Catastrophe Modeling

Anup Jindal
COO, RMSI
Agenda

- CAT Modeling Concepts
- CAT Modeling: Case Study
- CAT Risk: Emerging Issues for India
- CAT Risk Management
CAT Modeling Concepts
Insights from recent CAT events

Japan Earthquake and Tsunami Event

- “We can only work on precedent, and there was no precedent,” said Tsuneo Futami, a former Tokyo Electric nuclear engineer who was the director of Fukushima Daiichi in the late 1990s. “When I headed the plant, the thought of a tsunami never crossed my mind.” - New York Times

Thailand Flood Event

- “McCauley said a study last year carried out jointly by the Manila-based ADB, the World Bank and the Japan International Cooperation Agency forecast the flooding in Thailand -- but did not predict how soon it would come."The floods that we saw in Thailand are consistent with what's predicted to occur as a result of climate change," he said – ABS CBN News

New Zealand Earthquakes

- “It’s not a new fault in the sense that it has only just been created but it is a new fault that has only just been discovered,” Dr Roger Musson, head of seismic hazards and archives at the British Geological Society, told The Independent. “Some fault lines are very easy to see but the one under Christchurch is covered by sediment and would have been invisible without thorough geophysical searches.” – The Independent
What Are Catastrophes?

- Single events that produce such a large number of claims – that it is very highly improbable such an event would actually occur
- Usually resulting from a special type of peril either natural or man made: hurricane, earthquake, terrorist attack, etc.
CAT Versus Non-CAT Experience

Hypothetical Example Of Characteristic Non-Catastrophic Experience Pattern

Hypothetical Example Of Characteristic Catastrophic Experience Pattern

Source:
CAT Experience

- Uncertainty of losses – Huge variation in losses over the years
- Highly correlated losses – Year 2005 losses were primarily in Mumbai region

Economic Damage due to floods in India (US million $)

Source: EM-DAT
The Need for CAT Modeling

Given the uncertainty inherent to CAT events…

- How to identify, quantify or at least estimate the chance of a CAT event occurring and the likely losses from such an event?

- How to set premiums that yield a profit and avoid unacceptable level of loss?

- How to analyze risk in a portfolio of exposures and decide on appropriate risk transfer mechanisms?

- How to assess the financial strengths of insurers who take on CAT risks?

If not answered correctly, the implications can be catastrophic …
CAT Modeling Framework

- Stochastic Module
- Hazard Module
- Exposure Module
- Vulnerability Module
- Socio Economic Module
CAT Modeling Framework

Define Earthquake Hazard
(Seismic Sources, Recurrence, Attenuation, Soils)

Earthquake Recurrence
Attenuation Relationship
Soil Mapping Schemes

Define Inventory Characteristics
(Structure Location, Value, Year Built, Construction Class, etc.)

Estimate Inventory Damage
Through Historical Loss Data, Engineering Data, Expert Opinion

Fragility
(Before and After Mitigation)

Calculate Economic Loss
Expected Loss or WCL to Insurer and Homeowner

Inventory Exposure

Source: Grossi
Output of CAT models – EP curves

- Probability that loss will exceed $L$

- Reinsurance Layer

- Loss, $L$ (in Dollars)

Source: Grossi
## EP Curves – Simple Example

<table>
<thead>
<tr>
<th>Event (E_i)</th>
<th>Annual probability of occurrence (p_i)</th>
<th>Loss (L_i)</th>
<th>Exceedance probability [EP(L_i)]</th>
<th>E[L_i] = (p_i * L_i)</th>
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<tbody>
<tr>
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<td>8</td>
<td>0.0500</td>
<td>800,000</td>
<td>0.1903</td>
<td>40,000</td>
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<tr>
<td>9</td>
<td>0.0500</td>
<td>700,000</td>
<td>0.2308</td>
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<tr>
<td>10</td>
<td>0.0700</td>
<td>500,000</td>
<td>0.2847</td>
<td>35,000</td>
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<td>11</td>
<td>0.0900</td>
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<td>0.3490</td>
<td>45,000</td>
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<tr>
<td>12</td>
<td>0.1000</td>
<td>300,000</td>
<td>0.4141</td>
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<td>13</td>
<td>0.1000</td>
<td>200,000</td>
<td>0.4727</td>
<td>20,000</td>
</tr>
<tr>
<td>14</td>
<td>0.1000</td>
<td>100,000</td>
<td>0.5255</td>
<td>10,000</td>
</tr>
<tr>
<td>15</td>
<td>0.2830</td>
<td>0</td>
<td>0.6597</td>
<td>0</td>
</tr>
</tbody>
</table>

