International Insurance Conference
Catastrophe Events A Challenge
Karachi – 10-12 April, 2012

Pakistan Insurance Institute

Catastrophe Risk: Assessment and Management

George Attard

11th April 2012

Empower Results

AON BENFIELD

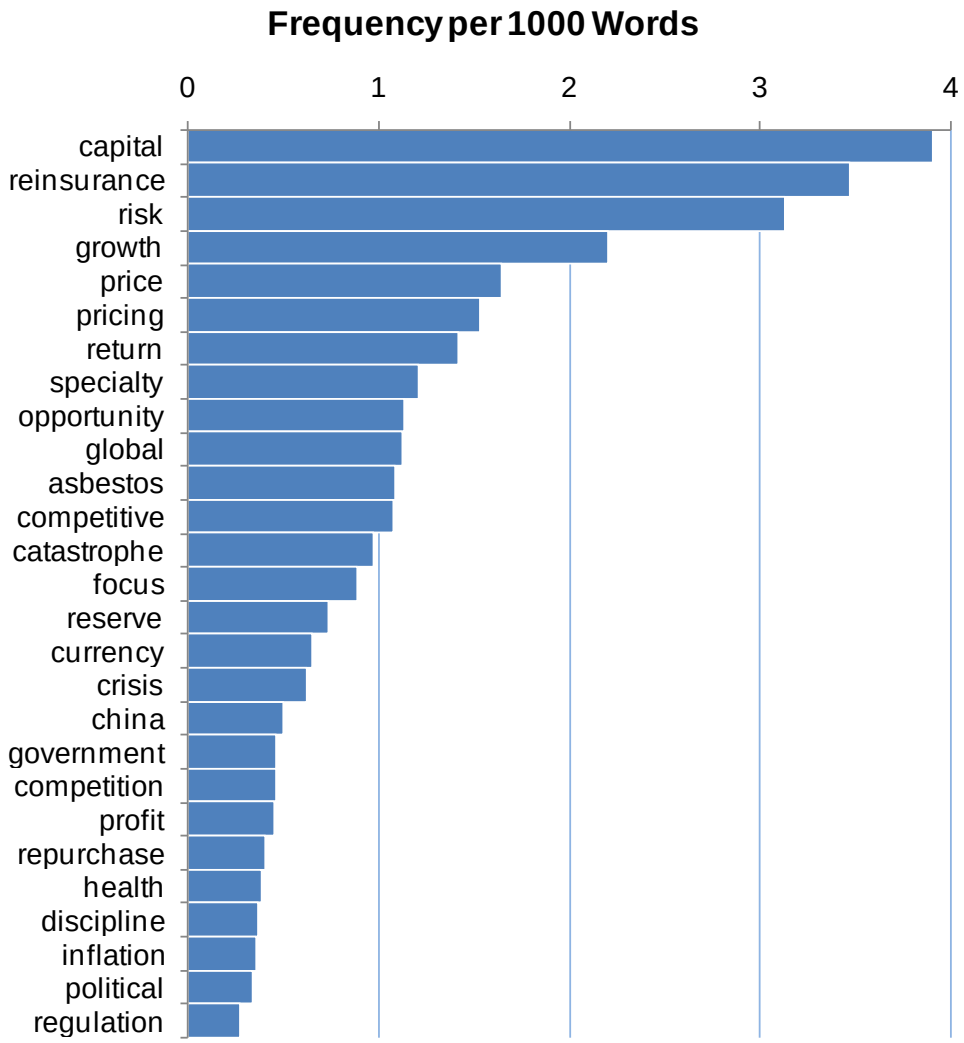
Agenda

- ❑ Challenges Facing The Industry
- ❑ Catastrophe Management
- ❑ Black Swans
- ❑ Looking Ahead

Tag Cloud Word Frequency – Ace Q1 2010 Earnings Call; Aon Benfield Analysis

AON BENFIELD

What Is On Investor's and Management's Minds?
Public Document Word Frequency



Selected word frequency thirteen selected 10Ks, quarterly conference call and investor presentation transcripts, H1 2010

Ace, Allstate, Axis, Chubb, CNA, Hartford, Markel, Progressive, Ren Re, Travelers, W.R. Berkley, XL

AON BENFIELD

Management Focus – 1st Half 2010

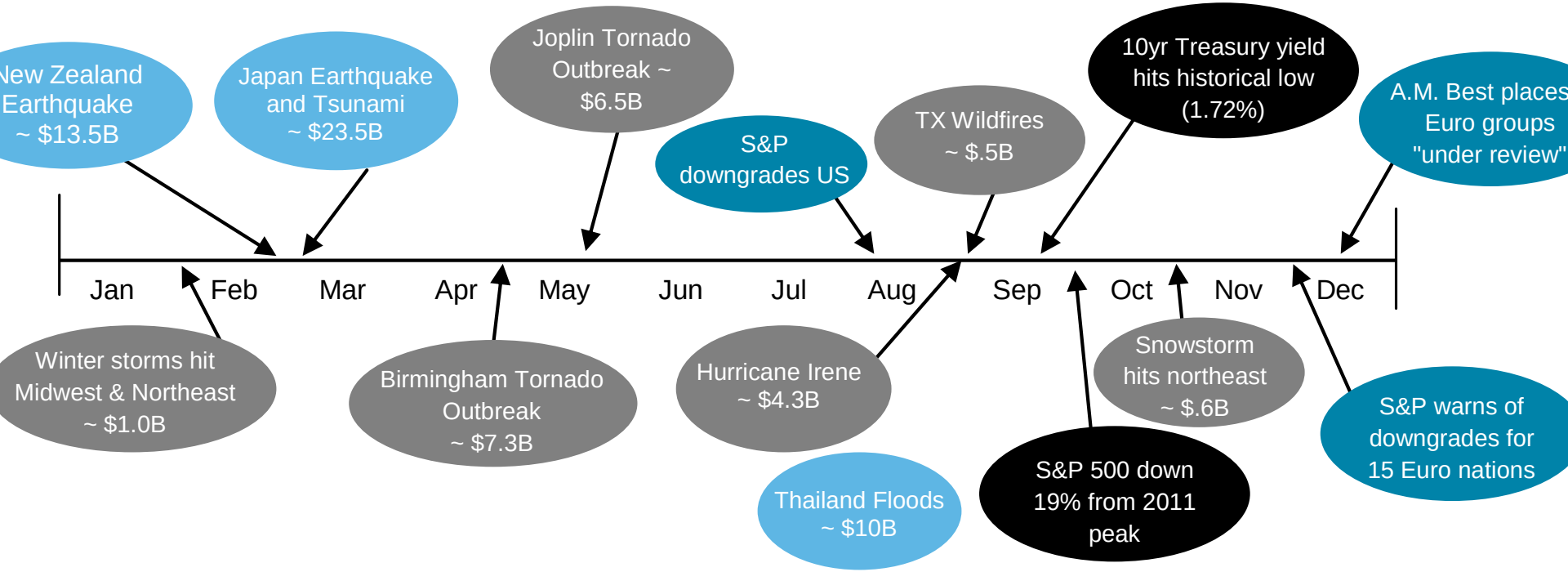
Capital	• Capital management #1 challenge for industry – RBC!
Reinsurance	• Volatility transfer, capital & capacity
Risk	• ERM, Rating agency, regulator, investor
Growth	• Product enhancement & differentiation
Price	• Tariff, flexibility, competitive pressures and growth objectives

Management Focus – 2011

Catastrophe	• Australia, New Zealand, Japan, Thailand
Risk	• ERM, Rating agency, regulator, investor
Capital	• Capital management was #1 challenge for industry!
Growth	• Product enhancement & differentiation
Price	• Tariff, flexibility, competitive pressures and growth objectives

Timeline of 2011 Industry Events

- 2011 was an eventful year with elevated catastrophe losses, volatile stock market conditions, record low investment yields and downgrade of U.S. debt and the European sovereign debt crisis

