Natural Catastrophe Risk Assessment &Management

Vineet Kumar, Swiss Re| ERM Webinar | 11 December 2013

Swiss Re

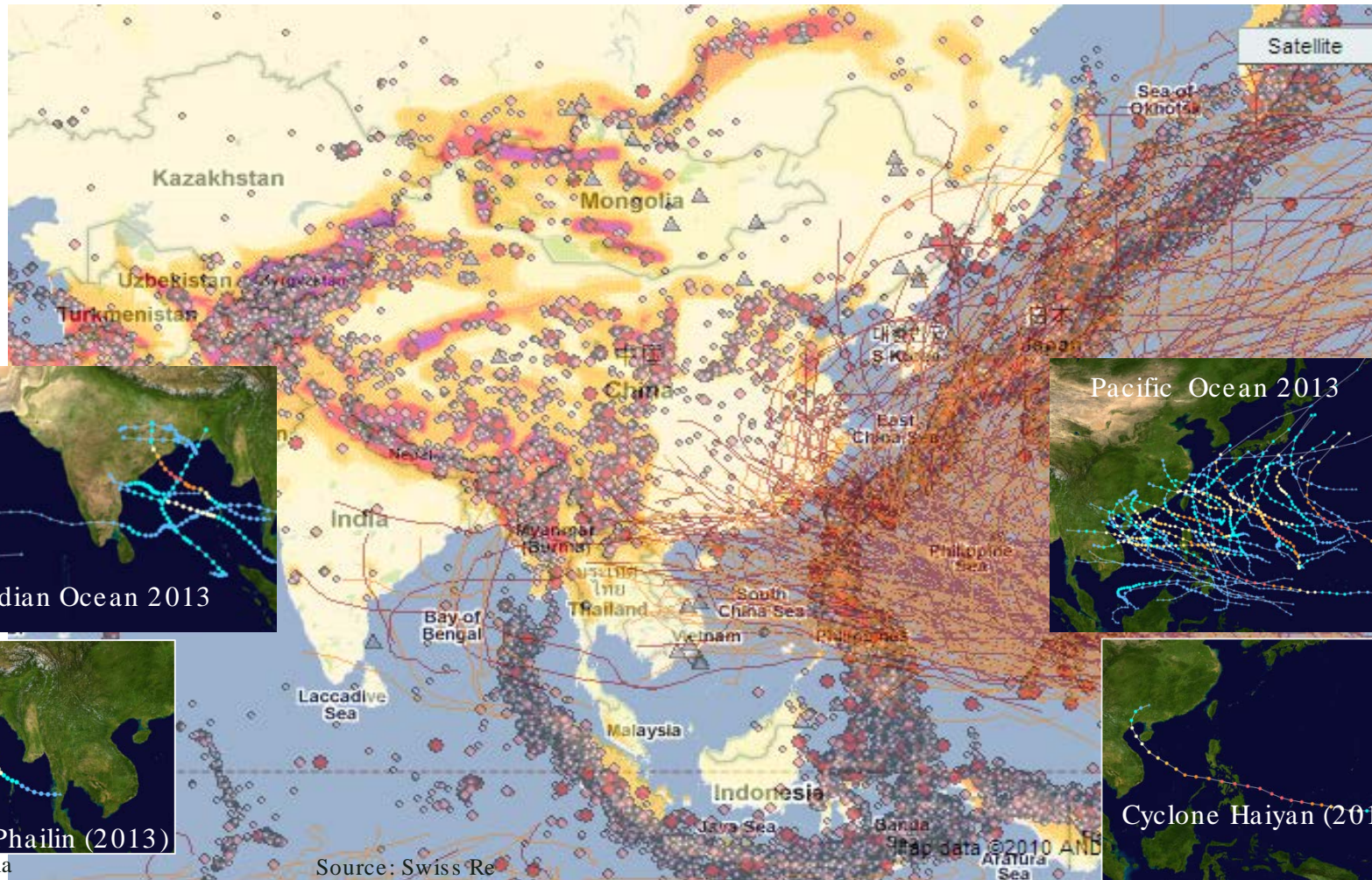SWISS RE
150
YEARS

Agenda

- Nat Cat Risk in Asia & India

- Overview of Nat Cat Modeling

- Lessons Learnt from Recent Events in Asia

- Nat Cat Capacity Management

Nat Cat Risk in Asia

Natural Perils across Asia

North Indian Ocean 2013
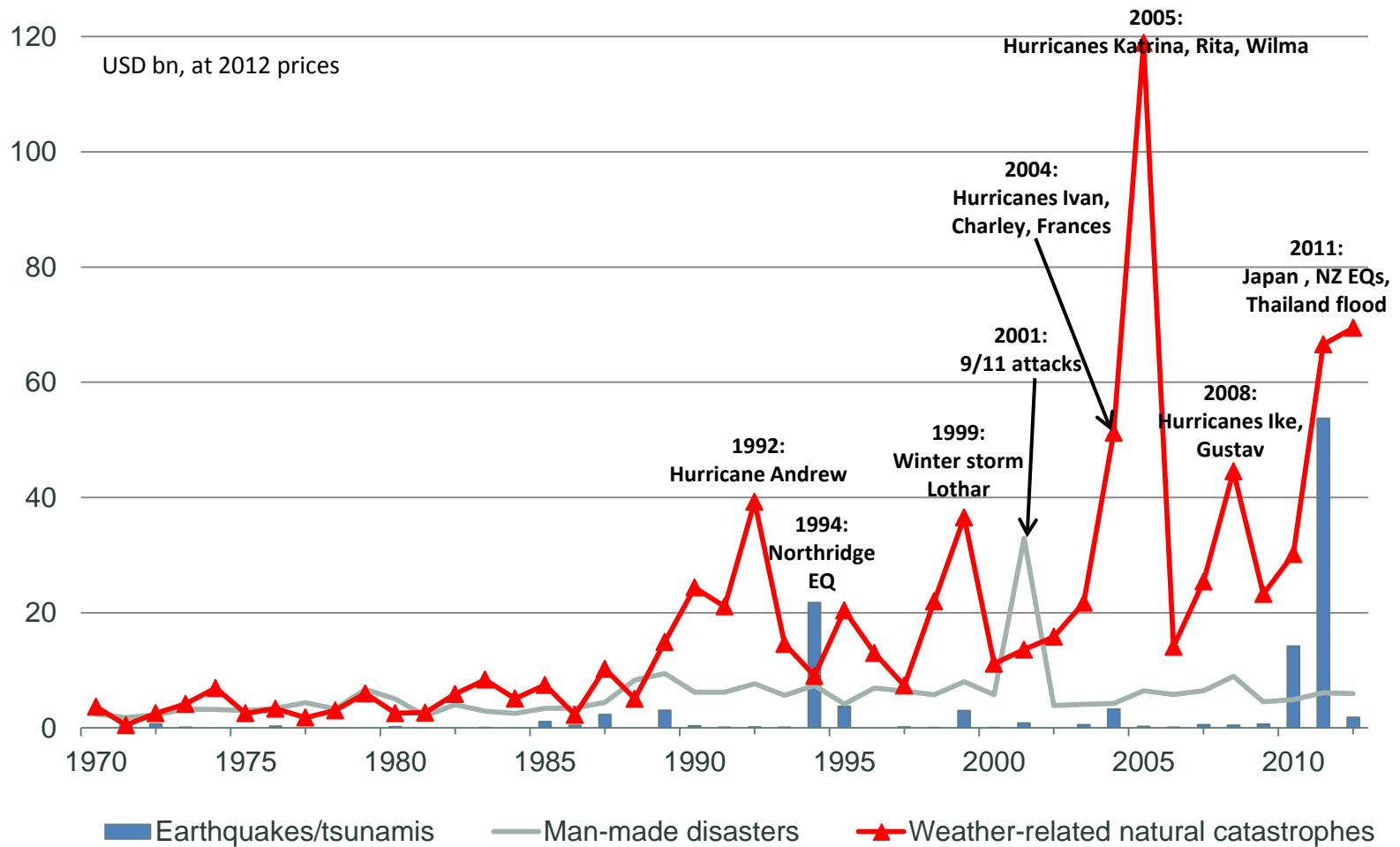
Pacific Ocean 2013

Cyclone Phailin (2013)

Cyclone Haiyan (2013)

