ACTUARIAL SOCIETY OF SOUTH AFRICA

The Business of Change: 2010 and Beyond

Catastrophe Modelling

Oscar Kitasoboka & Pieter Visser

Benfield

Agenda

1. Why catastrophe modelling is important
2. What you should know about catastrophe models
3. Data requirements
4. Discuss some results
5. SA Market practice vs. catastrophe model results
6. Conclusions
7. Questions & Contributions

The Business of Change: 2010 and Beyond

Why catastrophe modelling is important

The Unknown

"Reports that say that something hasn't happened are always interesting to me, because as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns - the ones we don't know we don't know."

D.H. Rumsfeld, Feb. 12, 2002, Department of Defence news briefing

Conclusion:

Focus on minimising the unknown unknowns

What you should know about catastrophe models

Loss characteristics usually differ by region and company depending on

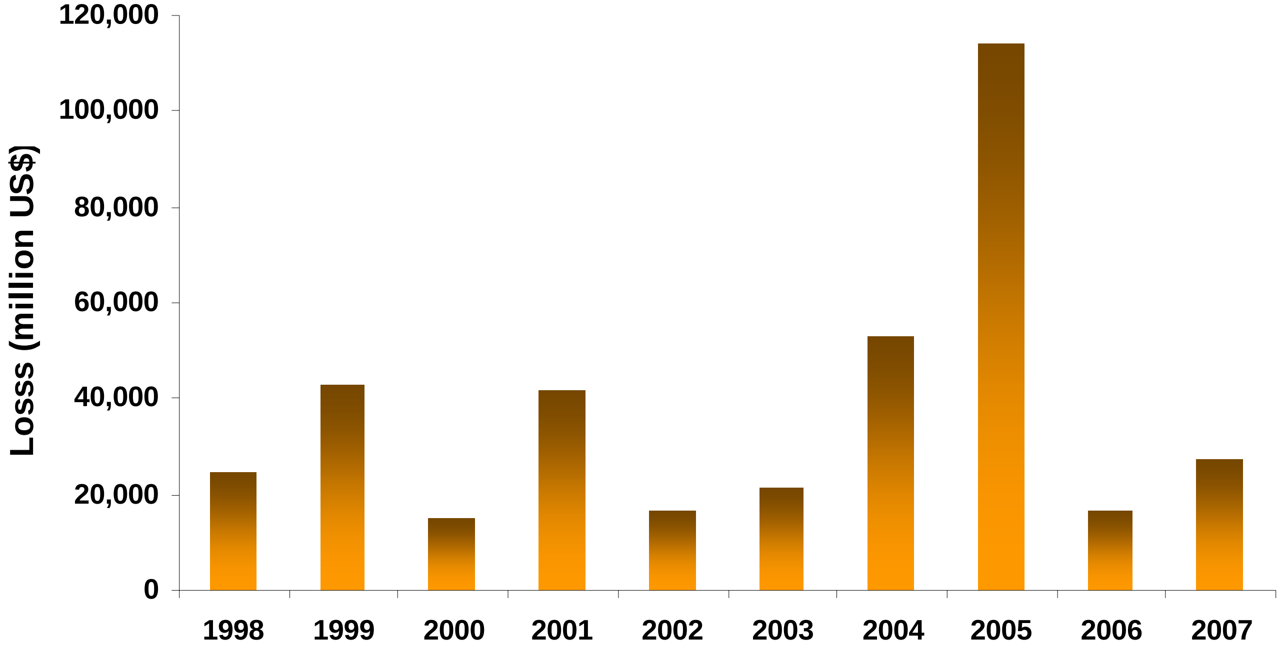
- Hazard being modelled
- Exposure (geographical location of risks)
- Vulnerability of exposures to hazards
- Policy terms & conditions (e.g., deductibles and limits)

Users of catastrophe models

- Insurers / Reinsurers / Capital markets
- Brokers
- Rating Agencies / Regulators

The Business of Change: 2010 and Beyond

World Insured Catastrophe Losses 1997-2007



2005 – Hurricane Katrina (68 billion US$)
2001 – WTC (22 billion US$)
(Swiss Re)

World Insured Catastrophe Losses (ranked)

ACTUARIAL SOCIETY OF SOUTH AFRICA

Rank	Event	Date	Insured Loss (million US$)
1	Hurricane Katrina (USA)	25 August 2005	68,515
2	Hurricane Andrew (USA)	23 August 1992	23,654
3	WTC (USA)	11 September 2001	21,999
4	Northridge Earthquake (USA)	17 January 1994	19,593
5	Hurricane Ivan (USA)	02 September 2004	14,115
6	Hurricane Wilma (USA)	19 October 2005	13,399
7	Hurricane Rita (USA)	20 September 2005	10,704
8	Hurricane Charley (USA)	11 August 2004	8,840
9	Typhoon Mireille (Japan)	27 September 1991	8,599
10	Hurricane Hugo (USA)	15 September 1989	7,650
??	Hurricane Ike (USA)	13 September 2008	15,000 (est)

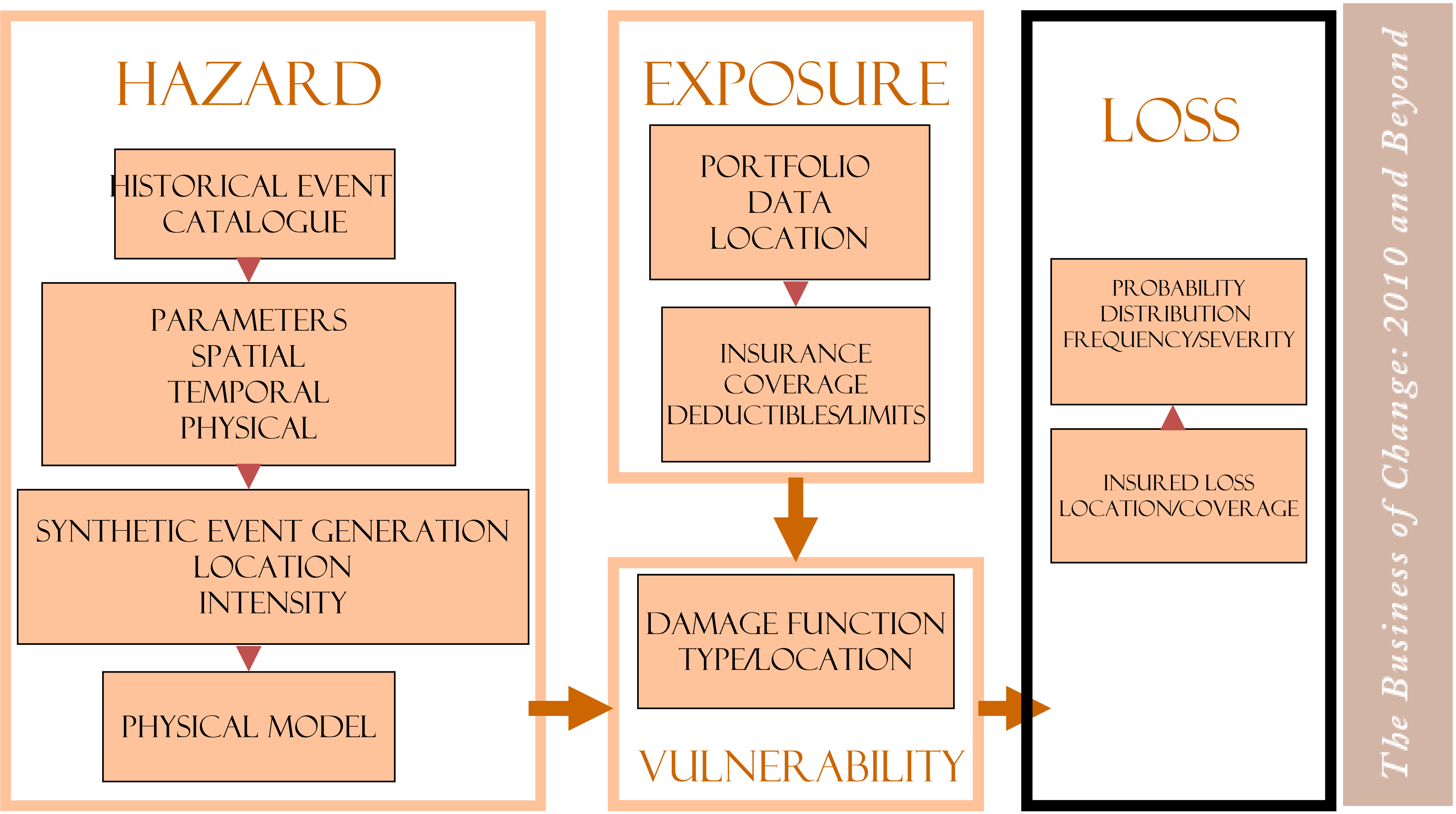
The Business of Change: 2010 and Beyond

Insured Losses South Africa (est)

Event	Date	Loss (million ZAR)
KZN Floods	September 1987	2,400
Pretoria Hail	November 1985	450
Cyclone Eline	February 2000	430
Forestry Fires	August 2007	255
Cape Storms	July 2006	240
Gauteng Hail	October 2004	180
Free State Floods	February 1988	148
KZN Storms	March 2008	116
Stilfontein Earthquake	March 2005	110
Welkom Tornado	March 1990	99