**Average Annual Loss (AAL) = $760,000**

Source: Grossi_1,2
EP Curves – Simple Example
Output of CAT models – EP curves

Probability that loss will exceed L

Uncertainty in Exceedance Probability

Uncertainty in Loss

Loss, L (in Dollars)

Source: Grossi
EP Curves – Uncertainty in losses

Source: Grossi
Risk Modeling – RMSI Continuum of Models

- Desktop study, catalogue review
- Reconstruct Historical Events
- Historical Risk Maps
- Probable Maximum Loss
- Full Probabilistic Models
- Coupled numerical models

- Quake
- Cyclone
- Flood
- Drought
- Climate Change
CAT Modeling – Case Study
Types of CAT Risks in India

- Geological/geo-physical risks
  - Earthquake, Landslide

- Hydro-meteorological risks
  - Rapid onset disaster (Flood, Cyclone)
  - Slow onset disaster (Drought)
  - Coastal risks assessment – sea level rise
  - Avalanche
Modeling Catastrophe Risk in Select States of India

- A World Bank initiative
- A pilot study for catastrophe risk management
- Strategic intent – risk transfer
- RMSI study objectives
  - Risk assessment
  - Inputs for decision-making
- Deliverables
  - A detailed report
Study Scope and Complexity

- **Assets:**
  - Housing
  - Public infrastructure
    - Educational buildings
    - Medical buildings
    - Roads & bridges

- **Perils:** earthquake, cyclone & flood

- **States:** Gujarat, Maharashtra, Orissa & Andhra Pradesh

- **Results:**
  - Exposure databases
  - Hazard/Risk mapping
  - Potential costs of disasters

- **Resolution:** Block

- **Derivatives:** District and State
CAT Modeling Methodology - Exposure

- **Exposure**
  - Buildings
    - RES
    - Com
    - Ind.
  - Infrastructure
  - Demographics
  - Agriculture

- **Transportation**
  - Rail
  - Bridges
    - Road Rail
  - Buses
    - Bus Depot
  - Roads
    - NH
    - SH
    - MDR
    - VR

- **Critical Facilities**
  - School
  - Medical
  - Police
  - Fire station
  - EOCs

- **Utilities**
  - Potable Water Pipeline
  - Gas Pipeline
  - Sewage
  - Cooking gas
  - Electricity
    - TL, SubStn
  - Communication
  - Oil – Petrol/Diesel
Resolution

Gujarat state map
(184.3k sq. km/
71.16k sq. mi.)

District map (25)

Block map
(184)
CAT Modeling Methodology – Hazard

EARTHQUAKE HAZARD MODULE

Major Historical Events

Earthquake Data
- Catalog
- Seismo - tectonic data
- Other

Seismic Sources
- Subduction Sources
- Crustal faults

Seismicity Parameters
- Magnitude distribution
- Rate of occurrence
- Maximum magnitude

Stratified Sampling

Stochastic Event Set
- Location
- Size
- Rate

Ground Motion Model
- PGA, PGV, PGD

Ground Motion Footprint
- By events
- VRG grid level

Local Soil Conditions

Calibration
- Reconstruction of historical events

Ground Motion Hazard Maps
- By return period
- VRG grid level

Liquefaction Potential
Covered in vulnerability module
Probabilistic Framework for Risk Modeling - Earthquake

Where?
How large?
How often?

How strong are the ground motions?
How do they attenuate?
How are they amplified?

Where is the exposure?
What is its value?
What types of buildings?

How are the buildings damaged?