Source: Wikipedia

Source: Swiss Re

Insured catastrophe losses 1970–2012

USD bn, at 2012 prices

2005:
Hurricanes Katrina, Rita, Wilma

2004:
Hurricanes Ivan,
Charley, Frances

2011:
Japan , NZ EQs,
Thailand flood

2001:
9/11 attacks

1999
Winter storm
Lothar

2008:
Hurricanes Ike,
Gustav

1992:
Hurricane Andrew

1994:
Northridge
EQ

■ Earthquakes/tsunamis   Man-made disasters   ▲ Weather-related natural catastrophes

Source: Swiss Re, *Sigma*

Catastrophes and losses in 2012 by region

Region	Number	Victims	in %	Insured loss in USD bn	in %	Total loss in USD bn
North America	43	560	4.0%	64.6	83.6%	118.5
Latin America & Caribbean	30	1167	8.4%	0.9	1.2%	4.2
Europe	33	1480	10.7%	5.5	7.1%	26.8
Africa	53	2300	16.5%	0.2	0.3%	1.5
Asia	115	7177	51.5%	3.4	4.4%	30.5
Oceania/Australia	7	97	0.7%	0.3	0.4%	1.1
Seas/Space	37	1148	8.2%	2.4	3.1%	3.1
Total	318	13929	100.0%	77.2	100.0%	185.7

Source: Swiss Re, *Sigma*

Metropolitan Areas at Risk from Nat Cats

- 616 metropolitan areas are globally analyzed with Swiss Re CatNet® tool
  - in terms of people potentially affected
  - value of working days lost (proxy for GDP lost) absolutely and relative to country

Value of working days lost (global index, relative to national economy of home country)

Legend:
- Earthquake (red)
- Wind speed (green)
- River flood (blue)
- Storm surge (light blue)
- Tsunami (orange)

People potentially affected (cumulative number in mn)
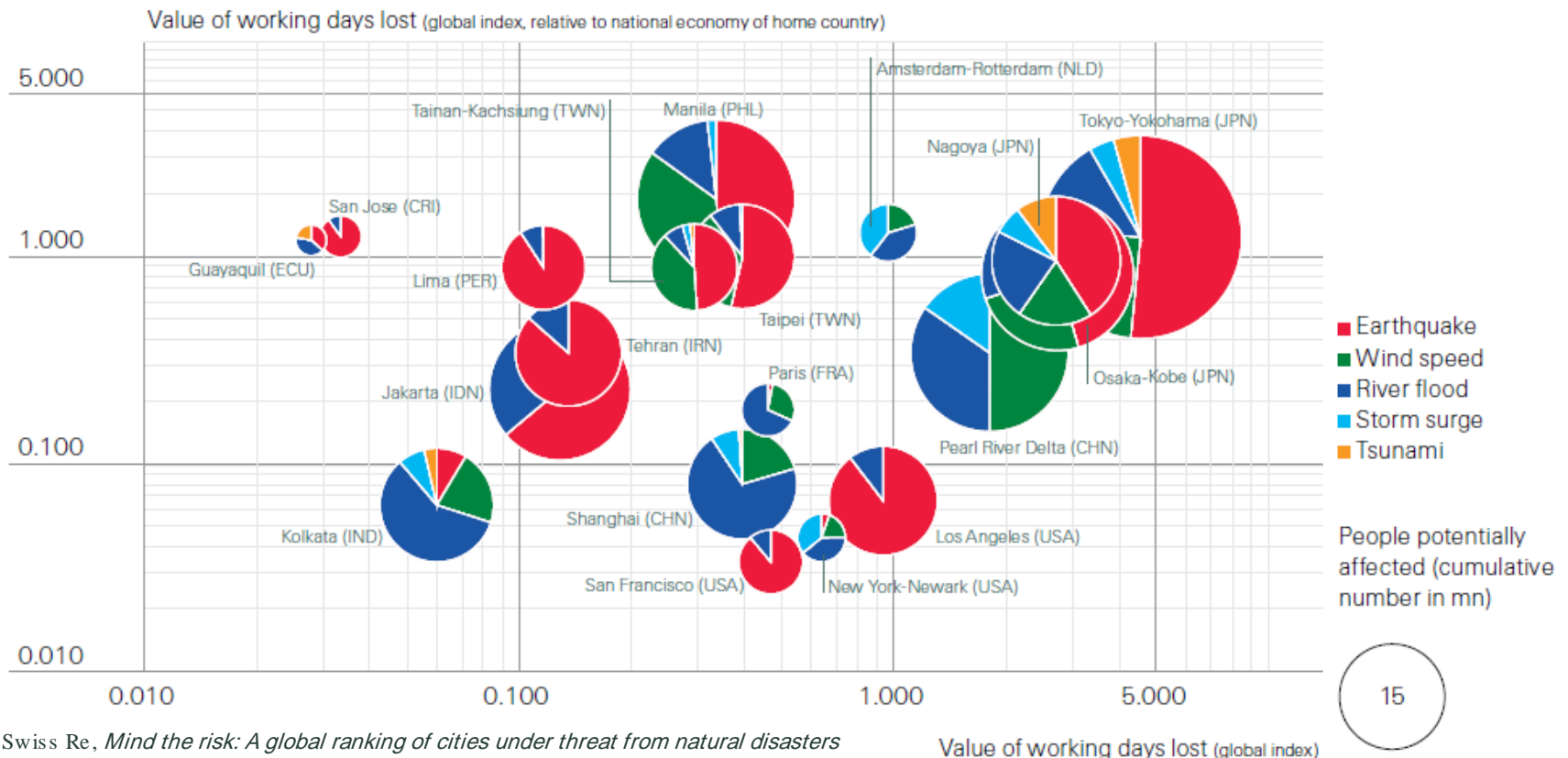
Source: Swiss Re, *Mind the risk: A global ranking of cities under threat from natural disasters*

Value of working days lost (global index)

Indian cities at risk from Nat Cats (Earthquake, River Flood, Storm, Storm Surge, and Tsunami)

- Kolkata (Population:19.1m)
  - Rank 7th for the people potentially affected (PPA) aggregated for all perils (17.9m)
  - Rank 3rd for the PPA by river flood (10.5m)
  - Rank 8th for the PPA by storm surge (1.4m)
  - Rank 5th for the PPA by tsunami (0.6m)

- Mumbai (Population: 20.6m)
  - Rank 8th for the PPA by storm (4.3m)
  - Rank 3rd for the PPA by storm surge (2.6m)

- Chennai (Population: 8.5m)
  - Rank 9th for the PPA by storm (4.0m)
  - Rank 10th for the PPA by Tsunami (0.2m)

- Delhi (Population: 21.9m)
  - Rank 5th for the PPA by river flood (8.9m)

People at Risk - All Scenarios
People at Risk
Sum of fields
280'000
- Earthquakes
- Storm
- River Flood
- Storm Surge
- Tsunami

Source: Swiss Re, *Cat Net®*
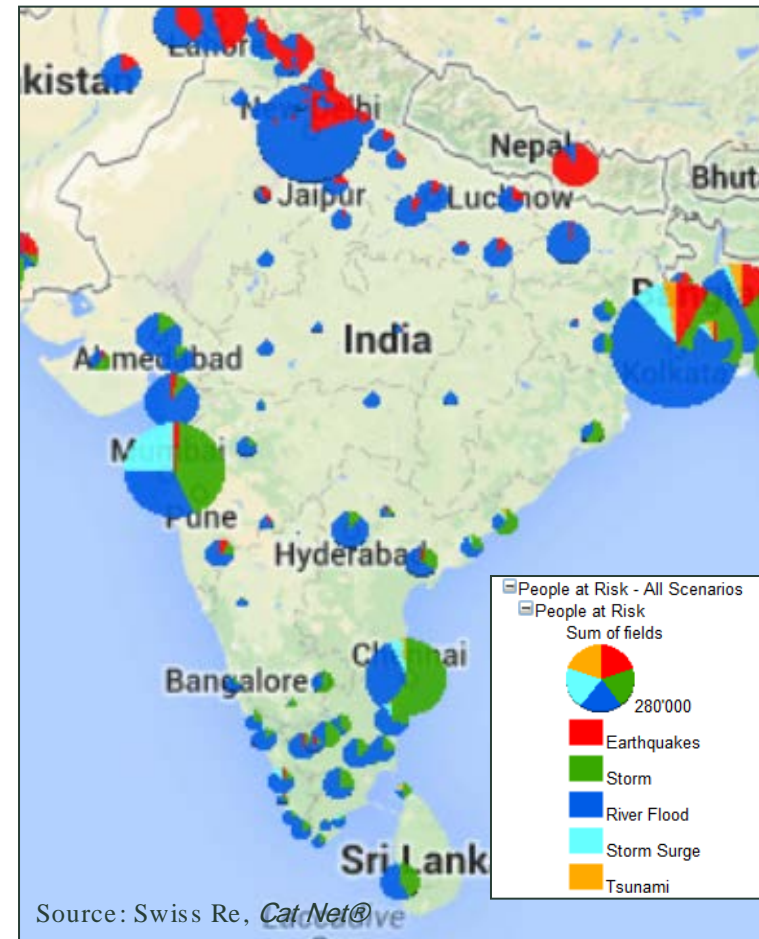
Why we need Nat Cat models

