GUY CARPENTER

# ICLR Friday Forum

# CANADIAN CATASTROPHE RISK & MODELING – 2012 AND BEYOND

September 14th, 2012

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MARSH & McLENNAN COMPANIES

# Catastrophe Modeling – 2012 and Beyond
## Agenda

- Current landscape: Recent events and the state of the market
- Model availability and usage for Canadian perils
- Model enhancements expected in the future
- Managing model change and uncertainty
- Model result blending and customization

Section 1

# Current Landscape: Recent Events and the State of the Market

# Current Landscape
## 2011: Active Cat Year for Canada

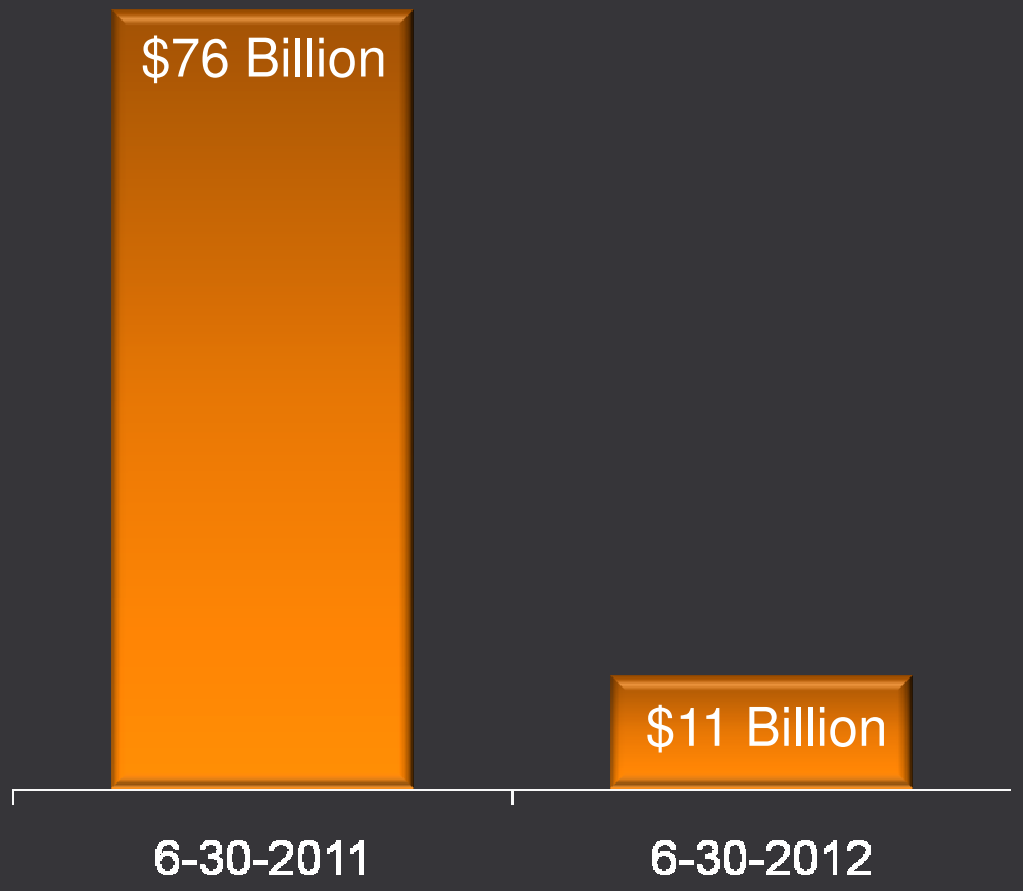
| Date | Place | Event | Insured Loss (CAD) |
|---|---|---|---|
| March 5-7 | Quebec, Ontario | Winter Weather, Heavy Rainfall | 50,000,000 |
| April 14 - May 31 | Manitoba | Assiniboine River Floods | 160,000,000 |
| April 27-28 | Ontario, Quebec | Storms with gusts up to 100km/hr, hail | 210,000,000 |
| May 14-17 | Alberta | Slave Lake wildfire | 700,000,000 |
| July 18-19 | Alberta, Manitoba, Saskatchewan | Thunderstorms, heavy winds, rain, hail, tornado | 185,000,000 |
| August 21 | Ontario | F3 tornado, hail, winds, flooding | 135,000,000 |
| August 28-30 | New Brunswick, Ontario, Quebec | Hurricane Irene post tropical flooding, wind | 130,000,000 |
| November 27 | Calgary, Alberta | Windstorm up to 149 km/hr | 200,000,000 |
| | | | 1,770,000,000 |

Source: Swiss Re 2011 Sigma Report


- 1998 and 2009 were higher
  - 1998 $2.3 bln CAD in 2011 dollars
    - Primarily Jan ’98 Quebec Icestorm
  - 2009 $2.1 bln CAD in 2011 dollars
    - Primarily 3 Alberta weather events

# Current Landscape
## Global Cat Events

2011 and 2012 Compared at June 30th



# Current Landscape
## Events Shape Catastrophe Market

**January 2011**
**Catastrophe Cover Renewals**


**Auto/Casualty**

Upward Pricing
Limited Capacity
Few Markets

**Catastrophe**

Downward Pricing
Strong Capacity
Many Markets

**Property Risk**

Downward Pricing
Strong Capacity
Many Markets

# Current Landscape
## Events Shape Catastrophe Market

**January 2012**
**Catastrophe Cover Renewals**


| Catastrophe | Property Risk | Auto Casualty |
|---|---|---|
| Upward Pricing<br>Limited Capacity<br>Many Markets | Even Pricing<br>Good Capacity<br>Many Markets | Even Pricing<br>Good Capacity<br>Growing Markets |

- The global market was well positioned to absorb big hits in 2011
- Cat pricing hardened in Canada more than some had anticipated
- Exposures were up, limits increased, and the cat spend grew

# Current Landscape
## Events Shape Catastrophe Market

**Anticipated Mid 2012 to January 2013**
**Catastrophe Cover Renewals**


**Catastrophe**

Flat to Soft Pricing
Limited Capacity
Many Markets

**Property Risk**

Even Pricing
Good Capacity
Many Markets

**Auto Casualty**

Even Pricing
Good Capacity
Growing Markets

Section 2

# Model Availability for Canadian Perils

# What Questions Are Catastrophe Models Designed to Answer?

- Where are future events likely to occur?
- How intense are they likely to be?
- For each potential event, what is the estimated range of damage and insured loss?

Catastrophe models are designed to estimate the probability of loss severity. They are not intended to forecast future events.

