Quantifying disaster and climate related risk for public sector applications

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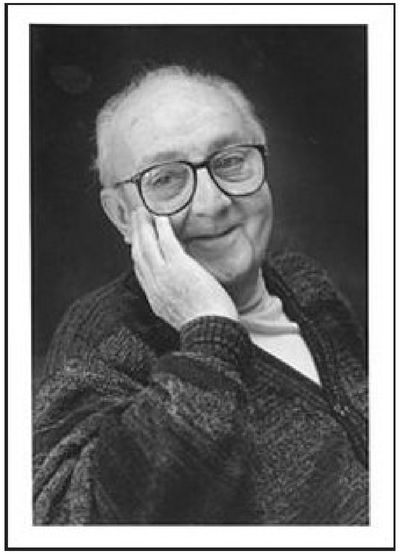
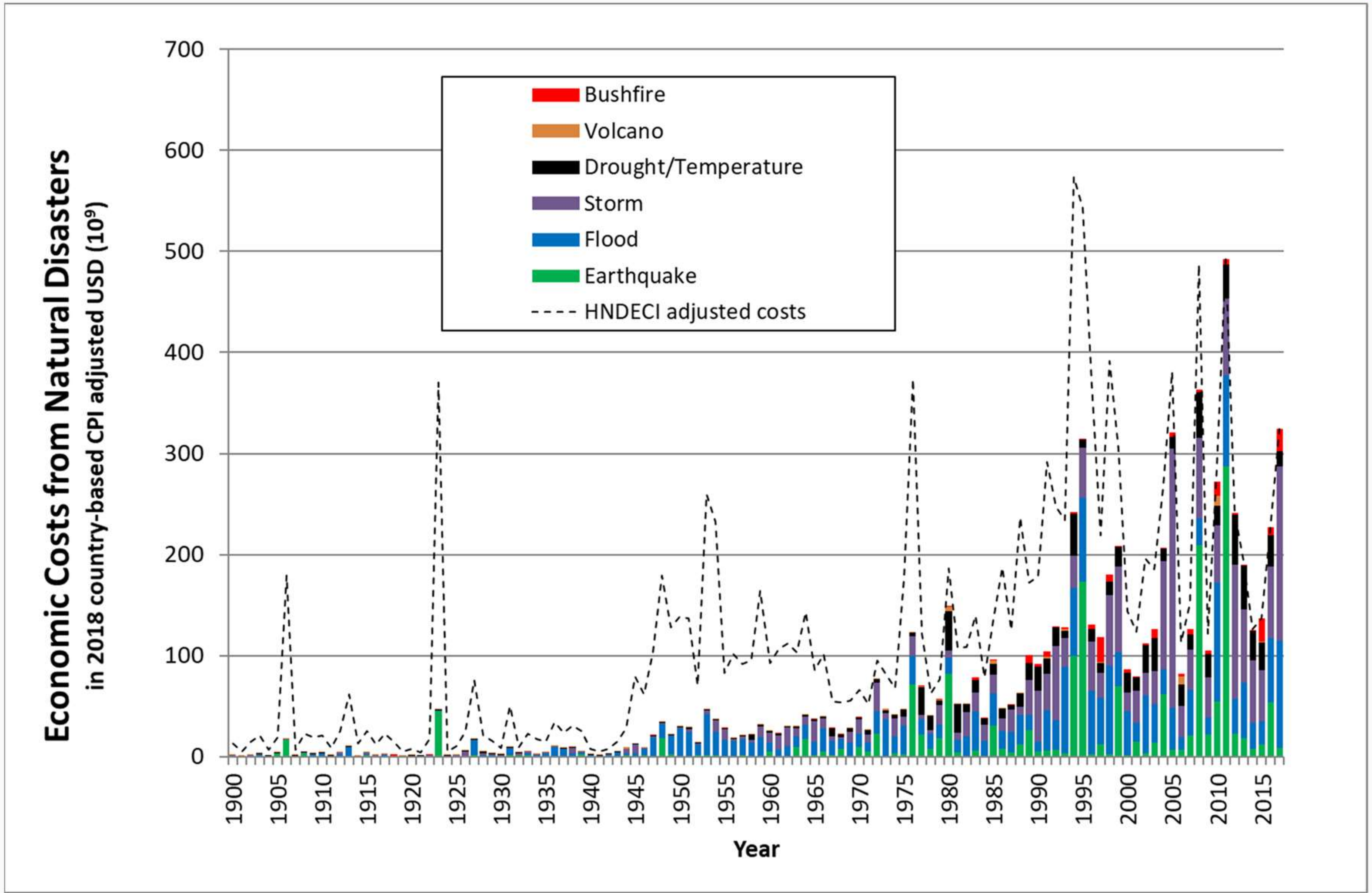
“Essentially, all models are wrong, but some are useful”

