Case study from the region – Vietnam World Bank project

Explore how exposure database and catastrophe modelling helps a country's government and industry in catastrophe risk management

Prepared by Himavant Mulugu of Impact Forecasting

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Agenda

Section 1   Introduction

Section 2   Challenges

Section 3   Solutions

Section 4   Vietnam World Bank Project

Section 4   Conclusions
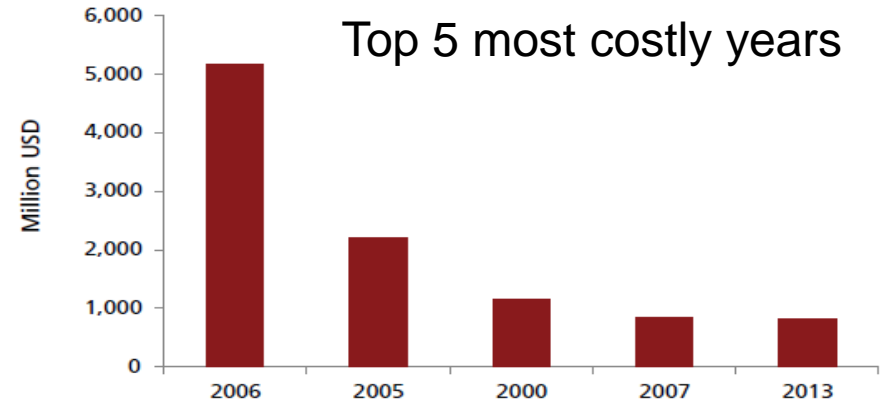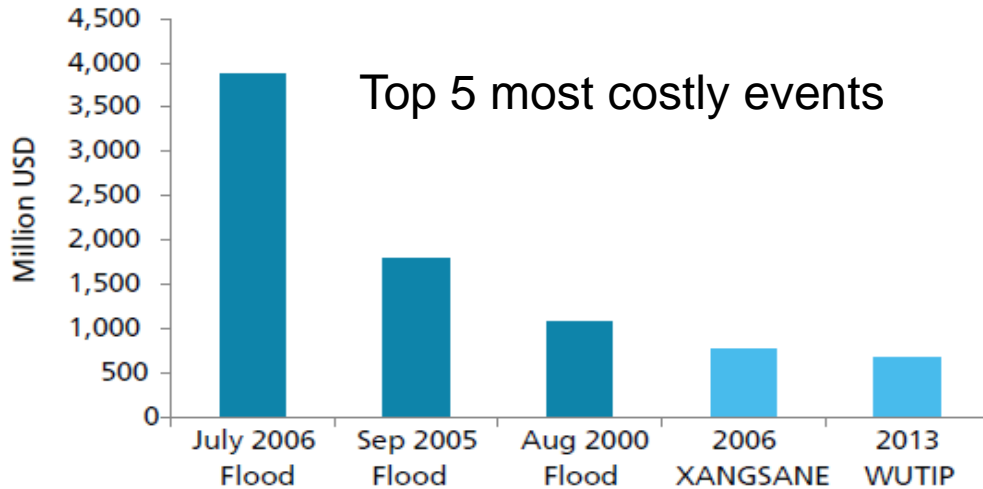
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Introduction

Vietnam is one of the world's most exposed countries to multiple natural hazards including typhoons, floods, earthquakes and drought – causing average annual economic losses of 0.8% of Vietnam's GDP.

To address this challenge, the World Bank stepped in to help the Government of Vietnam.

Impact Forecasting team was appointed to undertake a probabilistic catastrophe risk assessment and modelling for the quantification of the risk posed in Vietnam by earthquakes, typhoons and floods.

The goal of the study is to provide a basis for the design of a national strategy, and inform the Ministry of Finance, and especially the Insurance Supervisory Authority (ISA), in the development of a national disaster risk financing and insurance strategy, including the development of domestic catastrophe risk insurance
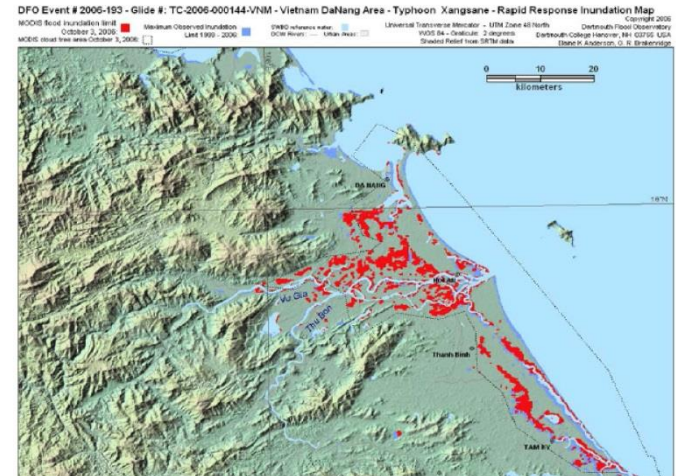
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Challenges – Cost of natural disasters

Top 5 most costly events

Top 5 most costly years

Source: Consequence database, including CCFSC, EM-DAT, etc.

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Challenges – The protection gap

APAC: Economic Loss
(2018 USD)

Legend:
- Drought
- Earthquake
- Flooding
- Wildfire
- Tropical Cyclone
- Severe Weather
- Winter Weather
- Other

Source: Impact Forecasting
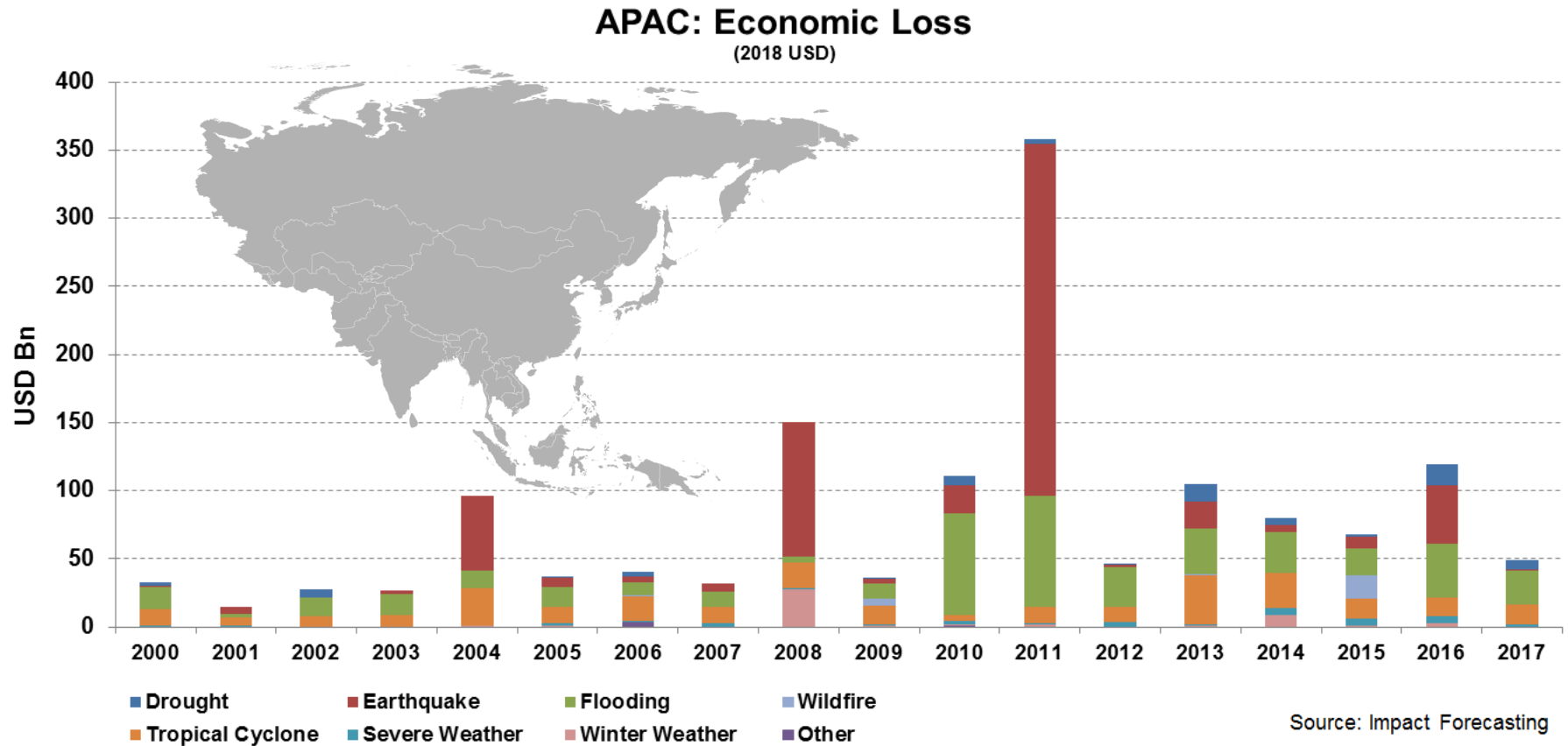
Challenges – The protection gap