Massive gap between economic and insured losses

Natural catastrophe losses 1982-2012, in USD billion (2012 prices)

*2012 Loss numbers are a preliminary estimate
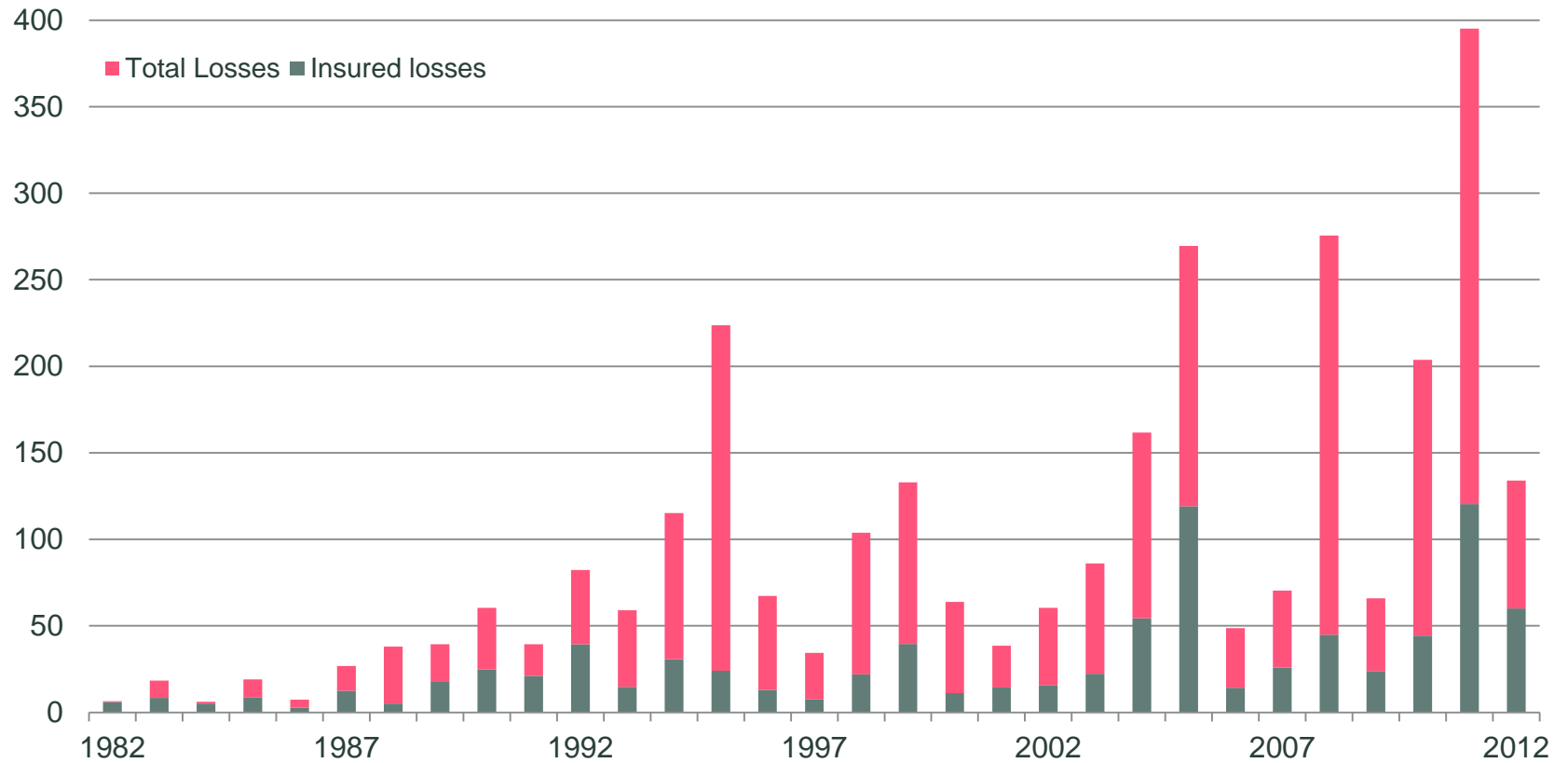
Note: Insured losses: property and business interruption, excluding liability and life insurance losses   Source: Swiss Re sigma

Growth of values is the main driver of increasing natural catastrophe losses

Mumbai, 1900s*	Mumbai, 2000s*	Reasons
Flora Fountain, Mumbai (1900s)*	Flora Fountain, Mumbai (2000s)*	Increasing values Concentration of values in exposed areas Increasing vulnerability Growing insurance penetration Changing hazard (climate variability, climate change)

*Source/Photo Credit: Himansu Kamdar and Discover India Team<http://discoverindiabyroad.blogspot.ch/p/lost-mumbai.html>

Loss history is not a good guide for risk, models are an indispensable tool.

Nat Cat risk assessment: Premium income vs. losses

Fire:

■ Fire Premium   ■ Fire Loss
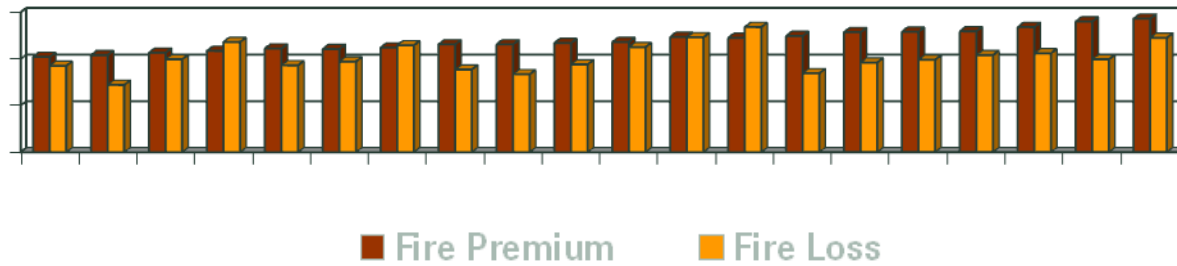
Natural catastrophes:

■ NatCat Premium   ■ NatCat Loss
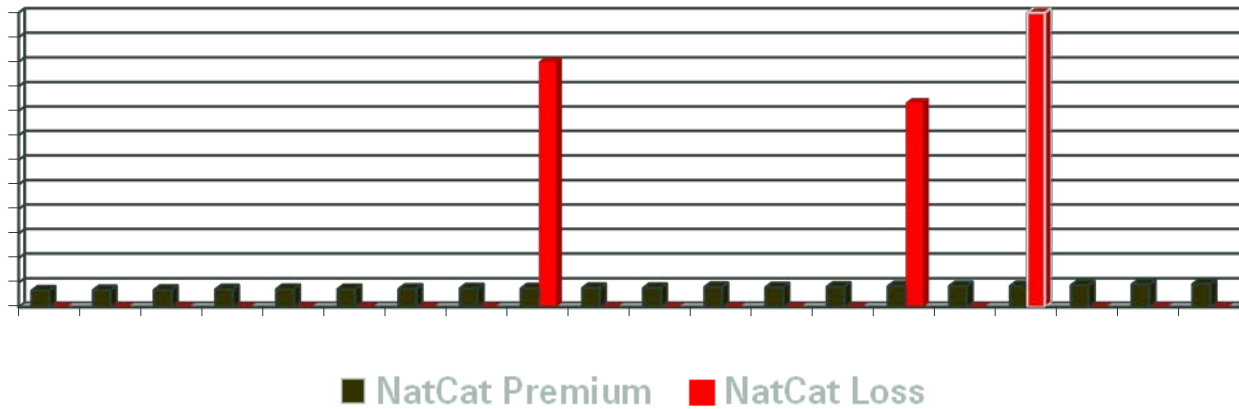
Nat Cat modeling landscape