George E. P. Box



Historical losses not a good indicator for future losses



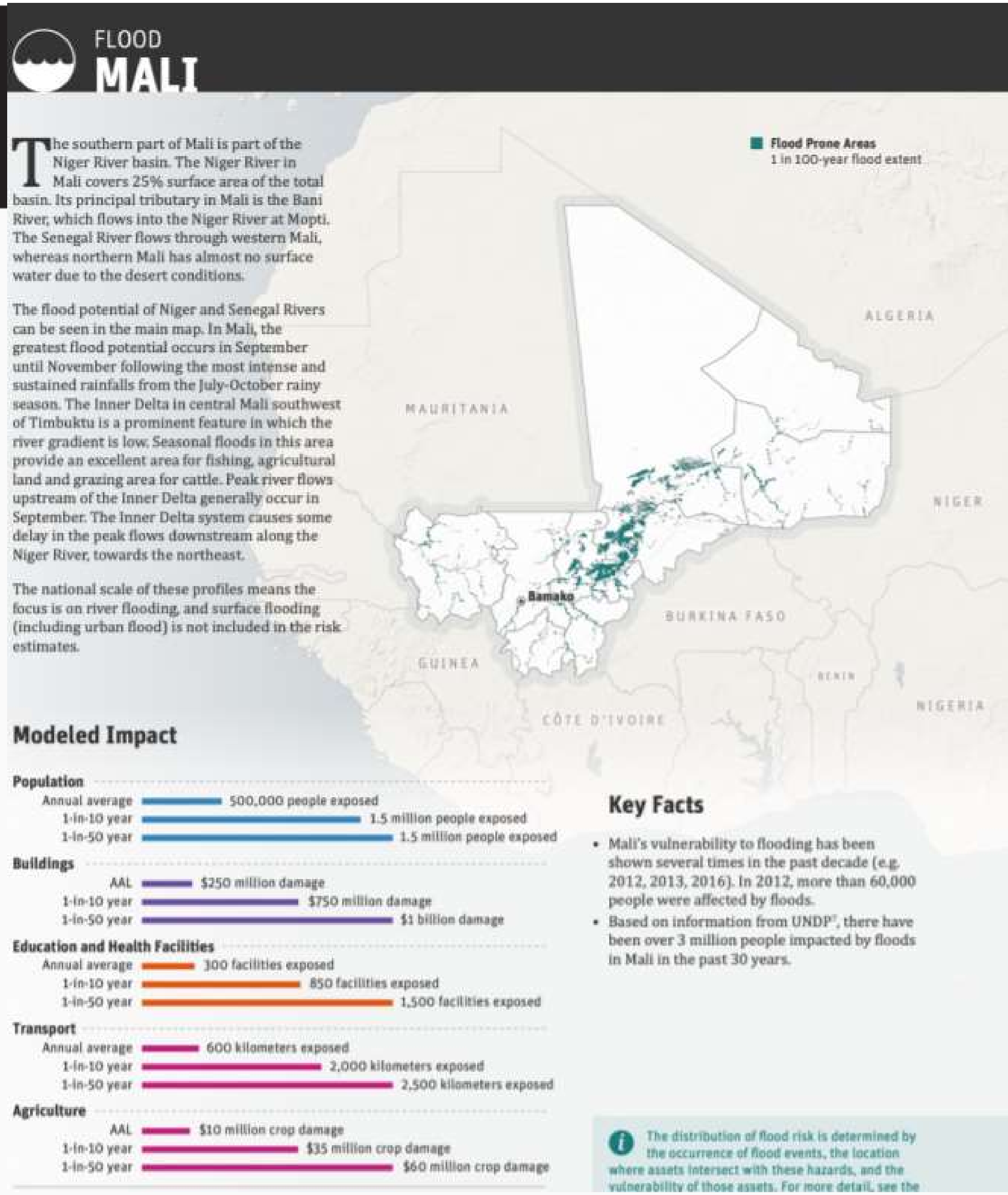
Source: Daniell et al (2018), EGU, Vienna.