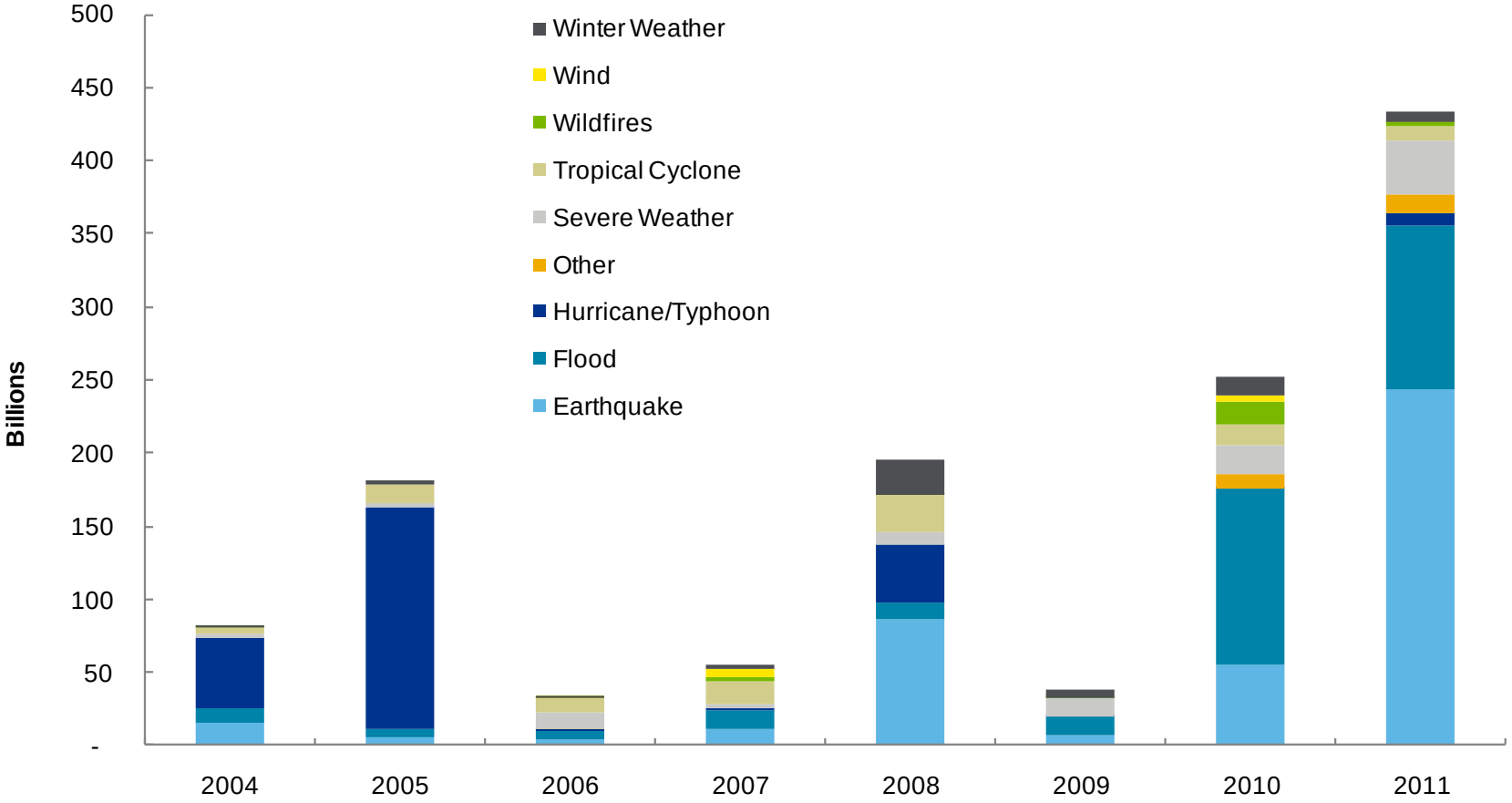


Source: Aon Benfield Analytics

AON BENFIELD

Impact Forecasting Economic Loss Estimates

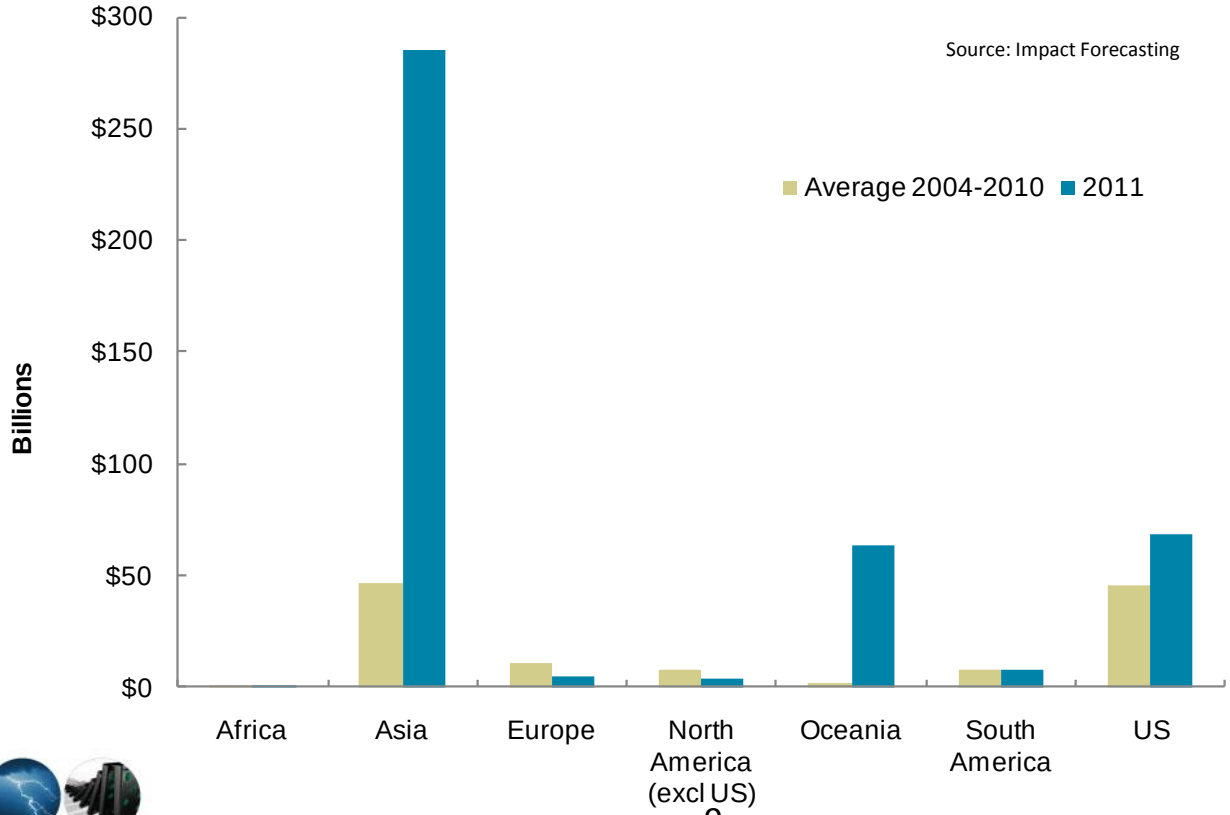
- Global losses for 2011 are currently estimated at USD 435 billion



Source: Impact Forecasting

2011 Economic Loss versus Average

- Losses in Asia alone accounted for 65 percent of total losses for 2011, more than six times the average annual economic loss in that region in recent years
- Higher insurance penetration in the regions with loss in 2011 increased total loss covered by insurance to approximately 25 percent (USD 107 billion), up from 15 percent in 2010.



