Workshop on Climate and Disaster Risk Finance in the Pacific

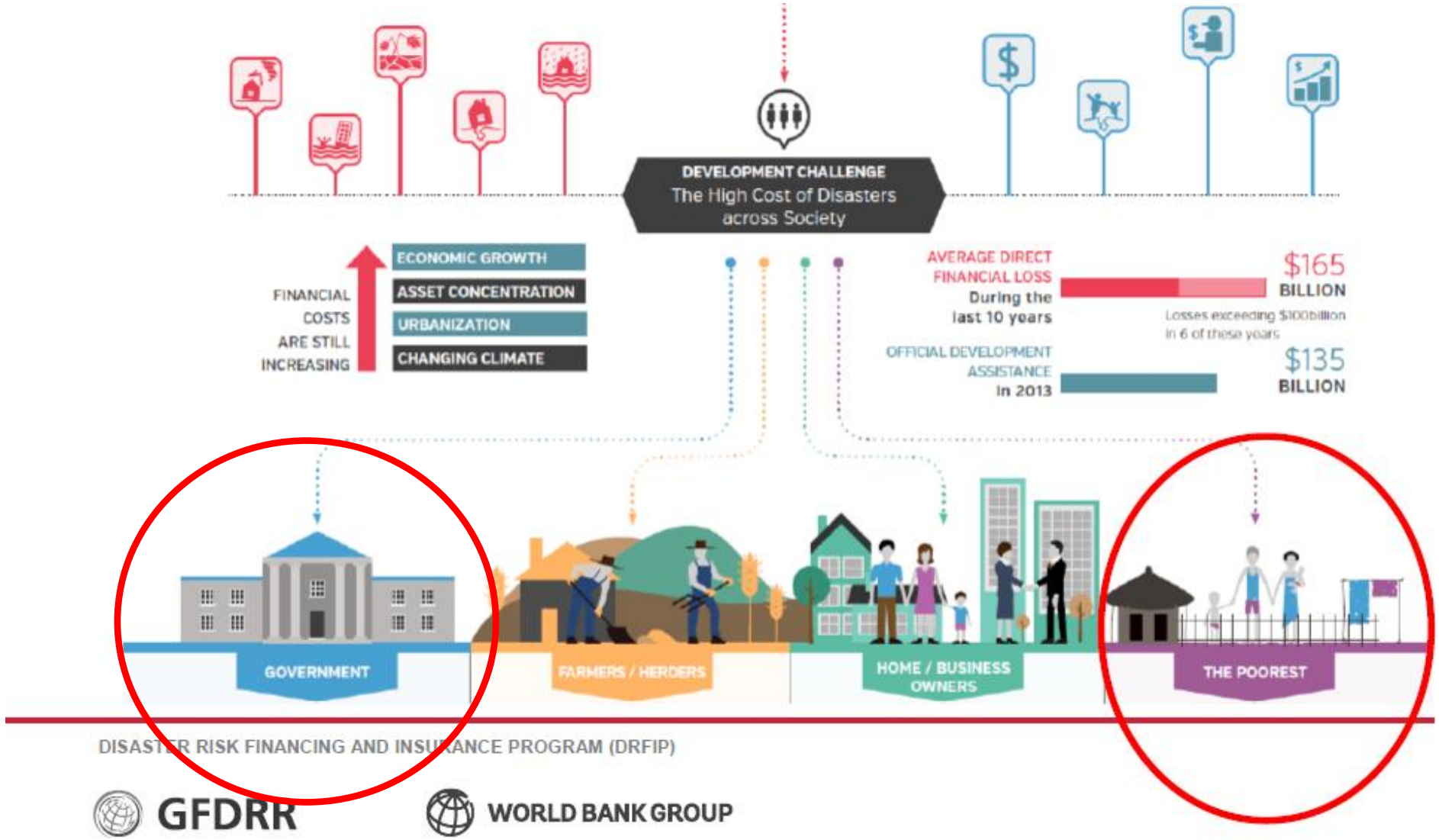
17th – 21st February 2025

Organized by World Bank and PCRIC, with contributions from:

Risk data and modelling as an enabler for CDRF

Disaster Risk Financing

Protecting lives and livelihoods



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How do we reduce and manage risks in the best ways?

- What are the risks we face?

  How severe are they and how are they changing due to urbanization, population change, climate change, etc.?

  Where are the risks concentrated?

  Which risks may impact on development gains the most?

  What policies and interventions are needed to reduce and manage disaster risk in the most effective ways?

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Aim and Process: Disaster Risk Assessments

A **quantification** of the likelihood (probability) of estimated property, infrastructure, monetary or casualty losses caused by adverse natural event in a specific area.

Hazard

Exposure

Vulnerability

Fatalities, injuries, displaced persons

Damage to buildings, infrastructure, financial loss

Impact

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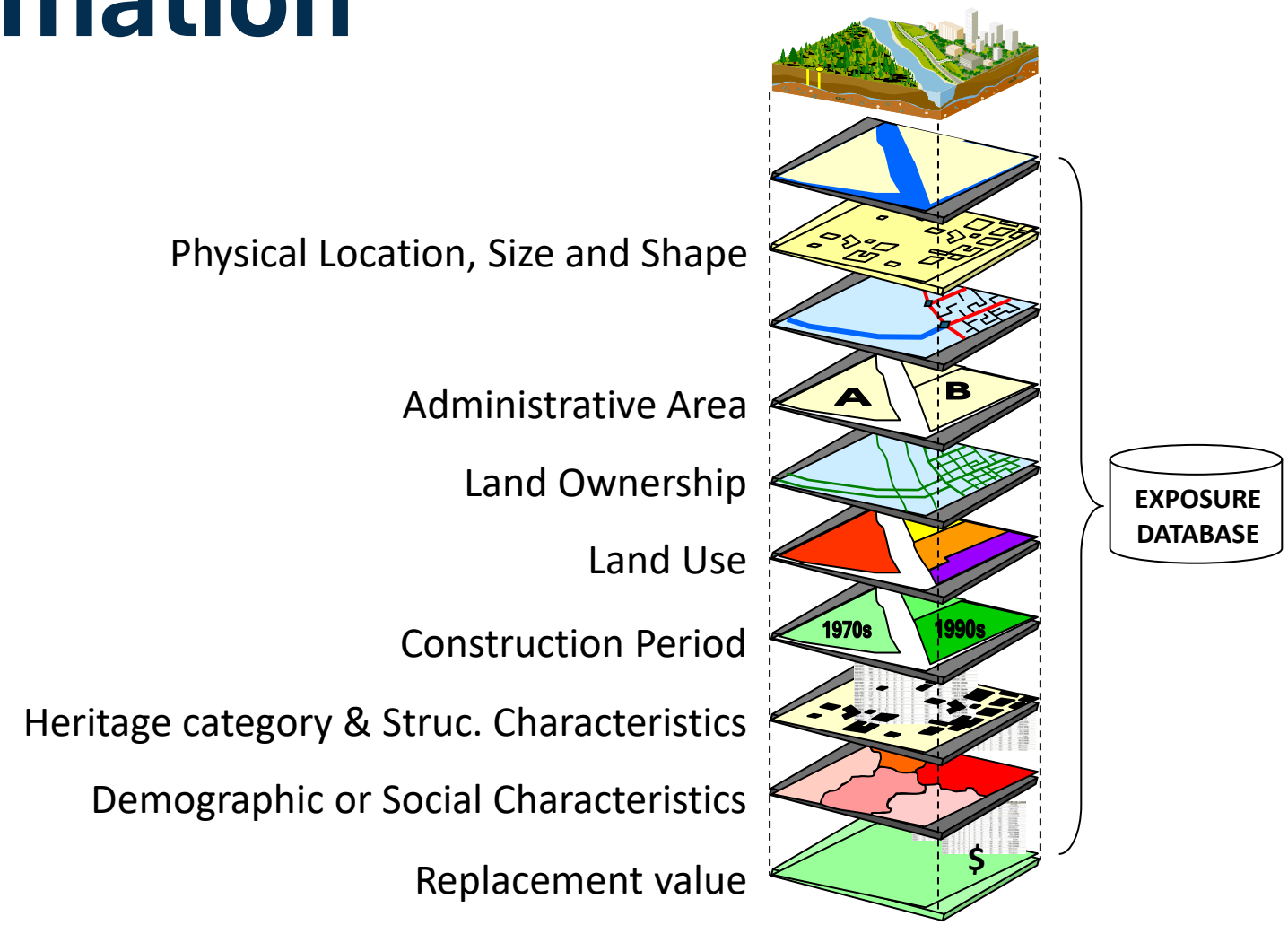
Exposure Information

