



# Catastrophe Exposure Management

Ronald Kozlowski and Shitalkumar Khandar

**Singapore Actuarial Society  
General Insurance Conference “What’s Next?”  
May 6-7, 2010**

# Agenda

- What is catastrophe exposure management?
- Risks affecting Asia
- Catastrophe modeling basics
- Data importance
- Model results
- Model comparisons
- What actuaries need to do when using models
- Management's philosophy
- Underwriting strategy
- Ratemaking considerations
- Reinsurance strategy
- Modeling and exposure management issues



# What is catastrophe exposure management?

- Management philosophy
- Measuring catastrophe exposure
  - Ensuring data quality
- Ratemaking
- Underwriting strategy
- Reinsurance strategy
- Post event operations

# Risk affecting Asia

## Natural Disasters in Asia- Top 10 Costliest, 1990-2009

Date	Country	Disaster Type	Numbers Killed	Total Affected	Est. Damage (US\$ Million)
17/01/1995	Japan	Earthquake – Kobe	5,297	541,636	100,000
12/5/2008	China	Earthquake – Sichuan	87,476	45,976,596	85,000
1/7/1998	China	Flood - <i>Hubei, Hunan, Sichuan</i>	3,656	238,973,000	30,000
23/10/2004	Japan	Earthquake - Chūetsu	40	62,183	28,000
1/8/1995	North Korea	Flood - <i>Chagan, Huichun, Pyongyang</i>	68	5,700,000	15,000
21/09/1999	Taiwan	Earthquake - Chi-chi	2,264	108,664	14,100
30/06/1996	China	Flood - <i>Anhui, Guizhou, Hebei</i>	2,775	154,634,000	12,600
16/07/2007	Japan	Earthquake -Chūetsu Offshore	9	14,000	12,500
27/09/1991	Japan	Tropical cyclone-Mireille (n°19)	66	91,128	10,000
3/9/2004	Japan	Tropical cyclone-Songda (Nina/22W)	41	40,900	9,000

\*Figures corresponds to the damage value at the moment of the event

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

Data version: v12.07



# Risk affecting Asia

## Natural Disasters in Asia- Top 10 Deadliest, 1990-2009

Date	Country	Disaster Type	Numbers Killed	Total Affected	Est. Damage (US\$ Million)
26/12/2004	Indonesia	Earthquake- Indian Ocean Tsunami	165,708	532,898	4,452
29/04/1991	Bangladesh	Tropical cyclone- Gorky (02B)	138,866	15,438,849	1,780
2/5/2008	Myanmar	Tropical cyclone- Nargis	138,366	2,420,000	4,000
12/5/2008	China	Earthquake - Sichuan	87,476	45,976,596	85,000
8/10/2005	Pakistan	Earthquake - Kashmir	73,338	5,128,000	5,200
26/12/2004	Sri Lanka	Earthquake- Indian Ocean Tsunami	35,399	1,019,306	1,317
26/01/2001	India	Earthquake - Gujarat	20,005	6,321,812	2,623
26/12/2004	India	Earthquake- Indian Ocean Tsunami	16,389	654,512	1,023
28/10/1999	India	Tropical cyclone- 05B	9,843	12,628,312	2,500
29/09/1993	India	Earthquake - Latur	9,748	30,000	280

\*Figures corresponds to the damage value at the moment of the event

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Universite catholique de Louvain, Brussels, Belgium"

Data version: v12.07

# Risk affecting Asia

## Natural Disasters in Asia, 1900-2010

	# of Events	Killed	Total Affected	Damage (ooo US\$)
Metrological (Storm, Tropical Cyclones, etc)	1,365	1,260,474	777,948,221	163,360,493
Average per event		923	569,925	119,678
Hydrological (Flood, Coastal Flood, Avalanches, Landslide, Subsidence, etc)	1,809	6,801,220	2,999,621,905	248,015,076
Average per event		3,760	1,658,166	137,101
Geophysical (Earthquake, Tsunami, Avalanche, Landslide, Volcano, etc)	711	1,817,824	129,833,966	320,341,925
Average per event		2,557	182,608	450,551