Need for Disaster Risk Quantification

- Before – Poor identification of extremes – no geography, no science, no engineering
- Key questions *before* an event with respect to management of disaster risk are:
- **How much is at risk?**
- **What would it take to reduce the risk?**
- **Where and what can we prioritize as interventions?**
- **What are their costs and benefits?**

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	$$$
Risk identification to identify critical infrastructure and establish early warning systems	To inform preparedness and risk reduction, based on understanding of potential damage at the regional/local level	Urban, regional, national	Moderate-high: Requires asset-level information across large spatial areas	$$-$$$ [broad range depending on geographic scope]
Catastrophic risk assessment for financial planning	For financial and fiscal assessment of disasters and to catalyze catastrophe risk insurance market growth	National to multi-country	High: Requires high-resolution, high-quality data of uncertainty	$$$

Solution - Disaster Risk Quantification!



FLOOD

MALI

The southern part of Mali is part of the Niger River basin. The Niger River in Mali covers 25% surface area of the total basin. Its principal tributary in Mali is the Bani River, which flows into the Niger River at Mopti. The Senegal River flows through western Mali, whereas northern Mali has almost no surface water due to the desert conditions.

The flood potential of Niger and Senegal Rivers can be seen in the main map. In Mali, the greatest flood potential occurs in September until November following the most intense and sustained rainfalls from the July-October rainy season. The Inner Delta in central Mali southwest of Timbuktu is a prominent feature in which the river gradient is low. Seasonal floods in this area provide an excellent area for fishing, agricultural land and grazing area for cattle. Peak river flows upstream of the Inner Delta generally occur in September. The Inner Delta system causes some delay in the peak flows downstream along the Niger River, towards the northeast.

The national scale of these profiles means the focus is on river flooding, and surface flooding (including urban flood) is not included in the risk estimates.

Modeled Impact

Population
- Annual average: 500,000 people exposed
- 1-in-10 year: 1.5 million people exposed
- 1-in-50 year: 1.5 million people exposed

Buildings
- AAL: $250 million damage
- 1-in-10 year: $750 million damage
- 1-in-50 year: $1 billion damage

Education and Health Facilities
- Annual average: 300 facilities exposed
- 1-in-10 year: 850 facilities exposed
- 1-in-50 year: 1,500 facilities exposed

Transport
- Annual average: 600 kilometers exposed
- 1-in-10 year: 2,000 kilometers exposed
- 1-in-50 year: 2,500 kilometers exposed

Agriculture
- AAL: $10 million crop damage
- 1-in-10 year: $35 million crop damage
- 1-in-50 year: $60 million crop damage

Key Facts

- Mali's vulnerability to flooding has been shown several times in the past decade (e.g. 2012, 2013, 2016). In 2012, more than 60,000 people were affected by floods.
- Based on information from UNDP[7], there have been over 3 million people impacted by floods in Mali in the past 30 years.

The distribution of flood risk is determined by the occurrence of flood events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the

What is Disaster Risk Quantification

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

Hazard

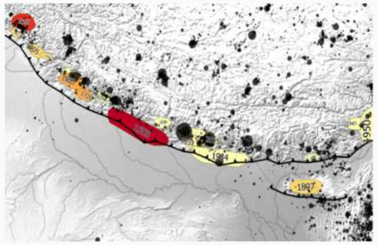
Exposure

Vulnerability

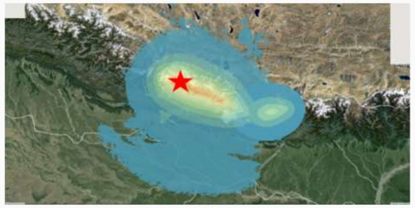
Fatalities, injuries, displaced persons
Damage to buildings, infrastructure, financial loss