The types of exposure information that improves model outputs



Increasing Effort & Complexity

Hazard/Risk Index

Pros: fast, low data requirements, output easy to understand

Cons: Low resolution, subjective

Historical Scenario

Pros: based on event-specific data, good for frequent hazards

Cons: misses extreme events, potential impacts of climate change

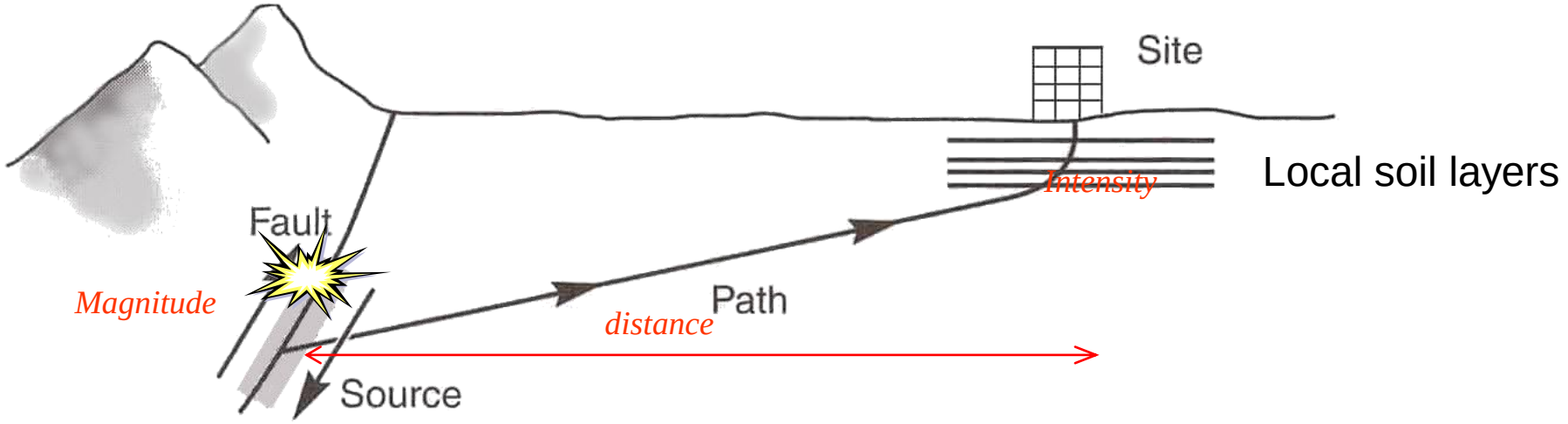
Probabilistic

Pros: accounts for both frequent/low-impact and rare/extreme events

Cons: high data/expertise requirements, need to ensure outputs can be understood

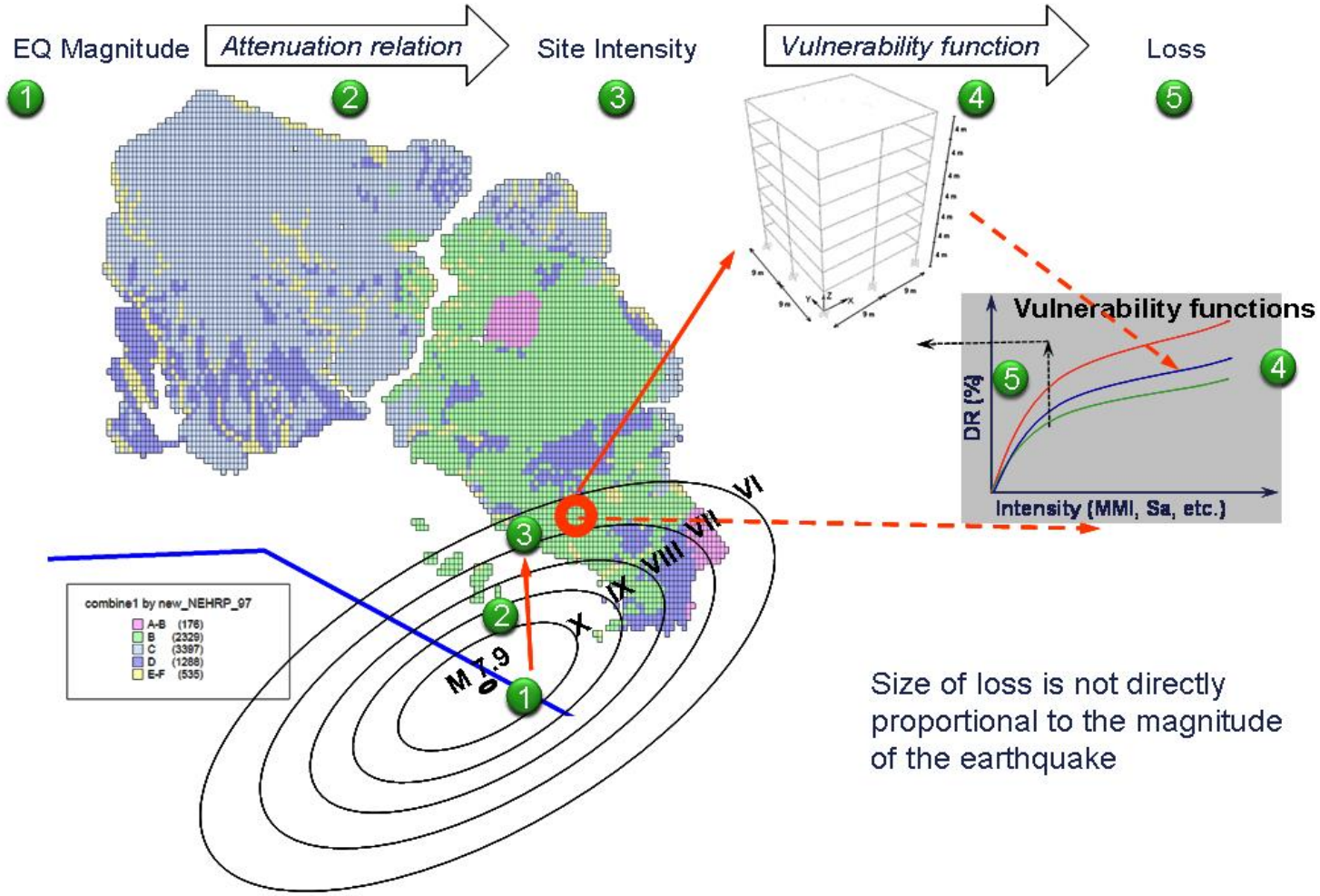
Product	Purpose	Scale	Data Requirements	Cost
Qualitative national risk profile	For advocacy and initiation of DRM dialogue	National	Low: Requires global, regional, and/or national data sets	$
Community-based disaster risk assessment	To engage communities, communicate risk, and promote local action	Community level	Low: Typically based on historical disaster events	$
Quantitative national risk profile	For advocacy and initiation of DRM dialogue based on quantitative assessment	National	Low-moderate: Requires global, regional, and/or national data sets	$$
Asset-level risk assessments, including cost-benefit and engineering analysis	To inform design of building-level/asset-level risk reduction activities and promote avoidance of new risk	Building / infrastructure level	Moderate-high: Requires high-resolution local data for large spatial areas with clear articulation	$$
Macro-level risk assessment for risk reduction, including cost-benefit analysis	To inform urban/regional risk reduction measures	Urban, regional, national	Moderate-high: Requires moderate to high resolution across large spatial areas	$$$
Risk identification to identify critical infrastructure and establish early warning systems	To inform preparedness and risk reduction, based on understanding of potential damage at the regional/local level	Urban, regional, national	Moderate-high: Requires asset-level information across large spatial areas	$$-$$$ [broad range depending on geographic scope]
Catastrophic risk assessment for financial planning	For financial and fiscal assessment of disasters and to catalyze catastrophe risk insurance market growth	National to multi-country	High: Requires high-resolution, high-quality data of uncertainty	$$$

Process: Disaster Risk Assessment



- Released energy of the Earthquake in the source is represented by *Magnitude*
- Severity of ground motion in a site at a certain distance from source is indicated by *Intensity* (*spectral parameters, etc.*) based on the magnitude and *attenuation relation*
- Due to the intensity and based on the resistance of structures, they will undergo different grades of *damage*
- This damage will result in *loss* (financial or casualties)
- *Achieved through deterministic or probabilistic approaches*