- Vendor models

- Broker models

- Company proprietary models

Research driven NatCat underwriting
Think tank "Cat Perils"

In-house models as key source for accurate Underwriting at reasonable cost
- Taylor-made, state-of-the-art models to allow efficient Underwriting process, incl. hot line
- No black box approach
- Option to react swiftly on new findings e.g. EQ Chile & BI, Japan EQ aftershocks

Engineers   Physicists
  Meteorologists
          Geologists
Hydrologists

Team of experts to develop custom made solutions and train Underwriters
- Value proposition and client centric approach as key drivers
- Structure and rate complex cases due to available R&D data set e.g. ILS
- Educated Underwriters to go beyond simple tool usage, strong link to Universities

Valuable client services, value proposition and branding
- Own R&D and natcat risk awareness brings added value to clients and builds SR reputation
- Client tools e.g. CatNet
- Support communication activities of Swiss Re with sound expertise

Integrated & transparent risk management
- All relevant lines of business included, automatic process
- Successful portfolio steering thanks to transparent figures and sound hazard assessment
- No big surprises as long as "mother nature behaves"

Natural catastrophe models

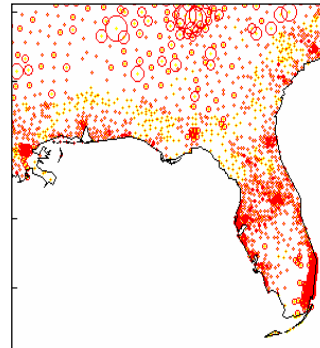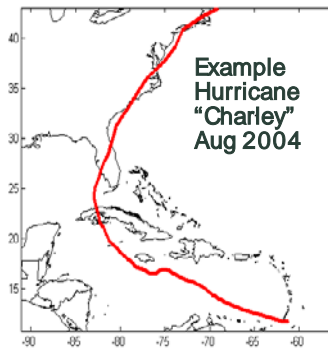# Four elements to model losses

Risk	Loss resistance	Value distribution	Coverage conditions

How often? How strong?	How well built and protected?	What is covered? Where? How?

Example Hurricane "Charley" Aug 2004

- Insurance sums
- Limits
- Excess
- Exclusions
- etc.

Simplest catastrophe model
Calculating a loss scenario
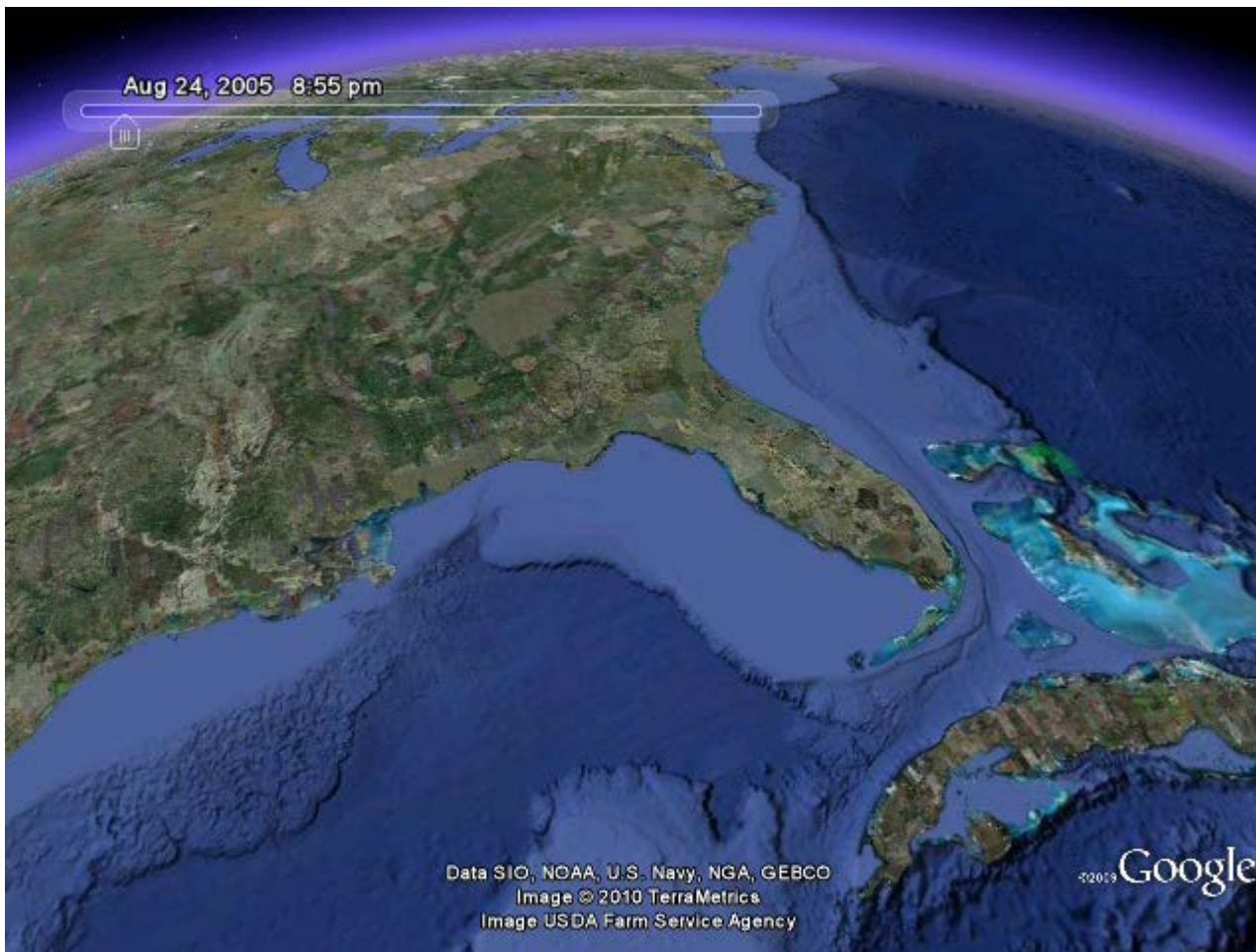
Hurricane
Katrina 2005

Tropical cyclones in the north Atlantic historical tracks

historical tracks SS3
historical tracks SS4
historical tracks SS5

Historical

~100 years
~1'000 events
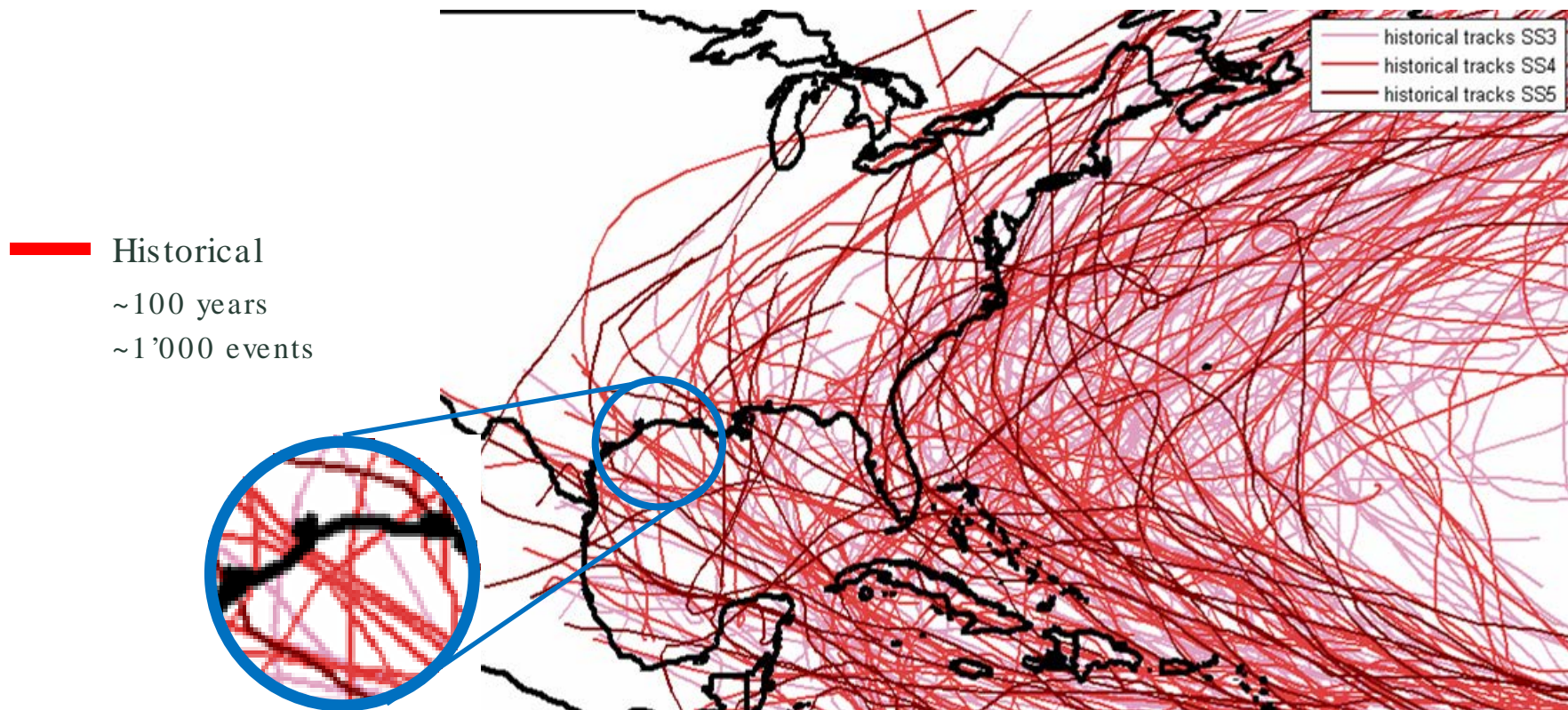
Even 100 years worth of historical events are not enough to fully reflect risk.

