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南洋理工大學



Institute of Catastrophe Risk Management

Characteristics of Asia's Natural Catastrophe Risks

presented by

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NCREE Tainan Lab Grand Opening Forum, Tainan, Taiwan

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Contents

- Cost of Natural Catastrophes
- Emerging Risks of Asia – MegaCities
 - Exposure Growth
 - Industry Clusters
 - Population Increase
 - Urban Expansion
 - Dynamics of Urban Infrastructure Risk



Meinong, Taiwan Earthquake (M_L 6.4) - 2016.02.06

Scienc Park /
TSMC & UMC



Building / Infrastructure



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Transportation
System

Typhoon Megi, Taiwan - 2016.09.27

- Evacuation: 14,000 people
- Blackout: 5 mil households
- Agriculture: NT\$3.4b (USD 107m)
- Schools: 814 campuses, NT\$ 160m (USD 5m)

Infrastructure



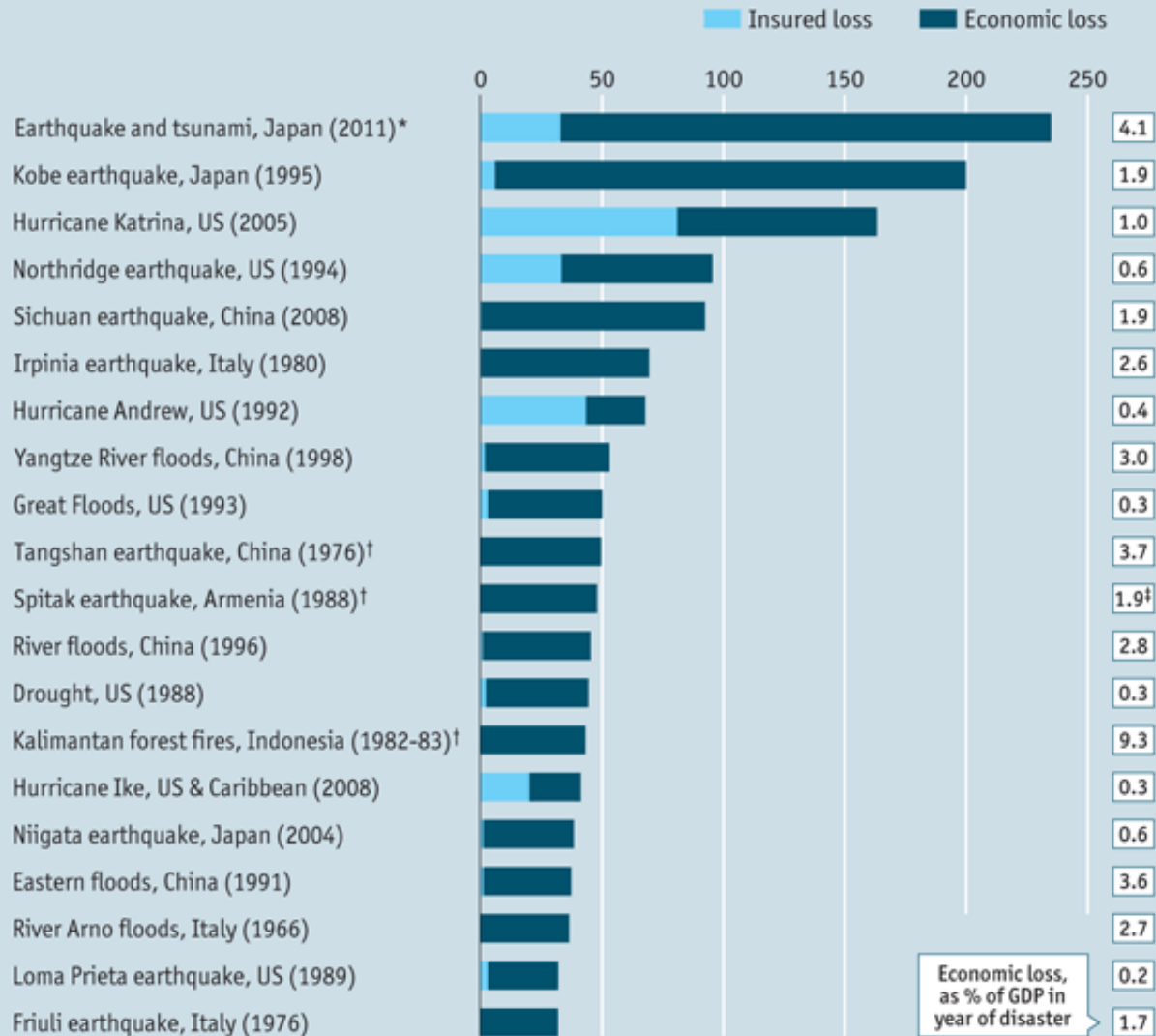
Transportation System



Natural Disasters: Counting the Cost

World's costliest natural disasters since 1965

2010 \$bn



Sources: Munich Re; IMF;
World Bank; *The Economist*

*Provisional †Insured loss unavailable
‡Soviet Union's estimated GDP



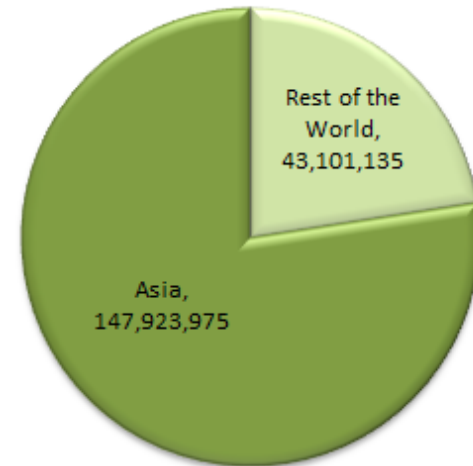
Earthquake Loss of Asia (1960-2016)

Number Killed



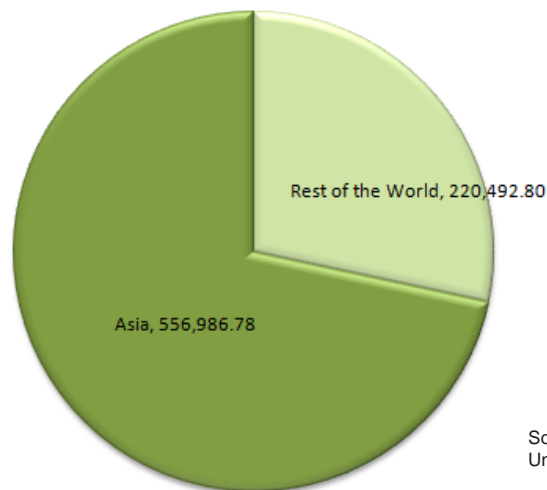
Total = 2,576,105

Number Affected



Total = 191,025,110

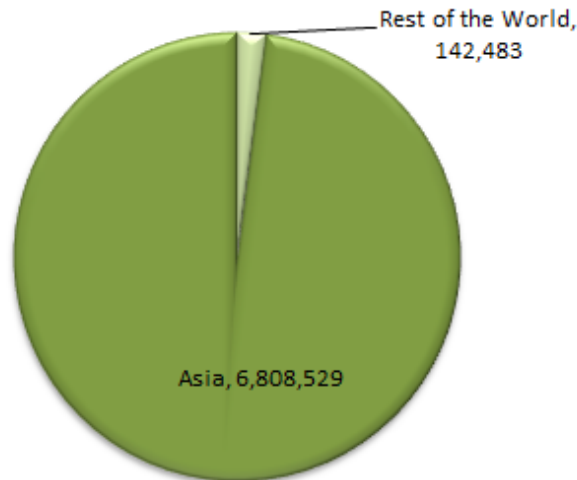
Estimated Damage (USD \$ 1,000,000)



Total = 777,479.58

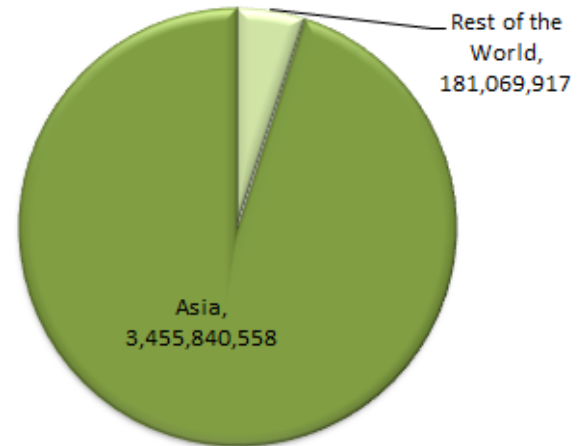
Flood Loss of Asia (1960-2016)

