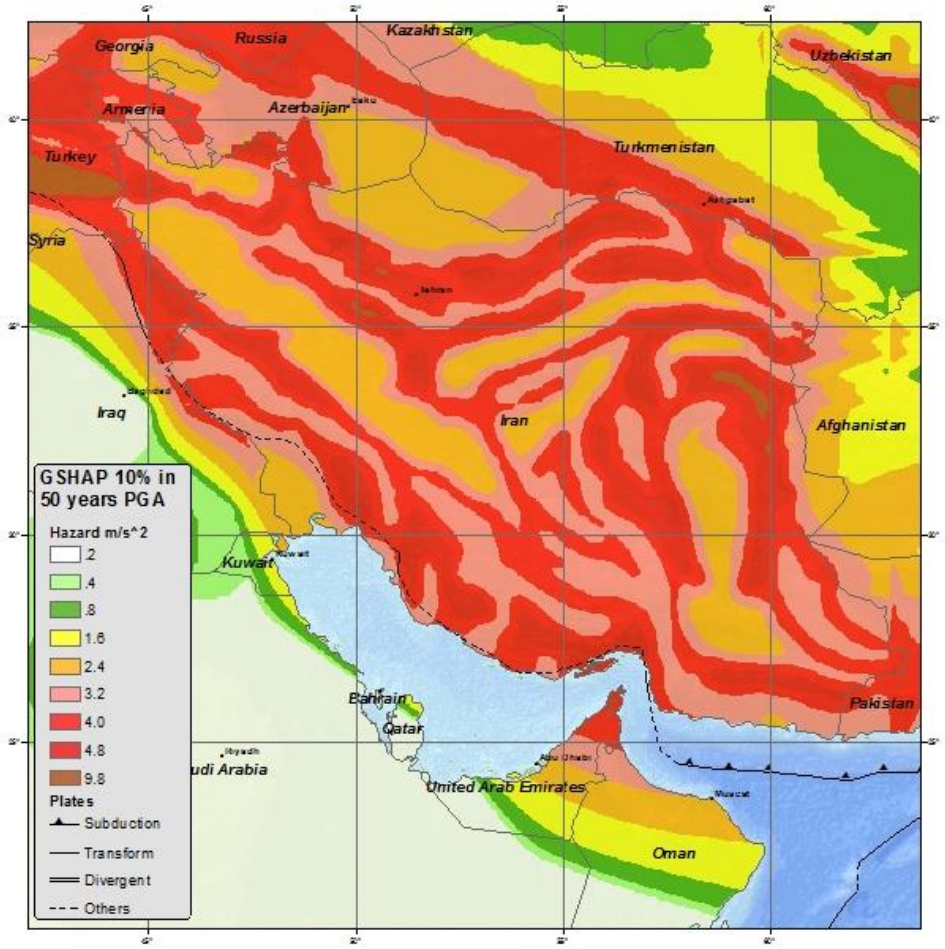
& Contacts

physical characteristics of Holocene volcanoes and their eruptions. This filtered based on location (set using a map), country, volcano name, and types of volcanic features. Name and country searches will also e, or features filters are used, only primary volcano names will be preadsheet.

Volcano Search

# Seismicity and Intensity Information for Non-Modelled Regions Can Be Used for Simple Risk Quantification




Source: http://earthquake.usgs.gov/earthquakes/world/iran/seismicity.php

Source: http://earthquake.usgs.gov/earthquakes/world/iran/gshap.php

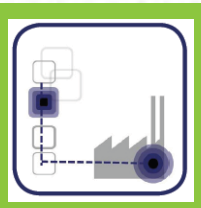
# Distributing Aggregate Exposure for Non-Modelled Risk Quantification Can Be Informed Using Night Lights Data

**Source:**
**http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=79765**

| Country | TIV |
|---|---|
| Italy | €2bn |

| Country | TIV |
|---|---|
| Rome | €0.5bn |
| Venice | €0.2bn |
| … | … |
| | |

# 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

| | |
|---|---|
| Name: | Account for Japan Storm Surge Risk |
| Description: | Apply loss modification factor of 1.2 to all coastal Ku in Japan and only storms with a central pressure of less than 960mb |
| Created: | 08/31/2014 by air-worldwide\I80895 |
| Modified: | 08/31/2014 by air-worldwide\I80895 |

The following rules will apply to ground up numbers only.

| Peril * | Admin Boundary | Event Parameters | Factor * |
|---|---|---|---|
| Tropical Cyclone | Japan | Less than 960 mb | 1.2000 |

Apply loss modification by:

- ✓ Peril
- ✓ Geographic Region
- ✓ Coverage
- ✓ Line of Business
- ✓ Event Parameter