# Catastrophe Model Evolution

## *Changing Risk Landscape*

Cat Management

1992


**Hurricane Andrew**

2001

**WTC 9/11**

2005

**KRW**

2008


**Financial Crisis**

**ERM**

**Increased Regulatory Oversight**

**Re-adjust Frequency, Severity assumptions**

**Rating Agency Increases Capital Requirements**

**Loss Correlation / Data Rapidly Improving**

**Capital Markets Enter into Reinsurance**

**Models Go Worldwide / Influence Rate Adequacy**

**Rating Agencies Empowered**

**Poor Data / Limited Models**

With each market turning event, the industry realized it had more exposure than previously believed

# Catastrophe Modeling and Model Vendors


- Founded at Stanford University in 1988
- World's leading provider of products and services for the quantification and management of catastrophe risks
- Grew in the 1990s, expanding services and perils covered


- Founded in 1987
- Pioneered the probabilistic catastrophe modeling technology


- Founded in 1980s
- One of first catastrophe models in industry

Other models

- Most large reinsurers and other risk management companies have developed their own in-house models

# Current Canadian Licensed Modeling Capabilities

- **RMS**
  - Earthquake
  - Fire-Following Earthquake
  - Severe Convective Storm (Tornado, Hail, Lightning and Straight-Line Winds)
  - Winterstorm (Freeze, Snow, Wind and Ice)
  - North Atlantic Hurricane (new to RMS v11.0)
- **EQECAT**
  - Earthquake
  - Fire-Following Earthquake
- **AIR**
  - Earthquake
  - Fire-Following Earthquake (not for automobiles)
  - Severe Thunderstorm

# Current Model Versions

| Model / Peril | RMS RiskLink | AIR CLASIC/2 | EQECAT |
|---|---|---|---|
| Earthquake | 2009 | 2005 | 2011 |
| Fire Following | 2009 | 2005 | 2011 |
| Severe Storm | 2008 | 2005 | NA |
| Winter Storm | 2008 | NA | NA |
| Hurricane | 2011 | NA | NA |

# Catastrophe Model Use in Canada by Peril
# Earthquake

- Available Models: RMS, AIR, EQECAT
- Usage:
  - RMS is widely used as compared to AIR / EQECAT in the industry
- Latest Updates:
  - RMS: 2009
    - Western Canada PMLs increased about 30%
    - Clients generally bought more cat limit and there were no capacity issues with the reinsurers
  - EQECAT: 2011
  - AIR: 2005

# Catastrophe Model Use in Canada by Peril
# Severe Storm

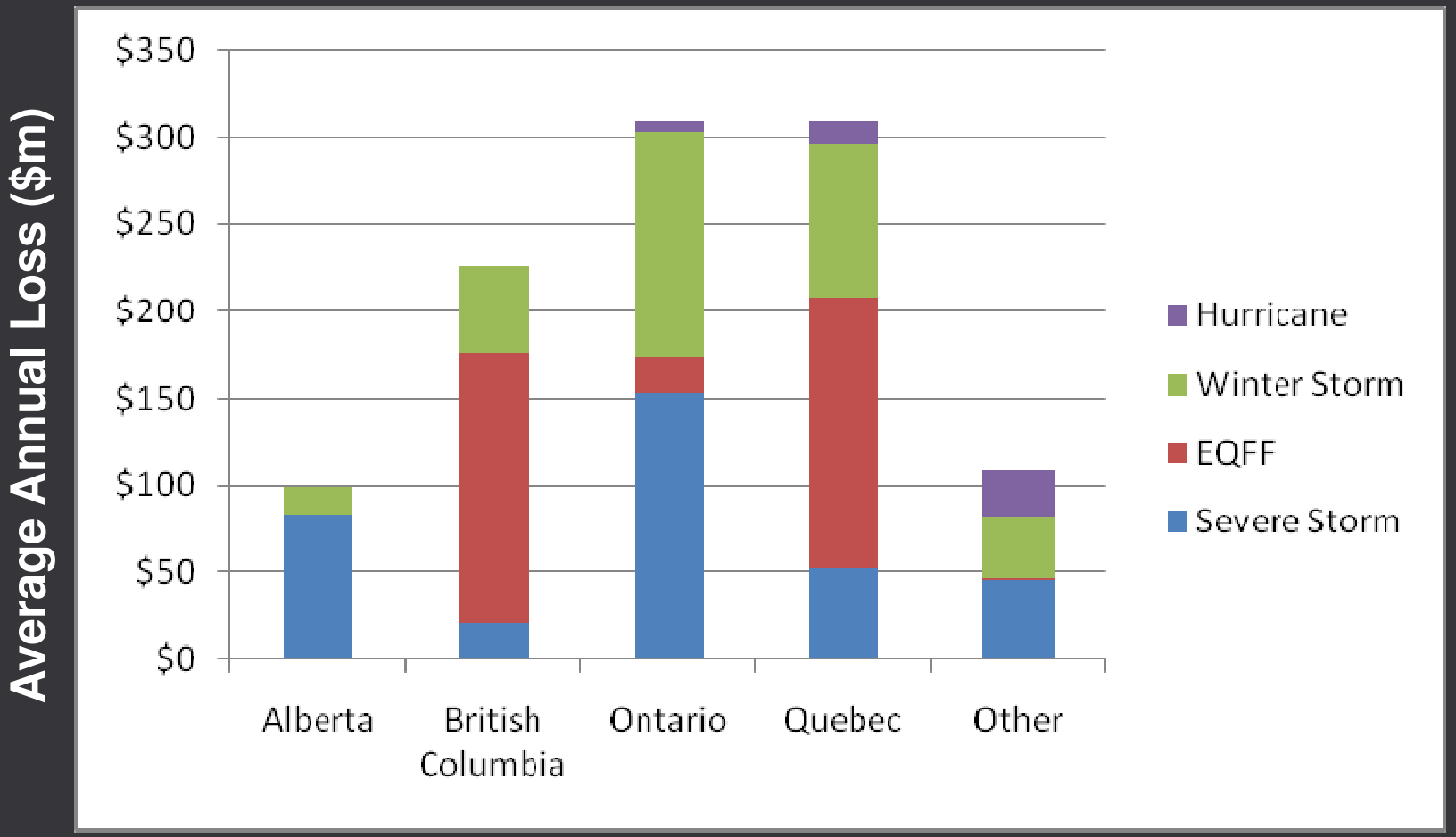
- Available models: RMS and AIR
- Usage:
  - RMS is widely used as compared to AIR in the industry
- Latest Updates:
  - RMS updated their SCS model in 2008 (RiskLink v8.0)
    - Losses decreased approximately 30% pending geography and LOB
  - AIR's last Severe Storm model update was in 2005.

# Catastrophe Model Use in Canada by Peril
# Winter Storm and Hurricane

- Available models: RMS
- Usage:
  - RMS only
- Latest Updates:
  - Winterstorm initial release in 2008
  - Hurricane initial release in 2011