Number Killed



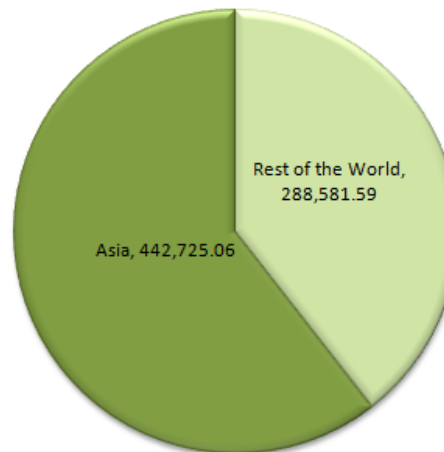
Total = 6,951,012

Number Affected



Total = 3,636,910,475

Estimated Damage (USD \$ 1,000,000)



Total= 731,306.65



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Source: EM-DAT: The OFDA/CRED International Disaster Database
Université Catholique de Louvain, Brussels, Belgium (www.emdat.be)

ASEAN Needs to Pool Disaster Risk Management Fund

- Natural Disasters eat up a chunk of economic growth in the Association of Southeast Asian Nations (ASEAN):
 - In the last 20 years, Average Annual Cost is as high as USD 56 billion, more than doubled for the 3 years from 2011 to 2013.
 - Tohoku Earthquake and Tsunami in 2011,
 - Thai Floods in 2011, and
 - Typhoon Yolanda in 2013
- A Disaster Risk Management Fund which can strengthen financial resilience would be beneficial for the countries in the region.

by Iwan J. Azis, Office of Regional Economic Integration, ADB, 2014



Why the Focus on Asia?