\*Figures corresponds to the damage value at the moment of the event

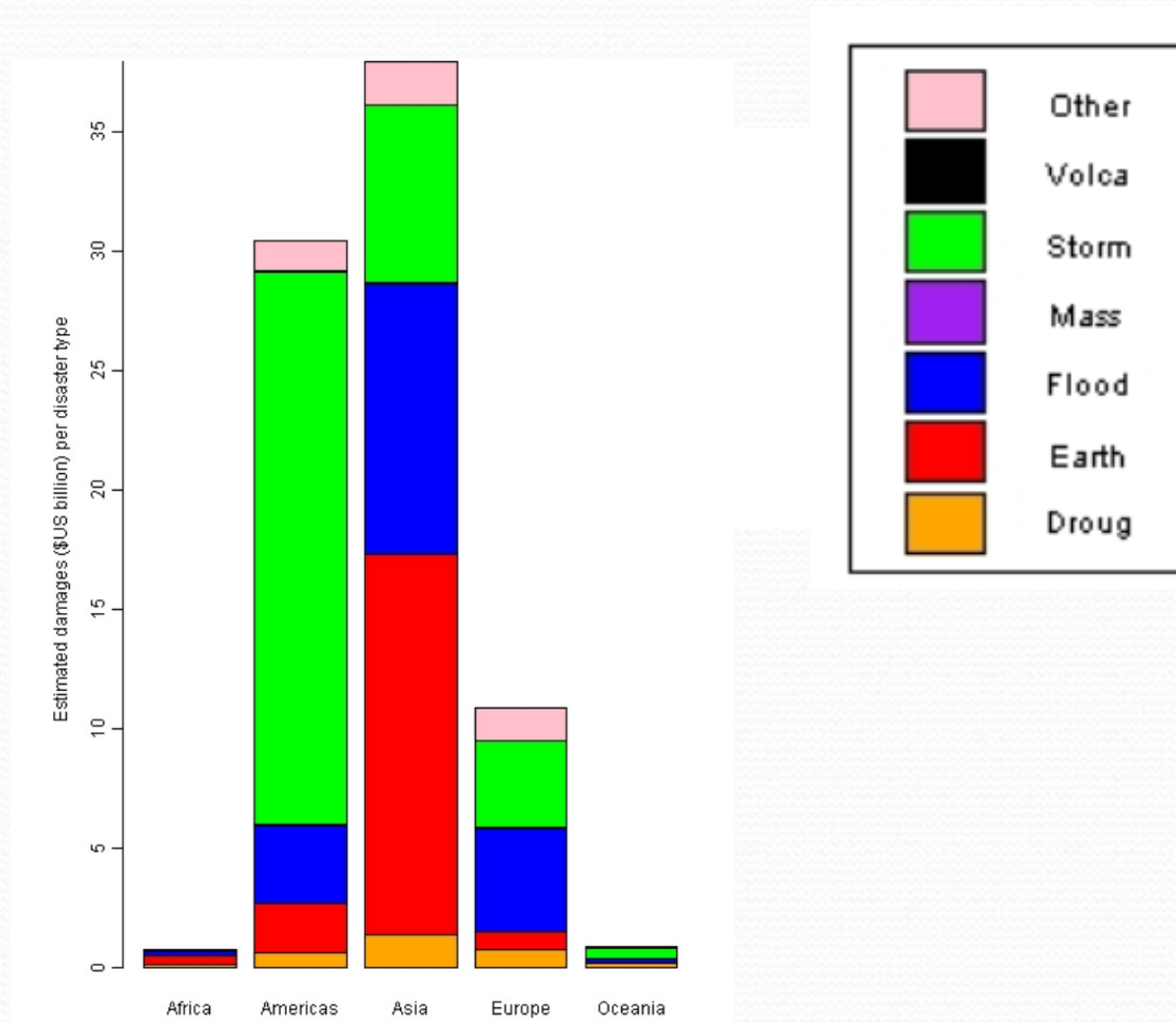
Source: "EM-DAT: The OFDA/CRED International Disaster Database, Universite catholique de Louvain, Brussels, Belgium"