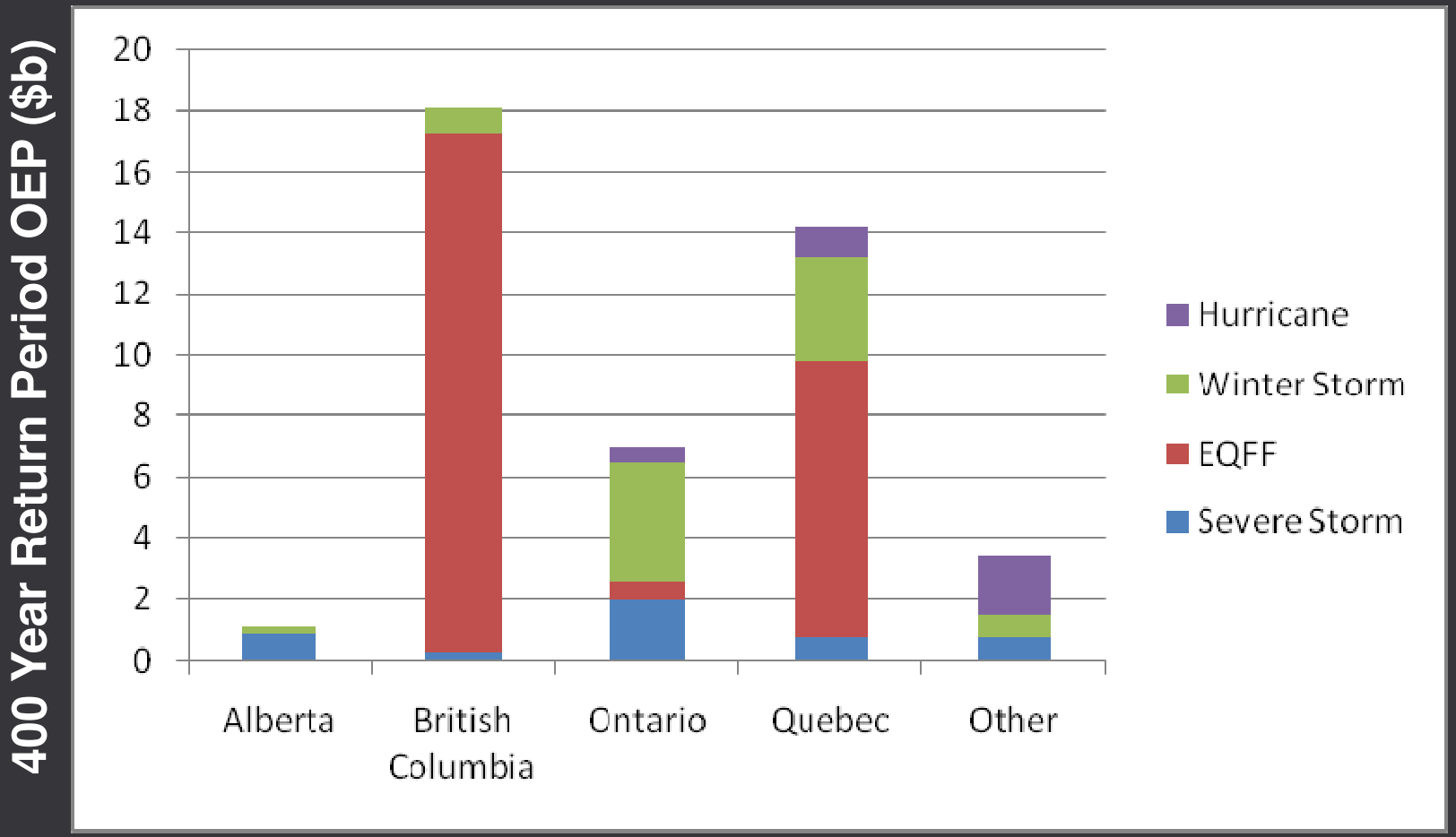
# Catastrophe Model Industry Loss

## RMS Industry Loss Contribution by Province / Peril



# Catastrophe Model Industry Loss

## RMS Industry Loss Contribution by Province / Peril



# Earthquake Industry Loss Comparison

| Canada Total (Mlns CAD) | | | |
|---|---|---|---|
| **Return Period** | **Model X** | **Model Y** | **Index Y/X** |
| 500 | 18,952 | 34,190 | 1.80 |
| 400 | 16,943 | 28,538 | 1.68 |
| 250 | 13,266 | 18,462 | 1.39 |
| 50 | 738 | 1,386 | 1.88 |
| AAL | 175 | 331 | 1.89 |

| British Columbia (Mlns CAD) | | |
|---|---|---|
| **Model X** | **Model Y** | **Index Y/X** |
| 16,678 | 20,725 | 1.24 |
| 14,761 | 17,011 | 1.15 |
| 11,529 | 10,117 | 0.88 |
| 258 | 407 | 1.58 |
| 123 | 154 | 1.26 |

| Ontario (Mlns CAD) | | |
|---|---|---|
| 500 | 211 | 960 | 4.55 |
| 400 | 168 | 634 | 3.78 |
| 250 | 87 | 209 | 2.40 |
| 50 | 6 | 0 | 0.00 |
| AAL | 4 | 19 | 5.26 |

| Quebec (Mlns CAD) | | |
|---|---|---|
| 1,503 | 12,624 | 8.40 |
| 1,188 | 9,070 | 7.63 |
| 645 | 4,090 | 6.34 |
| 61 | 115 | 1.90 |
| 48 | 157 | 3.24 |

# Severe Storm Industry Loss Comparison

| Canada Total (Mlns CAD) | | | |
|---|---|---|---|
| Return Period | Model X | Model Y | Index Y/X |
| 500 | 2,463 | 5,817 | 2.36 |
| 400 | 2,225 | 5,584 | 2.51 |
| 250 | 1,773 | 4,836 | 2.73 |
| 50 | 741 | 2,439 | 3.29 |
| AAL | 356 | 514 | 1.44 |

| Alberta (Mlns CAD) | | |
|---|---|---|
| Model X | Model Y | Index Y/X |
| 906 | 5,473 | 6.04 |
| 848 | 5,096 | 6.01 |
| 721 | 4,503 | 6.25 |
| 321 | 2,119 | 6.60 |
| 83 | 301 | 3.63 |

| Manitoba (Mlns CAD) | | | |
|---|---|---|---|
| 500 | 478 | 569 | 1.19 |
| 400 | 429 | 517 | 1.21 |
| 250 | 338 | 358 | 1.06 |
| 50 | 123 | 80 | 0.65 |
| AAL | 23 | 11 | 0.48 |

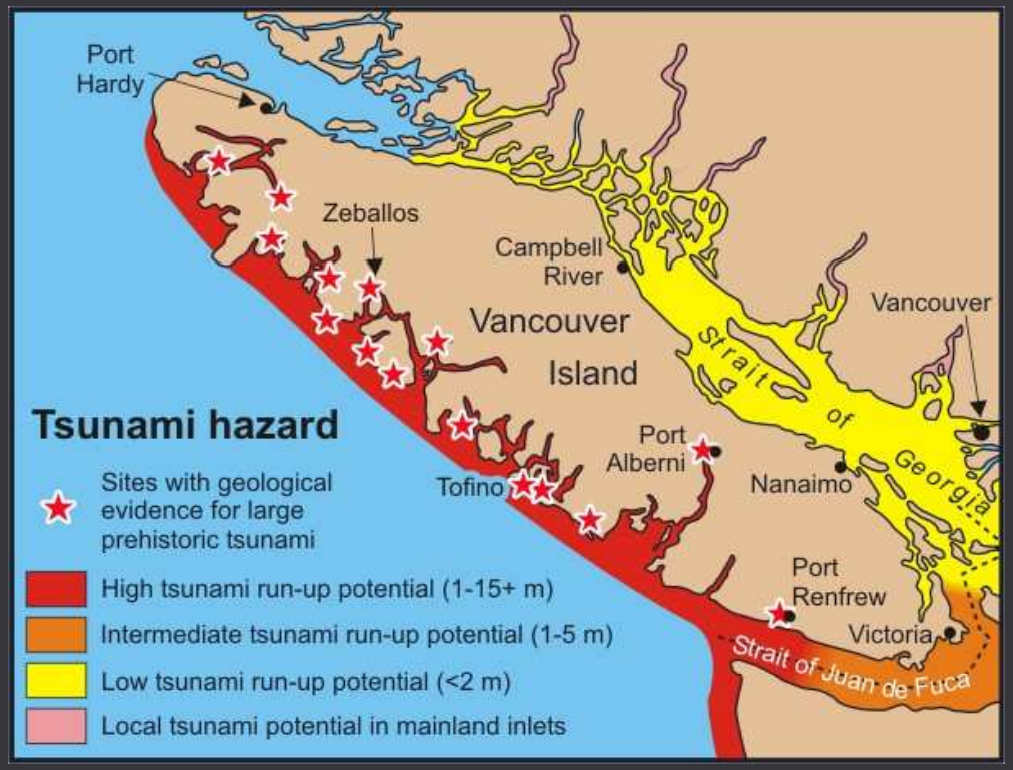
| Ontario (Mlns CAD) | | |
|---|---|---|
| 2,208 | 2,304 | 1.04 |
| 1,971 | 2,036 | 1.03 |
| 1,518 | 1,594 | 1.05 |
| 512 | 458 | 0.89 |
| 154 | 98 | 0.64 |