Process: Disaster Risk Assessment



Size of loss is not directly proportional to the magnitude of the earthquake

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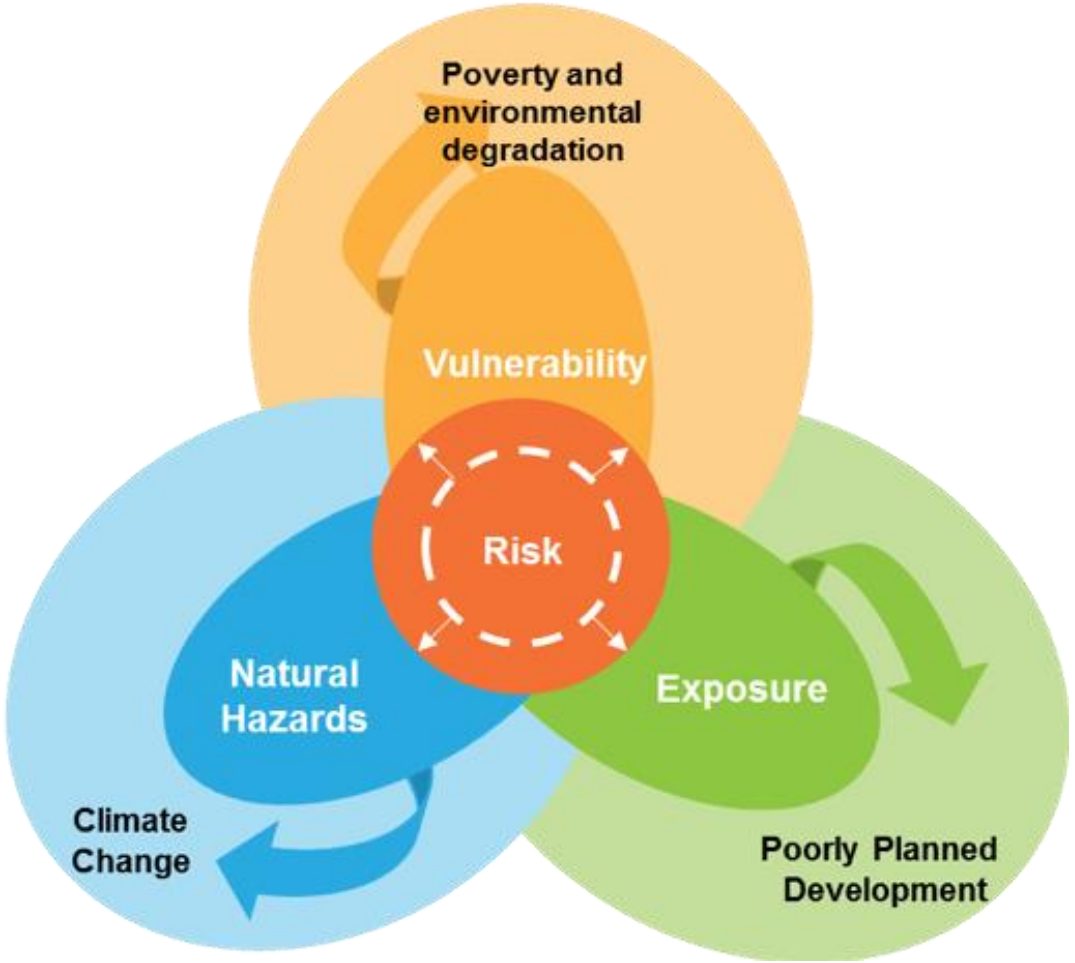
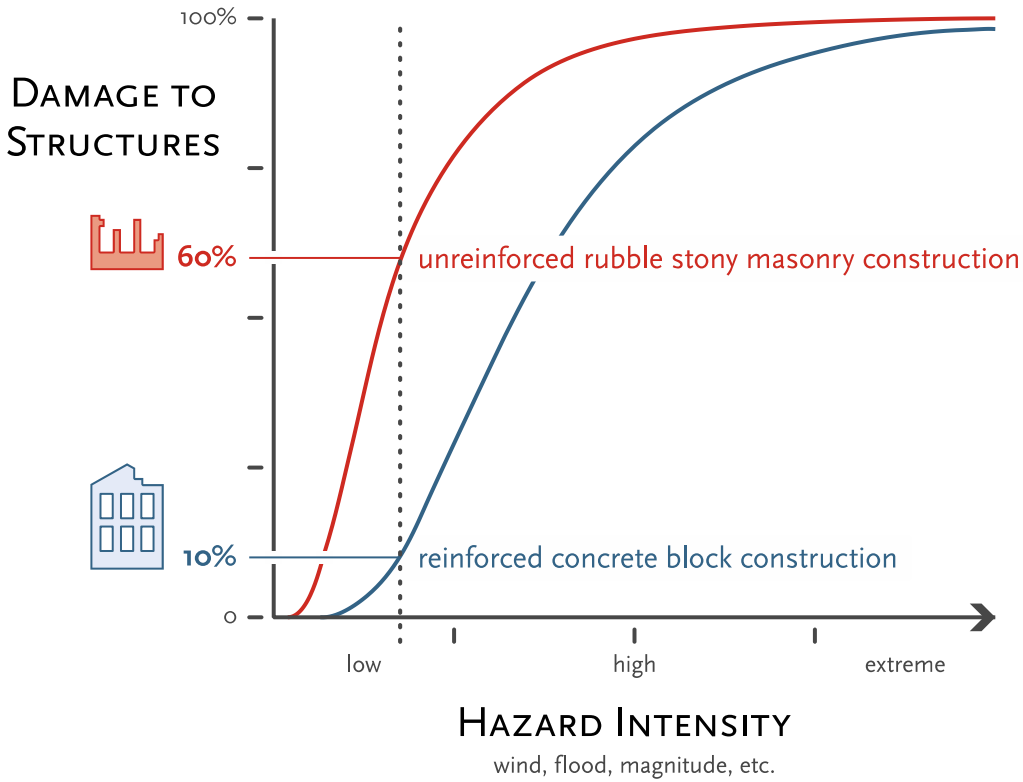
Drivers of Risk