What are the financial implications to local/provincial federal govt. stakeholders, insurers and reinsurers?
Seismicity Catalog Development for India

- Indian Society of Earthquake Technology (ISET), Roorkee 1668 to 1979
- USGS significant events 1063 to 1984
- USGS/NEIC (PDE) 1973 - 2004
Ground Motion Attenuation

- Peninsular India
  - Toro et al. (1997) modified
  - Singh et al. (2003)
- Himalayas and Northeast region
  - Boore, Joyner and Fumal (1997) modified
- Koyna region

2001 Bhuj Mw7.6 Intensities

Ahmadabad structure, post-Bhuj
Hazard Module

- Intensity of earthquake at a location
  - Attenuation from source to location
    - Magnitude
    - Depth
    - Earthquake mechanism
  - Local soil condition

- Collateral hazards
  - Liquefaction
  - Landslide
Hazard Mapping

100 year Return period earthquake hazard map of Gujarat

100 year Return period earthquake hazard map of Maharashtra
Flood Hazard Model

Probabilistic Risk Model
Runoff based
Multi-Variate Extreme Value Analysis
Durations (1 to 7 day)

Stochastic Events

Inundation Model
1D Analysis
Flood Extent and Depth

Calibration
Reconstruction of Historical Events

Satellite Flood Images

Flood Extent and Depth
By Return Period
Municipal Level

GIS Input
DEM
River
Cross-sections
Roughness
Historical Floods

Andhra Pradesh

Orissa
Model Calibration

- Gumbel extreme value distribution for annual peak flows
- Generate discharge events for key return periods.
- Generate steady state water surface profiles using HEC – RAS.
- Determine flood extent and flood depth at grid level resolution

![Graph of Gumbel's Method for River Krishna at Vijayawada, Andhra Pradesh, India](image)
GIS data & Processing

- Stream Centerlines
- Bank Lines
- Flow Path Lines
- Cross-Cut Lines
- TINs

TIN Sample
Flood Hazard Map for river Mahanadi delta
Wind Hazard Model – Structure of a Tropical Cyclone

- Descending Dry Air
- Eyewall
- Eye
- Rain Bands

Source: COMET
Parameters Defining a Cyclone

- Storm Track
- Forward Velocity
- Heading at Landfall
- Central Pressure
- Radius to Maximum Wind
- Filling Rate after Landfall
Terrain Features Affecting Wind speeds

- Surface roughness and fetch affect wind speed estimation.
  - Rougher terrain cause larger frictional effects on the wind speed
  - Distance or “fetch” over which wind travels over land from “effective” coastline
Modeled Block level Wind speed (Orissa 1999)
Exposure Mapping
Distribution of Exposures

Value (Million USD)

- ANDHRA PRADESH
- GUJARAT
- MAHARASHTRA
- ORISSA

- Housing
- Roads & Bridges
- Education
- Medical
Assessing Vulnerability

Assessment of Vulnerability through exposure data

- **Structural (physical)**
  - Infrastructure
    - \( V = f \) [Types of infrastructure (age, construction materials), Type of utilities/facilities (age, wall and roof types)]
    - Risk Value = \( f(V, \text{damage to hazard}) \)

- **Non-structural (biological)**
  - Indicator/Proxy based approach
    - \( V = f(\text{Rainfall (drought, wet spells), Duration and Distribution}, \text{Temp (low/high – above normal conditions), duration and intensity}) \)
    - Risk Value = \( f(V, \text{damage to hazard}) \)

Loss estimate (in USD) = Risk Value \( \times \) value of exposure (in USD)
CAT Modeling Methodology - Vulnerability

HAZARDS

HAZARD ZONATION

ELEMENTS AT RISK

VULNERABILITY

VULNERABILITY ASSESSMENT

RISK ASSESSMENT

Persons
Structures
Landuse
Activities & Functions

Human Vulnerability
Structural Vulnerability
Content Vulnerability
Functional Vulnerability
Vulnerability Module- Inventories

- Buildings: residential, education & medical
  - Source: Census 1991 projected to 2001
- Roads & bridges: NH, SH, MDR, ODR, VR
  - Source: Remote sensing images

Housing inventory in Gujarat

Housing inventory in Maharashtra
Earthquake – Physical Vulnerability Model

- Use vulnerability curves developed for regions of similar building types and construction practices as a starting point
- Calibrate against available data for historical events
- Ensure logical relativities between construction and occupancy types
- Leverage knowledge from empirical data and analytical modelling in other regions
Flood – Physical Vulnerability Model

Step 1 – Study Flood Damage
Sources of data
- Flood forces (analysis)
- Flood vs. building damage (inspection)
- Claims

Step 2 – Components Damage
- Doors, Windows
- Wall finish
- Wall cabinets etc..