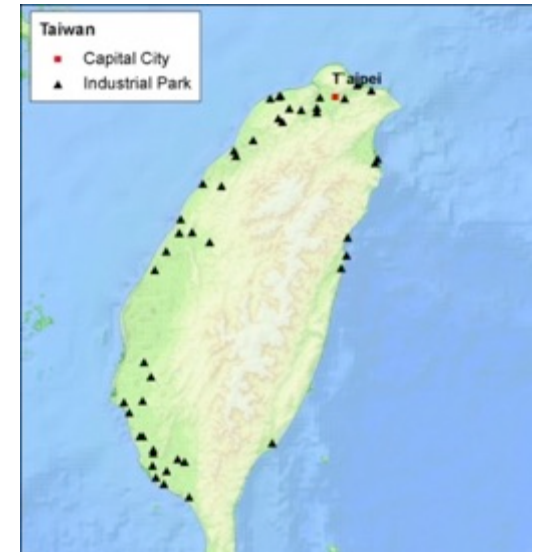
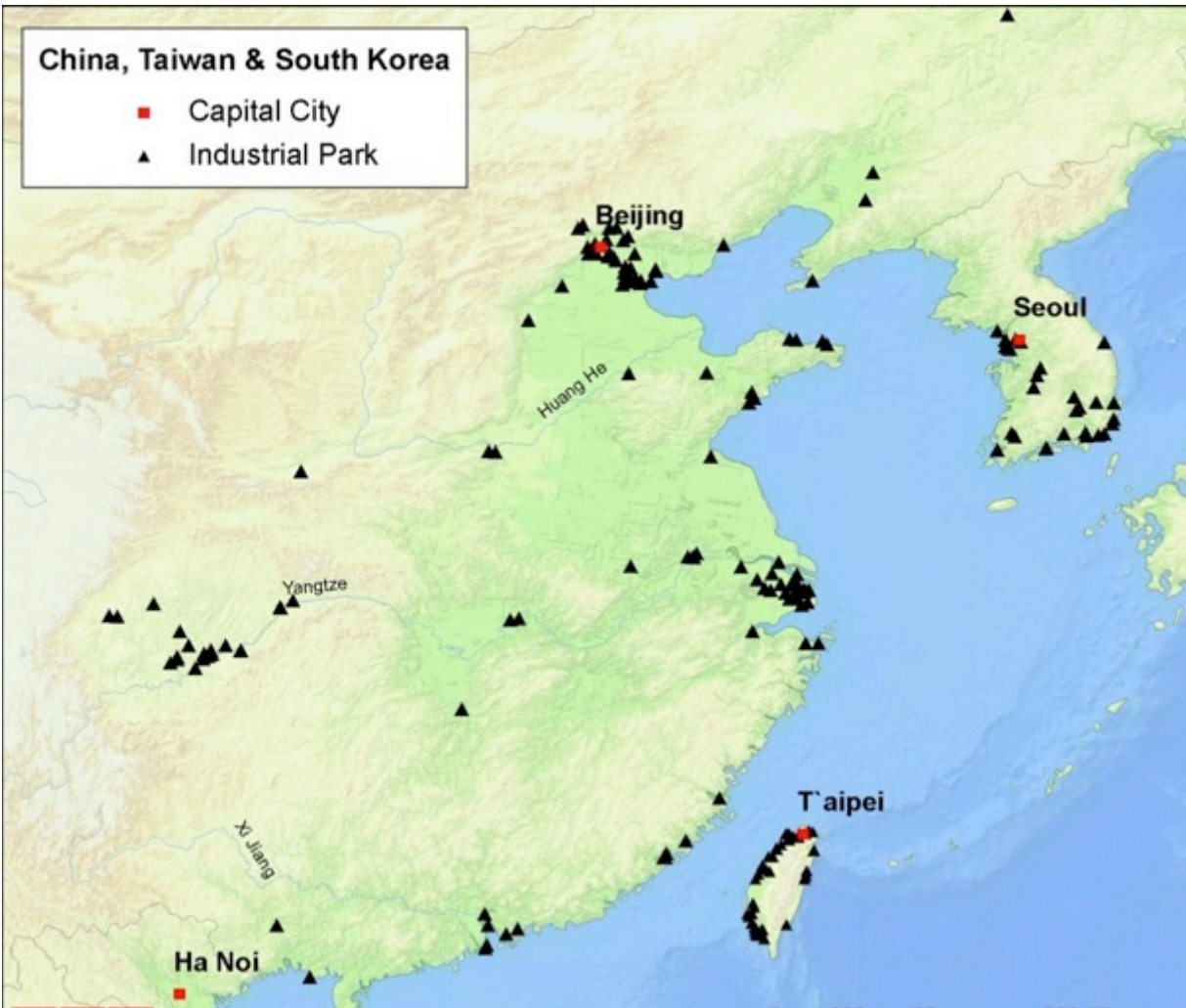
- Asia has the *largest growth of real assets and urban centers* on Earth. This has exacerbated the problems of Catastrophe Risks.
- Asia is home to the *largest number of 'poor' people* of the world. Catastrophe micro-insurance products need to be developed.
- Historically, Asia has suffered the most due to catastrophic events, but has the least amount of safety net or *risk transfer mechanisms*.
- *Climate change* issues will potentially impact Asia more than any other continent.
- Catastrophe *insurance penetration is extremely low* in regions / countries in Asia (e.g. under 0.5% in India, Philippines and China).

'Competitive Advantage' of Business Clusters – Michael Porter (1990)