Dynamic Exp, Displacement



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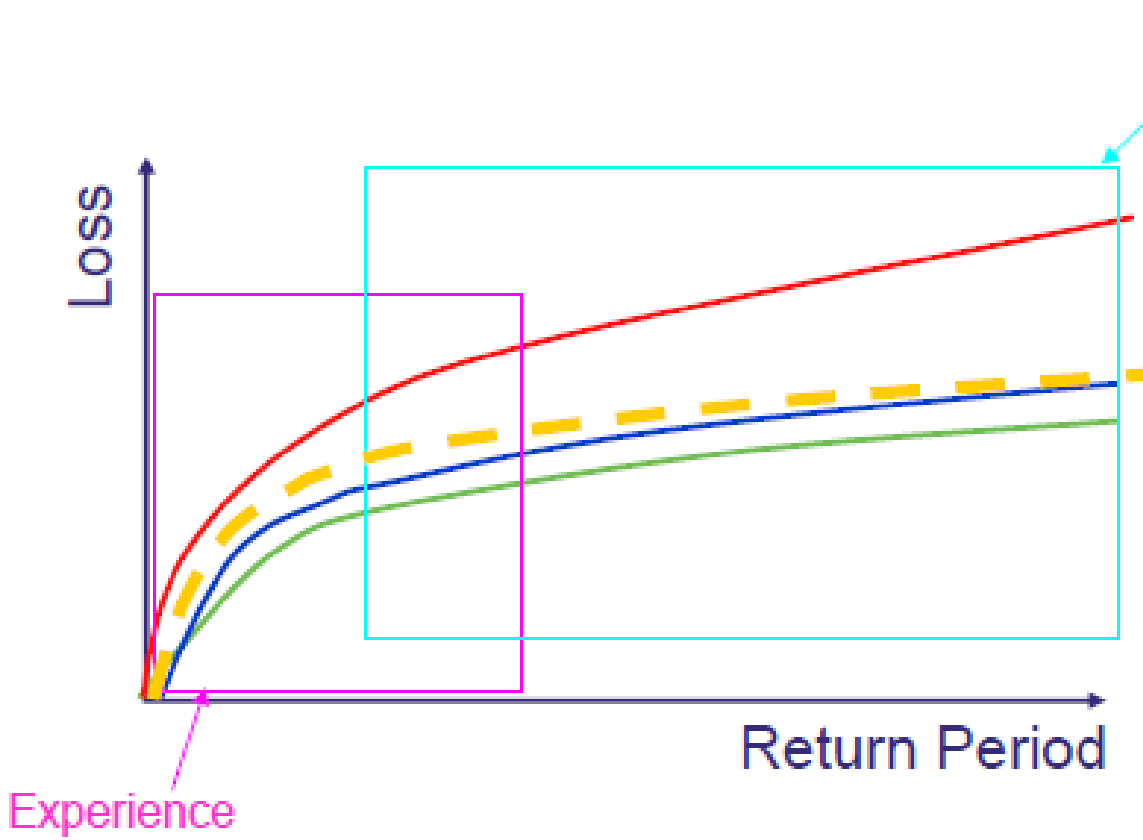
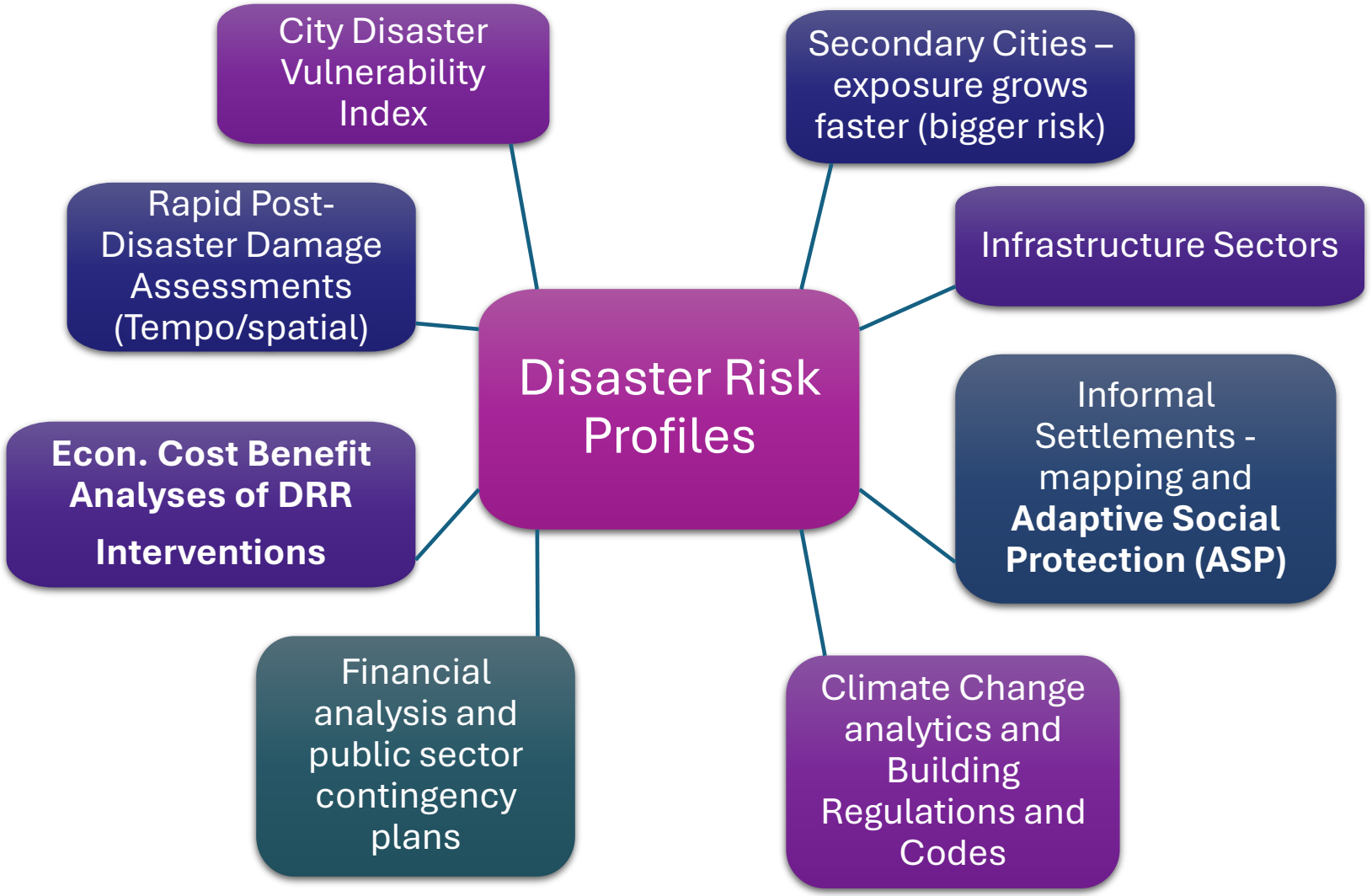
Output: EP curves and implications



- Prob. modeling provides evidence for financial decision making
- We need to be mindful of sensitivity and uncertainty in the models