| Quebec (Mlns CAD) | | | |
|---|---|---|---|
| 500 | 846 | 1,204 | 1.42 |
| 400 | 732 | 982 | 1.34 |
| 250 | 537 | 806 | 1.50 |
| 50 | 223 | 347 | 1.56 |
| AAL | 52 | 60 | 1.15 |

| Saskatchewan (Mlns CAD) | | |
|---|---|---|
| 295 | 765 | 2.59 |
| 257 | 670 | 2.61 |
| 189 | 459 | 2.43 |
| 70 | 92 | 1.31 |
| 18 | 15 | 0.83 |

# Non-Modelled Perils
## Tsunami

- Tsunami Risk
  - Canada working on a National Hazard Map for Tsunami
  - Expected to be an area of interest for commercial model development in the future
- Canada Tsunami Risk
  - Vancouver Island
  - B.C. Coast
  - Baffin Island
  - Mackenzie Delta
  - St. Lawrence Estuary
  - Atlantic Coast

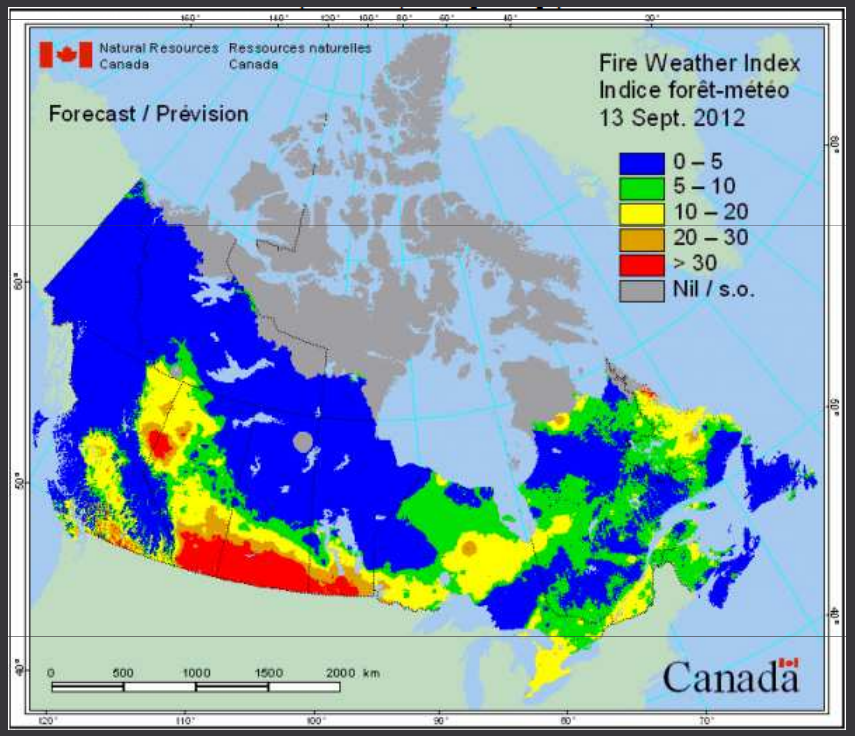



**Graphic from Natural Resources Canada**

# Non-Modelled Perils
## Wildfire

- Slave Lake – $700-$750M CAD Insured Loss
  - 2nd largest cat loss in Canada history
  - ~50% of wildfires caused by humans

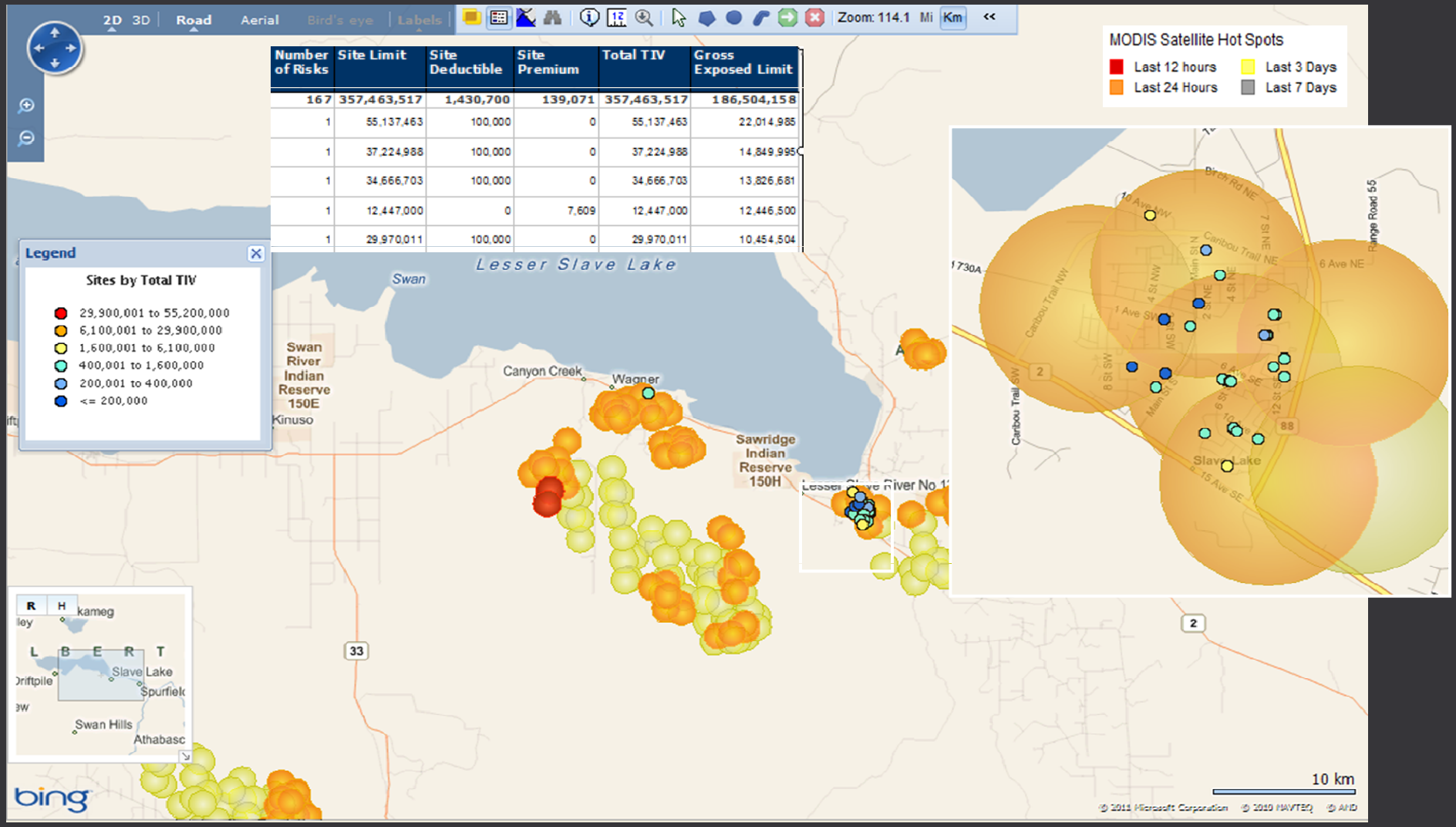
**Photograph by: Caezer Ng/The Lakeside Leader, edmontonjournal.com**