Top 10 Insured Loss Events in 2011

Event Date	Event Name Or Type	Event Location	# Of Deaths	# Of Structures/ Claims	Economic Loss Estimates (USD)	Insured Loss Estimates (USD)
3/11	Earthquake	Japan	15,844	1,100,000	210.00 billion	35.00 billion
2/22	Earthquake	New Zealand	182	156,313	*30.00 billion	13.50 billion
7/25-11/30	Flooding	Thailand	790	4,000,000	45.00 billion	10.78 billion
4/22-4/28	Severe Weather	U.S. (Southeast, Plains, Midwest)	344	700,000	10.20 billion	7.30 billion
5/21-5/27	Severe Weather	U.S. (Plains, Midwest, Southeast)	181	750,000	9.10 billion	6.75 billion
8/22-8/30	HU Irene	U.S., Bahamas, Caribbean Isl.	46	835,000	8.55 billion	5.00 billion
12/21-1/14	Flooding	Australia (Queensland)	36	58,463	30.00 billion	2.42 billion
4/3-4/5	Severe Weather	U.S. (Midwest, Southeast, Plains)	9	225,000	2.80 billion	2.00 billion
6/13	Earthquake	New Zealand	1	53,963	*30.00 billion	1.80 billion
4/14-4/16	Severe Weather	U.S. (Plains, Southeast, Midwest)	48	150,000	2.50 billion	1.70 billion
				All Other Events	86.69 billion	20.90 billion
				Totals	**434.84 billion**	**107.15 billion**

Source: Impact Forecasting

Top 10 Human Fatality Events in 2011

Event Date	Event Name Or Type	Event Location	# Of Deaths	# Of Structures/ Claims	Economic Loss Estimates (USD)
3/11	Earthquake	Japan	15,844	1,100,000	210.00 billion
12/16-12/17	TS Washi	Philippines	1,257	48,499	31.70 million
1/10-1/14	Flooding	Brazil	903	21,500	1.20 billion
7/29-11/30	Flooding	Thailand	790	4,000,000	45.00 billion
10/23	Earthquake	Turkey	604	15,000	750.00 million
8/12-9/30	Flooding	Pakistan	520	1,600,000	2.00 billion
4/22-4/28	Severe Weather	Southeast, Plains, Midwest	344	700,000	10.20 billion
9/10-10/31	Flooding	Cambodia	250	250,000	521.00 million
6/1-6/24	Flooding	China	239	500,000	6.65 billion
10/19-10/21	TS 02B	Myanmar	215	8,000	1.70 million

Source: Impact Forecasting

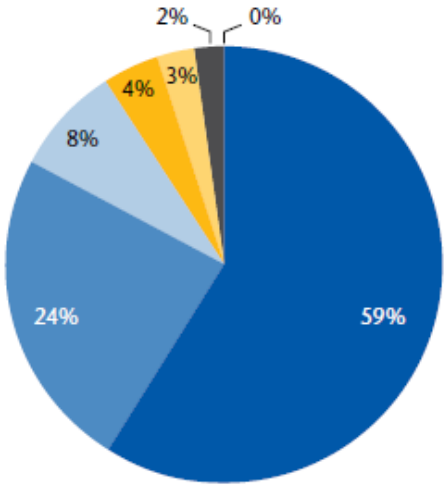
Top 10 Structural Damage Claim Events in 2011

Event Date	Event Name Or Type	Event Location	# Of Deaths	# Of Structures/ Claims	Economic Loss Estimates (USD)
7/29-11/30	Flooding	Thailand	790	4,000,000	45.00 billion
8/12-9/30	Flooding	Pakistan	520	1,600,000	2.00 billion
3/11	Earthquake	Japan	15,844	1,100,000	210.00 billion
8/22-8/30	HU Irene	U.S., Bahamas, Caribbean Isl.	46	835,000	8.55 billion
5/21-5/27	Severe Weather	Plains, Midwest, Southeast	181	750,000	9.10 billion
4/22-4/28	Severe Weather	Southeast, Plains, Midwest	344	700,000	10.20 billion
3/21-4/8	Flooding	Thailand	61	609,967	880.00 million
6/1-6/24	Flooding	China	239	500,000	6.65 billion
1/1-5/31	Flooding	Colombia	116	375,000	5.85 billion
7/27-7/30	TY Nock-ten	Philippines, China, Vietnam	94	340,000	126.00 million

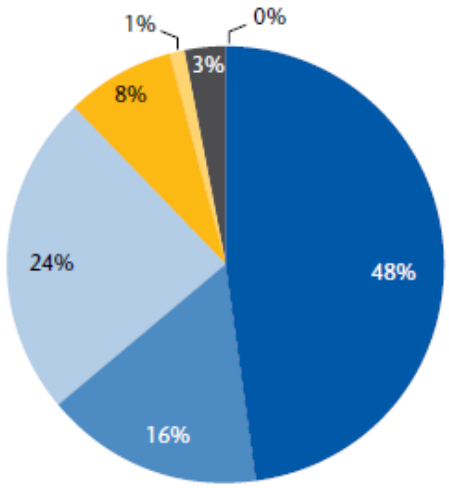
Source: Impact Forecasting

Total Economic and Insured Losses in 2011

- The costliest individual global economic events by natural disaster type in 2011 were:
  - **Earthquake:** Japan (March 11) — USD210 billion
  - **Flooding:** Thailand (July - November) — USD45 billion
  - **Severe Weather:** United States (April 22-28) — USD10.2 billion
  - **Tropical Cyclone:** United States, Bahamas, Caribbean Islands (August 22-30) — USD8.55 billion
  - **Winter Weather:** United States (October 28-30) — USD3 billion
  - **Drought/Wildfires:** United States (January – December) — USD10 billion