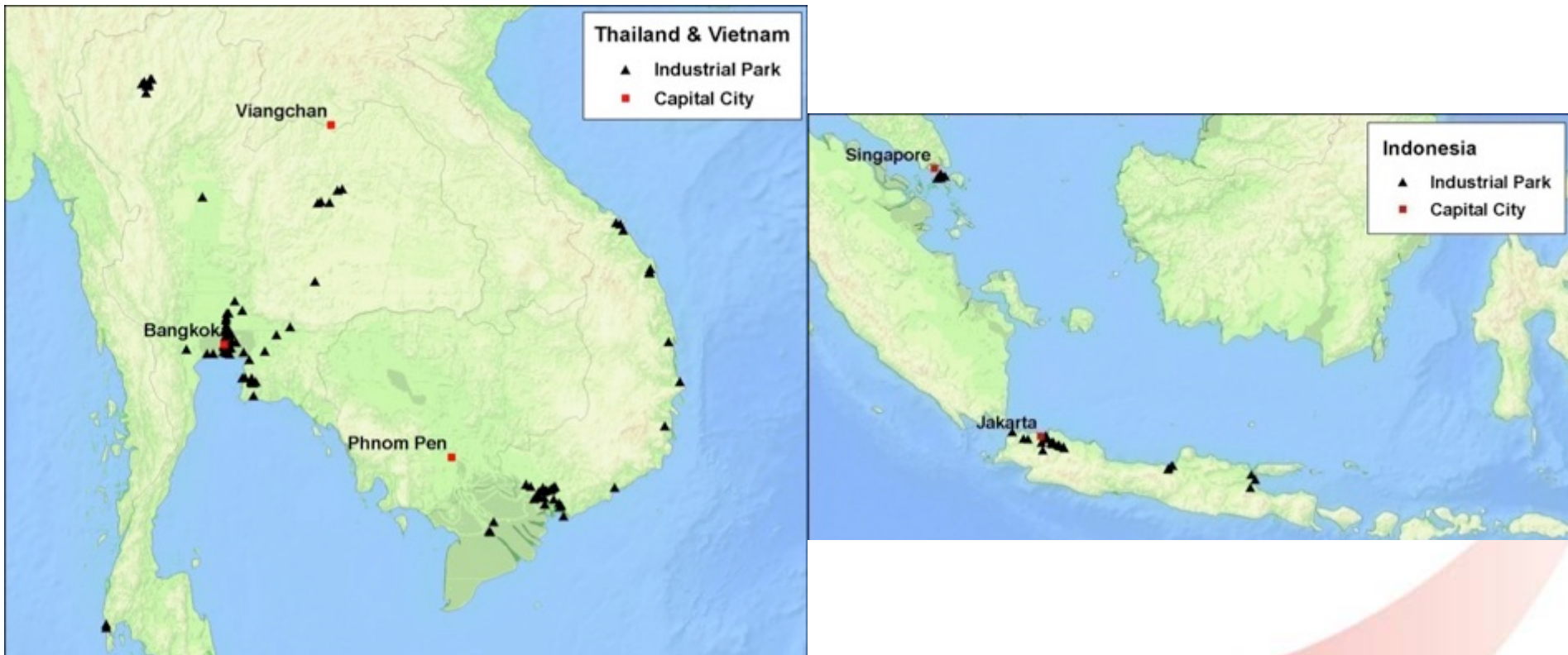
- Professor at Harvard Business School and the leading thinker around international business strategy
- Studied how sectorial 'business clusters' in developed countries had fostered competitive
- **The concentration of resources and competence in the cluster reaches a critical threshold such that industries outside will choose to relocate into the cluster to improve their competitiveness.**



Industrial Clusters in East Asia and Northeast Asia



and ... in Southeast Asia



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2011 Thai Floods – an unprecedented flood event?

Return period estimated to be 100+ year by the Danish Hydrological Institute

Has this happened before?



October 13, 1942 at Sanam Luang

System Shock – Network Topography of a Consumer Electronic Device



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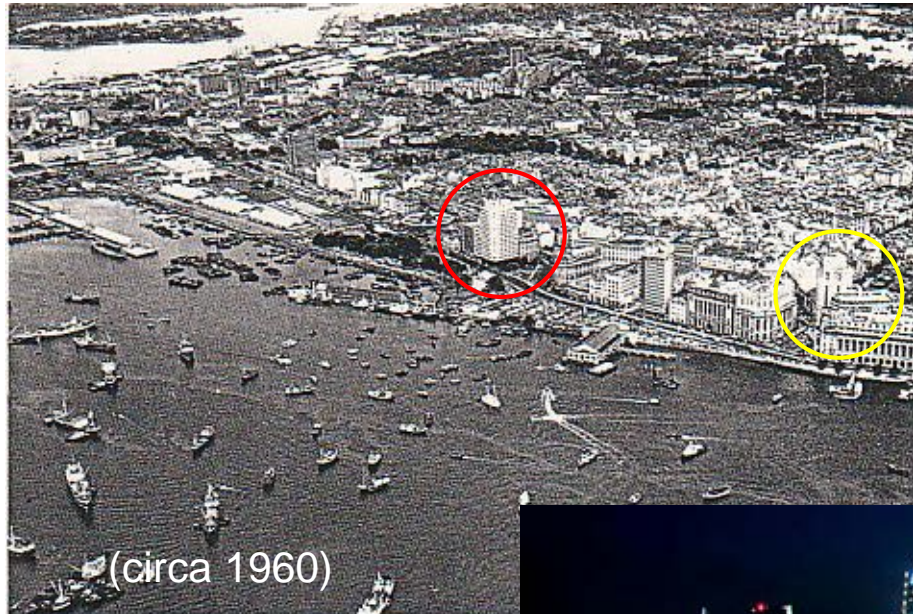
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**UNIVERSITY OF
CAMBRIDGE**
Judge Business School