% insured 2000 -2017
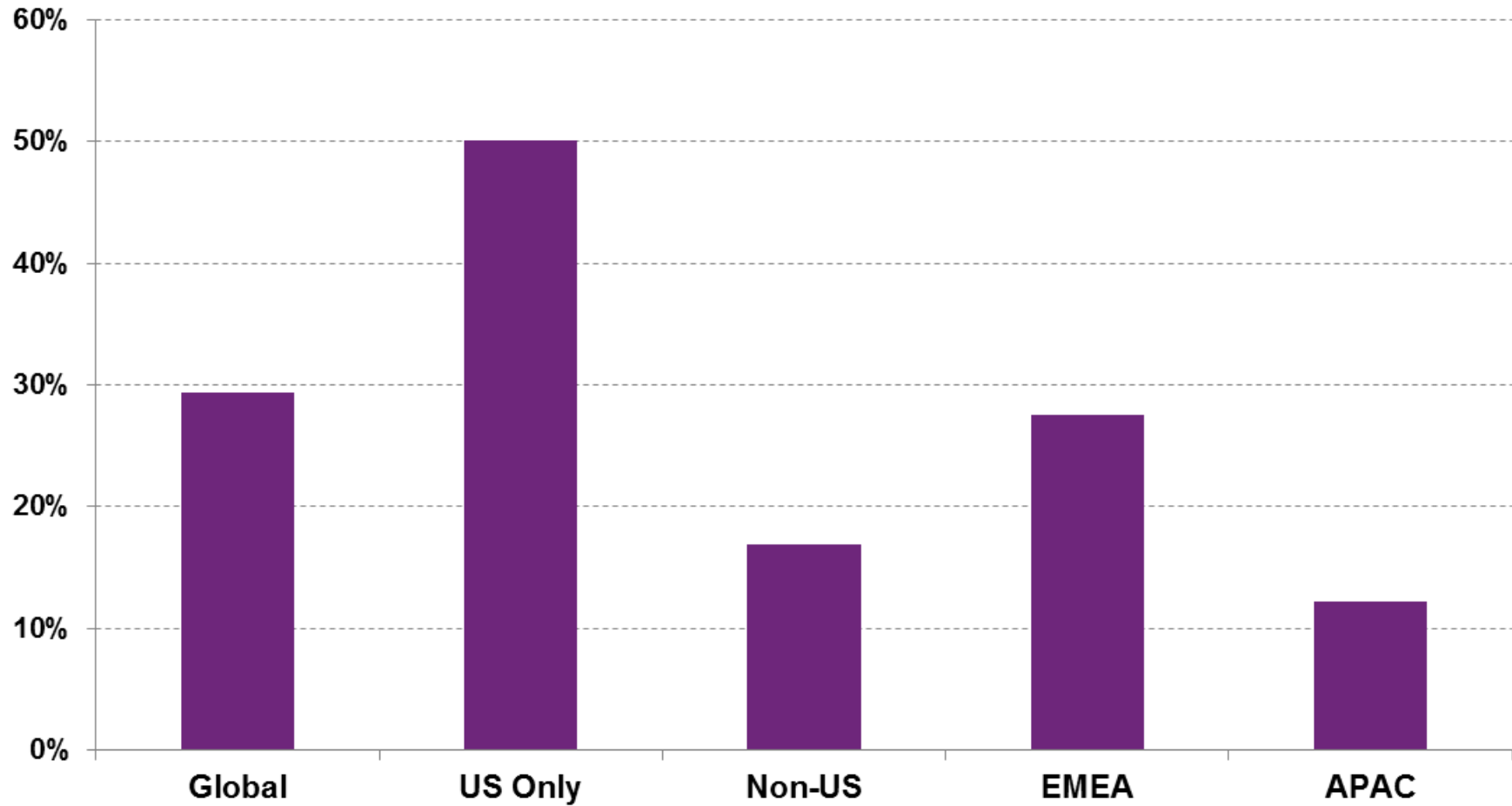
Challenges – Demand Side

Affordability

Appeal
&
Quality
of Products

Behavioral
Biases

Awareness

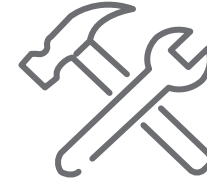Cultural
&
Social
Factors

Trust

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Challenges – Supply Side

No Historical data
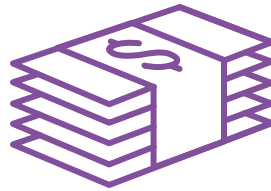
Transaction costs

No tools to quantify catastrophe risk

Regulatory and Institutional

Insurability

Regionally tailored product design

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Some examples

Micro insurance , Takaful
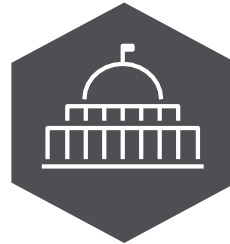
Distribution channels

Catastrophe pools

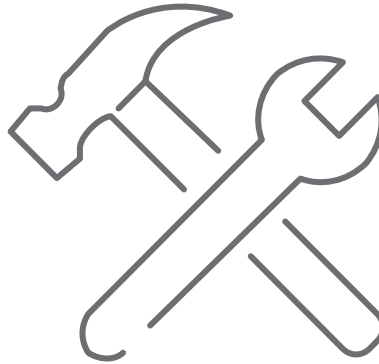**Public Insurance**

Parametric triggers

Public Private Partnerships

But……

Limited or NO tools to quantify catastrophe risk in the region

Why do governments need catastrophe risk models?

- Exposure
  - Population
  - Buildings (e.g., public)
  - Infrastructure (bridges, dams, ports, etc.)
  - Crops and Livestock
- Impact
  - Fatalities, injuries
  - Monetary losses
  - Resiliency
- Primary needs
  - Ex-ante risk assessment, mitigation and management
  - Emergency preparedness
  - Post-event response

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Cat risk models support risk management decisions
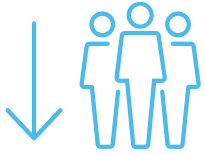
Risk Reduction

- Sector planning & Infrastructure retrofitting
- Education
- Building codes
- Risk mitigation works

Financial Protection

- Reserve mechanisms
- Risk transfer
- Insurance
- Budget appropriations
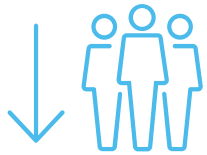
Preparedness

- Early warning systems,
- response & contingency, planning, response systems

Resilient Reconstruction

- Ensure reconstruction considers ALL risks
- Reconstruction & rehabilitation planning

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Cat risk models support risk management decisions

Risk Reduction
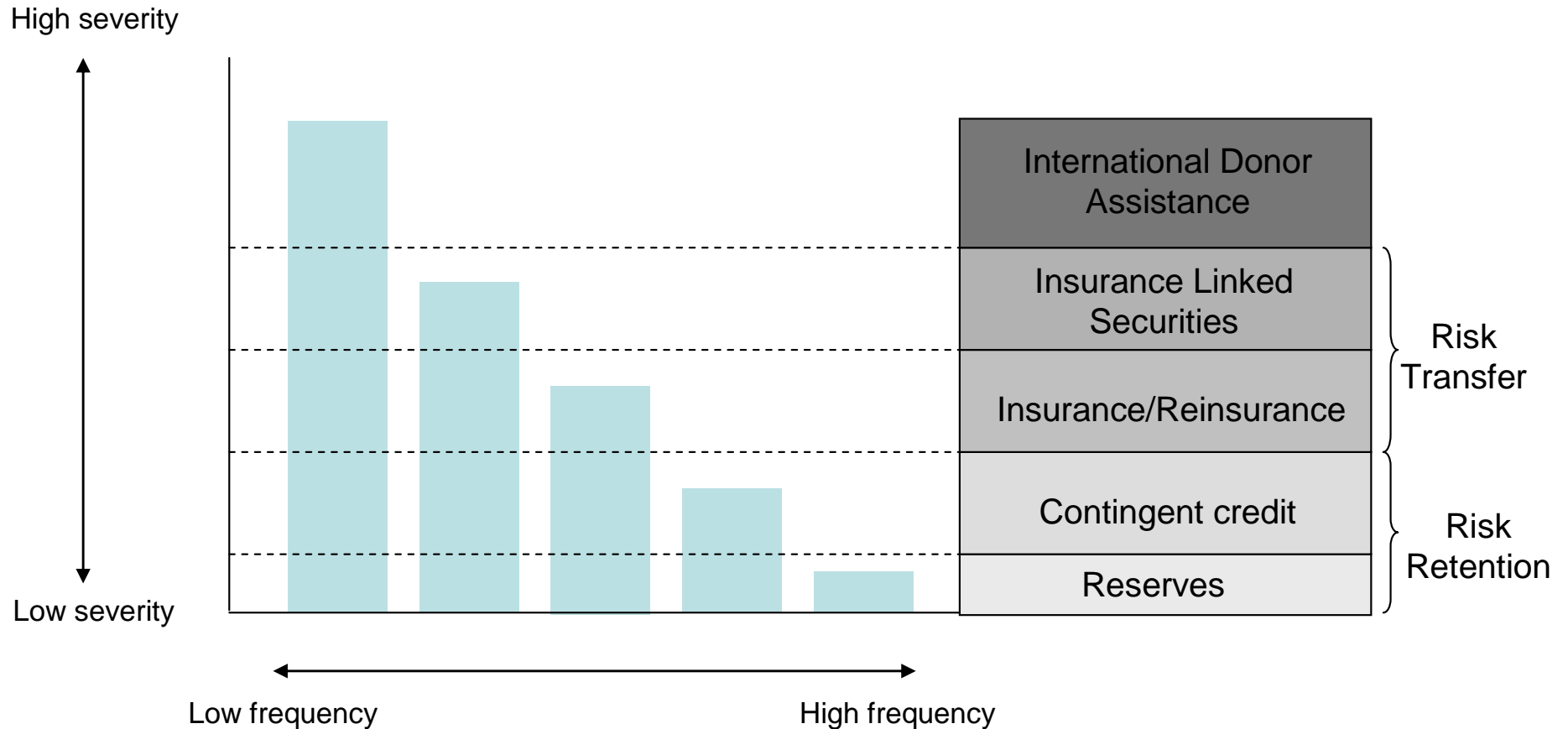
Financial Protection

Preparedness

Resilient Reconstruction

Risk Identification and Assessment

- Hazard Mapping/Modeling
- Quantification of Exposure and Vulnerability
- Risk Assessment
- Cost-Benefit Analysis
- Analysis of Disaster Financial Losses

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A country catastrophe risk management relies on an optimal combination of risk retention and risk transfer
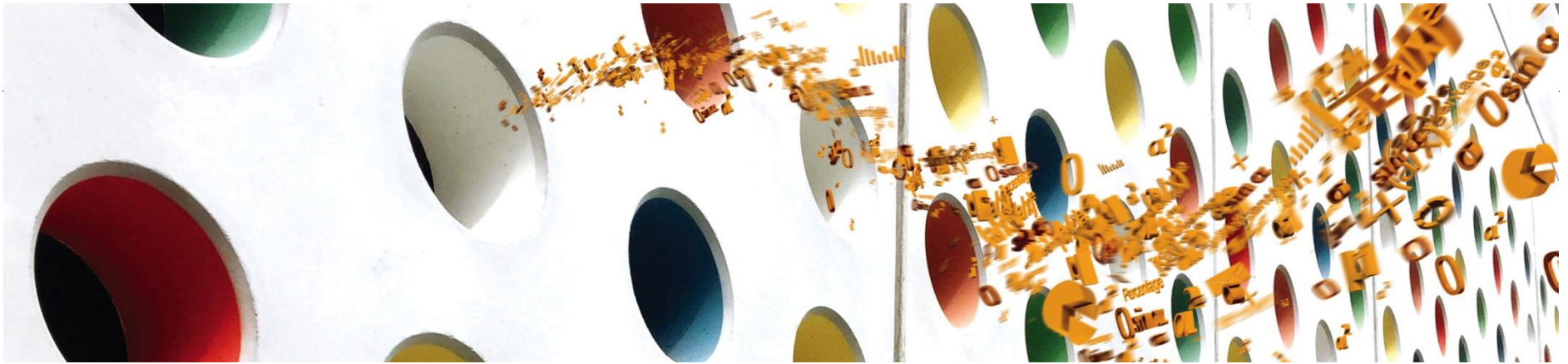
High severity