** VALUES ADJUSTED TO BASE 2008

Catastrophe Model Components

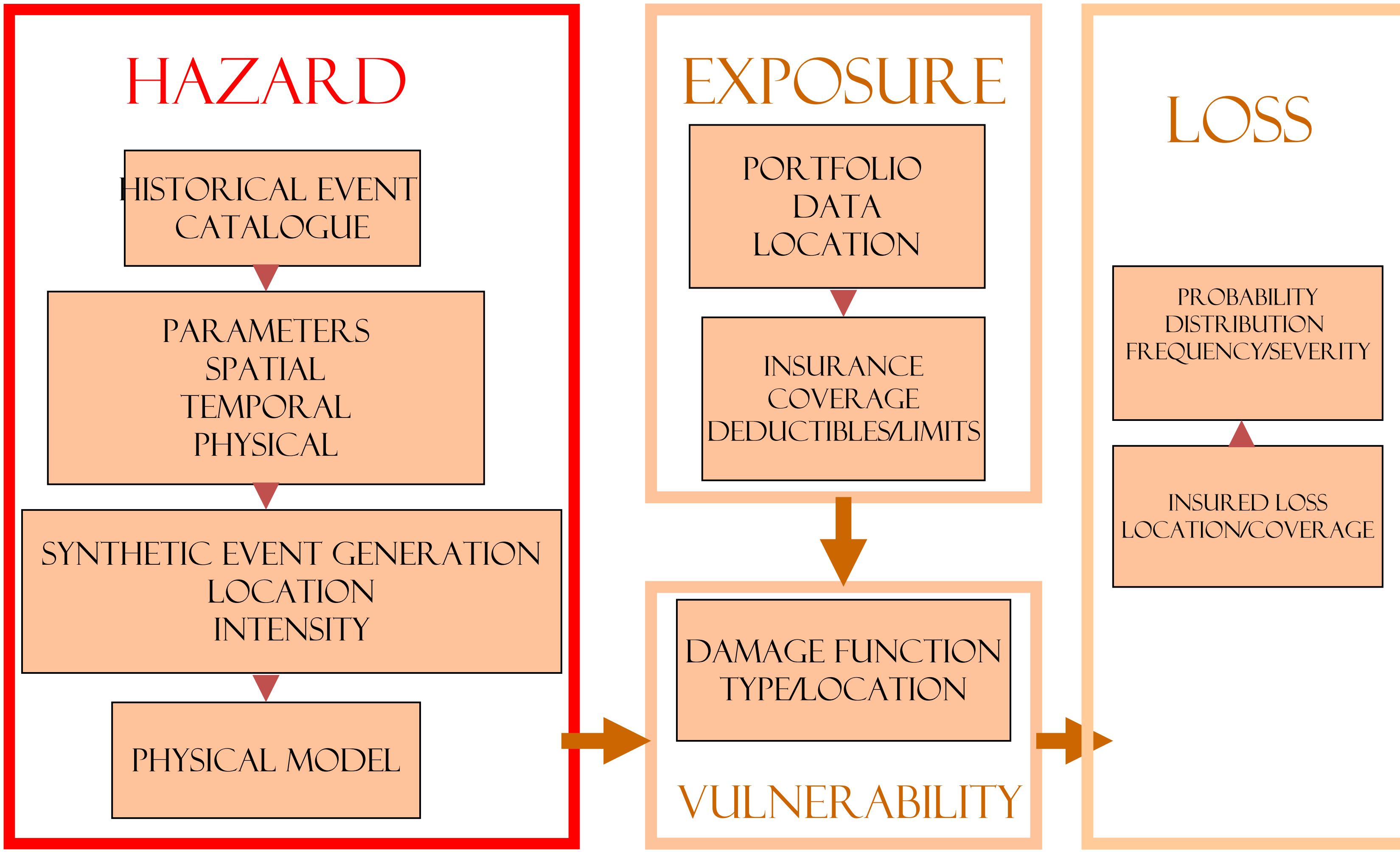


HAZARDS

- Earthquake
- Flood
- Tropical Cyclone
- Hailstorms
- Bush Fires
- Tornado
- Tsunami
- Epidemics

The Business of Change: 2010 and Beyond

HAZARD

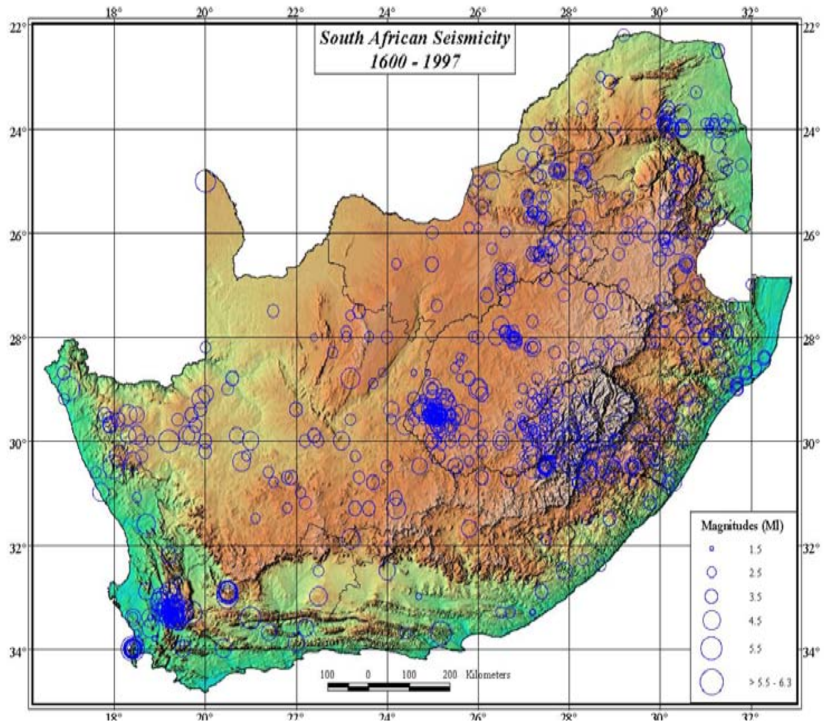


The Business of Change: 2010 and Beyond

Hazards (Seismicity South Africa)

Understanding the hazards:

- Historical hazard information
- Limited record of events that are instrumentally recorded
- Source zones (dynamic)
- Physical features (geology, topography, ground motion)
- Vulnerability and performance of exposures

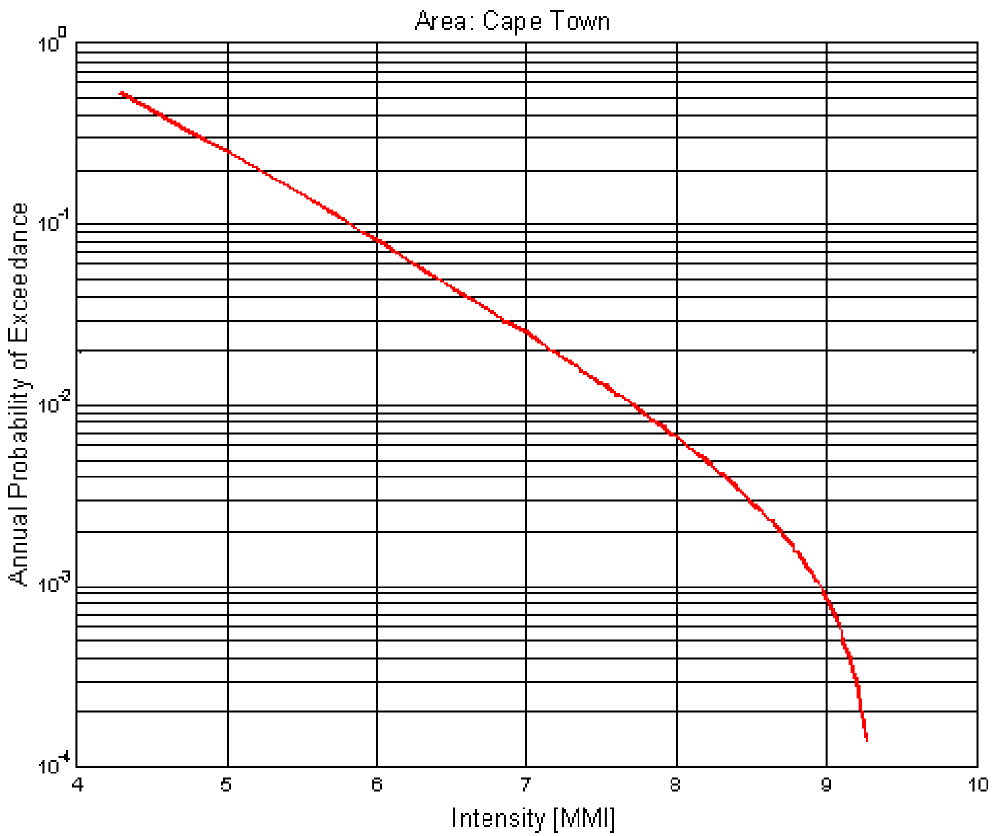


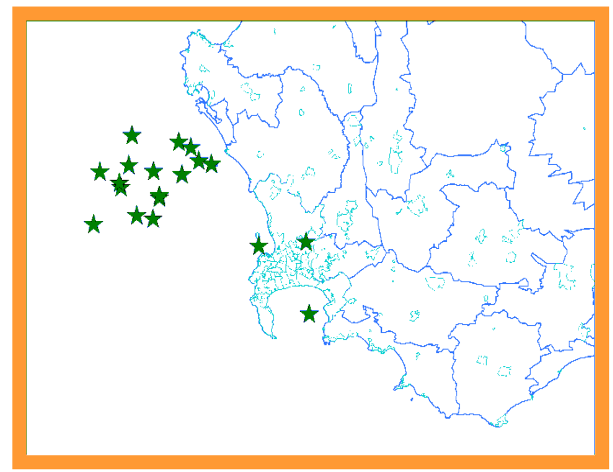
Hazards (Seismicity South Africa)