**Centre for
Risk Studies**

Singapore's Waterfront Skyline



- Classic Change in Exposure due to Urbanization;
- Code for Earthquake Resistant Design of Buildings against earthquakes



GDP Growth of Shenzhen (深圳)

- When set up as a new city in 1979, GDP of Shenzhen was US\$30 million.
- 深圳1979年建市，当时GDP US\$30 millions。



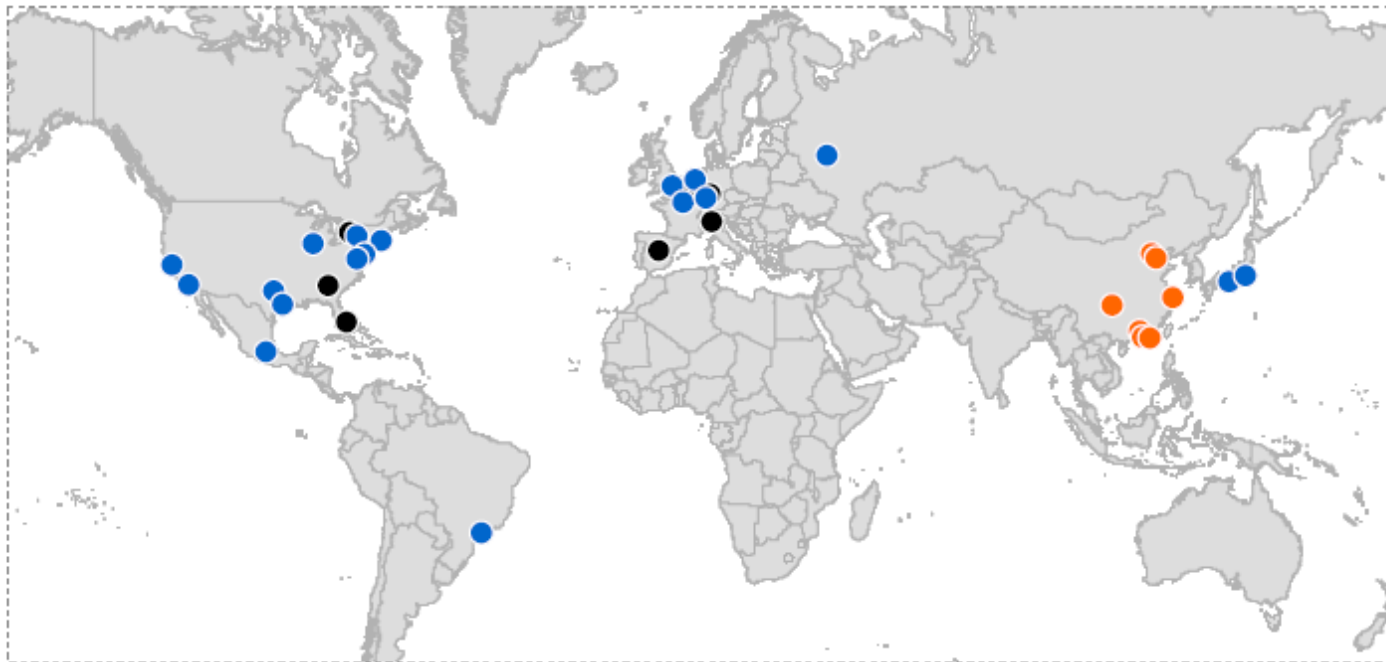
0 97 98 98 00 01 02 03 04 05 06 07 08 09 10
年份 (Year)

Asia Urbanization Driving Growth

There will be a major shift in urban economic weight from the United States and Western Europe toward Asia

Top 25 cities by GDP, 2007 and 2025¹

- Dropout—included in 2007 but not in 2025
- Top 25 in both 2007 and 2025
- Newcomer—absent in 2007 but included in 2025



¹ Predicted real exchange rate.