Data version: v12.07



# Risk affecting Asia

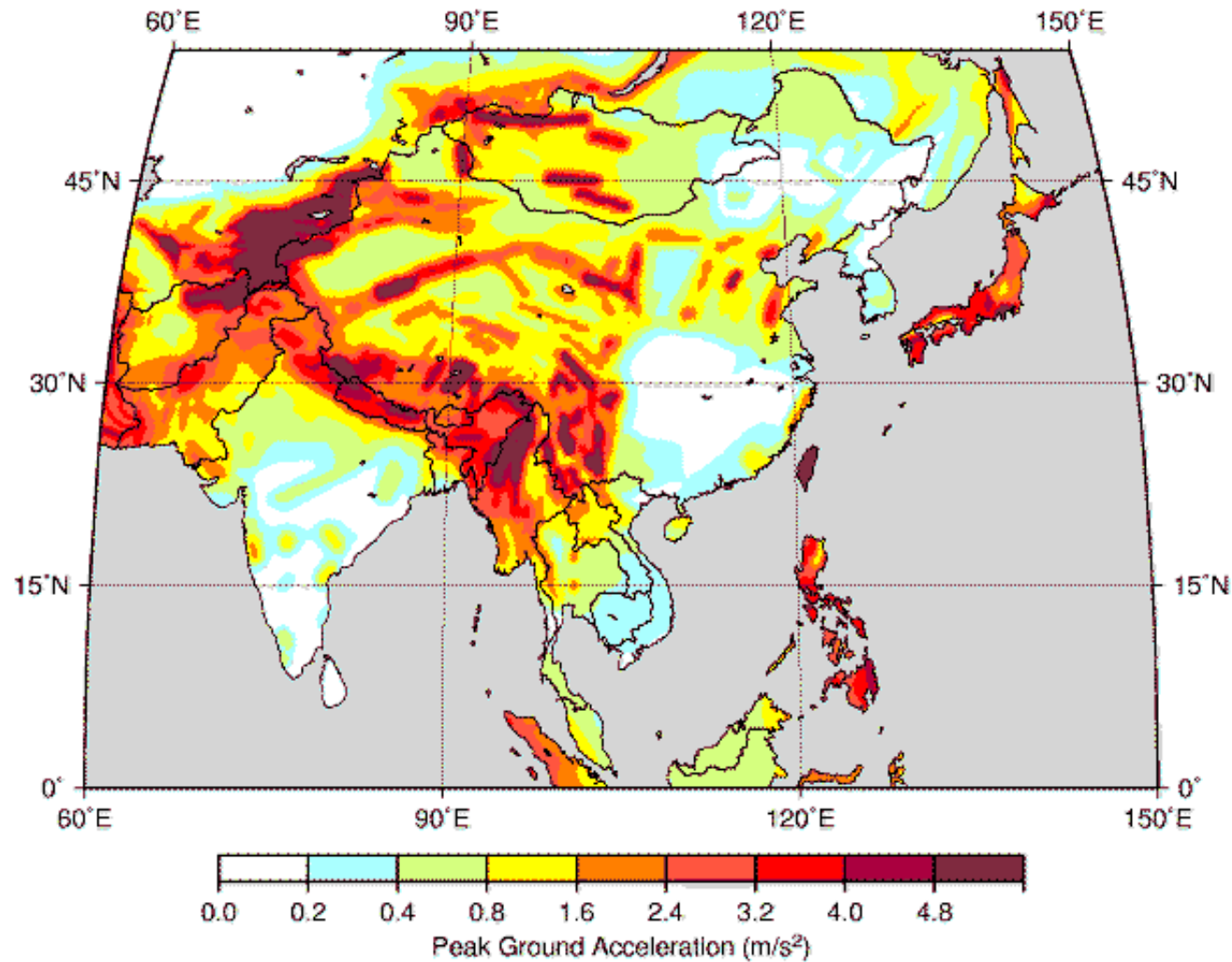
Annual Average Damage (\$US billion) 1990-2009



Source: "EM-DAT: The OFDA/CRED International Disaster Database, Universite catholique de Louvain, Brussels, Belgium"