Economic Losses

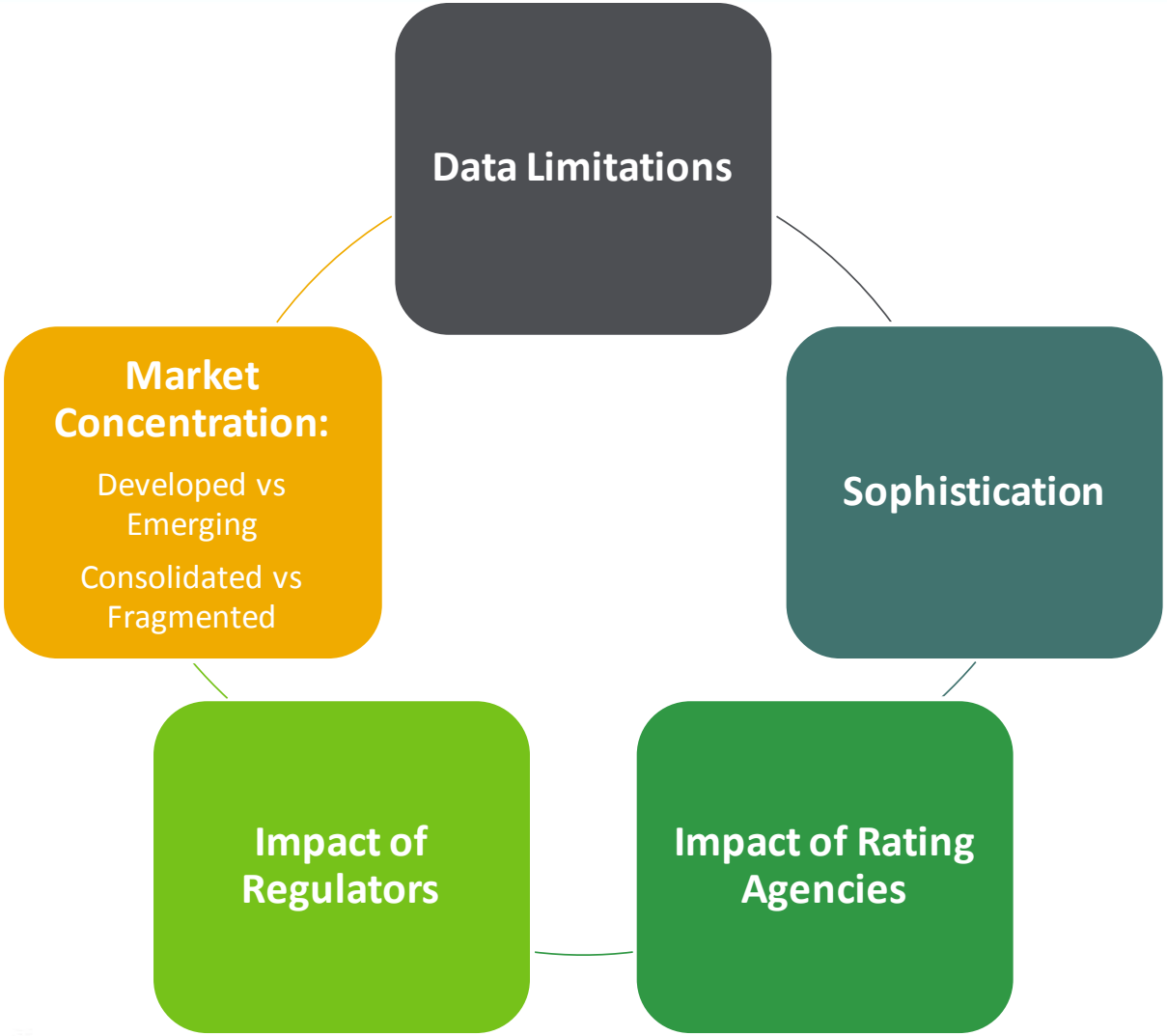


Insured Losses

Source: Impact Forecasting

AON BENFIELD

Challenges in Our Region

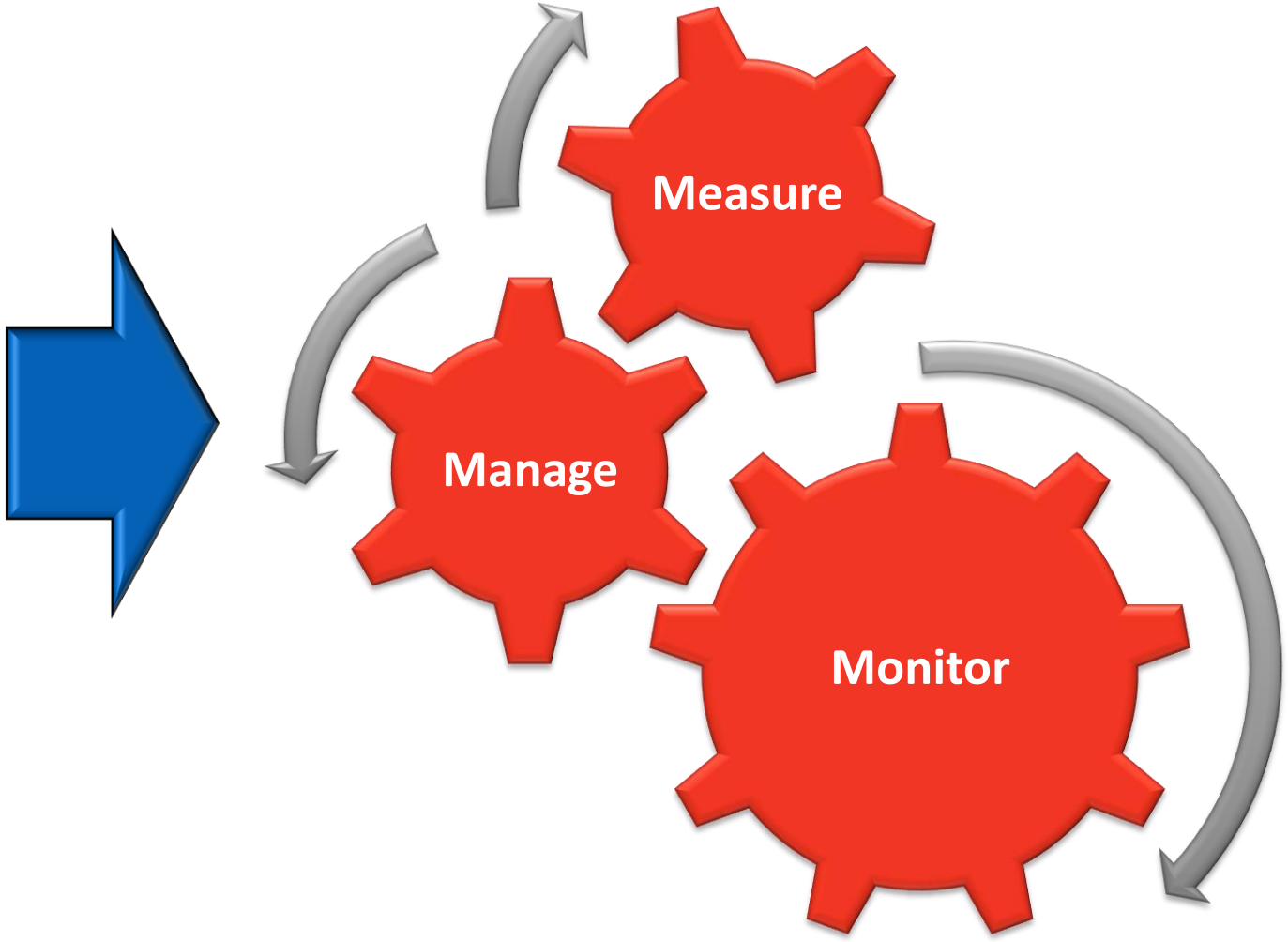


Agenda

- ❑ Challenges Facing The Industry
- ❑ Catastrophe Management
- ❑ Black Swans
- ❑ Looking Ahead

Look beyond simply transferring risk

ERM



Catastrophe Management

Modelled Catastrophe Perils by Territory

Territory	RMS		EQECAT		AIR		IF	
	EQ	TY	EQ	TY	EQ	TY	EQ	TY
China	X	X	X	X	X	X		X
Kong Kong	X	X	X	X	X	X		X
Taiwan	X		X	X	X	X		X
India	X		X	X				X
Thailand			X	X				X
Malaysia			X	X				X
Vietnam								X
Pakistan			X	X				X
Indonesia	X		X		X	X		X
Philippines	X		X	X	X	X		X
Singapore			X					
Japan	X	X	X	X	X	X	X	
South Korea			X	X		X		X
Australia	X	X	X	X	X	X	X	X
New Zealand	X		X	X	X		X	X
Guam	X	X						

Earthquake

- ❑ Available in all main EQ territories.