Step 3 – Building Damage
- Construction material
- Construction practice
- Rebuild cost

Step 4 – Damage Function
- Residential, Commercial, Industrial & Agricultural LOBs
- Buildings, Contents & BI

RMSI Private Limited – Proprietary & Confidential
Vulnerability Functions (Wind)

- RC Building with Tile roof
- RC Building with RC slab roof
- General RC Building
- Brick Building with RC slab roof
- Brick building with Tile roof
- General Brick Masonry Building

Wind speed

Damage Ratio
Historical Events Loss Validation (Cyclones)

- 1 Crore Rs ~ 250,000 USD
Financial Module

- Loss analysis
  - Average Annual Loss (AAL)
  - Loss Cost
  - Exceeding Probability loss (EP)
    - Aggregate EP (AEP)
    - Occurrence EP (OEP)
- Probable Maximum Loss (PML)
Cyclone Average Annual Loss

[Map showing cyclone average annual loss in Andhra Pradesh and Gujarat]
Annual Loss Exceeding Probability Curves

Earthquake Loss EP Curves for Housing in Gujarat

- Housing EP losses due to earthquakes in Gujarat
## Average Annual Loss

- **AAL in million USD**

<table>
<thead>
<tr>
<th>State</th>
<th>Peril</th>
<th>Housing</th>
<th>Public Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>CY</td>
<td>44.1</td>
<td>17.1</td>
</tr>
<tr>
<td></td>
<td>FL</td>
<td>16.2</td>
<td>5.5</td>
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<tr>
<td>GJ</td>
<td>EQ</td>
<td>14.9</td>
<td>1.9</td>
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<tr>
<td></td>
<td>CY</td>
<td>21.9</td>
<td>4.1</td>
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<tr>
<td></td>
<td>FL</td>
<td>16.1</td>
<td>5.9</td>
</tr>
<tr>
<td>MR</td>
<td>EQ</td>
<td>2.5</td>
<td>0.5</td>
</tr>
<tr>
<td>OR</td>
<td>CY</td>
<td>22.6</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>FL</td>
<td>4.0</td>
<td>4.0</td>
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</tbody>
</table>
## Probable Maximum Loss

- 150-year loss considered as PML
  - Loss in million USD and as % of total exposure

<table>
<thead>
<tr>
<th>State</th>
<th>Peril</th>
<th>Housing</th>
<th>Public Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>CY</td>
<td>733 (1.69%)</td>
<td>203 (0.47%)</td>
</tr>
<tr>
<td></td>
<td>FL</td>
<td>142 (0.33%)</td>
<td>49 (0.11%)</td>
</tr>
<tr>
<td>GJ</td>
<td>EQ</td>
<td>669 (1.41%)</td>
<td>76 (0.16%)</td>
</tr>
<tr>
<td></td>
<td>CY</td>
<td>461 (0.97%)</td>
<td>61 (0.13%)</td>
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<tr>
<td></td>
<td>FL</td>
<td>155 (0.33%)</td>
<td>71 (0.15%)</td>
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<tr>
<td>MR</td>
<td>EQ</td>
<td>49 (0.06%)</td>
<td>9 (0.01%)</td>
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<tr>
<td>OR</td>
<td>CY</td>
<td>290 (1.93%)</td>
<td>177 (1.18%)</td>
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<tr>
<td></td>
<td>FL</td>
<td>63 (0.42%)</td>
<td>67 (0.45%)</td>
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</table>
Management of Hazard Risks

- Integrate Disaster Risk Management into the national, regional, and local economic development process
- Undertake detailed risk and vulnerability assessment studies to gather accurate information for ex-ante pre-hazard risk management
  - What is the country’s hazard exposure
  - What is the nature of hazards and their disruptive characteristics
  - Where is the risk concentrated
  - What can be the economic and social losses
  - Who are the people at risk – individuals and groups
  - What economic activities are vulnerable
How to manage Climatic (Hydro-met) Risks?

What does “Vulnerability to Climate Change“ mean?

Change in hazard -> Vulnerability to hazard -> Change in risk

Global Climate -> Flood -> Flood risk

Global Climate -> Drought -> Drought risk

Global Climate -> Storm -> Storm risk

Climate related risk
CAT Modeling – Emerging Issues for India
India is one of the most NatCat prone countries in the world

- 89.1% of global natural catastrophe victims in 2009 were in Asia
- 38.5% of global economic damage from natural catastrophes was in Asia followed by Americas (32.1%) and Europe (24.8%)
- 4th ranking for India both for number of natural disasters and economic damages in 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>Disaster distribution</th>
<th>Damages (US$ Bn.)</th>
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<tbody>
<tr>
<td>United States</td>
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<td>10.8</td>
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<td>China P Rep</td>
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<td>5.2</td>
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<td>France</td>
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<td>3.2</td>
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<td>2.6</td>
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<td>Indonesia</td>
<td></td>
<td>2.4</td>
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<td>Spain</td>
<td></td>
<td>1.9</td>
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<td>Australia</td>
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<td>1.5</td>
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<td>Japan</td>
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<td>1.4</td>
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<tr>
<td>Viet Nam</td>
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<td>1.1</td>
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</tbody>
</table>

Sources: EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Universiteit Catholique de Louvain – Brussels – Belgium
Floods have caused maximum economic damage.