# Risk affecting Asia

## Seismic Hazard - Asia

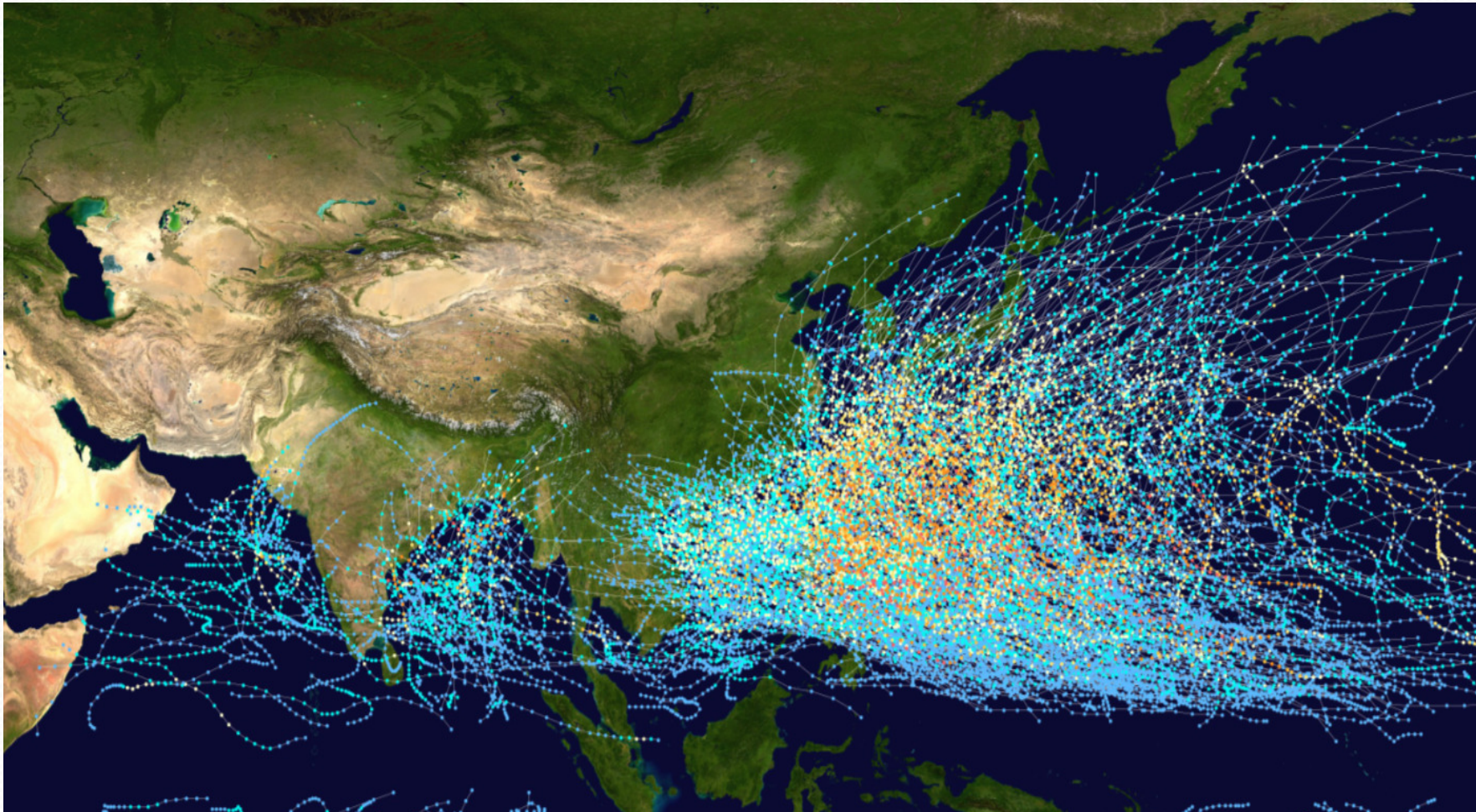


Source: Global Seismic Hazard Assessment Program



# Risk affecting Asia

## Tropical Cyclone - Asia





# Risk affecting Asia

## Models available- Asia

Country	AIR		EQECAT		RMS	
	Tropical Cyclone	Earthquake	Tropical Cyclone	Earthquake	Tropical Cyclone	Earthquake
China	✓	✓	✓	✓		✓
Guam					✓	✓
Hong Kong*	✓		✓	✓	✓	✓
India			✓	✓		✓
Indonesia		✓		✓		✓
Japan	✓	✓	✓	✓	✓	✓
Macau*						✓
Malaysia			✓	✓		
Pakistan			✓	✓		
Philippines	✓	✓	✓	✓		✓
Saipan**						✓
Singapore				✓		
South Korea			✓	✓		
Taiwan	✓	✓	✓	✓		✓
Thailand			✓	✓		