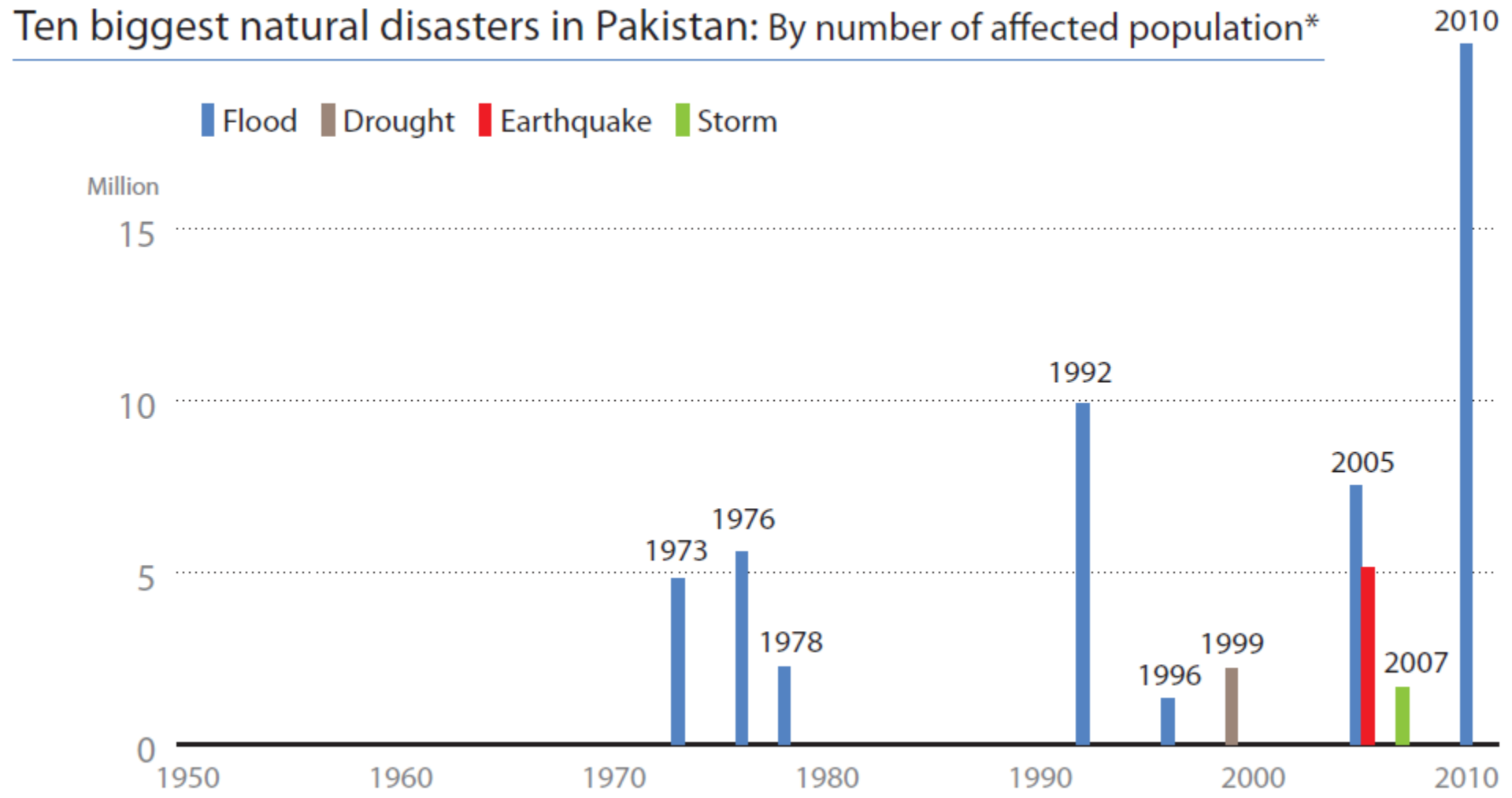
Typhoon

- ❑ Typhoon models exist which incorporate typhoon induced flooding but no monsoonal flood models. Typhoon is just a secondary peril compared with monsoonal flood in many territories.

Pakistan is exposed to a variety of natural disasters, including earthquakes, tsunamis, landslides, cyclones, but the most damaging and the most frequent of the natural perils facing the country is flood.

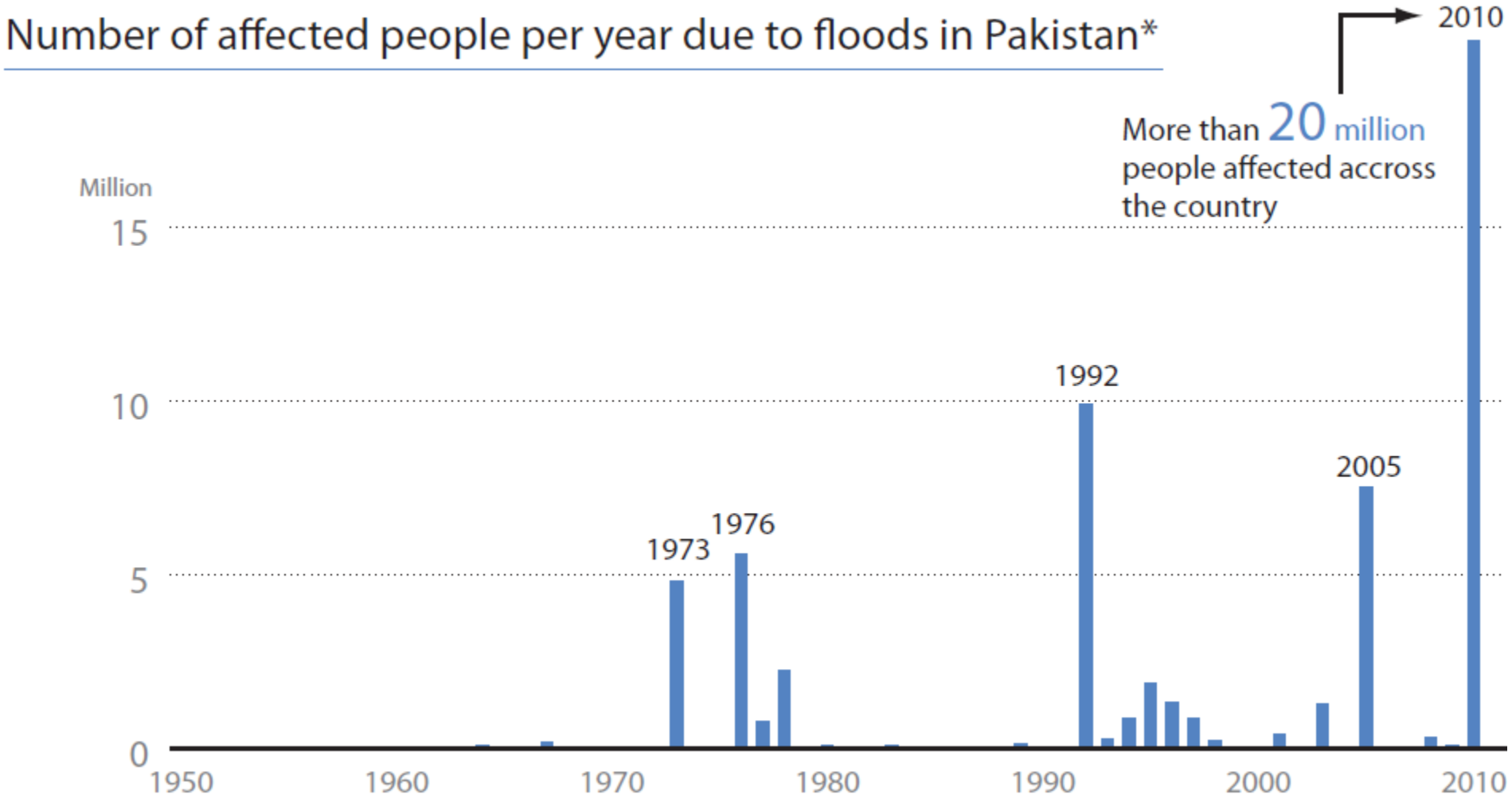
Regionally, earthquake is the PML driver in this region. However other perils may occur more regularly and drive the higher frequency part of the loss curve - such as flooding and convectional windstorm.