Use Cases of Disaster Risk Profiles



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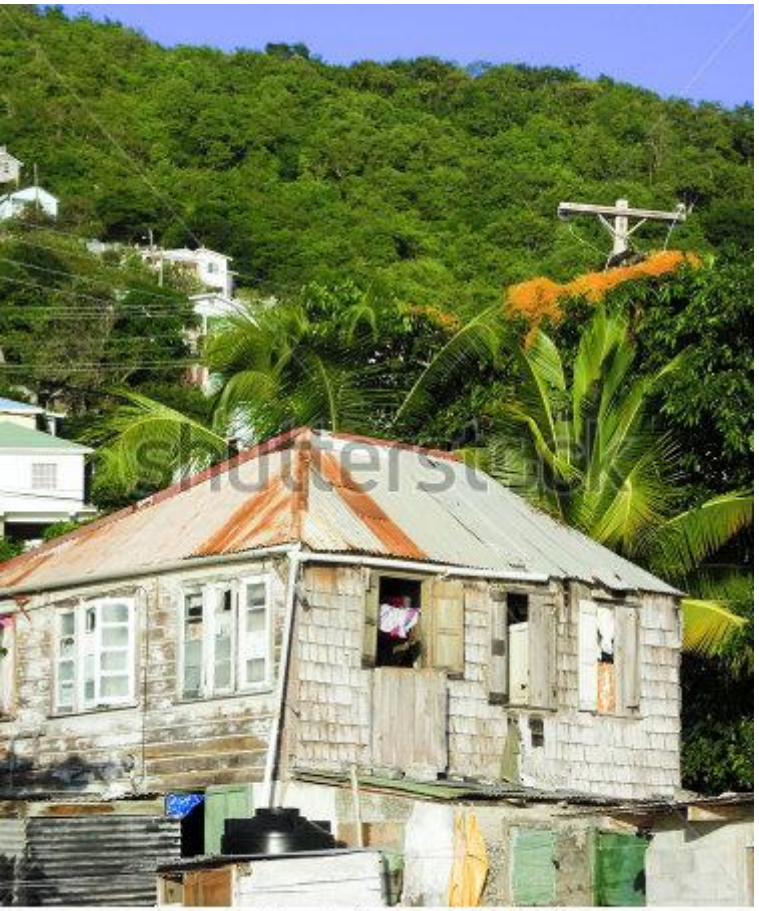
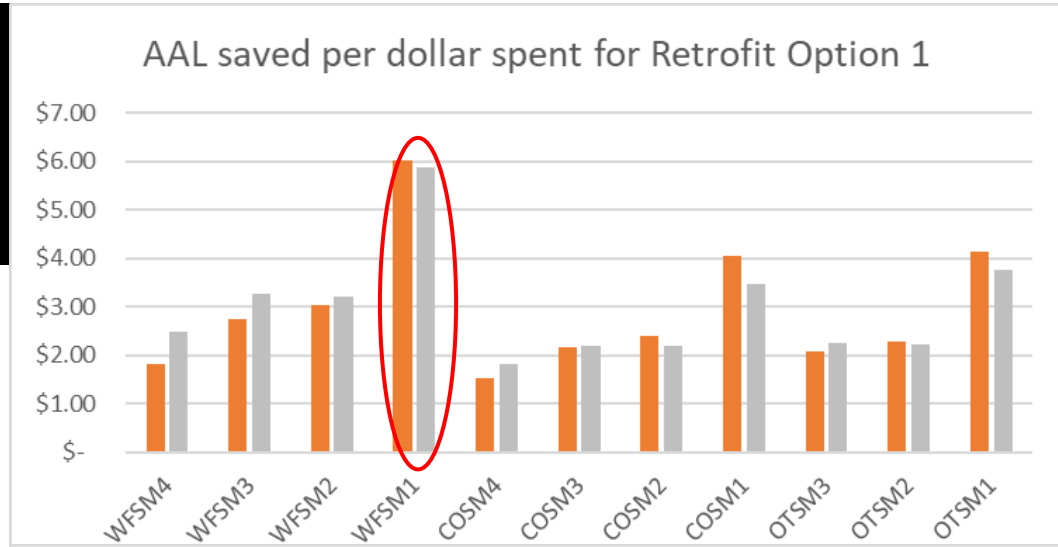
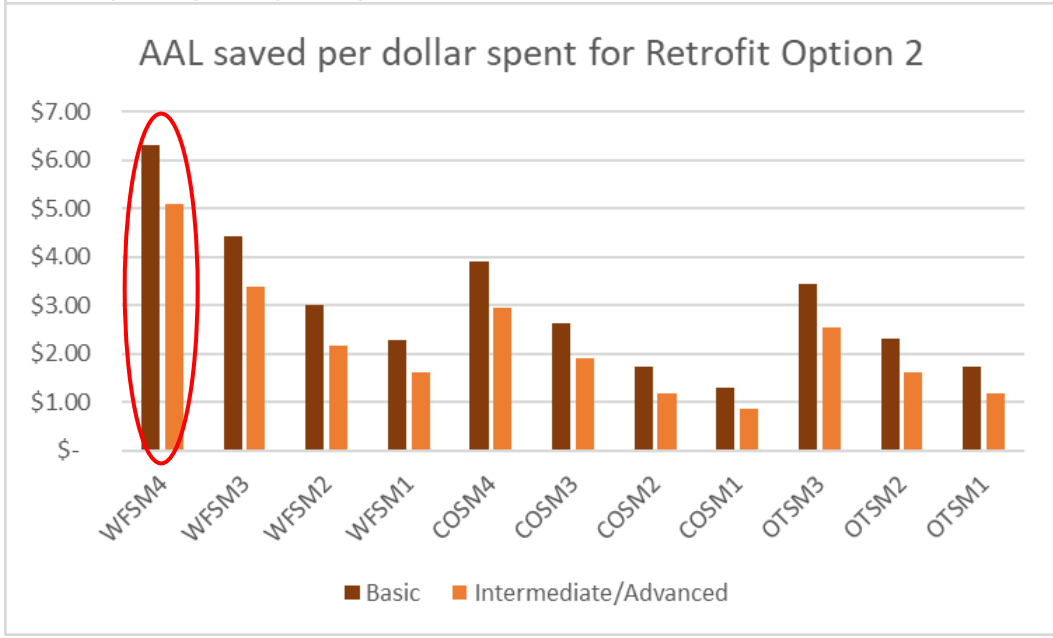
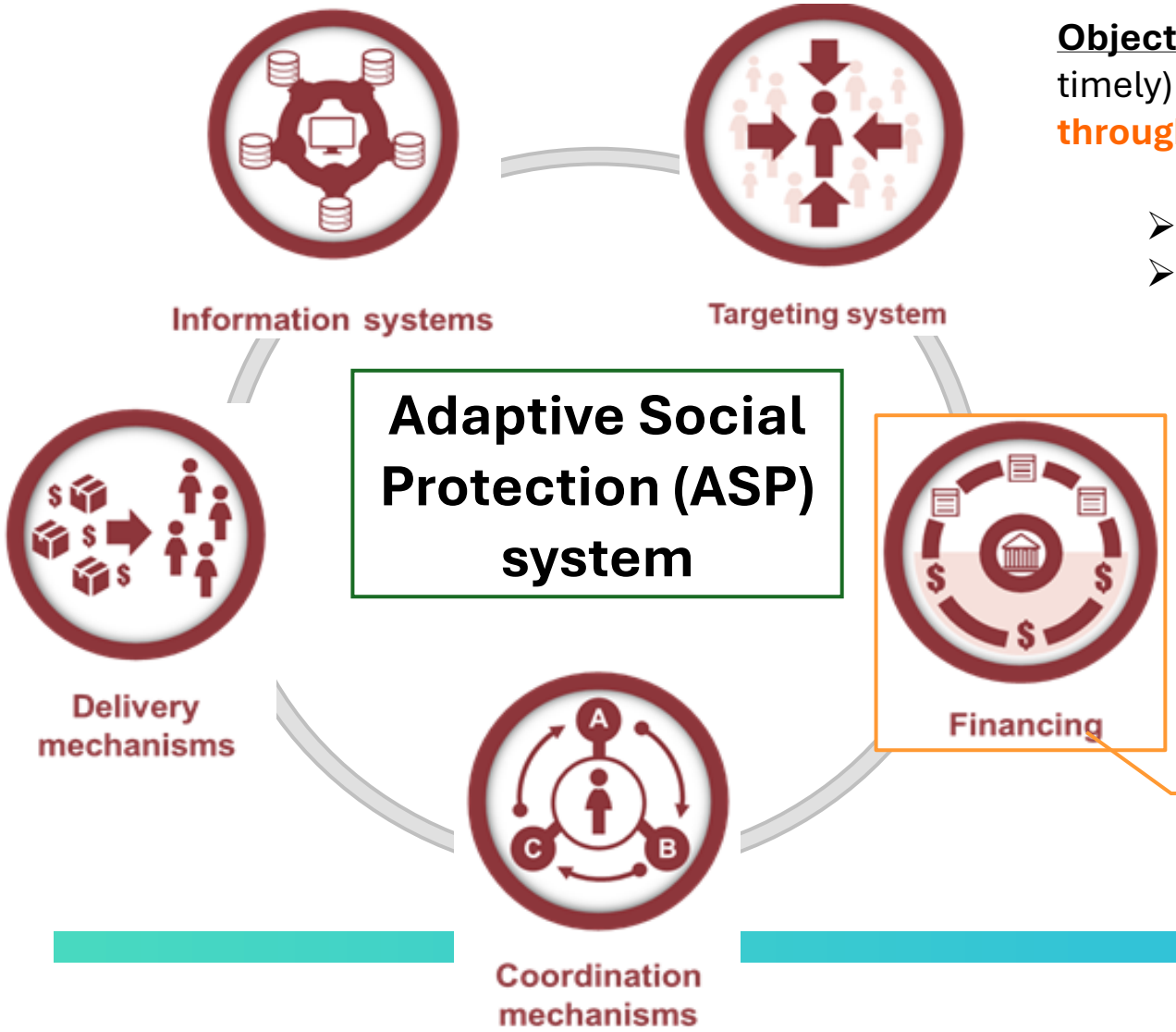
What would it take to reduce the risk?







Applications: ASP System - focus on the financing pillar



Objective of the financing pillar: adequately (in amount and timely) mobilize financial liquidities for assisting the population **through the ASP mechanism**.

- Estimate what could potentially be the liquidity needs
- Quantify the potential impacts of disasters that would trigger the activation of the ASP system

The financing pillar is essential to adequately operationalize the ASP system: it should not be developed in silo but rather be considered as the **financing arm of the overall system**.