Low severity

Low frequency   High frequency

International Donor Assistance

Insurance Linked Securities

Insurance/Reinsurance

Contingent credit

Reserves

Risk Transfer

Risk Retention

Source: World Bank (2015)

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Objectives of the project

To provide a scientific basis for the development of:
- a national disaster risk financing and insurance strategy; and
- domestic catastrophe insurance

Ministry of Finance
- assessment of economic and fiscal impacts of disasters;
- managing budget volatility and contingent liability related to disasters

ISA – regulating and supervising cat risk insurance business

Insurance companies – designing, pricing and managing cat risk insurance products

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Project timeline

No	Activity	*Months 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	COMPONENT 1	█	█	█	█											
1	Historical event databases (catalogs)	▓	▓													
2	Consequence database and loss data	▓	▓													
3	Ancilliary hazard datasets and gap analysis	▓	▓	▓												
4	Deliverables - technical report, databases, e-library				▓											
B	COMPONENT 2			█	█	█	█	█	█							
5	Economics, statistics and costing of buildings			▓	▓											
6	Inventories of public and private assets			▓	▓	▓	▓	▓								
7	Vulnerability of physical assets					▓	▓	▓								
8	Initial outputs					▓										
9	Deliverables - technical report, databases, e-library							▓	▓							
C	COMPONENT 3					█	█	█	█	█	█	█	█	█	█	█
10	Hazard modules for flood, typhoon & earthquake					▓	▓	▓	▓	▓						
11	Vulnerability modules for all perils								▓	▓	▓	▓	▓	▓		
12	Model implementation, calibration and testing										▓	▓	▓	▓		
13	Loss profiles													▓	▓	
14	Peer review													▓		
15	Initial outputs										▓					
16	Deliverables - technical report, brochures, software, databases, manuals													▓	▓	▓

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Project Components

Component 1

Hazard data and loss data collection and management.

Component 2

Exposure data collection and management and vulnerability function development.

Component 4

Support for the placement of the financial transaction

Component 3

Catastrophe risk modelling and assessment

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Scope of the project

Perils

Resolution and scale
- Nationwide catastrophe risk assessment
- Focus on key cities
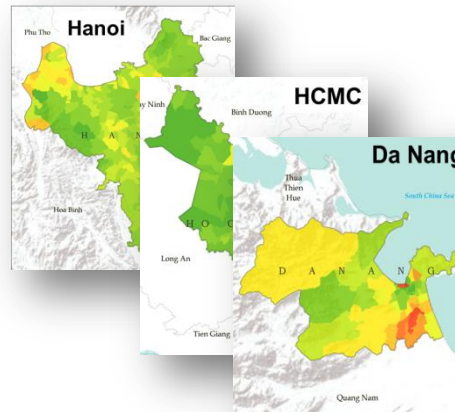
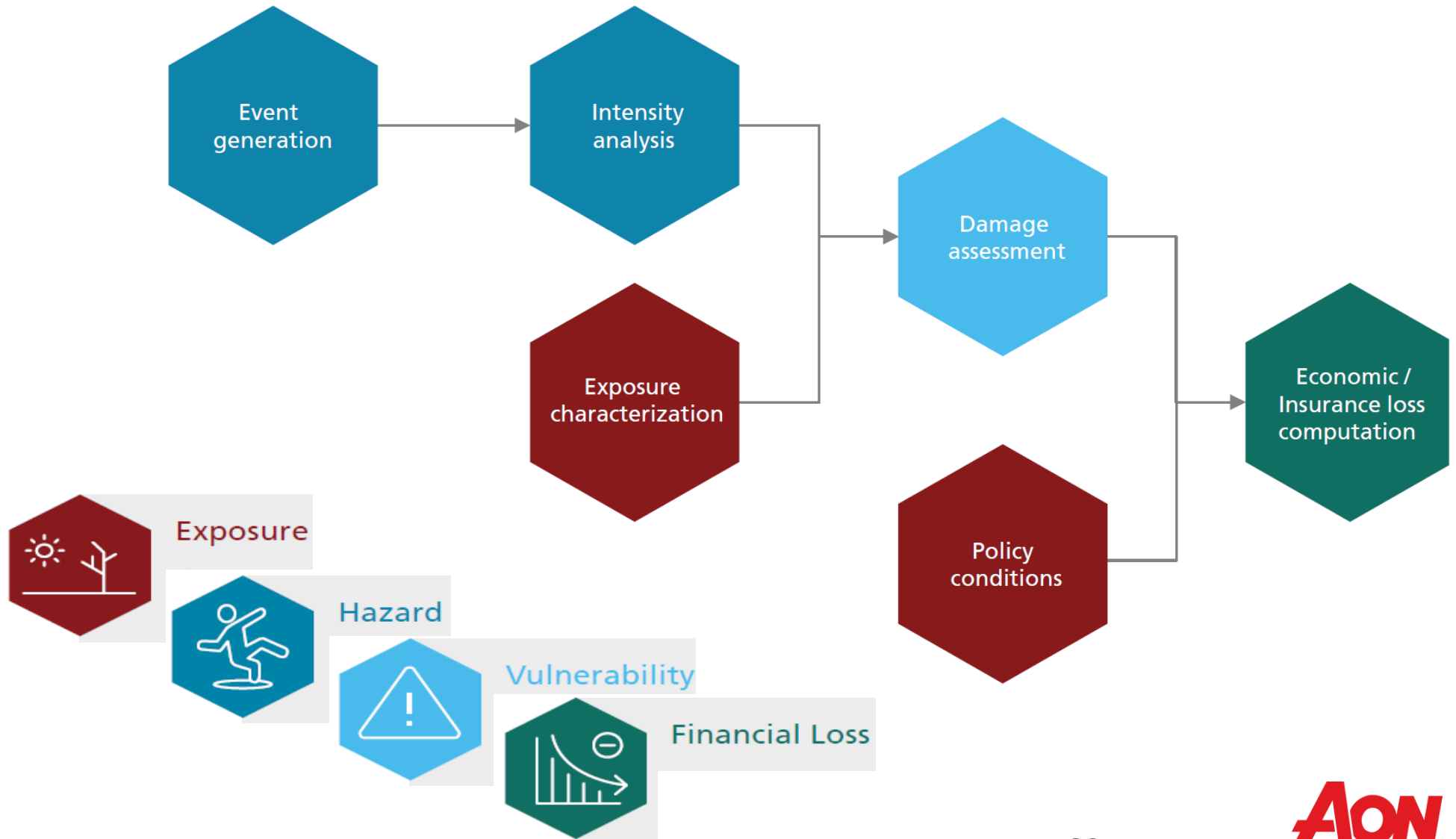**Exposures**

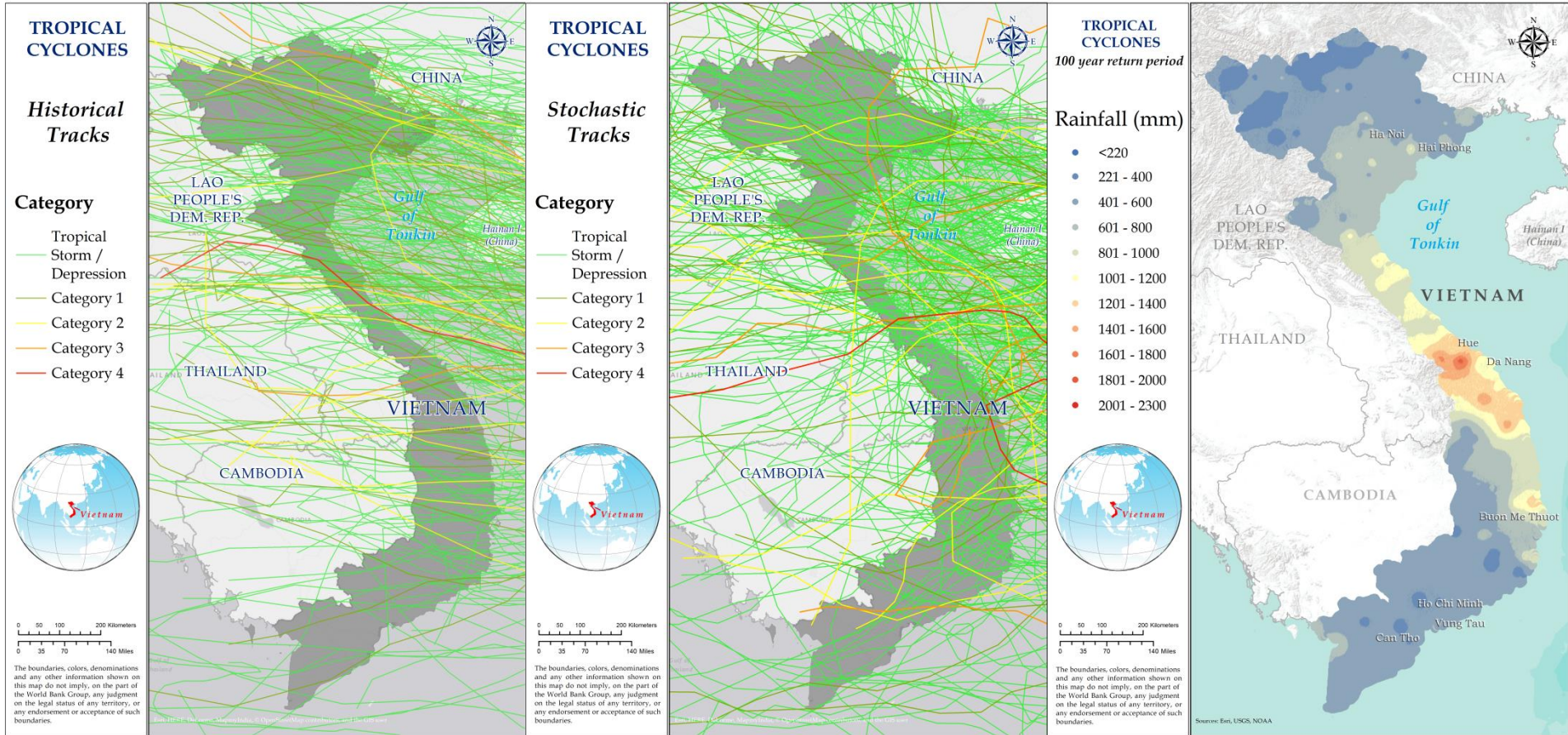Residential Commercial Industrial
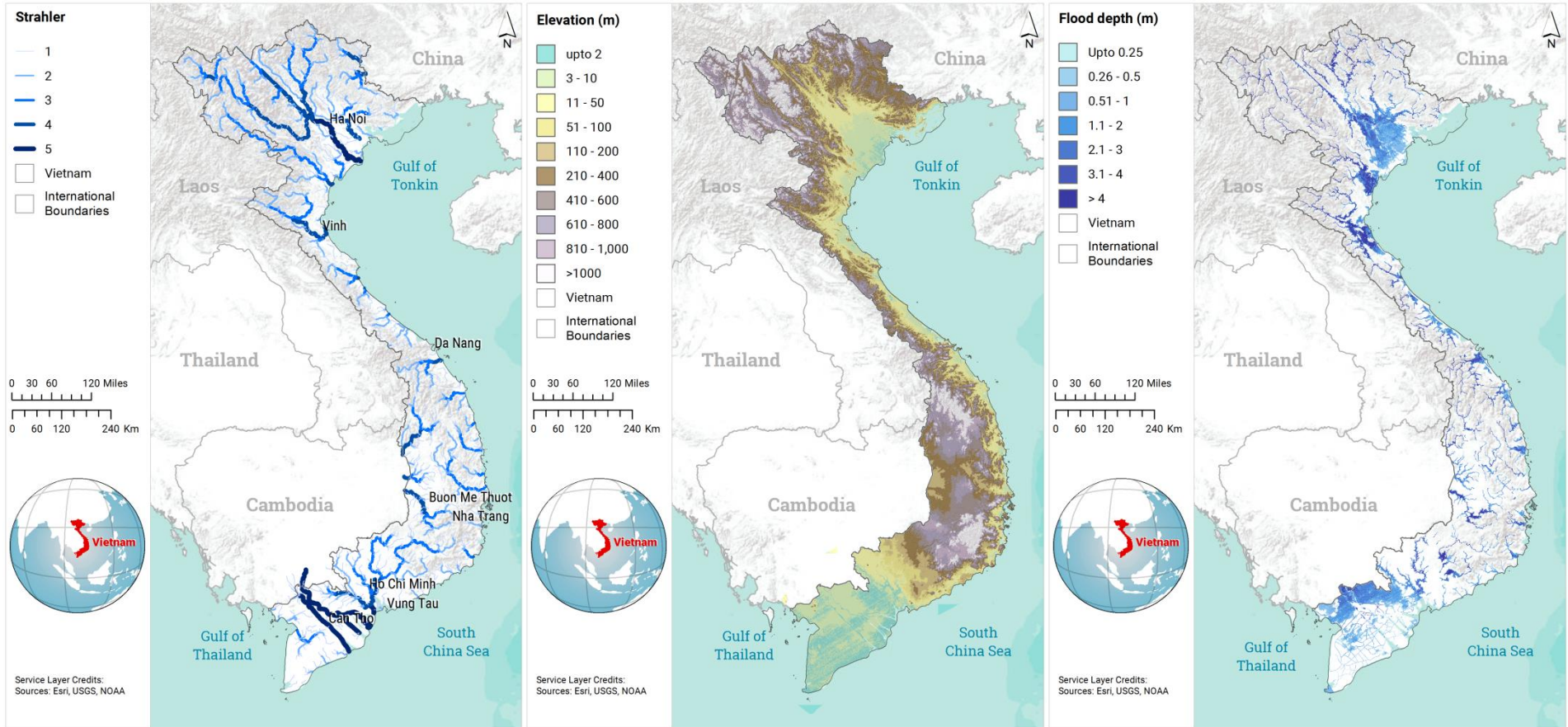
Population Public buildings Public infrastructure