SOURCE: McKinsey Global Institute Cityscope 1.0

Learning from Tohoku Earthquake, Japan – *Multiple Hazards*

- Earthquake(s)
- Fires following earthquake
- Tsunami ensuing
- Nuclear Power Reactor Incidents induced



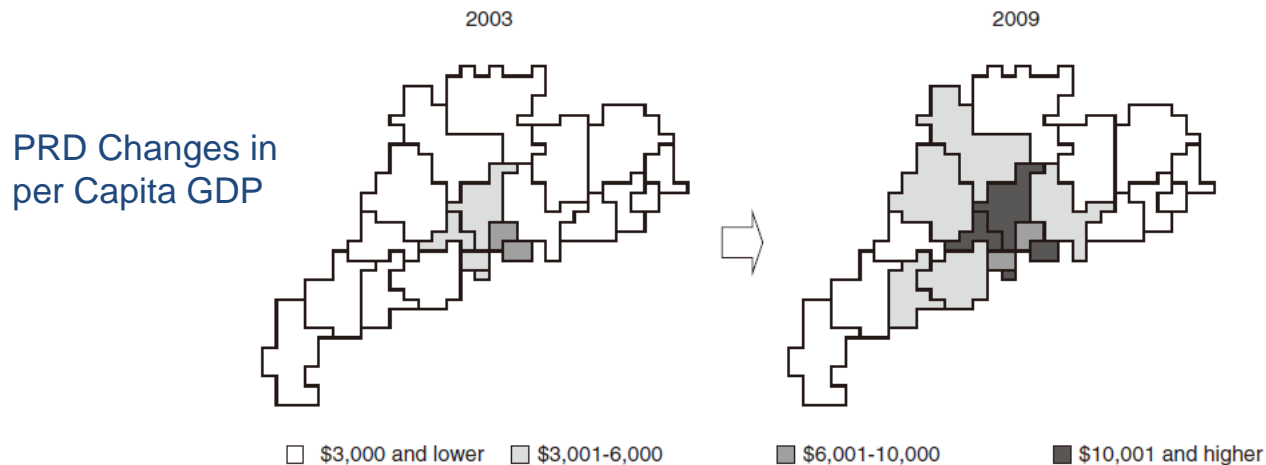
Pearl River Delta (PRD): Regional Risk Assessment Programme

- Risk Assessment of Earthquake, Flood and Wind Related Hazards
 - One of China's fastest growing region with Mega Cities
 - To establish a Regional R&D programme collaborating with universities in China and Hong Kong



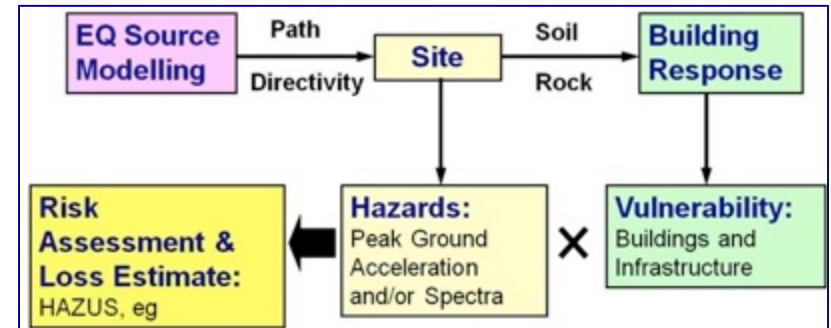
Pearl River Delta (PRD): Regional Risk Assessment Programme

- PRD Area: 41,698 km sq. (0.43% of China's area)
- PRD is one of the most vibrant economic regions. In 2010,
 - Real GDP of the PRD grew by an average of 12.2%
 - 4.2% of China's total population
 - 9.4% of China's GDP
 - 10.3% of China's gross industrial output
 - 27.4% of China's total export



Framework for Seismic Risk Assessment – challenges for PRD Region

- Evolving nature of catastrophe risk management for a region of megacities with rapid economic growth, e.g. Pearl River Delta (PRD) region in Southern China
- Most catastrophe risk models to date are for a single peril-based catastrophes, ie localized systems.



- The Challenges ahead:
 - **Spatial Effects:** network of cities interacting as a complex dynamic system → **Socio-Economic Dimension** of Catastrophes
 - **Temporal Effects:** rapid economic growth and urbanization of megacities → **Future Loss** from Catastrophes

Characteristics of Catastrophe Risks in Asia

- ▶ Escalating Economic Exposures – Coastal Megacities
- ▶ Increasing Losses – Intensified Hazards
- ▶ Low Insurance Penetrations – Wider Protection Gaps, thus Higher Burden on Taxpayers