Impact

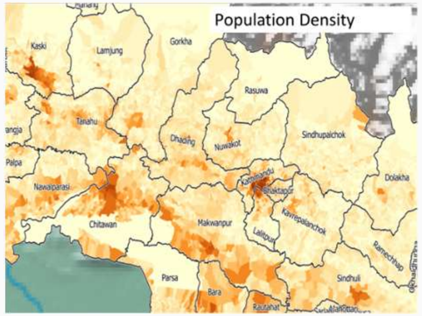
Data sets in its Analysis



Historical damage data

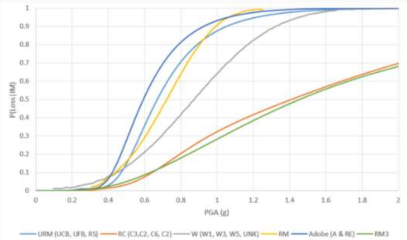


Event scientific data



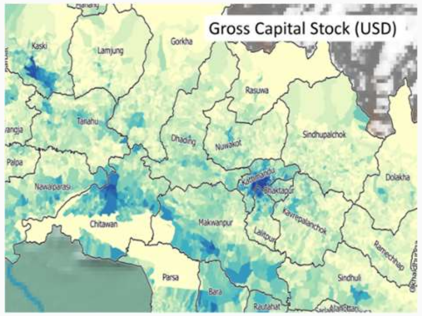
Census data