Hanoi

HCMC

Da Nang

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Catastrophe modelling

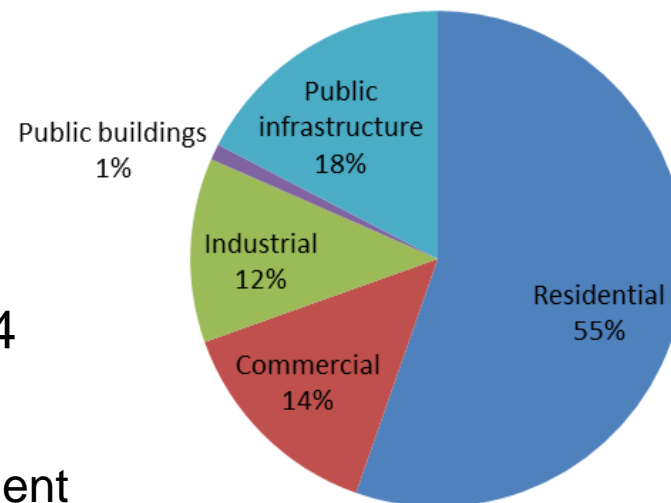# Hazard – Tropical Cyclones

Hazard – Flood

Hazard – Earthquake
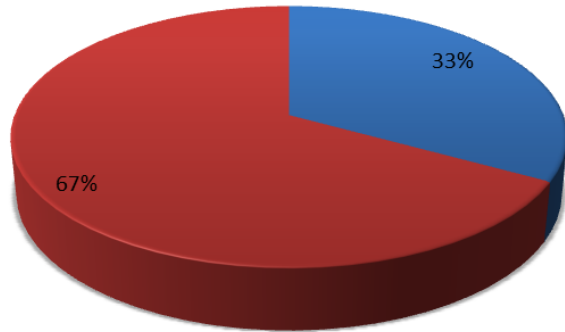
Exposure database

- **Exposure definition**
  - Structure and contents
  - Value as the replacement cost of asset
  - Number of risks/assets
- **Compiled at commune level as of Dec 2014**
- **Major sources**
  - Census: Population, Housing and Establishment
  - Unit costs from Ministry of Construction
- **Exposure classes**

Total economic exposure = USD 1.32 trillion

Pie chart values:
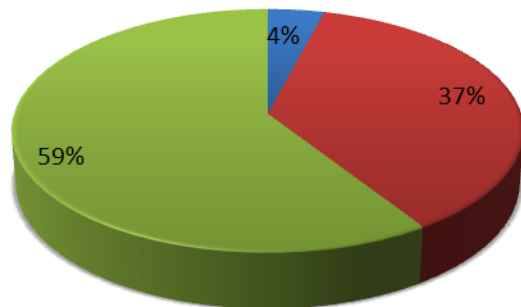- Public buildings 1%
- Public infrastructure 18%
- Industrial 12%
- Commercial 14%
- Residential 55%

Exposure class icons: Population | Residential | Commercial | Industrial | Public buildings | Public infrastructure

Residential exposure

Pie chart (top left):
- Urban 33%
- Rural 67%
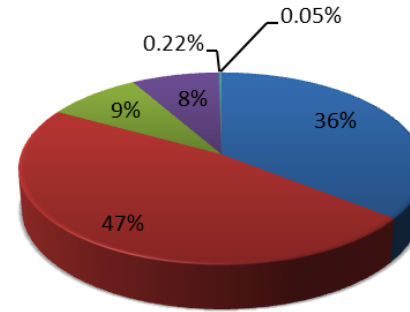
Pie chart (top right):
- Concrete 36%
- Brick/ stone 47%
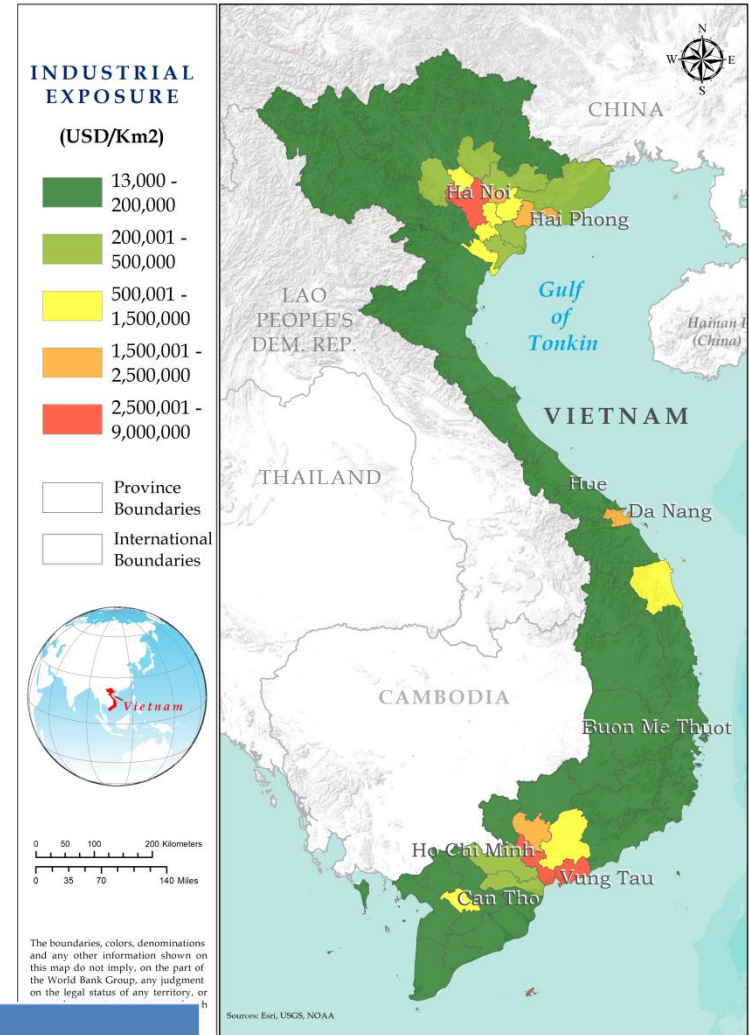- Steel/ Iron/ Durable wood 9%
- Wood of Low quality/ Bamboo 8%
- Soil 0.22%
- Others 0.05%

Location	Urban / Rural
Housing type	Apartment / Villa / Single Detached House
Age	Pre-1975 / 1975 to 1999 / After 1999
Construction type	Concrete Frame / Confined Masonry / Masonry / Wood
Height	Low Rise / Mid Rise / High Rise

Pie chart (bottom left):
- Before 1975 4%
- From 1975 to 1999 37%
- After 1999 59%

Pie chart (bottom right):
- Villas 0.1%
- Apartments 1.4%
- Single Detached Houses 98.5%

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Non residential exposure

COMMERCIAL EXPOSURE (USD/Km2)

- 5000 - 150,000
- 150,001 - 450,000
- 450,001 - 900,000
- 900,001 - 1,800,000
- 1,800,001 - 28,000,000
- Province Boundaries
- International Boundaries

INDUSTRIAL EXPOSURE (USD/Km2)