Pakistan – 10 largest Natural Disasters



Source: OFDA/CRED

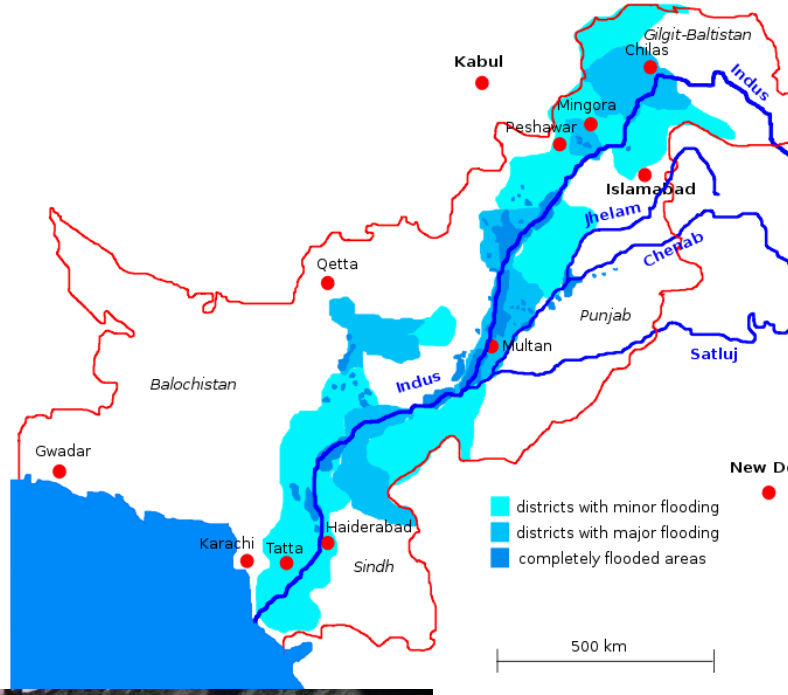
Pakistan - Flood



Source: OFDA/CRED

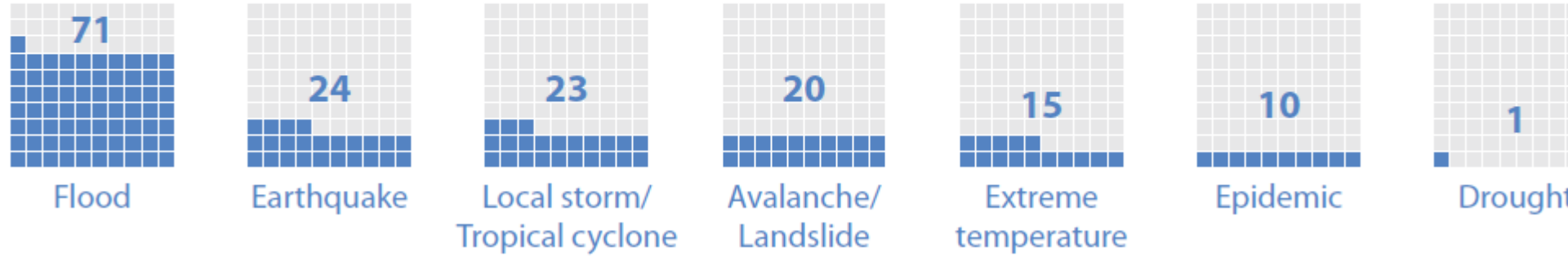
2010 Pakistan Flood

- Resulted from heavy monsoon rains and affected the Indus River basin
- Approximately one-fifth of Pakistan's total land area was underwater
- About 20 million people were affected and 2,000 people died
- Has cost more than 5.3 million jobs
- Total economic loss USD 43 billion



Pakistan – Major Perils

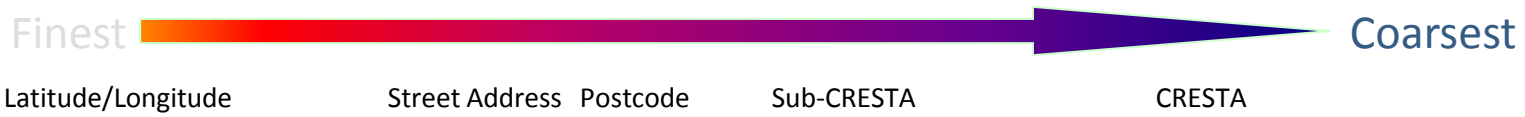
umber of natural disaster events in Pakistan since 1900*



- The information presented here is taken from EM-DAT: The OFDA/CRED International Disaster Database. In order for a disaster to be entered in to the database at least on eof the following criteria has to be fulfilled
  - 10 or more people reported killed
  - 100 people reported affected
  - a call for international assistance
  - Declaration of a state of emergency

Other Considerations
Data Quality

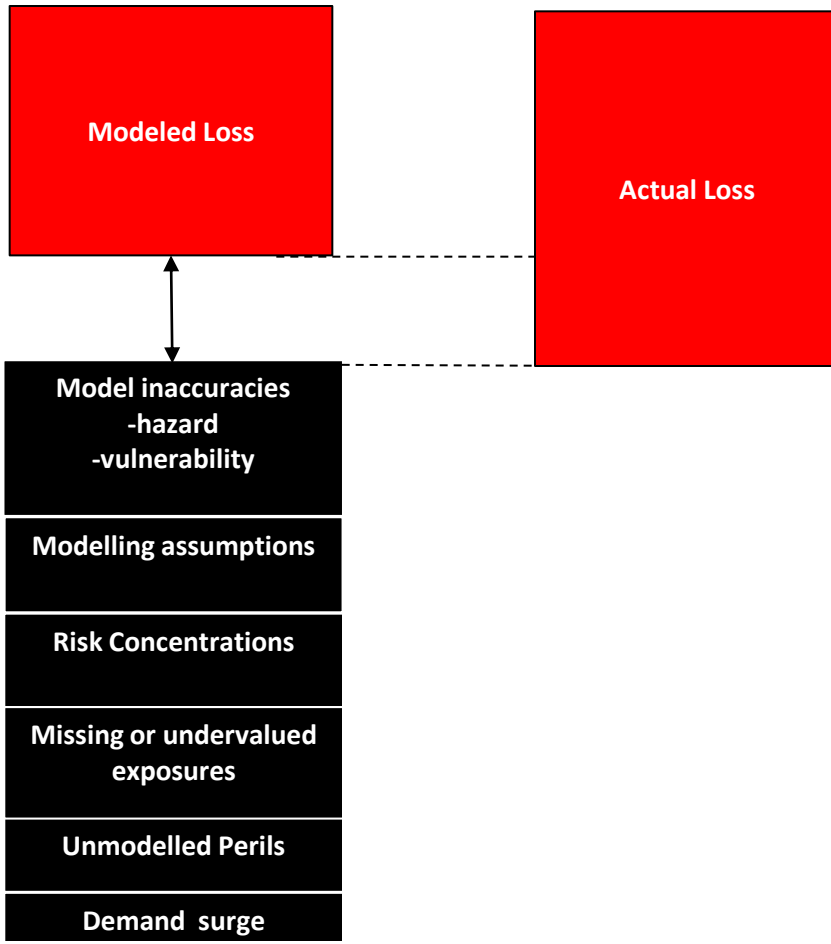
- Input data quality determined by completeness and correctness of data used in analysis
- **Location:** resolution of Addresses (the finer the better) - impacts hazard intensity calculated at site



- Insured Value by **Coverage:** Building, Contents, BI – impacts loss
- **Building Characteristics:** Construction type, Number of storeys, etc – impacts damageability and therefore loss
- **Policy Conditions:** deductibles, co-insurance, limits – impacts loss projections to financial structures
- Any unspecified value may result in non-inclusion of risk or use of default values that may not reflect portfolio being modelled

Other Considerations
Model Miss

- Model Miss - Difference between actual and modelled loss
- Noticed during benchmarking of individual events
- No cat model is able to fully reproduce a historical loss
  - Models differ from reality
  - Science of perils not fully established, require certain assumptions which could vary
  - Distribution of possible damage not a point loss
- Law of Large Numbers applies – run enough events and on average the cat model will converge towards reality



AON BENFIELD

Other Considerations

More than just the Core Peril

Earthquake

Other Considerations
Non-Modelled Perils

- Unmodelled perils that may have potential to cause total building loss to large numbers of properties:
  - Fire following earthquake (FFE)
  - Tsunami
  - Flooding from EQ-triggered failure of man-made dam
  - Flooding from EQ-triggered failure of natural dam formed by any means
  - Flood from tropical cyclones

Other Considerations
Non-Modelled Perils

- Consider losses that have occurred in the Asian Region recently
  - Japan Earthquake – considerable loss from Tsunami following loss which is unmodelled
  - Australian Floods – not part of formal Cat Modelling suite
  - NZ Earthquake – hit an area not thought to be on a fault, subsequently found to be on three.
  - Thailand Floods – no formal models available
- Un-modelled perils and “non-peak territories” will attract far more attention than in previous years