Expert knowledge



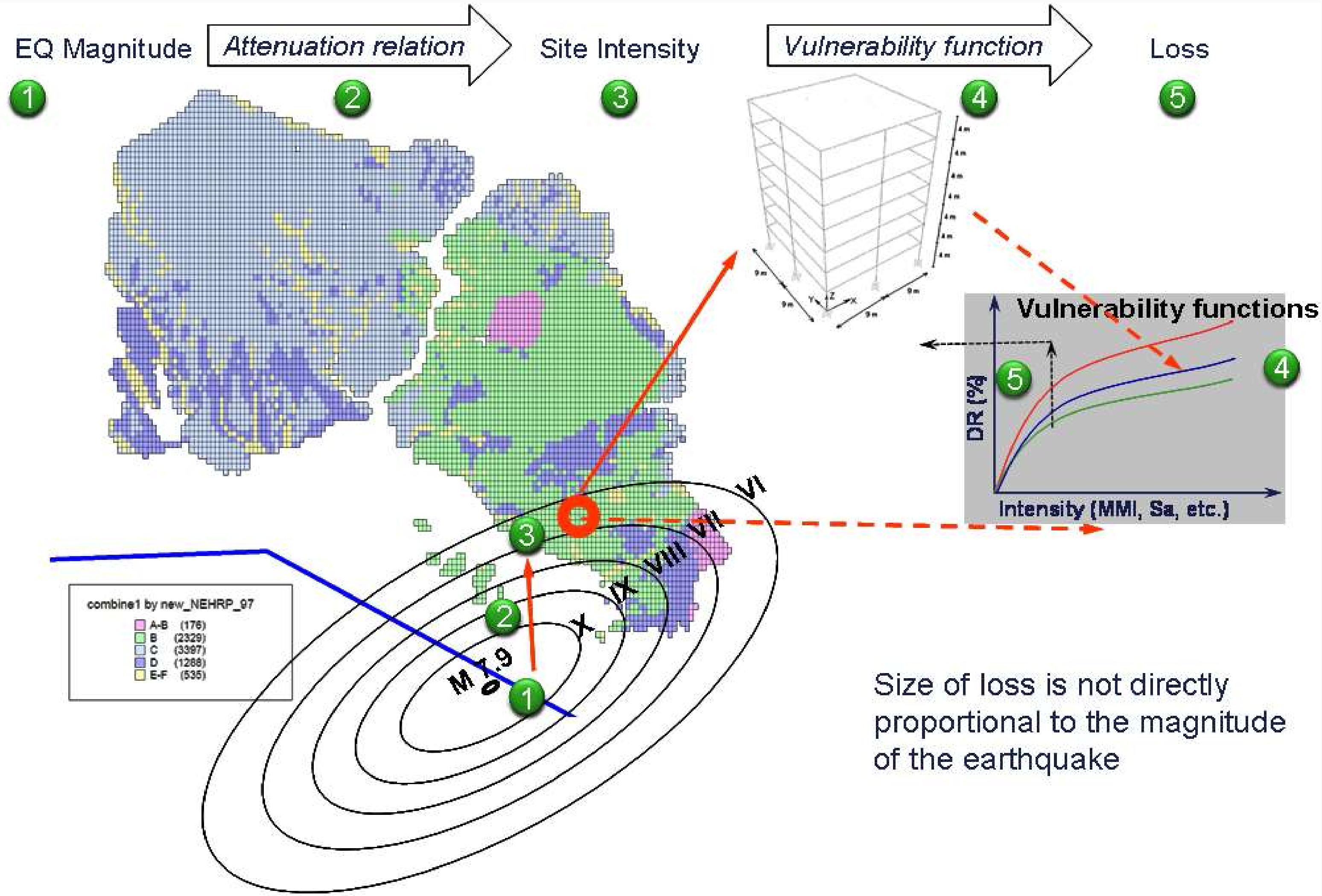
Vulnerability/Built Data

Remotely-sensed data / Social Media



Socioeconomic data

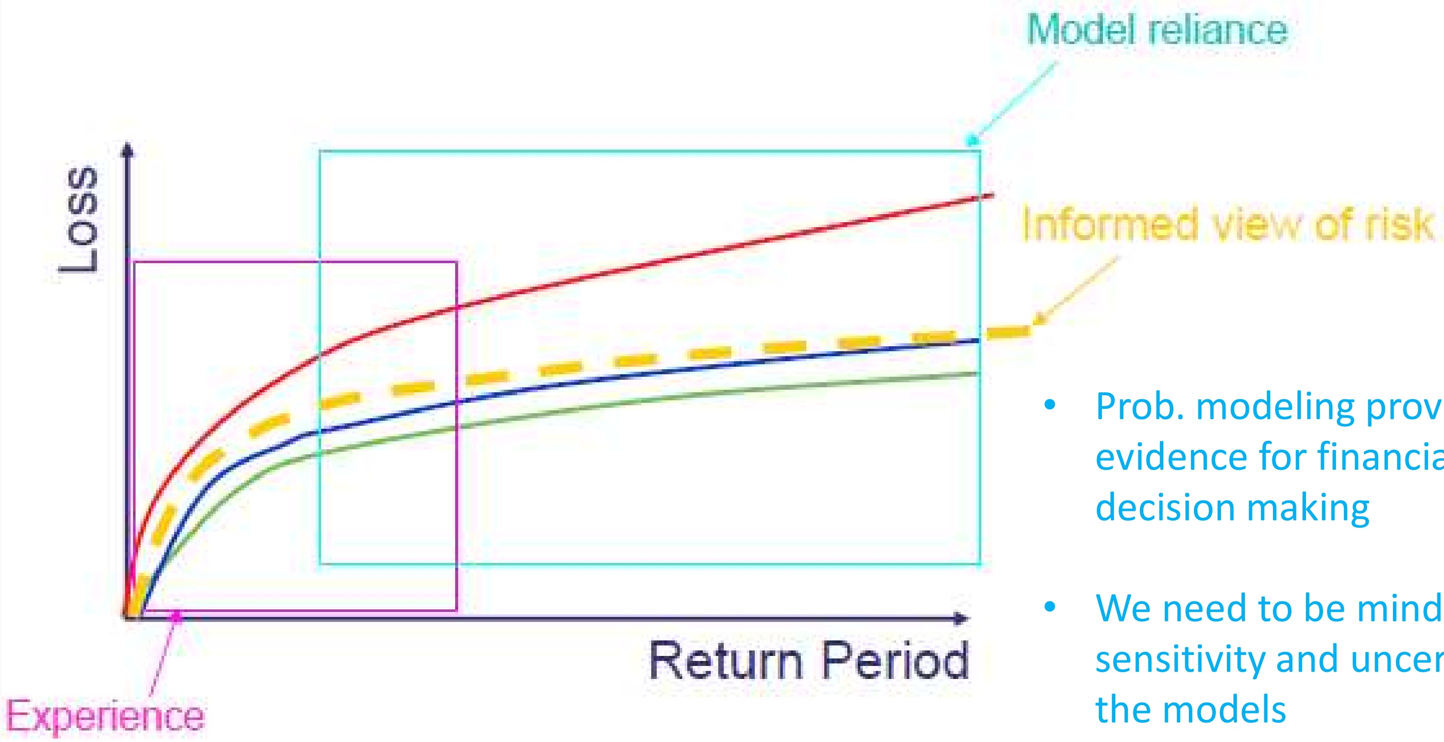
How to quantify future risk?