Creating additional events based on physical correlation
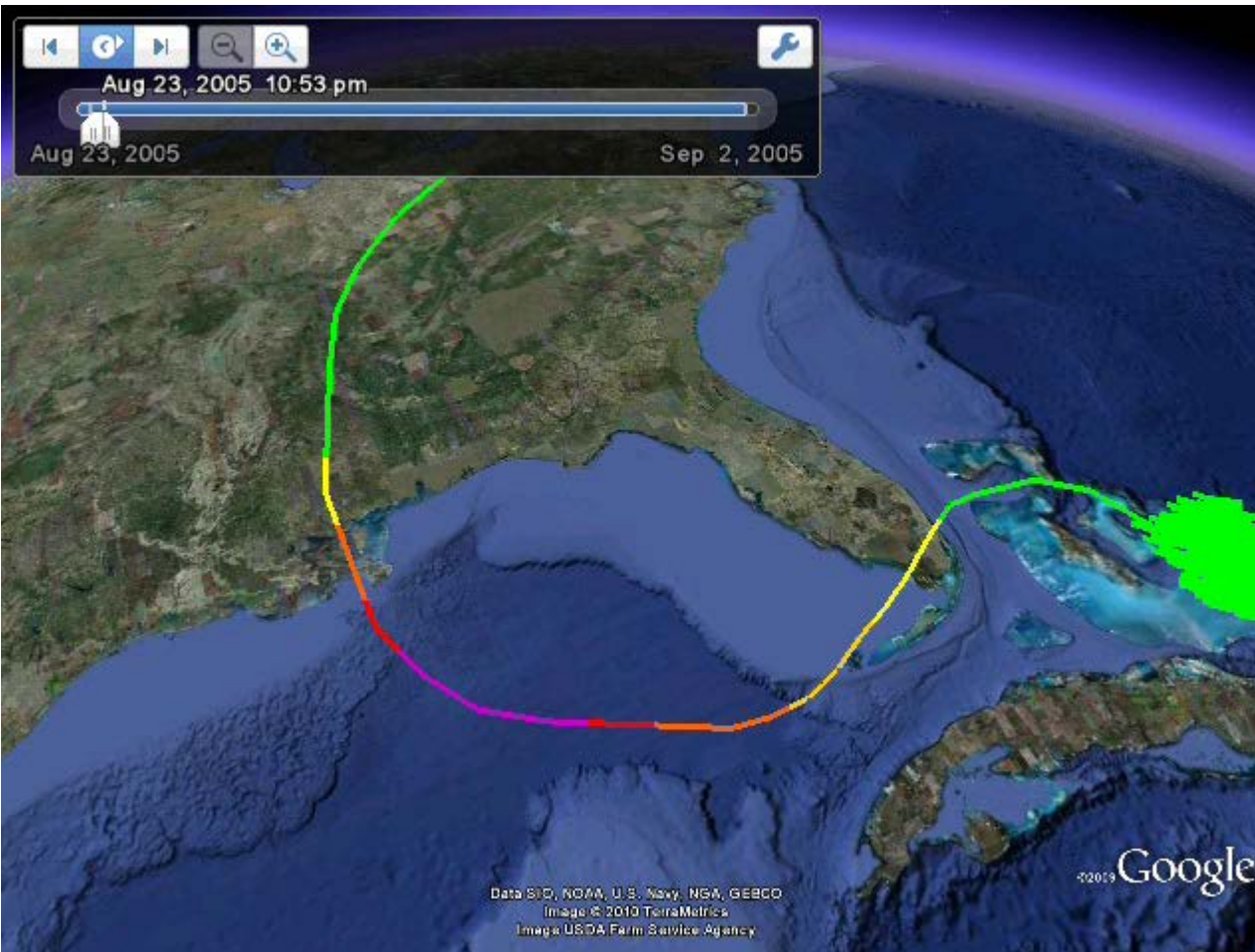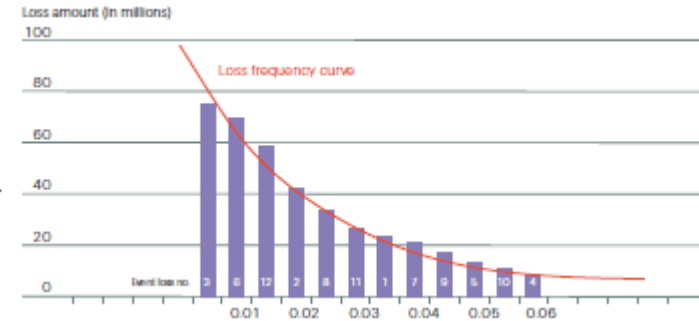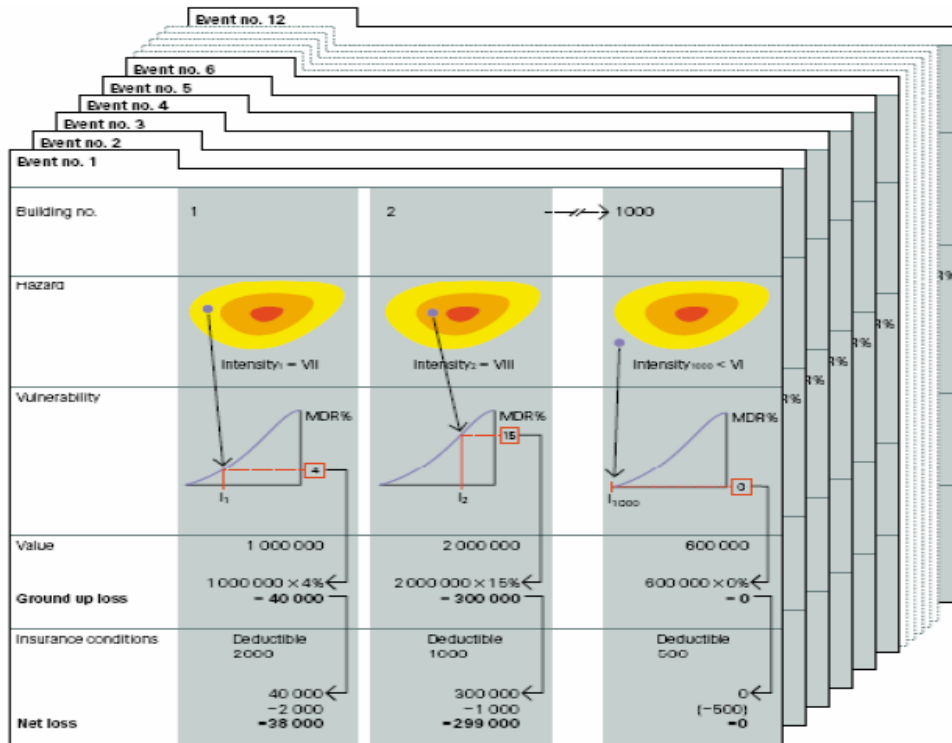