### Economic Damage from NatCat events in India from 1900 - 2010

<table>
<thead>
<tr>
<th>Event</th>
<th>No. of events</th>
<th>Fatalities</th>
<th>Economic Damage ($ B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>232</td>
<td>60,218</td>
<td>31.9</td>
</tr>
<tr>
<td>Storm</td>
<td>151</td>
<td>1,64,112</td>
<td>11.1</td>
</tr>
<tr>
<td>Earthquake</td>
<td>32</td>
<td>78,387</td>
<td>5.1</td>
</tr>
<tr>
<td>Drought</td>
<td>14</td>
<td>42,50,320</td>
<td>2.4</td>
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<tr>
<td>Extreme Temperature</td>
<td>47</td>
<td>13,801</td>
<td>0.5</td>
</tr>
<tr>
<td>Epidemic</td>
<td>68</td>
<td>45,43,874</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

*Source: EM-DAT*

### Economic Damage Distribution

- **Flood**: 62%
- **Storm**: 10%
- **Earthquake**: 10%
- **Drought**: 5%
- **Extreme Temperature**: 22%
- **Epidemic**: 1%
Distribution of flood risk zones
Distribution of flood risk zones
Distribution of wind storm risk zones
Distribution of windstorm risk
Distribution of earthquake hazard risk zones
Distribution of earthquake hazard risk zones
Impact of socio-economic changes

India’s unprecedented urbanization will have profound impact on vulnerability to natural catastrophes

McKinsey Global Institute Study predicts that by 2030:

- 590 Million people will live in cities which is nearly twice the population of the USA today
- 5 large states will have more people living in cities than villages (Tamilnadu, Gujrat, Maharashtra, Karnataka, Punjab)
- 68 cities will have population of more than 1 million, up from 42 today
- 69 % of India’s GDP will come from cities
- 4 fold increase in disposable per capita income in urban areas
  - Per capita income in Mumbai Metropolitan Region will increase to $8000 p.a from $1800 p.a. today
- 700 to 900 million square feet of residential or commercial space will need to be built every year from now onwards
Delhi – Case Study

- Delhi’s population is projected to grow to 22.5 Million by 2035
- North East, Central, East districts of Delhi have the highest population density
- Yamuna River - bed section, extending till NOIDA and Faridabad, is more vulnerable to damage even by a moderate earthquake because it is on alluvial soil up to 200 meter deep
- Large parts of east Delhi are low lying areas that have developed right behind flood embankments
- According to Delhi State Disaster Plan in the eventuality of a 1 in 100 year frequency flood, all these embankments would fail to meet the requirement
Yamuna riverbed in 2001
Yamuna Riverbed in 2010
Flood threat in Delhi - 2010

- ‘This Friday, Delhi braces for worst flood since 1978’ – Times of India, September 9th, 2010
- Water level in river Yamuna reached 206.83 meters, which is 2 meters above danger level
- Flood waters rise by the newly constructed Commonwealth Games village

![Flood waters in Delhi](attachment:image.jpg)
Impact of Climate Change on India

Modeled change in max. Temperature and rainfall in 2071-2100 compared to 1961-1990 time period

Source: RMSI, 2009
Climate change will impact crop yields in India

Source: RMSI, 2009
Key findings of the OECD - RMSI study

- In a SRES A2 upper bound climate scenario the likelihood of 2005 type could more than double by 2080
- Losses due to a similar event could triple just due to climate change, rapid urbanization and other socio-economic changes will only worsen the situation
- Frequency of rainfall events that cause smaller floods will increase
- Climate change adaptation can significantly reduce projected losses
## Top 20 cities ranked in terms of population exposed to coastal flooding in the 2070s