Models the loss from a single scenario

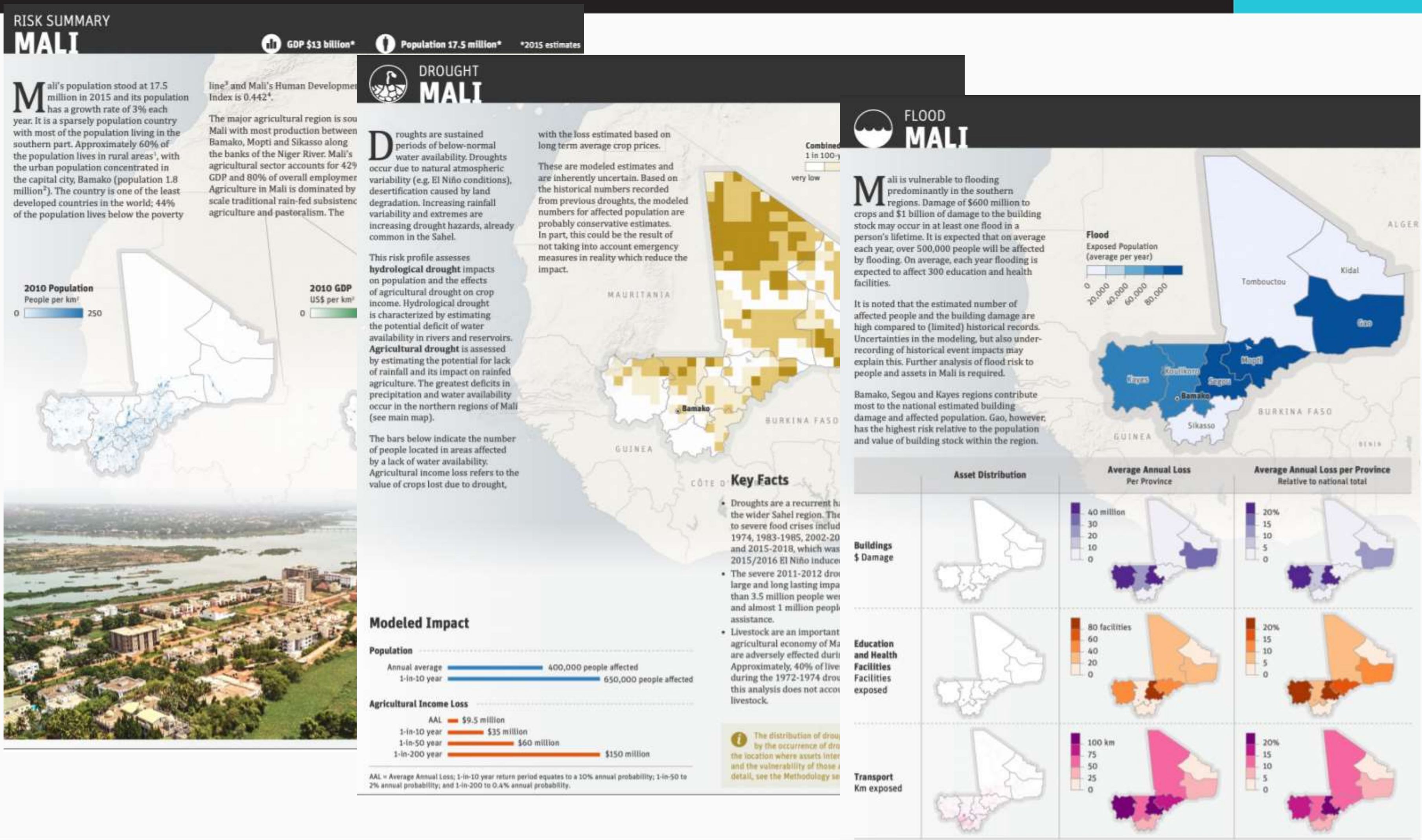
But we can 1000s of simulations to derive future risk