- 13,000 - 200,000
- 200,001 - 500,000
- 500,001 - 1,500,000
- 1,500,001 - 2,500,000
- 2,500,001 - 9,000,000
- Province Boundaries
- International Boundaries
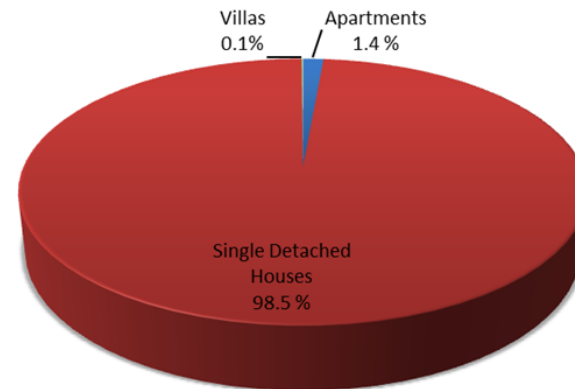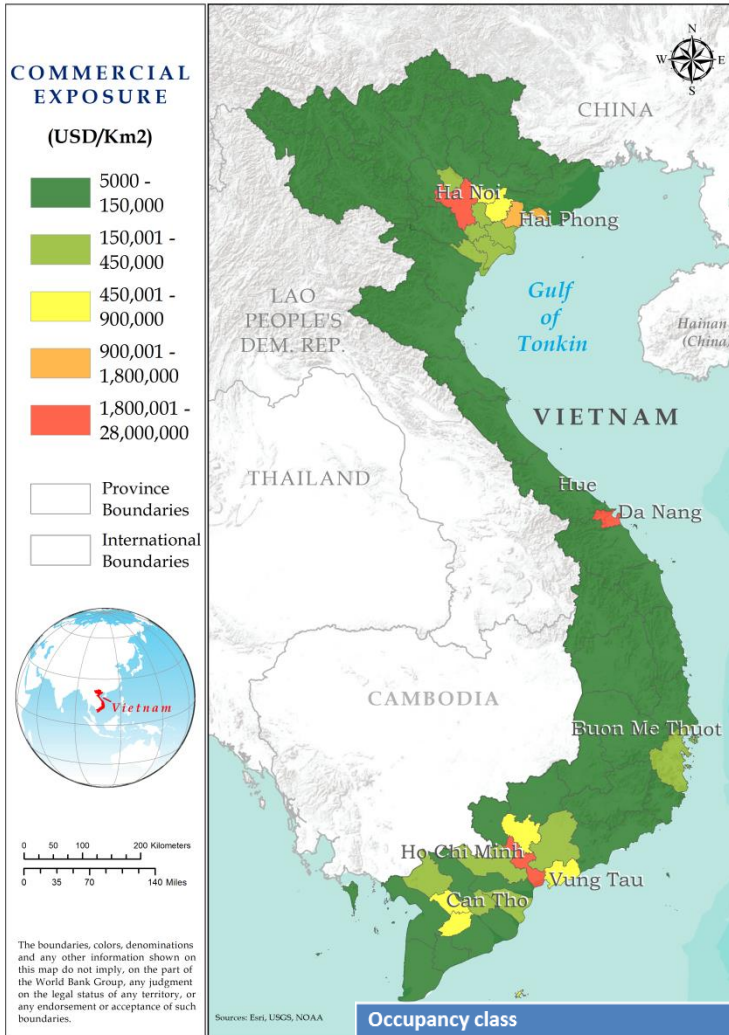
| Occupancy class	Commercial / Industrial
Occupancy type (only for industrial)	Light / Medium / Heavy
Construction type	RCC / Confined Masonry / Steel / Unknown
Height	Low Rise / Mid Rise / High Rise

29

Public buildings

- **Source: National Database of State Assets from the Ministry of Finance**
  - Value and number by asset class by province
  - Disaggregated to commune using GDLA land use data

| Asset Class	Original price (in USD billions)		
		Including of	
	Total	**National budget**	**Other sources**
Land	32.75	32.75	0.00
House	11.38	10.88	0.51
Car	0.99	0.87	0.10
Other assets greater than VND 500 million	2.17	1.59	0.59
Other assets lesser than VND 500 million	0.007	0.002	0.004
Total	47.31	46.09	1.20

PUBLIC BUILDINGS EXPOSURE

Replacement Cost* (Million USD)

- 30 - 200
- 201 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000

Province Boundaries
International Boundaries

*Aggregated at province

The boundaries, colors, denominations and any other information shown on this map do not imply, on the part of the World Bank Group, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.

Sources: Esri, USGS, NOAA

Public infrastructure

Infrastructure	Count or Length (km)	Exposure (Billion USD)
Airports	22	0.82
Bridges	37	3.16
Sea Ports	43	4.19
Dams	16	0.19
Roads	97,393 km	191.10
Railways	2,720 km	0.88
Power plants	48	14.30
Transmission Lines	4,100 km	14.34

Energy

Pie chart — Energy:
- Coal: 2.92, 20%
- Gas: 2.94, 21%
- Hydro: 7.2, 50%
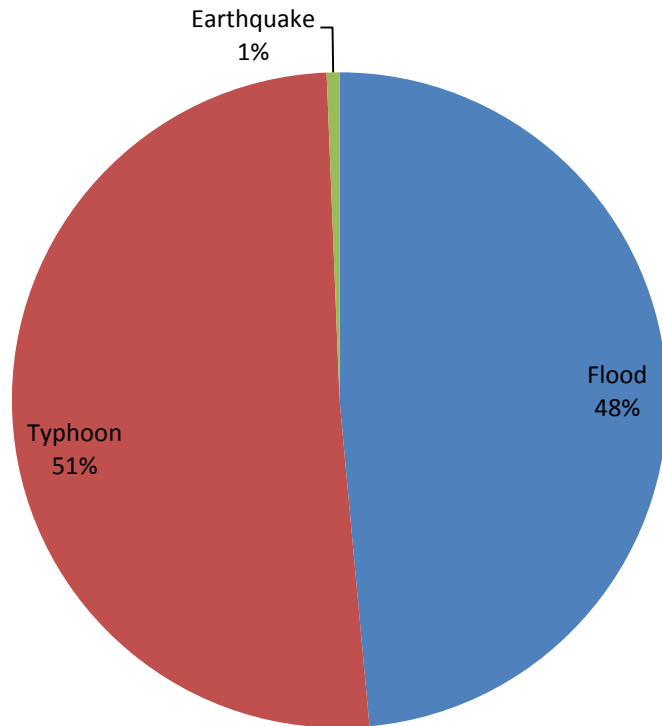- Oil: 1.24, 9%
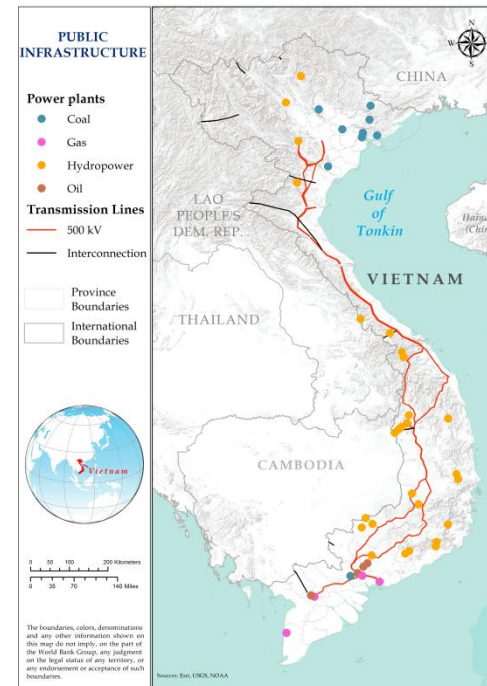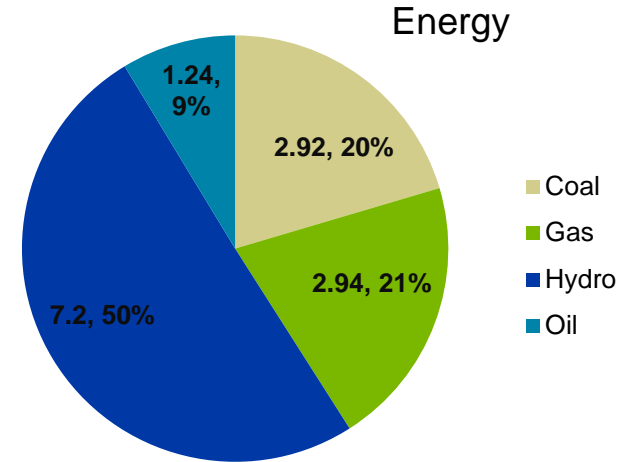
Exposure analysis for 3 cities