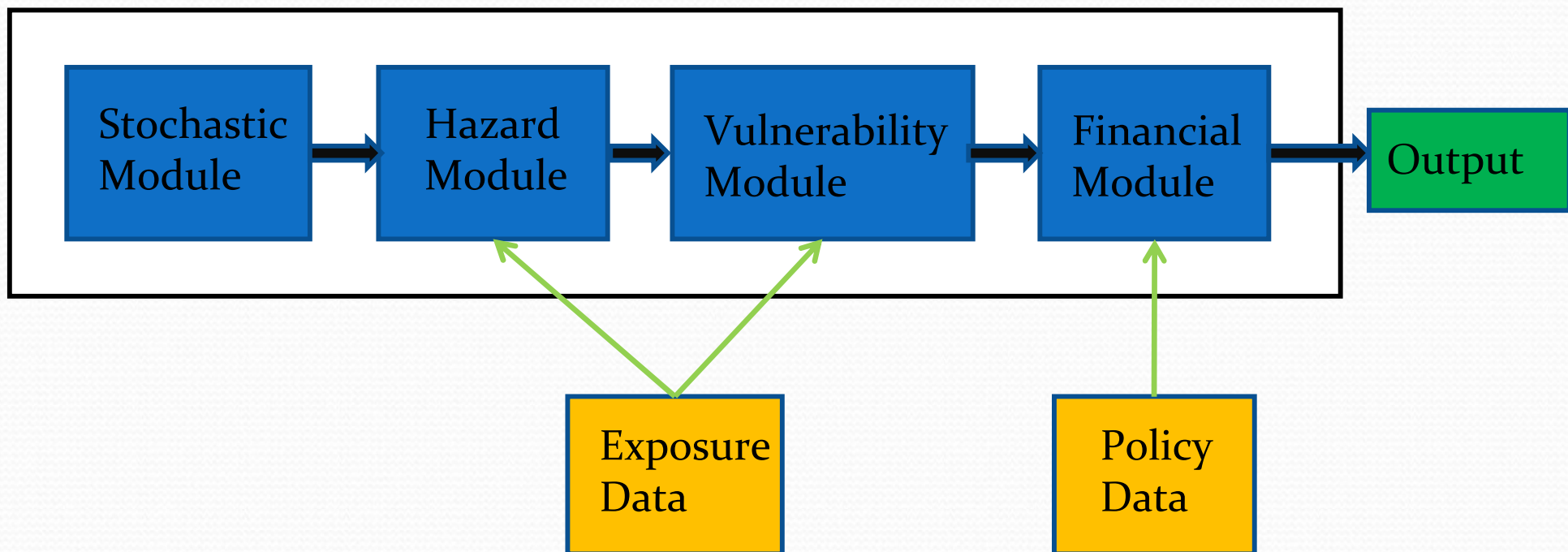
\* Included in China EQ

\*\* Included in Guam EQ



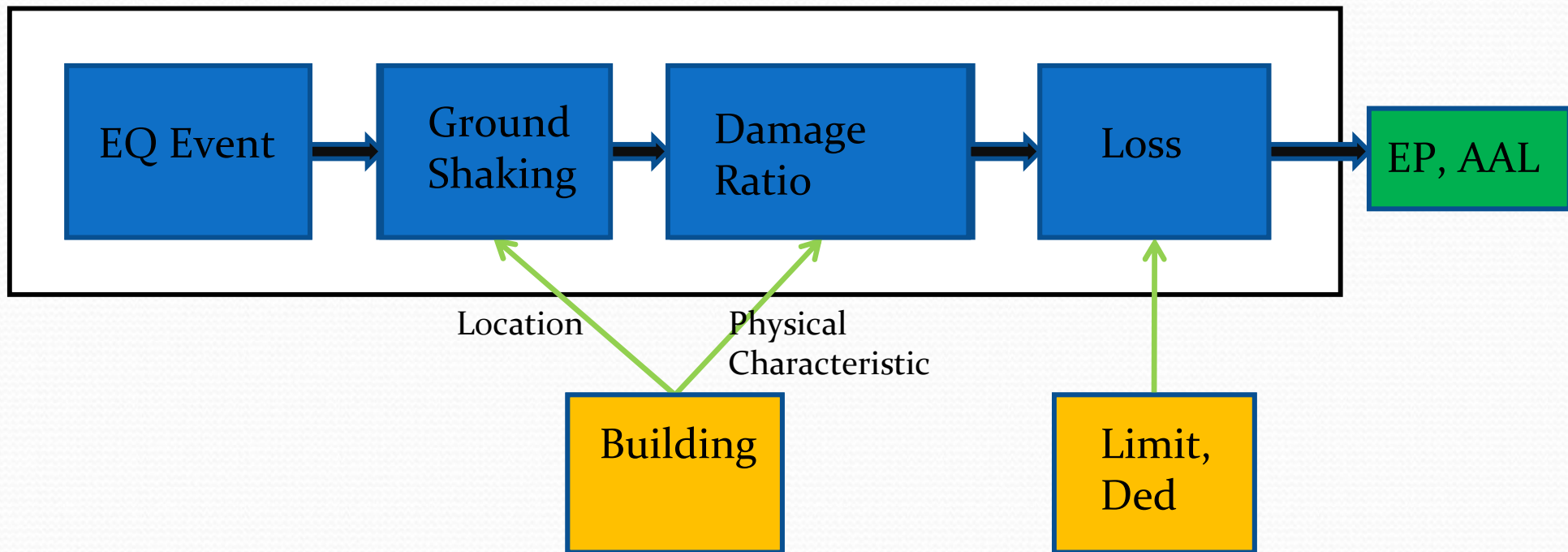
# Catastrophe modeling basics

## Basic Building Blocks



# Catastrophe modeling basics

## Basic Building Blocks - Example EQ





# Catastrophe modeling basics

## What is modeled?

- Perils
  - Tropical Cyclone
    - Wind
    - Rain
    - Storm Surge
  - Earthquake
    - Shake
    - Fire Following
    - Sprinkler Leakage
  - Severe Thunderstorm
    - Tornado
    - Hail
    - Lighting
  - Flood
    - Riverine Flood
    - Off-flood plain
  - Winter Storm
  - Terrorism