Components of the hazard (earthquake) model:

- Few real events so derive a synthetic event set (above a certain threshold)
- Statistically simulate frequency / severity relationships that is used as the basis for the synthetic catalogue
- Consider tectonic and mining induced events
- Synthetic catalogue covers 50,000 years and includes several instances of the most extreme events likely to occur and these are linked to:
  - Seismic source zones
  - Ground motion attenuation functions
  - Vulnerability and seismic performance of buildings

Hazards (Seismicity South Africa)





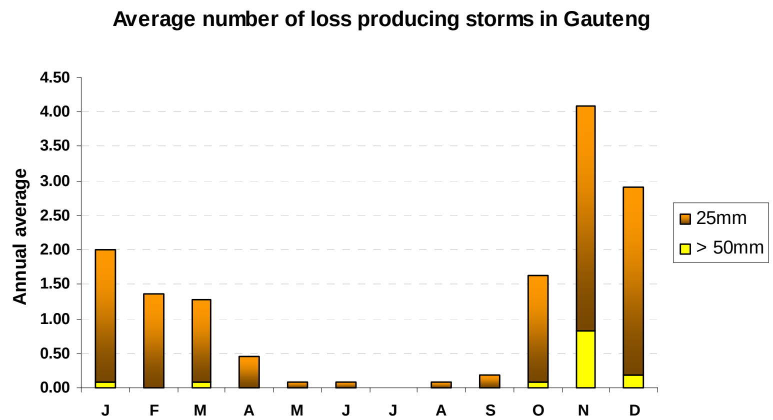
MMI :MODIFIED MERCALI INTENSITY
STRUCTURAL DAMAGE > 6

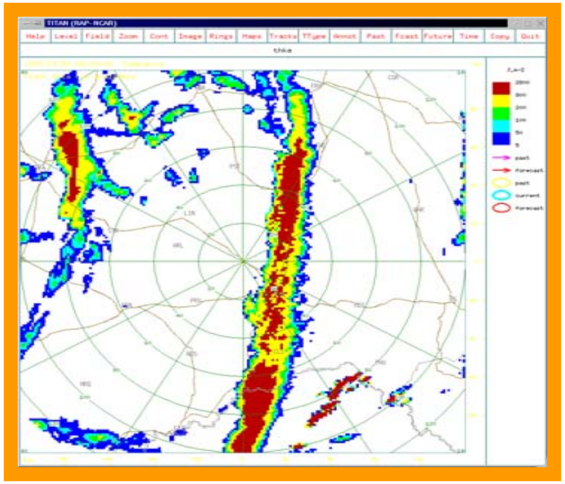
The Business of Change: 2010 and Beyond

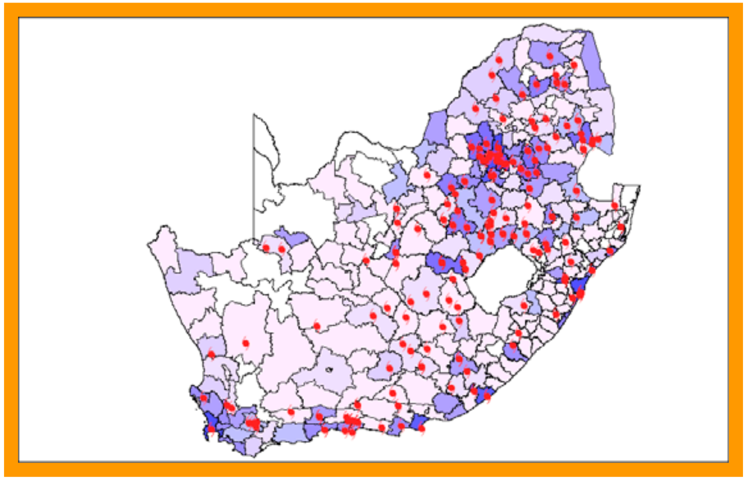
Hazard (Severe Storms)

Damaging effects of hailstorms are linked to:

- Storm size
- Hail size
- Storm origin
- Spatial frequency
- Seasonal distribution



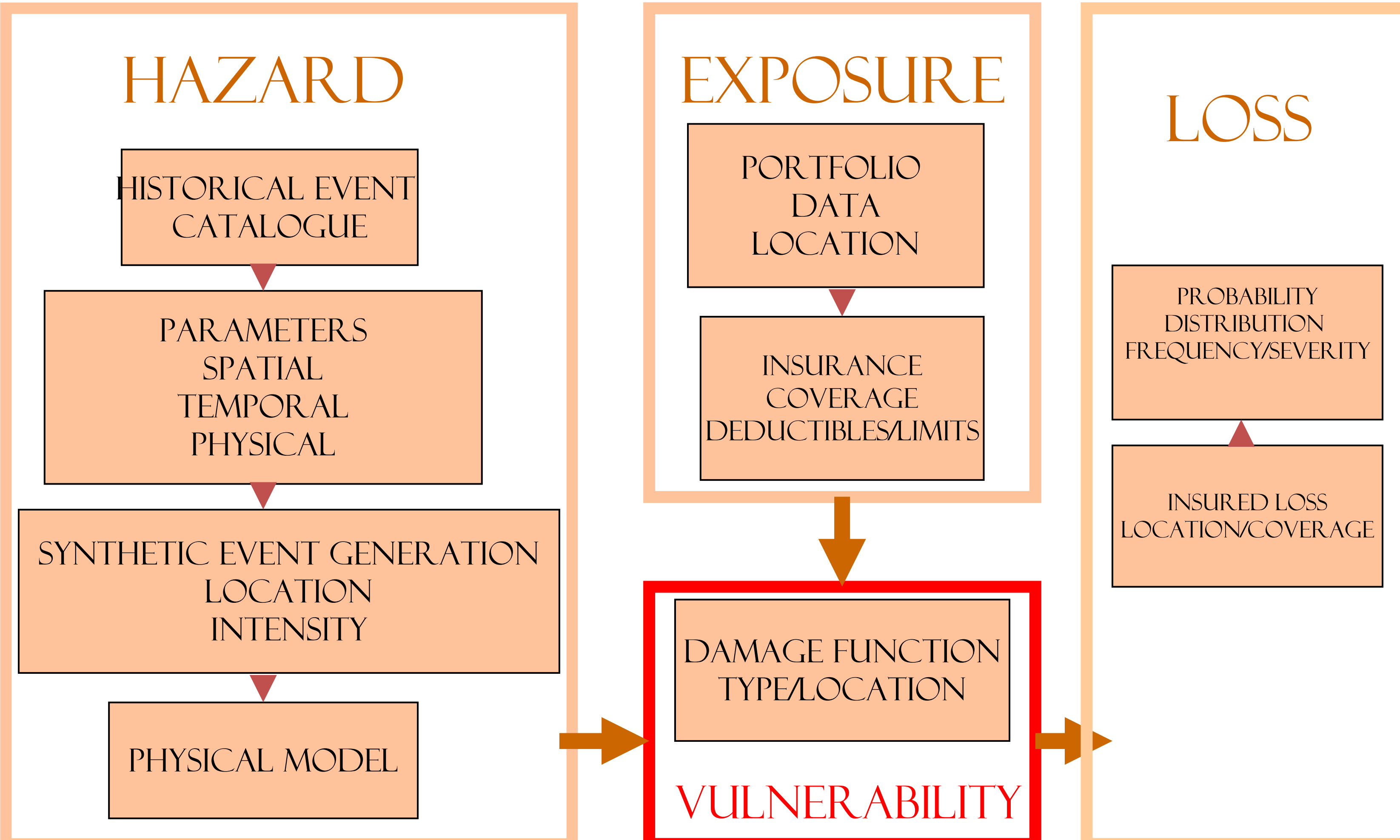




The Business of Change: 2010 and Beyond

VULNERABILITY

ACTUARIAL SOCIETY OF SOUTH AFRICA

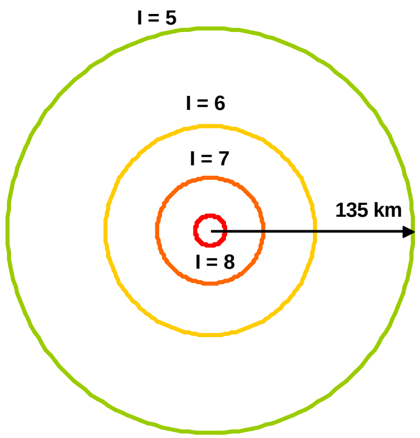


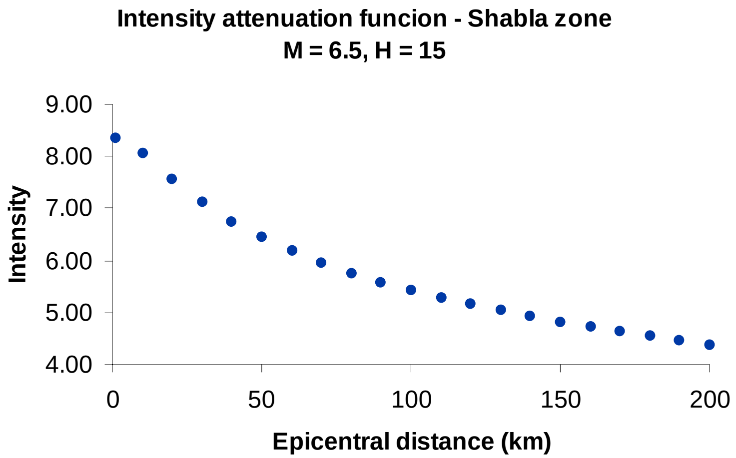
The Business of Change: 2010 and Beyond

Vulnerability (Damage Curves)