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INDIA</td>
<td>Kolkata (Calcutta)</td>
<td>1,929,000</td>
<td>14,014,000</td>
</tr>
<tr>
<td>2</td>
<td>INDIA</td>
<td>Mumbai (Bombay)</td>
<td>2,787,000</td>
<td>11,418,000</td>
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<tr>
<td>3</td>
<td>BANGLADESH</td>
<td>Dhaka</td>
<td>844,000</td>
<td>11,135,000</td>
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<tr>
<td>4</td>
<td>CHINA</td>
<td>Guangzhou</td>
<td>2,718,000</td>
<td>10,333,000</td>
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<tr>
<td>5</td>
<td>VIETNAM</td>
<td>Ho Chi Minh City</td>
<td>1,931,000</td>
<td>9,216,000</td>
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<tr>
<td>6</td>
<td>CHINA</td>
<td>Shanghai</td>
<td>2,353,000</td>
<td>5,451,000</td>
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<tr>
<td>7</td>
<td>THAILAND</td>
<td>Bangkok</td>
<td>907,000</td>
<td>5,138,000</td>
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<tr>
<td>8</td>
<td>MYANMAR</td>
<td>Rangoon</td>
<td>510,000</td>
<td>4,965,000</td>
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<td>20</td>
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<td>Jakarta</td>
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Top 20 cities ranked in terms of assets exposed to coastal flooding in the 2070s

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Urban Agglomeration</th>
<th>Exposed Assets, Current ($Billion)</th>
<th>Exposed Assets, Future ($Billion)</th>
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<tr>
<td>1</td>
<td>USA</td>
<td>Miami</td>
<td>416.29</td>
<td>3,513.04</td>
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<td>Guangzhou</td>
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<td>New York-Newark</td>
<td>320.20</td>
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<td>Kolkata (Calcutta)</td>
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<td>Shanghai</td>
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<tr>
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<td>EGYPT</td>
<td>Alexandria</td>
<td>28.46</td>
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</tbody>
</table>

CAT Risk Management
Three Pronged Approach for Managing NatCat Risk

- **Exposure Management**
  - Identify & manage accumulations
  - Monitor new submissions against existing exposure in hazard zones

- **Scenario loss modeling**
  - Manage losses of benchmark scenarios to “acceptable” loss levels

- **Probabilistic loss modeling**
  - Assist underwriters in risk selection
  - Evaluate reinsurance needs and options
  - Determine key drivers of risk
Framework for Understanding re/insurance Risk

Core Process

Data Source → Input to system → Exposure Analysis → Enhance Data → Cat Model Analysis

Re-insurance → Alternate Risk Transfer
Exposure Management

Interrogate the data

- Managing exposures
- Managing capacity
- Underwriting guidelines
- Monitoring aggregates
Which exposures are in the zones of high risk from Earthquake?
How to minimise potential losses?

- Understanding location attributes
- Managing accumulations of exposure
- Managing loss accumulations
- Developing underwriting rules in respect to your capital allocation
- Understanding the frequency and severity of losses
- Purchasing adequate cover via reinsurance or alternate risk transfer
How to use enhanced exposure information for competitive advantage?
Profiler for Insurance Exposure and Risk
What Applications Make Actuaries Care About Catastrophes?

- Ratemaking for policies exposed to catastrophes
- Reserving for long tail catastrophic losses
- Analyses of reinsurance programs
- Analyses of insurer catastrophe risk, such as catastrophic return period loss estimates
Better risk management using CAT modeling

- Provides clearer understanding of geographical distribution of natural hazards both in terms of frequency and severity
- Quantifies potential losses
- Identifies key risk drivers
RMSI Today

- Asia’s leading provider of CAT risk management solutions
- Ranked Best Employer in India for three years in a row (2007, 08, 09) by Economic Times - Great Places to Work® study
- Over 1200 professionals in India
- Presence across India: Noida (National Capital Region), Hyderabad, Dehradun, Navi Mumbai, Jaipur
- Ranked amongst Indian IT industry’s Top 20 employers for six years in a row
- Quality certifications - SEI CMMI Level 5, ISO 27001 and ISO 9001:2000
- Clients in Indian insurance include reinsurers, direct insurers and brokers
- RMSI’s PIER (Profiler for Insurance Exposure & Risk) Solution for the Indian Insurance adjudged the “Technology Initiative of the Year” at the 15th Asia Insurance Awards, 2011
Thank You!

Email: anup.jindal@rmsi.com