  - Pandemic
- LOB
  - Personal
  - Commercial
  - Automobile
  - Builders Risk
  - Workers Compensation
  - Offshore/Marine
- Other
  - Business Interruption or Additional Living Expense
  - Demand Surge

# Data Importance

## Data Completeness

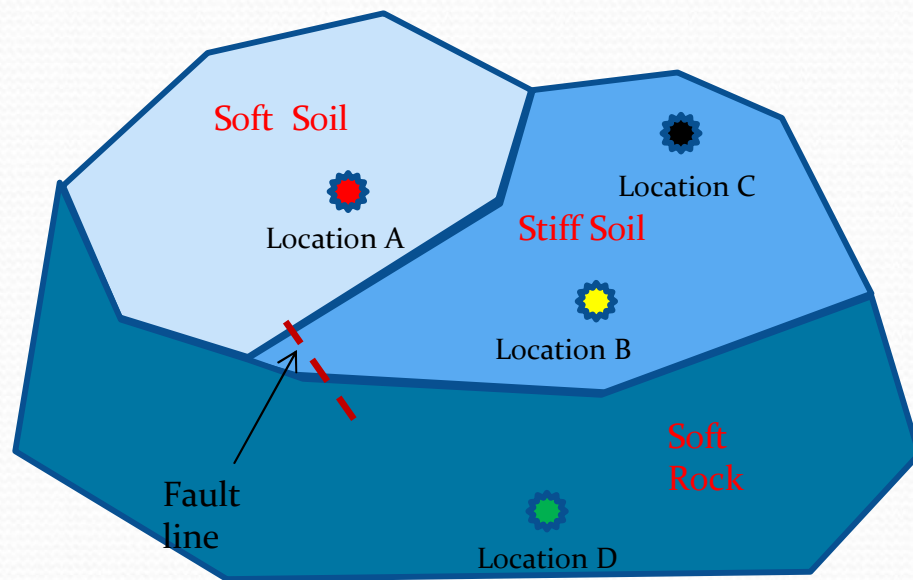
- Location information
  - Geo-coding
- Physical characteristics
  - Construction, occupancy, age, number of stories, etc
- Policy Information
  - Coverage type, limits and deductible
- Data checks
  - Logical data checks : e.g. Zero TIV
  - Common business rules : e.g. Limit < Deductible
  - All risk included