Damage is linked to:

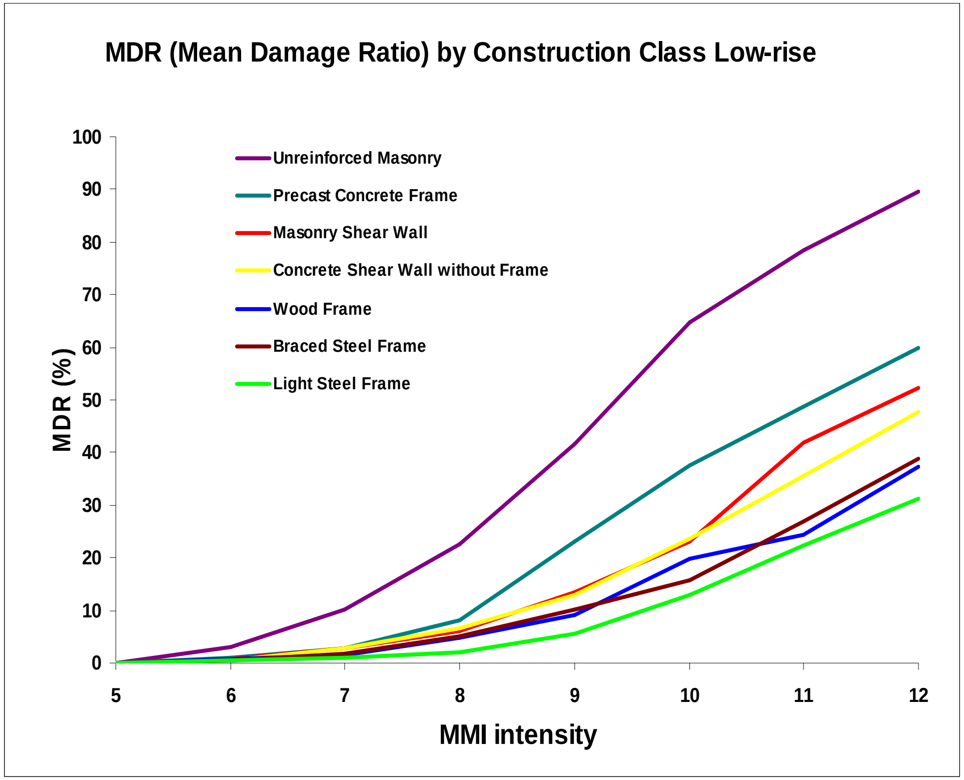
- **Distance** from earthquake epicentre
- **Severity** of earthquake induced ground motion
- **Geological** local conditions
- **Vulnerability** of exposed buildings

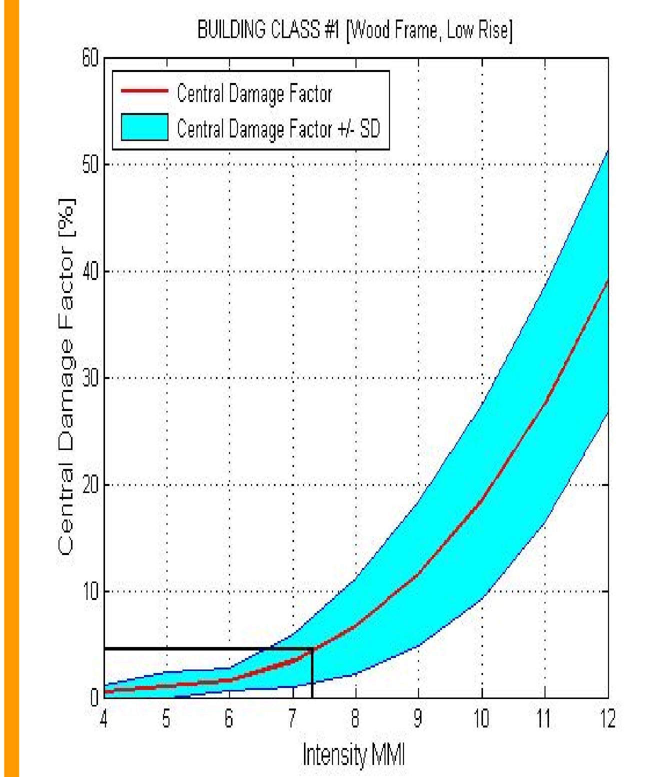




The Business of Change: 2010 and Beyond

Vulnerability (Damage Curves)





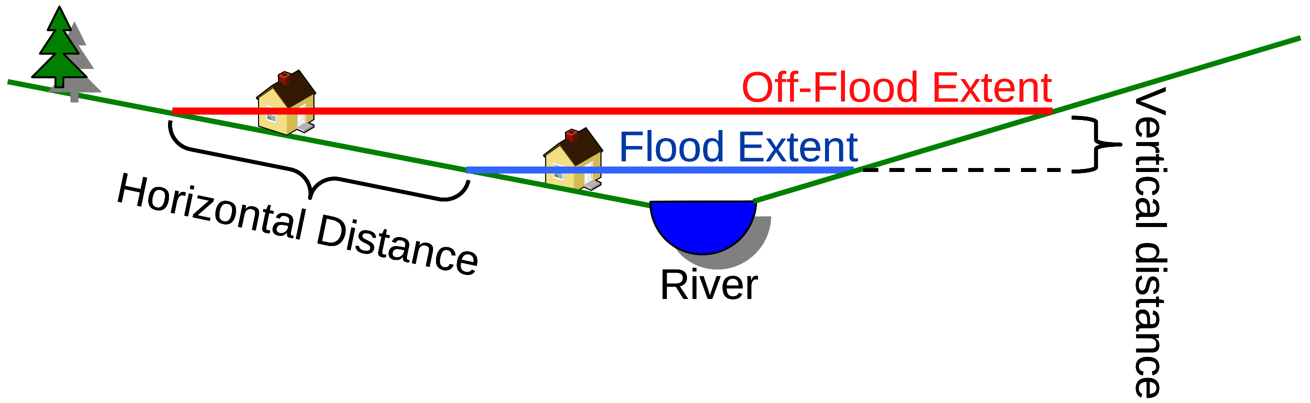
The Business of Change: 2010 and Beyond

Vulnerability (Flood models)