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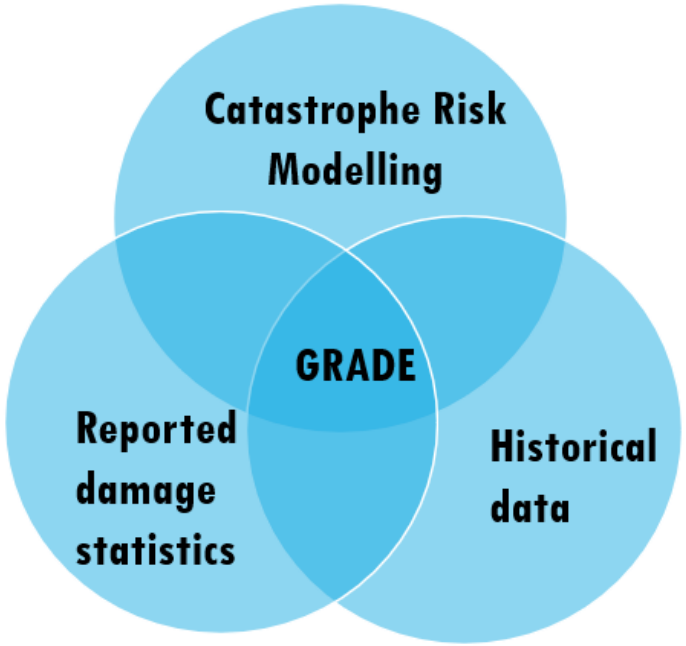
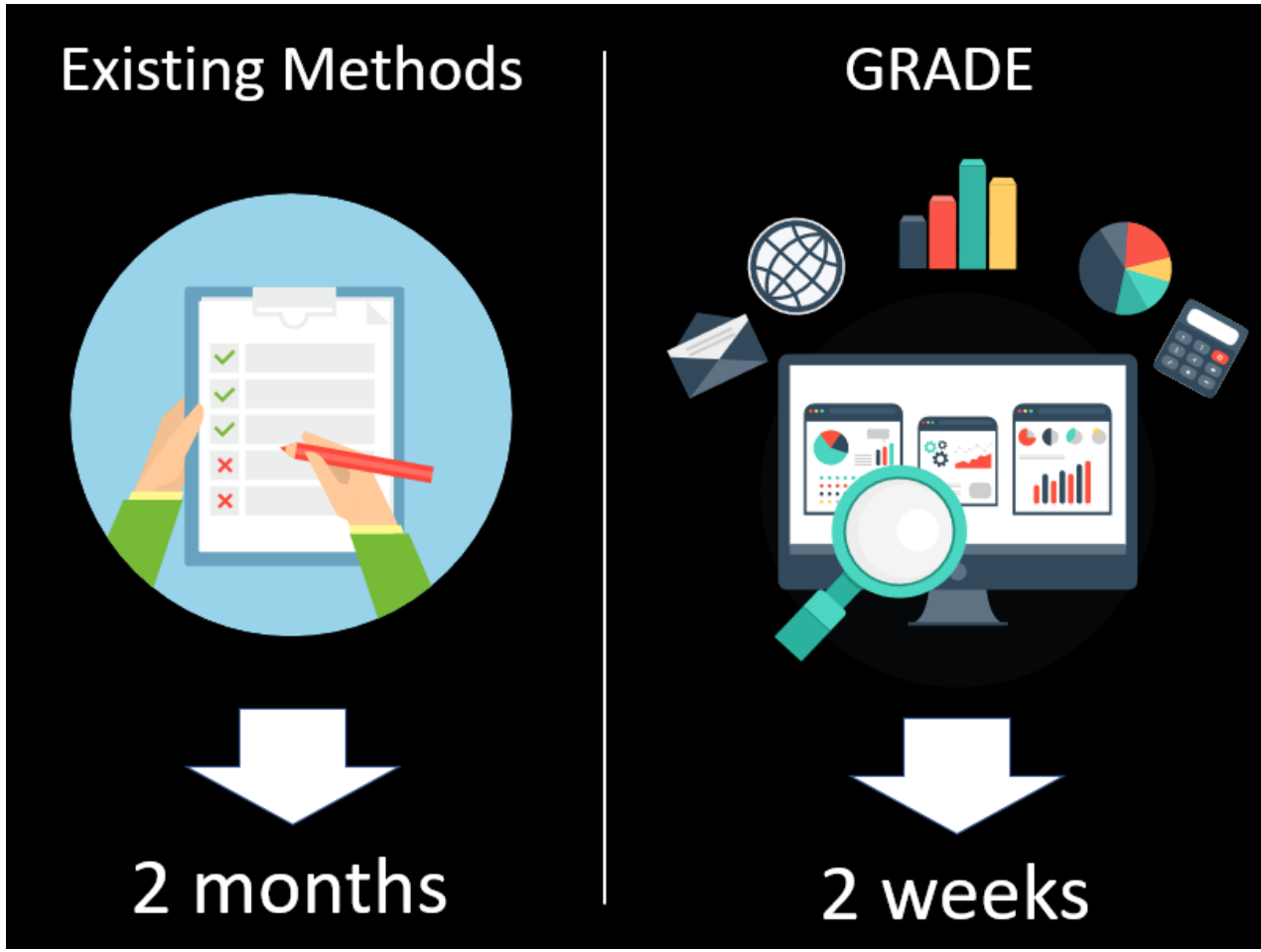
How do we assess damage?

What are the costs of the damage?

Where are the damages distributed?

What is the socio-economic impact?





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GRADE – Vanuatu EQ

Table 3: Summary of estimated damages by sector in Vanuatu.

Sector	Definition	Estimated damage (USD millions)	Proportion of total damage
Residential	Houses and contents	$49.9	25%
Non-Residential	Commercial, industrial, public and mixed-use buildings and contents	$86.2	44%
Infrastructure	Power networks, water networks, telecoms, seaports, jetties, coastal structures, airports, roads, bridges, fisheries	$52.3	27%
Agriculture	Agricultural buildings, assets and related infrastructure	$8.7	4%
Total		**$197.0 (17% of 2023 GDP[15])**	

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Riskviewer platform

- What risk-profiles are available?
- How do different results compare?
- What can/can't I use these profiles for?
- How does my risk compare?

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- How do different results compare?
- What can/can't I use these profiles for?
- How does my risk compare?

TONGA

MAJOR EARTHQUAKES

1977 M 8.0 - Tonga Islands - Unknown fatalities
2009 M 8.1 - Matavai* - 192 fatalities
2023 M 7.6 - Hihifo - 0 fatalities

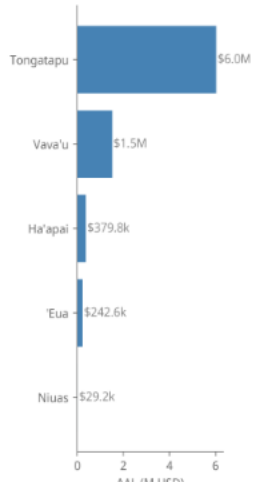
SOCIAL INDICATORS

- Population **107k**
- GDP **0.5B USD**
- Gini Index **33.5**
- Population Growth **0.72%/year**
- GDP per Capita **4,426 USD**
- Human Development Index **0.745**

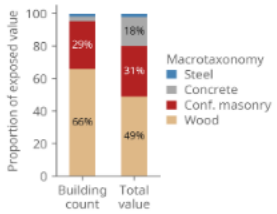
RISK INDICATORS

	Replacement cost (Billion USD)	Avg. annual loss (Thousand USD)	Avg. annual loss ratio (‰)
Residential	2.9	6,690	2.309
Commercial	0.7	1,333	1.959
Industrial	0.1	178	2.204
Total	3.7	8,201	2.242

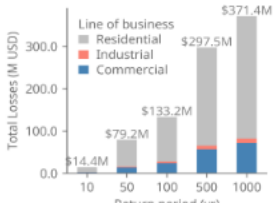
LOSS BY REGION



BUILDING CLASSES



LOSS CURVES



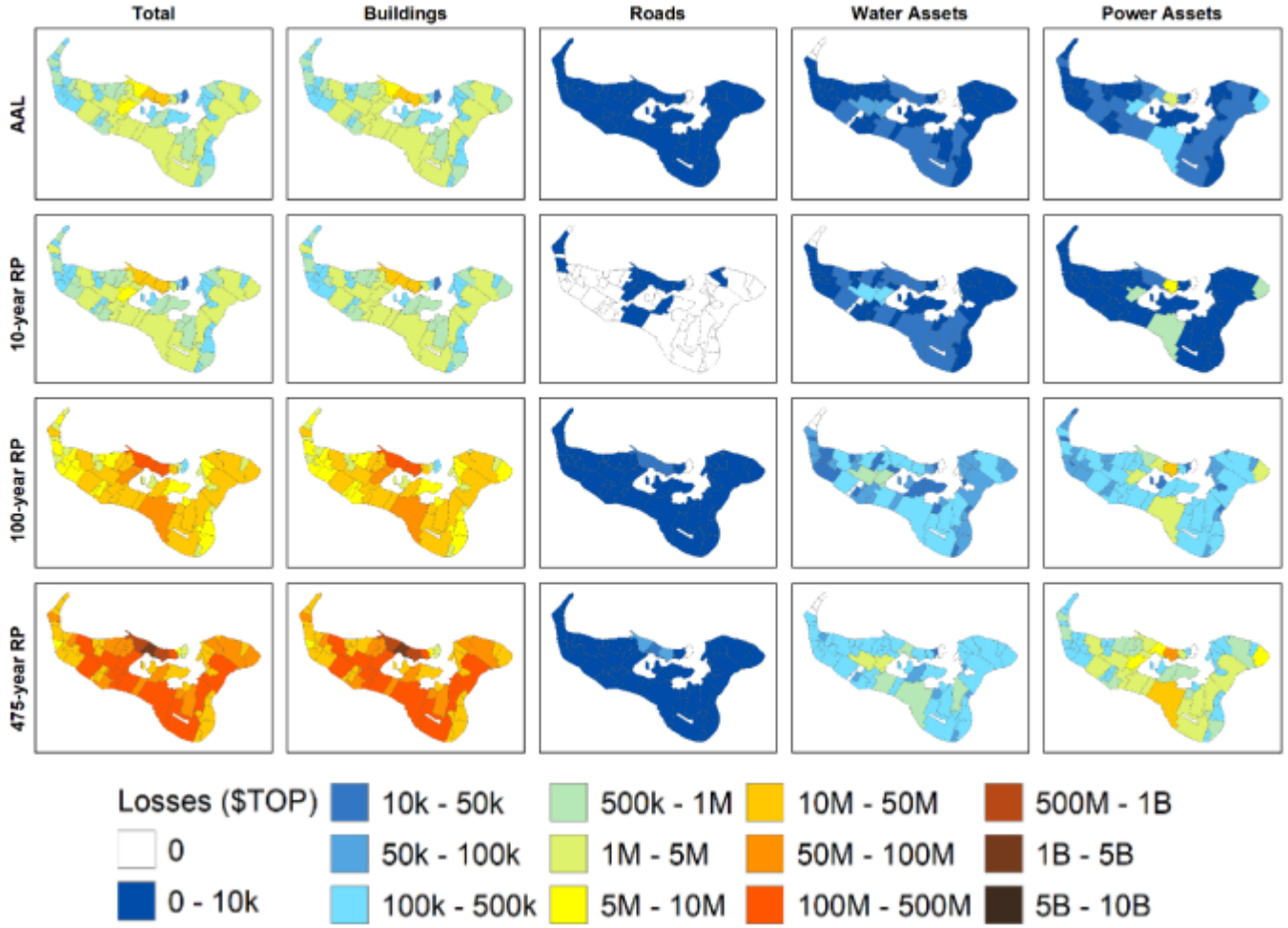
Average Annual Loss by ha

Total AAL - Current Climate...