Hurricane Katrina with daughter events

Tropical cyclones in the north Atlantic - historical and probabilistic tracks

historical tracks SS3
historical tracks SS4
historical tracks SS5
probabilistic tracks SS3
probabilistic tracks SS4
probabilistic tracks SS5

historical
~100 years
~1'000 events

probabilistic
~20 '000 years
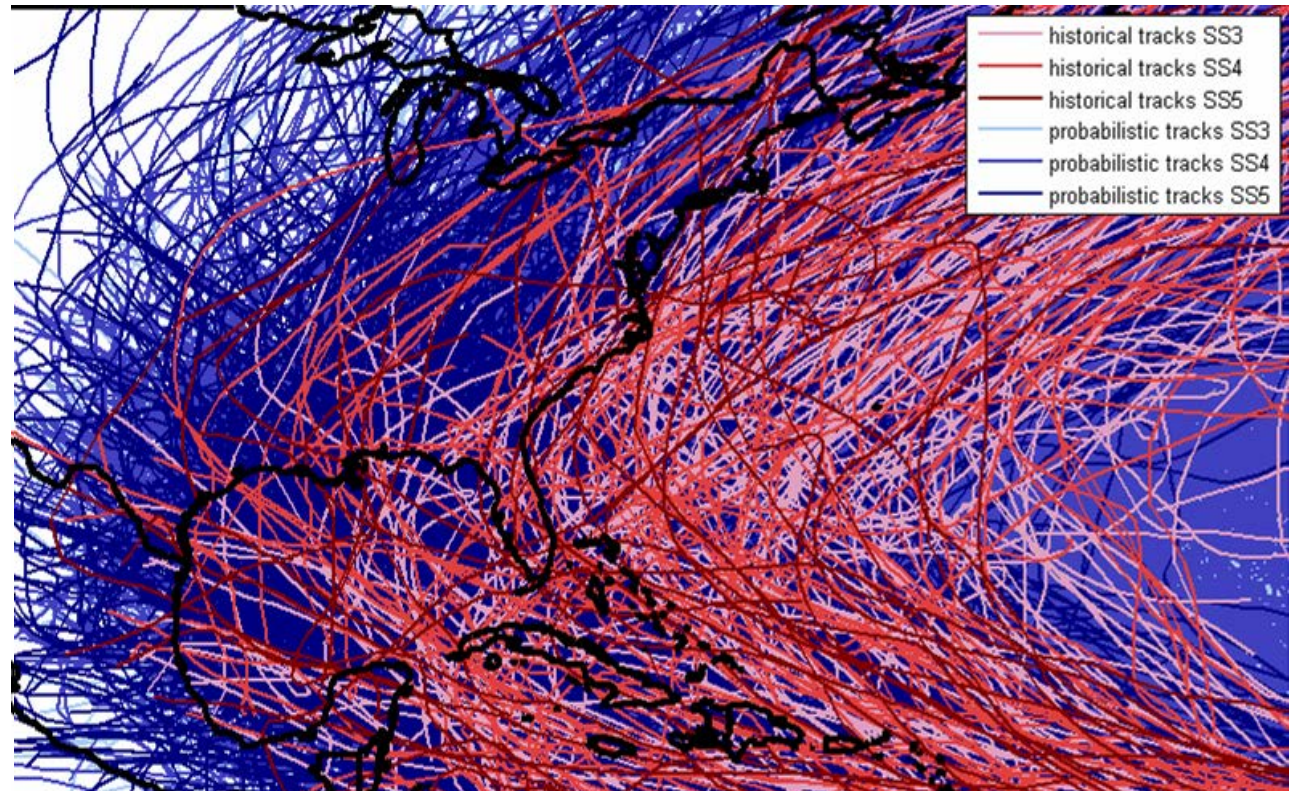
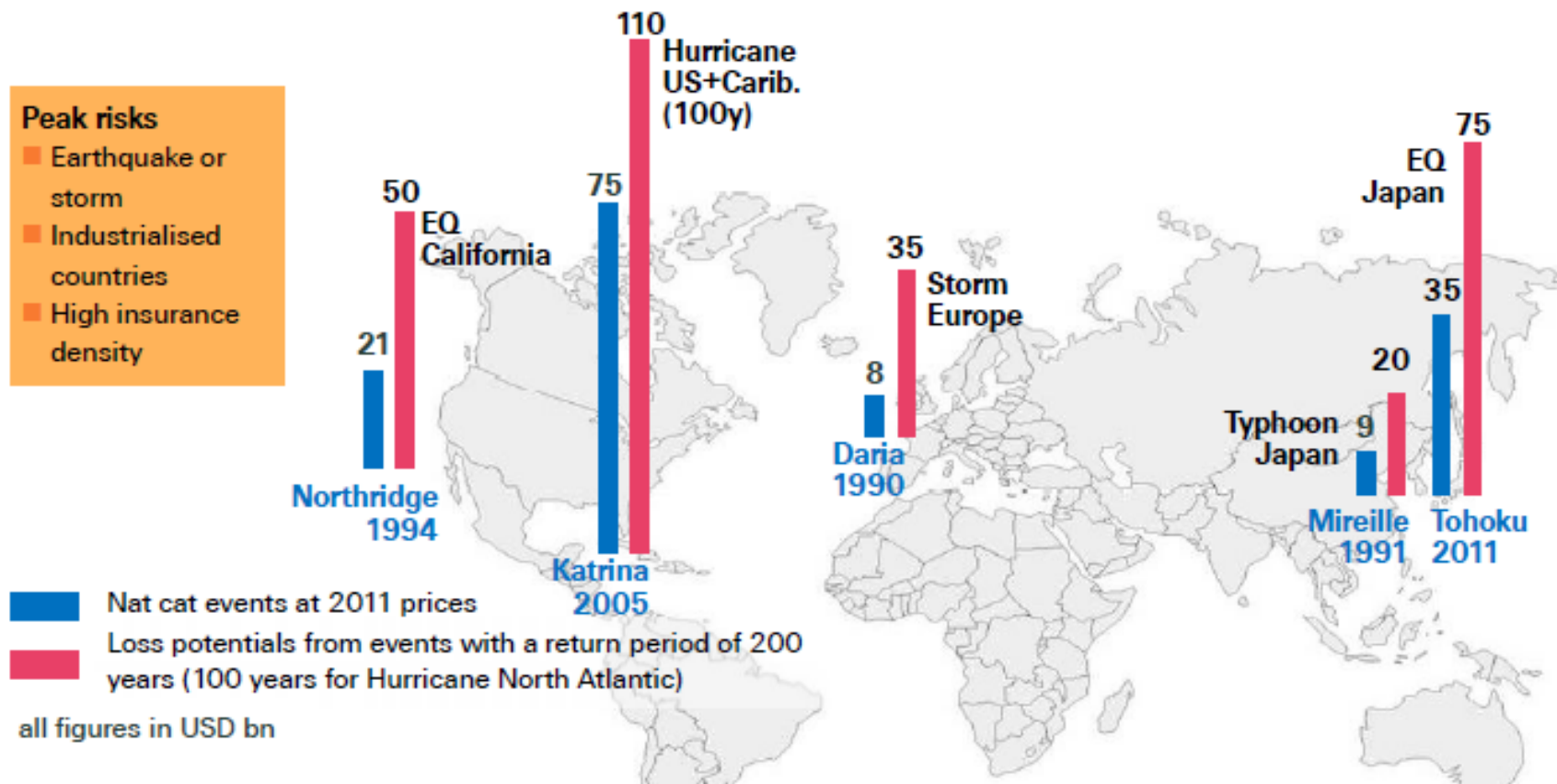Probabilistic event set aims at reflecting full range of possible storms.

Example: Loss modeling process

Loss Frequency Curve

Nat Cat potential losses

Growth in emerging markets with high insurance penetration over time will significantly increase the Nat Cat potential losses

Learning from events

Recent earthquakes in Chile, New Zealand and Japan

	Chile 27 February 2010	New Zealand 22 February 2011	Japan 11 March 2011
Magnitude	8.8	6.3	9.0
Energy released (compared to NZ)	5 600	1	>11 000
Fatalities/missing	562	>160	>20 000
Economic loss, USD bn	30	25	210
Insurance loss, USD bn	8	9-12	30

- **Chile:** Significant losses from industrial facilities, mainly due to business interruption
- **New Zealand:** Back to back, relatively small events on a relatively low hazard zone, generating significant insurance losses, mainly due to liquefaction-related damage
- **Japan:** Major damage and losses from tsunami; complications due to failure of nuclear power plants

Each of the earthquakes surprised us with a larger than anticipated loss.