# Non-Modelled Perils
## Wildfire

**Slave Lake Wildfires – May 2011**

***2011 Exposure – i-aXs RealCat***




| Number of Risks | Site Limit | Site Deductible | Site Premium | Total TIV | Gross Exposed Limit |
|---|---|---|---|---|---|
| 167 | 357,463,517 | 1,430,700 | 139,071 | 357,463,517 | 186,504,158 |
| 1 | 55,137,463 | 100,000 | 0 | 55,137,463 | 22,014,985 |
| 1 | 37,224,988 | 100,000 | 0 | 37,224,988 | 14,849,995 |
| 1 | 34,666,703 | 100,000 | 0 | 34,666,703 | 13,826,681 |
| 1 | 12,447,000 | 0 | 7,609 | 12,447,000 | 12,446,500 |
| 1 | 29,970,011 | 100,000 | 0 | 29,970,011 | 10,454,504 |

# Non-Modelled Perils
## Flood

- Flood – May/June 2011
  - Insured Loss
    - $160M CAD
  - Total Economic Loss
    - $815M CAD


The Assiniboine River threatens to breach the 18th Street Bridge in Brandon, Man. on May 11. The province has announced that a controlled breach of a dike is set to occur on May 12. (David Lipnowski/Canadian Press)

Section 3

# Model Enhancements Expected in the Future

# Upcoming Model Changes

- **RMS**
  - No Canadian model updates currently planned
  - Next Generation Platform scheduled for 2014
  - Respond to 2015 GSC update
- **EQECAT**
  - No Canadian model updates currently planned
  - RQE scheduled for late 2012
  - Research efforts underway on liquefaction, underwater landslide, tsunami, windstorm, hail, and flood
- **AIR**
  - Earthquake, Severe Storm, and Winter Storm likely in 2014
  - New Hurricane model likely in 2014

Section 4

# Managing Model Change and Uncertainty

# Major Sources of Uncertainty Cat Models

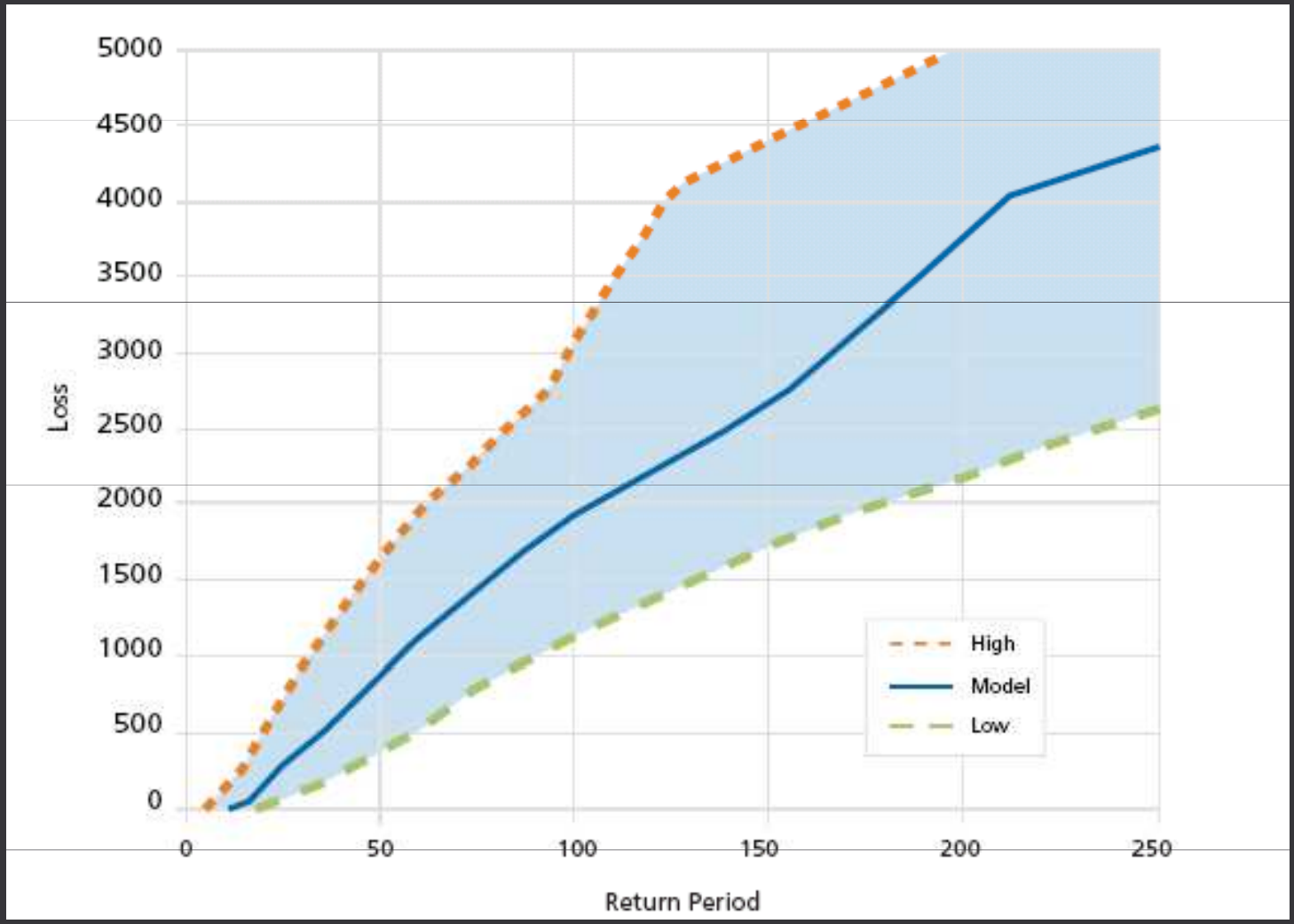
- Data
  - Address Information
  - Multi location
  - Insurance to value and other coverage issues
  - Imperfect sight into risk characteristics