Summary EP Table

| Agg/Occ | Perspective | AIR/Mod | AAL(EV) | SD | 20 | 50 | 100 | 250 | |
|---|---|---|---|---|---|---|---|---|---|
| AGG | Ground Up | | 26,247,505,041 | 255,076,112,789 | 72,268,041,644 | 233,928,810,052 | 485,020,111,172 | 1,167,214,904,371 | 1 |
| | | | 31,388,027,537 | 306,069,678,747 | 86,478,298,117 | 280,713,874,201 | 582,021,251,373 | 1,400,549,797,882 | 2 |
| | | Δ | 5,140,522,496 | 50,993,565,958 | 14,210,256,472 | 46,785,064,149 | 97,001,140,201 | 233,334,893,511 | |
| | Gross | | 3,131,969,675 | 21,982,150,203 | 8,377,719,122 | 28,230,177,240 | 68,948,894,091 | 181,383,760,355 | |
| | | | 3,531,594,933 | 23,911,474,400 | 9,443,435,098 | 32,130,165,335 | 82,450,589,874 | 209,140,159,512 | |
| | | Δ | 399,625,258 | 1,929,324,197 | 1,065,715,975 | 3,899,988,095 | 13,501,695,783 | 27,756,399,156 | |
| | round Up | | 25,657,747,480 | 254,049,964,293 | 69,760,265,212 | 223,294,808,129 | 484,566,980,780 | 1,128,440,514,402 | 1 |
| | | | 30,702,116,517 | 304,855,002,245 | 83,496,269,903 | 267,953,780,402 | 581,480,400,042 | 1,354,128,671,091 | 2 |
| | | Δ | 5,044,369,037 | 50,805,037,951 | 13,736,004,691 | 44,658,972,273 | 96,913,419,262 | 225,688,156,689 | |
| | | | 3,041,337,722 | 21,723,475,926 | 8,135,882,659 | 26,618,424,211 | 68,891,098,294 | 175,574,255,421 | |
| | | | 3,427,952,490 | 23,592,059,994 | 9,043,338,765 | 30,827,132,173 | 82,383,139,498 | 202,831,282,919 | |
| | | Δ | 386,614,769 | 1,868,584,067 | 907,456,106 | 4,208,707,961 | 13,492,041,204 | 27,257,027,499 | |

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

*IAEG2006 Paper number 392*

**The engineering geology of İstanbul, Turkey**

ÖMER ÜNDÜL[1] & ATIYE TUĞRUL[2]

[1] *İstanbul University. (e-mail: oundul@istanbul.edu.tr)*
[2] *İstanbul University. (e-mail: tugrul@istanbul.edu.tr)*