Model blind spots revealed by recent earthquakes Model vendors

Loss Driver	Modelled?	Pass?
Tsunami	Not as such. A few models/markets have a slight loading on the shock rates for coastal locations.	✗
Increased seismicity after large event	Not modelled.	✗
Liquefaction	Some models/markets consider liquefaction. However, all models by far underestimated impact in Christchurch.	✗
Business interruption	Included in most models. However, impact for BI-sensitive industries generally underestimated.	✗
Contingent business interruption	Not modelled. Exposure not fully understood.	✗
Next surprise?	?	

Many vendor models have not yet taken into account experience from recent events.

# Model blind spots revealed by recent earthquakes
Swiss Re model

Loss Driver	Modelled?	Pass?
Tsunami	Tsunami model for Japan in operation. Global model under development.	✓
Increased seismicity after large event	Models are updated within weeks.	✓
Liquefaction	Soil quality is part of all new earthquake models.	✓
Business interruption	Vulnerabilities in earthquake adjusted globally.	✓
Contingent business interruption	Not modelled. Addressed with underwriting measures.	✗
Next surprise?	?	

Swiss Re is able to quickly learn from events and update models.

Nat Cat Capacity Management

Use of event loss sets from Nat Cat models

Expected Loss

Loading

Pricing

Risk Management

Event Loss Set

Pre/Post Event Loss Estimate
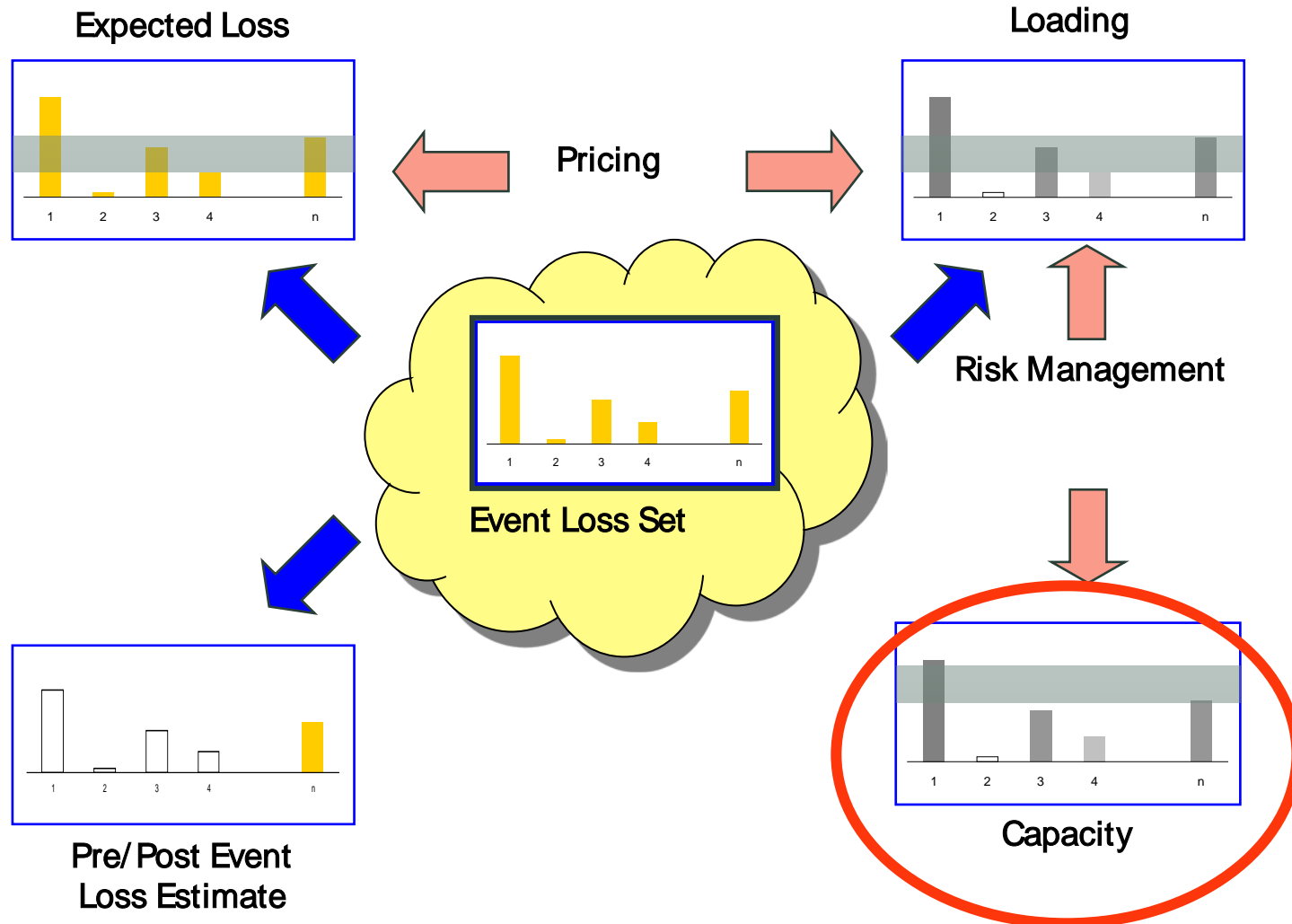
Capacity

What is Capacity?
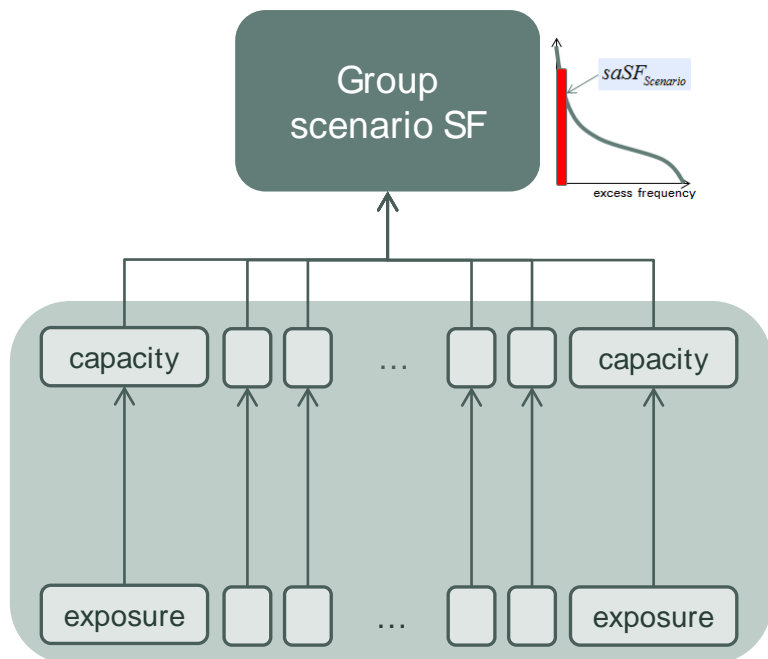
The Group scenario Short Fall (SF) can only be calculated with the entire portfolio at hand.

Capacity is an approximation of each deal's contribution to the Group scenario SF. The capacity can be calculated on a deal-by-deal basis.

Group Capacity is the sum of the capacities of the individual deals.

Capacity is used to make sure we are not overstepping the solvency limit, as well as to control growth and market share.