Lessons Learned from Observed Events

- Loss events in 2011 brought interesting tests of coverage, deductibles, policyholder co-participations and government / private insurer partnerships

Event	Issue Observed	Event Coverage	Issues to Consider
Japan Earthquake and Tsunami	Overwhelming debris created by tsunami	No coverage for debris removal by Japanese insurers	Large scale debris removal operations in many nations will require a coordination of the insurance policy coverage for debris with the need for extensive government involvement in the debris removal process.
	Minority of homes and businesses purchased earthquake insurance	Banks do not require earthquake insurance in Japan	The impact on communities that did not have sufficient insurance was clear in New Orleans after Hurricane Katrina and it is clearly going to be an issue in Japan. Insurers and reinsurers have capacity to provide more coverage should governments recognize the inadequacy of banking policies. These policies place undue catastrophe burdens on financial systems and consequently destroy communities when the known catastrophic risks eventually occur.
	50% co-participations for all homeowners	Coverage for earthquake in Japan is viewed as financial assistance after an event rather than indemnity coverage	While a 50% co-participation is substantially larger than the deductibles in place in most other nations there appear to be no signs of policyholder unrest with this form of coverage. Would co-participations be more useful to policyholders than large deductibles? Would insurance take-up rates improve if co-participations were used rather than deductibles?
New Zealand Earthquake and Liquefaction	Severe liquefaction combined with low levels of shake related damage to homes and businesses	Government underlying and private insurer excess coverage combine to insure homes and businesses	Liquefaction can affect very large areas and the decisions about relocating homes and businesses are made by governments, not private insurers. Insurers may need to reconsider whether excess coverage can include coverage for government requirements to relocate homes.
United States Tornado and Hail Missouri and Alabama	Nature's most powerful winds affecting high concentrations of insured values	Tornado and hail losses are covered under substantially all property policies	Very high level of damage can occur as a percentage of total insured values. Some of the highest levels of insured damage to insured values ever observed in tornado and hail losses occurred in these events. Concentration risk is real everywhere. Some of the debris removal coordination issues mentioned above were also revealed in these events.
United States Hurricane Irene	Non-uniform deductibles required or allowed in multiple states affected by the same event	Varying deductibles state to state and coastal versus inland in the same state	Consistency of deductibles may be more important than previously considered and the pressure from individual state insurance regulators for extra contractual allowances to policyholders may have been underappreciated.

Source: Aon Benfield Analytics

Agenda

- ❑ Challenges Facing The Industry
- ❑ Catastrophe Management
- ❑ Black Swans
- ❑ Looking Ahead

Black Swans

- Theory popularized by Nassim Nicholas Taleb

- Black Swan event:
  - is an outlier as it lies outside the realm of regular expectations,
  - carries an extreme impact, and
  - makes it explainable and predictable retrospectively.

- Typically, falls under the risk category ‘Unknown Unknowns’

- They can and do occur on a regular basis and likely to become more common

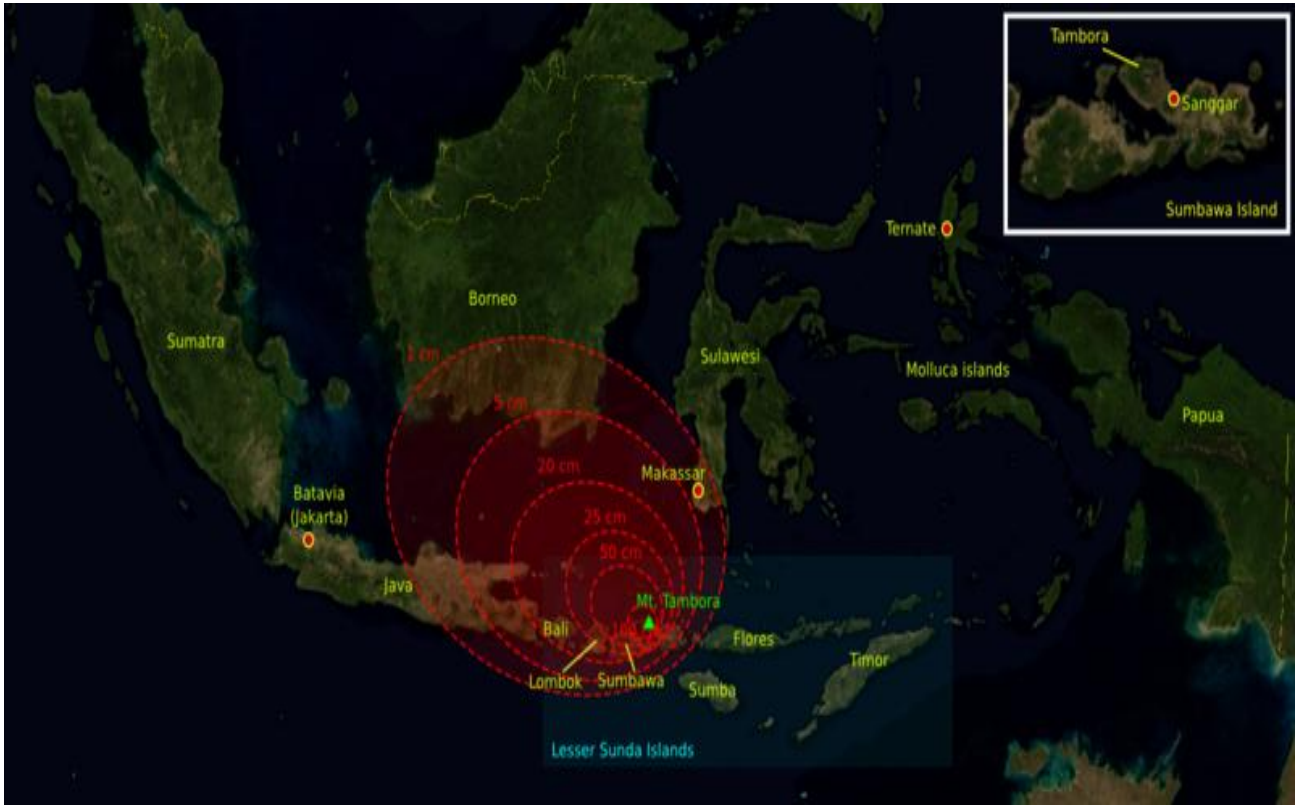
Black Swans

- The occurrence of black swans can, and repeatedly does, overwhelm the insurance industry
- Left unattended, black swans can threaten a company's very existence
- Rating agencies, investors and increasingly regulators are less likely to provide favorable opinions when insurers fail to demonstrate emerging risk management processes

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change"

1816 - “The Year Without a Summer”

- In April 1815, Mount Tambora on the island of Sumbawa, Indonesia erupted
- Greatest eruption in recorded history
- Explosion heard >2,000 km away



The estimated volcanic ash fall during the 1815 eruption

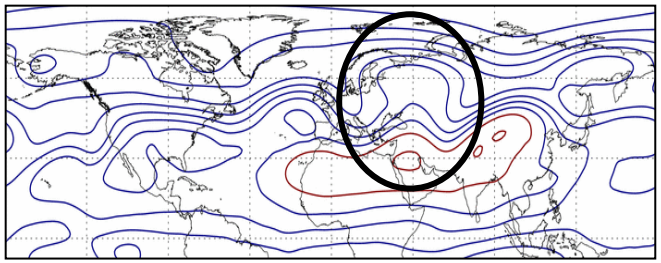
1816 - “The Year Without a Summer”
Local and Global Impact

- Local Impact:
  - Darkness within 600km radius for 1-2 days
  - About 10,000 people died on Sumbawa and 80,000 due to famine and disease in the surrounding regions
  - Massive crop failure led to famine; it took up to five years for vegetation to return 400 km around Tambora