Courtesy of AIR Worldwide / EERI

- Hazard
  - Lack of history of large earthquakes limits our ability to simulate them
    - We rely on indirect sources of information, like GPS measurements or paleo-seismology (e.g. historical liquefaction)
  - We know relatively little about seismicity potential in areas of low seismicity (like in Eastern Canada)
  - Even in areas of high seismicity like southwestern Canada, there is a limited amount of data and there is room for the unexpected (Japan M9.0 in 2011, for example)

- Engineering
  - Limited claims data for catastrophic events
  - Lack of understanding of structural behavior under severe loads

# Catastrophe Models
# An Imprecise Science






Source: RMS, GC

# Catastrophe Models
# An Imprecise Science

If the (1999) cat model says:

**"Your 100 year return period loss is $1,117,243,572,"**

what it really means is:

**"Your 100 year return period loss is about a billion dollars;**

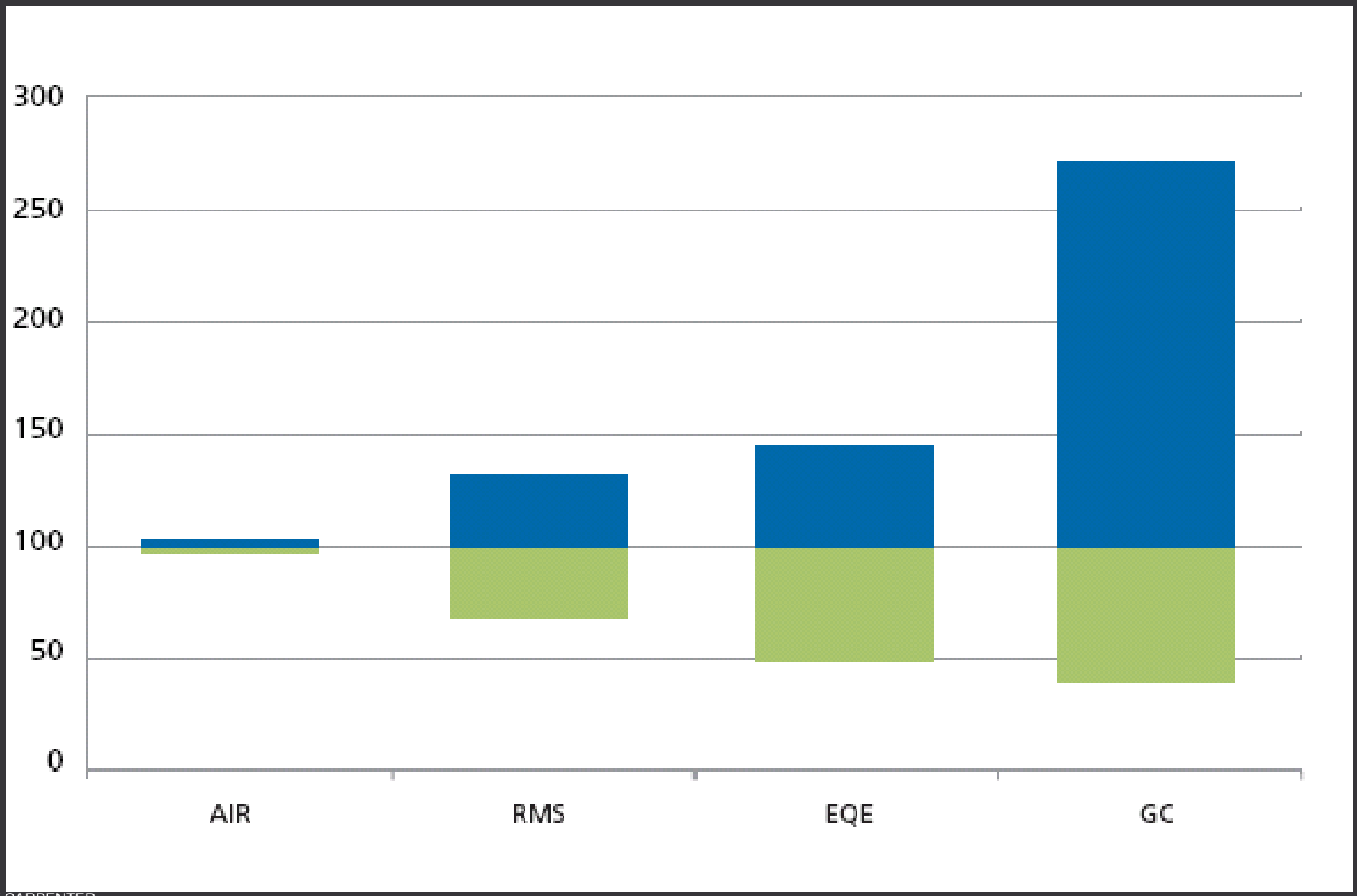
**but it could be 500 million dollars or maybe two and**