- Detailed analysis for Hanoi, Ho Chi Minh and Da Nang
    - Exposure analysis by occupancy and special report
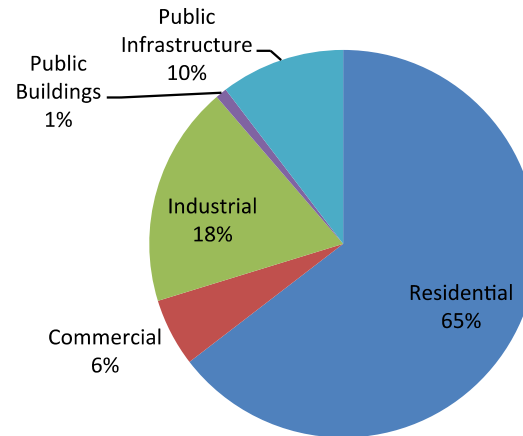   - Detailed exposure maps
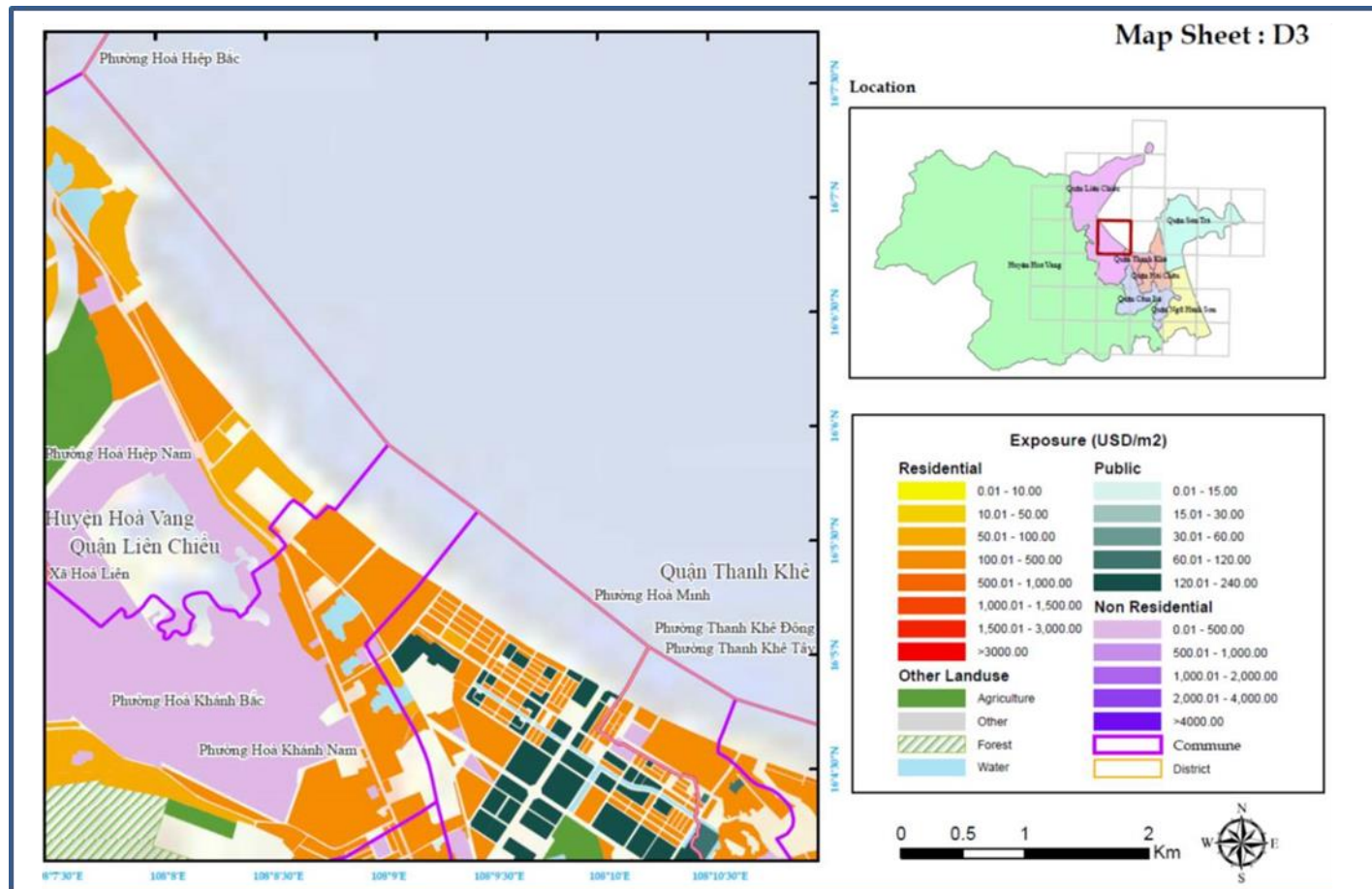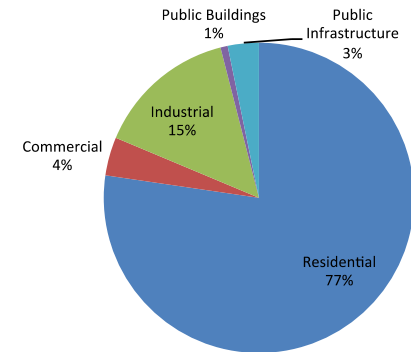
Direct economic damage - average annual loss (AAL) $1.4b

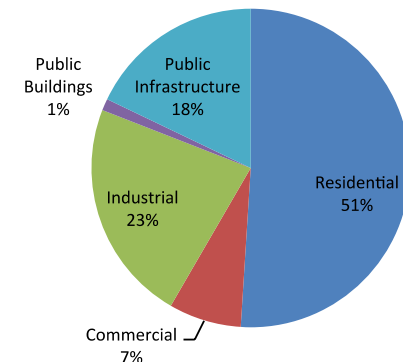## Damage are equally split between typhoons and floods

Earthquake 1%

Flood 48%

Typhoon 51%

Two thirds of damage are from residential assets

Public Infrastructure 10%

Public Buildings 1%

Industrial 18%

Commercial 6%

Residential 65%

All perils

Public Buildings 1%

Public Infrastructure 3%

Industrial 15%

Commercial 4%

Residential 77%

Typhoon

Public Buildings 1%

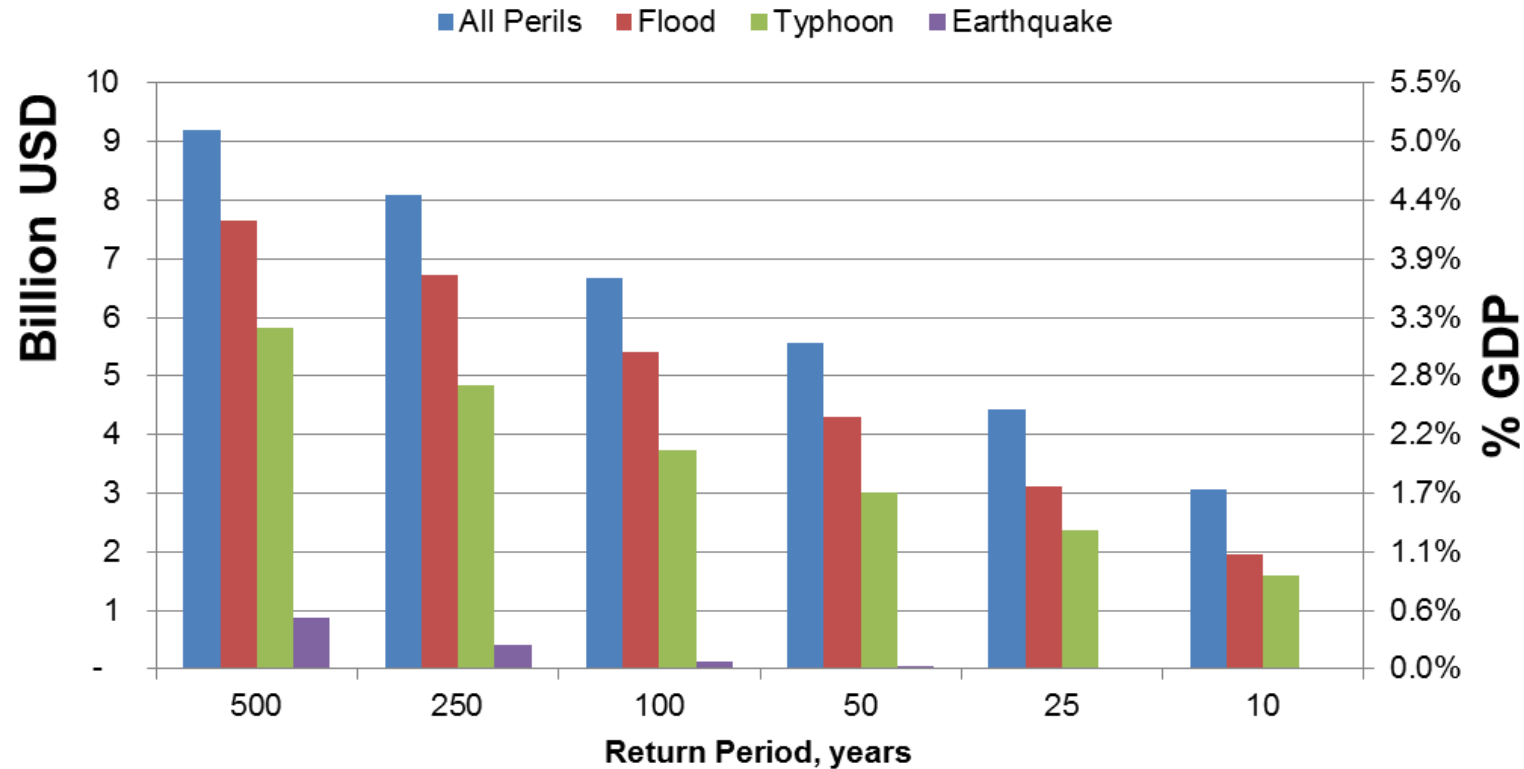Public Infrastructure 18%
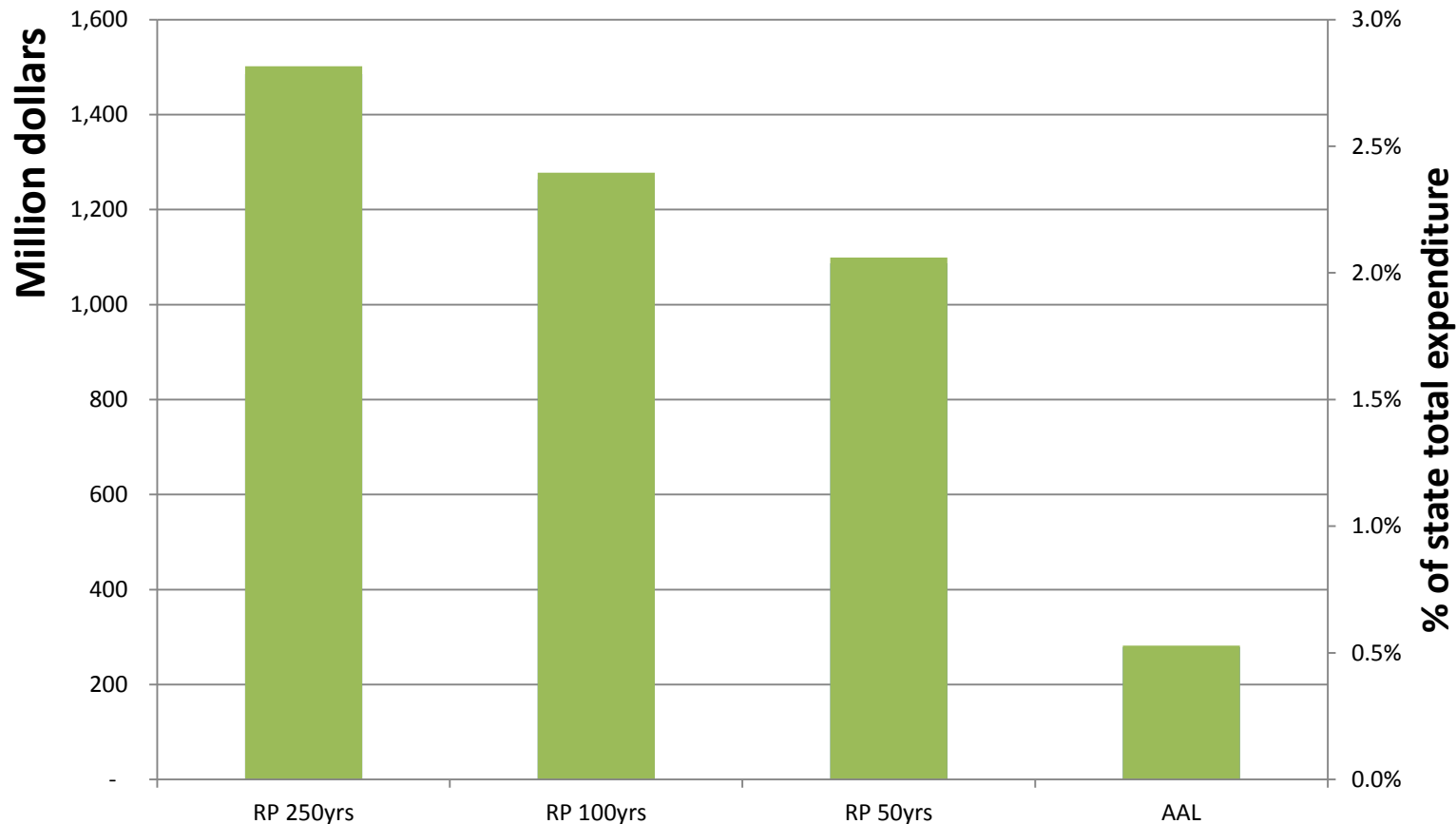
Industrial 23%