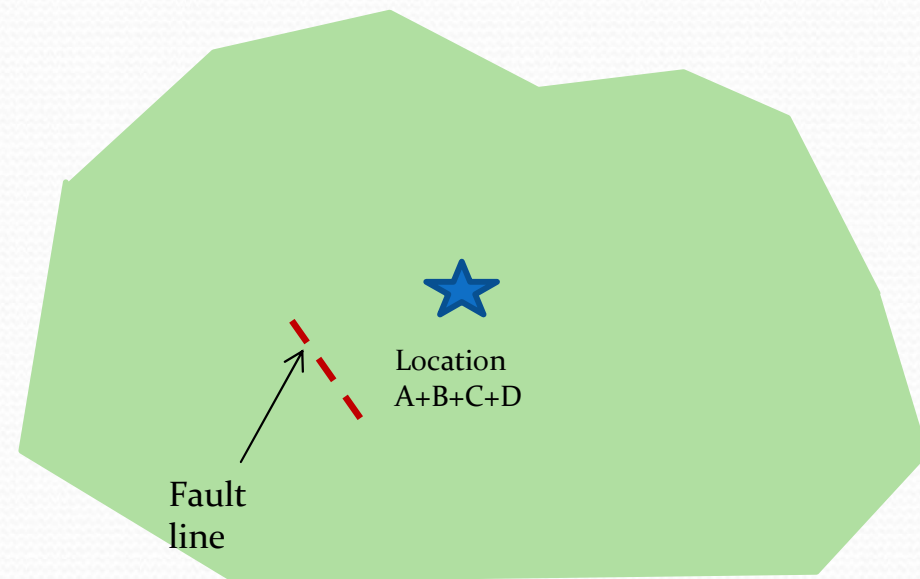
# Data Importance

## Detailed and Aggregate Models

*CRESTA ABC*



*Detailed Data*

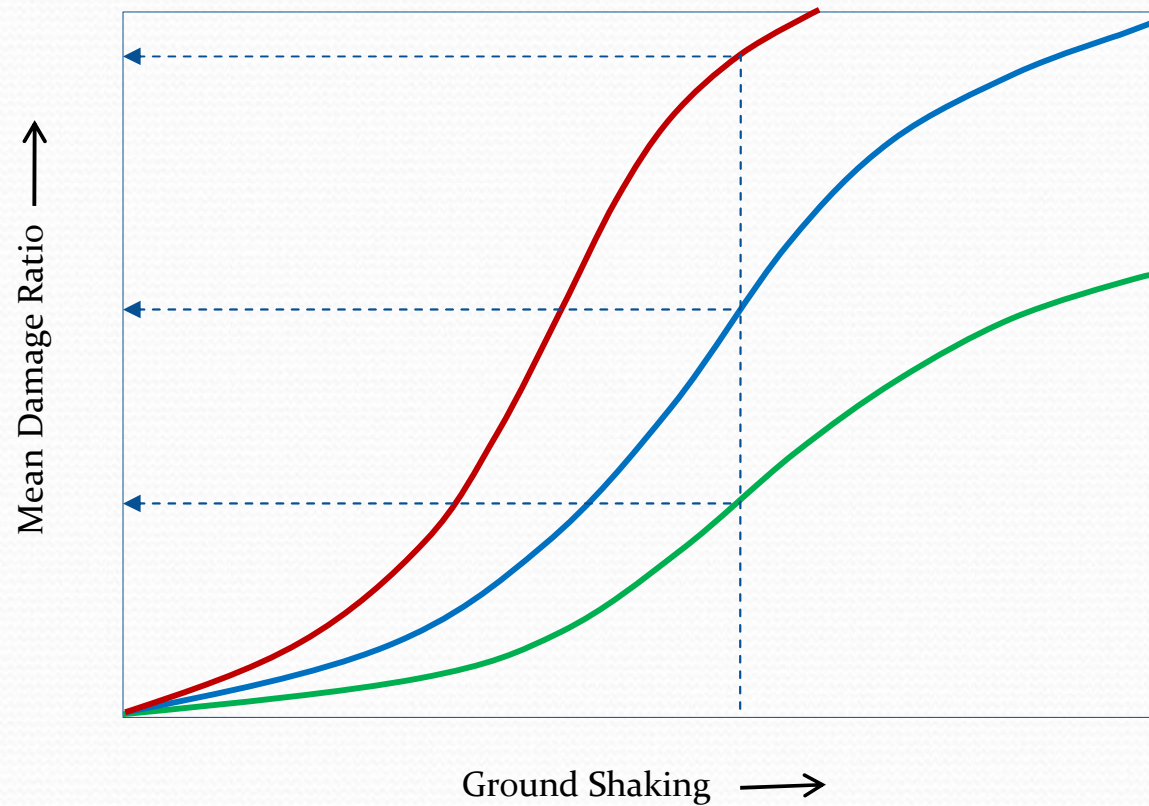


*Aggregate Data*

*\*For illustration purpose only*

# Data Importance

## Physical Characteristic



*\*For illustration purpose only*



# Model Results

- Model outputs – probabilistic modeling
  - For each specific event (w/ associated probability) – losses by location
    - If sum by event – loss probability distribution
      - probable maximum loss (a.k.a. value at risk)
    - If sum by location - expected loss
  - Models have difficulty estimating company specific losses
    - Correct exposure data?
    - Hazard module
      - e.g., interpolation and evaluation of event parameters (e.g., radius of maximum winds, forward speed)
    - Vulnerability module
      - E.g., impact of surrounding property
  - Models are better at understanding relative value
    - Deal A is riskier than Deal B