ACTUARIAL SOCIETY OF SOUTH AFRICA

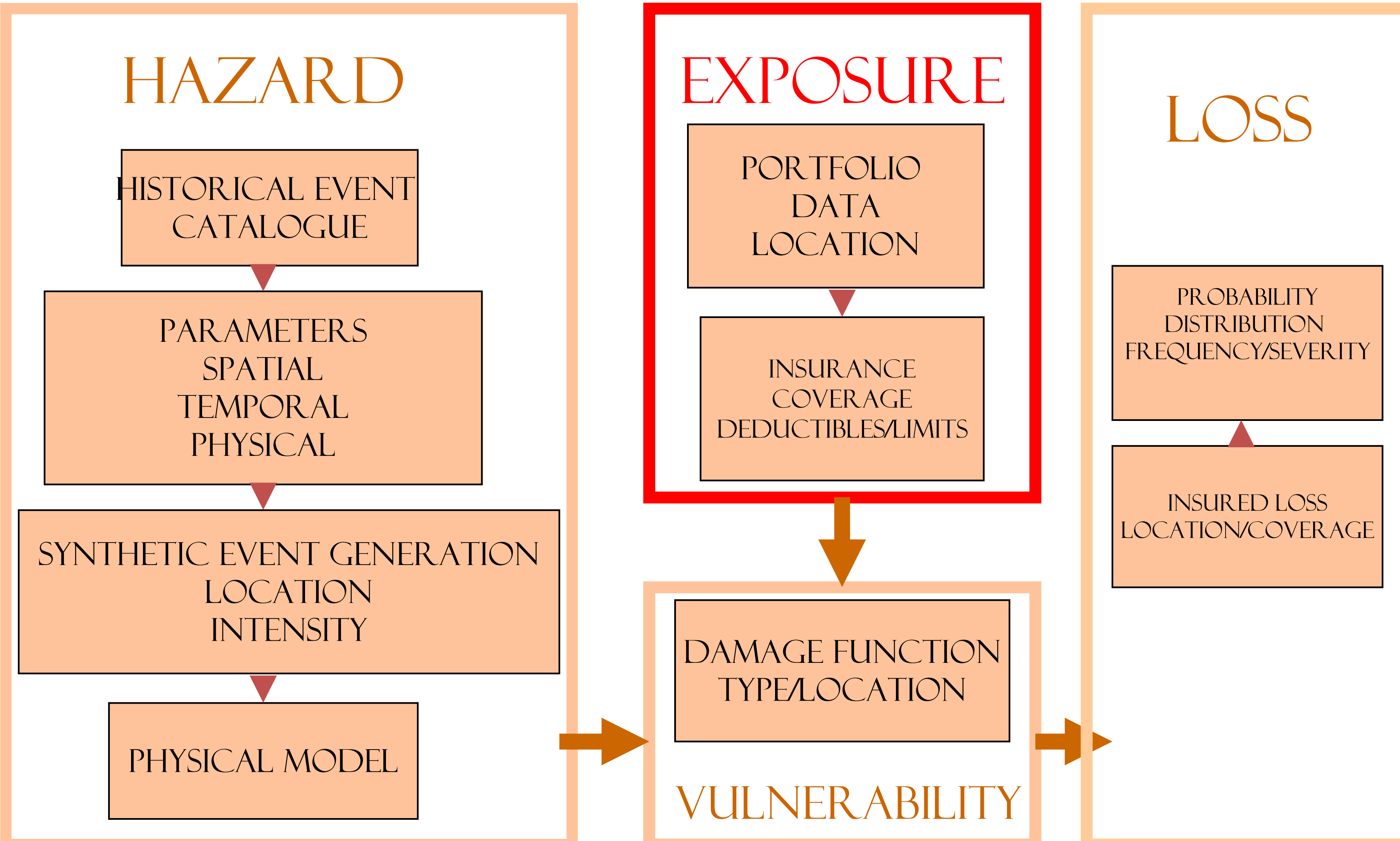
Damage particularly sensitive to:

- Horizontal distance
- Vertical distance (elevation)



The Business of Change: 2010 and Beyond

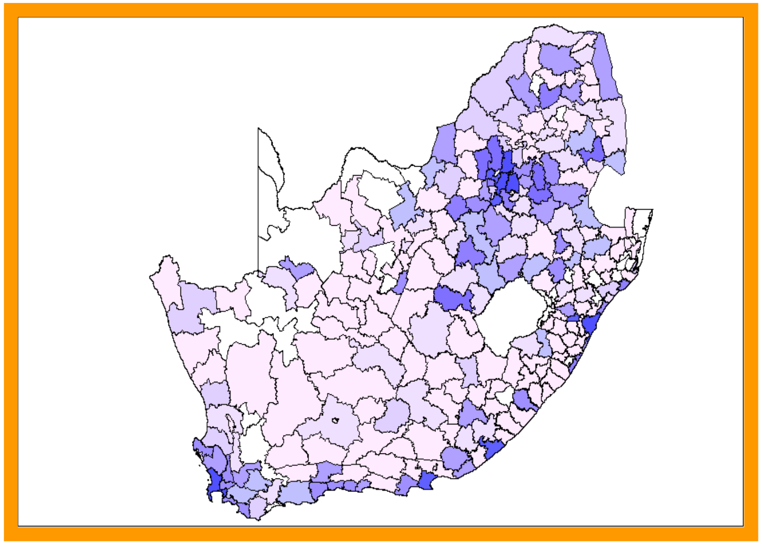
EXPOSURE

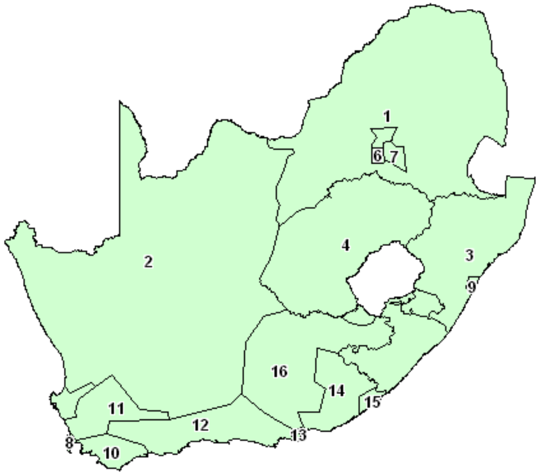

HAZARD
HISTORICAL EVENT CATALOGUE
PARAMETERS
SPATIAL
TEMPORAL
PHYSICAL
SYNTHETIC EVENT GENERATION
LOCATION
INTENSITY
PHYSICAL MODEL
EXPOSURE
PORTFOLIO
DATA
LOCATION
INSURANCE
COVERAGE
DEDUCTIBLES/LIMITS
DAMAGE FUNCTION
TYPE/LOCATION
VULNERABILITY
LOSS
PROBABILITY
DISTRIBUTION
FREQUENCY/SEVERITY
INSURED LOSS
LOCATION/COVERAGE

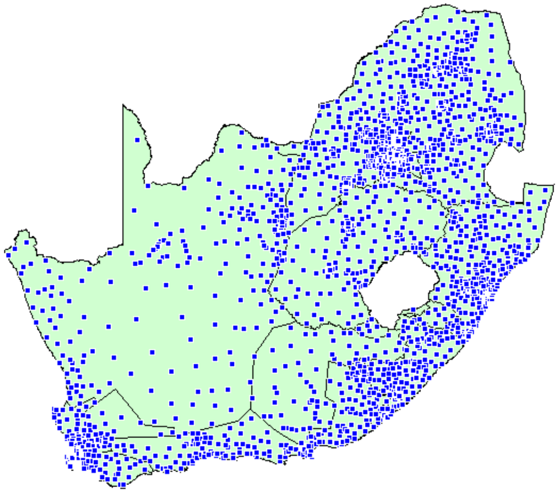
Exposure

Damaging effects of earthquakes are linked to:

- CRESTA aggregates norm in insurance industry
- Multiple location single policies - is the exposure really in Sandton?
- Static vs non static risks (e.g., motor)
- Business Interruption / Construction Type
- Group Schemes (Who knows the what/where?)

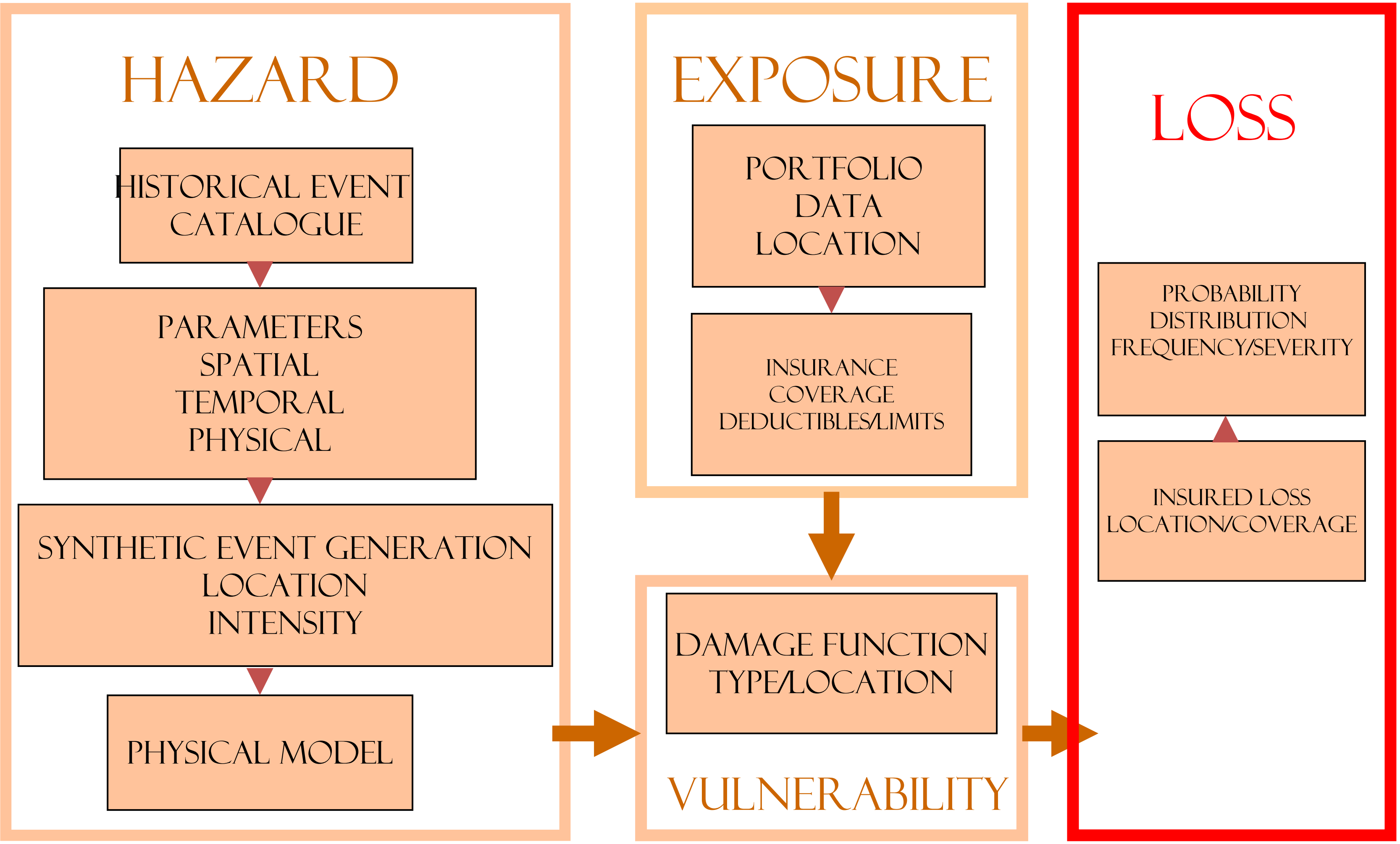






The Business of Change: 2010 and Beyond

LOSS


HAZARD
HISTORICAL EVENT CATALOGUE
PARAMETERS
SPATIAL
TEMPORAL
PHYSICAL
SYNTHETIC EVENT GENERATION
LOCATION
INTENSITY
PHYSICAL MODEL
EXPOSURE
PORTFOLIO
DATA
LOCATION
INSURANCE
COVERAGE
DEDUCTIBLES/LIMITS
DAMAGE FUNCTION
TYPE/LOCATION
VULNERABILITY
LOSS
PROBABILITY
DISTRIBUTION
FREQUENCY/SEVERITY
INSURED LOSS
LOCATION/COVERAGE