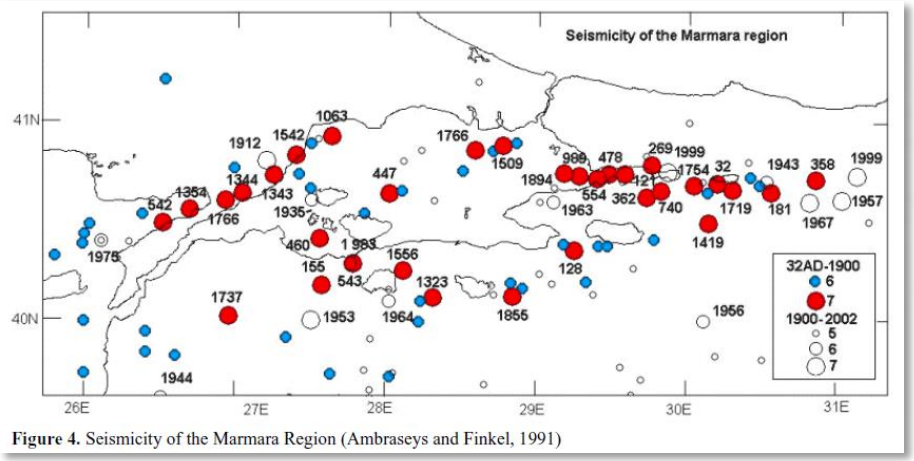



**Figure 4.** Seismicity of the Marmara Region (Ambraseys and Finkel, 1991)

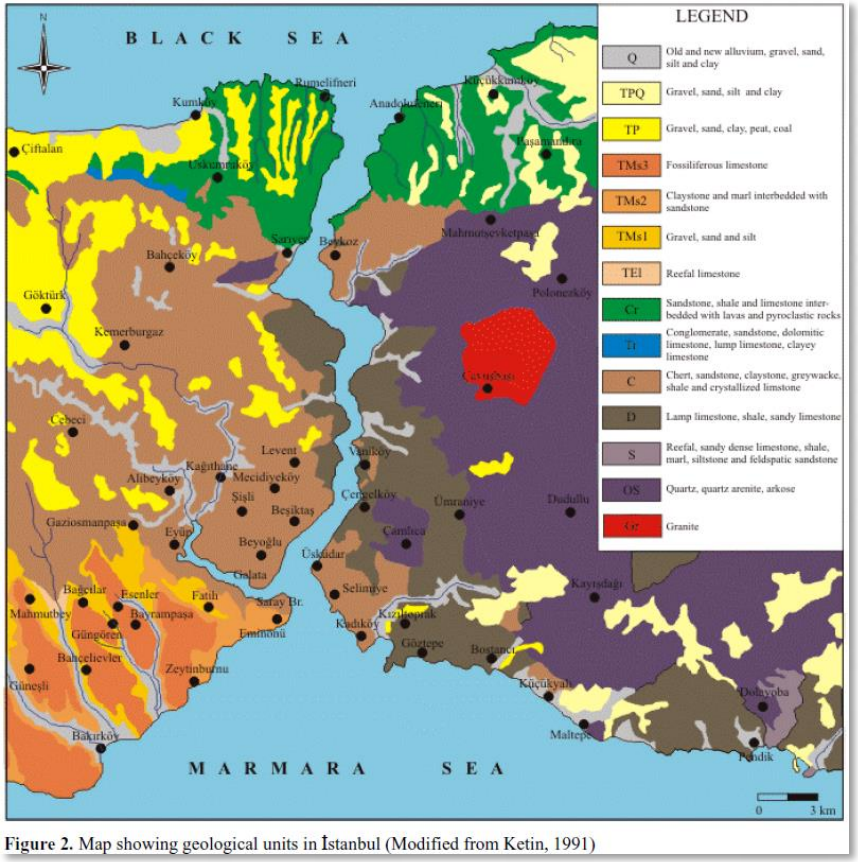
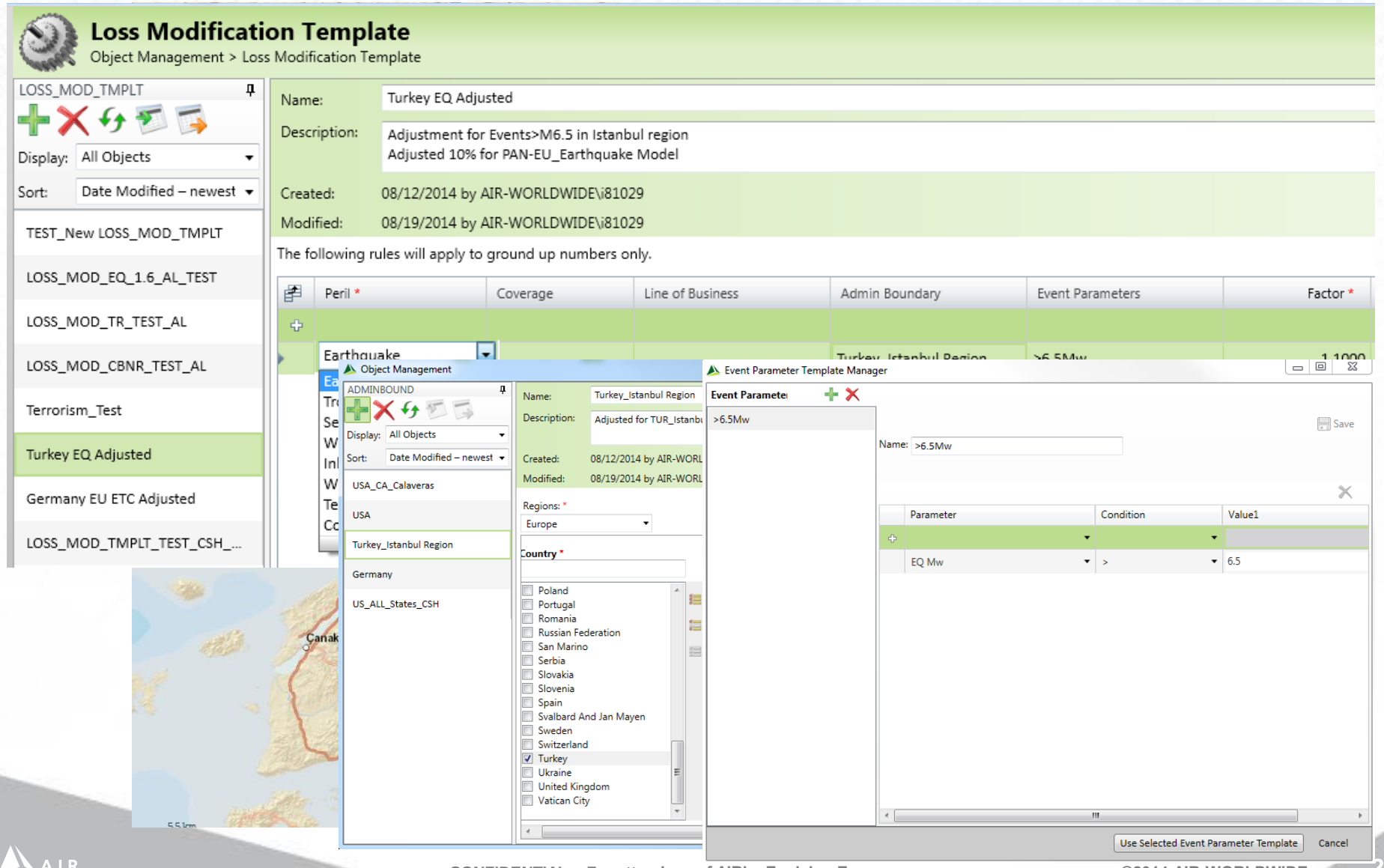



**Figure 2.** Map showing geological units in İstanbul (Modified from Ketin, 1991)

# Adjust Losses by Event Parameters - Turkey Earthquake



# 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