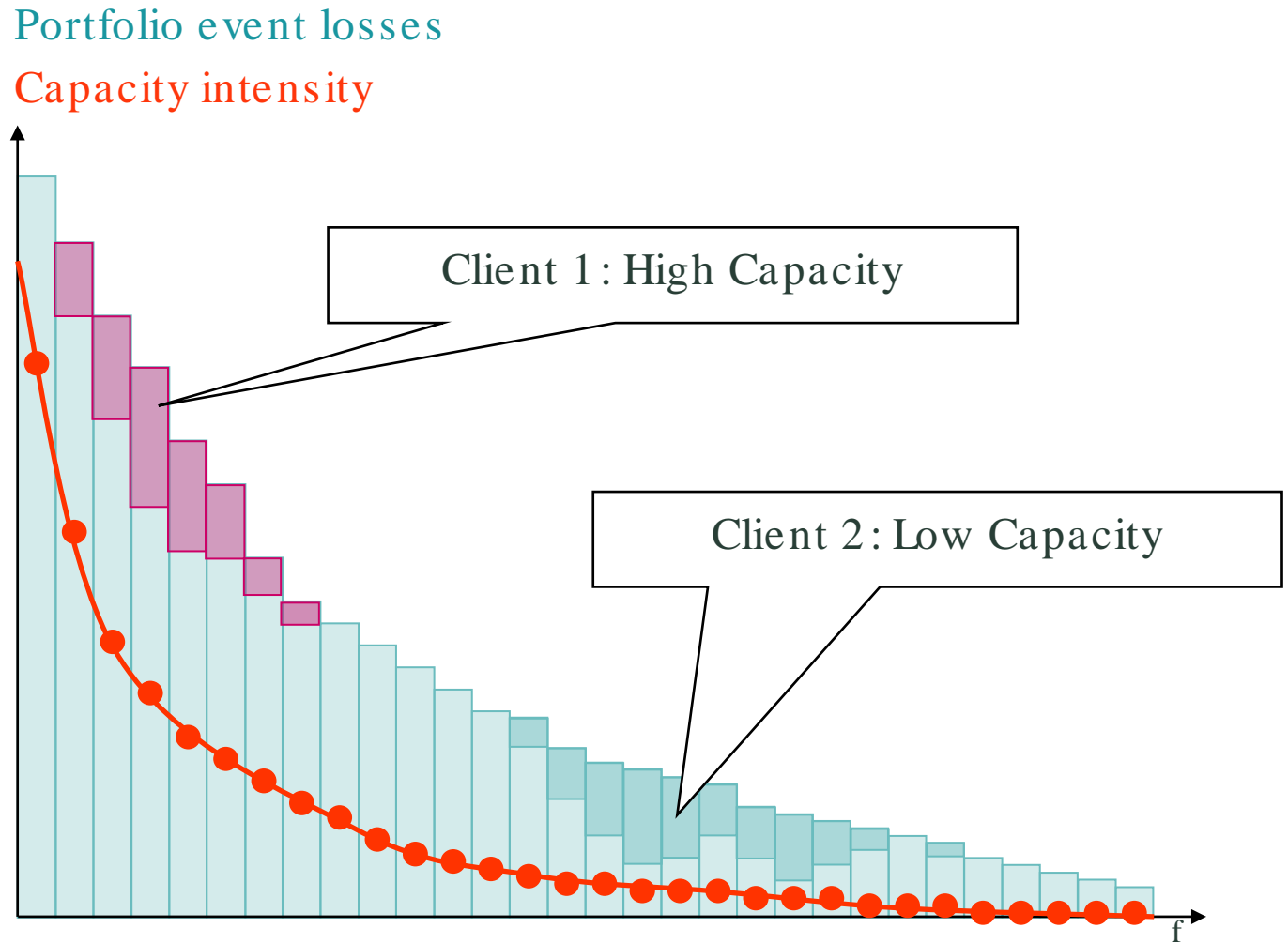# Event set based group portfolio aggregation

... event based
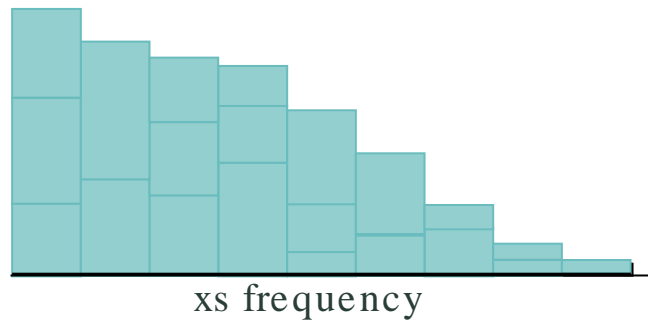
Capacity Calculation
Comparing Client Exposure to Swiss Re's

- Expected loss of both client portfolios identical

- Client 1 strongly correlates with Swiss Re portfolio

Portfolio event losses

Capacity intensity

Client 1 : High Capacity

Client 2 : Low Capacity

f

How much Tropical Cyclone North Atlantic Capacity is Consumed with the Same Expected Losses?

Capacity oL

High

Low

Exposures in Chilhowie, VA diversify well
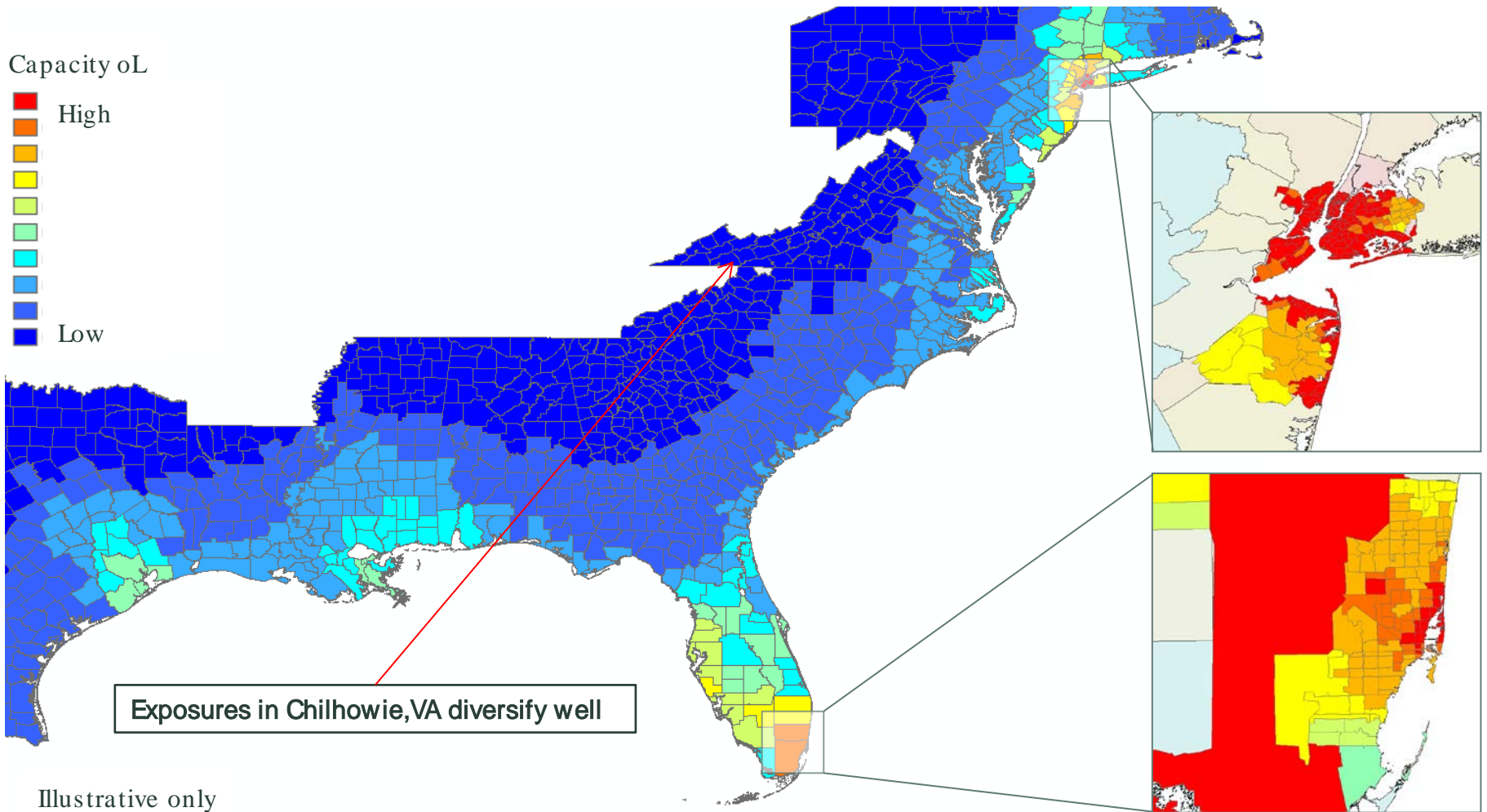
Illustrative only

Conclusion

Summary

- ❑ Massive gap between economic and insured losses in Asia

- ❑ Growth of values is the main driver of increase in losses over time

- ❑ Natural catastrophe model framework (four elements) is essential for the robust estimation of Nat Cat potential losses

- ❑ Recent events have indicated that vendor models had missed some key loss drivers (secondary perils) in the loss estimation

- ❑ Nat cat modelling can be integrated in the risk management framework for capacity and capital management

Thank you

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