12.0

Current Climate (Million USD)

Seismic Losses



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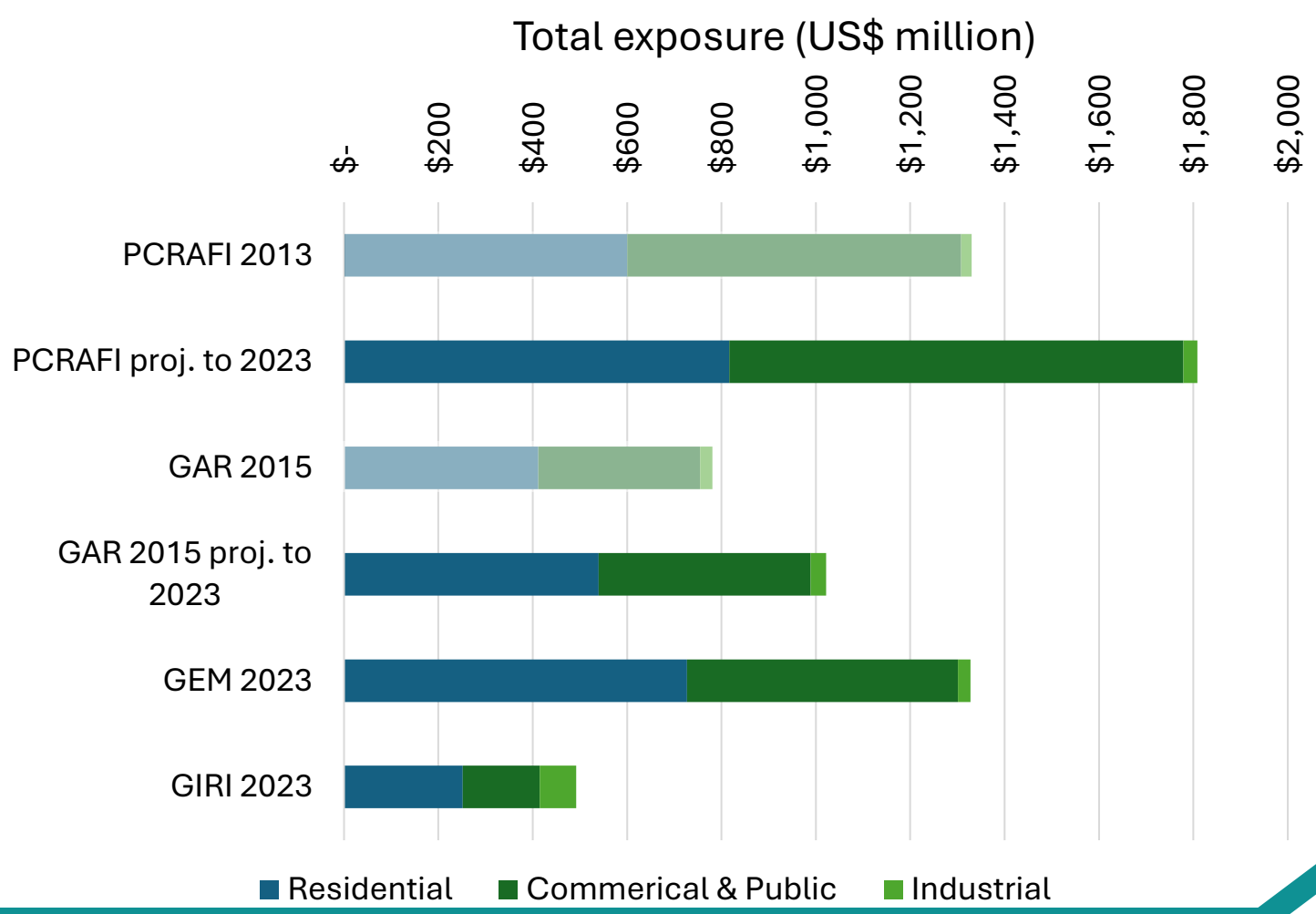
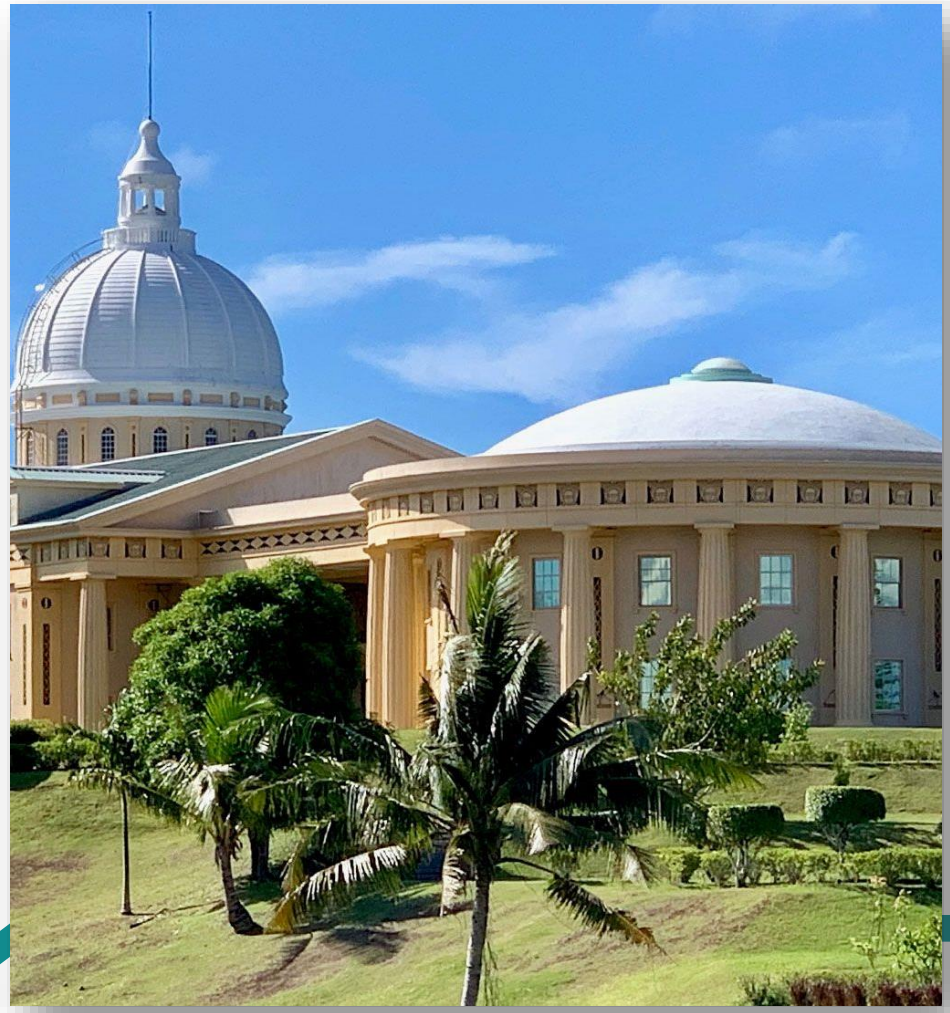
Analysis of Existing Disaster Risk Profiles for Palau

Comparison of buildings exposure models





Analysis of Existing Disaster Risk Profiles for Palau

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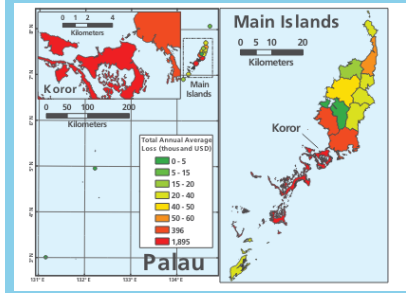