Output: EP curves and implications

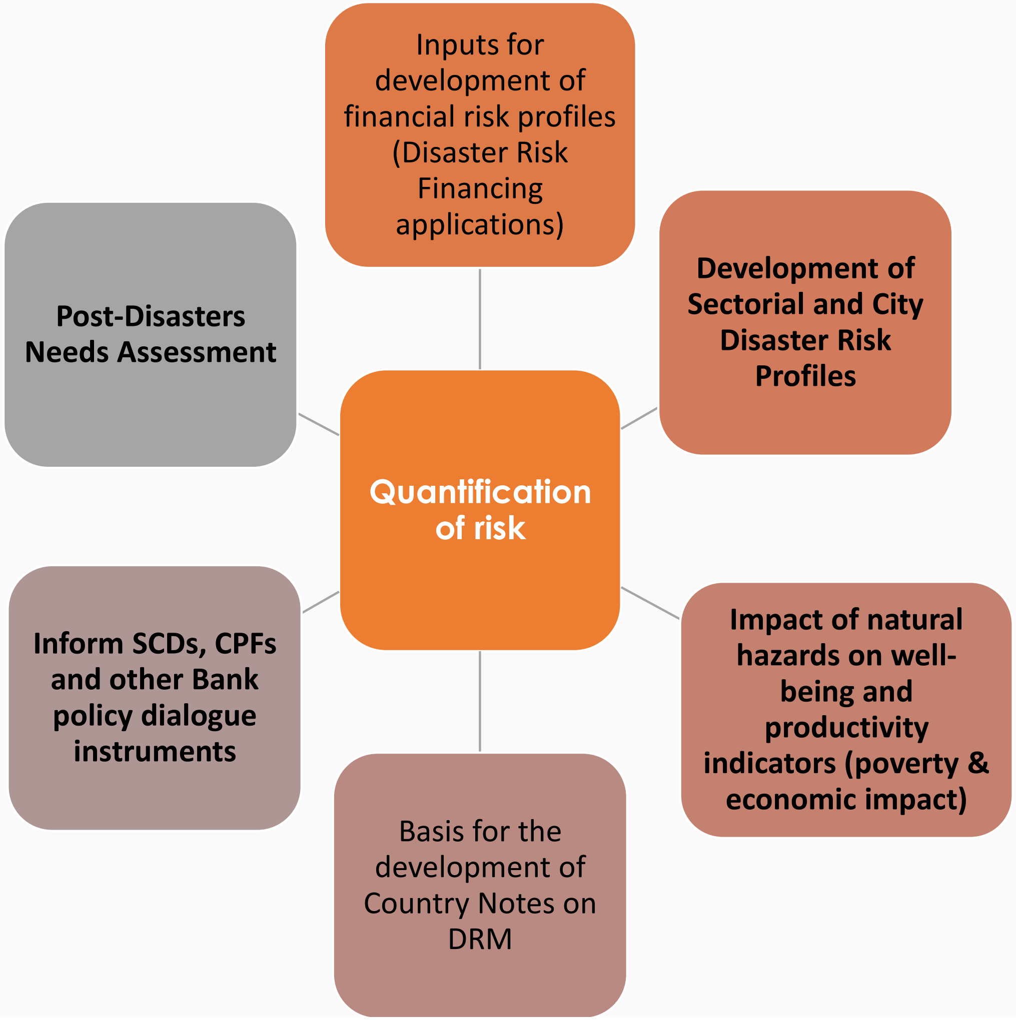


- Prob. modeling provides evidence for financial decision making
- We need to be mindful of sensitivity and uncertainty in the models

Output: Maps, Hazards and decision making



What can we do with this information?



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