Model Outputs

ACTUARIAL SOCIETY OF SOUTH AFRICA

- Aggregate losses from each event
- Aggregate annual losses
- Distribution of losses by return period
- Event losses by geographic location (e.g., postcde, CRESTA, etc.)

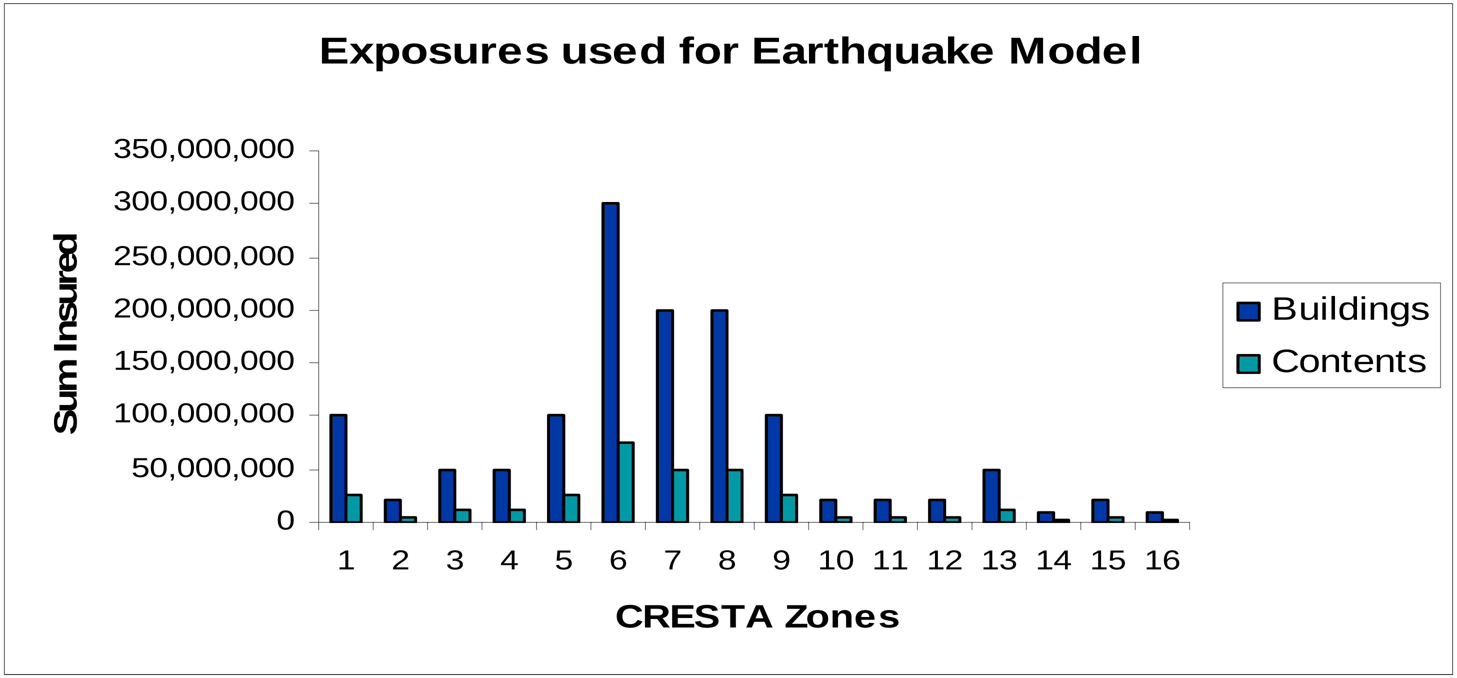
The Business of Change: 2010 and Beyond

Results – Earthquake model

- GapQuake SA (Benfield's proprietary model) vs. EQECAT
- Try and explain the differences
- Expressed results relative to the total sums insured
- Selected certain return periods
- Key areas:
  - Exposures - Impact of Geographical location of exposures
  - Vulnerability and seismic performance of building types
  - Hazards – allowance for mining vs non-mining events

Results - Exposures

ACTUARIAL SOCIETY OF SOUTH AFRICA



- 50% Gauteng
- 15% CPT
- 35% Other

The Business of Change: 2010 and Beyond

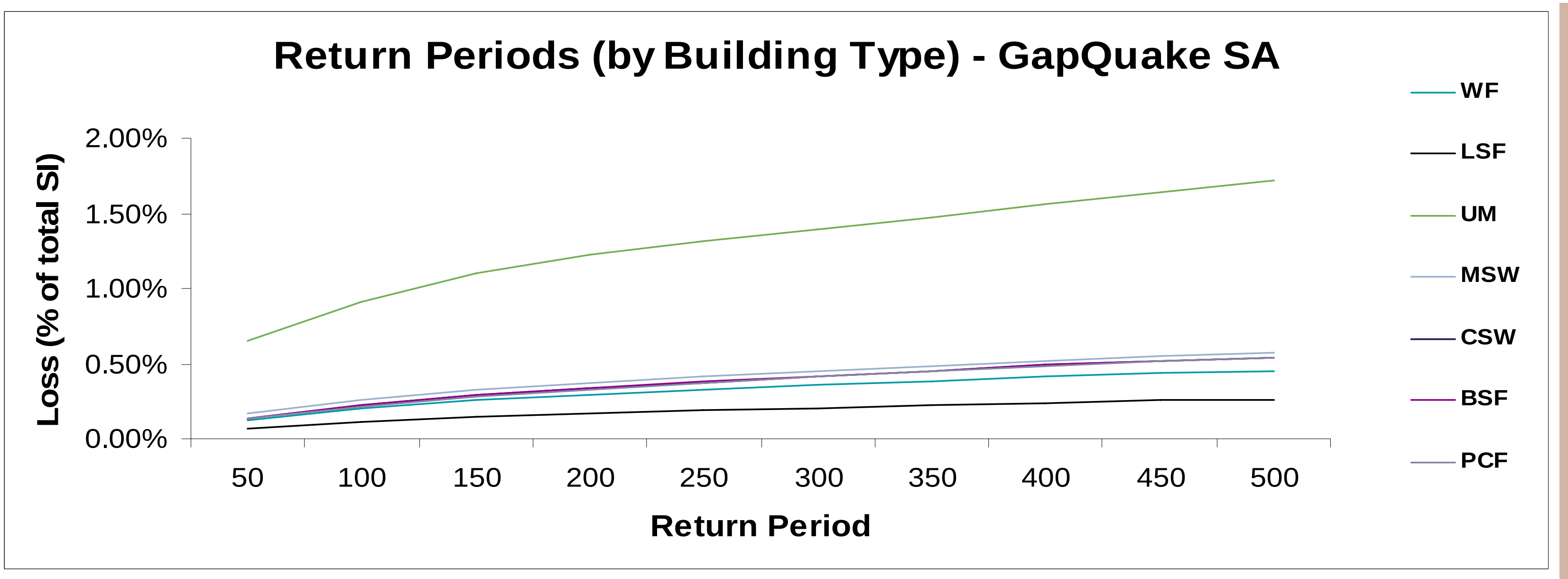
Results – Building types

- Approximate match for building types used in the two models based on results and names

Tag Name	GQ	EQE
Masonary	MSW (Masonary Sheer Wall)	Masonary
Concrete	CSW (Concrete Sheer Wall) PCF (Precast Formed)	Concrete Reinforced Concrete
Steel	BSF (Braced Steel Frame) LSF (Light Steel Frame)	Steel
Unreinforced	UM (Unreinforced Maisonary)	Timber
Unmatched	WF (Woof Frame)	X (Unknown)