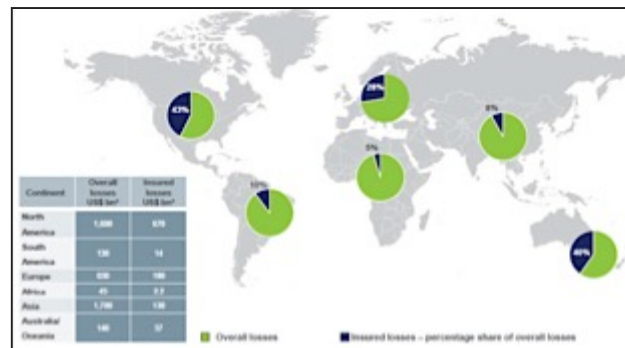


Top 10 Coastal Megacities exposed to flooding in 2070, OECD Graphic, Straits Times

Earthquake Loss
(1900-2016)
Estimated Damage (USD\$'000)



Flood Loss
(1900-2016)
Estimated Damage (USD\$'000)



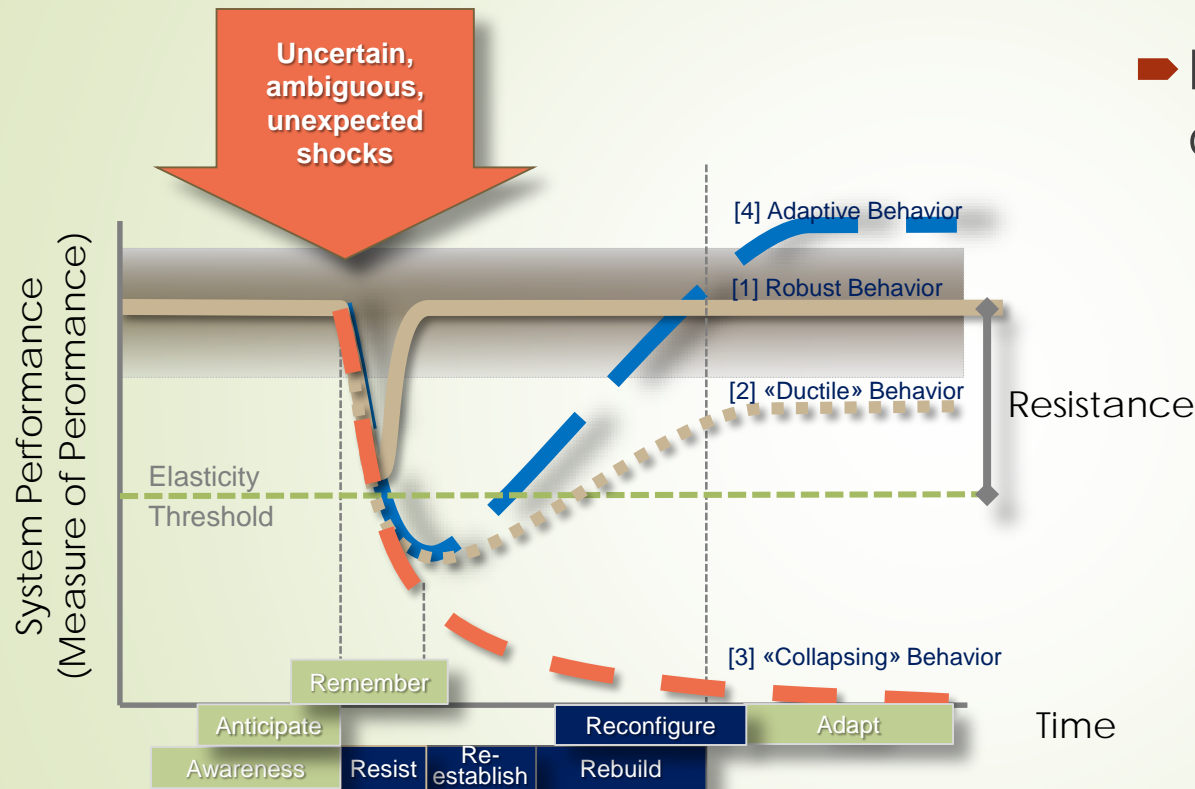
Insurance Penetration (1980-2014), NatCatService, Munich Re

Thank You!

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<http://icrm.ntu.edu.sg>



Resilience



- Exacerbated by coupling in particular
- "Bouncing back cycle" of biophysical systems
- Distributed cognitive processes of acquiring knowledge, understanding and initiating actions through senses, experience and thought, aka "people"