Commercial 7%

Residential 51%

Flood

- Typhoon losses are caused by wind and storm surge
- Losses caused by rain are included in flood losses
- Drought losses are not included

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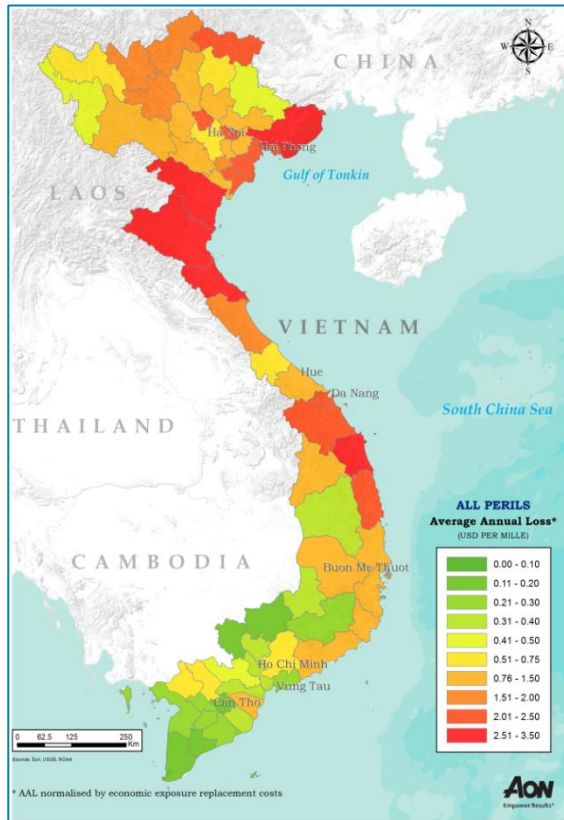# Direct economic damage - probable maximum loss (PML)

34

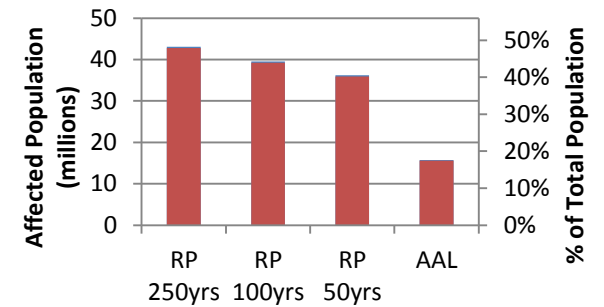# Contingent liability of government due to floods, typhoons and earthquakes
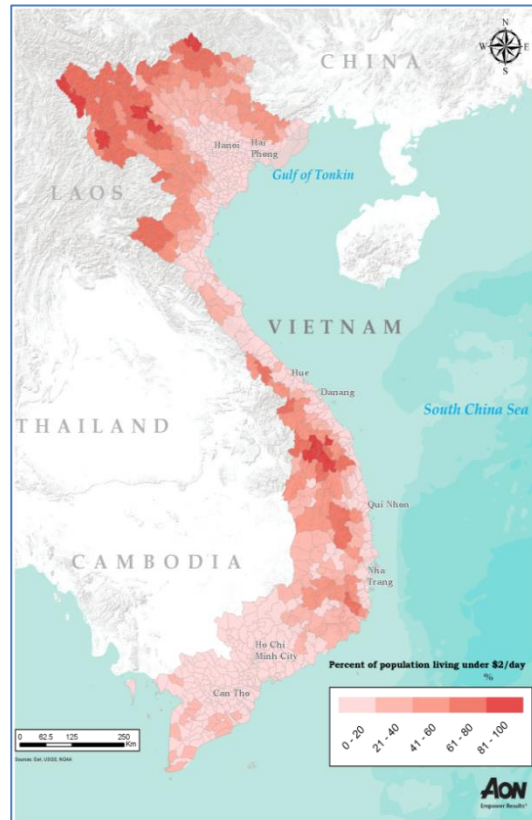

Note: contingent liabilities include public assets and low income housing.
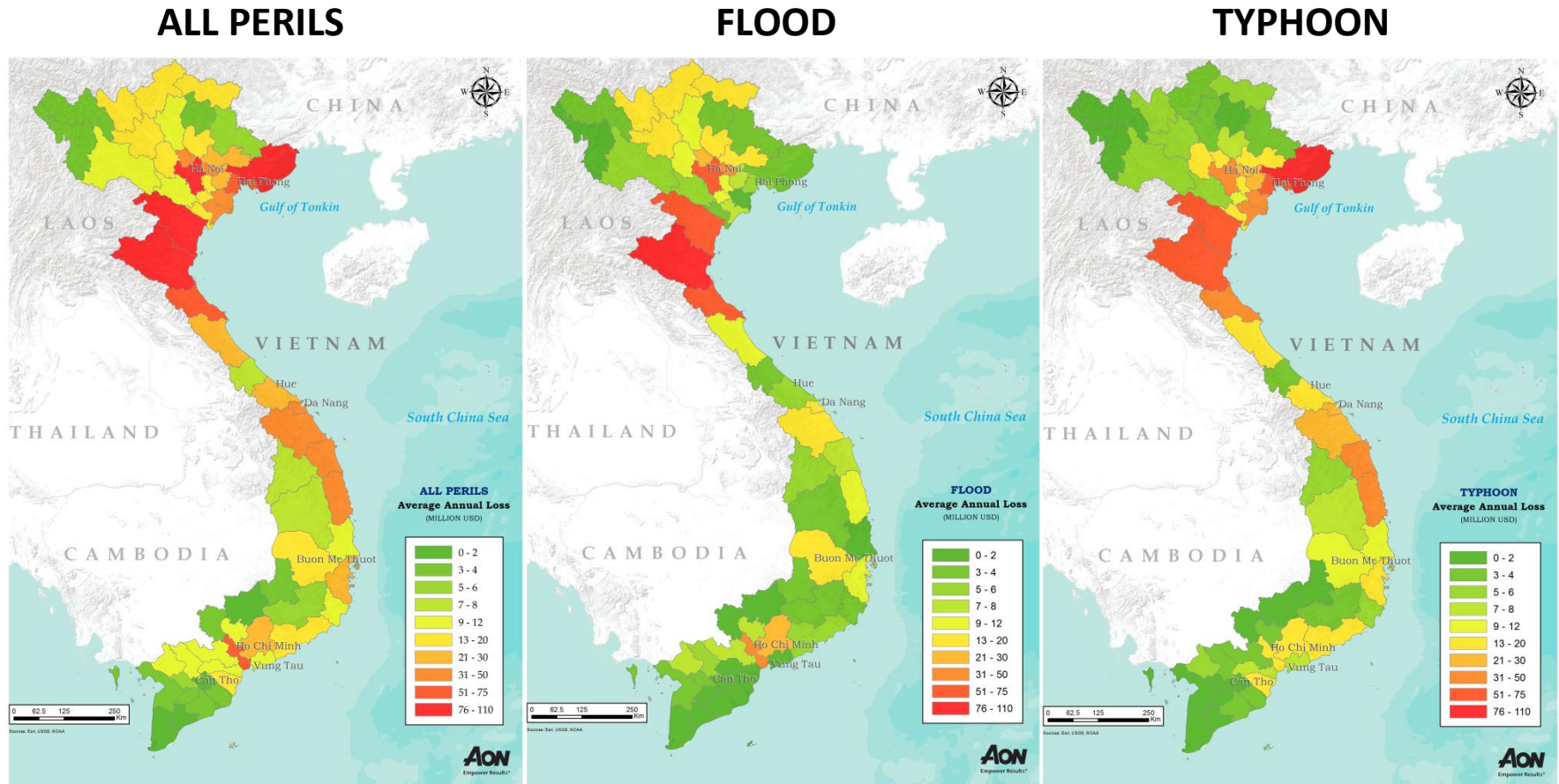
Poverty and disaster risk exposure

Average Annual Loss (normalized)
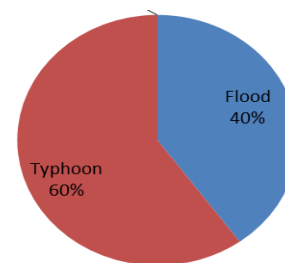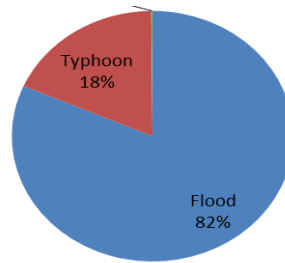

Population living in poverty

Data source: http://www5.worldbank.org/mapvietnam/

Distribution of AAL by province (USD)

All perils: typhoons, floods and earthquakes (drought NOT included)