The Business of Change: 2010 and Beyond

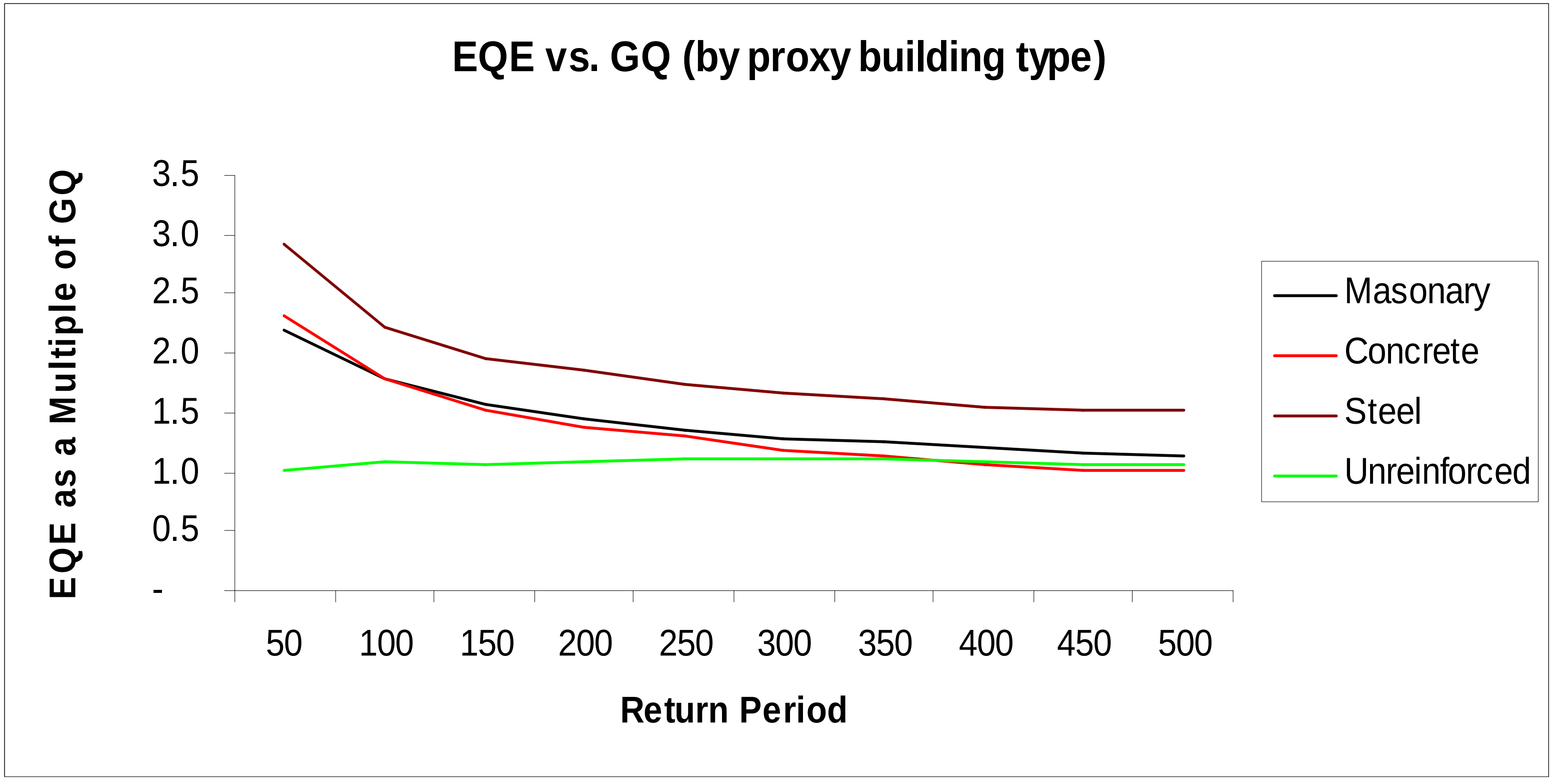
Results – Building types



- Most residential houses in SA are MSW and older buildings are UM
- Commercial buildings/apartments (MSW, CSW and PCF)
- WF are not common in SA
- LSF, BSF mainly used in industrial sites

Results – Building Types (GQ vs. EQE)

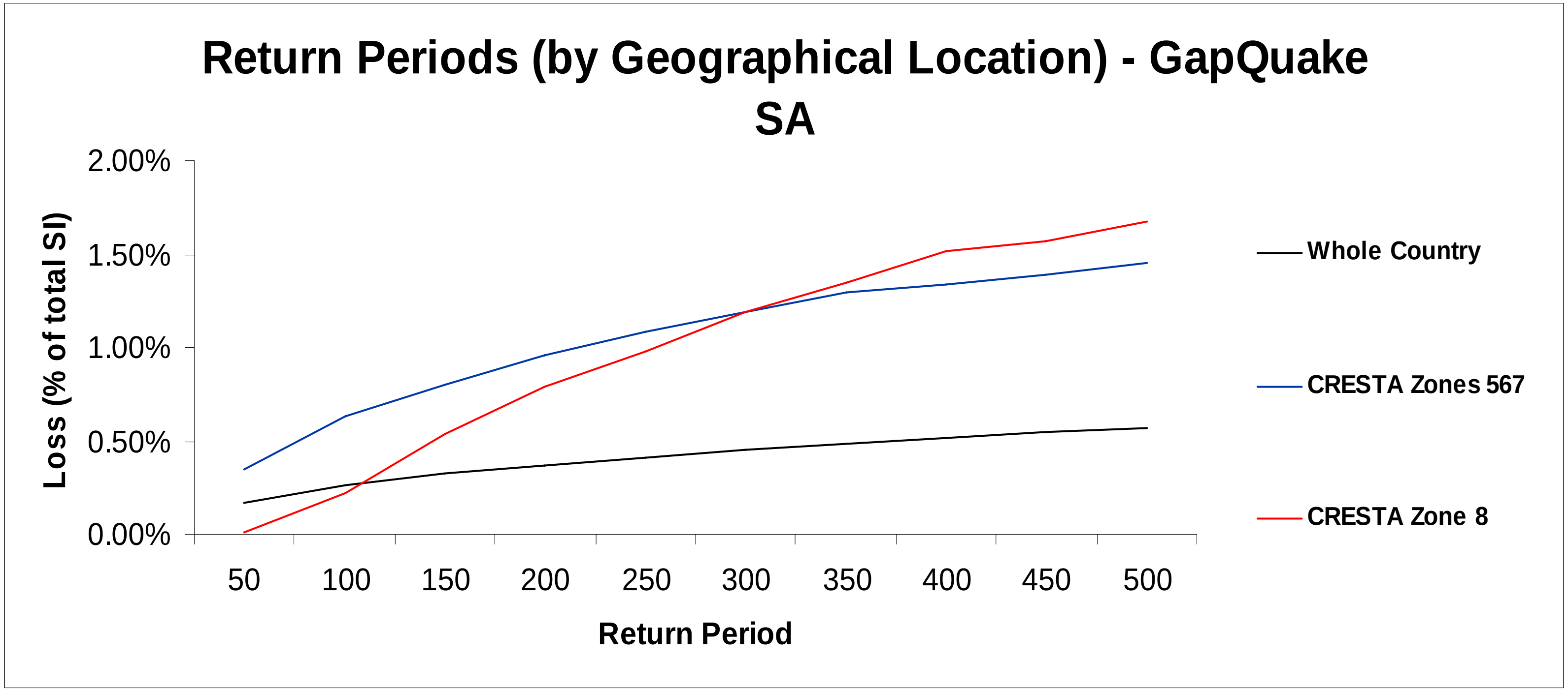
ACTUARIAL SOCIETY OF SOUTH AFRICA



- EQE estimated more seismic activity for near term return periods than GQ
- Steel results heavily impacted by the inclusion of LSF in GQ average