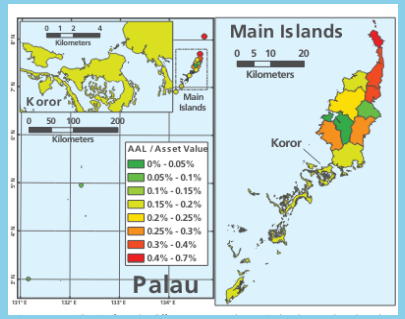
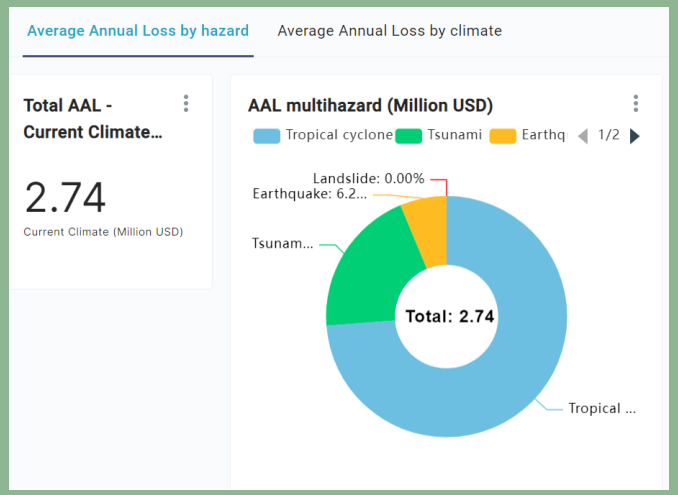
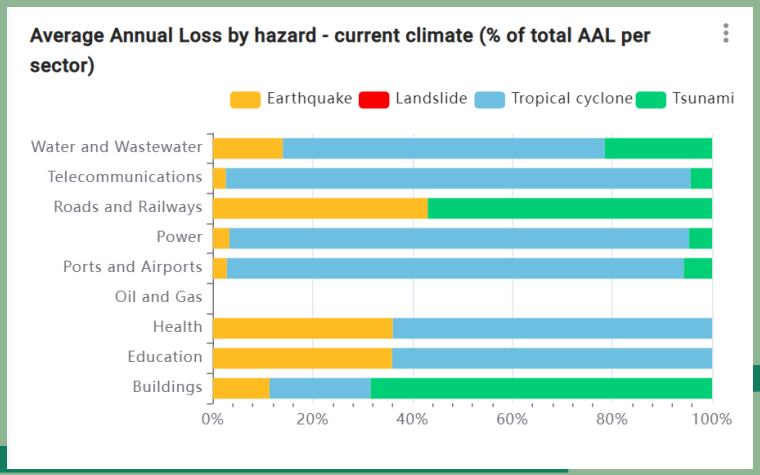


TABLE 2: Estimated Losses and Casualties Caused by Natural Perils

Mean Return Period (years)	AAL	50	100	250
Risk Profile: Tropical Cyclone				
Direct Losses				
(Million USD)	2.3	13.2	34.1	125.3
(% GDP)	1.4%	7.8%	20.1%	73.8%
Emergency Losses				
(Million USD)	0.5	3.0	7.8	28.8
(% of total government expenditures)	0.8%	4.3%	11.0%	40.5%
Casualties	3	28	61	135
Risk Profile: Earthquake and Tsunami				
Direct Losses				
(Million USD)	0.3	0.0	0.6	14.1
(% GDP)	0.2%	0.0%	0.4%	8.3%
Emergency Losses				
(Million USD)	0.1	0.0	0.1	2.2
(% of total government expenditures)	0.1%	0.0%	0.1%	3.2%
Casualties	0	0	0	3

CDRI





GAR 2015

Probabilistic risk results

Average Annual Loss (AAL) by hazard

Hazard	Absolute [Million US$]	Capital stock [%]	GFCF [%]	Social exp [%]	Total Reserves [%]	Gross Savings [%]
Earthquake	0.13	0.017	0.000	0.228	0.000	0.000
Wind	11.88	1.523	0.000	20.860	0.000	0.000
Storm Surge	0.93	0.119	0.000	1.633	0.000	0.000
Tsunami	0.06	0.008	0.000	0.105	0.000	0.000
Multi-Hazard	13.00	1.667	0.000	22.826	0.000	0.000

Probable Maximum Loss (PML)

Mean return period in years - Values for hazard are in million US$

Hazard	20	50	100	250	500	1000	1500
Earthquake	0	1	1	4	10	20	28
Wind	36	233	423	464	499	570	0
Storm Surge	3	10	34	38	42	47	47
Tsunami	0	0	0	1	4	11	18

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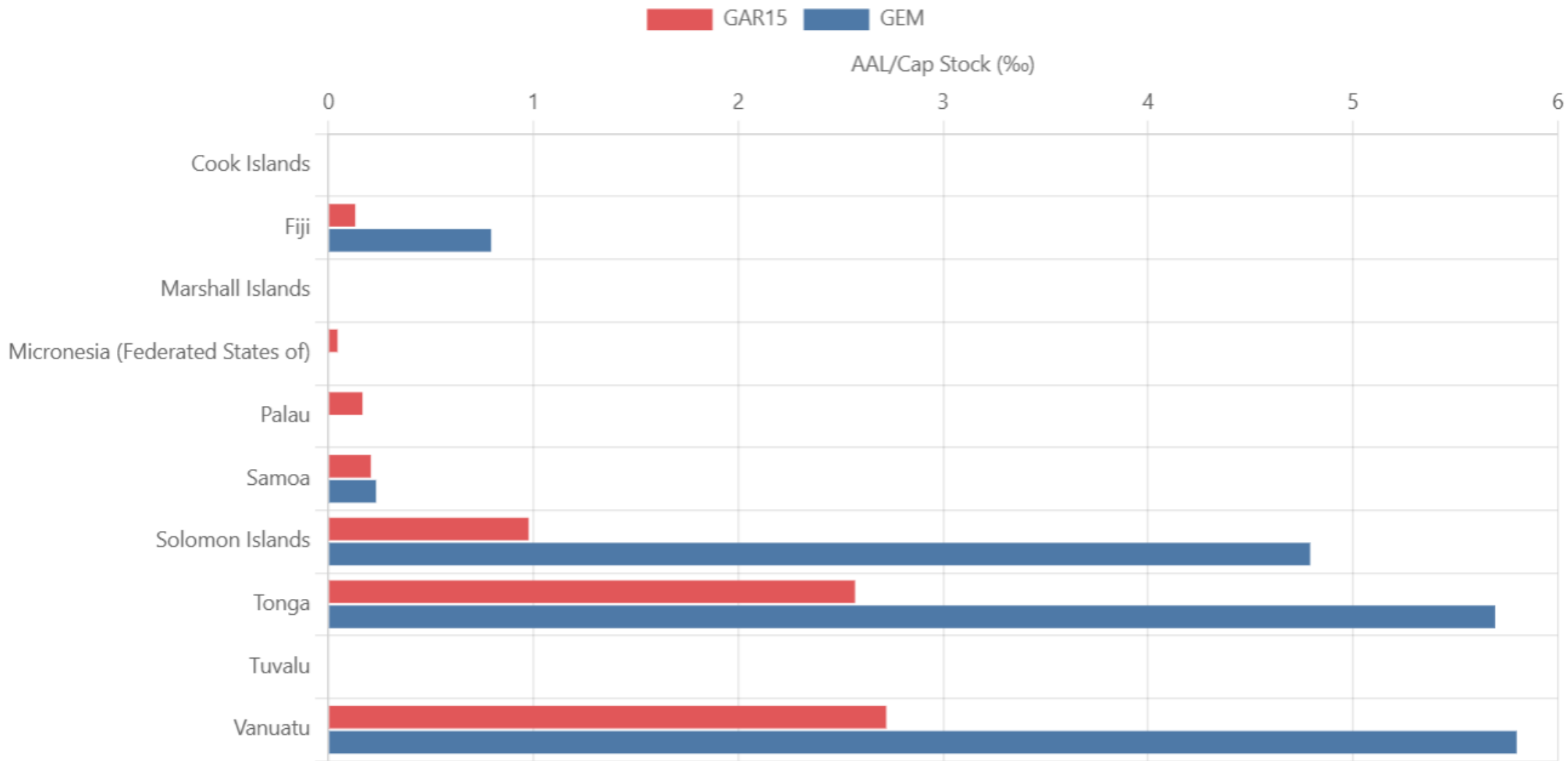
EXPOSURE	EARTHQUAKE	WINDSTORM	FLOOD	VOLCANO	DROUGHT

RISK METRIC

AAL	AAL/CAP STOCK	PML_{200}	PML_{250}/CAP STOCK	PML_{250}



“Essentially, all models are wrong, but some are useful” - George E. P. Box

Strong
PARTNERSHIPS

Build
SUSTAINABLY

Resilient
FUTURE

Closing Remarks

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  1818 H Street NW
  Washington DC 20433
  Telephone: 202-473-1000
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Title

Subtitle

- Key point 1
- Key point 2
- Key point 3

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