City loss cost by commune
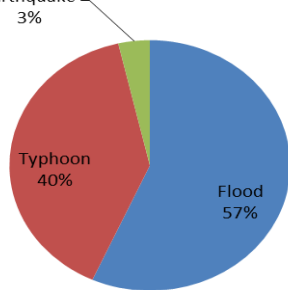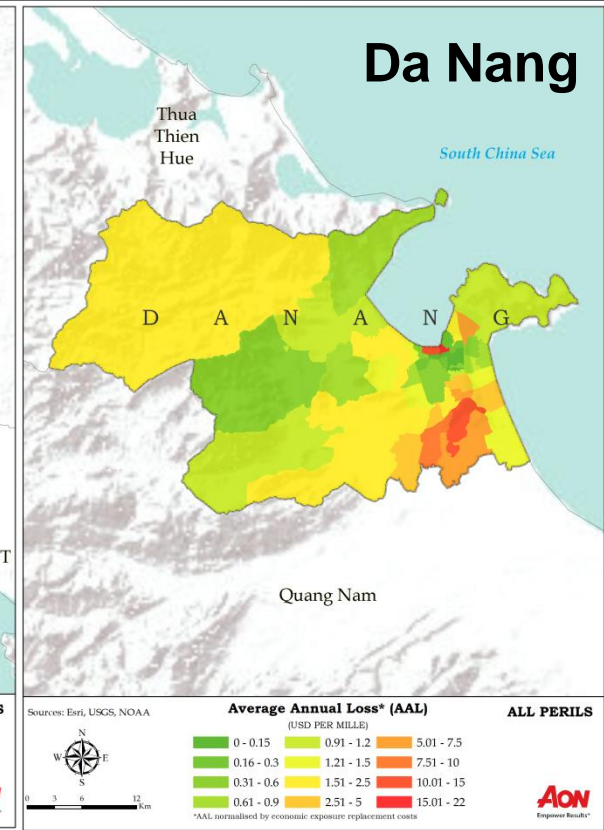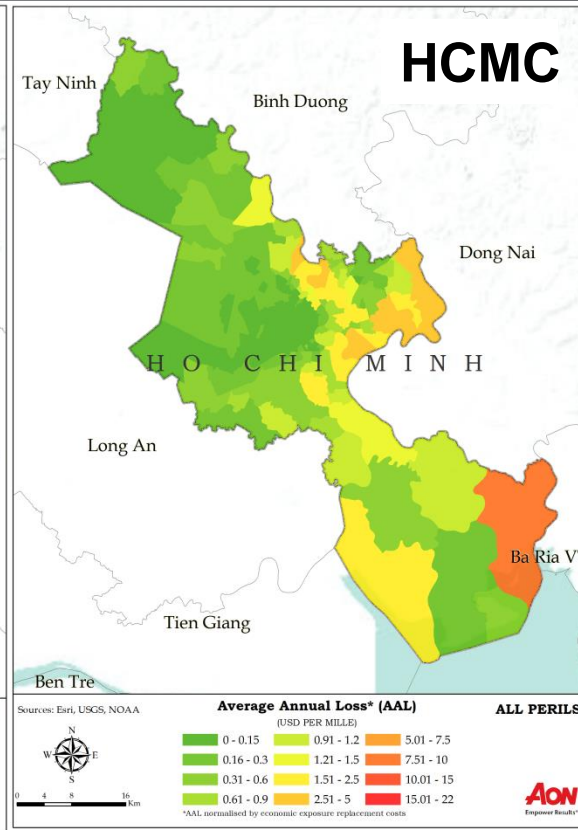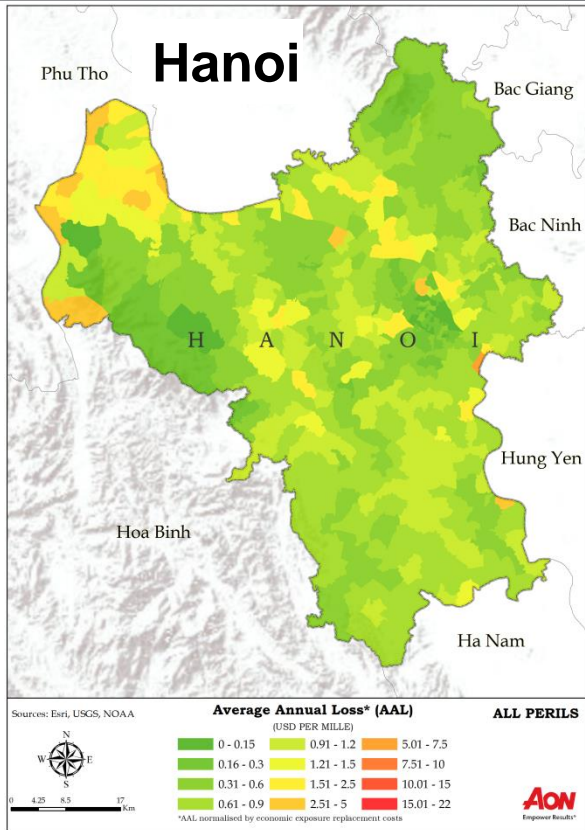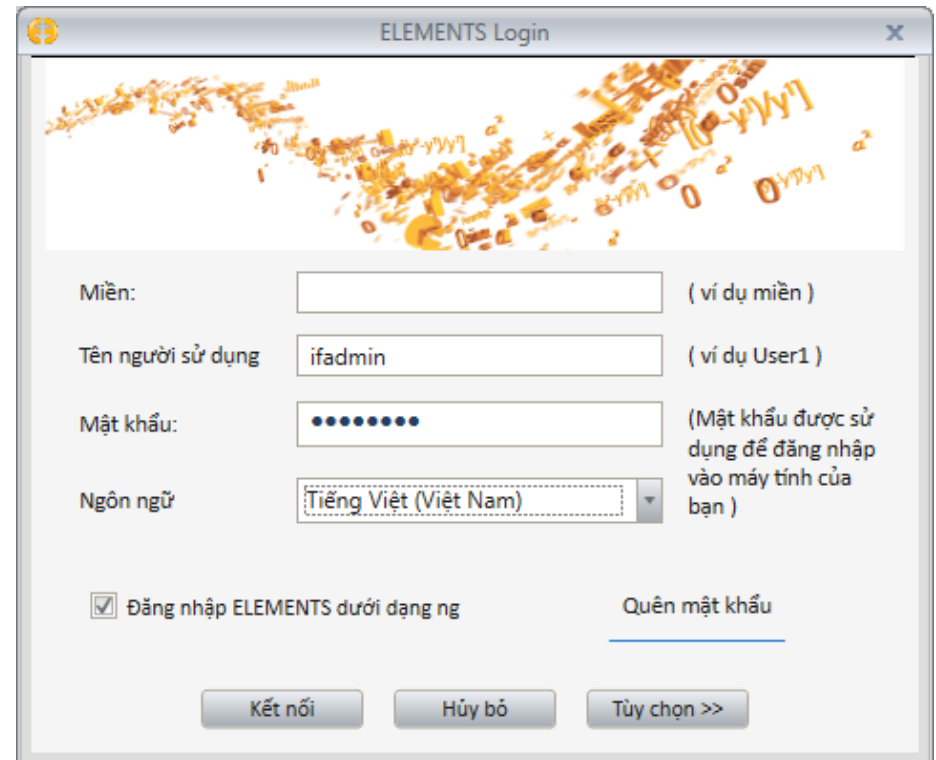
Agenda

Deliverables from the Vietnam project

- Detailed economic exposure database

- High resolution Cat models
  - Until last year there were no Cat models for Vietnam
  - Even now IF model is the only flood model
  - Available on ELEMENTS with an option of UI in Vietnamese language

- Risk profiles and mapping at national, provincial and city levels
  - Location, frequency and severity

- Hazard maps to inform policy decisions on urban planning and building codes

Market awareness
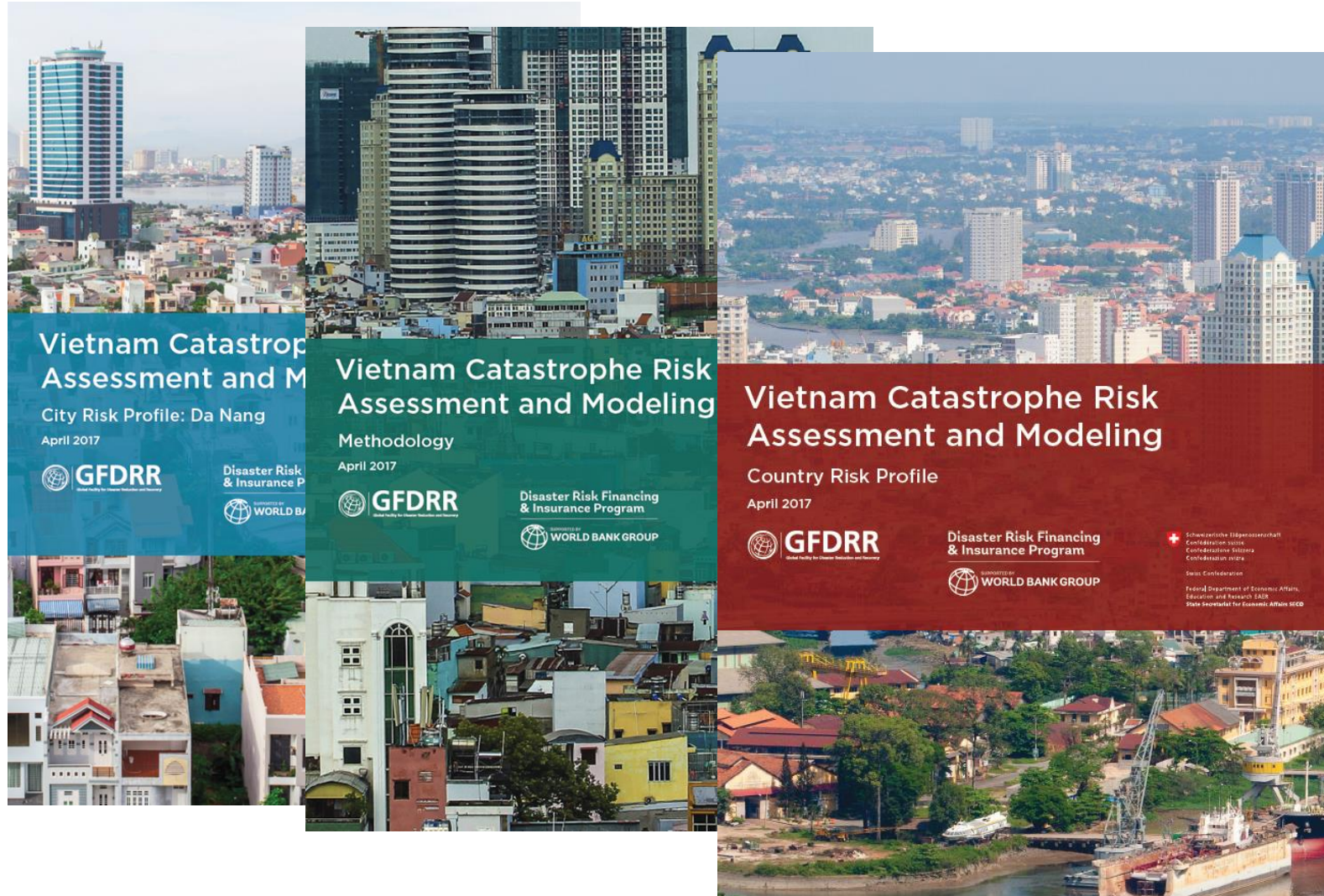
Conclusions

◆ Effective financial management of natural disasters relies on detailed catastrophe risk assessment

◆ Catastrophe risk models can support risk informed decision making
- National financial protection strategy
- Poverty reduction and social protection strategies
- Catastrophe risk market development
- Urban planning and risk reduction investments

◆ Insurance industry can greatly benefit from the detailed catastrophe models

Contacts

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