**a half billion dollars... something like that."**



Source: RMS, GC

# Catastrophe Models
# An Estimation of Model Uncertainty



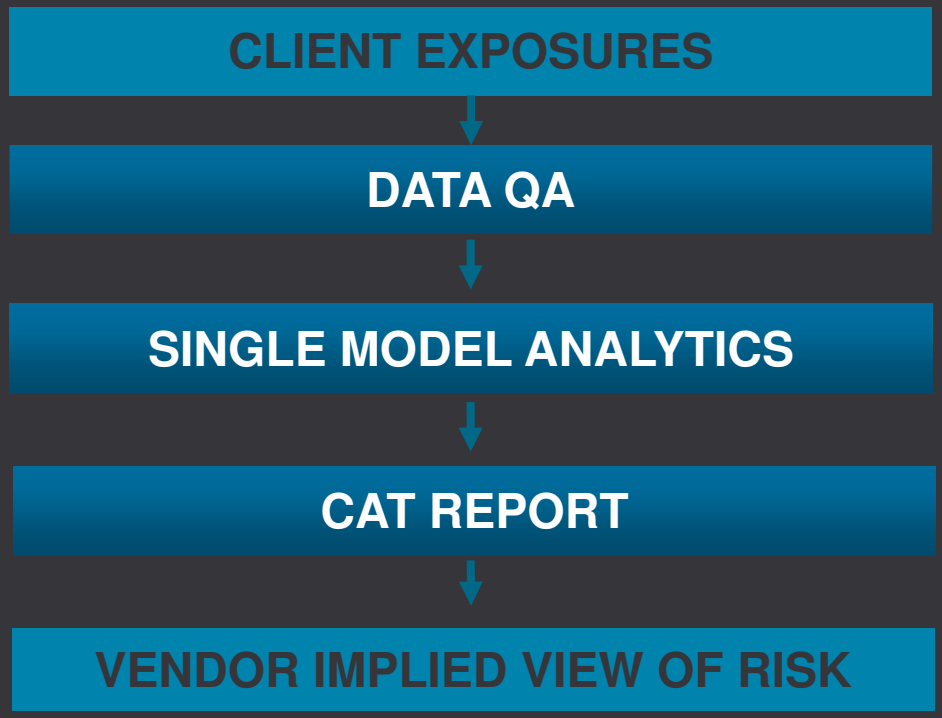



Source: AIR, EQECAT, RMS, GC

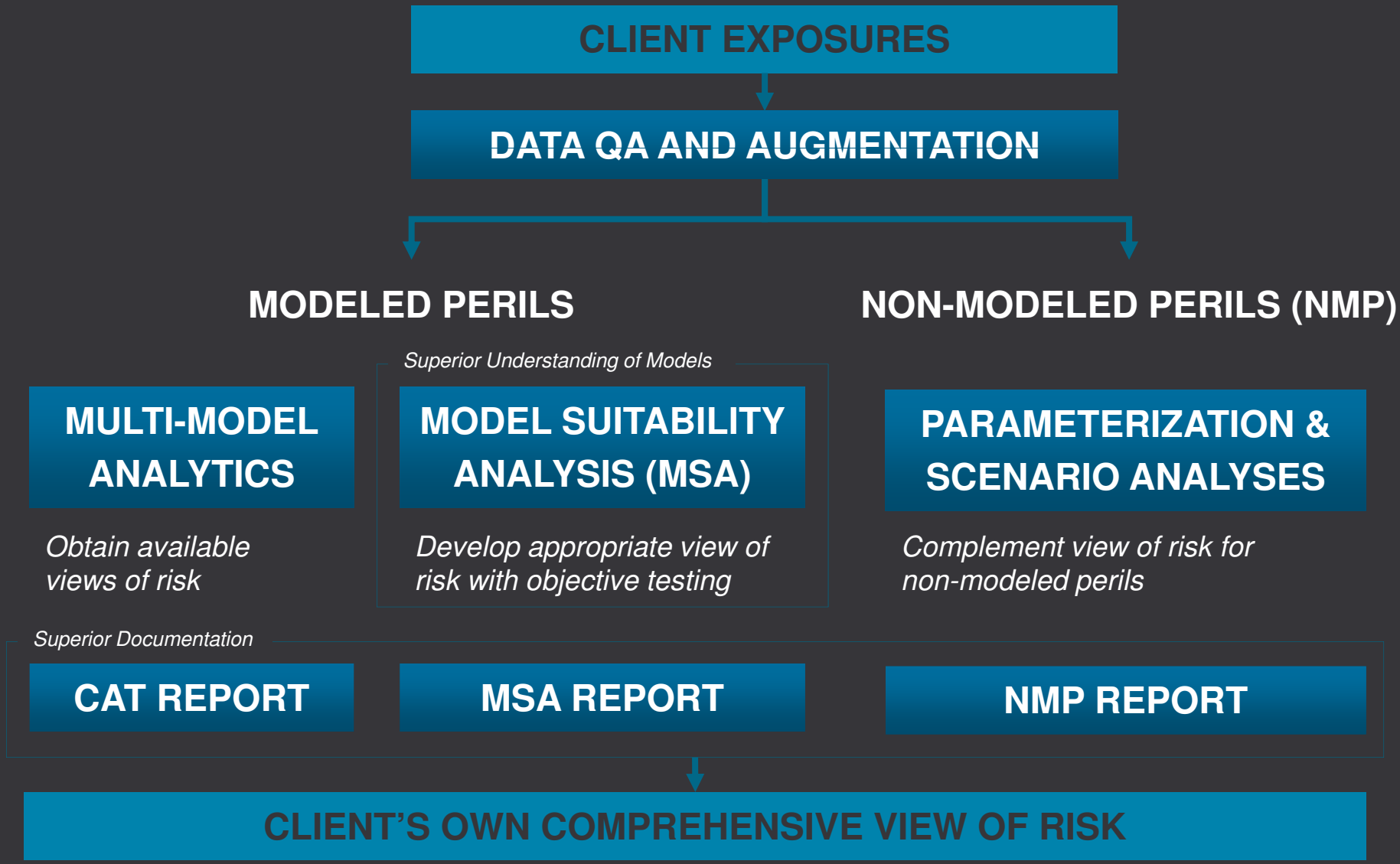
Section 5

# Catastrophe Model Result Blending and Customization

# Current Cat Modeling Approach

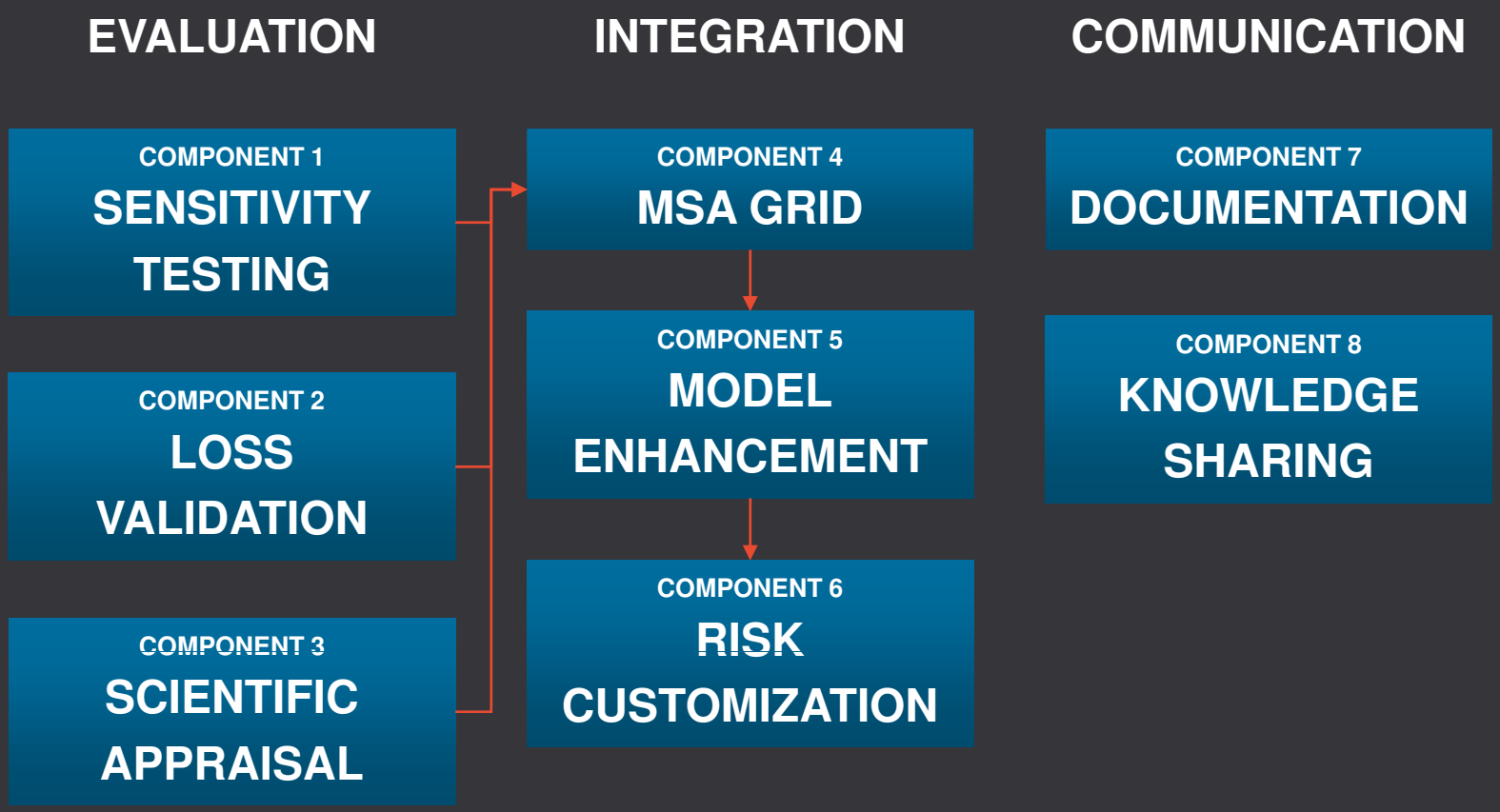


# The Future: Guy Carpenter's Customized Cat Modeling Approach



# Guy Carpenter's Model Suitability Analysis (MSA)SM

*Client's View of Risk*



# Guy Carpenter's Model Suitability Analysis (MSA)SM

*Client's View of Risk*

**INTEGRATION** **COMMUNICATION**

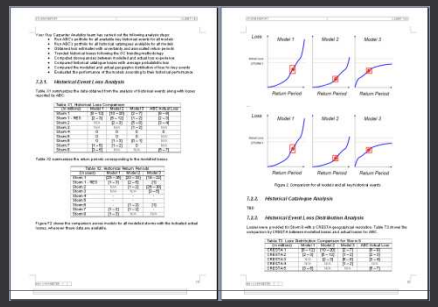
**COMPONENT 4**
**MSA GRID**

**COMPONENT 7**
**DOCUMENTATION**

GC + Client Defined →

| | C1: ST | C2: LV | C2: LV | C3: SA | C3: SA |
|---|---|---|---|---|---|
| | Relative RC Bldg Code | Klaus Loss Validation | Hi-Freq EP Validation | Agreement Dmg Funcs | Agreement Event Ftprts |
| MODEL 1 | GOOD | 10% ERROR | SO-SO MATCH | MATCHES RESEARCH | MATCHES UK MET |
| MODEL 2 | GOOD | 200% ERROR | POOR MATCH | NO MATCH | MATCHES UK MET |
| MODEL 3 | NO LATEST AGE BAND | 50% ERROR | SO-SO MATCH | MATCHES CLAIMS | NO MATCH UK MET |

MSA C3: SA CHAPTER



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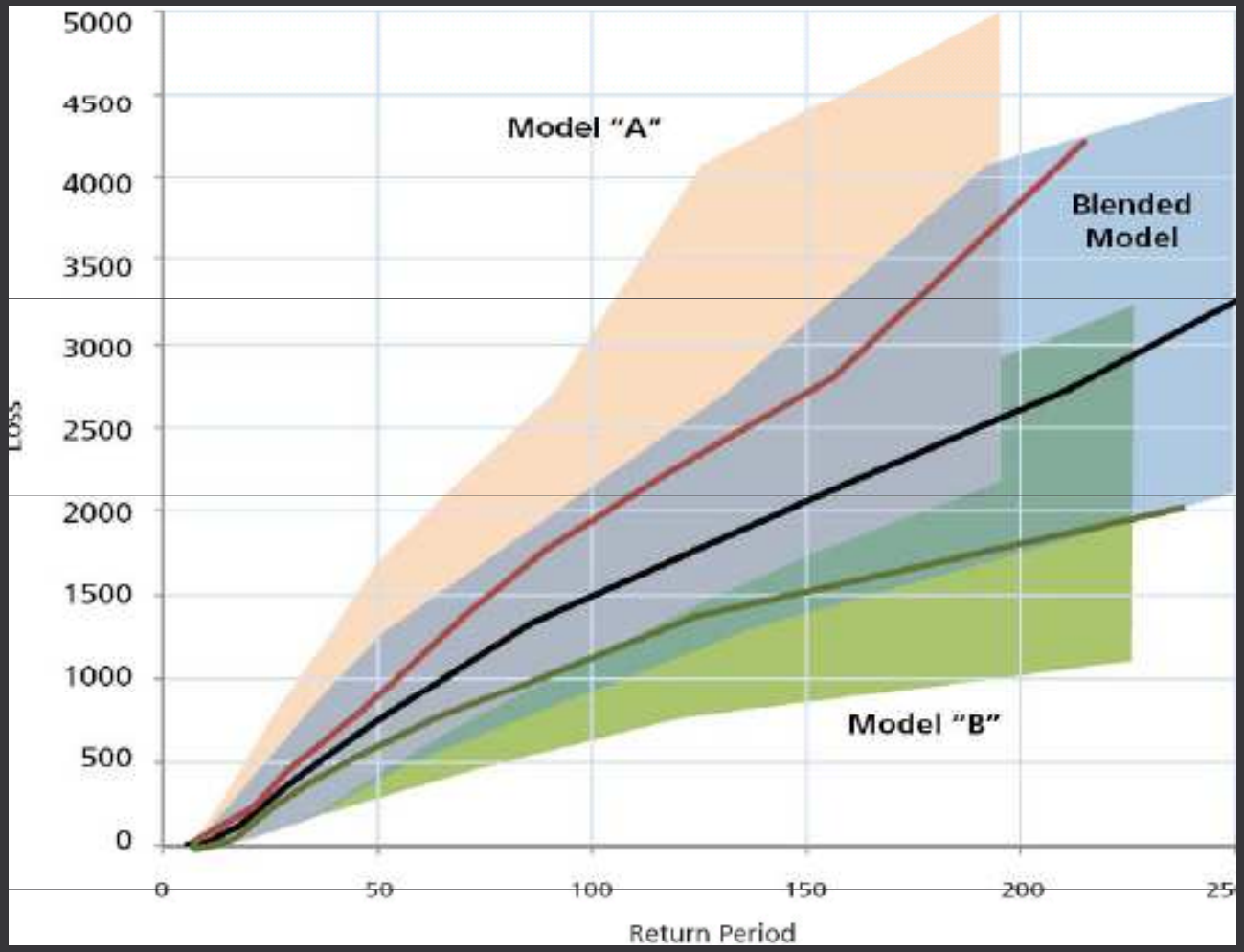
# Future Of Catastrophe Risk Analysis
# Model Customization

- Markets more willing to accept company specific views
- Rating agencies allowing – if not encouraging - a "Corporate View"
- Next Generation Platforms encourage sensitivity testing, transparency and multi model approach



# Conclusion

# Conclusion
## Some Basic Things to Remember Regarding Cat Risk

- Widespread and deep usage of models is relatively young
- Models are models: there are many uncertainties in them
- Data and scientific hypotheses all matter a lot
- Suitability analyses of models will be increasingly important
- Don’t assume a catastrophe model is useful – prove it useful yourself or rely on another to help

# Recent Briefings and White Papers

- *Responding to Catastrophe Model Change*
  GC Briefing, October 2011

- *Managing Catastrophe Model Uncertainty: Issues and Challenges*
  GC Analytics White Paper, December 2011

- *Beyond PML: A 360 Degree View of Risk*
  GC Analytics White Paper, February 2012

- *Spring Conditions Suggest Tempered Atlantic Hurricane Season*
  GC Analytics White Paper, May 2012

- *Cold Spots Heating Up: The Impact of Insured Catastrophe Losses in New Growth Markets*
  GC Report, September 2012

# Questions?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