# Model Comparisons

## Do all models give same results?

- Data
  - Source
  - Resolution
- Modeling techniques
  - Data distribution and fittings
  - Event creation
  - Event parameters
  - Number of events
  - Financial component
  - Secondary perils
- Assumptions
  - Vulnerability functions
  - Industry exposure distribution
  - Calibration and validations
- Revisions and updates
  - New research
  - Validation based on claims data from major event
  - Market conditions



# Actuarial Standard Board: ASOP# 38

## Using Models Outside the Actuary's Area of Expertise

- Analysis of Issues and Recommended Practices – The actuary should:
  - Determine appropriate reliance on experts
    - Developed by experts, opined on by experts or differences of opinions, standards of practice in appropriate fields)
  - Have basic understanding of model
    - Model components, user input, model output
  - Evaluate whether model is appropriate for intended application
    - Applicability of historical data
    - Developments in relevant fields
  - Determine that appropriate validation has occurred
    - User input
    - Model output (comparable to other models, compare to historical results, consistency and reasonableness of relationships among output results, sensitivity of output to inputs)
  - Determine appropriate use of model

# Management Philosophy

- Catastrophe Risk - an “opportunity” or “a necessary evil”?
- Defining Appetite
  - How much catastrophe risk am I willing to take?
  - What is an acceptable “probability of ruin”? risk tolerance?
  - How much surplus or earnings are we willing to lose?
  - Risk appetite is used to give underwriters a maximum guideline for monitoring whether catastrophe risk in the insured portfolio is within acceptable limits
- What determines appetite?
  - Earnings volatility
  - Market pricing
  - Availability & cost of reinsurance
  - Cost of capital
  - Solvency regulation
  - Capital allocation
  - Rating agency evaluations
  - Tax considerations
  - Cash flow needs
  - Finance requirements
  - Rate regulation
  - Other business written by insurer



# Underwriting Strategy

- Limiting aggregate risk/geographic spread
  - Grow w/o exceeding capacity
  - Reduce where exceeded capacity (i.e., new business limitations)
  - Risk optimization
- Risk selection
  - Select better risks
  - Engineering / loss control
  - Encourage risk mitigation
- Deductibles / limits / policy language
  - Minimum deductibles
  - Restrict coverage for appurtenant structures/loss of use
  - Restrict against perils
    - (e.g., exclude flood, mold exclusions, mold sub-limits)

# Underwriting Strategy (cont'd.)

- Profit consideration versus reinsurance costs
- Other considerations
  - Agency considerations
  - Account rounding
  - Legislative restrictions on eliminating exposure



# Ratemaking Considerations

- Expected costs
- Non-modeled events
- Risk charges
  - Capital charge
  - Volatility charge (e.g., standard deviation)
  - Uncertainty charge
- Reinsurance risk charge
- Mitigation/retrofitting credits
- Coverage changes
- Rating variables
- Rating geography
  - Site specific or territories
  - Subsidizations vs. adverse selection
- Deductibles/limit costing

# Reinsurance Strategy

- Reinsurance solutions
  - Pro rata
  - Per risk
  - Catastrophe coverage
- Capital market solutions
  - Securitization/swaps
- Cost considerations
  - Cost of capital versus reinsurance
- Retentions/limits
  - How much should I buy?



# Modeling and Exposure Management Issues

- Data quality
- Sub-perils (flooding, storm surge, typhoon spun tornadoes, fire following earthquake, mold)
  - Separating fire versus storm surge, earthquake vs. fire following
- One event or two?
- Building codes
- Pollution, debris removal
- Demand surge
- Business interruption (influence by other risks, time to repair, power outages)
- Fraud
- Regulators changing coverage
- Liability issues (failure to provide reasonable care, failure or moorings, poor construction)
- Health issues (unclean water, decaying bodies)
- Reinstatement premiums
- Global warming/cycle adjustments

# **Catastrophe Exposure Management Needs An End-to-end Risk Management Solution**