- Global Impact: the “Year without a Summer”:
  - Sunlight was blocked by acid aerosols, led to global cooling and worldwide harvest failure
  - Rains were interrupted in India, leading to deadly Cholera outbreak
  - Crops failed in Europe
  - Floods occurred in China
  - Snow fell in northeast US in June

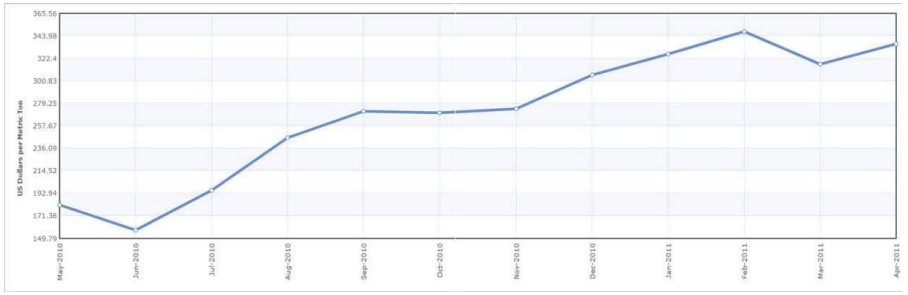
Volcanic Eruption

Effect of a Year Without a Summer Today?



Upper level atmospheric map from late July and early August 2011 showing an ‘omega block’ in western Russia

Russian Heat Wave



Contributes to doubling of wheat price

Food prices spike, help trigger unrest

1908 Tunguska Explosion

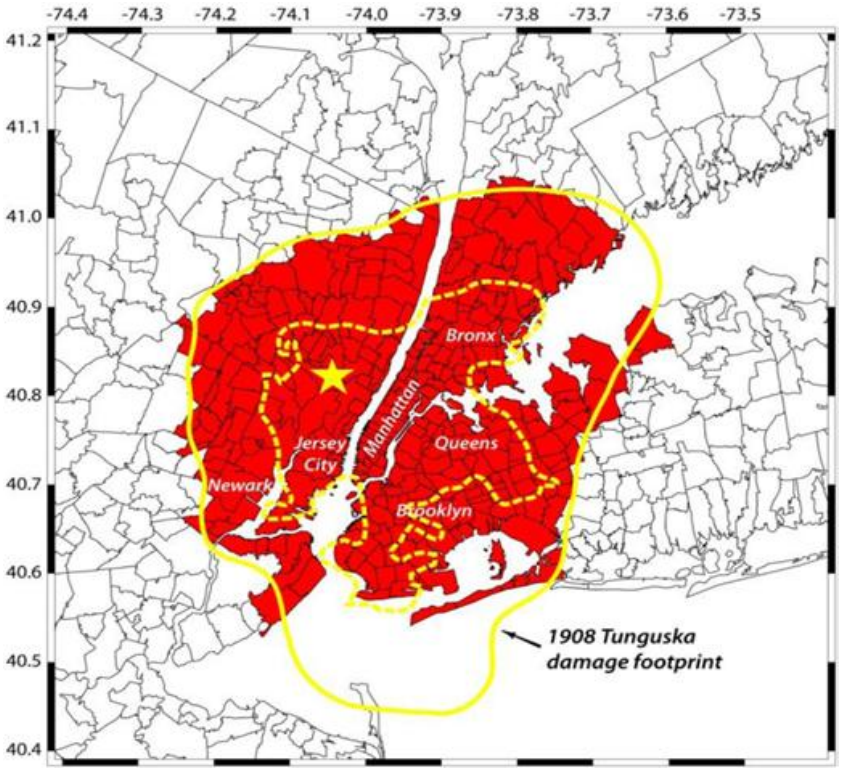
- On 30 June 1908 in Tunguska, Russia, the most powerful natural explosion in recent history rocked the earth
- Believed to be an air burst of a meteorite 6-10 km above the earth's surface
- Explosion was 1,000 times more powerful than the atomic bomb dropped on Hiroshima
- 20,000 Near Earth Objects of concern

An area of 2150 square kilometres and about 80 million trees were destroyed

The event occurred in a remote part of Siberia in Russia

1908 Tunguska Explosion – Today

- The graphic shows the 1908 Tunguska event overlaid over Manhattan with estimated property losses of $1.19 trillion (RMS 2009)



1918-1919 Influenza Pandemic

The pandemic was caused by a form of influenza that probably originated due to army barrack conditions during World War I

1918-1919 Influenza Pandemic

Effects

- First reported cases in Fort Riley, Kansas - January 1918
- Within weeks 1,127 soldiers were infected and 46 died as virus spread across the US
- The flu appeared in France in August 1918, spreading East and South to Russia, Africa, and eventually to China and Japan
- 27% of global population infected, killing 3%-6%, making it deadlier than World War I

A Pandemic Today

- Estimates of the economic impact of a similar epidemic today:
  - 175 – 350 million deaths
  - GDP reduced by $2 trillion

- Improvements since 1918:
  - Better medical technology (e.g. antibiotics)
  - Planning due to SARS and bird flu scare

- Additional complexity since 1918:
  - International air travel
  - Modern cities
  - More interdependent and vulnerable society (e.g. commuting)

2011 Tohoku Earthquake

- A totally unforeseeable event - a seismological “black swan”
- The Japan Trench was not expected to generate quakes above magnitude 8.0
- A surprise to catastrophe risk modelers
- M 9.0 earthquake and tsunami caused a nuclear disaster, persistent power shortages, and a host of other major societal and economic challenges



2011 Tohoku Earthquake – really a Black Swan?

- Hazard/Event vs Consequences
- Stone Tablets were remnants of prior tsumanis.
- Hundreds of such markers dot the coastline, some more than 600 years old. Collectively they form a crude warning system for Japan – inscriptions included:
  - High dwellings are the peace and harmony of our descendants“
  - "Remember the calamity of the great tsunamis. Do not build any homes below this point.“
  - "If an earthquake comes, beware of tsunamis"

Agenda

- ❑ Challenges Facing The Industry
- ❑ Catastrophe Management
- ❑ Black Swans
- ❑ Looking Ahead

Factors to Consider

- Climate change and/or socio-economic change:
  - Population
  - Urbanization
  - Land use
  - Demographic
  - Economic

- Increasingly complex and interdependent society
  - Communications and the internet
  - Globalized supply chains
  - Air travel
  - Urbanization

- Interaction with economic and non-insurance environments
  - Unforeseen exposures, peril correlation, dominos

Preparing for the ‘unforeseen’

- What you don’t know is far more relevant than what you do know
- You can't prepare for a specific event, but you can prepare for the impact
- Improvements in cat models to capture the black swans
  - Focus on robustness of model rather than accuracy of forecasts
  - Focus on uncertainty in results rather than mean
  - Focus on tail rather than body of loss distribution
- “what-if” and “as-if” analyses
  - Statistical analysis can be of limited value and re/insurers need scenario planning (RDS)
  - Realistic disaster scenarios (RDS)
  - Historical events if they were to occur in today’s socio-economic environment
- Understanding economic linkages and dominos

A Final Note

- Enough emphasis cannot be put on the exposure data
- In the end, data will determine the relevance of the catastrophe analysis.

"All discussions of catastrophic exposure management begin with the accuracy and availability of the exposure data. The most sophisticated, complex catastrophe modeling systems cannot estimate an insurer's losses if the insurer cannot identify what insurance coverages have been written and where those risks are located."

Source: ***Measuring and Managing*** *Catastrophe Risk (1995) Kozlowski &Mathewson,* CAS.

Thank You

George Attard, BEc FIAA
Managing Director
Analytics

Aon Benfield Asia
80 Raffles Place
#42-01 UOB Plaza 1
Singapore 048624

t +65.6239.8739
m +65.8268.6810
george.attard@aonbenfield.com
aonbenfield.com