The Business of Change: 2010 and Beyond

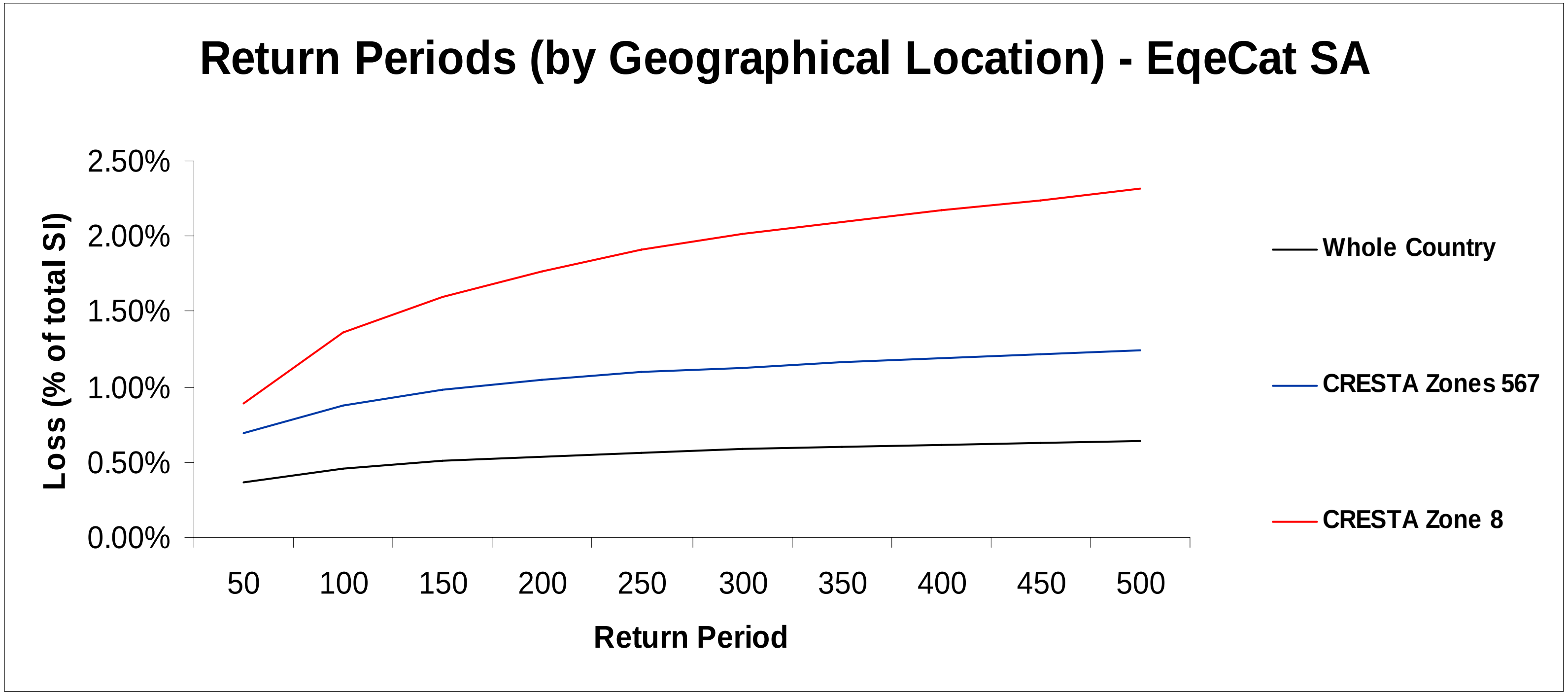
Results – Hazard



- Not much near term seismic activity in CPT
- Mining-induced events dominate in the near term
- Diversified portfolio helps to dampen the impact of the two extremes

Results – Hazard

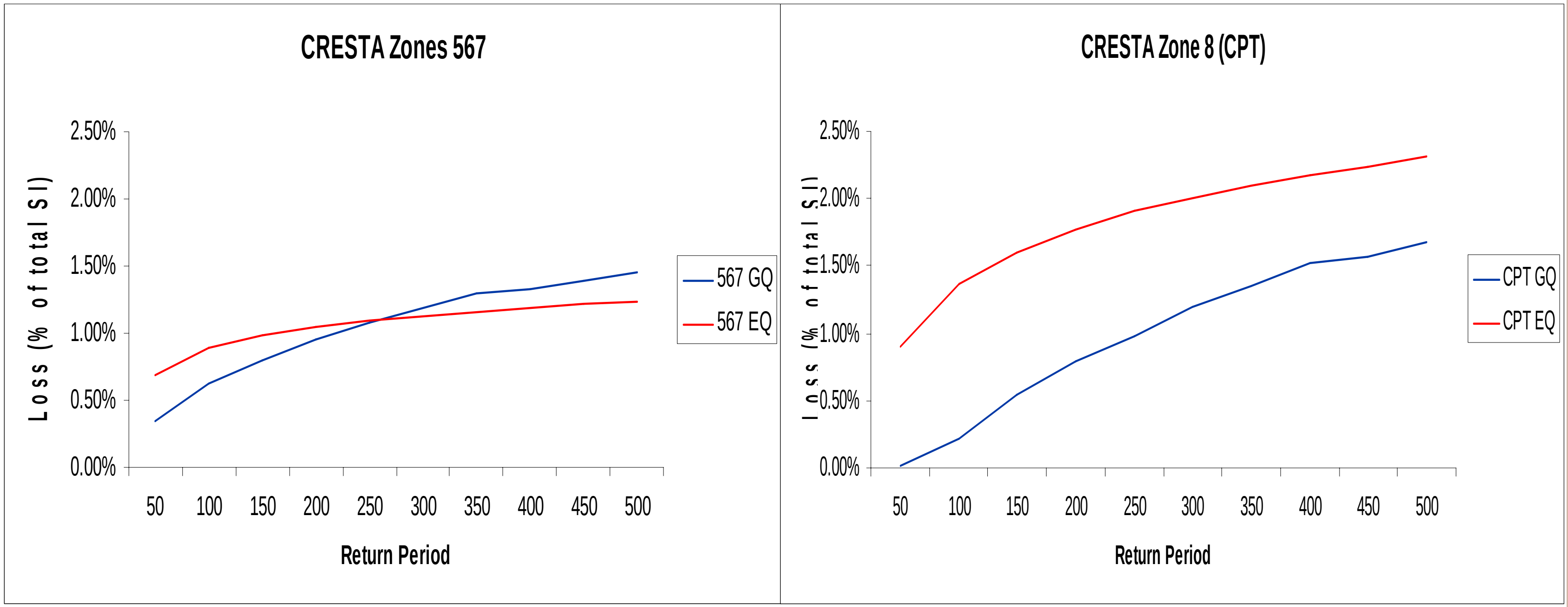
ACTUARIAL SOCIETY OF SOUTH AFRICA



- More near term seismic activity from EQE compared against GQ
- Greater loss potential in CPT than Gauteng because mining-induced events are excluded
- Flattish tail – results from CRESTA aggregation of exposures

The Business of Change: 2010 and Beyond

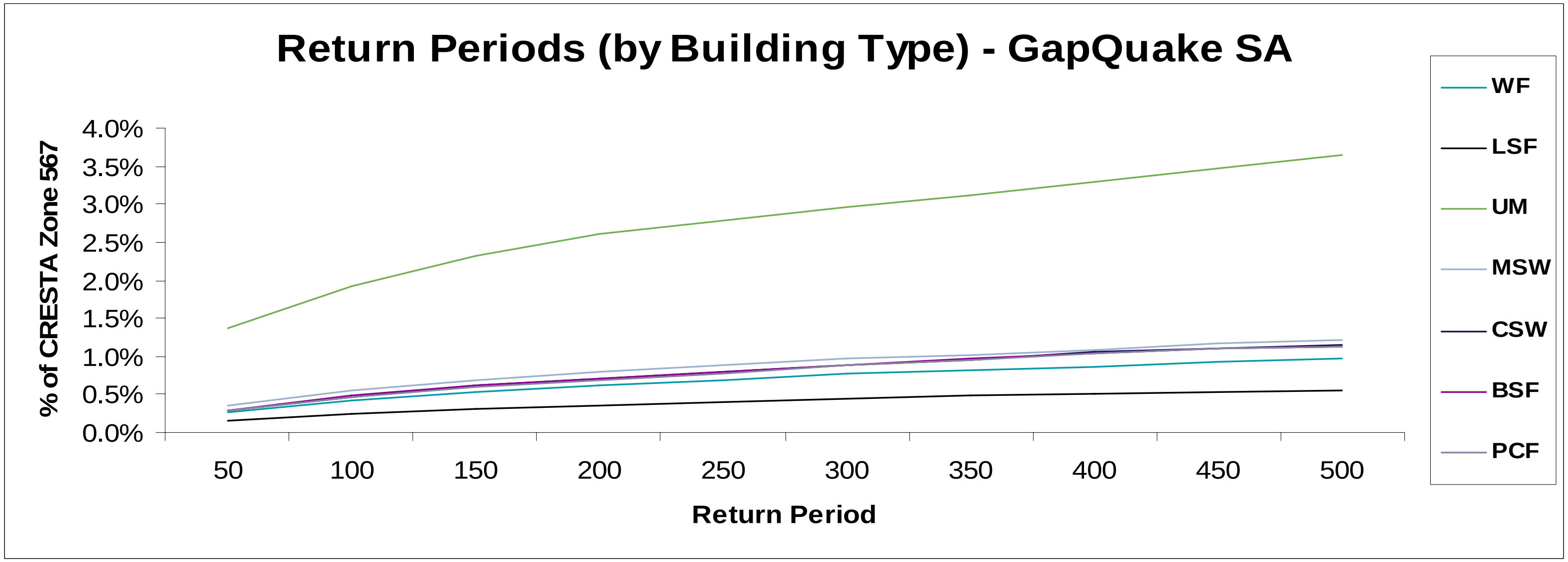
Results – Hazard



- EQE clearly dominates in CPT
- Trend in GQ points to mining induced events
- But…remember we have assumed building types are close enough to compare

The Business of Change: 2010 and Beyond

Results – Commonly used SA benchmark



- MPL benchmarks between 1.5% and 3% of exposures in CRESA zones 5,6,7 (incl. BI and all static risks)
- Lower end reflects location of risks for multiple location single policies
- Model results exclude BI (impacted by the amount of Commercial risks underwritten)
- EQE = 1.2% of 5,6,7 (36% higher than GQ at the 1-in-250 return period, for Masonary buildings)
- Comparison against benchmarks is dependant on specific exposures (no one size for all)

The Business of Change: 2010 and Beyond

Conclusions

- Do not interpret results dogmatically
- Understanding and collecting the right data will help
- Stochastic models not always available so deterministic approaches may help, for example,
  - Lloyd's Realistic Disaster Scenario framework
  - Extrapolating losses using Pareto model (Swiss Re)
- Further research being done, for example,
  - Benfield Natural Hazards Centre at the University of Pretoria

Questions

Oscar.Kitasoboka@benfieldgroup.com

Pieter.Visser@benfieldgroup.com

Tel - 011 726 5755